Chapter 23: Estuary Management Plans

1. Index

1.1. Large estuaries

- Diep River Estuary Management Plan
- Zandvlei Estuary Management Plan

1.2. Small estuaries

- Eerste River Estuary Management Plan
- Hout Bay River Estuary Management Plan
- Lourens River Estuary Management Plan
- Silvermine River Estuary Management Plan
- Sir Lowry's Pass River Estuary Management Plan
- Zeekoevlei Estuary Management Plan

C.A.P.E. Estuaries Programme

Estuary Management Plan
for the
Diep Estuary

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Prepared by
Coastal & Environmental Consulting

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The original edition of this plan was completed under the auspices of Peak Practice. The proposals made therein were based on a series of discussions and workshops involving numerous individuals and organizations from relevant government agencies, to research institutions, non-governmental organizations and representatives of the local resident's associations. The proposals in this second edition of the plan have similarly involved many stakeholders through bilateral discussions and participation in the meetings of the EMP Forum (Rietvlei Management Working Group).

The active and enthusiastic participation in the process augurs well for the successful implementation of this plan and the rehabilitation of the estuary and we would like to express our appreciation to everyone who has contributed.

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The Coastal & Environmental Consulting Team

Lynn Jackson (CEC: Project Manager)
Julian Conrad (GEOSS)
Marilie Carstens (GEOSS)

TABLE OF CONTENTS

1. INTRODUCTION

The management of estuaries in South Africa

The term estuary refers to the body of water which forms the interface between a river and the sea into which it flows. Estuaries may be permanently or periodically open to the sea. When open, they are characterized by fluctuations in water levels related to the tides, and by salinities which are measurably higher than freshwater as a result of seawater intrusion.

Estuaries are generally highly productive ecosystems, and provide a range of goods and services ranging from nursery areas for juvenile fish, to stopovers for migrant birds, and recreational opportunities for local inhabitants. Their productivity, combined with their natural beauty and the shelter they provide also means that they are highly sensitive and vulnerable to development, with many towns and cities, ports and harbours being deliberately located in and around them. As a result, many estuaries have been seriously degraded.

South Africa has approximately 260 estuaries, of which 62 are located within the Cape Floristic Region. Despite the fact that their value – particularly from a biodiversity perspective – has long been recognized, there has been a lack of effective management, largely due to the fact that they did not fit clearly within the mandate of any one government Department. This was highlighted during the recent development of a National Biodiversity Strategy and Action Plan, and has been addressed through the inclusion of relevant provisions in the National Environmental Management: Integrated Coastal Management Act, 2008. Amongst other things, the Integrated Coastal Management Act introduces a requirement for Estuary Management Plans.

In parallel with the development of the legislation, the C.A.P.E. Estuaries Programme has provided funding for the development of Estuary Management Plans for a number of priority estuaries in the Cape Floristic Region, including the Diep.

The management of the Diep Estuary

The Diep River has its origins in the Riebeek Kasteel Mountains north-east of Malmesbury, and flows for about 65 kilometres south-west towards Cape Town, before entering the sea at Milnerton, some 5 kms north of the Port of Cape Town. It has one major tributary – the Mosselbank – which drains the northern slopes of the Durbanville Hills. Other tributaries include the Swart, Groen, Klein, and Riebeeck, with the Klapmuts being a tributary of the Mosselbank. The total size of the catchment is 1,495 km2 or 154,347 ha.

Before entering the sea, the Diep River flows through the Rietvlei wetland and the Milnerton Lagoon, which together cover an area of approximately 900 hectares. These two features together have generally been considered to comprise the “estuary”. More specifically, for purposes of the Estuary Management Plan, the estuary is defined as the area from the estuary mouth, to the Blaauwberg Bridge at

the upper end of Rietvlei, with the lateral boundaries being the 5 metre mean sea level contour. These boundaries, as well as the 1:100 year floodline are shown in Figure 1. below.

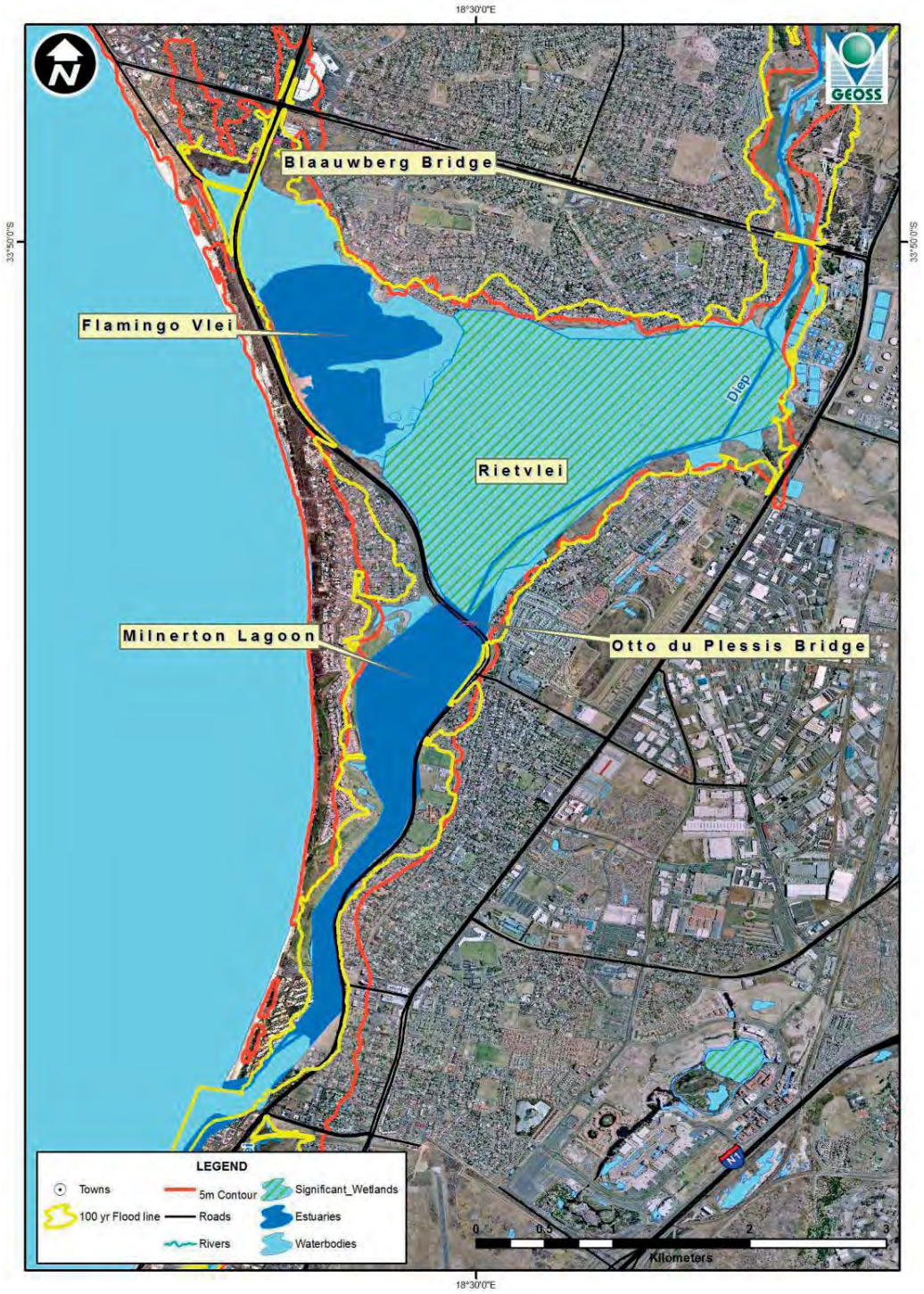


Figure 1: The Diep Estuary comprising Rietvlei and the Milnerton Lagoon.

The catchment of the Diep River has a relatively flat topography, making it suitable for both agriculture and urban development. This, together with its proximity to Cape Town has meant that it has become highly developed, with agricultural activities going back to van Riebeeck's time, and the establishment of an outpost by the Dutch East India Company. Urbanisation around the estuary began in earnest following the founding of Milnerton Estates Limited in 1897, and has continued to gain momentum, with the area to the north of Rietvlei today being the fastest growing in Cape Town. The Diep River, and particularly its lower reaches, has therefore been significantly modified over the past few centuries.

Rietvlei is considered as the most important area for waterbirds in the region and is recognized as an Important Bird Area by Birdlife International. Official recognition of its importance to biodiversity by the South African government was first afforded in 1984, when a Nature Reserve was established. This was followed by its declaration as a Protected Natural Environment in 1989, and the establishment of the Rietvlei Wetland Reserve in 1993. The first formal Management Plan for the reserve was developed in 1994, and this served to guide management activities until the publication of the first edition of this plan in 2008.

Despite these initiatives, development has continued to encroach into the margins of the estuary, the hydrodynamics of the system has been altered, water quality has seriously deteriorated, and the area has been invaded by a number of alien and indigenous species. A fish kill in December, 2006 highlighted these problems, and led to the inclusion of the Diep Estuary in the C.A.P.E. Estuaries Programme.

1.3 The Diep Estuary Management Plan and Action Plan

As per the requirements of the C.A.P.E. Estuaries Programme, the original edition of this management plan was developed in two phases: i) a Situation Assessment; and ii) the Estuary Management Plan (EMP) and Action Plan. The latter was developed through a consultative process including public meetings, the development of a Vision and Strategic Objectives, and the establishment of Technical Working Groups comprising experts and public representatives.

This updated version of the EMP and Action Plan was produced in consultation with the EMP Forum and should be read in conjunction with the Situation Assessment. It takes into account the progress that has been made in implementation of the Action Plan over the past two years, and now covers the period 2011 – 2015.

2. VISION AND STRATEGIC OBJECTIVES

The Vision for the C.A.P.E. Estuaries Programme as a whole is: "***Our estuaries are beautiful, rich in plants and animals, they attract visitors, sustain our livelihoods and uplift our spirits."***

In this context, the following more specific Vision and Strategic Objectives for the Diep Estuary were adopted at a public meeting in September, 2008.

Vision: The Diep River, Rietvlei and Milnerton Lagoon are natural assets, beautiful and rich in biodiversity, and a part of our heritage. They should be restored, enhanced and protected for sustainable use and appreciation by current and future generations.

Management Objectives

Overall Objective**: "***To manage the Diep River, Rietvlei, the Milnerton Lagoon and their environs in a manner that is sustainable, and compatible with the conservation of an ecosystem of international significance for biological diversity".*

Key management objectives:

- *To develop a mechanism to manage the hydrodynamics of the system in a manner which simulates as far as possible the natural condition and which:*
  - alleviates the dust problem
  - protects property against flooding
  - reduces siltation
  - optimises flows from and through the various components of the system
  - establishes optimum conditions at the estuary mouth.

- *To prevent, reduce or minimise pollution from all sources so as to be able to restore the water quality to a standard suitable for supporting natural resources and human recreation.*

- *To ensure that any relevant future planning and development decisions acknowledge the socio-economic value and conservation significance of the estuary.*

- *To promote and manage recreation, education and eco-tourism in the estuary in a manner compatible with its conservation status.*

- *To create conditions suitable for the restoration and ongoing protection of the Diep Estuary ecosystem and its biodiversity, including:*
  - creating an appropriate buffer between the estuary and the surrounding urban areas;
  - controlling and removing key invasive alien species;
  - improving water quality;
  - promoting sustainable use of natural resources.

3. OPERATIONAL OBJECTIVES

3.1 Long-term objectives:

3.1.1 Rietvlei should function optimally as a wetland with the pans undergoing seasonal cycles, and the lagoon should have appropriate tidal flows and salinity levels.

3.1.2 Water quantity and quality should meet Resource Quality Objectives to be developed through a reserve determination, with water quality standards being based on the guidelines for recreation and freshwater and marine ecosystems as appropriate.

3.1.3 Biological communities should be restored to as close to natural species composition and structure as possible.

3.1.4 There should be an appropriate balance between conservation and sustainable use of the system.

3.1.5 The system should comply with South Africa's obligations under relevant international agreements such as the Ramsar Convention, the Convention on Migratory Species (Bonn Convention) and the associated Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA).

3.2 Objectives for Action Plan: 2011 - 2015

This management plan includes an Action Plan for the period 2011 – 2015 (see section 7). Since a number of the long-term objectives will not necessarily be achievable within this period, more detailed specific objectives which are intended to be met by 2015, if not before, are set out below.

3.2.1 Land-use and Infrastructure Development

For purposes of this plan, the Diep Estuary is defined as including the river from the mouth to the Blaauwberg Bridge, with the lateral boundaries being the 5 meter countour above sea level. While the majority of this falls within the Rietvlei Nature Reserve, there are, unfortunately some areas within the 5m contour which have already been developed. On the other hand, there are still some undeveloped portions of land – many of which are currently considered as Public Open Space – lying between the Reserve boundaries and the 5 m contour. These, as well as the Dolphin Beach ponds and a stretch of coastline between Dolphin Beach and Sunset Beach, should be formally included into the Reserve to ensure the best possible protection for the estuary in future. See Fig. 2 below.

Furthermore, subject to discussions with the City's Roads Planning Department, it is proposed to incorporate all City-owned land between Blaauberg Bridge and the railway bridge into the reserve, with a view to establishing a corridor between the Blaauberg Conservation Area and Rietvlei/Milnerton Lagoon.

In addition:

- The wetland should be delineated using the guidelines developed for South African wetlands;
- There should be no further developments within the boundaries of the reserve or the estuary [apart from approved conservation-related structures].
- Facilities within the reserve must be designed to promote conservation objectives, including effective management of the reserve, education, awareness-raising and non-consumptive uses.
- There must be secure boundary conditions around the entire reserve, and where appropriate, between different zones within the reserve.
- Stringent environmental conditions should be included in approvals for rezoning and future development in areas nearby the reserve and with potential to impact on the estuary (eg. on water quality).

Fig. 2. Proposed new boundaries for the Rietvlei Nature Reserve (excluding area upstream of Blaauberg Bidge).

*3.2.2 **Water Quantity and Quality***

Over the years, there have been significant changes to the volumes and quality of water and associated sediments flowing into the Diep Estuary. In combination with physical developments (such as roads and bridges) these changes mean that the system will never function as a completely natural system again and, at present is seriously degraded. At the same time, the estuary remains highly valuable from both a conservation and socio-economic perspective. The primary objective is therefore to develop a management regime which will restore the flows to, from and within the system and the water quality to the extent possible, with a view to maintaining and enhancing its current value.

Water Quantity and Circulation

At present there is insufficient information available to set specific objectives in relation to the management of water quantity. The initial objective must therefore be to obtain a better understanding of the water requirements, hydrodynamics and other aspects of the system. Nevertheless, in the interim, there are a number of more general objectives which can be used as a guide to begin the process of rehabilitation over the next few years.

These interim objectives include:

Salinity

As a consequence of the various changes to the system, the estuary is currently fresh-water dominated. A salinity regime more typical of an estuarine system, with tidal effects and saline penetration up to at least the Otto du Plessis Bridge needs to be re-established. From a biological perspective, the salinity regime should be such that it facilitates the rehabilitation of estuarine communities - such as *Callianassa* - in those areas which they previously occupied.

Mouth conditions

Historically the mouth closed periodically during the summer months of low-rainfall years. More recently, the discharge of sewage effluent into the system has maintained flows at levels which have precluded the closing of the mouth with a variety of consequences (including the drop in salinity). Optimum conditions should therefore be re-established at the estuary mouth. In the longer term, this would imply the mouth closing in late summer at least in some years, and then opening again after a few months. It is noted that in the short-term – until water quality conditions have been improved – it is probably preferable that that the mouth does not close, or that it closes for very short periods only.

Water levels

The water levels in the vlei should be managed such that they fluctuate on a seasonal basis, thereby allowing the pans to maintain the ecological characteristics which make them attractive to wading birds. At the same time, the period during which they are allowed to dry out completely should be limited to the shortest time

possible with a view to alleviating the dust problem. (It is noted that there will need to be expert consultations, and possibly even a study, to determine this).

Water levels should not be allowed under normal conditions to rise to a point where residential areas are under immediate threat of flooding - noting that some areas have already been constructed within areas already prone to flooding (see Fig. 3 below). Residents of such areas must be made aware of this threat, and a Disaster Management Plan should be put in place for such eventualities. It is further noted that the extent of areas under threat of flooding may increase as a consequence of climate change.

Sedimentation

At present there is a lack of understanding of the rates and patterns of sedimentation in the system, and the impacts thereof on channel depth, drying of seasonal pans, circulation, mouth conditions etc. The initial objective should therefore be to generate the required information and, if necessary, sediment inputs and deposits should then be managed so as to limit impacts on the system.

Circulation

Flows of water and stratification within the system are not clearly understood. Relevant data needs to be generated so that flows can be optimised so as to, for example, reduce the potential for development of anoxic conditions.

Fig.3 Floodprone areas around the Diep Estuary (based on the 1:100 -year floodline).

Water quality

The long term objective should be for the water quality to meet Resource Quality Objectives to be developed in terms of the National Water Act (1998) specifically for the Diep Estuary and covering i) the freshwater inflow from the river; and ii) the estuary itself. These will be based on socio-economic requirements and existing guidelines for freshwater or marine ecosystems and/or full contact recreation as appropriate. Interim targets for parameters of particular concern are outlined below. These will be reviewed halfway through the 5-year period of the Action Plan.

Supplementary objectives are:

- that the number of accidental discharges of wastewater per year (i.e. sewage overflows from sewerage bockages and sewage pump stations) should be reduced through monitoring, maintenance and appropriate capital investment;
- to obtain a better understanding of the relative contributions of the different sources of pollution, in particular the stormwater drains.

Bacteriological targets

- The Resource Quality Objectives for bacteriological parameters should be based on those for full contact recreation (especially given the high prevalence of HIV in the country, and the consequential lowered immune system of a substantial proportion of the population). The most important of these is *E.coli*, with others being Faecal coliforms and *Enterococc*i as follows:
  - *E. coli* – which are more specific to warm-bodied animals and show a high correlation with swimming-related gastric illness - with a target range of 0 – 130 counts (based on the DWAF South African Water Quality Guidelines: Recreational Use (2nd Edition, 1996)). To meet the target, the range should not be exceeded by the geometric mean of fortnightly samples over a three-month period.
  - Faecal coliforms (including *E.coli*) – which are used as an indicator of general faecal contamination - for which the target range should be between 0 – 100 counts per 100 ml (based on the 1995 South African Water Quality Guidelines for Coastal Marine Waters). To meet this target, 80% of samples taken from the water body should fall within this range (i.e. less than 100 counts); and 95% of samples should be below 2,000 counts.
  - *Enterococci* – there are currently no guidelines for South Africa, but guidance is obtainable from the Blue Flag Programme and/or World Health Organisation recommendations.
- The bacteriological standards should be met in the northern section of Flamingo Vlei (which is zoned for recreational use) within 3 years (i.e. by the end of 2011).
- There should be an improvement in the bacteriological quality of the water in the Milnerton Lagoon (also zoned for recreational use) over the next 3 years (to end of 2013) as follows: At present, only around 10% of the faecal coliform samples are < 100 counts/ 100 ml, while about 60% of the samples are < 2,000 counts/ 100ml. By 2013, 95% of the samples should be < 2,000 counts/100ml; and 50% of the samples should be < 100 counts/ 100ml.

Nutrient targets

Target values need to be established for the Diep Estuary as part of the reserve determination process, and once there is greater clarity on the discrepancy between target and current actual values, a time-frame can be developed for the achievement of the target values. In the interim, the following targets are proposed:

- The current guideline on dissolved inorganic nutrients for marine aquatic ecosystems is: "Waters should not contain concentrations of dissolved nutrients that are capable of causing excessive or nuisance growth of algae or other aquatic plants or reducing oxygen concentrations below the target range.."(see below).
- The Coastal Water Quality Guidelines provide a more specific guideline for Total Ammonia-N – namely 600 *u*g/l - while the freshwater guideline for unionized ammonia (NH_3) is < 7 *u*g/l (DWAF, 1996). More recent guidelines developed through the Reserve Determination methodology suggest that values of 0.015 – 0.058 mg/l (or 15 – 58 ug/l) are good.[1] It is therefore proposed that this be adopted as the target range for the Diep Estuary.
- The DWAF Water Quality Guidelines: Aquatic Ecosystems provide a guideline for inorganic nitrogen (NH_3 + NH_4 + NO_2 + NO_3) which states that i) concentrations should not deviate by more than 15% from that of the local water body; ii) the trophic status of the water body should not be increased; and iii) that the amplitude and frequency of natural cycles should not be changed. The Guidelines also state that concentrations below 0.5 mg/l are indicative of oligotrophic conditions, 0.5 – 2.5 mg/l mesotrophic, and 2.5 – 10 mg/l, eutrophic. However, according to Taljaard (pers. comm..) although only limited data is available for estuaries in South Africa, concentrations of 1 – 2 mg/l were sufficient to stimulate dense macrophyte growth in the Sundays River. Moreover, recent guidelines developed through the Reserve Determination methodology equate values of 0.25 – 1 mg/l with good conditions, and it is proposed that this be adopted as the target range for the Diep Estuary.
- Phosphorus occurs in a number of forms, of which Soluble Reactive Phosphate (SRP) or orthophosphate is immediately available to aquatic biota. The recent guidelines developed through the Reserve Determination methodology suggest that values of between 0.005 – 0.025 mg/l (or 5 – 25 ug/l) indicate good conditions, and it is proposed that these be adopted as the target value for the Diep Estuary.

Dissolved oxygen

The current guideline on dissolved oxygen for marine aquatic ecosystems is: "For the east coast, the dissolved oxygen level should not fall below 10% of the established natural variation. For the south and east coasts the dissolved oxygen should not fall below 5 mg/l 99% of the time, and below 6 mg/l 95% of the time." The recent guidelines developed through the Reserve Determination methodology suggest that

[1] Information on the guidelines from the Reserve Determination process provided by Candice Haskins.

values of between 6 – 8 mg/l are good, and it is proposed that these be used as the general target range for the Diep Estuary.

For the north and south lakes (Flamingo Vlei), which reach a depth of around 10 metres in places, and where there is likely to be stratification in the water body, it is recommended that a target of 6 mg/l to a depth of 2 metres for 100% of the time be adopted.

Salinity

Target values for salinity also need to be determined for critical species. For example, *Callianassa* requires a salinity of at least 17 ppt to breed successfully. Soil salinities, together with inundation, are also important for macrophyte growth. *Sarcocornia perennis*, for example, has been found to grow best in water-saturated soil at salinities between 0 and 15 ppt (Adams and Bate, 1994).

Biological criteria

In general, the water quality should be sufficient to support all biological communities. More specifically, it should allow for:

- The re-establishment of primary producers (such as *Zostera*) and benthic invertebrates such as *Callianassa* in the lagoon;
- Improved water quality and the recovery of the benthos (which are a food source for fish) should also see the juveniles of species such as the White steenbras and Cape stumpnose re-entering the estuary.
- In the south lake, water quality should be sufficient to support *Galaxius zebratus.*

At the same time [2]:

- Chlorophyll *a* levels (which are a measure of phytoplankton growth/eutrophication) should not create nuisance conditions or produce surface scums. Mean annual concentrations should be < 15 ug/l (DWAF Water Quality Guidelines).
- Cyanobacteria (toxic blue-green algae) should be at levels < 6 blue-green units[3] (DWAF WQ Guidelines), and < 10 ug/l of cyanobacterial toxins (microcystin toxin) (WHO recreational guidelines).

3.2.3 ***Sediment quality***

A number of previous reports have referred to erosion in the catchment and siltation in the lagoon and other parts of the system. More recently there have also been reports of significant accumulations of organic material on or near the bottom. Apart from possible impacts on circulation, mouth conditions etc, sediments tend to be a

[2] Candice Haskins and Robert Siebritz – pers. comm..
[3] This refers to the number of blue-green units (colonies and filaments) counted in a two-minute scan of 0.5 mR of water at x 200 magnification.

sink for contaminants with consequential impacts on bottom-dwelling organisms. It is therefore also important to quantify and manage sediment quality.

The following objectives are proposed for sediment quality:

- Sediment quality objectives should be developed and implemented. These should be based on current international practice (see guidelines developed under BCLME), and should include bacteriological parameters.
- The sediments should be restored as far as possible to their original condition (eg. particle size distribution, organic content etc).
- Bacteriological loads in the sediments should not pose a threat to human health.
- From a biological perspective, the sediment quality in the lagoon should be sufficient to allow the re-establishment of benthic invertebrates such as *Callianassa.*

In the interim, the following guidelines are proposed for trace metals (based on the DEA guidelines)[4]:

Trace Metal	Target (mg/kg dry weight)
Arsenic	< 30
Cadmium	< 1.5
Chromium	< 50
Copper	< 50
Lead	< 100
Mercury	< 0.5
Nickel	< 50
Zinc	< 150
Combined levels of Cd & Hg	< 1.0
Combined levels of As, Cr, Cu, Pb, Ni & Zn	< 50

3.2.4 *Conservation and sustainable use*

Conservation and rehabilitation

Although there were some relatively thorough studies of the biodiversity of the estuary some years back, there are a number of taxonomic groups for which there is fairly limited information. Moreover, there has not been regular monitoring of the biodiversity. Nevertheless, a comparison of some of the reports completed over the years – in particular those on the vegetation – suggests that there have been significant changes to the biodiversity. These are probably a consequence of changes to the habitat, a deterioration in water quality, and the introduction of a variety of invasive species. General objectives therefore are that a more complete understanding of the biota of the estuary needs to be obtained, and that biological

[4] The values given are those which trigger precautionary measures when dumping dredged materials. Updated guidelines are in the process of development.

communities should be restored to as close to original species composition and structure as possible, noting that this may not always i) be possible to determine (given that the system has been compromised over a period of > 300 years); and ii) be practical in the current urban context.

More specific objectives include:

- The restoration of Strandveld in relevant parts of the reserve.
- The stabilization of the shorelines of the central pans and the north lake.
- Restoration of primary producers, benthic invertebrates (*Callianassa* communities) and fish in the lagoon.
- The development and implementation of an invasive species management plan for the reserve covering the eradication of alien species where possible, and where this is not possible, their control. The plan should also include provisions for the control of invasive indigenous species as appropriate.

Human use of the estuary/ reserve

The Diep Estuary is important from both conservation and socio-economic perspectives, the latter primarily due its aesthetic value and the recreational opportunities it affords in an area close to the City centre. Management initiatives must take account of both aspects, with objectives being:

- An appropriate balance between conservation and sustainable use of the system.
- Use of the estuary and adjacent terrestrial areas within the reserve for non-consumptive purposes such as recreation should not further compromise the biological integrity of the system, and should be limited to specific zones.

Resource exploitation

Consumptive use of resources within the estuary is relatively limited. Nevertheless, the exploitation of natural resources that does occur – for example, fishing and bait collection – should be limited to specific zones and seasons to ensure that such exploitation is sustainable.

Education and awareness-raising

Public awareness is essential for the effective implementation of environmental programmes, and the Rietvlei Education Centre offers an ideal opportunity to build awareness of a variety of environmental issues, in particular, the role of wetlands and estuaries. Existing programmes should be expanded and facilities upgraded.

4 ZONATION IN THE RIETVLEI WETLANDS RESERVE

Rietvlei was first designated as a Nature Area in 1984, later becoming a Protected Natural Environment under the Environment Conservation Act (1989) and then the NEM: Protected Areas Act (2003). This was largely on the strength of its regional importance as a habitat for waterbirds ranking in the top ten of South Africa's largest estuaries. It is listed as an Important Bird Area by Birdlife International, and consideration has been given to applying for Ramsar status for the area with the wetland being of international importance for at least four bird species.

At the same time:

- Development of the surrounding areas has continued to encroach into areas which fall within the 100-year floodline of the estuary; and
- historical records show that parts of the estuary have been utilized for recreational purposes for over a century, and today there is a well-established aquatic club on the north lake, as well as a canoeing club on the lagoon. Its establishment as a Nature Reserve, and the construction of an Education Centre and related facilities, has also encouraged walking, bird-watching, picnicking etc. In addition, there is limited bait collection and fishing.

The objectives of this management plan therefore include:

- the prevention of any further inappropriate development/land-use within the reserve; and
- the achievement of an appropriate balance between conservation and sustainable use of the Nature Reserve and estuary.

An important tool in achieving these objectives is zonation. This term can be applied to the designation of particular areas or zones for specific developmental or land-use purposes or to the delineation of different zones for specific visitor uses. Both of these approaches have been applied to the reserve/estuary and are discussed further below.

4.1 City of Cape Town Guidelines

The City of Cape Town has recently developed Guidelines for Land Use Zoning for Nature Reserves and Conservation Areas.[5] These guidelines make provision for the following land-use zones and associated conservation objectives:

- Primary Conservation: Natural areas should be kept intact in order to protect habitat required to meet biodiversity targets for various vegetation types and to provide undisturbed habitat for a range of species. Where possible degraded areas should be rehabilitated.

- Conservation: Natural areas should be kept intact in order to protect habitat required to meet biodiversity targets for various vegetation types and to provide

[5] The name of the current Table is actually Guidelines for Visitor Use Zoning, but according to Arne Purves this should be corrected.

undisturbed habitat for a range of species. Where possible degraded areas should be rehabilitated.

- Low Intensity Leisure: Although some areas will be impacted by a range of activities and limited infrastructure, most areas should be kept largely intact and ecological processes should remain functioning. Where possible degraded areas should be rehabilitated.

- High Intensity Use: The activities and infrastructure in these areas should be managed to minimize impacts on biodiversity and visitor experience in other zones. Where feasible, non-crucial infrastructure should over time be removed from the reserve and the sites rehabilitated.

- Utility Zones: The activities and infrastructure in these areas should be managed to minimize impacts on biodiversity and visitor experience in other zones. Where feasible, non-crucial infrastructure should over time be removed from the reserve and the sites rehabilitated.

Based on these, the City has proposed the following zones for the Rietvlei Wetlands Reserve:

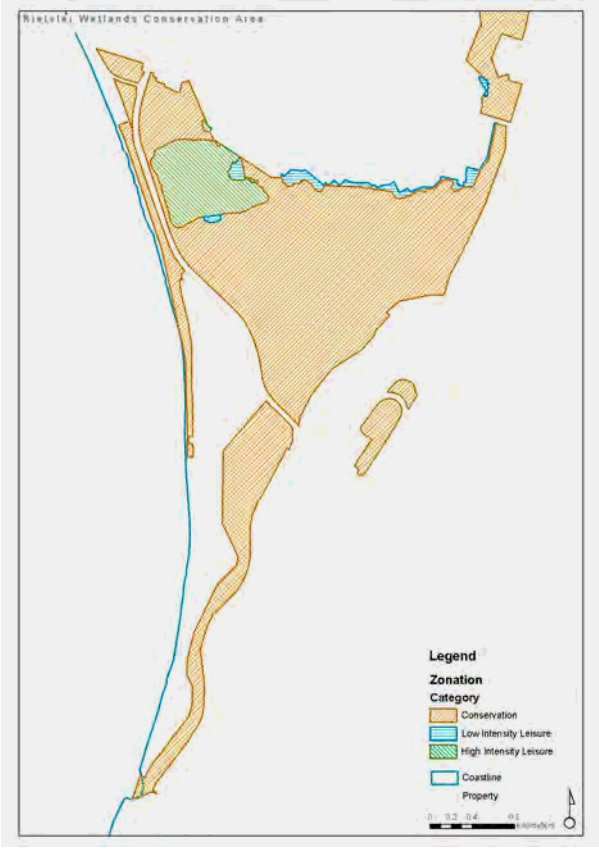


Fig. 4: Developmental/land-use zones in the Rietvlei Wetlands Nature Reserve

As can be seen from the map, the majority of the area of the reserve is designated for conservation. High intensity use is restricted to the northern part of Flamingo Vlei where there are facilities which support boating, educational and other recreational activities.

4.2 Visitor Use Zones in the Rietvlei Wetlands Reserve

The City guidelines make recommendations on the type of activities, frequency of use, group size, sophistication and type of facilities, user movement/transport and roads and footpaths which are considered appropriate to each category. The specific details however, may vary from one reserve to the next, and the activities allowed in the various different parts of the Rietvlei Wetlands Reserve are outlined below and in Fig. 5.

*4.2.1 **Closed areas or sanctuaries***

These are areas where no human disturbance is permitted, and includes the southern part of Flamingo Vlei and the seasonal pans, both of which are important as sanctuaries for birds. This area comprises 357.94 ha or 44% of the total area of the estuary.

*4.2.2 **Low intensity Use***

In these areas only low impact activities such as bird-watching and walking are allowed. They include the entire upper lagoon, as well as a number of strips bordering the sanctuary thus providing some sort of buffer between parts of the sanctuary and developed areas. This covers 128.69 ha, or 15.9 % of the total area.

*4.2.3 **Medium Intensity Use Areas***

Within the reserve, there are 3 different types of low intensity use areas, based on the characteristics of the area and/or use:

a) The terrestrial areas along the eastern bank of north lake, and the western bank of the river just below Blaauberg Bridge. Activities in these areas include picnicking, bird-watching, walking and fishing.
b) The lower lagoon (below the wooden bridge), where canoeing, bait collection and swimming are allowed – the latter only when water quality permits.
c) The area within the Sanctuary just to the east of Otto du Plessis Drive (and adjacent to Sunset Beach) which is used for model aircraft flying. It is noted that this zone is temporary, and will be discontinued in 2014 when the permit expires, at which time this will be incorporated into the sanctuary area.

Together these make up 30.97 ha or 3.8% of the total.

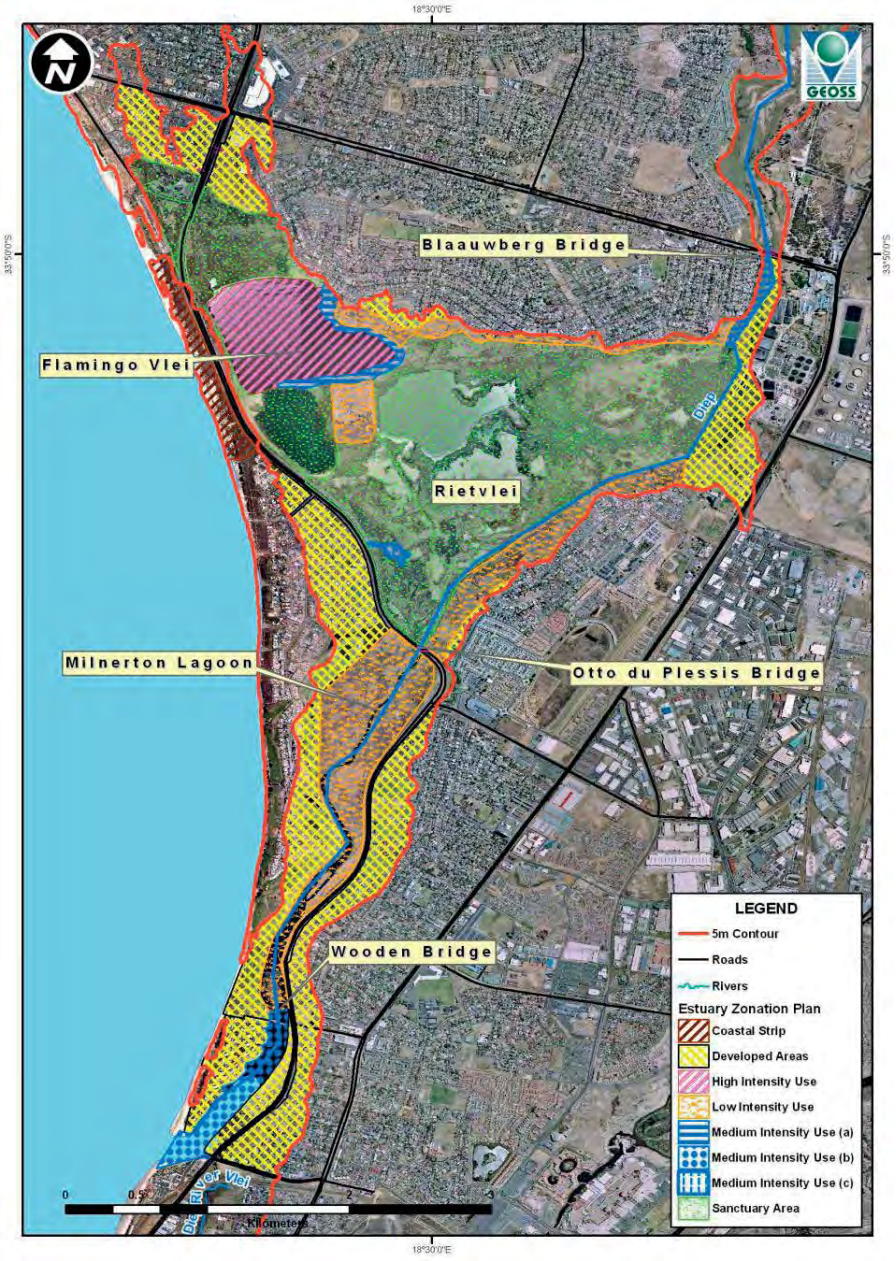


Fig. 5. Visitor Use Plan for the Diep Estuary.

4.2.4 High Intensity Use areas

High intensity use is limited to the north lake of Flamingo Vlei, where power-boating, water-skiing, and sailing are allowed. Limited fishing is also allowed on specifically designated open days. The lake covers 54.51 ha, or 6.73 of the total area.

5 MANAGEMENT STRATEGIES

5.1 Management of water quantity and quality

The prevailing national strategy for managing the water quantity and quality requirements of aquatic ecosystems is through the determination of Reserves and Resource Quality Objectives. These are provided for in the National Water Act (Act 36 of 1998) and the National Water Resource Strategy, and are intended to be implemented through Catchment Management Strategies and Agencies. However, neither the Reserve, nor Resource Quality Objectives have as yet been determined for the Diep River or Estuary. Nor has a Catchment Management Strategy been developed.

National policies on pollution and waste management are also pertinent to water quality. The policies of both DEA and DWA are intended to promote the precautionary approach and a hierarchy of management steps starting from pollution prevention and minimisation. Moreover, the operational policy for the disposal of wastewater derived from land (adopted by DWAF in 2004) espouses a Receiving Water Quality Objectives Approach rather than one based on effluent standards. The policy further states that:

i) the disposal of wastewater into sensitive areas (such as estuaries) will not be considered, except in exceptional circumstances;
ii) wastewater discharges that were existing on 31 May, 2004 (when the policy was adopted) should be re-evaluated during a 5-yearly licence-review process;
iii) revisions can also be motivated on the grounds of negative impact on the environment and non-compliance with licence conditions.

These policies have not yet been applied to the management of water quality in the Diep Estuary. In fact, despite the serious deterioration of water quality in the system, the Western Cape Department of Environmental Affairs and Development Planning (DEA & DP) on the 3rd August, 2010 issued a Record of Decision giving their approval for the further expansion of the Potsdam Wastewater Treatment Works without placing any specific restrictions on disposal of the effluent. While disposal of the effluent would be regulated by a permit from DWA , this raises an urgent need to investigate alternative options for such disposal (other than discharge into the estuary).

5.1.1 Water quantity

There is general consensus that given the history of changes to and around the Diep Estuary caused by historical and ongoing urbanization, the system will never be able to function naturally and there is therefore a need for management interventions to ensure that there is an appropriate balance between runoff from the catchment, inflow from other sources, drainage from the system, and evaporation. There is also general agreement that increasing the salinity in the system – which is now freshwater dominated as a consequence of the changes - could have a number of benefits, and that this must be taken into account in developing a management regime. At the same time, the information available on the system is insufficient to develop a comprehensive and effective water quantity management strategy. There

is therefore an urgent need for a number of studies to, amongst other things, properly quantify the inputs and losses to and from the system, and to determine the ecological reserve for the estuary.

Information requirements

Of the studies proposed, only the topographic survey and development of a Digital Elevation Model (DEM) have been completed, with the following still being required:

i) A study of the hydrology of the estuary needs to be undertaken in order to get a clear understanding of the water balance in the system, including any seasonal variations therein. This will require an accurate determination of all flows into (from the river, groundwater, stormwater and effluent) and out of the system. The data will be obtained from:
   - Existing DWA flow stations;
   - Planned and completed studies on stormwater which include an assessment of flows;
   - A determination of the groundwater contribution to the river base flow;
   - Water level and salinity recorders in the lagoon (at the Woodbridge Island Bridge), to supplement the existing ones in Rietvlei and at the Otto du Plessis Bridge.

   All recorders must be properly maintained, and data downloaded on a regular basis. Once complete, the study should be able to recommend an optimal water balance.

ii) A study of the geohydrology of the estuary is required to determine groundwater flow directions, groundwater gradients, groundwater depths and seasonal fluctuation, as well as groundwater quality variation. The groundwater underpins the surface hydrology dynamics and plays a crucial role in the management of the desiccation of the central pans in summer. The geohydrological study will require the installation of at least 8 piezometers throughout the study area. The piezometers should be equipped with water level and water quality data loggers which then need to be read at regular intervals. The piezometer water level data will also provide valuable input into assisting with the understanding of surface water dynamics. (At certain times of the year the piezometers may well be flooded).

iii) A study of the patterns of stratification in the deep water lakes needs to be undertaken so as to have a better understanding of their contribution to the development of anoxic conditions.

iv) A study of the quantity and quality of sediments and the rate of sedimentation needs to be undertaken (including core sampling of sediments) with a view to determining their impact on drainage patterns and the dust problem, as well as on the environmental health of the system. Sediments act as a sink for pollutants which can be re-released into the water column under certain conditions.

v) GIS based mapping of all historical aerial photos to measure possible changes in the extent and duration of the drying of the seasonal pans.

vi) A study on the ecology of the central pans – and especially those species which are the main food sources of the wading birds – to determine

optimal seasonal cycles from an ecological perspective. In particular, the requirements of the Palearctic waders must be taken into account.

vii) Ultimately, a comprehensive reserve determination in terms of Chapter 3, Parts 2 and 3 of the National Water Act (1998) needs to be undertaken, noting that some of the above studies will contribute to this process.

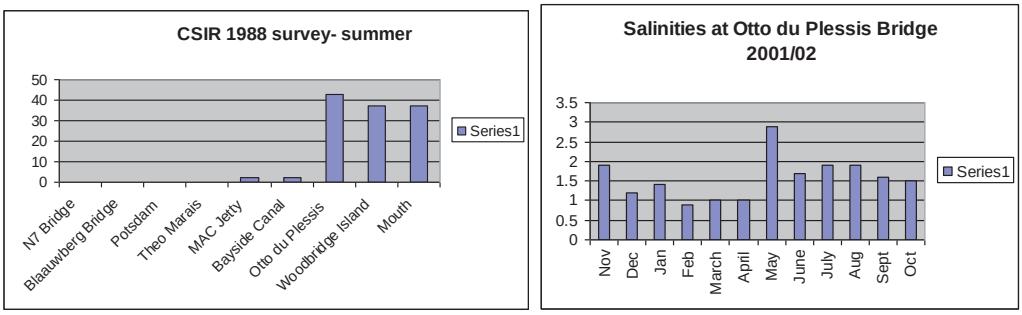
viii) The above data needs to be compiled and collated so that a hydrodynamics model can be established to optimize the various management options available.

Interim management measures

In parallel with the above-mentioned studies, it is proposed to implement some interim measures to alleviate current problems until longer-term solutions can be found. These include:

Reduction/manipulation of flows from Potsdam

Since the establishment of the channel along the east bank of Rietvlei(1991/92), the estuary has become increasingly freshwater dominated, as can be seen by comparing the salinities at Otto du Plessis Bridge in 1988 and 2001/02 (Fig. 6 below). In summer, with the river effectively drying up, the flow is made up predominantly of the effluent from Potsdam. Amongst other things, this has to a large extent eliminated the seasonal fluctuations in flow into the lagoon, and as a result, the mouth no longer closes. This is probably exacerbated by the increased sedimentation in the lower lagoon which further limits tidal penetration.



Figs 6 a and b: (a) Salinities in the Diep Estuary during a CSIR survey in the summer of 1988; and (b) Salinities at Otto du Plessis Bridge in 2001/02.

The capacity of Potsdam has recently been increased from 32 to 47 Ml/day and would be further increased to 100 Ml/day should the most recent proposal go ahead. At the same time, an increasing amount of the effluent is now being re-used – up to 20 Ml/day over the summer months since January 2006 (see Fig. 7 below). During those periods, the effluent discharge to the estuary is at times reduced to around 15 Ml/day. However, a monitoring programme undertaken between January and March, 2010 – which looked at the correlation between daily volumes of effluent discharged, salinity at two points in the estuary, and tidal height – suggested that discharges would need to be reduced to at least 10 Ml/day in order to achieve a significant increase in salinity in the estuary. Even then, the ingress of salt water is only likely to reach the Otto du Plessis Bridge at high spring tides. While the monitoring

programme was of limited duration, the conclusions are supported by the study done by WAM Technology in 2004, which suggested that flows from Potsdam could be reduced to 8 Ml/day before the mouth would be affected.

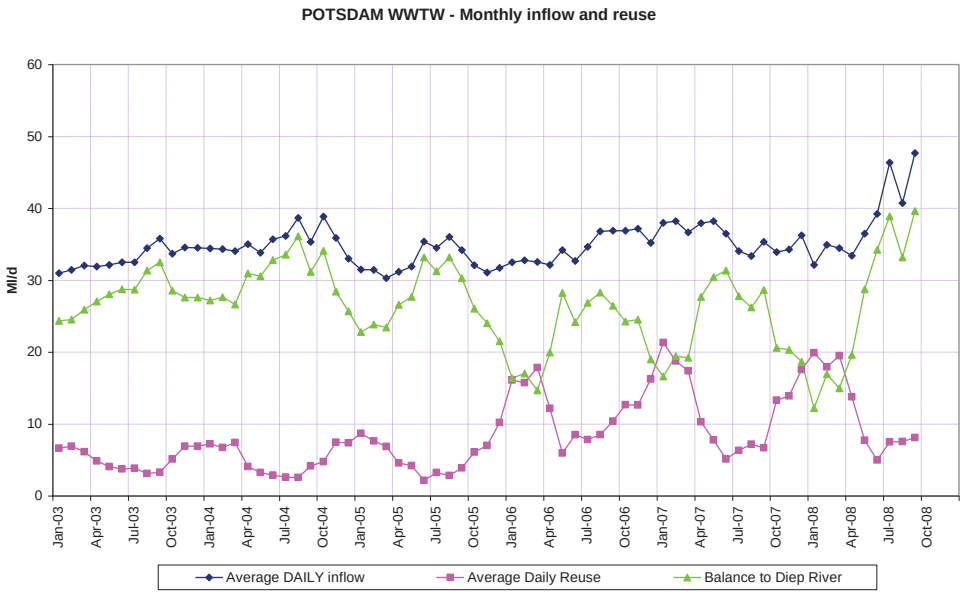


Fig. 7. Average daily flows of effluent from the Potsdam WWTW.

It is therefore proposed that a programme for the further reduction of effluent discharges from Potsdam be developed in collaboration with Water and Sanitation Services. Initially this should focus on trying to achieve such reductions on dates coinciding with high spring tides of the summer months.

The necessity for these measures may fall away should an alternative disposal option be identified and implemented.

Flows from the catchment

The flow-guaging station at Vissershok, which was operational between May 1967 and May 1982 recorded a Mean Annual Runoff of 44.4 million m^3. This was replaced by the guage at Adderley, which has been operational since 1998, and has recorded a Mean Annual Runoff of 40.17 million m^3. Both show significant variations from year to year, as well as between seasons(see Figure 8 below) Of significance for the estuary, and the proposed management of flows, is that flows from the river during the summer months are effectively zero.

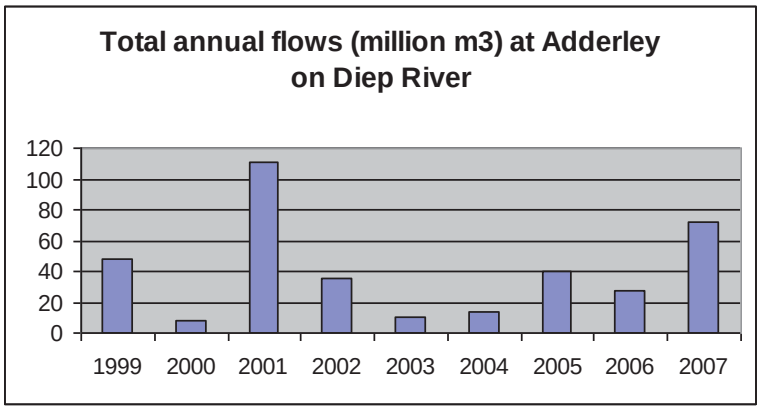


Fig. 8 (a) Variations in annual flow from the Diep River.

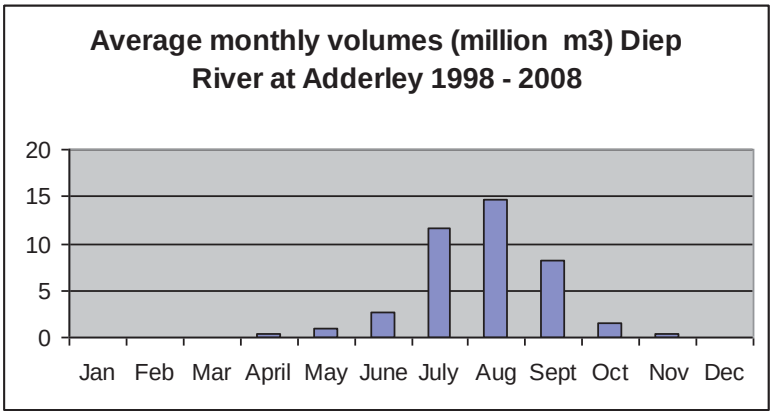


Fig. 8 (b) Seasonal fluctuations in the flow in the Diep River.

Although not immediately apparent from the above graphs, there have been suggestions that the runoff from the catchment has been reduced in recent years as a result of an increasing number of farm dams amongst others. The capacity of such dams, and their impact on flows, needs to be investigated as part of a Catchment Management Strategy. Other measures to be included in such a strategy include:

- Clearing of alien plants along the river channel, especially gum trees
- The promotion of appropriate agricultural practices to reduce infestation of invasive alien species.

Stormwater flows

The Stormwater Master Plan for the areas north of Rietvlei is in line with the City's Policy on Minimising the Impact of Stormwater from Urban Development on Receiving Waters, and promotes measures which facilitate the retention and infiltration of stormwater close to source. This should be implemented with a view to reducing stormwater flows into the estuary.

Management of water levels

Dust problem

While there is insufficient data at this stage to prove it, there have been suggestions from a variety of sources (including a specialist study conducted during the development of the 1994 Rietvlei Management Plan) that the construction and ongoing maintenance of the bypass channel along the east bank in 1991/92 has increased the rate of drainage of Rietvlei during the dry summer months by lowering the water table. This is further exacerbated by the channels which have been dug at a number of the stormwater discharge points along the boundaries of the vlei. And although the central pans have always dried out – and indeed need to go through seasonal changes in water levels to maintain their ecological function – the extent of this phenomenon may have been altered. Whether this is true or not, the dust emanating from the dry pans is a problem to residents in the area.

It is therefore proposed that measures be introduced to manage the water table with a view to limiting the rate and extent of drainage from the vlei, BUT within the constraints of the ecological requirements of the wetland (which still need to be determined). Once the ecological requirements have been established, a mechanism which will allow management of the water table will be developed and implemented. As far as possible, this should be based on natural, sustainable solutions (i.e. costly engineering solutions to be avoided), and may include the partial or complete filling in of the Potsdam bypass and stormwater channels.

In the interim, it is proposed:

i) that the maintenance excavations of these channels be discontinued, at least in certain sections; and
ii) the pumping of water from the northern lake onto the pans when they start to dry out in January should continue until a more permanent solution is found.

Flooding

Residents in areas which fall within the 1:100 -year floodline must be made aware of this fact, and a Disaster Management Plan must be put in place to facilitate response during a major storm event.

*5.1.2 **Water quality***

The data from the City's water quality monitoring programme shows that the water quality for most of the system – with the possible exception of the Flamingo Vlei area – is unacceptably poor in comparison with existing guidelines, particularly with regards to bacteriological contamination and nutrients. Fig. 9 below for example, shows that the water in Milnerton Lagoon has not been suitable for contact recreation since at least 2001, while Fig. 10 shows that the majority of Total Nitrogen samples at the Otto du Plessis Bridge are at levels indicative of eutrophic or hypertrophic conditions. This suggests that current management efforts are ineffective.

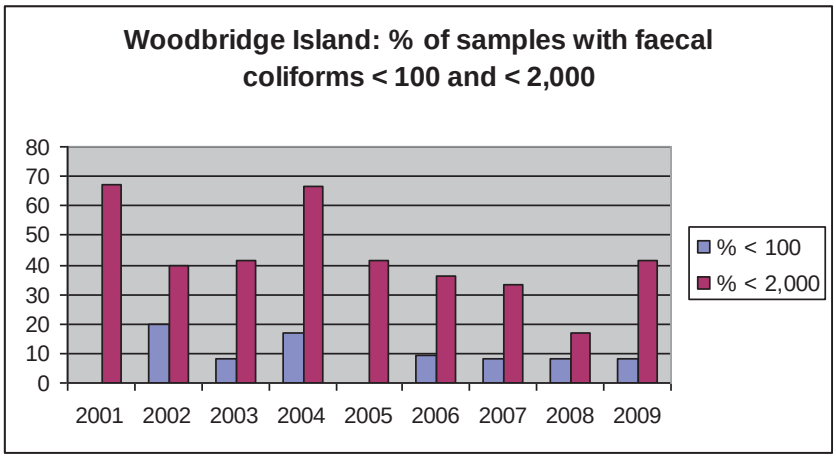


Fig. 9. Bacteriological quality of water at Woodbridge Island.

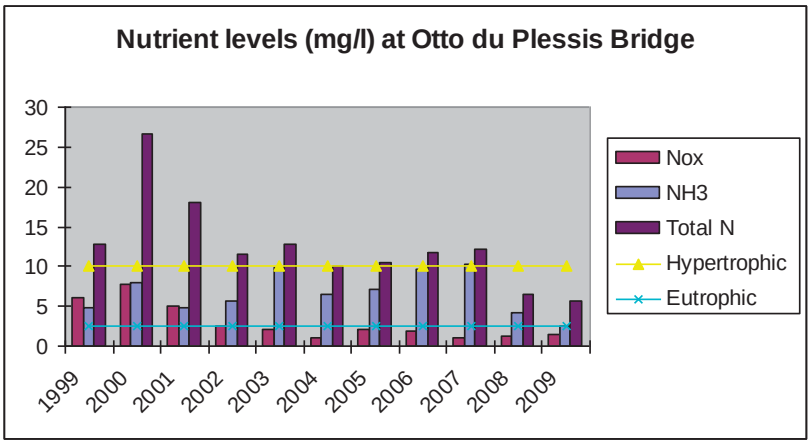


Fig. 10. Levels of nitrates and nitrites (Nox), Ammonia (NH^3) and Total Nitrogen in mg/l at Otto du Plessis Bridge. Values for Total Nitrogen > 2.5 are indicative of eutrophic conditions, and > 10 are indicative of hypertrophic conditions.

This situation needs to be addressed by the development of Resource Quality Objectives specific to the system, and the application of pollution prevention/ minimisation measures to each of the sources of pollution with a view to achieving these objectives. The sources include:

- Inflow from the river (which carries pollution from a variety of sources in the catchment)
- Potsdam and related infrastructure
- Stormwater
- Informal settlements and low-cost housing areas

The relative contribution of each of these sources also needs to be determined so that prevention efforts can be prioritized.

Setting of Resource Quality Objectives

The development of Resource Quality Objectives is provided for in Chapter 3, Parts 2 and 3 of the National Water Act (1998). The RQO should include target values for i) the freshwater inflow from the river; and ii) the estuary itself. These will be based

on existing guidelines for natural environments and/or recreation and, where appropriate, should elaborate interim targets for parameters of particular concern and a timeline for their achievement.

Pollution Prevention/ minimisation

Although the monitoring programme being undertaken by the City has provided an insight into the water quality of the estuary, many of the various sources of pollution still need to be properly quantified so as to obtain a better understanding of their relative contributions to the overall pollution load. This requires expanding and improving data collection on flows and contaminant levels, especially for stormwater drains. To date, the only in depth study which has been conducted on stormwater has been on the Bayside Canal, although a study of those on the East Bank was initiated in 2009 and is nearing completion.

In the interim, steps should also be taken to start reducing or, where possible, preventing the pollution at source.

i) Potsdam

During the summer months, when there is little or no flow from the river or stormwater drains, Potsdam is the primary source of water in the estuary. Thus the quality of the Potsdam effluent has a significant influence on water quality in the estuary during summer, if not the whole year round.

The effluent standards for Potsdam are set out in a permit issued by the Department of Water Affairs and Forestry in 2000 (and which effectively expired in 2004). A new permit is currently being processed by DWA as part of the current Potsdam expansion from a capacity of 32 Ml/day to 47 Ml/day, and could include a tightening of standards, although according to the DWA operational policy, they should, in fact, be moving to a management regime based on Receiving Water Quality Objectives. The latter have, however, yet to be determined for the Diep Estuary, although interim objectives have been proposed in this document (see Section 3.2.2).

The current permit requires the effluent to meet the General Standard for most parameters. It is also required to meet the Special Standard for Phosphate (Section 21 (1)(a) of the National Water Act. Exceptions are made for Nitrate/Nitrite as Nitrogen, which is set at 10 mg/l, and Faecal coliforms, which are set at 1000 counts/100 ml. Given that during the summer months there is effectively no dilution of the effluent, and the permitted levels exceed the water quality guidelines, any improvement in the situation would require a significant reduction in the permitted levels in the new permit.

On top of this, over the past few years – during the expansion process – Potsdam has not been able to meet many of these standards. For *E. coli*, for example, although the situation appeared to improve considerably in the latter half of 2008 and 2009, the effluent still regularly exceeds the standard and is, in fact, again showing an upward trend (see Figs 11(a) and (b) below).

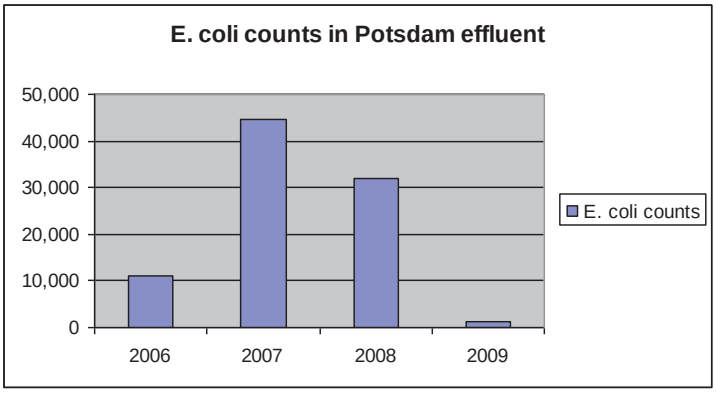


Fig. 11 (a) Average annual E.coli counts in Potsdam effluent.

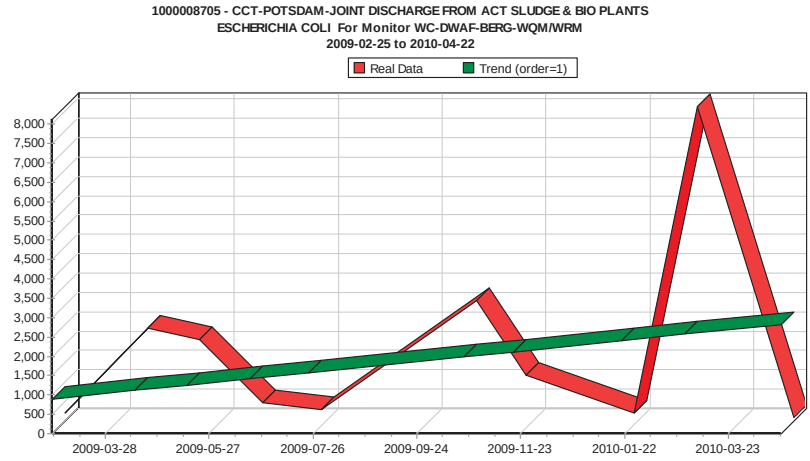


Fig. 11 (b) E.coli counts in Potsdam effluent for 2009/10 (provided by DWA).

This is of particular concern given the recent developments in relation to the investigation into WW Treatment expansion options for the broader Blaauwberg area, namely the Record of Decision issued by DEA & DP to further increase the capacity of Potsdam to 100 Ml/day. Such an expansion, with an associated increase in the volumes of effluent being discharged into Rietvlei, would lead to a further significant deterioration in the water quality. On the other hand, such an expansion combined with an alternative disposal system (i.e. one which does not involve discharging the Potsdam effluent into Rietvlei), could ultimately see a significant improvement in the water quality of the estuary. It is therefore critical, since this was not addressed in the EIA, that alternative disposal options for the effluent from Potsdam be investigated before any final decisions are taken.

ii) Sewerage infrastructure in the Milnerton/ Blaauberg area.

There have been a number of accidental spills of sewage into the estuary via the stormwater system which have had serious consequences for the biodiversity (and have health implications). These are the result of either blockages in the sewerage infrastructure in the catchment area or

malfunction of the sewage pump stations. The following actions are proposed to address these problems:

- Sewerage blockages

  The causes of these blockages are varied but in many cases are illegal discharges into the sewerage system. A system of recording and managing these blockages is being developed with a view to instituting preemptive maintenance and thereby a reduction of sewerage blockages.

- Pump stations

  All pump stations are monitored via a telemetry system and pump station malfunctions are generally expeditiously attended to without significant spillages. However, there have been significant spillages when telemetry systems fail and power outages occur. All the major pump stations adjacent to the estuary have therefore been equipped with standby generator sets. Minor pump stations will be serviced by mobile generators.

- Reporting and response to spillages

  Any significant spillages from either blockages or pump station malfunctions should immediately be reported to the Reserve Manager. They should then be treated and cleaned up using appropriate methodologies in consultation with Reserve staff.

iii) Stormwater drains.

The City's policy on minimizing impacts of stormwater on receiving waters – based on the concepts of Water Sensitive Urban Design and Sustainable Urban Drainage Systems - needs to be implemented. This includes the development of structural and non-structural best management practices for stormwater – such as retention ponds, vegetated swales, infiltration basins, bioretention cells, education, stormwater master planning etc, which are implemented at site or regional level as appropriate.

In addition, the flows and pollution loads of all existing stormwater discharges into the estuary need to be quantified and those having the greatest impact should be addressed. As mentioned above, the study on the stormwater drains along the eastern bank of the estuary is nearing completion, following which the recommended solutions should be implemented.

Following an earlier study, a number of proposals were made for managing the stormwater in the Bayside Canal – including the construction of an off-channel riparian reedbed for the treatment of stormwater low flows (chiefly suspended solids and attached pollutants) in undeveloped land immediately south of Parklands Main (Link) Road,

structural changes to increase the capacity of the canal and the introduction of litter management structures and practices. While implementation of these proposals was initiated during 2009/10, as of September 2010, these had not yet been completed. This needs to happen as soon as possible, following which they should be properly maintained.

Stormwater management systems on sites supporting industrial activities need to be inspected on a regular basis, and the policing of illegal discharges into stormwater drains needs to be improved.

Litter traps need to be placed on all stormwater discharges unless there is a strong chance of serious backflooding They should then be properly maintained to prevent litter, especially plastics, from entering the system.

iv) Informal settlements and low-cost housing areas

There are a number of informal settlements and low-cost housing areas in the area – some between the Blaauberg and N7 bridges – which have a significant impact on water quality via stormwater or direct runoff. These include Doornbach, Du Noon, Joe Slovo and Phoenix. The problem in low-cost housing areas is a consequence of both malfunctioning plumbing and the presence of backyard shacks without plumbing.

Doornbach is near Killarney and is right on the bank of the river. There are some chemical toilets on the edge of the area, but they are seldom used. Moreover, there are no roads and so it would not be possible to service toilets further into the settlement. Pressure needs to be put on relevant authorities to upgrade the area to a formal settlement – and in doing so, create a buffer zone along the river bank.

Stormwater from the Du Noon area discharges to the river above the Blaauberg Bridge, while Joe Slovo and Phoenix drain via the Erica Road stormwater drain, reaching the estuary opposite the tennis courts at Milnerton High. These have been addressed as part of the project on stormwater drains along the east bank.

It is also proposed to have an education/awareness-raising campaign emphasizing the health related problems around water and sanitation. This will be implemented in collaboration with the Department of Water Affairs, which has significant experience in this area.

v) Pollution sources in the river catchment

There are a variety of sources of pollution in the catchment, including:

- Waste-water treatment works (eg. Fisantekraal, Malmesbury) – and it is noted that the Malmesbury WWTW is currently not meeting the required standards.

- Stormwater from urban areas (formal and informal – eg. on the Mosselbank)
- Agriculture (runoff of fertilizers, pesticides etc, as well as discharges and runoff from eg. dairy farms). Many farms allow cattle to drink from the river which results in significant trampling, erosion and also contributes to pollution due to fouling of the water by cattle manure.
- Mining.

These all affect the water quality of the inflow from the river to the estuary, and need to be addressed as part of a Catchment Management Plan.

Mitigation measures

Reed beds act as sinks, and can be used to reduce nutrients in flows entering aquatic environments. However, this is not necessarily true for all situations. Moreover, their effectiveness tends to reduce over time, and the reedbeds therefore need to be managed – eg. harvested and removed for composting, burned etc. The reedbeds in the Diep Estuary have expanded significantly in recent years, and are a nuisance in some areas. A proper plan for their management needs to be developed and implemented.

Aerators could be used in emergency situations to prevent anoxic conditions from developing. They would need to be used in combination with an appropriate monitoring system which would provide early warning of such conditions.

5.1.3 ***Sediment quantity and quality***

While it is generally agreed that there have been and are considerable amounts of sediment entering the estuary from the catchment and other sources, this has not been quantified. It is therefore proposed that a series of sediment cores across the system should be taken to determine rates and quantities of sediment input from the catchment and other sources. These could also be used to determine historical patterns of salinity in the system.

In the interim, some preliminary work has been done in the catchment on guidelines for setback distances/conservation corridors with a view to reducing the silt load entering the estuary as a result of poor agricultural practices. These guidelines need to be further developed and implemented as part of a Cathcment Management Strategy.

Until relatively recently there had also not been any studies on the quality of the sediments or levels of bioaccumulation into the biota in the estuary since the work by Taljaard et al in 1992. However, in 2009, Jackson *et al* published a report on an investigation into levels of a range of metals in water and sediment samples from the Plankenburg and Diep Rivers which indicated high levels in both, with those for water exceeding the DWAF Water Quality Guidelines. In 2009/2010, DEA & DP funded a survey of heavy metal concentrations in the sediments and biota of the Diep and Berg estuaries, with biota including fish and invertebrate species. The results

indicated that trace metal concentrations in sediments from both the Diep and Berg estuaries exceeded relevant South African and international sediment quality guidelines at many stations – a significant increase over the levels found by Taljaard et al (1992). The concentrations of trace metals in biota (fish and invertebrates) were also high in most of the samples analysed and exceeded the South African legal limits for foodstuffs for a number of species commonly consumed by locals, including mullet (*Liza richardsonii)*, Mozambique Tilapia (*Oreochromis mossambicus),* Banded Tilapia (*Tilapia sparrmanii)* and carp (*Cyprinus carpio*).

Some 8 tonnes of fish are estimated to be harvested from the Rietvlei/Diep system annually, and it is important that those communities who might be consuming this fish are made aware of the potential health impacts. It is also recommended that surveys of heavy metals – and other potential contaminants – in the sediments and biota are conducted on a regular basis.

*5.1.4 **Monitoring***

The City's water quality monitoring programme – funded by the Catchment, Stormwater and River Management Branch - should be supplemented with annual surveys (or at least, every second year) of heavy metal levels in sediments and biota. If possible, these surveys should include a broader array of toxic constituents as well as bacteriology. The biological monitoring should include indicator species such as the sandprawn, other invertebrates, fish and wading birds. This would provide a good measure of overall ecosystem health, and help track the recovery of the system and progress towards the achievement of the Water Quality Objectives.

It is noted that the analytical techniques which are currently being utilized by Scientific Services, and which are suitable for freshwater, will need to be re-evaluated once tidal ingress to the estuary increases.

In addition, some of the more variable and key parameters need to be measured more regularly (eg. oxygen, ammonia, temperature and salinity). This should preferably be done on site from a small lab to be included in the new building. Amongst other things, it should be designed to provide an early warning system for anoxic conditions which could then trigger appropriate management interventions – for example, deployment of aerators during low oxygen conditions. Current monitoring is limited to surface samples, but when these samples show a drop in oxygen of below the target value (6 mg/l), additional samples should be taken lower down in the water column to determine the extent of the problem and need for intervention.

5.2 **Conservation, Planning and Sustainable Use**

*5.2.1 **Legal status of the Reserve***

The overarching management strategy for the area to date has been its declaration as a protected area since 1984 – initially as a Nature Area, and then as a Protected Natural Environment in terms of the Environment Conservation Act (1989) and then the NEM: Protected Areas Act (2003). This was successful in as much as it led to

the acquisition of the land (with WWF as the landowner), the establishment of an Advisory/Management Committee, and the development of a Management Plan in 1994.

Currently, however, the proclaimed boundaries of the reserve are not in line with the area which is currently being managed. This is being addressed as part of a new application to CapeNature by the City to have the reserve declared a Contract Nature Reserve. The formal submission of this application should be completed as soon as possible.

5.2.2 Urban Development and Planning

While there are no further opportunities for significant developments along the boundaries of the estuary itself, the west coast area to the north of Rietvlei is amongst the fastest growing in the City. The Integrated Zoning Scheme and the Spatial Development Plan for the City – currently under development – must ensure that any further rezoning for urban development in areas upstream and/or likely to impact on the estuary must be subject to stringent environmental conditions. These should include:

- the establishment of biodiversity corridors and buffer zones;
- installation of stormwater drainage in line with the Policy on Minimising the Impact of Stormwater from Urban Development on Receiving Waters;
- retention of existing natural wetlands on the site and incorporation into the development;
- restrictions on the construction of overhead transmission lines in the vicinity of the estuary;
- establishment of Environmental Liaison Committees to oversee compliance with the environmental conditions of the approvals.

5.2.3 Conservation and ecotourism development

A conservation development framework needs to be developed for the Northern District – which includes the Diep Estuary (cf that developed for the Southern District). Issues to be addressed include:

- The development of an on-site management facility, including office space for reserve staff and a small laboratory to facilitate the management of water quality;
- The erection of fencing or construction of berm and channel boundaries around the entire reserve.
- The establishment and/or upgrading of links to the Blaauberg Conservation Area, Potsdam Outspan, and Zoarvlei;
- Additional bird hides and other bird viewing facilities should be erected, and screened walkways for the existing ones constructed, possibly using reeds;
- Breeding features for birds should be established, particularly in and around the south lake (for example, an island at the tip of the Peninsula);
- Walking trails to be developed;

- o Plans to relocate the model aircraft site in 2014 (when their permit expires) need to be finalized.
- o A corridor between Vissershok and Atlantis needs to be provided for in the Catchment Management Strategy.

*5.2.4 **Biological research and monitoring***

Despite the fact that the area has been a Nature Reserve since 1984, there are a number of taxonomic groups which have not been studied in any detail. At the same time, as a consequence of the physical and chemical changes to the system, there have been changes to the biodiversity. It is therefore recommended that a structured programme be put in place to fill these gaps in knowledge through projects undertaken by the Nature Conservation students, and in collaboration with tertiary institutions[6]. This should include the identification of any threatened species present within the area.

Biological monitoring using indicator species should also be put in place, and a photographic record of changes to the reserve vegetation should be kept based on aerial photos (especially for historical changes) and fixed-point photography (cf. the MCA system).

*5.2.5 **Rehabilitation and habitat restoration***

Rehabilitation of the estuary must necessarily include issues of water quantity and quality. However, since these have already been addressed in earlier sections of this plan, this section is focused primarily on the biological aspects.

A rehabilitation plan covering both aquatic and terrestrial areas needs to be developed. This should include:

- The re-introduction of primary producers (such as *Zostera*) and benthic invertebrates, such as sandprawns into the lagoon[7]. However, these should not be attempted until the water and sediment quality have improved to suitable levels;
- Salt marsh vegetation (*Sarcocornia*) – although there is not much experience in propagating this.
- The establishment of sand plain fynbos in the Milnerton Ridge area..

Prior to this, there needs to be groundtruthing of the terrestrial vegetation which was originally low-lying strandveld and sand plain fynbos. It is noted that the shoreline areas around parts of the vlei have been transformed, and the substrate is no longer the same. In these areas, therefore, consideration could be given to bringing in plants which would specifically enhance bird habitat – for example, to promote the establishment of a heronry. Although there was not a heronry historically, this issue should be looked at in regional terms. For example, since the number of breeding

[6] It is noted that during 2010, a student project was completed on frogs in the reserve.
[7] It is noted that sandprawns have now returned to the lower lagoon, although it is not certain in what quantities.

pairs of herons at Century City has been reduced from 1,200 to 250 pairs, Rietvlei could provide opportunities to increase numbers in the region.

There was also a suggestion that consideration be given to “shallowing” the edges of the south lake to recreate pans, and possibly even to construct an island, to provide additional habitat for wading birds. However, there was concern over the possible impacts on indigenous fish species in the lake (eg. *Galaxius zebratus*) which require a minimum average depth of 50 cm. This proposal therefore needs further discussion.

Another area which needs attention is the erosion on the shores of north lake. These need to be stabilized.

*5.2.6 **Invasive species***

Initial work on an invasive alien species management plan for the Nature Reserve has consolidated existing information on invasive species, including:

- Aquatic and semi-aquatic plants – at least 9 species reported although some of these have yet to be verified;
- Grasses – at least 5 species reported, with *Paspalum* and *Pennisetum* (Kikuyu) being of greatest concern. *Paspalum* or vleigrass, was recorded as far back as 1985, and was reported by Withers et al (2002) to cover an area of some 78.54 ha (27% of the area studies – essentially Rietvlei). It is outcompeting the indigenous sedgeland species and is encroaching onto the Open Pans – the primary habitat for wading birds (see Fig. below).
- Other terrestrial plants – these have been the focus of initial work on invasive species in the area and the woody species at least are now largely under control;
- A variety of alien fish, mostly deliberately introduced;
- Mallard ducks – mainly in the lagoon area;
- Indigenous invasives such as *Typha* and *Phragmites* which only occurred in localized areas prior to 1967, but which have expanded their distribution significantly as a result of the increased nutrient levels.

Fig. 12 *Paspalum vaginatum* encroaching onto the pans at Rietvlei

A comprehensive invasive alien species management plan for the reserve needs to be completed as soon as possible. This should be in line with relevant national, provincial and city-wide policies and strategies with first steps including:

- The identification and GIS mapping of invasive species from all taxa;
- Assessment of the impacts of the IAS on conservation goals and management objectives;
- The identification of pathways/vectors for their introduction and dispersal;
- Prioritisation of species and pathways;
- Development and implementation of species-specific management strategies for priority species;
- Development and implementation of management strategies for priority pathways;
- Establishment of an early detection and rapid response strategy and an ongoing monitoring and evaluation system to determine the effectiveness of management interventions;
- Identification of needs and gaps in information and management capacity.

A plan to manage the reedbeds (*Phragmites* and *Typha*) also needs to be developed. In developing the plan, consideration needs to be given to the various management options which are available, including:

- Mechanical harvesting
- The manipulation of salinity to manage, for example, the *Typha capensis* problem in the Dolphin Beach ponds
- Herbicides
- Burning.

5.2.7 ***Resource Utilisation***

Fishing in the reserve is limited to recreational fishermen with appropriate permits and even then, only on specific days and/or sites, although there is thought to be a significant amount of illegal fishing. The exploitation of bait organisms is, however, allowed and catches have historically included mainly the sandprawn (*Callianassa*), harder and springer.

However, the *Callianassa* population has suffered a significant reduction in recent years as a result of water quality problems, and even though they appear to be returning now it is suggested that future exploitation should be controlled through the introduction of closed areas and seasons.

5.3 **Education and awareness**

Public awareness around the role and importance of estuaries and wetlands is crucial for the effective implementation of management programmes. Some specific proposals for improving the education and awareness activities around the Diep Estuary include:

- In the longer term, there should be a bigger public education and information centre, and consideration should be given to expanding the existing one.

- There should be displays on wetlands function and other interpretive material, including signage and a brochure on the rehabilitation programme.
- The information should include a component on water quality.
- The programme with school groups should be expanded and consideration should be given to having trained Xhosa-speaking bird-guides (cf. Intaka).
- Links should be established with the Two Oceans, the Wetland Forum and WESSA, especially in relation to opportunities for teacher training.
- A DVD documenting the rehabilitation of the Diep Estuary system should be produced. The Film Academy should be approached to do this as a student project/s. Another option would be to approach 50/50.
- A Catchment-to-Coast brochure highlighting the importance of landcare in protecting the Diep Estuary should be developed and distributed, especially to farmers in the catchment.
- There should be a specific initiative to make all relevant departments within the City aware of the current efforts to rehabilitate the Diep Estuary so as to ensure that decisions of such departments do not undermine the rehabilitation programme.

6 RESOURCE REQUIREMENTS

6.1 Staffing

The current level of staffing at the Nature Reserve is insufficient to cope with the additional work which will be required for full implementation of this Action Plan. Since the City does not have any additional posts available, other options for boosting the human resource capacity therefore need to be investigated. These include raising funds and appointing staff in partnership with relevant NGO's and other organizations.

In addition, there should be two students and an intern.

6.2 Finances

Many of the proposed actions can be undertaken by existing staff in the relevant organizations, and within existing budgets – for example, costs associated with the ongoing water quality monitoring programme and the pumping of water during the summer from the north lake onto the central pans. However, there are a number of new activities which have been proposed and for which funding has not yet been secured. These include:

- A number of projects which fall clearly within the mandate of the competent authorities, but for which funds have not as yet been secured because of competing priorities (eg. the Reserve Determination/s which is estimated to require R 1.2 million);
- Projects which have been recommended by studies funded by the City, but for which funds have not yet been secured (eg. the recommendations on source reduction measures arising from the study on the East Bank stormwater drains).[8]
- Project proposals which have arisen during the EMP development process and which at present are not covered by the budget of any particular department and for which funds have not been forthcoming despite the fact that some of them are critical to the effective management of the estuary.

The costs for the latter category of projects are estimated to be in the order of R 1.5 million. These could be covered by the Rietvlei Trust Fund which currently stands at around R 5 million. It is therefore recommended that the issues around accessing these funds be resolved as soon as possible so that at least some of the priority projects can be implemented.

Other potential sources of funds should also be investigated.

[8] It is understood that these are likely to amount to several hundred million rand, and it is unclear as to whether/when they will be implemented.

7 ACTION PLAN

The Situation Assessment (2008) highlighted significant problems in the Diep Estuary, with the following being identified as priorities:

- Water quantity and hydrodynamics
- Water quality
- Changes to biodiversity
- Conservation and legal status.

During the development of the Estuary Management Plan (EMP) a large number of proposals aimed at addressing these issues emerged. These were captured in the Action Plan 2009 – 2013 set out in Section 7 of the first edition of the Estuary Management Plan (2008). Since then, some of the proposed actions have been completed, while new proposals have emerged. This second edition of the EMP therefore includes a revised version of the Action Plan covering the period 2011 – 2015 in Section 7.2 below. There is also an updated list of those considered the highest priority in 7.1 below.

7.1 Revised List of Priority Actions

The status of the initial list of priorities is summarized in the table below, while a list of the acronyms used here and in subsequent tables can be found in Annex I:

	Action	Status	Constraints
1	Preliminary Determination of Ecological Reserve & Resource Quality Objectives	Some low confidence reserve determinations have been completed for parts of the catchment.	This is a DWA responsibility, & the Diep is not high priority at the national level of the Department, so funding has not been available.
2	Studies on the hydrology & geohydrology of the estuary	TOR in place but study not initiated. Partial funding available from TMF.	There have been difficulties in accessing the Rietvlei Trust Fund.
3	Topographic survey & DEM	Completed	
4	Study on East bank stormwater	In progress but behind schedule	
5	Field trials around salinity regime/ effluent management	Modified study implemented and completed	Infrastructural limitations prevented further reduction of Potsdam effluent within the time-frame.
6	Expansion of water quality monitoring programme to include sediments & biota	Once-off survey of heavy metals in sediments & biota funded by DEA & DP	Insufficient capacity at the City's Scientific Services & existing Service Contract.
7	On-site water quality monitoring capacity	Incorporated into plans for on-site office block	Building plans on track for completion in 2011.
8	IAS management plan	Preliminary draft completed, new proposals tabled.	Insufficient funds for work required (comprehensive assessment of
9	Formalisation of new reserve boundaries	In progress	Coordination with submissions for other reserves.
10	Assistant Reserve Manager		No posts available.

During the first two years of the implementation of the EMP, a Record of Decision (ROD) was issued giving initial approval for the expansion of Potsdam from 47 to 100 MgL/day. Since the EIA did not investigate alternative disposal options for the effluent, this appears to assume that the additional effluent will be discharged into Rietvlei. This will undermine the achievement of many of the operational objectives of this plan and alternatives need to be investigated as a matter of urgency.

Based on the above, the updated list of priorities is as follows:

i) Investigation into alternative options for the disposal of effluent from Potsdam, including recycling, re-use and disposal to sea;
ii) Sourcing of funding for a Comprehensive Determination of the Ecological Water Requirements and Resource Quality Objectives for the Estuary;
iii) Sourcing of funding for studies on the hydrology and geohydrology of the estuary possibly by resolving the issues around the use of funds from the Rietvlei Trust Fund;[9]
iv) Installation of a permanent salinity recorder/s;
v) Implementation of source reduction measures for the stormwater inputs along the East Bank of the estuary as per recommendations of the study underway;
vi) Institution of regular (at least every 5 years, and preferably every two years) surveys of heavy metals and other toxic contaminants in sediments and biota;
vii) Compilation of leaflet/brochure on potential health impacts of consumption of fish for distribution in surrounding communities;
viii) Construction of the on-site administrative block, including facilities for on-site monitoring capacity for key water quality parameters;
ix) Completion and implementation of the invasive species management plan;
x) Conclusion of an MoU with the Department of Agriculture Forestry and Fisheries (DAFF) regarding fish surveys.

In addition, while the catchment is beyond the scope of this plan, it is recommended that riverine buffer zones be implemented on a pilot basis in the catchment as per the study undertaken by GEOSS.[10]

[9] The results of this study would contribute to the reserve determination. Moreover, if it is implemented, it will include the installation of salinity recorders, in which case the next point will fall away.

[10] Conrad, J. and Carstens, M (2010) A methodology and guideline for improved hydrological functioning due to poor agricultural practices in the Diep River catchment, Western Cape. GEOSS Report No: G2010/08-06

7.2 Detailed Action Plan: 2011 - 2015

WATER QUANTITY MANAGEMENT				
Steps	**Date**	**Responsibility**	**Estimated Budget**	**Indicator**
Objective A: Re-establishment of a regime more typical of an estuarine system				
1. Comprehensive Ecological Reserve Determination for the estuary.	2011- 2013	DWA + Manager ERMD	R 1.2 million (including det. of resource quality objectives)	Target value for water quantity in place.
2. Investigation into alternative options for the disposal of Potsdam effluent	2011	Manager: WSS	TBD	Alternative options identified, assessed & costed, but implementation likely to be beyond the time-frame of this Action Plan.
3. Development & implementation of a programme for the reduction of discharges from Potsdam during the summer months to 10 MgL/day or below (at least at high spring tides).	2011 - 2015	Manager: WSS (Potsdam, Water Demand Management Committee, Reticulation) + Manager: ERMD	TBD	Achievement of optimal salinity regime and mouth conditions (closes late summer for a short period).
Objective B : Management of water levels, flood risk and seasonal drying				
1. Pumping of water from north lake onto the central pans during summer months as required (until an alternative solution has been determined).	January-April annually	Manager: ERMD (BM and E & H) + Manager: Roads & Stormwater (Operational Division)	R 200,000/ year	Reduction in complaints about dust.
2. Maintenance excavations of the bypass channel from below the Potsdam outlet to be discontinued.	Ongoing	Manager: ERMD + Manager: Roads & Stormwater, (Operational Division)	N/A[11]	Channel depth reduced.
3. Sourcing of funds to undertake study of hydrology & geohydrology of the estuary + execution of study.	2011/2013	Manager: ERMD: BM & Chair: Rietvlei MWG	R 375,000	Improved understanding of water balance in the system, and therefore capacity to manage it.

[11] N/A in relation to budget implies that the work will be done in-house and can be accomplished by existing staff and within normal running costs.

4. Development of a hydro-dynamics model based on the above data to support management decisions.	2013/14	ERMD: Manager: BM & Chair: Rietvlei MWG	TBD	Improved capacity to manage hydrodynamics.
5. Based on the hydrodynamics model, implement alternative solution.	2014 onwards	Manager: ERMD (BM and E & H)	TBD	Effective management of water levels, especially in the central pans during summer.
6. Ongoing monitoring of water levels, salinity etc. at stations established during hydrology study. (Could be done in-house, or by consultant).	2013 - 2015	Regional Director: DWA + Manager: Catchment, Stormwater & River Management Branch (CSRM)	R 5,000 per sampling run (if done by consultant).	Database to support management of hydrodynamics.
7. Study of the sediments – rates of sedimentation & source of sediments. Should include a bathymetric survey of the bypass channel every second year to assess fill rates.	2011/2012	Manager: ERMD: BM & Chair: Rietvlei MWG	TBD	Improved understanding of sedimentation + management proposals.
8. Development of a Disaster / Flood Management Plan, including the installation of an early warning system at the mouth.	2011	Manager: CSRM, Head: Disaster Management + Regional Director: DWA	TBD	Plan in place and water level recorder + extras in place.
9. Implement riverine buffer zones/set-back lines in the catchment	2011/12	Department of Agriculture	N/A	Reduction in sediment loads in the estuary

ESTUARINE ENVIRONMENTAL QUALITY MANAGEMENT				
Steps	**Date**	**Responsibility**	**Estimated Budget**	**Indicator**
Objective C : Establishment of binding Resource Quality Objectives				
1. Determination of Resource Quality Objectives using Rapid Determination methodology	2011	Regional Director: DWA	R 250,000	Resource Quality Objectives in place + requirements for Potsdam.
2. Gazetting of Resource Quality Objectives.	2011	Regional Director: DWA	N/A	Binding Resource Quality Objectives in place.
3. Sediment quality guidelines based on international practice.	2011/2012	DEA (Oceans & Coasts)	N/A	RSA sediment quality guidelines in place.
Objective D : To meet interim and longer-term water quality objectives				
1. Investigation into alternative options for the disposal of Potsdam effluent (see also A2).	2011	Manager: Water and Sanitation Services	TBD	Alternative options identified, assessed and costed, but implementation likely to be beyond the time-frame of this Action Plan.
2. Review of Potsdam permit standards and stormwater quality objectives should water quality in the receiving waters not improve.	January 2013	Manager: ERMD (BM and E & H) Regional Director: DWA, & DEA (Marine Pollution)	N/A	Revised permit conditions for Potsdam effluent and revised stormwater quality objectives.
3. Implementation of source reduction measures for contaminants in stormwater (as recommended in study).	2011 – 2015 & beyond	Manager:CSRM	TBD	Stormwater complies with recommended quality objectives.
4. Institution of regular surveys of toxic contaminants in sediments & biota (preferably every second year)	From 2012	Managers: CSRM/ ERMD	TBD	Improved information on trends in contamination.
5. Mapping and assessment of stormwater drains along the western and northern banks of the estuary.	2011	Manager: CSRM	TBD	Inclusion of all stormwater outlets on GIS map, and report on quantity and quality of flows.
6. Comparative assessment of pollution loads from various sources.	2012	Manager: CSRM	TBD	Comprehensive understanding of pollution sources to the estuary.

Steps	Date	Responsibility	Estimated Budget	Indicator
Objective E : Reduction in accidental discharges to the estuary				
1. Development of system for recording & managing blockages through preemptive maintenance	2011	Manager: Water and Sanitation Services: (Reticulation)	N/A	Reduction in blockages..
2. Install back-up generators (fixed or mobile) to cater for power outages.	2011/2012	Manager: Water and Sanitation Services: (Reticulation)	TBD	Reduction in frequency of accidental discharges as a result of pump station failures.
3. Inclusion of Reserve Management in incident reporting system, & development of a Response Plan.	2011/2012	Manager: Water and Sanitation Services: Reticulation + Manager: ERMD	N/A	Improved communications around and response to accidental spills.
Objective F : To reduce inputs from informal settlements				
1. Development of a community health & sanitation awareness programme	2011 – 2012	Regional Director: DWA + Manager: ERMD	R 50,000	Increased utilization of sanitation facilities.
Objective G : To manage short-term fluctuations in critical water quality parameters				
1. Establish on-site monitoring of key parameters.	2012	Reserve Management	TBD	Early warning of potential water quality problems eg. low oxygen events.
2. Develop response plan in the event of changes to critical parameters eg. aerators in the case of low oxygen.	2012	Reserve Management	TBD	Effective response to low oxygen and pollution events.

BIODIVERSITY MANAGEMENT				
Steps	**Date**	**Responsibility**	**Estimated Budget**	**Indicator**
Objective H : To improve understanding of the ecological requirements of the central pans (wading birds)				
1. Review of relevant literature & expert consultation.	2011	Manager: ERMD (BM and E & H)	R 20,000	Recommendations on ecological requirements in management of water levels in central pans.
Objective I : To improve knowledge of the biology of the estuary				
1. Identify gaps in the knowledge base and prioritise taxonomic groups, species, habitats etc.	2011	Reserve Manager & Chair: Rietvlei MWG	N/A	List of priority biological studies.
2. Develop a programme to address priorities, through student projects.	2011 – 2015	Reserve Manager & Chair: Rietvlei MWG	N/A	Structured programme in place to address priority knowledge gaps.
3. Approach tertiary institutions for possible involvement in this programme.	2011	Reserve Manager & Chair: Rietvlei MWG	TBD	Externally funded projects involving tertiary institutions.
4. MoU in place with DAFF on fish surveys	2011	CapeNature/DAFF/Reserve Manager	N/A	Improved understanding of the fish populations in the estuary.
Objective J : Invasive species management				
1. Development of an invasive species management plan for the RWNR (terrestrial and aquatic).	2011	Reserve Management + City's Invasive Species Unit (ISU)	R 60,000	Integrated approach to addressing invasive species in the estuary/Nature Reserve.
2. Ongoing maintenance clearing of terrestrial invasives (woody plants) in and near the reserve.	Ongoing	Reserve Management	R 100,000 for 2010/11	Priority areas cleared of woody plants.
3. Development & implementation of plan on invasive grasses (esp. *Paspalum*)	2011-2013	Reserve Management + City's ISU	TBD	Reduction of extent of invasive grasses
4. Development & implementation of programme on aquatic invasives.	2012- 2014	Reserve Management + City's ISU	TBD	Reduction in aquatic invasives.
5. Annual surveys with EDRR/SANBI for emerging species (eg. *Lythrum*) + establishment of volunteer network.	2011 - 2013	Reserve Management + EDRR + ISU	N/A	Early detection & removal of potential invasives

Steps	Date	Responsibility	Estimated Budget	Indicator
Objective K : Rehabilitation of biodiversity				
1. Rehabilitation of sand plain fynbos in Milnerton Ridge area.	2011 - 2015	Reserve Management	TBD	Sand plain fynbos re-established.
2. Rehabilitation of aquatic areas (once water quality has improved).	2013	Reserve Management	TBD	Aquatic biodiversity restored.
3. Rehabilitation of salt marsh vegetation.	2013	Reserve Management	TBD	Salt marsh vegetation restored.
4. Annual discussions with Working for Wetlands on priorities for wetland rehabilitation.	2011/2015	Reserve Management + Working for Wetlands	TBD	Partnership with Working for Wetlands & funding for agreed priorities.

CONSERVATION AND PLANNING INITIATIVES				
Steps	**Date**	**Responsibility**	**Estimated Budget**	**Indicator**
Objective L : Development and upgrading of Reserve infrastructure				
1. Appointment of building contractors	2011/12	Reserve Management + City Planners/Works	Approx. R 4 million	Construction of office block completed.
2. Development of a detailed assessment of fencing requirements, including budget and motivation.	February, 2011	Reserve Manager	TBD	Submission of budget request for at least priority fencing requirements.
3. Installation of fencing in priority areas	2012	Reserve Management + City Works	TBD	Priority areas fenced & reduction in wildlife kills.
Objective M : Conservation & ecotourism development				
1. A Conservation Development Framework for the North District – which includes the estuary - should be put in place (links, bird hides, breeding features, walking trails etc).	2011	Manager: ERMD + SDI & GIS + Reserve Manager	N/A	Structured approach to development of appropriate facilities, features etc in the reserve.
2. Implementation of the CDF.	2011 - 2015	Reserve Management	TBD	Facilities, features etc. in place.

LEGAL/POLICY MEASURES				
Steps	**Date**	**Responsibility**	**Estimated Budget**	**Indicator**
Objective N : to formalize the expanded boundaries of the reserve				
1. Formal submission of application for Contract Nature Reserve status – including expanded reserve boundaries to the Province (has been approved in principle).	2011	Manager: ERMD: BM	N/A	Rietvlei recognized as a Contract Nature Reserve with expanded boundaries.
Objective O : to formalize the Estuary Management Plan				
1. The EMP – including the Zonation Plan – to be formalised according to the National Protocol (to be finalized in March, 2011)	2011	Manager: ERMD: BM & Chair: Rietvlei MWG	N/A	Estuary Management Plan formally adopted.
Objective P : to improve protection of the reserve from encroachment of private gardens and invasive plants				
1. Make submission to City's IAS policy process on possible development of an appropriate by-law or other mechanism to facilitate this.	2011	Manager: ERMD: BM, Chair: Rietvlei MWG, City ISU	N/A	By-law approved and implementation initiated.

EDUCATION AND AWARENESS-RAISING				
Steps	**Date**	**Responsibility**	**Estimated Budget**	**Indicator**
Objective Q : To improve public awareness on the importance of wetlands in general and the Diep Estuary in particular				
1. Update and improve displays, posters brochures etc. To include socio-economic value, link to River Health Programme etc.	2011	Reserve Manager + Environmental Communications + Friends of Rietvlei	R 50,000	Updated material available for distribution.
2. Establish contact with Intaka re Xhosa-speaking guides.	2011	Reserve Manager + Avifauna Advisor	N/A	Xhosa-speaking guides available for school programme
3. Establish links with Two Oceans, the Wetland Forum etc re teacher training opportunities.	2011	Reserve Manager + Friends of Rietvlei	N/A	Teacher training programmes include material on wetlands
4. Develop a Catchment-to-Coast brochure to promote understanding of the links to catchment activities.	2011	Reserve Manager + Department of Agriculture (Landcare)	R 25,000	Brochure available for distribution to farmers, miners etc in the catchment.
Objective R : To promote awareness of and compliance with the Estuary Zonation Plan				
1. Displays, posters and brochures showing the zoning	July, 2012	Reserve Manager + ERMD (Communications) + Friends of Rietvlei	R 25,000	Awareness of Zonation Plan.
Objective S : To document and promote awareness of the rehabilitation initiative				
1. Investigate options for the production of a DVD.	2011	Reserve Manager + ERMD (Communications) + Friends of Rietvlei	TBD	Partnership with relevant institution.
2. Implement	2011 - 2015	Reserve Manager + ERMD (Communications) + Friends of Rietvlei		DVD documenting rehabilitation process, with clips aired on 50/50 & other relevant programmes
Objective T : To promote awareness of health & sanitation issues around the estuary				
1. Develop brochure in relevant languages	2011	Reserve Manager + Environmental Communications + DWA	R 25,000	Brochure available for use in community education programme.
2. Meetings with community leaders	2011-2012	Regional Director: DWA	N/A	Support of community leaders for educational programme.

3. Compilation of a leaflet/brochure on potential health impacts of consumption of fish from Rietvlei & distribution in surrounding communities	2010/11	DEA & DP	TBD	Community awareness of potential health impacts of fish from Rietvlei.
Objective U : To promote and market the Reserve				
1. Improve signage in line with new policy	2011	Reserve Manager + Roads Department	TBD	Increased number of visitors
2. Brochures provided to Cape Town Tourism	2010 (ongoing)	Reserve Manager	N/A	Increased number of visitors

RESOURCE REQUIREMENTS				
Steps	**Date**	**Responsibility**	**Estimated Budget**	**Indicator**
Objective V : To increase capacity of human resources				
1. Training in estuaries management (C.A.P.E. Training)	2011/2012	Manager: ERMD	R 10,000	Staff capacity increased.
Objective W : To improve availability of financial resources to implement the Action Plan				
1. Investigate mechanisms to access the funds from the Rietvlei Trust Fund and/or have the funds transferred to Friends of Rietvlei	2011	Manager: ERMD/ Rietvlei Management WG	N/A	Funds available to implement relevant aspects of the EMP/Action Plan.
2. Identify and target additional potential sources of funding	2011 ongoing	ERMD/ Rietvlei Management WG	N/A	Funds available to implement relevant aspects of the EMP/Action Plan.

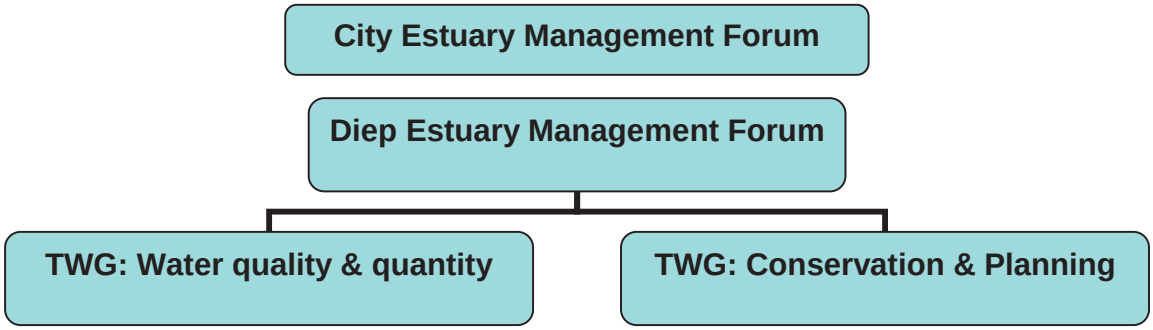
8. FRAMEWORK FOR IMPLEMENTATION

A Management Committee for the Rietvlei Nature Reserve has been in existence since the establishment of the reserve, and has taken on the responsibility for overseeing the implementation of the EMP. The original committee has been expanded to include a number of additional members, although it is noted that not all members are active.

Members of the committee include:

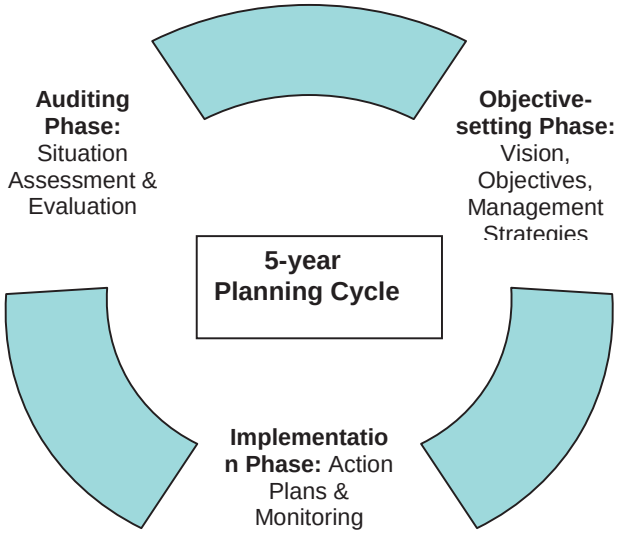
- City of Cape Town (various different divisions)
- Department of Water Affairs
- Cape Nature
- WWF
- Chevron
- Friends of Rietvlei
- Milnerton Aquatic Club
- Bird expert
- Department of Environmental Affairs (DEA – Oceans & Coasts (Estuaries & Pollution Divisions)
- Department of Agriculture (Landcare)
- Department of Environmental Affairs and Development Planning (W.Cape)
- Ratepayers

In addition, there should be two Technical Working Groups to continue providing guidance to the implementation of relevant aspects of the plan.



9. AUDITING AND EVALUATION

The Situation Assessment which preceded the development of this Estuary Management Plan should be regarded as the first of 5-yearly Evaluations in an ongoing cycle of planning for the management of the estuary as shown in the diagram below.



However, particularly in the initial 5-year period, it is recommended that progress on the implementation of the EMP is audited on a more regular basis as follows:

- There should be quarterly meetings of the Diep Estuary Management Forum (Rietvlei Management Working Group), with the minutes of these meetings being made available to the City Estuary Management Forum, CapeNature, the Provincial Coastal Committee, and other relevant bodies.
- There should be annual report backs to a open Public Meeting on progress in terms of implementation of the EMP/Action Plan. The report should be made on the basis of an annual “mini-audit” of progress by an external consultant, with the appointment of the consultant being facilitated by the Forum.

In the case of this first 5-year period, where a number of the actions in the second half of the period are dependant on the outcome of studies or other actions scheduled for the first two years, it is also proposed that a more thorough audit take place at the mid-point of the 5-year period, as well as at the end. This would be accompanied by revisions and/or refinements to the current EMP and Action Plan.

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Annex I: List of Acronyms:

BM	Biodiversity Management Branch (City)	EIA	Environmental Impact Assessment
CSRM	Catchment, Stormwater & River Management Branch (City)	EMP	Estuary Management Plan
DAFF	Department of Agriculture, Forestry and Fisheries	ERMD	Environmental Resource Management Department (City)
DEA	Department of Environment Affairs (National)	IAS	Invasive alien species
DEA & DP	Department of Environmental Affairs & Development Planning (W.Cape)	TBD	To be determined
DEM	Digital Elevation Model	TMF	Table Mountain Fund
DWA	Department of Water Affairs (National)	WSS	Water & Sanitation Services (City)
E & H	Environment & Heritage Branch (City)		

Annex II: Catchment Management Strategy for the Diep Estuary

In order to effectively manage the Diep Estuary, activities in the catchment which affect the estuary must be addressed through a Catchment Management Strategy. Issues to be covered include:

- A more accurate determination of the base flow of the river, and factors impacting the flow such as:.
  - the capacity of farm dams (registered and unregistered),
  - clearing of alien plants along the river channel, especially gum trees
  - the promotion of appropriate agricultural practices to reduce infestation of invasive alien species.

- Pollution sources in the river catchment including:

  - Waste-water treatment works (eg. Fisantekraal, Malmesbury) – and it is noted that the Malmesbury WWTW is currently not meeting the required standards.
  - Waste disposal sites eg. Vissershok.
  - Stormwater from urban areas (formal and informal – eg. on the Mosselbank)
  - Agriculture (runoff of fertilizers, pesticides etc, as well as discharges and runoff from eg. dairy farms). Many farms allow cattle to drink from the river which results in significant trampling, erosion and also contributes to pollution due to fouling of the water by cattle manure.
  - Mining.

- Sources of sediment:

  - Erosion as a result of poor agricultural practices.
  - Mining.

C.A.P.E. Estuaries Programme

Estuary Management Plan
for the
Zandvlei Estuary

December, 2010

Prepared by Coastal & Environmental Consulting
1 Karakal Road,
Hout Bay 7806.

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The proposals made in this plan are based on a series of discussions and workshops involving numerous individuals and organizations from relevant government agencies, research and academic institutions, non-governmental organizations and representatives of the local resident's associations. The active and enthusiastic participation in the process augurs well for the successful implementation of this plan and the rehabilitation of the estuary and we would like to thank all those involved for their very valuable contributions.

We would also like to note that while all the publications cited are listed in the bibliography, much of the information was taken from a few more substantial reports which are listed below. In these cases, the extent of the quotations would have made it cumbersome to reference every point in the text. We would therefore like to acknowledge them here as primary sources of information:

City of Cape Town (undated) Zandvlei: Factors concerning Water Level Management. Pamphlet.

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The Coastal & Environmental Consulting Team

Lynn Jackson (Project Manager:CEC)
Julian Conrad (GEOSS)
Marilie Carstens (GEOSS)

TABLE OF CONTENTS

1. INTRODUCTION

1.1 The management of estuaries in South Africa

The term estuary refers to the body of water which forms the interface between a river and the sea into which it flows. Estuaries may be permanently or periodically open to the sea. When open, they are characterized by fluctuations in water levels related to the tides, and by salinities which are measurably higher than freshwater as a result of seawater intrusion.

Estuaries are generally highly productive ecosystems, and provide a range of goods and services ranging from nursery areas for juvenile fish, to stopovers for migrant birds, and recreational opportunities for local inhabitants. Their productivity, combined with their natural beauty and the shelter they provide also means that they are highly sensitive and vulnerable to development, with many towns and cities, ports and harbours being deliberately located in and around them. As a result, many estuaries have been seriously degraded.

South Africa has approximately 260 estuaries, of which 62 are located within the Cape Floristic Region. Despite the fact that their value – particularly from a biodiversity perspective – has long been recognized, there has been a lack of effective management, largely due to the fact that they did not fit clearly within the mandate of any one government Department. This was highlighted during the recent development of a National Biodiversity Strategy and Action Plan, and has now been addressed through the inclusion of relevant provisions in the National Environmental Management: Integrated Coastal Management Act, 2008. Amongst other things, the Integrated Coastal Management Act introduces a requirement for Estuary Management Plans.

In parallel with the development of the legislation, the C.A.P.E. Estuaries Programme has provided funding for the development of Estuary Management Plans for a number of priority estuaries in the Cape Floristic Region, including Zandvlei.

1.2 The management of Zandvlei

The Zandvlei catchment falls entirely within the boundaries of the City of Cape Town, and is bordered by Muizenberg Mountain, Silvermine Plateau, Constantiaberg, Cecilia Ridge, Wynberg Hill, and a less conspicuous watershed along the eastern boundary. It is a relatively small catchment comprising an area of 92 km^2 or 9,655 ha, and is drained by a number of rivers and streams of which the main ones are the Little Princess Vlei Stream, Westlake Stream, the Keysers River, Langvlei Canal and the Sand River Canal/Diep River.

These rivers converge on Zandvlei, with the Keysers River and Westlake Stream entering it through an extensive reed bed on its north-western margin, while the Sand River canal enters the vlei east of Wildwood Island. The wetland area covers some 60 ha, while the main body of the vlei is 56 ha. In addition, the system includes a marina of 31 ha along its eastern margin, and an outlet channel of 9 ha which links to the sea on the north-western shore of False Bay.

For purposes of the Estuary Management Plan, the estuary is defined as the area from the estuary mouth, to the upstream end of the wetlands. Both the northern and lateral boundaries comprise the 100-year floodline as shown in Figure 1 below.

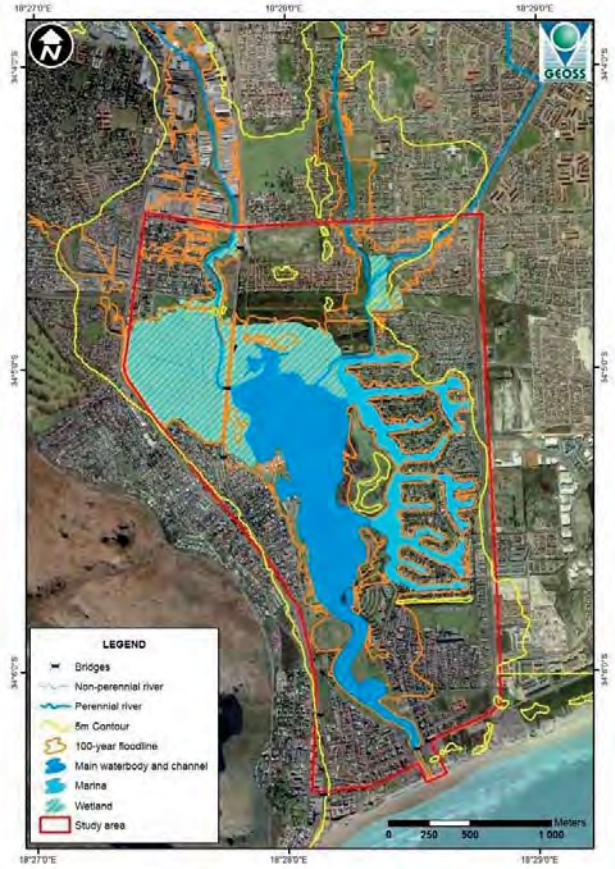


Figure 1: The Zandvlei Estuary comprising the channel, vlei, marina and wetland.

Land-use in the catchment is highly varied ranging from light industry to housing, agriculture, forestry and conservation. In general, the more heavily urbanized areas – including industrial and commercial areas and middle to lower-income housing – are situated in the eastern part of the catchment (42%) centering around the Diep and Sand Rivers and Langvlei Canal. Agricultural land, forested areas and middle to high-income housing are located in the west of the catchment (58%) along the Keysers River and Westlake Stream and their tributaries. The light industrial area of Retreat however, is adjacent to the Keysers River a short distance upstream of where it discharges into Zandvlei. A map of land-use in the catchment, reproduced from the Sand River Catchment Management Plan is shown in Fig. 2 below.

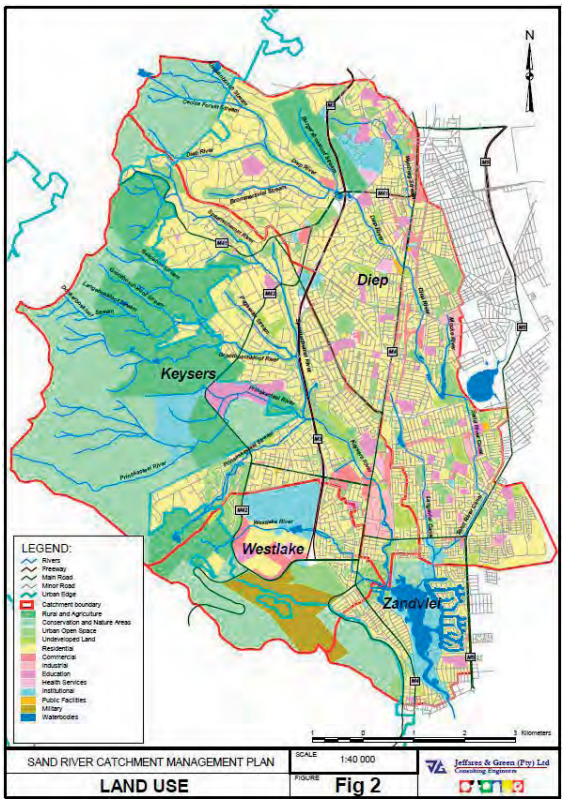


Fig. 2 Land-use in the catchment (reproduced from the Catchment Management Plan (Jeffares & Green, 2003)

Although the catchment as a whole has a relatively low population, the eastern parts, together with lower reaches of the river – including the estuary – fall within a highly urbanised environment. The 1996 census data put the population figure at 10,472 for Muizenberg, Lakeside and Marina da Gama alone while the projections from Thornton et al (1995) quoted above, suggest that the population for the catchment as a whole could be of the order of 100,000.

Despite the modifications that have taken place, Zandvlei remains highly valued for its natural attributes and the recreational opportunities which it affords. Recreational use includes various boating activities, picnicking, birdwatching, hiking and a limited amount of fishing, although bait collection is not permitted. It is regarded as being of regional importance in recreational terms, and hosts a number of sports events including an international kite-flying competition, provincial canoe championships, and various yachting events.

There is also an increased understanding of the need to maintain the environmental health of Zandvlei in order to optimize the recreational and conservation benefits. The GZENR also has a strong environmental education programme involving both learners from local schools, and a number of environmental clubs, and local residents are actively involved in the management of the area.

1.3 The Zandvlei Management Plan and Action Plan

According to the requirements of the CAPE Estuaries Programme, this management plan has been developed in two phases: i) a Situation Assessment; and ii) the development of the Estuary Management Plan and Action Plan. The latter was developed through a consultative process including public meetings, the development of a Vision and Strategic Objectives, and the establishment of Technical Working Groups comprising experts and public representatives.

This document – which comprises the Estuary Management Plan and an Action Plan for the period 2011 – 2015 – is the outcome of this process, and should be read in conjunction with the Situation Assessment.

2. VISION AND STRATEGIC OBJECTIVES

The Vision for the C.A.P.E. Estuaries Programme as a whole is: "***Our estuaries are beautiful, rich in plants and animals, they attract visitors, sustain our livelihoods and uplift our spirits."***

In this context, the following more specific Vision and Strategic Objectives for the Zandvlei Estuary were adopted following a public meeting in July, 2010.

Vision: Zandvlei is a beautiful and important component of Cape Town's natural assets. It is valued by the local community and visitors alike for recreation, education and other uses. It is also home to a rich diversity of flora and fauna and is used in a way that balances conservation with the needs of the users for the benefit of present and future generations.

Management Objectives

Overall Objective**:** *To manage Zandvlei and its environs, including the catchment, in a balanced manner that promotes the rehabilitation and conservation of its biodiversity values, maintains its suitability for recreation and education, and mitigates flooding of adjacent property***.**

Key management objectives:

1. *To develop a mechanism to manage the hydrodynamics of the estuary in a manner which:*
    - *does not compromise its biological integrity;*
    - *maintains salinity at optimal levels for healthy estuarine functioning;*
    - *enhances the role of the estuary as a nursery for marine migrants;*
    - *maintains the competitive advantage of pondweed over phytoplankton;*
    - *promotes flushing for water quality improvement;*
    - *reduces siltation;*
    - *optimises water depth fluctuations for healthy estuarine functioning while minimising flood risk and damage to shoreline properties and meeting recreational needs; and*
    - *takes account of the potential impacts of sea-level rise.*

2. *To prevent, reduce or minimise pollution from all sources so as to be able to restore the water quality to a standard suitable for supporting natural resources and human recreation.*

3. *To create conditions suitable for the restoration and ongoing protection of Zandvlei and its biodiversity, including:*
    - *establishing a zonation plan which designates conservation areas, areas for different uses (boating, walking, swimming etc);*
    - *introducing, where possible, buffer zones between the estuary and surrounding urban areas;*
    - *preventing introduction of alien species and eradicating or controlling established invasive species;*

- *improving water quality and increasing salinity through improved tidal exchange; and*
- *promoting sustainable use of resources.*

4. *To ensure that any relevant future planning and development decisions acknowledge the socio-economic value and conservation significance of the estuary and prevent any further development within the boundaries thereof.*

5. *To promote and manage recreation, education and eco-tourism in the estuary in a manner compatible with its conservation status.*

6. *To establish a coordinated and streamlined monitoring programme linked to clear operational objectives and indicators within a framework which facilitates adaptive management based on the monitoring results.*

3. OPERATIONAL OBJECTIVES

Over the years, there have been numerous changes to the physical structure of Zandvlei and the influent rivers. These, in turn, have given rise to changes to the volumes and quality of water and associated sediments flowing into it – both from the rivers and the sea - as well as to the biological communities which originally inhabited it. Given the extent of the development in the catchment and immediate surrounds, including the physical presence of structures such as the marina, roads and the railway bridge, the system will never function as a completely natural system again. At the same time, the estuary remains highly valuable from both a conservation and socio-economic perspective. The primary objective is therefore to develop a management regime which will restore the system to the extent possible, with a view to maintaining and enhancing its current value.

3.1 **Long-term objectives:**

3.1.1 Zandvlei should function optimally as an estuary with appropriate mouth conditions, tidal flows and salinity levels and water levels undergoing seasonal cycles sufficient to meet the needs of biota such as wading birds without compromising socio-economic values;

3.1.2 Water quantity and quality should meet Resource Quality Objectives to be developed through a reserve determination, with interim water quality targets based on the guidelines for recreation and freshwater and marine ecosystems as appropriate;

3.1.3 Biological communities should be restored to as close to natural species composition and structure as possible;

3.1.4 There should be an appropriate balance between conservation and recreational use of the system.

3.2 **Objectives for Action Plan: 2011 - 2015**

This management plan includes an Action Plan for the period 2011 – 2015 (see section 7). Since a number of the long-term objectives will not necessarily be achievable within this period, more detailed specific objectives which are intended to be met by 2015, if not before, are set out below.

3.2.1 Water Quantity and Circulation

Attempts to manipulate the amount of water in the estuary go back to 1866 when a decision was taken to close off and drain it so as to use it for agricultural purposes. This failed and later initiatives were instead focused on maintaining water levels for recreational boating and preventing flooding of the surrounding areas. The outlet channel was canalized in the 1950's, and was followed by the construction of a rubble weir just below the Royal Road Bridge. Although the original purpose of this weir was to protect a sewage pipe from scouring, it has subsequently been used in the management of water levels in the estuary together with the artificial opening and closure of the mouth.

The main impacts of managing the mouth and water levels have been:

- Reduced salinity levels, with consequential changes to the biodiversity much of which is now dominated by freshwater species. For example, vlei grasses such as *Ruppia maritima* and *R. cirrhosa* have been replaced by pondweed and there has been a decline of halotolerant species such as *Enteromorpha intestinalis* One exception is the fish population whose species diversity is still dominated by estuarine and estuary-dependent species, although the biomass is dominated by alien species (carp and catfish)[1] ;
- A diminishment of the role of the estuary as a nursery for certain species of commercially important fish;
- A reduction in the seasonal fluctuations of the water levels with a consequential loss of wading birds;
- Reduced flushing/increased residence time of water in the system (or parts thereof) increasing the potential for accumulation of pollutants and increased anoxia particularly of the bottom sediments.

Following a study by Ninham Shand (2000) which evaluated various engineering options for managing the Zandvlei mouth/water levels, the City implemented a new management regime from 2001.

In order to evaluate the effectiveness of this new approach, Ninham Shand (2000) also recommended a monitoring programme. This included monitoring of salinity, water levels, mouth conditions and various species/ biological parameters. Although only some elements of the proposed monitoring have been implemented, the results do suggest that there has been an improvement in the situation. Salinities have increased to some extent and there has been good recruitment of the fingerlings of a number of fish species – including Leervis and White Steenbras - which had not been seen for years have been present in recent surveys.

Although the apparent improvements need to be confirmed by a more targeted monitoring programme, it is proposed that this positive trend be taken a step further. At the same time, given the limitations of the current monitoring efforts, it is difficult to set long-term objectives. It is therefore proposed to set interim objectives for a number of parameters until better information is available.

The proposed interim objectives for the physical parameters are outlined below, while biological targets can be found in the section on biodiversity.

Salinity

In general, the salinity regime in the system should be such that it allows the re-establishment of fish and benthic communities in those areas which they previously occupied. While the fish populations are quite tolerant of low salinities – as evidenced by the fact that they are still dominated by estuarine species - they generally do not like hypersaline conditions. Invertebrates and plants on the other hand are more sensitive to salinity variations. The sandprawn *Callianassa*, for example, requires a salinity of between 16 - 17 ppt to be able to breed (although adults can tolerate lower levels), while *Potamogeton pectinatus* has been reported to be tolerant of salinities of between 5 and 20 ppt and has a competitive advantage over other macrophytes and phytoplankton at an ambient salinity of between 5 – 10

[1] Stephen Lamberth, pers. comm.).

ppt. In contrast, *Phragmites,* cannot survive in salinities > 16ppt for more than 3 months.

The existing ambient target salinities[2] are as follows:

- for the main body of the estuary:
  - in winter, between 5 ppt (surface) and 7 ppt (bottom); and
  - in summer 10 ppt throughout the water column;
- for the outlet channel:
  - in winter, 6 ppt (surface) and 18 ppt (bottom); and
  - in summer, 11 ppt (surface) and 13 ppt (bottom).

These targets will be retained until monitoring results from a more comprehensive salinity monitoring programme and the fish surveys are available, provided that:

i) the outlet channel is understood to extend up to a point parallel to the downstream end of the marina; and
ii) the bottom salinity in summer be increased to 18 ppt.[3]

Mouth conditions

Ideally the mouth should be de-canalised so that it can function more naturally. In the short-term the proposed operational objective is that the mouth should be kept open as much as possible during peak fish recruitment periods which are from August/September through November. Although historical records of the opening and closing of the mouth are intermittent and therefore likely to be inaccurate, they seem to indicate that in at least some years, the mouth has been kept open for between 5 – 14 days/month over this period (see Fig. 3 below)[4]. It is proposed that this should be achieved on a regular basis, although it is noted that this period conflicts with the yachting season, which runs from August through March/April, so that cognizance must be taken of depth requirements.

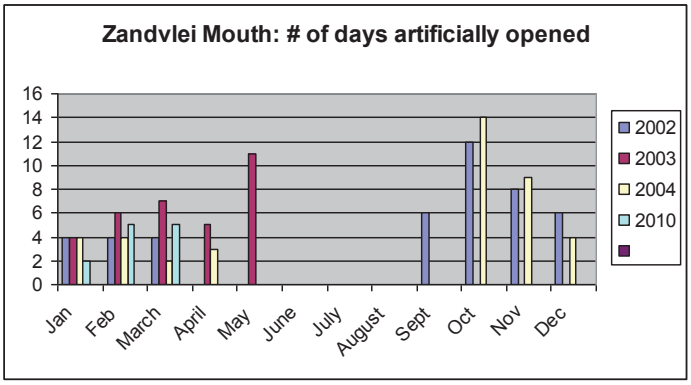


Fig.3. Number of days/month that the estuary mouth has been deliberately kept open.

[2] These are thought to have been based on the salinity required to ensure the competitive advantage of pondweed over other aquatic macrophytes and algae (Dick, 1992 quoted in Harding, 1999).
[3] Although *Callianassa* breeds primarily between May and August, in some areas there is a smaller breeding peak in December/January. Given that it is probably easier to achieve higher bottom salinities in summer, the chances of successful summer breeding should be maximized.
[4] Information provided by Talcott Persent.

In addition, the height of the weir will be lowered to 0.6m during the summer months (September to March/April) to facilitate the movement of fish and other biota into and out of the estuary. During winter it will be adjusted to 0.7m.

Water levels

The fluctuation in water levels is at present largely limited to a range of between 0.7 – 1.4m aMSL in order to prevent flooding, protect the revetments in the marina (the revetments were designed for an operating water level of 0.7m and some of the residences in the marina are threatened at water levels of 1.4m (and lower)), and to ensure sufficient water depths for boating purposes (1 metre). In addition, a depth of 0.8m is required to operate the weedharvester.

These levels will be retained for the main body of the estuary, except possibly for short periods when the mouth is opened during for longer periods to facilitate fish recruitment. The requirements of the yachting fraternity over this period should continue to be catered for by timing events to coincide with periods that the mouth is closed.

Water levels on the central pan should be manipulated using the weir such that they simulate the natural condition, namely that they retain some water for most of the year but dry out for a short period in late summer.

Sedimentation

Ninham Shand (2000) estimated that a total of 44 000 m^3 of sediment had accumulated in the vlei between 1988 and 2000. This equates to approximately 6.5 mm per year over the total vlei area or 77 mm for the 12 year period, compared with 50 mm (or 4.17 mm/year) for the 12 year period from 1958 to 1970. Most of the sedimentation took place in the "delta area" (where the Keysers and Westlake Rivers and Sand River canal enter the vlei) in spite of regular clearing of the lower reaches of the rivers.

In addition to the sediments from upstream, there is considerable encroachment of sea-borne sand (up to 6 000 m^3) into the Zandvlei outlet channel (City of Cape Town, 1989) right up to Thesen's Bridge (Martin Thompson, pers. comm.).

The riverine siltation is caused primarily by erosion in the catchment and proposals to address this were incorporated into the Sand River Catchment Management Plan. The goals of these proposals included:

- In relation to the siltation of the Sand River canal upstream of Military Road: Limit the silt load entering the water course to the extent that the average frequency of maintenance is not more than once in two years; and
- In relation to the siltation of Zandvlei at river discharge locations: to limit the silt load entering the vlei to the extent that the average frequency of dredging is not more than once in five years.

However, due to changes in the maintenance methodologies employed, these goals are no longer applicable. It is suggested that actual rates of sedimentation be measured, with the target being a reduction in annual rates.

Circulation

Flows of water within the system should be optimised so as to improve flushing and to avoid the creation of stagnant areas with the potential for development of anoxic conditions. This is thought to be a problem in the channels of the marina which are generally deeper than the main body of the estuary, and where there are dense growths of pondweed which can result in the accumulation of decaying organic matter on the bottom. Dissolved oxygen levels should meet water quality guidelines (see 3.2.2).

Thornton et al (1995) constructed a water balance for the estuary based on records from the flow gauging station at the outlet of Little Princess Vlei, the level recorder in Zandvlei, and various rainfall gauging stations in the area. Their estimates included:

- mean annual runoff of around 22 x 10^6 m^3
- direct precipitation of 0.89 x 10^6 m^3
- tidal inflows of around 3.1 x 10^6 m^3
- evaporation of 1.65 x 10^6 m^3
- residence time of 0.06 years.

These should be re-calculated for the current management regime and an appropriate target set.

3.2.2 Water Quality and Litter

The long term objective should be for the water quality to meet Resource Quality Objectives to be developed in terms of the National Water Act (1998) specifically for Zandvlei. Proposed interim targets for parameters of particular concern, based on existing guidelines for freshwater or marine ecosystems and/or full contact recreation as appropriate, are outlined below[5]. These exclude salinity, which was discussed in 3.2.1. They should be reviewed halfway through the 5-year period of the Action Plan at which time they should also be linked with the proposed DWA estuary monitoring programme.

Supplementary objectives are:

- To maintain the low number of accidental discharges of wastewater per year (eg. from pump station failures) although it is noted that these are sometimes a result of vandalism;
- To reduce the frequency of overflows from blocked manholes;
- To reduce dumping of litter and other waste into the stormwater drain system.[6]

[5] It is noted that there are no guidelines specific to estuaries, and that those listed include both marine and freshwater examples. Should guidelines specific to estuaries be developed, these should replace those currently included here.

[6] While records of litter removed from stormwater drains have been kept, they have not been analysed. It is suggested that a student project be used to generate the information required to set a numerical target for this objective.

Bacteriological targets

The targets for bacteriological parameters should be based on those for full contact recreation (especially given the high prevalence of HIV in the country, and the consequential lowered immune system of a substantial proportion of the population). The most important of these is *E.coli*, with others being Faecal coliforms and *Enterococci* as follows:

- *E. coli* – which are more specific to warm-bodied animals and show a high correlation with swimming-related gastric illness, with a target range of 0 – 130 counts (based on the DWAF South African Water Quality Guidelines: Recreational Use (2nd Edition, 1996)). To meet the target, the range should not be exceeded by the geometric mean of fortnightly samples over a three-month period.
- Faecal coliforms (including *E.coli*) – which are used as an indicator of general faecal contamination - for which the target range should be between 0 – 100 counts per 100 ml (based on the 1995 South African Water Quality Guidelines for Coastal Marine Waters). To meet this target, 80% of samples taken from the water body should fall within this range (i.e. less than 100 counts); and 95% of samples should be below 2,000 counts.
- *Enterococci* – there are currently no guidelines for South Africa, but guidance is obtainable from the Blue Flag Programme and/or World Health Organisation recommendations.

The proposed objective for Zandvlei is that the *E.coli* target should be met in all sections of the estuary which are zoned for recreational use within 3 years (i.e. by the end of 2013).

Nutrient targets

- The current guideline on dissolved inorganic nutrients for marine aquatic ecosystems is: "Waters should not contain concentrations of dissolved nutrients that are capable of causing excessive or nuisance growth of algae or other aquatic plants or reducing oxygen concentrations below the target range"(see below).
- The Coastal Water Quality Guidelines provide a more specific guideline for Total Ammonia-N – namely 600 *u*g/l - while the freshwater guideline for unionized ammonia (NH_3) – which is responsible for the toxicity of ammonia - is < 7 *u*g/l (DWAF, 1996). More recent guidelines developed through the Reserve Determination methods suggest that values of 0.015 - 0.058 mg/l (or 15 – 58 *u*g/l) are good. It is therefore proposed that this be adopted as the target range for Zandvlei.
- The DWAF Water Quality Guidelines: Aquatic Ecosystems provide a guideline for total inorganic nitrogen (NH_3 + NH_4 + NO_2 + NO_3) which states that i) concentrations should not deviate by more than 15% from that of the local water body; ii) the trophic status of the water body should not be increased; and iii) that the amplitude and frequency of natural cycles should not be changed. The Guidelines also state that concentrations below 0.5 mg/l indicate oligotrophic conditions, 0.5 – 2.5 mesotrophic, and 2.5 – 10 mg/l, eutrophic. However, according to Taljaard (pers. comm.) although only limited data is available for estuaries in South Africa, concentrations of 1 – 2 mg/l

were sufficient to stimulate dense macrophyte growth in the Sundays River. More recent guidelines developed through the Reserve Determination methods propose 0.25 – 1 mg/l as good and it is proposed that this be adopted as the target value for Zandvlei.

- Phosphorus occurs in a number of forms, but that which is immediately available to aquatic biota is Soluble Reactive Phosphate (SRP) or ortho-phosphate. The recent guidelines developed through the Reserve Determination methods suggests that values of between 0.005 - 0.025 mg/l (or 5 – 25 *u*g/l) are good and it is proposed that these be adopted as the target value for Zandvlei.

Dissolved oxygen

The current guideline on dissolved oxygen for marine aquatic ecosystems is: "For the east coast, the dissolved oxygen level should not fall below 10% of the established natural variation. For the south and east coasts the dissolved oxygen should not fall below 5 mg/l 99% of the time, and below 6 mg/l 95% of the time." The recent guidelines developed through the Reserve Determination methods suggests that values of between 6 – 8 mg/l are good and it is proposed that these be used as targets for Zandvlei.

Biological criteria

In general, the water quality should be sufficient to support all biological communities. Targets for chlorophyll *a* (a measure of phytoplankton growth/ eutrophication) and Cyanophyta (blue-green algae) are outlined below, while those for other key indicator species are discussed in Section 3.2.6.

- Chlorophyll *a* should not create nuisance conditions or produce surface scums. Mean annual concentrations should be < 15 ug/l. (DWAF WQ Guidelines)

- Cyanobacteria: there should be < 6 blue-green units[7] (DWAF WQ Guidelines), and 1 microgram per litre of cyanobacterial toxins (total microcystin-LR) (WHO guideline for full contact recreation).

3.2.3 Sediment quality

Apart from the impacts of siltation on circulation, mouth conditions etc, sediments tend to be a sink for contaminants with consequential impacts especially on bottom-dwelling organisms. It is therefore also important to quantify and manage sediment quality.

The following objectives are proposed for sediment quality:

[7] This refers to the number of blue-green units (colonies and filaments) counted in a two-minute scan of 0.5 mR of water at x200 magnification.

- In general, the sediment quality in the lagoon should be sufficient to allow the re-establishment of benthic invertebrates such as *Callianassa (*see also Section 3.2.6);
- Trace metals (based on the DEA guidelines)[8]:

Trace Metal	Target (mg/kg dry weight)
Arsenic	< 30
Cadmium	< 1.5
Chromium	< 50
Copper	< 50
Lead	< 100
Mercury	< 0.5
Nickel	< 50
Zinc	< 150
Combined levels of Cd & Hg	< 1.0
Combined levels of As, Cr, Cu, Pb, Ni & Zn	< 50

- The sediments should be restored as far as possible to their original condition (eg. particle size distribution, organic content etc).
- Bacteriological loads in the sediments should not pose a threat to human health.

3.2.4 Biodiversity, conservation and planning

The establishment of the GZENR was a major step forward for conservation in this area. The objective now should be to further enhance this accomplishment by improving the understanding and protection of the biodiversity in and around the Nature Reserve. To this end, the following targets are proposed:

Extension of Reserve Boundaries

The boundaries of the reserve should be expanded with a view to:

- Improving the connectivity between Table Mountain National Park, the False Bay Ecology Park, the coastal protection zone and the Kogelberg Biosphere Reserve;
- Including a 5 – 10 m buffer zone along the western shoreline of Zandvlei;
- Incorporating the highly sensitive road reserve area to the north of the reserve; and
- Generally, protecting the estuary from future developments.

[8] The values given are those which trigger precautionary measures when dumping dredged materials. Updated guidelines are in the process of development.

Biodiversity information – availability, management and use

There is a substantial amount of information available on certain groups of biota at Zandvlei – for example, birds, fish and plants. On the other hand, inventories for other groups – such as most invertebrates, amphibians and reptiles – are primarily based on ad hoc observations. At the same time, even where information is available, it has not necessarily been consolidated and/or analysed. A variety of interventions have been proposed to improve this situation according to the following proposed targets:

- Ultimately, there should be comprehensive qualitative and quantitative information available on all the biodiversity of the reserve. Priorities for the 2011 – 2015 period are invertebrates, and endangered and threatened species;
- An overview of trends for those groups where there is sufficient data available (eg. birds) and an understanding of how they have been influenced by environmental parameters;
- Availability of on-site weather-related information;
- All relevant information consolidated and accessible to all stakeholders.

Rehabilitation/Restoration Initiatives

The populations of many different species have been altered over the years as a consequence of changes to the estuary, including water quantity and quality. Targets for the recovery of some of the key indicator species/ groups are as follows:

- Benthic populations of *Callianassa* should be restored to their original distribution range and densities as far as possible. The Southern Waters Baseline Biotic Monitoring Report (2001) reported that the sandprawn populations were largely confined to the southern end of the main body of the estuary and the outlet channel, with numbers ranging from 114/m2 at the southern end, to 20/m2 in the north. While the distribution range is probably reasonably consistent with historical patterns, Shelton (1975) reported numbers up to 576/m2. Target densities should therefore be closer to the latter.

- The nursery role of the estuary for marine fish should be re-established as per the following targets:
  - Size frequency distributions should indicate a number of different cohorts at any one time;
  - Species composition & abundance should reflect that of temp open/closed systems of equivalent size in the cool/warm temperate biogeographical transition zone;
  - There should be high numbers of new recruits in the system over peak recruitment periods (September/November).

- The habitat for waders should be restored with a view to:
  - Increasing the numbers of resident species already present: for example, Three banded Plovers, Pied Avocet, Black-winged Stilt;
  - Increasing breeding opportunities; and

- Encouraging the return of waders previously present in the estuary :for example, Wood Sandpiper, Common Sandpiper, Marsh Sandpiper, Curlew Sandpiper, Common Greenshank, Little Stint, Sanderling, Common Whimbril, African Snipe, Kittlitz's Plover, Common Ringed Plover**.**

In addition to the populations of key species, there are a number of areas within the reserve which are degraded and which have been identified for rehabilitation/restoration (see Section 5.3.3) All of these initiatives should be completed by 2015 if not before.

Conservation, recreation and ecotourism development

The public should be encouraged to see Zandvlei as an asset by:

- Improving the biodiversity experience for visitors to Zandvlei;
- Making ecotourism opportunities available for example, by advertising Zandvlei as a primary birdwatching destination; and
- Improving facilities for visitors (eg. a restaurant, canoe hire facility etc).

3.2.5 Pondweed Management

The pondweed, *Potamogeton pectinatus*, occurs naturally in Zandvlei and is, in fact, an important component of the ecosystem, providing food and shelter for a variety of organisms, and helping to oxygenate the water. However, as a result of the high nutrient conditions, pondweed has been a problem in Zandvlei for many years, at times forming dense mats which restrict boating activities, exacerbate flooding and, when they start to decompose, causing unpleasant odours. The pondweed in Zandvlei has therefore been managed since 1976 by harvesting it using a mechanical harvester. Although this has been successful at times, overharvesting led to a crash in the population in the late 1970's, while a second collapse which occurred in the early 1990's was attributed to the decline in salinity in the estuary. On the other hand, the excessive levels of pondweed currently present have been attributed primarily to logistical problems such as inadequate maintenance planning for the harvesters.

Given the ecological importance of pondweed, the overall objective of management efforts must be to achieve a sustainable level of pondweed in the system while at the same time preventing the development of nuisance conditions. More specific objectives include:

- Improved understanding of pondweed dynamics and especially the role of temperature, salinity, nutrients and depth in controlling its growth;
- Ongoing maintenance of a "pondweed reserve" consisting of closely connected beds throughout the system;
- Refinement of the harvesting protocol based on a monitoring programme which allows effort to be linked to harvesting needs;
- The main channels in the recreational areas free of pondweed.

On the logistical side, objectives include:

- Reduction of downtime of the weed harvester through improved maintenance planning;
- Improved working conditions for the drivers/operators.

Fig. 4: The mechanical harvester at work in the marina.

3.2.6 Invasive Species

A variety of both indigenous and alien invasive species have affected Zandvlei and the surrounding areas, some for many years. These include terrestrial and aquatic species, plants and animals, vertebrates and invertebrates and species introduced deliberately as well as unintentionally. To date, efforts to manage this problem have been relatively *ad hoc* and uncoordinated with those in other parts of the City and beyond. The main objective therefore is to integrate invasive species management in the GZENR with other initiatives in the City, Province and country as appropriate. More specific objectives include:

- IAS management plan in place for the estuary/nature reserve;
- Implementation of the pilot of the Aquatic Weed Management Plan project in the Sand River Catchment;
- Zandvlei should be included in the City-wide survey of alien fish;
- Establishment of partnerships with the EDRR units of the City and SANBI and a network of volunteers for the early detection of alien plants in the Zandvlei area.

The targets for the IAS management plan for the GZENR should as far as possible be in line with relevant targets in the City's Integrated Metropolitan Environmental Policy (IMEP), which are as follows:

2014 Target:

Invasive Alien Plant management:

o 60% of the surface area of the Protected Areas and Biodiversity Network will be in maintenance (defined as cleared with three follow-up operations);

- Aquatic invasive plant species will be reduced to 80% of the 2009 coverage in the City's water bodies.

Invasive Alien Animal management:

- The Indian house crow population in the city will be eradicated;
- The guttural toad population in the city will be eradicated;
- The mallard duck population in the city will be eradicated.

3.2.7 Education and Communications

The existing environmental education programme is entirely oriented towards learners, particularly from the schools in the adjacent suburbs. There are also two environmental clubs which meet on a relatively regular basis. The programme involves interacting with the learners to identify issues of concern and to develop possible solutions. These are then translated into active campaigns such as litter clean-up days, removal of alien vegetation, recycling initiatives, development of signboards etc. They have also been involved in the Leopard Toad project, and schools can request specific programmes.

In terms of a target for the learner programmes, it is recommended that:

- the number of schools visiting the Education Centre regularly be increased from 4 to 6; and
- the number of Environmental Clubs be expanded from 3 to 5;
- a partnership be established between the learner programme and the development programme initiated by the canoeing club.

In addition:

- a community outreach programme targeting adults should be initiated through presentations/ meetings with at least 5 relevant organizations;
- links be established between local conservationists and the Early Detection and Rapid Response Programmes (EDRR) at the City and SANBI;
- new posters communicating information on the GZENR and particularly the issues being addressed through the EMP should be produced and placed on notice boards in Zandvlei itself, and at local clubs, shopping centres etc.

Finally, the upgrading of the Resource and Education Centres should be completed, and overnight camping facilities established.

It should be noted that in order to achieve these targets, additional financial and human resources will be required. Resource needs are discussed further in Section 6.

4 ESTUARY ZONATION PLAN

The northern part of the estuary around Wildwood Island was officially recognized as the Zandvlei Nature Reserve in 1977. This was expanded in 2006 from 22 ha to 200 ha by including Westlake Wetlands, Little Australia and Park Islands, the water body of the estuary up to the 1-in-100 year floodline, and some adjacent and nearby outlying areas, and is now known as the Greater Zandvlei Estuary Nature Reserve.

However, historical records show that parts of the estuary have been utilized for recreational purposes for over a century, and nowadays it is regarded as a regional recreational centre. There are a number of recreational facilities on the banks of the estuary which are used by large numbers of visitors especially during peak holiday periods while many residents use it on a more regular basis (see also Section 5.3).

One of the objectives of this management plan is therefore to achieve an appropriate balance between conservation and recreational use of the estuary. An important tool in achieving this objective is zonation, or the delineation of different use zones. The proposed zonation plan for the Greater Zandvlei Estuary Nature Reserve is based on the City of Cape Town's Guidelines for Visitor Use Zoning for Nature Reserves and Conservation Areas and is shown in Fig. 5 below.

4.1 City of Cape Town Zonation Guidelines

The guidelines make provision for the following zones and associated conservation objectives:

- Primary Conservation: Natural areas should be kept intact in order to protect habitat required to meet biodiversity targets for various vegetation types and to provide undisturbed habitat for a range of species. Where possible degraded areas should be rehabilitated.

- Conservation: Natural areas should be kept intact in order to protect habitat required to meet biodiversity targets for various vegetation types and to provide undisturbed habitat for a range of species. Where possible degraded areas should be rehabilitated.

- Low Intensity Leisure: Although some areas will be impacted by a range of activities and limited infrastructure, most areas should be kept largely intact and ecological processes should remain functioning. Where possible degraded areas should be rehabilitated.

- High Intensity Use: The activities and infrastructure in these areas should be managed to minimize impacts on biodiversity and visitor experience in other zones. Where feasible, non-crucial infrastructure should over time be removed from the reserve and the sites rehabilitated.

- Utility Zones: The activities and infrastructure in these areas should be managed to minimize impacts on biodiversity and visitor experience in other zones. Where feasible, non-crucial infrastructure should over time be removed from the reserve and the sites rehabilitated.

In addition, the guidelines make recommendations on the type of activities, frequency of use, group size, sophistication and type of facilities, user movement/transport and roads and footpaths. The specific details however, may vary from one reserve to the next, and the activities for Zandvlei are outlined below.

4.2 Visitor Use Zones in Zandvlei[9]

Primary Conservation zones require controlled access which is not feasible in the GZENR, at least at present. The zones in Zandvlei are therefore limited to three of the above, namely conservation, low intensity and high intensity use as shown in the map below:

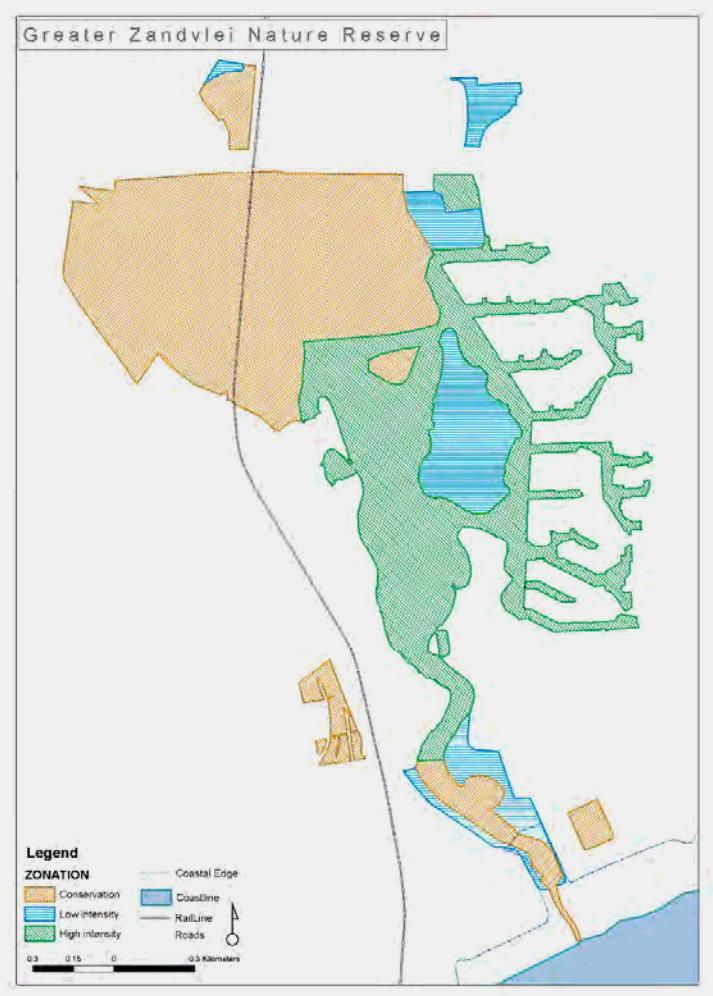


Fig. 5: Visitor use zones in the GZENR (provided by CoCT)

Within each of these zones, the specific activities allowed are detailed as follows, and as shown in Figure 6:[10]

[9] It should be noted that these proposals have been developed by the City and still need to go through a Public Participation process.

4.2.1 Conservation zones

The conservation zones may be used for self guided walks, bird watching, etc. Access to the land areas is pedestrian only, while the water body may be used by canoeists for relaxation purposes by individuals and small groups only i.e. not for competitive purposes. Moreover, canoes should not be launched or landed within these zones.

4.2.2 Low intensity use areas

In general these areas are intended for relatively frequent recreational and educational activities including walking, birdwatching etc. Facilities should be eco-friendly and promote conservation-related experiences and may include parking for access to this and other zones.

Specific activities permitted in the low intensity use areas at Zandvlei are as follows (with numbers corresponding to those on the map in Fig.6 below):

1. Keysers River Rehabilitation Block: this includes a small picnicking area on the NW border of the wetland;

2. Reedbed stand at the confluence of the Sand River and Langvlei Canal: this is used primarily as a thoroughfare rather than for recreation, although the general activities outlined above would be permitted;

3. Area adjacent to the Environmental Education and Resource Centres: this includes a small parking area for visitors as well as trails, bird-hides and picnicking areas.

4. Park Island: permitted activities include birdwatching, walking, running, and dogwalking on leashes only.

5. Lower West Bank: there are picnic spots (but no fires allowed) and children's playground facilities. Recreational fishing is permitted from the banks only.

6. Lower East Bank: permitted activities include walking, recreational fishing from the banks only, and dogwalking (dogs allowed to run free). There is also a playpark area, and special events (such as the Kite Festival) may be held with prior approval of the Reserve Manager.

4.2.3 High intensity use areas.

Apart from the City's administrative offices in the north-eastern corner of the Reserve, the high intensity use areas within the boundaries of the GZENR are limited to parts of the water body. These are used for a variety of boating activities as shown on the map below, and include regattas and other competitive events. Where these

[10] It should be noted that in terms of the regulations, recreational fishing in the estuary is allowed and at this stage is not restricted to any particular zone.

might impinge on the Conservation Zone, prior approval must be sought from the Reserve Manager.

In addition, there are areas and facilities along the western and eastern banks of the estuary which are used intensively for sport and recreation – including camping, picnicking and braaing – which, although they are outside of the boundaries of the estuary, nevertheless have the potential to impact on it.

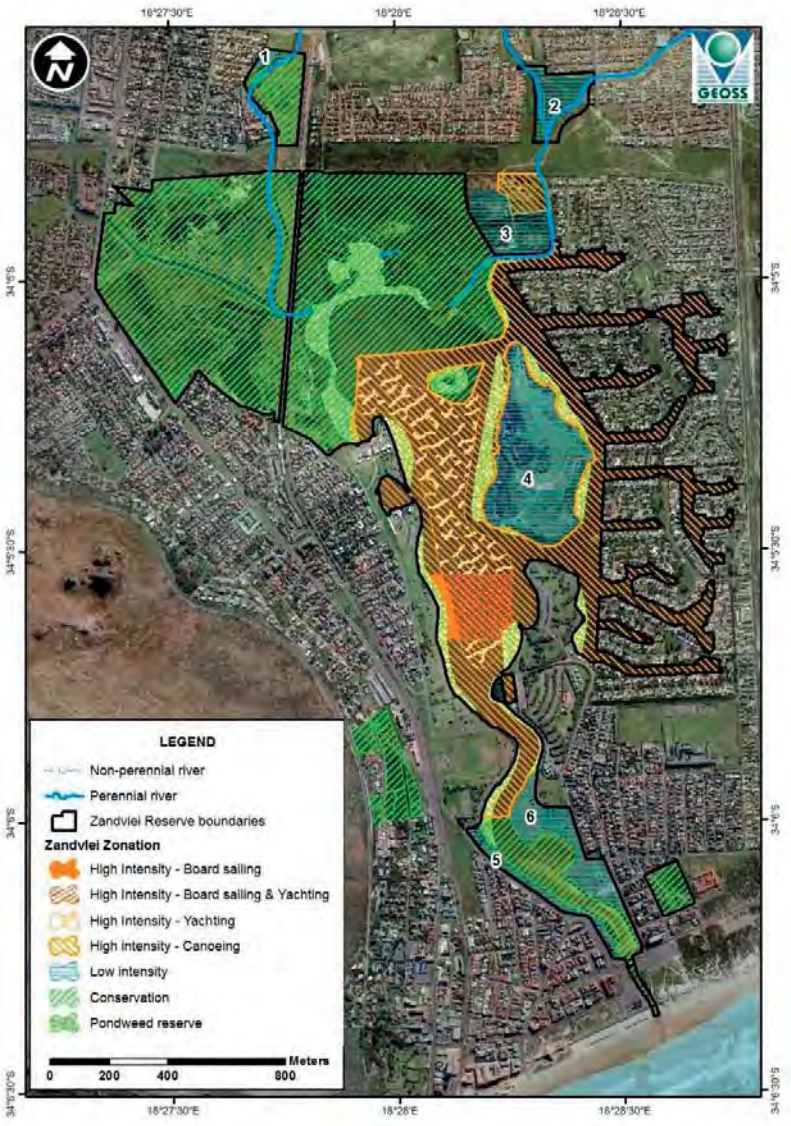


Figure 6: Areas zoned for high and low recreational activities at Zandvlei.

5 MANAGEMENT STRATEGIES

Zandvlei and its catchment have been progressively and extensively modified over the past 300 years giving rise to a range of problems. Given the nature of the changes, few, if any, of the problems are likely to be permanently solved. Rather, they will require ongoing management - as is reflected in the fact that the current list of issues is much the same as those identified thirty or more years ago. These include:

- The impact of the mouth/water level management regime on the natural functioning of the estuary (salinities, role as a fish nursery etc);
- Water quality issues – nutrients, bacteriological contamination and litter;
- Pondweed and other aquatic and semi-aquatic plants (alien or indigenous);
- Other introduced and invasive species, including Mallard ducks;
- Balancing recreational and conservation needs.

The management interventions proposed below are intended to build on existing initiatives.

5.1 Management of water quantity, salinity and circulation

5.1.1 Management of the mouth and water levels

Water levels in Zandvlei have, for many years, been managed primarily to provide water of sufficient depth for yachting, and to prevent flooding and/or the destabilisation of the revetments in Marina da Gama which were designed for an operating water level of 0.7 m aMSL. Concern over the resulting decrease in salinities in the estuary – and associated changes in the biodiversity – led to the implementation of a new management regime from 2001. This included reducing the height of the weir from 0.9 to around 0.7 m, with more emphasis being placed on the manipulation of the sandbar at the mouth to manage water levels as follows:

- In the rainy winter months[11], the sandbar is kept open so as to avoid flooding of the surrounding areas – unless there is a particularly dry spell, in which case the sandbar may be closed for short periods to restore water levels so as to meet the needs of the recreational users.
- During the summer months, the sandbar is kept closed except:
  - When water levels become too high (in excess of 1.0 m aMSL for long periods) since such levels destabilise the revetments in the marina);
  - When there is a high spring tide. This occurs 5 – 6 times each summer, and is intended to facilitate the intrusion of saline water into the estuary.

Since this does not always meet the water depth requirements for yachting (1m), this is being managed by scheduling the main yachting events for neap tide periods.

In order to assess the effectiveness of this regime, a monitoring programme was also initiated, and although it is deficient in some respects, the results indicate that

[11] Starting from the first heavy rain – varies between April and June.

salinities have increased – and may even be achieving current targets – and that there has been some recovery in the fish and sandprawn populations. Nevertheless, it is generally agreed that the situation could be further improved. To this end, the following interventions are proposed:

In the short-term:

- The rubble weir should be lowered to 0.6 m aMSL during the summer months (September to March) to increase tidal intrusion and to facilitate the passage of fish and other biota into and out of the estuary;
- A concerted effort should be made to keep the mouth open for a minimum of 10 days/month, and preferably more, during peak fish recruitment periods which are from August/September through November. It is noted that this is subject to constraints imposed by inflows to the vlei and prevailing weather conditions;
- Accurate records must be kept of mouth opening and closing;
- The yachting requirements will continue to be accommodated by scheduling events to coincide with neap tides.

In the medium to longer term, the sewer needs to be relocated so that the weir can be removed altogether. This is likely to entail raising it to run under the bridge, and since it is a gravity line, will require the construction of a new pump station at an estimated cost of R 12 million. As a first step, a proper costing needs to be done. It is also noted that this would require an EIA.

5.1.2 Management of central pans

Historically the water levels in the pans at the northern end of the Nature Reserve fluctuated on a seasonal basis, more or less drying up during the summer months, with the residual water having high salinity levels. These conditions attracted Teal and other waders. However, in the mid-1990's birds in the central pan area started dying of botulism because of the stagnant conditions which had developed there – possibly as a result of siltation. In 1995/96 a channel was dug to reconnect the pan to the main body of the vlei, and in 1999/2000 a weir was constructed across this channel so as to be able to control the water levels in the pan.

After a relatively short period the concrete base of the weir broke and it has not been operational since around 2004. The weir needs to be repaired and a protocol developed to manage its operation. It is suggested that this is done initially on a trial basis in combination with a study on its effectiveness in terms of encouraging the waders to return.

5.1.3 Reduce sedimentation

The primary cause of siltation in Zandvlei is erosion in the catchment. A number of general proposals to reduce erosion are included in the Sand River Catchment Management Plan. These include:

- Improvement of agricultural practices;

- Implementation of riverine buffer zones[12];
- Removal of alien vegetation (eg. Kikuyu) and restoration of riverine vegetation to improve riverbank stability
- Restoration/rehabilitation of altered water courses to a more natural state where possible.

The plan also lists a number of more specific projects, for example:

- Review and implementation of revised river maintenance programmes to eliminate undercutting and collapse of river banks in the Tokai and Constantia areas;
- Development and implementation of soil management guidelines/ regulations;
- Quantify silt removal requirements and construct silt traps at appropriate sites;
- Quantify the silt load entering Zandvlei and design a dredging operation.

The implementation of these projects should be encouraged, provided that a study should be undertaken to evaluate the costs and benefits of dredging in Zandvlei as there are many concerns over the potential environmental impacts thereof.

5.1.4 Optimising circulation

Circulation problems in the estuary can primarily be attributed to the conditions at the mouth and the construction of the Marina. The proposed changes to the weir and management of the mouth (5.1.1) will alleviate these to some extent, although not necessarily within the Marina. One additional possibility which has been proposed is the removal of accumulated tubeworm (*Ficopomatus enigmaticus*) colonies which are reported to be up to 2.5m thick in some areas, particularly under bridges, and which restrict the passage of boats/canoes. This needs to be further investigated.

Figure 7: Tubeworm colonies at Park Island Bridge (courtesy of Richard Borden)

[12] Proposals for riverine buffer zones have been developed as part of the work under the EMP for the Diep Estuary with a view to implementing them across the Western Cape.

5.1.5 Monitoring

The proposals by Ninham Shand (2000) which led to the implementation of the new management regime in 2001 also recommended the institution of a substantial restoration monitoring programme to evaluate the effectiveness of this regime. This included monitoring of salinity, water levels, mouth conditions and various species/ biological parameters.

Salinity is monitored as part of the Catchment, Stormwater and River Management Branch's (CSRM) water quality monitoring programme as well as through a Community Monitoring Programme. However, while the results suggest that the ambient targets are being met, it should be noted that there are no bottom samples being taken, the water quality monitoring programme is limited to a single station in Zandvlei (others in the catchment), and the CMP monitoring is not consistent at all stations and not linked to tides/mouth conditions.

It is therefore proposed that a more comprehensive salinity monitoring programme be undertaken over at least a 2-year period using either:

- A portable YSI multiprobe with standard temperature, salinity, oxygen, pH and turbidity probes which costs around R 145,000. This can be installed in a fixed position and then retrieved periodically to download data and to run salinity profiles along the length of the system;
- A hand-held YSI instrument (eg. EC300) which measures conductivity, temperature, salinity and TDS. which only costs around R 50,000. The latter presents fewer maintenance problems and has the advantage that measurements can be taken from multiple points (including depth profiles) simultaneously (at least on the same day) in the system. However, it requires staff to be available to take these measurements.

The monitoring programme should be designed to capture short term variations (i.e. daily measurements at multiple locations to examine the impact of mouth manipulations) as well as longer term seasonal variations (weekly measurements at a reduced number of sites).

In addition, the dates and times of the opening and closing of the mouth need to be properly documented and the records made available so that these can be correlated with fluctuations in salinity.

Water levels should be measured by a water level recorder at Thesen's Bridge but this has not been operational for three years and urgently needs to be repaired.

Biological monitoring: While monitoring of a number of species/taxa was recommended, financial constraints have resulted in this being limited to:

- A baseline study undertaken by Southern Waters in 2001 covering pondweed, sandprawns, tube worm, macrobenthos, zooplankton and fish;
- Monitoring of phytoplankton and algae as part of the Catchment Stormwater and River Management water quality monitoring programme;
- 24 hour surveys of fish populations by City staff (once off in 2003);
- Quarterly fish surveys being undertaken by DAFF (previously MCM), although due to a lack of capacity, the data has not yet been analysed.

Information on the biological populations is crucial to assessing the health of the system. It is therefore proposed that:

- Assistance with data capture in the form of a student project should be provided to DAFF to enable the analysis of the fish surveys to be brought up to date;
- An MoU should be developed between the City (Reserve staff) and DAFF to ensure regular (quarterly) fish surveys are continued according to an agreed protocol;
- A protocol should be developed for basic annual surveys of *Callianassa* populations which can be undertaken by Reserve staff; and
- There should be a detailed vegetation survey down to species level provide an indication of salinities, fresh water occurrence, groundwater inflows etc.

5.1.6 Information requirements

While a lot of work has been done on Zandvlei over the years, some additional information is required to support the management proposals. The following studies are proposed:

i) A study of the hydrology and geohydrology of the estuary needs to be undertaken in order to be able to get a clear understanding of the water balance in the system, including any seasonal variations therein. This will require an accurate determination of all flows into (from the river, groundwater, stormwater and effluent) and out of the system, circulation patterns, residence time etc. Once complete, the study should be able to recommend an optimal water balance.

ii) A study of the quantity and quality of sediments and the rate of sedimentation needs to be undertaken (including core sampling of sediments) with a view to determining their impact on drainage patterns, bird habitats and the environmental health of the system generally.

iii) A bathymetric survey to facilitate management and, in particular to look at possible barriers to the intrusion of seawater – such as the remnants of a causeway which was present in the estuary in 1954. (see below)

iv) Ultimately, a comprehensive reserve determination in terms of Chapter 3, Parts 2 and 3 of the National Water Act (1998) needs to be undertaken, noting that some of the above studies will contribute to this process.

Fig. 8: 1954 photograph of Zandvlei (courtesy Gavin Lawson)

5.2 Management of water quality and litter

There are a variety of potential sources of pollution to the estuary including run-off and effluent from residential, industrial and agricultural sources both from the catchment and directly into the estuary:

- Run-off from agricultural areas in the catchment – primarily vineyards in the Constantia Valley – is likely to contain fertilizers, organic waste and pesticides;
- There are 14 pump stations in the adjacent areas and although all pump stations are monitored by a telemetry system overflows do occur from time to time, the most recent in September, 2010 (see below). There is also a problem with blockages in the sewer system caused by people disposing of solid objects;
- There is an extensive system of stormwater drains around Zandvlei (see Fig. 9 below) which discharge directly into the estuary while others discharge into the rivers in the catchment;
- The Retreat industrial area borders on the Keysers River a short distance before it discharges into Zandvlei. This is a potential source of illegal discharges and stormwater runoff;
- Both the western and eastern banks of the vlei are bordered in parts by public open space which is used for a variety of recreational activities. These, as well as low-income residential areas upstream are sources of litter.

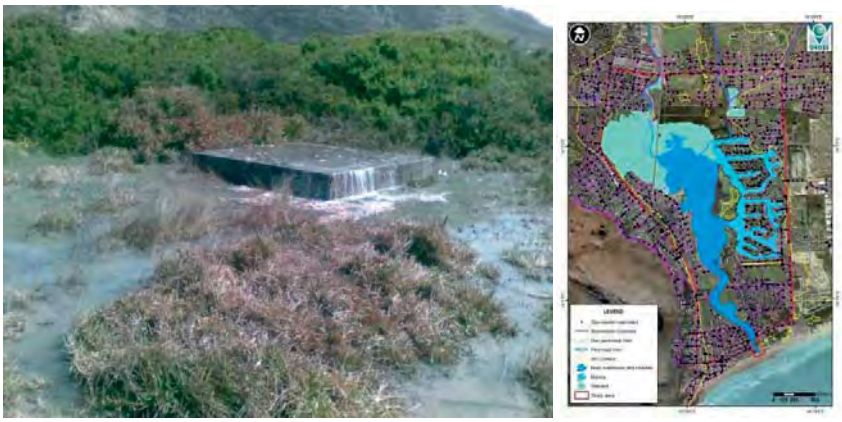


Fig. 9 (a) Overflow of sewage pump station in the Westlake area after being vandalized (Sept. 2010) (Courtesy C.Sheasby); and (b) network of stormwater drains around Zandvlei.

The water quality monitoring programme undertaken by the City indicates the following water quality problems:

- High – and increasing – levels of nutrients with Total Phosphorus, orthophosphates and Total Nitrogen indicating mesotrophic to eutrophic conditions;
- Levels of bacteriological contamination which exceed the water quality guidelines for full contact and, at times, even intermediate contact, recreation.

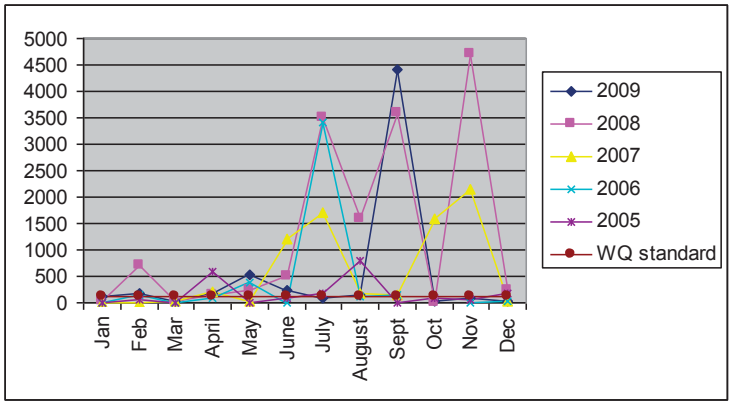


Fig.10 . Monthly *E.coli* levels at ZAV2 (2005 – 2009)

At the same time, there were some deficiencies in the monitoring programme which needed to be addressed.

In addition, despite ongoing efforts, there are large volumes of litter entering the system.

Fig. 11 (a) Accumulated litter in the Sand Canal just above the point of discharge into Zandvlei; and (b) a litter trap on the Sand Canal.

In general, the management of water quality should be in line with the national DEA and DWA policies on pollution and waste management which espouse a precautionary and pollution prevention approach. The following interventions are therefore proposed:

5.2.1 Resource Quality Objectives

The prevailing national strategy for managing the water quantity and quality requirements of aquatic ecosystems is through the setting of Resource Quality Objectives. This is provided for in the National Water Act (Act 36 of 1998) and the National Water Resource Strategy, and is intended to be implemented through Catchment Management Strategies and Agencies. However, Resource Quality

Objectives have not as yet been determined for Zandvlei or any of the rivers in the catchment although the establishment of an ecological reserve for the rivers was identified as a project under the Sand River Catchment Management Plan in 2003. This should be done as soon as possible.

5.2.2 Catchment management

The Sand River Catchment Management Plan (CMP) identifies the following sources of pollution in the catchment:

- Nutrient loading – runoff from urban areas, industrial waste, and fertilizers from agricultural lands and domestic gardens;
- Groundwater contamination;
- Bacteriological contamination from overflows of blocked sewers and informal ablutions;
- Litter and illegal dumping of refuse;
- Commercial and industrial areas.

The potential for pollution, as well as the impacts on water quality, are exacerbated by flooding and the extensive infestations of alien vegetation in and around the rivers. Water quality problems are summarized in Figure 7 of the CMP.

The CMP lists a large number of proposals aimed at addressing the sources of the pollution including:

- Identification & quantification of the pollution from various areas including the wine farms, commercial and industrial areas and other water bodies eg. Langvlei Inlet, Sand River Canal, Princess Vlei;
- Reduction of fertilizer use;
- Formalisation of maintenance plans for sewer lines, manholes and stormwater drains along the rivers and dams;
- Development and implementation of pollution abatement plans;
- Improve signage for ablution facilities;
- Additional/alternative locations for litter traps

Priority projects listed included:

i) Conduct study to establish ecological reserve for rivers
ii) Establish soil management & surveillance guidelines
iii) Determine impact of industry & commerce on Keysers River
iv) Determine impact of industry & commerce on Mocke River
v) Determine root causes of pollution at Langevlei
vi) Establish required pollution mitigation at Little Princess Vlei.

Where these have not been completed, they should be initiated as soon as possible. In addition, it is recommended that there should be engagement with the farming community - preferably through the Department of Agriculture – to improve land management practices.

The rehabilitation of particular areas of the catchment could also contribute to improving water quality. For example, the filtering function of the Westlake/Kirstenhof wetland could be enhanced by diverting the channels to pass through the wetland rather than bypassing it. Similarly, it is proposed that the Sand River should be rehabilitated in the Coniston area.

5.2.3 Prevention of Pollution from Industry and Commerce

As indicated above, there is limited information on pollution from industry and commerce. An assessment of this source should therefore be undertaken. In parallel with the assessment, there should be a campaign in collaboration with the City's Water Pollution Control Inspectors to improve housekeeping practices by industries, restaurants, complexes etc.

In addition, it is recommended that the Keyser's River Partnership be re-activated.

5.2.4 Stormwater

The City's policy on minimizing impacts of stormwater on receiving waters (prepared by the Catchment, Stormwater and River Management Branch) – based on the concepts of Water Sensitive Urban Design and Sustainable Urban Drainage Systems - needs to be implemented. This includes the development of structural and non-structural best management practices for stormwater – such as retention ponds, vegetated swales, infiltration basins, bioretention cells, education, stormwater master planning etc, which are implemented at site or regional level as appropriate.

In addition, the flows and pollution loads of all existing stormwater discharges into the estuary need to be quantified with a view to prioritizing those having the greatest impact.

5.2.5 Litter

Illegal dumping of solid waste (garden refuse and building rubble) is widespread but is particularly problematic in the middle reaches of the Diep and Keysers sub-catchments (CMP). To a large extent this is a social problem, and while there have been a number of initiatives in the past with only limited success, the following actions are proposed:

- The metal bypass side fences adjacent to the litter traps are frequently stolen for scrap metal. They should be replaced with a strong plastic product (eg. recycled plastic) and held in place with concrete blocks;
- There should be a mass action campaign on litter similar to that held a few years ago which did reduce litter for around 6 months;
- The City's Informal Settlement Task Team should be approached to look at service requirements for areas in which there are – or are likely to be – large numbers of backyard dwellers who at present are not catered for in terms of refuse removal services;
- The recently introduced charges for the disposal of waste at City dump-sites should be reconsidered as it encourages illegal dumping.

5.2.6 Water Quality Monitoring

There is currently a fairly extensive water quality monitoring programme being implemented by the City. This comprises:

A. Monthly sampling of stations in the catchment and Zandvlei (under the auspices of CSRM):

   o Chemistry and algae (of which two are in Zandvlei: ZAV2 at the centre of the estuary and WLW/ZAV10 in Westlake Wetlands)
   o Bacteriology (of which 6 stations are in Zandvlei: ZAV 1,2,3 & 5 from near the head of the estuary to the mouth, ZA Weir at the weir and at WLW/ZAV 10 in Westlake Wetlands.

See Fig. 12 below.

B. Quarterly samples for chemistry and bacteriology at 4 stations within the Marina da Gama channels (BM 20 – 23) as well as 4 stations in the catchment (Langvlei canal, Keysers River in the Retreat industrial area, WLW, and Silvermine) under the auspices of Biodiversity Management.

Fig. 12. Current water quality monitoring being undertaken by CSRM.

An analysis of this highlighted some concerns, namely:

- Chemical monitoring within Zandvlei proper is limited to a single station opposite the yacht club;
- All samples are being taken at the surface i.e there is no bottom sampling – which is where low oxygen levels are likely to occur;
- Whereas up until the mid-1990's fortnightly bacteriological samples were taken, sampling was subsequently reduced to monthly. This is problematic in relation to the target which states that the range for *E.coli* (0 – 130 counts) should not be

exceeded by the geometric mean of fortnightly samples over a three-month period;
- There appeared to be some discrepancies in the analytical methods being used for the CSRM and BM sampling;
- The BM sampling takes place on a quarterly basis which limits its usefulness;
- The data on the algal assemblages (identification and enumeration) has not been collated or analysed in detail.

The existing water quality monitoring programme will therefore be adjusted as follows:

- All sites (except at the weir[13]) will have both chemical (including chlorophyll *a*) and bacterial analyses undertaken – samples to be collected ~30 cm below the water surface;
- All samples to be collected on a monthly basis and quarterly monitoring at BM sites will fall away;
- At each site *in situ* measurements of dissolved oxygen and salinity should be taken near the surface and also just above bottom.
- All samples to be collected using a boat (including that in Westlake Wetlands);
- The consolidated network will comprise 9 sites as follows (and Fig. 12 above):

    - Zandvlei (ZAV1, ZAV2, ZAV5, ZAVweir) and
    - Marina da Gama (BM23 , BM20, BM22, ZAV9 and ZAV8).

Other monitoring points such as ZAV10 (Westlake Wetland) and the inflowing rivers (CR01, CR20, CR21 and CR22) will also be continued.

It is also proposed that:

i) Assistance be provided to Scientific Services in the form a student project to facilitate the collation and analysis of the data on algal assemblages;

ii) A protocol for data sharing be developed as the City had in a number of cases provided monitoring data for student projects and had not been sent copies of the resulting reports. Nor had the City been acknowledged as the source of the data.

5.2.7 Sediment quality

There is very limited information on toxic contaminants in Zandvlei or the catchment, although elevated levels of copper and zinc were reported in the lower Keyser's River in 2002. Since such contaminants tend to accumulate in sediments and biota, it is proposed that a survey of heavy metals in the sediments and biota of the estuary – and possibly other contaminants – be undertaken. If possible this should be included in any further such surveys undertaken by DEA & DP as a follow-up to their survey in the Diep and Berg estuaries.

[13] Scientific Services does not have a marine lab, so there are some problems analyzing the chemistry of samples with a strong marine influence.

5.3 Biodiversity, Conservation, Planning

Despite the fact that Zandvlei is, and will have to remain a highly managed system because of the historical modifications to it, it is clearly still important from a biodiversity and conservation perspective – as is evidenced by the declaration of the area as a Nature Reserve. This value needs to be protected and promoted, especially in the face of proposed future developments in the area.

The management interventions proposed here are intended to enhance our knowledge and understanding of the biodiversity of the Nature Reserve, and maintain and restore its integrity as far as possible

5.3.1 The GZENR – Boundaries and Facilities

The Greater Zandvlei Estuary Nature Reserve was formally established in October, 2006, expanding it from the 22ha Zandvlei Nature Reserve to some 200ha. There are currently proposals being considered to expand it further by incorporating some additional parcels of land as shown in Fig. 13 below.

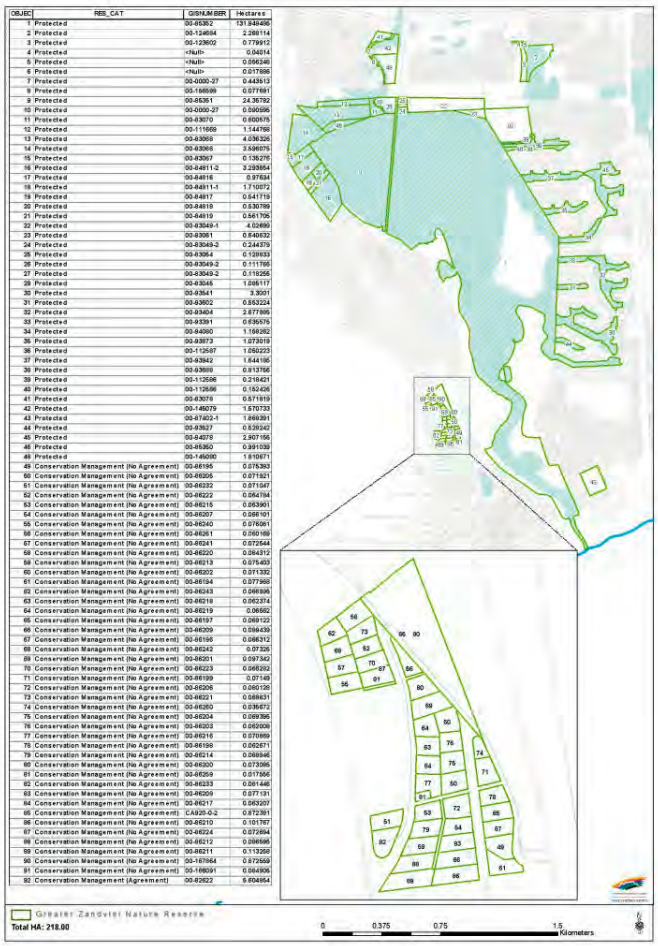


Fig. 13: Proposals for the expansion of the GZENR currently under consideration.

In the future, consideration should also be given to including:

- A buffer zone along the western boundary of the estuary (between the Sports Clubs/ recreational area and the estuary). This should be a linear strip of 5 – 10m with nodal points;
- The area to the north of the camp site;
- The road reserve adjacent to Military Road.

In identifying additional land to be incorporated into the reserve, particular attention should be given to building biodiversity corridors between the reserve and other protected and natural or semi-natural areas such as the mountain, the coast, Rondevlei, Princess Vlei, False Bay Ecology Park and even Pollsmoor dam and the dams on the wine farms.

In addition the facilities in the reserve need to be upgraded. At present a Resource Centre is being built next to the Education Centre using in-house staff. Additional resources need to be allocated for this to allow early completion and/or alternative sites/options need to be investigated. This is discussed further in Section 6.

5.3.2 Biodiversity information – status and management

It is proposed that biodiversity information collection is improved and expanded, and that better use is made of existing data as follows:

- The CWAC data should be analysed to look at trends in relation to various environmental factors – possibly through a student project;
- CWAC counts should be improved in terms of geographic coverage of the estuary, and, if possible, by increasing the counts to monthly even if only for a year or two;
- The data from counts of other (i.e. non-waders) birds should be consolidated and analysed;
- The proposed project on bird-ringing to look at the movement of bush birds should be implemented;
- Protocols for baseline and ongoing surveys of groups for which there is limited data should be acquired (eg. from CapeNature) or developed in consultation with experts and implemented through student projects. Priorities include inverterbrates and endangered or threatened species;
- Participation in the Butterfly census should be continued;
- The plant collection which is currently being established should be located in appropriate facilities in the Education/Resource Centre and launched at a public event;
- The vegetation maps should be updated and captured in a GIS system.

Although there is a weather station at Muizenberg, conditions away from the coast are sufficiently different to warrant the installation of additional stations and it is proposed to establish weather stations at the Zandvlei Sports Club and in the Nature Reserve.

In terms of managing the information, there are a number of relevant existing databases – in particular the Biodiversity database (www.biodiversity.org.za), the ADU website (http://cwac.adu.org.za/) which houses the CWAC data, and the ZIMP database (Zandvlei Inventory and Monitoring Project) which is accessible through the

Zandvlei Trust website (www.zandvleitrust.org.za). Each of these play different roles with the latter being more for public use, while the Biodiversity database has a more scientific role.

It is proposed that:

- all historical, current and future data be consolidated on the Biodiversity database;
- when the data is analysed the results should be put into a more accessible format and made available through the Zandvlei Trust website;
- links be established between the various websites.

Biological monitoring using indicator species should also be put in place, and a photographic record of changes to the reserve vegetation should be kept based on aerial photos (especially for historical changes) and fixed-point photography (cf. the MCA system).

5.3.3 Rehabilitation and restoration

A number of restoration/rehabilitation projects have either been completed or are underway, both in and around Zandvlei, and in the catchment. Additional projects to be addressed in the period covered by this plan include:

- The removal of the large berm of dumped material in the northern section of Zandvlei (Norfolk Park side adjacent to the Steenberg Rd Extension road reserve) and subsequent rehabilitation of the area;
- Rehabilitation of the additional land included into the reserve as proposed in 5.3.1 above;
- Restoration of the channels in Westlake Wetlands through a controlled burn of the reed beds;
- Implementation of the second phase of the Sand River reedbed project (at the confluence of the Sand River/Langevlei canals);
- Relocation of plants of particular interest from degraded areas outside of the reserve to conservation areas;
- Depending on the availability of appropriate material, the “shallowing” of the edges of the lower estuary to provide additional habitat for wading birds could be extended. Pre-planning should be completed as soon as possible.

There are also a number of rehabilitation proposals in the Catchment Management Plan, many of them aimed at decreasing erosion and/or improving water quality. Some of these have been mentioned earlier in this plan, but for full details, the CMP should be consulted.

5.3.4 Urban Development and Planning

There are currently two development proposals of significant concern to the area:

i) There is a long-standing proposal to build a new link between the M4 and M5 which would link up with Steenberg Rd (Steenberg Rd Extension). This is on the SDF maps and is supposed to happen within 5 – 10 years. If it goes ahead, it could have a major impact on the estuary. However, there is a

possibility that it is no longer a priority given the increased emphasis on provision of public transport.

ii) The road reserve for the proposed R300 Toll Road is south of blocks 12, 10, 25, 22 and north of blocks 48. 3, 2 (see Fig. x under 5.3.1). It would run between Main Road Lakeside in the west to Prince George (M5) in the east and then extend east of Prince George through Rondevlei, FBEP and Mitchells Plain to connect to the existing R300. However, there are also indications that this is unlikely to go ahead.

A watching brief should be kept on these initiatives.

5.3.5 Conservation, recreation and ecotourism development

Zandvlei has been used for recreational purposes since at least 1884, and is regarded as a regional recreational centre. During peak holiday periods there are some 2,000 and 3,000 visitors a day with popular activities include picnicking, braaiing, walking, boardsailing and fishing. It is also popular with residents for a variety of recreational uses as shown in the table below. [14] Turpie and Clark (2007) estimated the recreational value of the estuary as between R 1 – 5 million/year.

Zandvlei Recreational Users		
		October 2010
Canoeists/Kayakers		
Peninsula Canoe Club	Peninsula Canoe Club	232
Peninsula Canoe Club affiliates:	UCT	16
	Varsity College	8
	Bishop's School	10
Regular visitors from other clubs		119
Residents independent of clubs	Marina Da Gama only	379
	Total	**762**
Other Water-based Activities		
Residents with Pedalos	Marina Da Gama only	166
Stand Up Paddlers		41
Yacht Club		27
Wind surfers	estimated	30
Kite boarders	estimated	25
Sea Scouts/Girl Guides		?
Anglers	(in boats)	?
Land-based Activities		
Runners (Park Island only)	estimated	45
Bird Watchers		?
Anglers		?
Walkers		?
Dog-Walkers		?
Children's playgrounds		?

[14] Information provided by Ommund Sivertsen.

As can be seen from the table, very limited information is available on fishing. Despite this, concerns have been raised about the secondary impacts of fishing on the nature reserve, primarily as a result of poor fishing practices – for example, impacts on birds caused by abandoned hooks, fishing line etc. It is therefore proposed that a Code of Conduct for fishermen be introduced.

It is also proposed that, in addition to the zonation plan, a Visitor Management Plan should be developed which includes visible patrolling and policing.

In parallel with these initiatives, efforts should be made to further promote conservation-related recreational activities, including ecotourism developments. For example, the wide variety of birds in the area could be used to attract visitors to the reserve for a "bird watching experience". Other possibilities include canoe rentals and a coffee shop. These would help to market Muizenberg as an end destination in itself, rather than a place en route to other destinations and should be raised with the local Business Council with a view to establishing public-private partnerships.

5.4 **Pondweed Management**

In 1999, Southern Waters was contracted to develop management guidelines on amongst others, the "technique, frequency and extent of pondweed harvesting, including the identification of nursery areas". In addition, the consultant was to provide specifications for a monitoring programme to support the management efforts.

Prior to the development of these guidelines, the harvesting programme was based on a 4-weekly cycle drawn up by the Marina da Gama Residents Association, with each week covering a specific area (similar to that shown in Figure 14 below).

In addition, it was suggested that:

- Cutting be limited to a maximum depth of 0.45 – 0.5m;
- Cutting in the marina should be focused on providing central access for canoes and boats;
- There should be no cutting along the southeast or western shores of Park Island, in the northern section of the main vlei, or within 30m of any waterfowl nesting sites.

The conclusions/recommendations of Southern Water's 1999 report included the following:

- Mechanical harvesting and dredging/sediment removal were the most suitable management techniques;
- At least 3 cuttings per season would be required to keep the recreational areas clear of pondweed;
- The harvesting protocol should be more flexible – with harvesting being guided by surveys and monitoring – to allow for a more time and cost-effective approach;
- Training of operators;

- Harvesting should be concentrated around seasonal growth periods (peak is between January and April);
- At least 30% of the vlei and marina should be retained as "reserve" or nursery areas;
- Specific guidelines regarding depth of harvesting etc were provided for the recreational areas
- A detailed monitoring programme including seasonal surveys, logging of volumes of pondweed removed, and an assessment of the impact of harvesting on the fish nursery function.

In addition, the report stated that the recommended guidelines should be seen as a starting point for the management of pondweed, and that their implementation should be combined with monitoring and assessment with a view to fine-tuning the guidelines at a later stage.

Subsequent to this, The City's Parks Department – who are responsible for the harvesting programme - drew up an Annual Plan of Operation (2007) based largely on the Southern Waters Report, although it also covers other aquatic weeds and other areas (eg. Princess vlei, Rutter Road etc). It includes the following guidelines for harvesting of aquatic weeds (pondweed as well as alien species) in Zandvlei:

Frequency of Harvesting:

The minimum number of seasonal cuts required per area:

	Summer	Autumn	Winter	Spring
Zandvlei, marina	2	2	1	2

Time of harvesting:

Pondweed in Zandvlei attains its seasonal peak between October and April with growth declining during the winter months.[15]

	December to mid March	mid March to May	June to july	August to October	November
Zandvlei	Both machines at Zandvlei – control of pondweed	1 Machine at Zandvlei	Winter Repairs & Servicing	Both machines at Zandvlei	1 Machine at Zandvlei

Cutting limits:

	Distance from Shoreline property	Depth for canoes	Depths for Yachts
Zandvlei ,marina	2m	500mm	1.4m

All shoreline property owners at Marina Da Gama are responsible for clearing a 2m weed strip along their bank edge.

[15] Southern Waters (1999) identified January – April as the peak growing period.

Harvesting schedule:

There is an 8-week rotational schedule based on an adapted version of the proposals originally tabled by Marina da Gama residents as shown in the diagram below.[16]

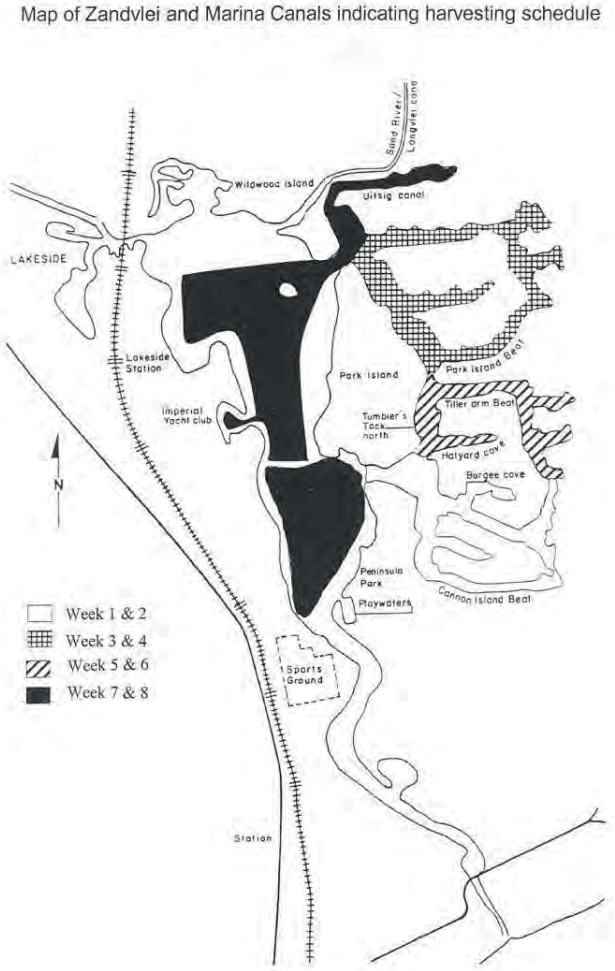


Fig. 14: 8-week cycle of current harvesting protocol

Based on the cutting rate of 0.14ha/hour (Southern Waters, 1999) and a 6-hour day, it should take about 8 machine weeks to cut the 35ha area – and 56 weeks to cut it 7 times/year as proposed. The current deployment of the machines – with two being based in Zandvlei for 26 weeks of the year – theoretically means that the current protocol allocates 66 machine weeks to Zandvlei which should be adequate to complete the harvesting. However, there are a number of constraints which hamper operations and this has frequently not been achieved. For example, the machines cannot operate in rainy weather and strong winds. They are ageing, and subject to extended breakdowns because parts not readily available. Between mid-August and mid-October, 2010, for example, at least 15 days were lost due to breakdowns. In

[16] Originally proposed as a 4-week schedule.

addition, operators have allegedly been requested to harvest in areas which should be the responsibility of residents.

This is of considerable concern given that, with the transfer of responsibility for the harvesting function to Biodiversity Management in January, 2011, only a single machine will be available for harvesting in Zandvlei. There is therefore a need to develop a new harvesting protocol which is more flexible with harvesting being guided by past experience, surveys and monitoring to allow for a more time and cost-effective approach – as was proposed by Southern Waters in 1999. To this end, a study of pondweed dynamics in combination with a monitoring programme should be instituted as soon as possible. In the interim, harvesting should continue on the following basis:

- The existing pondweed reserve areas be retained (as shown in Figure 6);
- Harvesting should be intensified over the peak growth period – January – April;
- Harvesting should continue to be planned on a rotational basis, but should be focused on the main channels, and cutting in the blind canals should be limited to once per season;
- Harvesting should be limited to a depth of 0.5m;
- There should be strict supervision of the operators by installing a GPS on the machine to track movements and times, amongst others to ensure that they are not cutting in areas outside of their responsibility;
- Residents responsible for 2m strip along channels;
- Any changes to the harvesting schedule to be approved by the Reserve Manager.

On the logistical side, the following interventions are proposed:

- Establishment of a stockpile of spare parts for the weed harvester;
- Training of additional drivers/ operators;
- Modification of the harvester to improve working conditions.

5.5 Invasive Species Management

Current management initiatives in the GZENR include:

5.5.1 Aquatic weeds

Common aquatic alien species include *Eichornia crassipes* (water hyacinth), *Ceratophyllum demersum* (hornwort), *Azolla filliculoides* (Red waterfern) and *Myriophyllum aquaticum* (Parrot's feather), although *Lemna spp* and *Salvinia molesta* have also been recorded. These species are generally concentrated in the upper reaches of the estuary, Westlake Wetlands and the influent rivers, where they inhibit recreational use (particularly water hyacinth) and exacerbate the potential for flooding.

In the main body of the vlei – where they are less common because of the salinity – any weeds that are present are removed as part of the *Potamogeton* harvesting programme, while weeds along the edges are removed by the GZENR staff.

In Westlake, there are several components to the management programme as follows:

- Annual mechanical clearing of weeds from the water courses (including river channels) by the City Council ahead of the winter rains to prevent flooding;
- *Ad hoc* clearing of areas not reached by the mechanical clearing eg. within the reeds on the sides of the channels, done either by Working for Wetlands or contractors at the request of – and funded by – Zandvlei Trust.

In addition, GZENR and Zandvlei Trust are currently running an experimental programme using biological controls in collaboration with Rhodes University (John Fowkes, pers. comm.).

5.5.2 Terrestrial plants

Invasive alien trees and grasses are common across the City including the GZENR. Those around Zandvlei include *Acacia spp* (Rooikrans and Port Jackson), Manatoka (*Myoporum tenuifolium*) and grasses such as Kikuyu (*Pennisetum clandestinum*), Pampas Grass (*Cortaderia selloana*) and the saltwater couchgrass (*Paspalum vaginatum*) which occurs along the banks of the estuary.

Clearing of terrestrial woody species is undertaken on an annual basis using herbicides, foliar sprays or manual removal as appropriate and these are now more or less under control. However, the proximity of urban areas makes it difficult to prevent re-invasions of vegetation such as kikuyu which is commonly used in gardens. Effectively controlling this would require a prohibition on its use, or the construction of some sort of barrier between the residences and the reserve.

5.1.3 Invasive animal species

Invasive animals include various species of fish mostly deliberately introduced by the conservation authorities to enhance fishing, as well as the guttural toad and mallard ducks. The grey squirrel has also recently been found in gardens in Frogmore Estate and poses a serious risk to the reserve as food sources include birds eggs, geckos etc. Guinea fowl, which are not indigenous to the Western Cape are also a problem as they compete with the Cape Francolin, and eat bulbs of fynbos species. Common pests such as the rat are most likely also present and it is noted that from a conservation perspective, domestic cats and dogs pose a threat to small mammals and birds in the reserve area. As for garden plants, preventing these from entering the reserve would require construction of some sort of barrier between the residences and the reserve.

To date efforts to manage animal species – such as the Mallard duck and alien fish - have been relatively *ad hoc*. A trial of an electric shocking methodology for the removal of alien fish was also undertaken some years ago. It was fairly successful on carp and Tilapia, but not as good for catfish, and it would need to be implemented over a 10-year period to achieve eradication.

5.1.4 Integrated IAS Management

The existing IAS initiatives at Zandvlei should be consolidated into an overall IAS plan which is integrated and aligned with the City's policy (under development) and strategy on IAS, as well as with national and provincial initiatives. The process of developing this plan should include:

- A thorough assessment of IAS and pathways in the GZENR;
- Prioritisation of species and pathways taking broader priorities into account;
- Development and implementation of strategies for priority species and pathways;
- Establishment of partnerships with Working for Water and Working for Wetlands to assist with management of aquatic invasives (ideally WfWater to clear, and Wf Wetlands to do restoration/rehabilitation work);
- Establishment of a partnership with the EDRR Units of the City and SANBI to facilitate the detection of emerging weeds (such as Purple Loosestrife) and the containment of species such as Pampas Grass which is present in Westlake Wetlands.

Other more specific activities include:

- Implementation of the pilot phase of the Aquatic Weed Management Plan project in the Sand River Catchment. This project covers 13 species: *Azolla filiculoides* - Red water fern; *Ceratophyllum demersum* - Rigid hornwort; *Commelina benghalensis* - Wandering Jew / tropical spiderwort; *Egeria densa* - Brazilian waterweed; *Eichornia crassipes* - Water hyacinth; *Ludwigia adscendens* subsp *diffusa* - Willow-herb; *Lythrum salicaria* - Purple Loosestrife; *Myriophyllum aquaticum* - Parrot's Feather; *Nasturtium officanale* - Watercress; *Persicaria (lapathifolia)* – Persicaria; *Pistia stratiodes* - Water lettuce / waterslaai; *Pontederia cordata* - Pickerel weed; and *Salvinia molesta* - Kariba weed.
- Seminar/presentation by EDRR units to the recreational users and residents and establishment of a network of volunteers for early detection;
- Interim culling of mallards (current population estimated at 500) until the national strategy kicks in;
- Investigate possibility of expanding the plant reference collection to include alien species;
- The CARA lists (and NEMBA lists once they are complete) and other information on IAS should be made available on local websites and on notice-boards in the reserve.

5.6 **Education and awareness**

Public awareness and understanding of the role and importance of estuaries and wetlands are crucial for the effective implementation of management programmes both in the Nature Reserve and in surrounding areas. This is particularly true in the case of Zandvlei where there is both a high level of recreational use, and low-income residential areas in relatively close proximity to the reserve and especially to the rivers flowing into it.

At present there is a well-established environmental education programme run by the Reserve staff with support from Zandvlei Trust. Moreover, members of the community are also involved in a salinity monitoring programme. The proposed actions below are intended to build on these existing initiatives.

i) Education and Resource Centre

There is an existing Environmental Education Centre adjacent to the City's administrative offices in the northern part of the Reserve. This is being upgraded and expanded to include a Resource Centre using internal resources. This is a drain on the time of the Reserve Staff, who are already stretched to capacity. Additional funds should be allocated to enable the hiring of contractors to complete this work.

There are also proposals to establish i) overnight camping facilities for the environmental education programme; and ii) an Interpretation Centre in the recreational area on the banks of the lower estuary. The various options for these – such as the existing camp site run by the City's Amenities Department – need to be explored further.

ii) Environmental education programmes

The existing schools programme should be continued and expanded in collaboration with Zandvlei Trust and WESSA to include additional schools, and to encourage regular visits and the establishment of environmental clubs to foster those with a real interest in the issues. The opportunity provided by the development programme initiated by the canoeing club should be taken up as a way of widening the learner's experience of the estuary.

An outreach programme should also be established to target the adults in those sections of the adjacent communities who currently have limited empathy with the estuary/nature reserve and its benefits. Approaches should be made through:

- Churches and women's organisations;
- Schools and sports clubs – by requesting opportunities to provide input at PTA and other meetings; and
- Presentations in the local library/ies.

Activities could include, for example, picnics for mothers and babies/toddlers, establishment of food gardens, as well as the more common environmental programmes such as recycling. The programme also needs to address the problem of people throwing material into the sewer system which results in blockages and overflows.

iii) Community monitoring programmes

Members of the Zandvlei community are already actively involved in a salinity monitoring programme. This active interest should be expanded to encourage people that regularly go out on the water, or visit parts of the Reserve to play a passive surveillance role for the early detection of alien invasive species. This should be initiated through a presentation/s by someone from the Early Detection and Rapid Response Unit at SANBI and the distribution of pamphlets and posters to raise awareness and facilitate identification of priority species.

iv) Communications materials

The information/messages should primarily be communicated by posters rather than pamphlets and flyers which are costly and are often just discarded. Posters should be put up in a number of different areas such as:

- All-weather boards in the recreational areas on the west bank and on Park Island;
- Notice boards at the Zandvlei Sports Club, libraries, shopping centres (eg. on the Zandvlei Trust notice board at Woolworths, the Shoprite in Military Road, and the Pick N Pay in Capricorn Park).

Provision has already been made for a number of new notice boards which will show the new boundaries of the reserve and provide general information on biodiversity. These should also be used to display the zonation map once complete as well as information on threats to biodiversity and health – such as pollution, invasive species and litter.

Articles should also be provided to the local newspapers and newsletters as well as to local organisations that could post them onto their websites (eg. Zandvlei Trust, the Marina da Gama Association, the Imperial Yacht Club etc).

v) Funding

Additional resources – financial and human – will be required to implement the proposed activities. It is therefore recommended that a proposal be drawn up with a view to submitting it to the National Lottery Board for funding – probably through the Zandvlei Trust.

Other potential sources of funding include the City (through the CTEET), Public Works Programme and the private sector – for example, companies distributing products with high volumes of packaging that contribute significantly to litter.

6 RESOURCE REQUIREMENTS

6.1 Staffing

The current level of staffing at the Nature Reserve is insufficient to cope with existing work, let alone the additional work which will be required for successful implementation of this Action Plan. Since the City does not have any additional posts available, other options for boosting the human resource capacity need to be investigated. These include raising funds and appointing staff in partnership with relevant NGO's and other organizations.

6.2 Facilities

The Reserve Staff are currently housed in offices of the City's Parks Department. An old building adjacent to the Environmental Education Centre is in the process of being upgraded as a Resource Centre and will include offices for the Reserve Staff. However, it is being done using internal resources (i.e. Reserve Staff themselves) as no funding is available to outsource the work. This should be rectified as soon as possible as it takes the time of the Reserve Staff away from their official responsibilities.

In the longer term, consideration should be given to relocating the Environmental Education Centre.

In addition, an investigation should be undertaken into options for the establishment of overnight camping facilities to be used for environmental education purposes.

6.3 Finances

Many of the actions proposed in this plan can be undertaken by existing staff in the relevant organizations, and within existing budgets – for example, the water quality monitoring programme which is funded by the Catchment, Stormwater and River Management Division of the City. However, there are also a number of new activities which have been proposed and for which funding has not yet been secured. A more detailed financing plan should therefore be developed as soon as possible which clearly distinguishes between:

- Those activities which are covered by existing budgets;
- Those which could be included into City and other budgets within the 5 year period of the Action Plan;
- Those for which alternative sources of funding should be sought.

The financing plan should also identify potential sources of additional funding.

7 ACTION PLAN

The Situation Assessment highlighted significant problems in Zandvlei, with the following being identified as priorities:

- Mouth conditions, water level management and salinity
- Water quality
- Pondweed management
- Invasive species
- Balancing recreation and conservation
- Coordinated and cost-effective monitoring programme
- Environmental education

During the development of the Estuary Management Plan a large number of proposals aimed at addressing these issues over the period 2011 – 2015 have emerged. These were discussed in Section 5, but are also are captured in the Action Plan set out in the tables under Section 7.2 which also provide a tentative time-frame and indicative budgets where possible. Given the number of proposals and the substantial resources required, those considered the highest priority are listed in 7.1 below, with additional detail being provided in the tables.

As indicated in Section 6, funds for the implementation of many of these activities has not yet been secured and it is proposed that a financing plan be developed to address this issue.

7.1 Priority Actions

Many of the impacts on Zandvlei are a result of activities in the catchment. Relevant remedial actions are detailed in the Sand River Catchment Plan (2003), and for the most part are not repeated here, although they are crucial to the effective management of the estuary. Thus, although it is not included in the list of priorities below, the implementation of the Catchment Management Plan should be regarded as a priority, and it is of concern that to date relatively few of the proposals have been effected because of a lack of funding.

Priorities more specific to Zandvlei include:

- Adjustment of mouth conditions to further facilitate tidal intrusion and passage of juvenile fish (short-term - reduction of weir height during summer, and increased number of days that the mouth is open during the recruitment period; longer-term – relocation of the sewer line and removal of the weir);
- Repair of the weir on the central pans and development of a protocol for its operation;
- Repair of the water level recorder at Thesen's Bridge;
- Analysis of historical fish survey data and development of a protocol and MoU to ensure regular fish survey data in future;
- Comprehensive salinity monitoring programme;
- Survey of heavy metals (and possibly other toxic contaminants) in the sediments and biota;
- Implementation of revised water quality monitoring programme;

- Analysis of CWAC data and increased CWAC counts for a 2-year period;
- Consolidation of information on Biodiversity database;
- Adaptation and refinement of pondweed harvesting protocol (including maintenance programme) to cope with new arrangements (transfer of function to Biodiversity Management which means that only one machine is available for Zandvlei);
- Development of an Invasive Species Management Plan;
- Development of a Visitor Management Plan;
- Development of a funding proposal to support expansion of the environmental education programme.

In addition, a financing plan needs to be developed to support the implementation of the Action Plan more generally.

A more comprehensive list of proposed activities is provided in Section 7.2 below.

7.2 Detailed Action Plan: 2011 – 2015

MANAGEMENT OF MOUTH CONDITIONS, WATER LEVELS, SALINITY AND CIRCULATION				
Steps	**Date**	**Responsibility**	**Estimated Budget**	**Indicator**
Objective A: Re-establishment of a regime more typical of an estuarine system				
1. Reduce the level of the weir to 0.6m during the summer months	Oct. 2010	Manager: CSRM	No additional costs	Salinities at target levels Increased fish recruitment
2. Increase the number of days of open mouth conditions between August & November within the constraints of inflow & weather.	August 2011	Manager: CSRM	No additional costs	Size frequency of fish populations shows multiple cohorts High numbers of recruits over this period.
3. Initiate EIA, budgeting process for removal of the weir, relocation of the sewer line & installation of a pump station.	2011	Manager: Reticulation	Est. costs for the entire job is R 12 million	Sewer line relocated to allow removal of the weir and improved tidal functioning of the estuary.
Objective B : Re-establishment of seasonal water level fluctuations on the central pans.				
1. Repair of the weir on the central pan	January 2011	Reserve Manager	TBD	Weir functioning as intended.
2. Development and implementation of a protocol for management of the weir and water levels.	2011	Reserve Manager with input from ZT & ADU.	No additional costs	Increased numbers of resident waders, breeding sites available, and return of migrant species.
Objective C: Reduction of sedimentation				
1. Implementation of relevant actions in Sand River Catchment Management Plan (improve agricultural practices, remove alien vegetation, restore riverine vegetation, construct silt traps etc)	2011 - 2015	Various: Manager: CSRM, Dept. of Agriculture, SANParks, City ISU etc.	TBD	Reduction in annual rates of sedimentation.
2. Study of quantity & quality of sediments & rate of sedimentation	2012	Manager: CSRM	TBD	Understanding of impacts of sedimentation on estuarine health.
3. Undertake a study to evaluate costs & benefits of dredging in Zandvlei	2012	Manager: CSRM	TBD	Report on costs & benefits of dredging
4. Implement riverine buffer zones	2012	DAFF	TBD	Reduced erosion

Steps	Date	Responsibility	Estimated Budget	Indicator
Objective D: Improve water circulation				
1. Investigation into options for remove of accumulated tubeworm colonies at strategic locations & implementation of recommendations	2011 - 12	Reserve Manager	TBD	Improved circulation through marina, reduction in anoxic conditions, improved passage for boats
2. Study of the hydrology & geohydrology, circulation patterns, residence time, bathymetry etc.	2013	Managers: CSRM/BM/ Reserve Manager	TBD	Improved understanding of the flows in the system to support management decisions.
3. Comprehensive Reserve Determination.	2014	Managers: CSRM/BM	TBD	Understanding of the flow requirements of the estuary.
Objective E : Monitoring of water levels, salinities, fish populations etc				
1. Water level recorder at Thesen's Bridge to be repaired & records kept on a database.	2011	Manager: CSRM	TBD (limited)	Regular & historical water level recordings available.
2. Accurate records to be kept of mouth opening & closing	2011 ongoing	Manager: CSRM	No additional costs	Accurate data available on # of days open/month
3. Comprehensive 2-year salinity monitoring programme	2012-2013	Managers: CSRM/BM	R 50,000 – R 250,000 depending on approach	In-depth understanding of salinity patterns in the estuary in relation to mouth management regime.
4. Analysis of historical fish survey data possibly through a student project	2011	Reserve Manager/ DAFF	No additional costs	Information on trends in fish populations btwn 2001 – 2010 available.
5. Development of a protocol and MoU btwn the City (BM) and DAFF on future fish surveys.	2011 ongoing	Reserve Manager/ CapeNature/DAFF	No additional costs	Fish surveys completed on a regular basis according to agreed protocol.
6. Development of protocol for basic annual surveys of *Callianassa* to be undertaken by Reserve staff.	2011 ongoing	Reserve Manager	No additional costs	*Callianassa* surveys completed on a regular basis according to agreed protocol.
7. Detailed vegetation survey to species level.	2013	Reserve Manager	TBD	Up-to-date vegetation map available.

WATER QUALITY MANAGEMENT				
Steps	**Date**	**Responsibility**	**Estimated Budget**	**Indicator**
Objective F : Establishment of binding Resource Quality Objectives				
1. Determination of Resource Quality Objectives using Rapid Determination methodology	2012	Manager: BM: CoCT	R 200,000	Resource Quality Objectives in place
Objective G : Reduction of pollution from sources in the catchment				
1. Implementation of relevant actions from the Sand River Catchment Management Plan (quantification of sources, reduction of fertilizer use, improved maintenance of reticulation, litter traps etc).	2011 - 2015	Managers: CSRM, WSS, & DAFF etc	TBD	Reduction in pollution load entering Zandvlei from the catchment.
2. Improve land management practices in the agricultural areas.	2012	DAFF	TBD	Reduction of nutrient/pesticide levels (and erosion).
3. Rehabilitation of the Sand River in the Coniston area.	2012	Manager: BM/CSRM	TBD	Reduction of silt & pollution loads entering Zandvlei from the Sand River
4. Awareness-raising campaign to improve housekeeping practices at industrial & commercial facilities	2012 - 2013	Manager: CSRM (Water Pollution Control Inspectors) + Reserve Manager	TBD	Reduction in illegal discharges to the influent rivers.
5. Re-activation of Keyser's River Partnership.	2011	Manager: BM/CSRM	TBD	Increased awareness & commitment by local businesses to environmental management.
Objective H : Reduction of pollution from stormwater discharges to the estuary				
1. Quantification of flows and pollution loads of stormwater discharges to the estuary.	2014	Manager: CSRM	TBD	Report identifying priority problem areas with recommendations for remediation.
2. Application of the City's Stormwater Policy to the stormwater system in the Zandvlei area.	2011 - 2015	Manager: CSRM	TBD	Best management practices for stormwater in place.

Steps	Date	Responsibility	Estimated Budget	Indicator
Objective I: Reduction of pollution from accidental spills				
1. Development of a Response Plan including procedures for incident reporting, ad hoc monitoring etc.	2011/2012	Manager: Water and Sanitation Services: Reticulation + Manager: ERMD	N/A	Improved communications around and response to accidental spills.
Objective J : Reduction of litter and dumping				
1. Replacement of metal bypass side-fences with plastic product cemented in place	2011	Manager: CSRM	TBD	Reduction in theft of metal structures associated with litter traps.
2. Mass action campaign on litter.	2011/12	Manager: Solid Waste Management/ CTEET	TBD	Reduction in volumes of litter removed from traps.
3. Investigation of service requirements in areas with large numbers of backyard dwellers (refuse removal & sanitation)	2011 (Underway)	Directors Water & Sanitation & Solid Waste Management (City)	N/A	Adequate provision for refuse removal for backyard dwellers.
4. Initiate discussions on charges for disposal of waste at City dumpsites.	2011	Managers: ERMD/CSRM + Director: Solid Waste Management	N/A	Reduction in illegal dumping.
Objective K : Improved understanding of environmental quality in the estuary				
1. Undertake a survey of toxic contaminants (heavy metals a priority) in the sediments and biota.	2012	Reserve Manager/ DEA & DP	R 75,000	Report on the levels of toxic contaminants in the estuary.
2. Implementation of revised water quality monitoring programme (see p. 37)	From 2011	Manager: CSRM + Scientific Services	No additional costs	Increased cost-effectiveness of monitoring.
3. Collation and analysis of data on algal assemblages through a student project.	2011/12	Reserve Manager + Scientific Services	No additional costs	Improved utilization of monitoring data.
4. Development of a protocol for data sharing (City data)	2011	Manager: CSRM + Scientific Services	No additional costs	Reports based on City data available to City and with due acknowledgement of data source.

BIODIVERSITY, CONSERVATION AND PLANNING				
Steps	**Date**	**Responsibility**	**Estimated Budget**	**Indicator**
Objective L: Further expansion of reserve to improve buffers and linkages.				
1. Initiate discussions with a view to incorporating a buffer zone along the western boundary of the estuary, the area north of the camp-site, and the road reserve adjacent to Military Road.	2011-2015	Manager: BM	No additional costs	Improved protection of biodiversity values.
2. Build biodiversity corridors to adjacent protected and semi-natural areas.	2011-2015	Manager: BM	No additional costs	Improved protection of biodiversity values.
Objective M: Improve and expand biodiversity information				
1. Analysis of existing CWAC data in relation to environmental factors	2011 - 2013	ADU	TBD	Information on trends in wading birds available.
2. Improve geographic coverage of CWAC counts at Zandvlei & implement a programme of monthly counts for a 2-year period	2011 - 2013	Reserve Manager, ADU, Cape Bird Club	No additional costs	Increased quality of information on wading birds
3. Consolidate & analyse counts of other birds	2011 - 2013	Reserve Manager, ADU, Cape Bird Club	No additional costs	Improved information available on non-wading birds
4. Implement proposed project on bird-ringing of bush birds	2012	Reserve Manager	TBD	Improved information available on bush birds
5. Source and/or develop protocols for surveys on other groups & implement through student projects	2011 - 2015	Reserve Manager	Limited additional costs	Quantitative information available for groups such as reptiles, amphibians, invertebrates etc.
6. Participate in Butterfly census	2011 – 2012?	Reserve Manager	No additional costs	Improved information available on butterflies
7. Provide facilities to house plant reference collection at Resource Centre & launch at public event.	2011	Reserve Manager	Limited additional costs	Reference collection available for educational and research purposes.
8. Update and digitize vegetation maps	2013	Reserve Manager	TBD	Vegetation information available in accessible format.
9. Establish weather stations at ZSC and in GZENR	2011	Reserve Manager + ZSC + Plant Cons. Unit/UCT	R 6,000	On-site weather data available.

Steps	Date	Responsibility	Estimated Budget	Indicator
10. Consolidate historical and current biodiversity information on Biodiversity database in accessible format.	2011/12	Reserve Manager	N/A	All relevant information available and accessible from Biodiversity database
11. Establish links between Biodiversity database, ADU/CWAC site and Zandvlei Trust website.	2011	Website/database managers	N/A	Freely available information on Zandvlei biodiversity.
12. Establish programme of biological monitoring of indicator species, including photographic records of vegetation changes.	2011/12	Reserve Manager	TBD	Adequate data available to be able to detect trends/changes in biodiversity.
Objective N : Restoration/rehabilitation of sites within the GZENR				
1. Remove berm in vicinity of Norfolk Park & rehabilitate the area	2011	Reserve Manager	TBD	Rehabilitation complete
2. Rehabilitate land proposed for incorporation (erfs 49 0- 92)	2012	Reserve Manager	TBD	Rehabilitation complete
3. Restoration of channels in Westlake Wetlands	2012	Reserve Manager	TBD	Rehabilitation complete
4. Implement 2nd phase of Sand River reedbed project	2013	Reserve Manager	TBD	Rehabilitation complete
5. Relocation of priority plants from degraded area to conservation areas	Ongoing	Reserve Manager	TBD	
6. "Shallowing"/rehabilitation of banks of lower estuary	Ad hoc	Reserve Manager	TBD	
Objective O: Visitor Management				
1. Development of a Visitor Management Plan	2011	Reserve Manager	TBD	Reduction in visitor impacts
2. Development of a Code of Conduct for fishermen	2011	Reserve Manager	No additional costs	Reduction in secondary impacts by fishermen
Objective p : Promotion of eco-friendly uses of Zandvlei				
1. Promotion of Zandvlei as a bird-watching destination	2011/12	Reserve Manager + Local Business Council	Private sector funds	Increased awareness of the value of Zandvlei
2. Provision of facilities such as canoe-hire, coffee shop/restaurant.	2011/12	Reserve Manager + Local Business Council	Private sector funds	Increased awareness of the value of Zandvlei

PONDWEED MANAGEMENT				
Steps	**Date**	**Responsibility**	**Estimated Budget**	**Indicator**
Objective Q: To improve understanding of pondweed dynamics.				
1. Appointment of consultants to investigate the role of temperature, salinity, nutrients, and depth in controlling pondweed growth (including bathymetry survey).	2011/12	Manager: BM	TBD	Availability of information on pondweed dynamics to improve effectiveness of harvesting
2. Accurate records to be kept of pondweed harvested (volumes, location, season etc).	2011 ongoing	Reserve Manager	No additional costs	Availability of information on pondweed dynamics to improve effectiveness of harvesting
Objective R: Improved time and cost-effectiveness of harvesting				
1. Adaptation and refinement of harvesting protocol	2011 ongoing	Reserve Manager	No additional costs	Main recreational channels free of pondweed
2. Logistical issues addressed (spare parts, training of operators, working conditions etc)	2011 ongoing	Reserve Manager	TBD	Reduction in work days lost as a result of downtime of harvester, operators off etc.
Objective S: To promote fulfillment by residents of their responsibilities				
1. Initiate discussions with Marina da Gama Association to ensure residents are aware of their responsibilities with regard to pondweed management.	2011	Reserve Manager	No additional costs	2 metre strip along marina channels cleared by residents.

INVASIVE SPECIES MANAGEMENT				
Steps	**Date**	**Responsibility**	**Estimated Budget**	**Indicator**
Objective T: Integration of IAS management both within the reserve and with external initiatives.				
1. Development of an IAS Management Plan for the GZENR through a process of assessment, prioritization and strategy development.	2011/12	Manager: BM + Invasive Species Coordinator (CoCT)	TBD	IAS Management Plan for GZENR adopted and ready for implementation.
2. Establishment of links with the EDRR units of the CoCT & SANBI as well as Working for Water, and Working for Wetlands	2011 ongoing	Reserve Manager	No additional costs	Additional expertise and capacity available to assist in IAS management within the GZENR.
3. Inclusion of Zandvlei in the City's/UCT survey of alien fish	2011	Invasive Species Coordinator (CoCT)/UCT	TBD	Information available on alien fish in Zandvlei.
Objective U: To prevent introductions of new alien species into Zandvlei				
1. Investigate the possibility of establishing a boat "cleaning station" at Zandvlei	2011	Reserve Manager, Invasive Species Coordinator (CoCT), + Zandvlei Sports Club	TBD	Reduced risk of introductions via boats from other areas
2. Produce educational material on the role of boats as a pathway for IAS introductions	2011	Reserve Manager, Invasive Species Coordinator (CoCT),	TBD	Increased awareness of the risk posed by boats
Objective V: To promote early detection of emergent species in Zandvlei				
1. Seminar/presentation to Zandvlei Sports Club, Zandvlei Trust etc	2011	EDRR Units of CoCT and SANBI	No additional costs	Identification of potential volunteers for monitoring
2. Establishment of a volunteer network for early detection in Zandvlei	2011 ongoing	EDRR Units of CoCT and SANBI	No additional costs	Early detection of priority emergent species.
3. Annual surveys for emergent species	2011 ongoing	EDRR Units of CoCT and SANBI	No additional costs	Early detection of priority emergent species.
Objective W: To promote more effective management of aquatic weeds				
1. Implementation of the pilot phase of the Aquatic Weed Management Plan in the Sand River catchment	2011 – 2013?	Invasive Species Coordinator (CoCT), Reserve Manager	TBD	Aquatic weeds reduced to 80% of the 2009 coverage.

Steps	Date	Responsibility	Estimated Budget	Indicator
Objective X: Ongoing control of existing IAS				
1. Continued ad hoc culling of mallards	2011 ongoing	Reserve Manager	No additional costs	Numbers maintained at manageable levels until National Strategy is implemented.
2. Continued control of existing aquatic and terrestrial plants	2011 ongoing	Reserve Manager	No additional costs	60% of the surface area in maintenance.

EDUCATION, AWARENESS-RAISING AND COMMUNICATIONS				
Steps	**Date**	**Responsibility**	**Estimated Budget**	**Indicator**
Objective Y : To expand the environmental education and outreach programme				
1. Identify additional schools interested in regular environmental education programmes.	2011/12	Reserve Manager + Education Officer + ZT + WESSA	Limited additional costs for transport	5 schools visiting Zandvlei on at least an annual basis
2. Foster interested learners through environmental clubs	2011/12	Reserve Manager + Education Officer	Limited additional costs for transport	5 environmental clubs active on a weekly basis
3. Establish partnership with the Zandvlei Canoeing Club's development programme to broaden the learner's experience	2011/12	Reserve Manager + Education Officer + Zandvlei Canoeing Club	Limited additional costs for transport	A number of members of environmental clubs participating in the canoeing development programme.
4. Establish an adult outreach programme through churches, women's organizations, schools (PTA), sports clubs etc.	2012	Reserve Manager + Education Officer	Limited additional costs	Increased appreciation of Zandvlei as a resource by members of local communities.
Objective Z: Expand the existing community monitoring programme				
1. Seminar/presentation to Zandvlei Sports Club, Zandvlei Trust etc & establishment of volunteer network.	2011	EDRR Units of CoCT and SANBI	No additional costs	Network of IAS monitoring volunteers in place
Objective AA: Improved communications on matters related to the reserve				
1. All-weather boards erected in various areas (west bank, Park Island etc)	2011	Reserve Manager	Limited costs	Strategically located notice boards in place
2. Erection of notice-boards in clubs, libraries, shopping centres etc.	2011	Reserve Manager, EDRR (SANBI), Zandvlei Trust	Limited costs	Strategically located notice boards in place
3. Relevant materials available for posting on notice-boards	2011 ongoing	Reserve Manager, EDRR (SANBI), IAS Coordinator (CoCT) Zandvlei Trust	TBD	Material available and on display covering various topics (Zonation map, EMP, pollution, litter, invasive species etc).
4. Articles provided to local newspapers, newsletters, websites etc.	2011 ongoing	Reserve Manager	No additional costs	Regular articles published.

RESOURCE REQUIREMENTS				
Steps	**Date**	**Responsibility**	**Estimated Budget**	**Indicator**
Objective AB : To increase capacity of human resources				
1. Identify opportunities for partnerships which will facilitate increase of HR capacity.	July, 2011	Manager: ERMD	TBD	External personnel available to assist Reserve Staff.
Objective AC : To upgrade and expand environmental education facilities and programme				
1. Completion of upgrading of Resource Centre	2011	Manager: ERMD	R 50,000	Resource Centre completed
2. Development of a proposal around environmental education for submission to the National Lottery Board	2011	Zandvlei Trust	Est. R 1.5 million	Funds available for expansion of environmental education programme.
3. Identification of other potential sources of funding & submission of applications	2011/12	Reserve Manager/Zandvlei Trust	TBD	Funds available for expansion of environmental education programme.
Objective AD : To improve availability of financial resources to implement other components of the Action Plan				
1. Development of a financing plan	2011	Manager: ERMD/ ZAC	N/A	Provision for listed activities in budget allocations & quantification of external funding needs.
2. Identify and target potential external sources of funding	2011 ongoing	Manager: ERMD/ ZAC	N/A	Funding available for implementation of Action Plan & related activities.

8. FRAMEWORK FOR IMPLEMENTATION

It is proposed that the existing Zandvlei Action Committee – with some additional members - be responsible for overseeing and driving the implementation of the EMP.

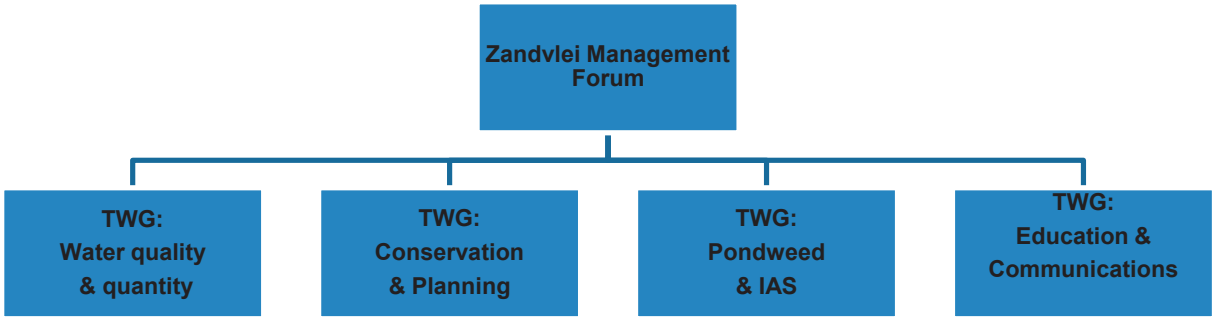
Existing members of the committee include:

- City of Cape Town (various different divisions)
- Zandvlei Trust
- Imperial Yacht Club
- Friends of Park Island
- Muizenberg and Lakeside Ratepayers Association
- Marina da Gama Association
- Sea Scouts base

Additional members should include:

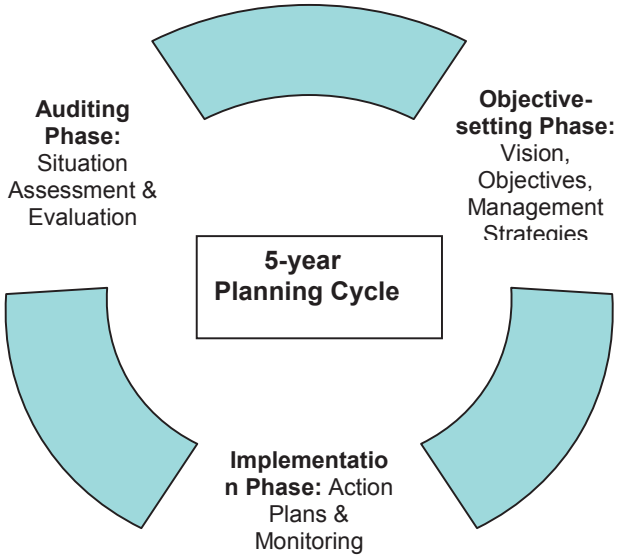
- Oceans and Coasts (DEA) (Estuaries and Pollution Divisions)
- DWA
- Department of Agriculture, Forestry and Fisheries (Landcare and Fisheries)
- Department of Environmental Affairs and Development Planning (W.Cape)
- Peninsula Canoe Club

In addition, there should be up to four Technical Working Groups to continue providing guidance to the implementation of relevant aspects of the plan.



9. AUDITING AND EVALUATION

The Situation Assessment which preceded the development of this Estuary Management Plan should be regarded as the first of 5-yearly Evaluations in an ongoing cycle of planning for the management of the estuary as shown in the diagram below.



However, particularly in the initial 5-year period, it is recommended that progress on the implementation of the EMP is audited on a more regular basis as follows:

- There should be quarterly meetings of the Zandvlei Management Forum with the minutes of these meetings being made available to an appropriate oversight body within the City, CapeNature, the Provincial Coastal Committee, and other relevant bodies.
- There should be annual report backs to an open Public Meeting on progress in terms of implementation of the EMP/Action Plan. The report should be made on the basis of an annual "mini-audit" of progress by an external consultant, with the appointment of the consultant being facilitated by the Forum.

In the case of this first 5-year period, where a number of the actions in the second half of the period are dependant on the outcome of studies or other actions scheduled for the first two years, it is also proposed that a more thorough audit take place at the mid-point of the 5-year period, as well as at the end. This would be accompanied by revisions and/or refinements to the current EMP and Action Plan.

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ESTUARY MANAGEMENT PLAN:

EERSTE RIVER ESTUARY

1. VISION

The Vision for the C.A.P.E. Estuaries Programme as a whole is: "Our estuaries are beautiful, rich in plants and animals, they attract visitors, sustain our livelihoods and uplift our spirits."

The Eerste River Estuary is part of an extensive urban environment and as such the vision for the estuary is:

"To manage the estuary and its catchment in such a manner as to reduce and minimise urban influence and pollutants on the estuary, where possible allow free and natural movement of the estuary mouth, manage alien invasive species, continuously work towards achieving high standards of water quality, recognise the estuary as an important marine nursery and biodiversity habitat and monitor the estuary in such a manner so as to intervene when urban influences have compromised the natural functioning of the estuary"

2. SITUATION ASSESSMENT AND CONTEXT

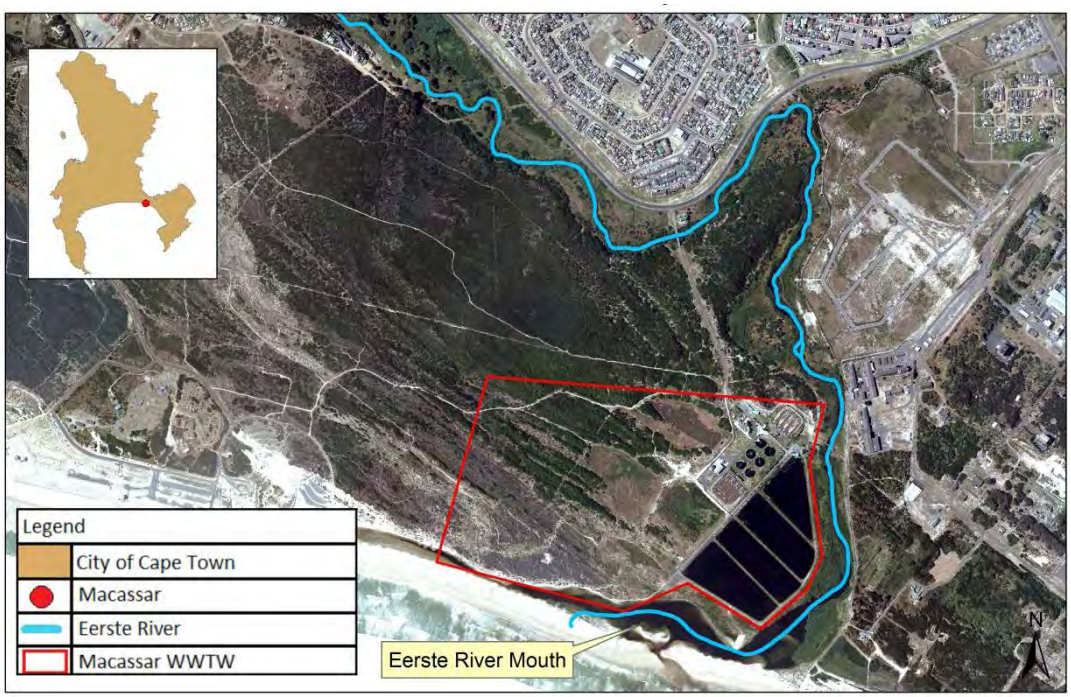

Figure 1: Eerste River Estuary

The Eerste River Estuary meets the ocean at Macassar Beach on the False Bay coastline. The Eerste River Estuary mouth forms the western boundary of the Helderberg Marine Protected Area (MPA) and as such must be considered a core component to the marine conservation objectives of the MPA.

The estuary is typified by a broad back ponding area with a highly mobile estuary mouth. The mouth is not canalised or fixed and is highly influenced by the prevailing coastal dynamics of a wind driven sand system as well as altered flow due to urban and farming impacts on the greater catchment area.

There are no residential properties located near the estuary, but a large sewage treatment facility (Macassar Wastewater Treatment Works) is located adjacent to the back ponding area and discharges final treated effluent directly into the estuary (see Figure 1). Some distance upstream is the suburb of Macassar which includes both residential and rural farming / small holding components. To the east of the estuary is the site of

the former AECI facility; redevelopment plans for this site are in the early phases, and it is not yet clear whether or how the site may be redeveloped.

The Eerste River is joined by the Kuils River approximately 4km upstream of the estuary. The latter river also receives treated effluent from a number of Wastewater Treatment Works (WWTW) located in the Kuils River catchment area. It is noteworthy that the Kuils River forms the backbone of the Kuils River Corridor which aims to connect CapeNature's Driftsands Nature Reserve with Macassar Dunes and the Coast.

The flow of the river at the mouth is persistent as a net seawards flow. This is partly due to the wastewater discharge contribution, which has the effect of keeping the mouth generally open.

While wind-blown sands generally encroach from the east, the longshore sediment supplies from wave action vary from west to east and therefore the location of the estuary mouth is inherently unstable. It is anticipated that climate change effects will result in greater instability of this system due to sea level rise and possible changes in wind dynamics. Significant meandering of the mouth to the west has been recorded leading to damage to an inappropriately located pump station and parking area in 2010/11.

Due to the fact that this system has a significant component of treated sewage effluent, the natural estuarine characteristics have been permanently altered. The objectives for managing such a system should therefore focus on protection of infrastructure while allowing beach and dune processes to function as naturally as possible.

2.1 WATER QUALITY OF ESTUARY

The condition of the estuary is highly influenced by the Greater Eerste-Kuils Catchment Area which chiefly results in the following:

- Altered seasonality and flow dynamics due to increased volumes as a result of urban run-off and discharge of wastewater effluent;
- Poor water quality due to litter, urban pollutants and wastewater effluent.
- Unplanned emergency overflow of untreated wastewater from the Macassar Wastewater Treatment Works

Comprehensive water quality monitoring is undertaken on a monthly basis by the City of Cape Town's Scientific Services Laboratory since 1989, and results indicate that the catchment as a whole has been significantly impacted by a range of urban land-uses and activities including the presence of several WWTWs, industrial areas, extensive high density formal and informal residential settlements and a major road network. The condition of the estuary itself is thus influenced by these upstream impacts and also more specifically by the presence of the Macassar WWTW within the estuarine environment.

Figure 2: Water Quality Sampling Points

Water quality monitoring points in the vicinity of Eerste River Estuary include:

- Eerste River (EK12)
- Eerste River estuary (EK17)
- Moddergatspruit – Macassar Road (EK18)
- Macassar Beach (XCS19)

The water quality of the Eerste River estuary is of concern, as it opens across a beach used for recreational purposes, as well as its influence on the Helderberg MPA.

2.2 SPECIES RECORDED IN THE CATCHMENT

The City of Cape Town's Alien Invasive Unit have recorded the following **invasive species** in the Eerste River Catchment (2012-2013):

Nasturtium officinale	Watercress
Commelina diffusa	Climbing dayflower
Lamium purpureum	Red deadnettle
Eichhornia crassipes	Water hyacinth
Ricinus communis	Castor bean
Acacia saligna	Port Jackson
Paraserianthes lophantha	Stinkbean
Canna indica	Indian shot
Persicaria decipiens	Slender knot-weed
Sagittaria platyphylla	Delta arrowhead
Melia azedarach	Syringa
Echium vulgare	Common Viper's Bugloss
Arundo donax	Giant reed
Lemna spp.	Duckweed
Various herbaceous species	

The Department of Agriculture, Forestry and Fisheries have recorded the following marine and freshwater species in the Eerste River Catchment (2013):

Marine Species	
Gilchristella aestuaria	Estuarine round herring
Atherina breviceps	Cape silverside
Psammogobius knysnaensis	Knysna sandgoby
Lichia amia	Leervis
Monodactylus falciformis	Cape moony
Mugilcephalus	Flathead mullet
Lithognathus lithognathus	White steenbras
Galeichthys feliceps	White sea catfish
Liza dumerilii	Groovy mullet
Liza tricuspidens	Striped mullet
Heteromycterus capensis	Cape sole
Solea bleekeri	Blackhand sole
Liza richardsonii	Harder
Pomatomus saltatrix	Elf
Rhabdosargus globiceps	White stumpnose
Etrumeus whiteheadi	Redeye round herring
Amblyrhynchotes honckenii	Blaasop
Anguilla bengalenis	African mottled eel
Anguilla marmorata	Madagascan mottled eel
Anguilla mossambica	Longfin eel

Freshwater Species	
Clarias gariepinus	Sharptooth catfish (invasive)
Cyprinus carpio	Carp (invasive)
Oncorhynchus mykiss	Rainbow trout (invasive)
Galaxias zebratus	Cape galaxias

2.3 RECREATION

Recreation in the estuary is minimal and is confined to occasional limited local recreational swimming. No commercial fishing is permitted however limited recreational fishing occurs. The size and scale of the estuary does not facilitate broader recreational use such as boating or sailing.

3. MANAGEMENT PLAN

The Eerste River Estuary has to date not had a specific management plan or long term objectives assigned to it, nor have specific roles and responsibilities been previously defined. As part of its new Integrated Coastal Management approach, the City has prioritised the management of small and large estuaries. Based on the situation assessment and the available information a number of management objectives have been defined. For each of these management objectives, a specific operational protocol has been developed.

These specific management protocols are intended to clearly define actions as well as responsibilities across City line departments. As implementation takes place and new information is gathered and understood, operational protocols may be amended and additional objectives and associated protocols added. Estuary management within an urban environment is seen as a long term approach following a principle of striving towards ongoing improvement in both the quality and management of our estuaries.

3.1 MANAGEMENT OBJECTIVES

The City has the following management objectives for the Eerste River Estuary:

A. Allow the estuary mouth to function naturally as part of the local coastal dynamic processes and intervene only under specific defined and documented circumstances
B. Reduce and minimise all sources of urban pollutants to the estuary
C. Regulation and development of infrastructure in or adjacent to the estuary
D. Allow the natural circulation and fluctuation in estuary water quantity to be determined by seasonal rainfall patterns, whenever possible
E. Monitor estuary dynamics and intervene if required
F. Monitor estuary water quality and work towards a high standard of water quality acceptable for public recreation and ecological functioning
G. Remove alien invasive species from the estuary
H. Appropriately regulate all recreational use of the estuary
I. Provide public awareness and education through a range of media
J. Undertake annual monitoring and sampling of the estuary's biodiversity
K. Implement an Estuary Emergency Contingency Plan in the event of a flooding, significant pollution event, oxygen depletion or other emergency events
L. Establish an estuary task team with relevant stakeholders
M. Regulate events and filming in the estuarine environment

OBJECTIVE A:

Allow the estuary mouth to function naturally as part of the local coastal dynamic processes and intervene only under specific defined and documented circumstances

LEGISLATION/STANDARDS:

Estuary mouth manipulation falls within the National Environmental Management Act (NEMA) Regulations in so far as mouth manipulation involves movement of sand and therefore triggers Activity 18 (Listing Notice 1). As such mouth manipulation may be undertaken either:

a) In terms of a *"management plan agreed to by the relevant environmental authority"*
b) In an emergency situation followed by notification to Department of Environmental Affairs and Development Planning (DEADP)

MANAGEMENT PROTOCOLS:

Due to the presence of the WWTW and the large volumes of effluent discharged into the estuary, it is likely that the mouth remains open for most of the year. However, lateral migration along the coast has been problematic in previous years, and it is therefore essential that protocols for opening and straightening of the river mouth are in place.

The following management protocols will be applied:

1) Risk of inland flooding
- The mouth of the estuary may be straightened and opened in the event that high rainfall prediction is indicative of a possible inland flooding event.
- Determination of this need as well as the responsibility for carrying out the action resides with the City's Catchment, Stormwater and River Management Branch.

2) Pollution or toxic event
- In the event of a toxic event in the estuary or catchment, the mouth may be mechanically opened to facilitate flushing of the estuary during high tide or high water levels. This action may also require the trapping of sea water in the estuary through the physical closing of the mouth for a short duration.
- Determination of this need resides with the City's Catchment, Stormwater and River Management Branch in consultation with the C.A.P.E. Estuary Programme Manager as well as the National Departments of Environmental Affairs (DEA) and Agriculture, Fisheries and Forestry (DAFF). Responsibility for carrying out the action resides with the City's Catchment, Stormwater and River Management Branch

3) Potential undermining of infrastructure or critical dune systems by estuary mouth movement.
- Where the estuary mouth moves or meanders in such a manner that it threatens critical dune systems or City infrastructure the mouth may be mechanically straightened or re-aligned.
- Determination of this need as well as the responsibility for carrying out the action resides with the City's Environmental Resource Management Department's Coastal Management Unit in consultation with the Helderberg district environmental office

RECORDS:

- All mouth manipulation, the reason, action and completion will be recorded in the City's Coastal Management Monitoring and Database System
- DEA, DAFF, DEADP and the C.A.P.E Estuary Programme will be informed of all mouth manipulation events by the City's Coastal Management Unit

MACHINE ACCESS FOR MOUTH MANIPULATION:

- In all circumstances listed within this management objective, access points and traverse routes for machinery to be used for mouth manipulation will be determined by the Environmental Resource Management Department
- As much as possible, access and traverse routes must adhere to existing road surfaces or previously disturbed areas.
- These access and traverse routes will be strictly adhered to at all times

OBJECTIVE B:

Reduce and minimise all sources of urban pollutants to the estuary

LEGISLATION/STANDARDS:

Pollution in the form of industrial waste, human waste, domestic waste and material waste is governed by a wide range of National Legislation and Standards.

- National Environmental Management Act (NEMA)
- National Water Act (NWA)
- National Waste Act
- Integrated Coastal Management Act (ICMA)

However, for practical reasons recognition must be given to the fact that both the catchment that feeds the estuary, the estuary itself as well as the marine environment with which the estuary interacts are all subject to various pollutant sources common within a highly developed and populated urban environment. As such, all means to reduce pollution into the estuary that are practical, cost effective and reasonable will be employed but targeting zero pollution within an urban environment is neither practical nor realistic.

MANAGEMENT PROTOCOLS:

To minimise and reduce all forms of pollution the following management protocols will be applied:

1) Regular and systematic litter removal from the general Eerste River Catchment area by the City's Solid Waste Management Department.
2) Monthly monitoring of water quality along the river by the City's Scientific Services Branch.
3) If deemed necessary, installation, clearing and maintenance of litter traps by the City's Operations and Assets Branch of the Roads and Stormwater Department.
4) On an ongoing basis and as required, implement interventions to reduce water pollution at source, through the application of the City's Water Quality Improvement Strategy and Implementation Plan.
5) On an ongoing basis, coordinating and liaising with the Winelands Municipality with regards to holistic management across the entire catchment

RECORDS:

1) All major pollution events to be recorded in the City's Coastal Monitoring Database. A major pollution event is defined as any pollution event deemed to be significantly greater than the level of background pollution present in the system. This may be determined either through water quality monitoring (i.e. a set of results that shows a significant spike in pollution, or through observation of an event (e.g. sewer overflow).

GENERAL

- In the event of major water based pollution events, the pollution event will be managed in accordance with the management protocol as set out in OBJECTIVE A.
- In the event of increased levels of litter within the catchment system a litter trap may be established at the most northern end of the back pond to reduce and minimise litter into the estuary

OBJECTIVE (C) :

Regulation of development of infrastructure in or adjacent to the estuary

LEGISLATION/STANDARDS:

Development of or building of any infrastructure within or adjacent to the estuary is regulated by the following:

a) National Environmental Management Act
b) City Zoning Scheme
c) Integrated Coastal Management Act
d) Coastal Edge and Setback Line
e) Floodplain and River Corridor Management Policy
f) Management of Urban Stormwater Impacts Policy

MANAGEMENT PROTOCOLS:

a) All development proposals must comply with relevant legislation and policies
b) Development proposals falling within the Coastal Edge/Setback Line or 1 in 50 year flood line should not be supported
c) The building or construction of any permanent or temporary structures that do not trigger NEMA regulations, but are adjacent to or within the estuary, require additional written permission from the City's Environmental Resource Management Department's Integrated Coastal Management Unit or the Helderberg district environmental office

RECORDS:

- Any written permission granted for a permanent or temporary structure to be recorded in the City's Coastal Monitoring Database

GENERAL:

- As the Eerste River Estuary forms part of the Helderberg MPA, construction of any permanent or temporary structures will in general not be supported unless strong rationale is provided with measurable benefits

OBJECTIVE (D):

Allow the natural circulation and fluctuation in estuary water quantity to be determined by seasonal rainfall patterns, whenever possible.

LEGISLATION/STANDARDS:

- National Water Act

MANAGEMENT PROTOCOLS:

a) At no time should the mouth of the estuary be impeded, diverted, blocked or altered unless under the specific conditions as defined in OBJECTIVE A
b) The estuary mouth may never be canalised or fixed
c) No water abstraction to be permitted from the back pond or estuary mouth
d) Water abstraction from the Eerste River Catchment to conform to all relevant legislation with strict permit conditions
e) On an ongoing basis, strive for improvement in wastewater discharge from the Macassar WWTW works to comply with permit conditions
f) On an ongoing basis, encourage the re-use of treated effluent from the various WWTWs in the greater catchment area

RECORDS:

- Permitted water abstraction from the Eerste River Catchment as well as permit conditions to be recorded in the City's Coastal Monitoring Database
- Cases and outcomes of any illegal water extraction in the Eerste River Catchment to be recorded in the City's Coastal Monitoring Database

GENERAL:

- In the event of major flow alteration, the City's Catchment, Stormwater and River Management Branch in conjunction with the Helderberg district environmental office to conduct an investigation to determine cause of flow change and make recommendations to rectify and restore flow regime

OBJECTIVE (E) :

Monitor estuary dynamics and intervene if required

LEGISLATION/STANDARDS:

- National Environmental Management Act

MANAGEMENT PROTOCOLS:

1) The City's Environmental Resource Management Department will develop an estuary dynamics monitoring programme based on aerial photography, including the establishment of baseline data, with the aim of annual assessment to determine whether changes in dynamics are taking place over time.

2) If the changing dynamics of the estuary are determined to be posing a management problem, the City's Catchment, Stormwater and River Management Branch in conjunction with the City's Environmental Resource Management Department will investigate and attempt to determine the cause. Areas of concern which may require intervention include, but are not limited to, increased rates of sedimentation and significant migration of the estuary or river mouth.

3) If it is determined that changes pose a management problem, the City will:
   a) Inform DAFF, DEA and the C.A.P.E. Estuary Programme Manager
   b) In consultation with DAFF, DEA and the C.A.P.E. Estuary Programme Manager determine the most appropriate plan of action
   c) Ensure compliance to NEMA if remedial action requires environmental authorisation

RECORDS:

- Changes in estuary dynamics to be monitored and recorded in the City's Coastal Management Monitoring and Database System.

GENERAL:

- Recognise that changes in estuary dynamics may form part of the natural variation in the estuary and as such retain a principle of least interference

OBJECTIVE F:

Monitor estuary water quality and work towards a high standard of water quality acceptable for public recreation and ecological functioning

LEGISLATION/STANDARDS:

- Water quality guidelines (DWA and DEA).

MANAGEMENT PROTOCOLS:

- Standardised water quality monitoring to be undertaken at one location within the estuary (EK17) and at various sites in the greater catchment area once per month (temperature, dissolved oxygen, conductivity/salinity, pH, total suspended solids, total phosphorus, orthophosphate, total nitrogen, soluble ammonia, nitrite & nitrate, faecal coliforms, *Escherichia coli* and enterococcus)

- ERMD to liaise with the Wastewater Department to ensure that data from the monitoring of the final effluent quality from Macassar Wastewater Treatment Works (and other relevant WWTWs) is provided to the Coastal Management Monitoring and Database System on a quarterly basis

- In the event that excessive poor water quality results are measured that threaten the estuary the management protocols established in OBJECTIVE A may be followed to restore improved water quality conditions

RECORDS:

- All water quality results will be recorded within Scientific Services' Laboratory Information Management System (LIMS) and the monthly Certificate of Analysis will be added to the City's Coastal Management Monitoring and Database System.

- All final effluent quality results obtained from the Wastewater department will be logged in the City's Coastal Management Monitoring and Database System

GENERAL:

- Estuary water quality management to be implemented in accordance with the Water and Sanitation Department's, and Catchment, Stormwater and River Management Branch's City-wide work programme, resources and priorities.

OBJECTIVE (G):

Remove alien invasive species from the estuary

LEGISLATION/STANDARDS:

- Conservation of Agricultural Resources Act, 43 of 1983 (CARA)
- National Environmental Biodiversity Act (NEMBA), 10 of 2004

MANAGEMENT PROTOCOLS:

The City's Invasive Species Unit to prepare an invasive species management plan for the estuary, to include, where relevant:

- Control of established invasive plants
- Control and management of invasive alien birds and animals where necessary
- Control and management of invasive alien fish, if deemed necessary
- Re-introduction of indigenous species where feasible
- Implementation of an early detection and rapid response programme to address new and emerging invasive alien species

RECORDS:

- The invasive species management plan will be appended to this Estuary Management Plan as Annexure A.

GENERAL:

- The estuary invasive species management plan to be implemented in accordance with the Invasive Species Unit city-wide work programme, resources and priorities.

- An integrated invasive species management approach will be followed in partnership with relevant stakeholders

OBJECTIVE (H):

Regulate all recreational use of the estuary

LEGISLATION/STANDARDS:

- DAFF Commercial Fishing Regulations
- DAFF Recreational Fishing Regulations
- DWA, Recreational Water Quality Standards
- Integrated Coastal Management Act
- City's Municipal Coastal Management Plan

MANAGEMENT PROTOCOLS:

- Only recreational fishing will be permitted, with a valid recreational fishing permit, available from the Post Office. This will be communicated through appropriate signage.
- No motorised water-craft of any kind permitted in the estuary or estuary mouth
- City's Marine and Coastal Law Enforcement Unit in conjunction with DAFF Fishery Control Officers to monitor, enforce and regulate
- Due to the close proximity of the WWTW, no swimming is permitted in the estuary. Signage to this effect will be installed.

RECORDS:

- Any non-compliance to regulations will be recorded in the City's Coastal Management Monitoring and Database System

GENERAL:

- The estuary recreational use management plan to be implemented in accordance with the Sport, Recreation and Amenities Department's City-wide work programme, resources and priorities.

- Appropriate recreation to be supported in line with the City's Social Development Strategy

OBJECTIVE (I):

Provide public awareness and education through a range of media

LEGISLATION/STANDARDS:

- None

MANAGEMENT PROTOCOLS:

Public education and awareness on the Eerste River Estuary may be provided in the following ways:

1) General catchment and estuary education and awareness through the City's Youth Environmental Schools (YES) Programme
2) General estuary education and awareness as part of the City's Educator Training Programme
3) General estuary education and awareness through the City's Nature Reserve Environmental Education

Programme
4) General City communication programmes focusing on awareness raising and education about pollution, its impact on human health and freshwater ecosystems
5) The installation of relevant and appropriate informative signage at the estuary

RECORDS:

- All signs and their locations to be recorded in the City's Coastal Management Monitoring and Database System.

GENERAL:

- All signage, regulatory and informative, must comply with the City's Coastal Signage Protocol
- The estuary public awareness and education management plan to be implemented in accordance with the Environmental Resource Management Department's city-wide work programme, resources and priorities.

OBJECTIVE J:

Undertake annual monitoring and sampling of the estuary's biodiversity

LEGISLATION/STANDARDS:

- None

MANAGEMENT PROTOCOLS:

ERMD in partnership with DAFF to undertake annual estuary biodiversity surveys through:

- Fish sampling through annual seine netting
- Bird counts
- Benthic sampling

RECORDS:

- All sampling results to be recorded in the City's Coastal Management Monitoring and Database System

GENERAL:

- Biodiversity sampling programme and schedule to be determined by DAFF
- The sampling programme is contingent on sufficient resources being made available for this programme

OBJECTIVE (K):

Implement an Estuary Emergency Contingency Plan in the event of a flooding, significant pollution event, oxygen depletion or other emergency events

LEGISLATION/STANDARDS:

- National Environmental Management Act

MANAGEMENT PROTOCOLS:

The following will be considered an Estuary Emergency requiring the Emergency Contingency Protocols to be implemented:

1) A land based (catchment) pollution event
2) Marine oil or pollution spill in False Bay
3) Rapid oxygen depletion
4) Marine / estuarine life die-off within the estuary

Emergency Contingency Protocols:

1) In the event of an emergency the estuary, estuary mouth and beach area (200m either side of the mouth) will be closed to the public and enforced by City Law Enforcement
2) The City's Coastal Co-ordinators will notify officials from DAFF, DEA and the C.A.P.E. Estuary programme manager
3) Where a land based pollution event is contaminating the estuary, the protocol established in OBJECTIVE A will be followed
4) Where there is a marine oil or pollution event, the estuary mouth will be boomed off and the Official Oil and Pollution Contingency Plan as per the City's Municipal Coastal Management Plan will become effective
5) In the event of a rapid oxygen depletion event, the estuary mouth will be breached and opened at low tide to allow high tide ocean water into the estuary, as per OBJECTIVE A.
6) In the event of significant marine life die-off, samples of dead marine life will be provided to DAFF and DEA for analysis. All remaining dead marine life will be recovered from the estuary by the City's Solid Waste Management department and disposed of at Vissershok Landfill site in accordance with City waste management procedures
7) The Estuary, estuary mouth and associated beach area will only be re-opened to public access once it is deemed safe

RECORDS:

- All estuary emergency events as well as the action taken will be recorded in the City's Coastal Management Monitoring and Database System
- DEA and DAFF to make any sampling results from a marine life die off available to the City

GENERAL:

- An emergency will only be declared if it is determined that the scale of the problem is such that it threatens the long term viability of the estuary as a functional ecosystem, or if it threatens the integrity of the Helderberg Marine Protected Area.
- This determination will be made by the City's Catchment, Stormwater and River Management Branch, in conjunction with the Environmental Resource Management Department. In the event of a biodiversity related emergency, ERMD will be the lead department in terms of decision-making.

OBJECTIVE (L):

Establish an estuary task team with relevant stakeholders

LEGISLATION/STANDARDS:

- Integrated Coastal Management Act

MANAGEMENT PROTOCOLS:

- Task team to be established as part of a city-wide Small Estuaries Task Team, which will include all estuaries except for the Zandvlei and Diep estuaries.
- Small Estuaries Task Team to meet on a quarterly basis

RECORDS:

- Action minutes of all meetings to be maintained as part of the City's Coastal Monitoring Database

GENERAL:

- Small Estuaries Task Team will function as a working group consisting of officials who are involved in management work related to the relevant estuaries
- Public engagement will be facilitated through the existing Sub-Council structure

OBJECTIVE M:

Regulation of Events and Filming

LEGISLATION/STANDARDS:

- City Filming and Events Policy
-

MANAGEMENT PROTOCOLS:

Any organisation or individual who wishes to hold, host or undertake a commercial or non-profit event or commercial filming of any kind on the estuary, or within the coastal edge surrounding the estuary must:

- Submit a formal application to the City's Events and Filming Office
- The application must be circulated to the Environmental Resource Management Department, Catchment, Stormwater and River Management Branch and Sport, Recreation and Amenities Department for consideration
- Officials from these departments will advise the Events and Filming Office on the suitability of the application and if supported the conditions attached to such support
- If approved, the final event or filming permit with attached conditions must be circulated to the Environmental Resource Management Department, Catchment Stormwater and River Management Branch and Sport, Recreation and Amenities Department at least 48 hours prior to the event or filming taking place

RECORDS:

- Events and Film Office to retain records of all applications, permits and conditions as well as any reported non-compliance

GENERAL:

- Event and filming applications for the estuary must demonstrate meaningful benefit

ESTUARY MANAGEMENT PLAN:

Hout Bay River Estuary

1. VISION

The Vision for the C.A.P.E. Estuaries Programme as a whole is: "Our estuaries are beautiful, rich in plants and animals, they attract visitors, sustain our livelihoods and uplift our spirits."

The Hout Bay River (also known as the Disa River) Estuary is part of an extensive urban environment and as such the vision for the estuary is:

"To manage the estuary and its catchment in such a manner as to reduce and minimise urban influence and pollutants on the estuary, where possible allow free and natural movement of the estuary mouth whilst ensuring that all risks to life and property are avoided, manage alien invasive species, continuously work towards achieving high standards of water quality, recognise the estuary as an important marine nursery and biodiversity habitat and monitor the estuary in such a manner so as to intervene when urban influences have compromised the natural functioning of the estuary"

2 SITUATION ASSESSMENT AND CONTEXT

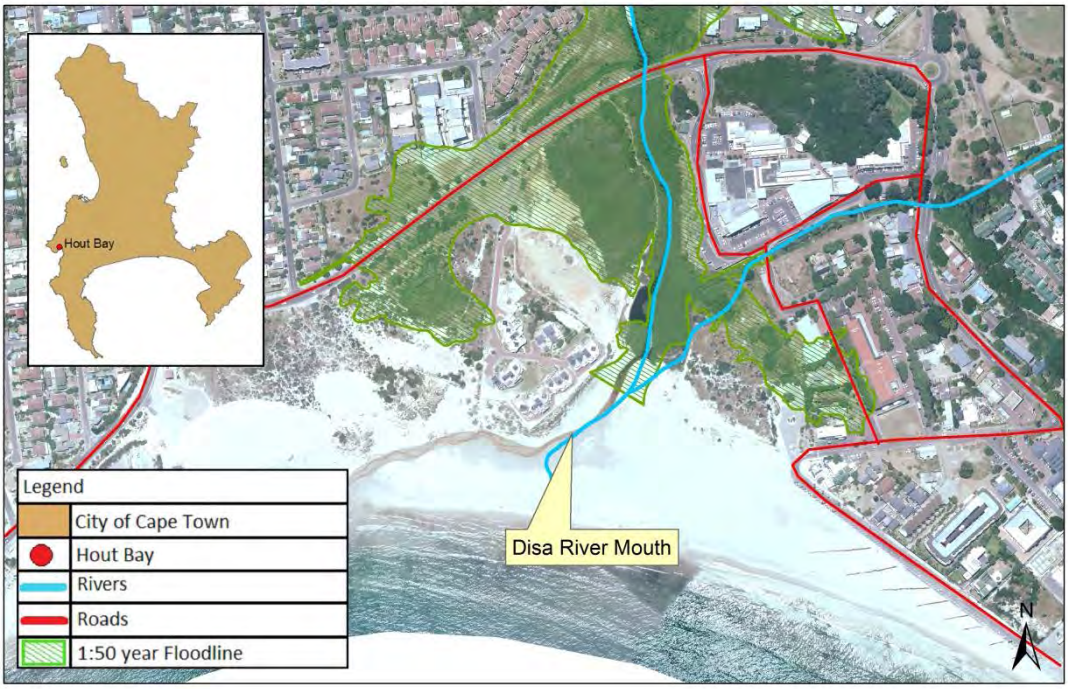

Figure 1: Hout Bay River Estuary

The Hout Bay River Estuary connects with the ocean at Hout Bay Beach. The estuary is an intermittently open system that opens when the Hout Bay River is in spate, but generally closes during summer. The river outlet is therefore not considered to be a true estuary with associated estuarine dependant species.

Reduction in natural flows due to retention of water in upper catchment dams, increase in urban stormwater flows, urban development, bank stabilisation and flood levees, sedimentation, litter from informal settlements, and stormwater discharges all impact the estuary and its contributing river. This has led to the alterations in the estuary's condition, water quality and depth.

Furthermore, the estuary is no longer in its natural state and tends to meander, effectively compromising efforts for dune rehabilitation. A Management and Rehabilitation Plan for the Hout Bay Dunes (Low, A B. and van Eeden J.D., Management and Rehabilitation plan for the Hout Bay Dunes. Volume 2. Vula Environmental Service, Vredenburg) has been compiled which points to sand accumulations on Hout Bay Beach contributing

to the unpredictable meandering of the river mouth. With the continuous accumulation of sand and no sand, estuary, or river management plan in place, the river embankment below the river mouth will continue to erode.

A number of developments are below the 1:50 flood line of the Hout Bay River and are therefore exposed to the effects of coastal dynamics, especially erosion.

2.1 WATER QUALITY OF ESTUARY

The condition of the estuary is highly influenced by the Hout Bay Catchment Area which chiefly results in the following:

- Altered seasonality and flow dynamics
- Poor water quality due to litter, urban pollutants and sewage.
- Occasional unplanned overflow of untreated sewage from the sewage reticulation network due to breakdown or damage

Comprehensive water quality monitoring has been undertaken on a monthly basis by the City's Scientific Services Laboratory since 1991, and results indicate that the upper reaches of the catchment are virtually pristine. However as the river traverses the increasingly dense residential area and adjacent informal settlement area of Imizamo Yethu the condition of the river deteriorates. Sporadically high bacterial contamination levels are of concern in the lower river reaches and outlet. Dog walkers need to be vigilant about removing pet waste; however the resident bird populations and horse riders also contribute to the bacterial load.

Water quality in the estuary can be of concern due to the fact that beachgoers (particularly children) sometimes enter the warmer waters in the river outlet. Stagnation of the water and concentration of pollutants when the mouth is closed means that there is potentially increased risk. Signage to warn about the potentially contaminated condition of the river outlet is in place.

Figure 2: Water quality monitoring points in the vicinity of Hout Bay River Estuary

Water quality sample collection points within the Hout Bay catchment area (arranged from the extreme upper catchment down towards the sea):

- Hout Bay near Princess St (DR02) - not estuarine

- Hout Bay at Victoria Road (DR01)
- Hout Bay River estuary (DR05)
- Hout Bay beach (XCN10) - not estuarine

The water quality of the Hout Bay River estuary is potentially of concern as the mouth of the river opens across a recreational beach.

2.2 SPECIES RECORDED IN HOUT BAY RIVER CATCHMENT AREA

The City of Cape Town's Alien Invasive Unit have recorded the following **invasive species** in the Hout Bay River Catchment (2012-2013):

Invasive Species	
Nasturtium officinale	Watercress
Commelina diffusa	Climbing dayflower
Canna indica	Canna
Arundo donax	Giant reed
Ceratophyllum demersum	Hornwort
Lantana spp.	Lantana
Lemna spp.	Duckweed
Various herbaceous species	

The Department of Agriculture, Forestry and Fisheries have recorded the following marine and freshwater species in the Hout Bay River Catchment (2013):

Marine Species	
Psammogobius knysnaensis	Knysna sandgoby
Liza richardsonii	Harder
Anguilla mossambica	Longfin eel

Freshwater Species	
Sandelia capensis	Cape kurper
Oreochromis mossambicus	Mozambique tilapia
Tilapia sparrmanii	Banded tilapia
Gambusia affinis	Mosquitofish
Galaxias zebratus	Cape galaxias

2.3 RECREATION

Recreation in the estuary is minimal and is confined to local recreational swimming, dog walking / paddling in the back ponding area and in the estuary mouth. No commercial fishing is permitted. The size and scale of the estuary does not facilitate broader recreational use such as boating or sailing.

3) MANAGEMENT PLAN

The Hout Bay River Estuary has to date not had a specific management plan or long term objectives assigned to it, nor have specific roles and responsibilities been previously defined. As part of its new Integrated Coastal Management approach, the City has prioritised the management of small and large estuaries. Based on the situation assessment and the available information a number of management objectives have been defined. For each of these management objectives, a specific operational protocol has been developed.

These specific management protocols are intended to clearly define actions as well as responsibilities across City line departments. As implementation takes place and new information is gathered and understood, operational protocols may be amended and additional objectives and associated protocols added. Estuary management within an urban environment is seen as a long term approach following a principle of striving towards ongoing improvement in both the quality and management of our estuaries.

3.1 MANAGEMENT OBJECTIVES

The City has the following management objectives for the Hout Bay River Estuary:

A. Allow the estuary mouth to function naturally as part of the local coastal dynamic processes and intervene only under specific defined and documented circumstances
B. Reduce and minimise all sources of urban pollutants to the estuary
C. Regulation and development of infrastructure in or adjacent to the estuary
D. Allow the natural circulation and fluctuation in estuary water quantity to be determined by seasonal rainfall patterns, whenever possible
E. Monitor estuary dynamics and intervene if required
F. Monitor estuary water quality and work towards a high standard of water quality acceptable for public recreation and ecological functioning
G. Remove alien invasive species from the estuary
H. Appropriately regulate all recreational use of the estuary
I. Provide public awareness and education through a range of media
J. Undertake annual monitoring and sampling of the estuary's biodiversity
K. Implement an Estuary Emergency Contingency Plan in the event of a flooding, significant pollution event, oxygen depletion or other emergency events
L. Establish an estuary task team with relevant stakeholders
M. Regulate events and filming in the estuarine environment

OBJECTIVE A :

Allow the estuary mouth to function naturally as part of the local coastal dynamic processes and intervene only under specific defined and documented circumstances

LEGISLATION/STANDARDS:

Estuary mouth manipulation falls within the National Environmental Management Act Regulations. As such mouth manipulation must be done as either:

a) In terms of a *"management plan agreed to by the relevant environmental authority"*
b) In an emergency situation followed by notification to Department of Environmental Affairs and Development Planning (DEADP)

MANAGEMENT PROTOCOLS:

The following management protocols will be applied:

1) Risk of inland flooding

- The mouth of the estuary may be straightened and opened in the event that high rainfall prediction is indicative of a possible inland flooding event.
- Determination of this need as well as the responsibility for carrying out the action resides with the City's Catchment, Stormwater and River Management Branch.

2) Pollution or toxic event

- In the event of a toxic event in the estuary or catchment, the mouth may be mechanically opened to facilitate flushing of the estuary during high tide or high water levels. This action may also require the trapping of sea water in the estuary through the physical closing of the mouth for a short duration.
- Determination of this need resides with the City's Catchment, Stormwater and River Management Branch in consultation with the C.A.P.E. Estuary Programme Manager as well as the National Departments of Environmental Affairs (DEA) and Agriculture, Fisheries and Forestry (DAFF). Responsibility for carrying out the action resides with the City's Catchment, Stormwater and River Management Branch

3) Potential undermining of infrastructure or critical dune systems by estuary mouth movement.

- Where the estuary mouth moves or meanders in such a manner that it threatens City infrastructure or sensitive environmental components such as the dune system, the mouth may be mechanically straightened or re-aligned.
- Determination of this need as well as the responsibility for carrying out the action resides with the City's Environmental Resource Management Department's Coastal Management Unit in consultation with the Southern district environmental office

RECORDS:

- All mouth manipulation, the reason, action and completion thereof will be recorded in the City's Coastal Management Monitoring and Database System
- DEA, DAFF, DEADP and the C.A.P.E Estuary Programme will be informed by the City's Coastal Management Unit of all mouth manipulation

MACHINE ACCESS FOR MOUTH MANIPULATION:

- In all circumstances listed within this management objective, access points and traverse routes for machinery to be used for mouth manipulation will be determined by the Environmental Resource Management Department
- As much as possible, access and traverse routes must adhere to existing road surfaces or previously disturbed areas.
- These access and traverse routes will be strictly adhered to at all times

OBJECTIVE B :

Reduce and minimise all sources of urban pollutants to the estuary

LEGISLATION/STANDARDS:

Pollution in the form of industrial waste, human waste, domestic waste and material waste is governed by a wide range of National Legislation and Standards.

- National Environmental Management Act (NEMA)
- National Water Act (NWA)
- National Waste Act
- Integrated Coastal Management Act (ICMA)

However, for practical reasons recognition must be given to the fact that both the catchment that feeds the estuary, the estuary itself as well as the marine environment with which the estuary interacts are all subject to various pollutant sources common within a highly developed and populated urban environment. As such, all means to reduce pollution into the estuary that are practical, cost effective and reasonable will be employed but targeting zero pollution within an urban environment is neither practical nor realistic.

MANAGEMENT PROTOCOLS:

To reduce all forms of pollution the following management protocols will be applied:

1) Regular and systematic litter removal from the general Hout Bay Catchment area by the City's Solid Waste Management Department
2) Monthly monitoring of water quality along the river by the City's Scientific Services Branch.
3) If deemed necessary, installation, clearing and maintenance of litter traps by the City's Operations and Assets Branch of the Roads and Stormwater Department.
4) On an ongoing basis and as required, implement interventions to reduce water pollution at source, through the application of the City's Water Quality Improvement Strategy and Implementation Plan.

RECORDS:

1) All major pollution events to be recorded in the City's Coastal Monitoring Database. A major pollution event is defined as any pollution event deemed to be significantly greater than the level of background pollution present in the system. This may be determined either through water quality monitoring (i.e. a set of results that shows a significant spike in pollution, or through observation of an event (e.g. sewer overflow).

GENERAL

- In the event of major water based pollution events, the pollution event will be managed in accordance with the management protocol as set out in OBJECTIVE A.
- In the event of increased levels of litter within the catchment system a litter trap may be established at the most northern end of the back pond to reduce and minimise litter into the estuary

OBJECTIVE C :

Regulation of development of infrastructure in or adjacent to the estuary

LEGISLATION/STANDARDS:

Development or building of any infrastructure within or adjacent to the estuary is regulated by the following:

a) National Environmental Management Act
b) City of Cape Town Integrated Zoning Scheme
c) Integrated Coastal Management Act
d) Coastal Edge and Setback Line
e) Floodplain and River Corridor Management Policy
f) Management of Urban Stormwater Impacts Policy

MANAGEMENT PROTOCOLS:

a) All development proposals must comply with relevant legislation and policies
b) Development proposals falling within the Coastal Edge/Setback Line or 1 in 50 year flood line should not be supported
c) The building or construction of any permanent or temporary structures that do not trigger NEMA regulations, but are adjacent to or within the estuary, require additional written permission from the City's Environmental Resource Management Department's Integrated Coastal Management Unit or the Southern district environmental office

RECORDS:

- Any written permission granted for a permanent or temporary structure to be recorded in the City's Coastal Monitoring Database

GENERAL:

- Construction of any permanent or temporary structures will in general not be supported unless strong rationale is provided with measurable benefits

OBJECTIVE (D):

Allow the natural circulation and fluctuations in estuary water quantity to be determined by seasonal rainfall patterns, whenever possible.

LEGISLATION/STANDARDS:

- National Water Act

MANAGEMENT PROTOCOLS:

a) At no time should the mouth of the estuary be impeded, diverted, blocked or altered unless under the specific conditions as defined in OBJECTIVE A
b) The estuary mouth may never be canalised or fixed
c) No water abstraction to be permitted from the back pond or estuary mouth
d) Water abstraction from the Hout Bay River Catchment to conform to all relevant legislation with strict permit conditions

RECORDS:

- Permitted water abstraction from the Hout Bay River Catchment as well as permit conditions to be recorded in the City's Coastal Monitoring Database
- Cases and outcomes of any illegal water extraction in the Hout Bay River Catchment to be recorded in the City's Coastal Monitoring Database

GENERAL:

- In the event of major flow alteration, the City's Catchment, Stormwater and River Management Branch in conjunction with the Southern district environmental office to conduct an investigation to determine cause of flow change and make recommendations to rectify and restore the flow regime

OBJECTIVE (E) :

Monitor estuary dynamics and intervene if required

LEGISLATION/STANDARDS:

- National Environmental Management Act

MANAGEMENT PROTOCOLS:

1) The City's Environmental Resource Management Department will develop an estuary dynamics monitoring programme based on aerial photography, including the establishment of baseline data, with the aim of annual assessment to determine whether changes in dynamics are taking place over time.

2) If the changing dynamics of the estuary are determined to be posing a management problem, the City's Catchment, Stormwater and River Management Branch in conjunction with the City's Environmental Resource Management Department will investigate and attempt to determine the cause. Areas of concern

which may require intervention include, but are not limited to, increased rates of sedimentation and significant migration of the estuary or river mouth.

3) If it is determined that changes pose a management problem, the City will:
   a) Inform DAFF, DEA and the C.A.P.E. Estuary Programme Manager
   b) In consultation with DAFF, DEA and the C.A.P.E. Estuary Programme Manager determine the most appropriate plan of action
   c) Ensure compliance to NEMA if remedial action requires environmental authorisation

RECORDS:

- Changes in estuary dynamics to be monitored and recorded in the City's Coastal Management Monitoring and Database System.

GENERAL:

- Recognise that changes in estuary dynamics may form part of the natural variation in the estuary and as such retain a principle of least interference

OBJECTIVE (F):

Monitor estuary water quality and work towards a high standard of water quality acceptable for public recreation and ecological functioning

LEGISLATION/STANDARDS:

- Water quality guidelines (DWA and DEA).

MANAGEMENT PROTOCOLS:

- Standardised water quality monitoring to be undertaken at one location within the estuary (DR05) and at various sites in the greater catchment area once per month (temperature, dissolved oxygen, conductivity/salinity, pH, total suspended solids, total phosphorus, orthophosphate, total nitrogen, soluble ammonia, nitrite & nitrate, faecal coliforms, *Escherichia coli* and enterococcus)

- In the event that excessive poor water quality results are measured that threaten the estuary the management protocols established in OBJECTIVE A may be followed to restore improved water quality conditions

RECORDS:

- All water quality results will be recorded within Scientific Services' Laboratory Information Management System (LIMS)

GENERAL:

- Estuary water quality management to be implemented in accordance with the Catchment, Stormwater and River Management Branch City-wide work programme, resources and priorities.

OBJECTIVE (G):

Remove alien invasive species from the estuary

LEGISLATION/STANDARDS:

- Conservation of Agricultural Resources Act, 43 of 1983 (CARA)
- National Environmental Biodiversity Act (NEMBA), 10 of 2004

MANAGEMENT PROTOCOLS:

The City's Invasive Species Unit to prepare an invasive species management plan for the estuary, to include, where relevant:

- Control of established invasive plants
- Control and management of invasive alien birds and animals where necessary
- Control and management of invasive alien fish, if deemed necessary
- Re-introduction of indigenous species where feasible
- Implement an early detection and rapid response programme to address new and emerging invasive alien species

RECORDS:

- The invasive species management plan will be appended to this Estuary Management Plan as Annexure A.

GENERAL:

- The estuary invasive species management plan to be implemented in accordance with the Invasive Species Unit city-wide work programme, resources and priorities.

- An integrated invasive species management approach will be followed in partnership with relevant stakeholders

OBJECTIVE (H):

Regulate all recreational use of the estuary

LEGISLATION/STANDARDS:

- DAFF commercial fishing regulations
- DAFF recreational fishing regulations
- DWA, Recreational water quality standards
- Integrated Coastal Management Act
- City's Municipal Coastal Management Plan

MANAGEMENT PROTOCOLS:

- Only recreational fishing will be permitted, with a valid recreational fishing permit, available from the Post Office. This will be communicated through appropriate signage.
- No motorised water-craft of any kind permitted in the estuary or estuary mouth
- City's Marine and Coastal Law Enforcement Unit in conjunction with DAFF Fishery Control Officers to monitor, enforce and regulate
- City Health Department, in conjunction with Catchment, Stormwater and River Management, to determine recreational safety based on water quality results and to inform the public accordingly.

RECORDS:

- Any non-compliance to regulations will be recorded in the City's Coastal Management Monitoring and Database System

GENERAL:

- The estuary recreational use management plan to be implemented in accordance with the Sport, Recreation and Amenities Department's City-wide work programme, resources and priorities.

- Appropriate recreation to be supported in line with the City's Social Development Strategy

OBJECTIVE (I):

Provide public awareness and education through a range of media

LEGISLATION/STANDARDS:

- None

MANAGEMENT PROTOCOLS:

Public education and awareness on the Hout Bay River Estuary may be provided in the following ways:

1) General catchment and estuary education and awareness through the City's Youth Environmental Schools

(YES) Programme
2) General estuary education and awareness as part of the City's Educator Training Programme
3) General estuary education and awareness through the City's Nature Reserve Environmental Education Programme
4) General City communication programmes focusing on awareness raising and education about pollution, its impact on human health and freshwater ecosystems
5) The installation of relevant and appropriate informative signage at the estuary

RECORDS:

- All signs and their locations to be recorded in the City's Coastal Management Monitoring and Database System.

GENERAL:

- All signage, regulatory and informative, must comply with the City's Coastal Signage Protocol
- The estuary public awareness and education management plan to be implemented in accordance with the Environmental Resource Management Department city-wide work programme, resources and priorities.

OBJECTIVE J:

Undertake annual monitoring and sampling of the estuary's biodiversity

LEGISLATION/STANDARDS:

- None

MANAGEMENT PROTOCOLS:

In partnership with DAFF undertake annual estuary biodiversity surveys through:

- Fish sampling through annual seine netting
- Bird counts
- Benthic sampling

RECORDS:

- All sampling results to be recorded in the City's Coastal Management Monitoring and Database System, and the City's Biodiversity Database

GENERAL:

- Biodiversity sampling programme and schedule to be determined by DAFF
- The sampling programme is contingent on sufficient resources being made available for this programme

OBJECTIVE (K):

Implement an Estuary Emergency Contingency Plan in the event of a flood, significant pollution event, oxygen depletion or other emergency events

LEGISLATION/STANDARDS:

- National Environmental Management Act

MANAGEMENT PROTOCOLS:

The following will be considered an Estuary Emergency requiring the Emergency Contingency Protocols to be implemented:

1) A major land based pollution event
2) Marine oil or pollution spill in Hout Bay
3) Rapid oxygen depletion
4) Marine life die-off

Emergency Contingency Protocols:

1) In the event of an emergency the estuary, estuary mouth and beach area (200m either side of the mouth) will be closed to the public and enforced by City Law Enforcement
2) The City's Coastal Co-ordinators will notify officials from DAFF, DEA and the C.A.P.E. Estuary programme manager
3) Where a land based pollution event is contaminating the estuary, the protocol established in OBJECTIVE A will be followed
4) Where there is a marine oil or pollution event, the estuary mouth will be closed and the Official Oil and Pollution Contingency Plan as per the City's Municipal Coastal Management Plan will become effective
5) In the event of a rapid oxygen depletion event, the estuary mouth will be opened at low tide to allow the coming high tide to bring ocean water into the estuary, as per OBJECTIVE A.
6) In the event of significant marine life die-off, samples of dead marine life will be provided to DAFF and DEA for analysis. All remaining dead marine life will be recovered from the estuary by the City's Solid Waste Management department and disposed of at Vissershok Landfill site in accordance with City waste management procedures
7) The estuary, estuary mouth and associated beach area will only be re-opened to public access once it is deemed safe

RECORDS:

- All estuary emergency events as well as the action taken will be recorded in the City's Coastal Management Monitoring and Database System
- DEA and DAFF to make any sampling results from a marine life die off available to the City

GENERAL:

- An emergency will only be declared if it is determined that the scale of the problem is such that it threatens the long term viability of the estuary as a functional ecosystem
- This determination will be made by the City's Catchment, Stormwater and River Management Branch, in conjunction with the Environmental Resource Management Department. In the event of a biodiversity related emergency, ERMD will be the lead department in terms of decision-making.

OBJECTIVE (L):

Establish an estuary task team with relevant stakeholders

LEGISLATION/STANDARDS:

- Integrated Coastal Management Act

MANAGEMENT PROTOCOLS:

- Task team to be established as part of a city-wide Small Estuaries Task Team, which will include all estuaries except for the Zandvlei and Diep estuaries.
- Small Estuaries Task Team to meet on a quarterly basis

RECORDS:

- Action minutes of all meetings to be maintained as part of the City's Coastal Monitoring Database

GENERAL:

- Small Estuaries Task Team will function as a working group consisting of officials who are involved in management work related to the relevant estuaries
- Public engagement will be facilitated through the existing Sub-Council structure

OBJECTIVE M:

Regulation of Events and Filming

LEGISLATION/STANDARDS:

- City Filming and Events Policy
- Coastal events and filming Protocol

MANAGEMENT PROTOCOLS:

Any organisation or individual who wishes to hold, host or undertake a commercial or non-profit event or commercial filming of any kind on the estuary, or within the coastal edge surrounding the estuary must:

- Submit a formal application to the City's Events and Filming Office
- The application must be circulated to the Environmental Resource Management Department, Catchment, Stormwater and River Management Branch and Sport, Recreation and Amenities Department for consideration
- Officials from these departments will advise the Events and Filming Office on the suitability of the application and if supported the conditions attached to such support
- If approved, the final event or filming permit with attached conditions must be circulated to the Environmental Resource Management Department, Catchment, Stormwater and River Management Branch and Sport, Recreation and Amenities Department at least 48 hours prior to the event or filming taking place

RECORDS:

- Events and Film Office to retain records of all applications, permits and conditions as well as any reported non-compliance

GENERAL:

- Event and filming applications for the estuary must demonstrate meaningful benefit

ESTUARY MANAGEMENT PLAN:

LOURENS RIVER ESTUARY

1. VISION

The Vision for the C.A.P.E. Estuaries Programme as a whole is: "Our estuaries are beautiful, rich in plants and animals, they attract visitors, sustain our livelihoods and uplift our spirits."

The Lourens River Estuary is part of an extensive urban environment and as such the vision for the estuary is:

"To manage the estuary and its catchment in such a manner as to reduce and minimise urban influence and pollutants on the estuary, where possible allow free and natural movement of the estuary mouth, manage alien invasive species, continuously work towards achieving high standards of water quality, recognise the estuary as an important marine nursery and biodiversity habitat and monitor the estuary in such a manner so as to intervene when urban influences have compromised the natural functioning of the estuary"

2 SITUATION ASSESSMENT AND CONTEXT

Figure 1: Lourens River Estuary

The Lourens River was declared a Protected Natural Environment (PNE) in 1997 and is the only river in South Africa that is a declared PNE. The Lourens River originates in the Hottentots Holland Mountains, flows through Somerset West and discharges to the sea at the Strand Beach. The Estuary of the Lourens River also defines the Helderberg Marine Protected Area's (MPA) eastern boundary and as such, must be considered a core component to the marine conservation objectives of the MPA.

The estuary is connected to the sea by means of a small western overflow channel and naturally tends to be saline during summer and becomes less saline during periods of high rainfall.

The Lourens River Estuary has been impacted by the following urban impacts:

- agricultural and stormwater runoff
- bank stabilisation

- sewage pump station failures
- alien fish
- changes in run off due to urbanisation and surface hardening

Consequently, this has led to the decrease in the estuary's water quality. The overall condition of the Lourens River is generally regarded as fair.

The Strand Beach Road crosses the estuary approximately 100m from the high water mark of the sea, on the south of Beach Road. The estuary is abutted by the Lourens River Pump Station to the west and a recreational area to the east. North of Beach Road the estuary is abutted by the Strand Golf Course to the West and the residential properties to the east.

2.1 WATER QUALITY OF ESTUARY

The quality of the estuary is highly influenced by the Lourens River Catchment which mainly results in the following:

- Reduction in seasonal and natural water flow
- Increased water flow as a result of increased urban run-off
- Urban pollutants including litter, runoff from agricultural areas: Vergelegen, Morgenster and Lourensford Estate

Comprehensive water quality monitoring is undertaken on a monthly basis by the City's Scientific Services Laboratory since 2000 and results indicate that the overall condition of the Lourens River is fair both in terms of nutrient and bacterial levels. It is rated amongst the top three in terms of water quality compared to other rivers in the City. The estuary mouth is however moderately more impacted.

Figure 2: Water quality monitoring points in the vicinity of Lourens River Estuary

Water quality sample collection points in the Lourens River catchment:

- Lourens in P.O.S Hillcrest Road (LOU02)
- Lourens at Broadway Road (LOU04)
- Lourens on Beach Road (LOU05)

2.2 SPECIES RECORDED IN ESTUARY

The City of Cape Town's Alien Invasive Unit have recorded the following **invasive species** in the Lourens River Catchment (2012-2013):

Nasturtium officinale	Watercress
Ricinus communis	Castor bean
Acacia saligna	Port Jackson
Canna indica	Canna
Arundo donax	Giant reed
Eucalyptus spp.	
Various herbaceous species	

The Department of Agriculture, Forestry and Fisheries have recorded the following **marine and freshwater species** in the Lourens River Catchment (2013):

Marine Species	
Gilchristella aestuaria	Estuarine round herring
Atherina breviceps	Cape silverside
Psammogobius knysnaensis	Knysna sand goby
Lichia amia	Leervis
Monodactylus falciformis	Cape moony
Mugil cephalus	Flathead mullet
Lithognathus lithognathus	White steenbras
Galeichthys feliceps	White sea catfish
Liza richardsonii	Harder
Pomatomus saltatrix	Elf
Rhabdosargus globiceps	White stumpnose
Sandelia capensis	Cape kurper
Anguilla bengalensis labiata	African mottled eel
Anguilla marmorata	Madagascan mottled eel
Anguilla mossambica	Longfin eel

Freshwater Species	
Galaxias zebratus	Cape galaxias
Lepomis macrochirus	Bluegill sunfish
Micropterus punctulatus	Spotted bass
Micropterus salmoides	Largemouth bass
Tilapia sparrmanii	Banded tilapia
Cyprinus carpio	Carp
Tinca tinca	Tench
Perca fluviatilis	Perch
Oncorhynchus mykiss	Rainbow trout

2.3 RECREATION

There is no access to the Lourens river mouth for recreation as the beach area is fenced off due to the operations of the SOMCHEM/DENEL site to the west.

3 MANAGEMENT PLAN

The Lourens River Estuary has to date not had a specific management plan or long term objectives assigned to it, nor have specific roles and responsibilities been previously defined. As part of its new Integrated Coastal Management approach, the City has prioritised the management of small and large estuaries. Based on the situation assessment and the available information a number of management objectives have been defined. For each of these management objectives, a specific operational protocol has been developed.

These specific management protocols are intended to clearly define actions as well as responsibilities across City line departments. As implementation takes place and new information is gathered and understood, operational protocols may be amended and additional objectives and associated protocols added. Estuary management within an urban environment is seen as a long term approach following a principle of striving towards ongoing improvement in both the quality and management of our estuaries.

3.1 MANAGEMENT OBJECTIVES

The City has the following management objectives for the Lourens River Estuary:

A. Allow the estuary mouth to function naturally as part of the local coastal dynamic processes and intervene only under specific defined and documented circumstances
B. Reduce and minimise all sources of urban pollutants to the estuary
C. Regulation and development of infrastructure in or adjacent to the estuary
D. Allow the natural circulation and fluctuation in estuary water quantity to be determined by seasonal rainfall patterns, whenever possible
E. Monitor estuary dynamics and intervene if required
F. Monitor estuary water quality and work towards a high standard of water quality acceptable for public recreation and ecological functioning
G. Remove alien invasive species from the estuary
H. Appropriately regulate all recreational use of the estuary
I. Provide public awareness and education through a range of media
J. Undertake annual monitoring and sampling of the estuary's biodiversity
K. Implement an Estuary Emergency Contingency Plan in the event of a flood, significant pollution event, oxygen depletion or other emergency events
L. Establish an estuary task team with relevant stakeholders
M. Regulate events and filming in the estuarine environment

OBJECTIVE (A) :

Allow the estuary mouth to function naturally as part of the local coastal dynamic processes and only intervene under specific defined and documented circumstances

LEGISLATION/STANDARDS:

Estuary mouth manipulation falls within the National Environmental Management Act Regulations and Lourens River Protected Natural Environment P.N. 161/1997 as such, mouth manipulation must be done as either:

a) Part of a pre-approved management plan with authorisation from the Department of Environmental Affairs and Development Planning (DEADP)
b) In an emergency situation followed by DEADP notification
c) With Protected Natural Environmental (PNE) approval from the City of Cape Town Environmental & Heritage Management Branch

MANAGEMENT PROTOCOLS:

The following management protocols will be applied:

1) Risk of inland flooding

- The mouth of the estuary may be straightened and opened in the event that high rainfall prediction is indicative of a possible inland flooding event.
- Determination of this need as well as the responsibility for carrying out the action resides with the City's Catchment, Stormwater and River Management Branch.

2) Pollution or toxic event

- In the event of a toxic event in the estuary or catchment, the mouth may be mechanically opened to facilitate flushing of the estuary during high tide or high water levels. This action may also require the trapping of sea water in the estuary through the physical closing of the mouth for a short duration.
- Determination of this need resides with the City's Catchment, Stormwater and River Management Branch in consultation with the C.A.P.E. Estuary Programme Manager as well as the National Departments of Environmental Affairs (DEA) and Agriculture, Fisheries and Forestry (DAFF). Responsibility for carrying out the action resides with the City's Catchment, Stormwater and River Management Branch

3) Potential undermining of infrastructure or critical dune systems by estuary mouth movement.

- Where the estuary mouth moves or meanders in such a manner that it threatens City infrastructure or sensitive environmental components the mouth may be mechanically straightened or re-aligned.
- Determination of this need as well as the responsibility for carrying out the action resides with the City's Environmental Resource Management Department's Coastal Management Unit in consultation with the Helderberg district environmental office

RECORDS:

- All mouth manipulation, the reason, action and completion will be recorded in the City's Coastal Management Monitoring and Database System
- DEA, DAFF, DEADP and the C.A.P.E Estuary Programme will be informed of all mouth manipulation events

MACHINE ACCESS FOR MOUTH MANIPULATION:

- In all circumstances listed within this management objective, access points and traverse routes for machinery to be used for mouth manipulation will be determined by the Environmental Resource Management Department
- As much as possible, access and traverse routes must adhere to existing road surfaces or previously disturbed areas.
- These access and traverse routes will be strictly adhered to at all times

OBJECTIVE (B) :

Reduce and minimise all sources of urban pollutants to the estuary

LEGISLATION/STANDARDS:

Pollution in the form of industrial waste, human waste, domestic waste and material waste is governed by a wide range of National Legislation and Standards.

- National Environmental Management Act
- National Water Act
- National Waste Act
- Integrated Coastal Management Act
- Protected Natural Environment legislation - P.N. 161/1997

However, for practical reasons recognition must be given to the fact that both the catchment that feeds the estuary, the estuary itself as well as the marine environment with which the estuary interacts are all subject to various pollutant sources common within a highly developed and populated urban environment. As such, all means to reduce pollution into the estuary that are practical, cost effective and reasonable will be employed but targeting zero pollution within an urban environment is neither practical nor realistic.

MANAGEMENT PROTOCOLS:

To minimise and reduce all forms of pollution the following management protocols will be applied:

1) Regular and systematic litter removal from the greater Lourens River Catchment area by the City's Solid Waste Management Department
2) Monthly monitoring of water quality along the river by the City's Scientific Services Branch.
3) If deemed necessary, installation, clearing and maintenance of litter traps by the City's Operations and Assets Branch of the Roads and Stormwater Department.
4) On an ongoing basis and as required, implement interventions to reduce water pollution at source, through the application of the City's Water Quality Improvement Strategy and Implementation Plan.
5) Promoting the implementation of Sustainable Urban Drainage Systems in new development applications to limit the direct input of stormwater into the Lourens River (Management of Urban Stormwater Impacts Policy - 2009)

RECORDS:

1) All major pollution events to be recorded in the City's Coastal Monitoring Database. A major pollution event is defined as any pollution event deemed to be significantly greater than the level of background pollution present in the system. This may be determined either through water quality monitoring (i.e. a set of results that shows a significant spike in pollution), or through observation of an event (e.g. sewer overflow).

GENERAL

- In the event of major water based pollution events, the pollution event will be managed in accordance with the management protocol as set out in OBJECTIVE A.
- In the event of increased levels of litter within the catchment system a litter trap may be established at the most northern end of the back pond to reduce and minimise litter into the estuary

OBJECTIVE (C) :

Regulation of development of infrastructure in or adjacent to the estuary

LEGISLATION/STANDARDS:

Development or building of any infrastructure within or adjacent to the estuary is regulated by the following:

a) National Environmental Management Act
b) City of Cape Town Integrated Zoning Scheme
c) Integrated Coastal Management Act
d) Coastal Edge and Setback Line
e) Floodplain and River Corridor Management Policy
f) Management of Urban Stormwater Impacts Policy
g) Protected Natural Environment legislation - P.N 161/1997

MANAGEMENT PROTOCOLS:

a) All development proposals must comply with relevant legislation and policies
b) Development proposals falling within the Coastal Edge/Setback Line or 1 in 50 year flood line should not be supported
c) The building or construction of any permanent or temporary structures that do not trigger NEMA regulations, but are adjacent to or within the estuary, require additional written permission from the City's Environmental Resource Management Department's Integrated Coastal Management Unit or the Helderberg district environmental office

RECORDS:

- Any written permission granted for a permanent or temporary structure to be recorded in the City's Coastal Monitoring Database

GENERAL:

- Construction of any permanent or temporary structures will in general not be supported unless strong rationale is provided with measurable benefits

OBJECTIVE (D):

Allow the natural circulation and fluctuations in estuary water quantity to be determined by seasonal rainfall patterns, whenever possible.

LEGISLATION/STANDARDS:

- National Water Act

MANAGEMENT PROTOCOLS:

a) At no time should the mouth of the estuary be impeded, diverted, blocked or altered unless under the specific conditions as defined in OBJECTIVE A
b) The estuary mouth may never be canalised or fixed
c) No water abstraction to be permitted from the back pond or estuary mouth
d) Water abstraction from the Lourens River Catchment to conform to all relevant legislation with strict permit conditions

RECORDS:

- Permitted water abstraction from the Lourens River Catchment as well as permit conditions to be recorded in the City's Coastal Monitoring Database
- Cases and outcomes of illegal water extraction in the Lourens River Estuary Catchment to be recorded in the City's Coastal Monitoring Database

GENERAL:

- In the event of major flow alteration, the City's Catchment, Stormwater and River Management Branch in conjunction with the Helderberg district environmental office to conduct an investigation to determine cause of flow change and make recommendations to rectify and restore the flow regime

OBJECTIVE (E) :

Monitor estuary dynamics and intervene if required

LEGISLATION/STANDARDS:

- National Environmental Management Act

MANAGEMENT PROTOCOLS:

1) The City's Environmental Resource Management Department will develop an estuary dynamics monitoring programme based on aerial photography, including the establishment of baseline data, with the aim of annual assessment to determine whether changes in dynamics are taking place over time.

2) If the changing dynamics of the estuary are determined to be posing a management problem, the City's

Catchment, Stormwater and River Management Branch in conjunction with the City's Environmental Resource Management Department will investigate and attempt to determine the cause. Areas of concern which may require intervention include, but are not limited to, increased rates of sedimentation and significant migration of the estuary or river mouth.

3) If it is determined that changes pose a management problem, the City will:
   a) Inform DAFF, DEA and the C.A.P.E. Estuary Programme Manager
   b) In consultation with DAFF, DEA and the C.A.P.E. Estuary Programme Manager determine the most appropriate plan of action
   c) Ensure compliance to NEMA if remedial action requires environmental authorisation

RECORDS:

- Changes in estuary dynamics to be monitored and recorded in the City's Coastal Management Monitoring and Database System.

GENERAL:

- Recognise that changes in estuary dynamics may form part of the natural variation in the estuary and as such retain a principle of least interference

OBJECTIVE F:

Monitor estuary water quality and work towards a high standard of water quality acceptable for public recreation and ecological functioning

LEGISLATION/STANDARDS:

- Water quality guidelines (DWA and DEA).

MANAGEMENT PROTOCOLS:

- Standardised water quality monitoring to be undertaken at one location within the estuary (LOU05) and at various sites in the greater catchment area once per month (temperature, dissolved oxygen, conductivity/salinity, pH, total suspended solids, total phosphorus, orthophosphate, total nitrogen, soluble ammonia, nitrite & nitrate, faecal coliforms, and *Escherichia coli*

- In the event that excessive poor water quality results are measured that threaten the estuary the management protocols established in OBJECTIVE A may be followed to restore improved water quality conditions

RECORDS:

- All water quality results will be recorded within Scientific Services' Laboratory Information Management System (LIMS)

GENERAL

- The estuary water quality management plan to be implemented in accordance with the Catchment, Stormwater and River Management Branch City-wide work programme, resources and priorities.

OBJECTIVE (G):

Remove alien invasive species from the estuary

LEGISLATION/STANDARDS:

- Conservation of Agricultural Resources Act, 43 of 1983 (CARA)
- National Environmental Biodiversity Act (NEMBA), 10 of 2004

MANAGEMENT PROTOCOLS:

The City's Invasive Species Unit to prepare an invasive species management plan for the estuary, to include, where relevant:

- Control of established invasive plants
- Control and management of invasive alien birds and animals where necessary
- Control and management of invasive alien fish, if deemed necessary
- Re-introduction of indigenous species where feasible
- Implementation of an early detection and rapid response programme to address new and emerging invasive alien species

RECORDS:

- The invasive species management plan will be appended to this Estuary Management Plan as Annexure A.

GENERAL:

- The estuary invasive species management plan to be implemented in accordance with the Invasive Species Unit city-wide work programme, resources and priorities.
- An integrated invasive species management approach will be followed in partnership with relevant stakeholders

OBJECTIVE (H):

Regulate all recreational use of the estuary

LEGISLATION/STANDARDS:

- DAFF commercial fishing regulations
- DAFF recreational fishing regulations
- DWA, Recreational water quality standards
- Integrated Coastal Management Act
- City's Municipal Coastal Management Plan
- Protected Natural Environment - P.N. 161/1997

MANAGEMENT PROTOCOLS:

- Although the estuary is small and the estuary mouth is fenced off, access is possible slightly upstream. Little to no recreation takes place in the surrounding area.
- Only recreational fishing will be permitted, with a valid recreational fishing permit, available from the Post Office. This will be communicated through appropriate signage.
- No motorised water-craft of any kind permitted in the estuary or estuary mouth
- City's Marine and Coastal Law Enforcement Unit in conjunction with DAFF Fishery Control Officers to monitor, enforce and regulate
- City Health Department, in conjunction with Catchment, Stormwater and River Management, to determine recreational safety based on water quality results and to inform the public accordingly.

RECORDS:

- Any non-compliance to regulations will be recorded in the City's Coastal Management Monitoring and Database System

OBJECTIVE (I):

Provide public awareness and education through a range of media

LEGISLATION/STANDARDS:

- None

MANAGEMENT PROTOCOLS:

Public education and awareness on the Lourens River Estuary may be provided in the following ways:

1) General catchment and estuary education and awareness through the City's Youth Environmental Schools (YES) Programme
2) General estuary education and awareness as part of the City's Educator Training Programme
3) General estuary education and awareness through the City's Nature Reserve Environmental Education Programme
4) General City communication programmes focusing on awareness raising and education about pollution, its impact on human health and freshwater ecosystems
5) The installation of relevant and appropriate informative signage at the estuary

RECORDS:

- All signs and their locations to be recorded in the City's Coastal Management Monitoring and Database System

GENERAL:

- All signage, regulatory and informative, must comply with the City's Coastal Signage Protocol
- The estuary public awareness and education management plan to be implemented in accordance with the Environmental Resource Management Department city-wide work programme, resources and priorities.

OBJECTIVE J:

Undertake annual monitoring and sampling of the estuary's biodiversity

LEGISLATION/STANDARDS:

- None

MANAGEMENT PROTOCOLS:

In partnership with DAFF and the Biodiversity Management Branch undertake annual estuary biodiversity surveys through:

- Fish sampling through annual seine netting
- Bird counts
- Benthic sampling

RECORDS:

- All sampling results to be recorded in the City's Coastal Management Monitoring and Database System

GENERAL:

- Biodiversity sampling programme and schedule to be determined by DAFF
- The sampling programme is contingent on sufficient resources being made available for this programme

OBJECTIVE (K):

Implement an Estuary Emergency Contingency Plan in the event of a flood, significant pollution event, oxygen depletion or other emergency events

LEGISLATION/STANDARDS:

- National Environmental Management Act

MANAGEMENT PROTOCOLS:

The following will be considered an Estuary Emergency requiring the Emergency Contingency Protocols to be implemented:

1) A major land based pollution event
2) Marine oil or pollution spill in the surrounding area
3) Rapid oxygen depletion
4) Marine life die-off

Emergency Contingency Protocols:

1) In the event of an emergency the estuary, estuary mouth and beach area (200m either side of the mouth) will be closed to the public and enforced by City Law Enforcement
2) The City's Coastal Co-ordinators will notify officials from DAFF, DEA and the C.A.P.E. Estuary programme manager
3) Where a land based pollution event is contaminating the estuary, the protocol established in OBJECTIVE A will be followed
4) Where there is a marine oil or pollution event, the estuary mouth will be closed and the Official Oil and Pollution Contingency Plan as per the City's Municipal Coastal Management Plan will become effective
5) In the event of a rapid oxygen depletion event, the estuary mouth will be opened at low tide to allow the coming high tide to bring ocean water into the estuary, as per OBJECTIVE A.
6) In the event of significant marine life die-off, samples of dead marine life will be provided to DAFF and DEA for analysis. All remaining dead marine life will be recovered from the estuary by the City's Solid Waste Management department and disposed of at Vissershok Landfill site in accordance with City waste management procedures
7) The beach will only be re-opened to public access once it is deemed safe

RECORDS:

- All estuary emergency events as well as the action taken will be recorded in the City's Coastal Management Monitoring and Database System
- DEA and DAFF to make any sampling results from a marine life die off available to the City

GENERAL:

- An emergency will only be declared if it is determined that the scale of the problem is such that it threatens the long term viability of the estuary as a functional ecosystem
- This determination will be made by the City's Catchment, Stormwater and River Management Branch, in conjunction with the Environmental Resource Management Department. In the event of a biodiversity related emergency, ERMD will be the lead department in terms of decision-making.

OBJECTIVE (L):

Establish an estuary task team with relevant stakeholders

LEGISLATION/STANDARDS:

- Integrated Coastal Management Act

MANAGEMENT PROTOCOLS:

- Task team to be established as part of the city-wide "Small Estuaries Task Team", which will include all estuaries except for the Zandvlei and Diep estuaries.
- Small Estuaries Task Team to meet on a quarterly basis

RECORDS:

- Minutes of all meetings to be maintained as part of the City's Coastal Monitoring Database

GENERAL:

- Small Estuaries Task Team will function as a working group consisting of officials who are involved in management work related to the relevant estuaries
- Public engagement will be facilitated through the existing Sub-Council structure and the existing Lourens River PNE Management Advisory Committee

OBJECTIVE (M):

Regulation of Events and Filming

LEGISLATION/STANDARDS:

- City Filming and Events Policy

MANAGEMENT PROTOCOLS:

Any organisation or individual who wishes to hold, host or undertake a commercial or non-profit event or commercial filming of any kind on the estuary, or within the coastal edge surrounding the estuary must:

- Submit a formal application to the City's Events and Filming Office
- The application must be circulated to the Environmental Resource Management Department, Catchment, Stormwater and River Management Branch and Sport, Recreation and Amenities Department for consideration
- Officials from these departments will advise the Events and Filming Office on the suitability of the application and if supported the conditions attached to such support
- If approved, the final event or filming permit with attached conditions must be circulated to the Environmental Resource Management Department, Catchment, Stormwater and River Management Branch and Sport, Recreation and Amenities Department at least 48 hours prior to the event or filming taking place

RECORDS:

- Events and Film Office to retain records of all applications, permits and conditions as well as any reported non-compliance

GENERAL:

- Event and filming applications for the estuary must demonstrate meaningful benefit

ESTUARY MANAGEMENT PLAN:

SILVERMINE ESTUARY

1. VISION

The Vision for the C.A.P.E. Estuaries Programme as a whole is: "Our estuaries are beautiful, rich in plants and animals, they attract visitors, sustain our livelihoods and uplift our spirits."

The Silvermine Estuary is part of an extensive urban environment and as such the vision for the estuary is:

"To manage the estuary and its catchment in such a manner as to reduce and minimise urban influence and pollutants on the estuary, where possible allow free and natural movement of the estuary mouth, manage alien invasive species, continuously work towards achieving high standards of water quality, recognise the estuary as an important marine nursery and biodiversity habitat and monitor the estuary in such a manner so as to intervene when urban influences have compromised the natural functioning of the estuary"

2 SITUATION ASSESSMENT AND CONTEXT

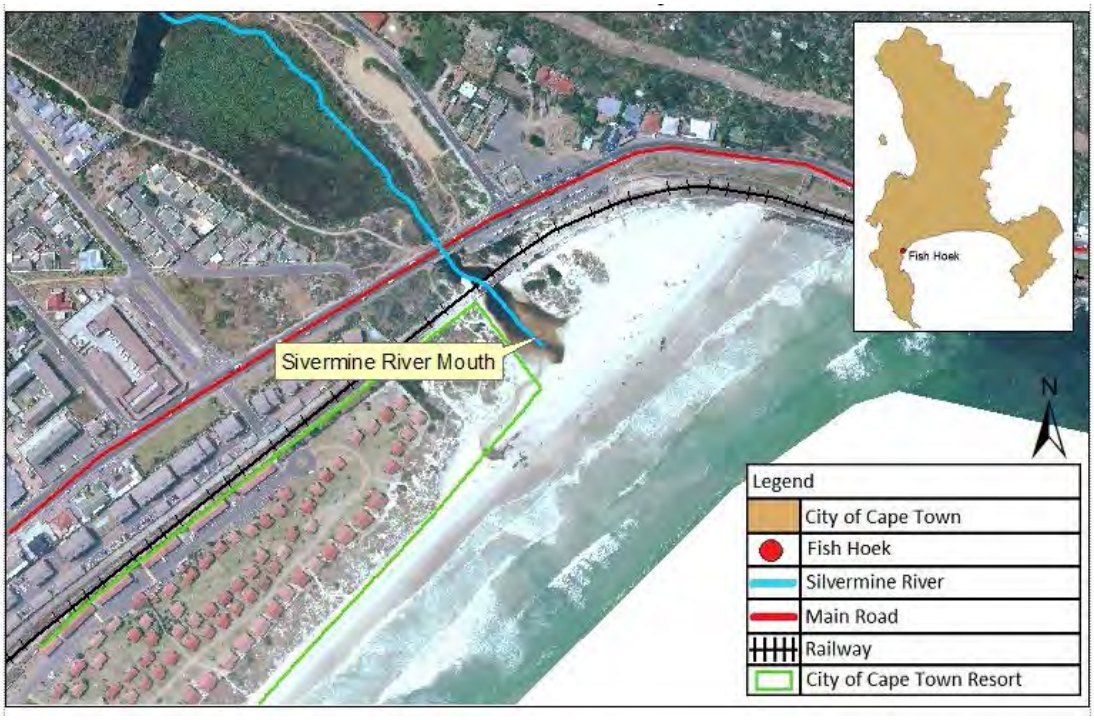

Figure 1: Silvermine River Estuary

Fish Hoek Bay's north-eastern corner is home to the Silvermine River Estuary. It is considered to be a small confined estuary, and is spanned by road and rail bridges providing vital connectivity between the river and coastline. The mouth of the estuary is generally closed during the dry season and occasionally open during winter.

The estuary's ability to effectively function as an ecological corridor has been threatened by rubble within the river channel and beneath the bridges, informal dwelling taking place under the bridge, stormwater drainage, and overflows from the sewage pump station.

The estuary act as a focal point on the beach for recreational activities, however those coming into contact with

the estuary's water expose themselves to possible health risks as the water quality of the estuary is considered to be poor due to stagnation of the water .

2.1 WATER QUALITY OF ESTUARY

The quality of the estuary is highly influenced by the Silvermine River Catchment which mainly results in the following:

- Reduction in seasonal and natural water flow
- Increased water flow as a result of increased urban run-off
- Urban pollutants including litter and other contaminants

Figure 2: Water quality monitoring points in the vicinity the Silvermine Estuary

Water quality sampling points:

- SIL02: Silvermine River at footbridge on wetland near Clovelly Beach
- SIL04: Silvermine River West Stormwater
- SIL06: Silvermine River at Bridge on Main Rd, Clovelly
- XCS17: Silvermine River Mouth

2.2 SPECIES RECORDED IN ESTUARY

The City of Cape Town's Alien Invasive Unit have recorded the following **invasive species** in the Silvermine River Catchment (2012-2013):

Nasturtium officinale	Watercress
Schinus terebinthifolius	Brazilian Pepper Tree
Myoporum montanum	Waterbush
Pittosporum undulatum	Victorian Box
Echium plantagineum	Purple Viper's Bugloss
Acacia saligna	Port Jackson
Persicaria lapathifolia	Willow Weed
Rapistrum rugosum	Turnipweed

The Department of Agriculture, Forestry and Fisheries have recorded the following marine and freshwater species in the Silvermine River Catchment (2013):

Marine Species	
Psammogobius knysnaensis	Knysna sand goby
Monodactylus falciformis	Cape moony
Mugil cephalus	Flathead mullet
Lithognathus lithognathus	White steenbras
Liza richardsonii	Harder

Freshwater Species	
Lepomis macrochirus	Bluegill sunfish
Micropterus dolomieu	Smallmouth bass
Tilapia sparrmanii	Banded tilapia
Galaxias zebratus	Cape Galaxias

2.3 RECREATION

Recreation in the estuary is minimal and is confined to local recreational swimming and paddling in the back ponding area and in the estuary mouth. No commercial fishing is permitted. The size and scale of the estuary does not facilitate broader recreational use such as boating or sailing.

3 MANAGEMENT PLAN

The Silvermine River Estuary has to date not had a specific management plan or long term objectives assigned to it, nor have specific roles and responsibilities been previously defined. As part of its new Integrated Coastal Management approach, the City has prioritised the management of small and large estuaries. Based on the situation assessment and the available information a number of management objectives have been defined. For each of these management objectives, a specific operational protocol has been developed.

These specific management protocols are intended to clearly define actions as well as responsibilities across City line departments. As implementation takes place and new information is gathered and understood, operational protocols may be amended and additional objectives and associated protocols added. Estuary management within an urban environment is seen as a long term approach following a principle of striving towards ongoing improvement in both the quality and management of our estuaries.

4 MANAGEMENT OBJECTIVES

The City has the following management objectives for the Silvermine River Estuary:

A. Allow the estuary mouth to function naturally as part of the local coastal dynamic processes and intervene only under specific defined and documented circumstances
B. Reduce and minimise all sources of urban pollutants to the estuary
C. Regulation and development of infrastructure in or adjacent to the estuary
D. Allow the natural circulation and fluctuation in estuary water quantity to be determined by seasonal rainfall patterns, whenever possible
E. Monitor estuary dynamics and intervene if required
F. Monitor estuary water quality and work towards a high standard of water quality acceptable for public recreation and ecological functioning
G. Remove alien invasive species from the estuary

H. Appropriately regulate all recreational use of the estuary
I. Provide public awareness and education through a range of media
J. Undertake annual monitoring and sampling of the estuary's biodiversity
K. Implement an Estuary Emergency Contingency Plan in the event of a flooding, significant pollution event, oxygen depletion or other emergency events
L. Establish an estuary task team with relevant stakeholders
M. Regulate events and filming in the estuarine environment

OBJECTIVE (A) :

Allow the estuary mouth to function naturally as part of the local coastal dynamic processes and intervene only under specific defined and documented circumstances

LEGISLATION/STANDARDS:

Estuary mouth manipulation falls within the National Environmental Management Act (NEMA) Regulations in so far as mouth manipulation involves movement of sand and therefore triggers Activity 18 (Listing Notice 1). As such mouth manipulation may be undertaken either:

a) In terms of a *"management plan agreed to by the relevant environmental authority"*
b) In an emergency situation followed by notification to Department of Environmental Affairs and Development Planning (DEADP)

MANAGEMENT PROTOCOLS:

The following management protocols will be applied:

1) Risk of inland flooding
- The mouth of the estuary may be straightened and opened in the event that high rainfall prediction is indicative of a possible inland flooding event.
- Determination of this need as well as the responsibility for carrying out the action resides with the City's Catchment, Stormwater and River Management Branch.

2) Pollution or toxic event
- In the event of a toxic event in the estuary or catchment, the mouth may be mechanically opened to facilitate flushing of the estuary during high tide or high water levels. This action may also require the trapping of sea water in the estuary through the physical closing of the mouth for a short duration.
- Determination of this need resides with the City's Catchment, Stormwater and River Management Branch in consultation with the C.A.P.E. Estuary Programme Manager as well as the National Departments of Environmental Affairs (DEA) and Agriculture, Fisheries and Forestry (DAFF). Responsibility for carrying out the action resides with the City's Catchment, Stormwater and River Management Branch

3) Potential undermining of infrastructure or critical dune systems by estuary mouth movement.
- Where the estuary mouth moves or meanders in such a manner that it threatens critical dune systems or City infrastructure the mouth may be mechanically straightened or re-aligned.
- Determination of this need as well as the responsibility for carrying out the action resides with the City's Environmental Resource Management Department's Coastal Management Unit in consultation with the Southern district environmental office

RECORDS:

- All mouth manipulation, the reason, action and completion will be recorded in the City's Coastal Management Monitoring and Database System
- DEA, DAFF, DEADP and the C.A.P.E Estuary Programme will be informed of all mouth manipulation events by the City's Coastal Management Unit

MACHINERY ACCESS FOR MOUTH MANIPULATION:

- In all circumstances listed within this management objective, access points and traverse routes for machinery to be used for mouth manipulation will be determined by the Environmental Resource Management Department
- As much as possible, access and traverse routes must adhere to existing road surfaces or previously disturbed areas.
- These access and traverse routes will be strictly adhered to at all times

OBJECTIVE (B) :

Reduce and minimise all sources of urban pollutants to the estuary

LEGISLATION/STANDARDS:

Pollution in the form of industrial waste, human waste, domestic waste and material waste is governed by a wide range of National Legislation and Standards.

- National Environmental Management Act (NEMA)
- National Water Act (NWA)
- National Waste Act
- Integrated Coastal Management Act (ICMA)

However, for practical reasons recognition must be given to the fact that both the catchment that feeds the estuary, the estuary itself as well as the marine environment with which the estuary interacts are all subject to various pollutant sources common within a highly developed and populated urban environment. As such, all means to reduce pollution into the estuary that are practical, cost effective and reasonable will be employed but targeting zero pollution within an urban environment is neither practical nor realistic.

MANAGEMENT PROTOCOLS:

To minimise and reduce all forms of pollution the following management protocols will be applied:

1) Regular and systematic litter removal from the general Silvermine River Catchment area by the City's Solid Waste Management Department.
2) Monthly monitoring of water quality along the river by the City's Scientific Services Branch.
3) If deemed necessary, installation, clearing and maintenance of litter traps by the City's Operations and Assets Branch of the Roads and Stormwater Department.
4) On an ongoing basis and as required, implement interventions to reduce water pollution at source, through the application of the City's Water Quality Improvement Strategy and Implementation Plan.

RECORDS:

1) All major pollution events to be recorded in the City's Coastal Monitoring Database. A major pollution event is defined as any pollution event deemed to be significantly greater than the level of background pollution present in the system. This may be determined either through water quality monitoring (i.e. a set of results that shows a significant spike in pollution, or through observation of an event (e.g. sewer overflow).

GENERAL

- In the event of major water based pollution events, the pollution event will be managed in accordance with the management protocol as set out in OBJECTIVE A.
- In the event of increased levels of litter within the catchment system a litter trap may be established at the most northern end of the back pond to reduce and minimise litter into the estuary

OBJECTIVE (C) :

Regulation of development of infrastructure in or adjacent to the estuary

LEGISLATION/STANDARDS:

Development of the building of any infrastructure within or adjacent to the estuary is regulated by the following:

a) National Environmental Management Act
b) City Zoning Scheme
c) Integrated Coastal Management Act
d) Coastal Edge and Setback Line
e) Floodplain and River Corridor Management Policy
f) Management of Urban Stormwater Impacts Policy

MANAGEMENT PROTOCOLS:

a) All development proposals must comply with relevant legislation and policies
b) Development proposals falling within the Coastal Edge/Setback Line or 1 in 50 year flood line should not be supported
c) The building or construction of any permanent or temporary structures that do not trigger NEMA regulations, but are adjacent to or within the estuary, require additional written permission from the City's Environmental Resource Management Department's Integrated Coastal Management Unit or the Southern district environmental office

RECORDS:

- Any written permission granted for a permanent or temporary structure to be recorded in the City's Coastal Monitoring Database

GENERAL:

- Construction of any permanent or temporary structures will in general not be supported unless strong rationale is provided with measurable benefits

OBJECTIVE (D):

Allow the natural circulation and fluctuation in estuary water quantity to be determined by seasonal rainfall patterns, whenever possible.

LEGISLATION/STANDARDS:

- National Water Act

MANAGEMENT PROTOCOLS:

a) At no time should the mouth of the estuary be impeded, diverted, blocked or altered unless under the specific conditions as defined in OBJECTIVE A
b) The estuary mouth may never be canalised or fixed
c) No water abstraction to be permitted from the back pond or estuary mouth
d) Water abstraction from the Silvermine River Catchment to conform to all relevant legislation with strict permit conditions

RECORDS:

- Permitted water abstraction from the Silvermine River Catchment as well as permit conditions to be recorded in the City's Coastal Monitoring Database
- Cases and outcomes of any illegal water extraction in the Silvermine River Catchment to be recorded in the City's Coastal Monitoring Database

GENERAL:

- In the event of major flow alteration, the City's Catchment, Stormwater and River Management Branch in conjunction with the Southern district environmental office to conduct an investigation to determine cause of flow change and make recommendations to rectify and restore flow regime

OBJECTIVE (E) :

Monitor estuary dynamics and intervene if required

LEGISLATION/STANDARDS:

- National Environmental Management Act

MANAGEMENT PROTOCOLS:

1) The City's Environmental Resource Management Department will develop an estuary dynamics monitoring programme based on aerial photography, including the establishment of baseline data, with the aim of annual assessment to determine whether changes in dynamics are taking place over time.

2) If the changing dynamics of the estuary are determined to be posing a management problem, the City's Catchment, Stormwater and River Management Branch in conjunction with the City's Environmental

Resource Management Department will investigate and attempt to determine the cause. Areas of concern which may require intervention include, but are not limited to, increased rates of sedimentation and significant migration of the estuary or river mouth.

3) If it is determined that changes pose a management problem, the City will:
   a) Inform DAFF, DEA and the C.A.P.E. Estuary Programme Manager
   b) In consultation with DAFF, DEA and the C.A.P.E. Estuary Programme Manager determine the most appropriate plan of action
   c) Ensure compliance to NEMA if remedial action requires environmental authorisation

RECORDS:

- Changes in estuary dynamics to be monitored and recorded in the City's Coastal Management Monitoring and Database System.

GENERAL:

- Recognise that changes in estuary dynamics may form part of the natural variation in the estuary and as such retain a principle of least interference

OBJECTIVE F:

Monitor estuary water quality and work towards a high standard of water quality acceptable for public recreation and ecological functioning

LEGISLATION/STANDARDS:

- Water quality guidelines (DWA and DEA).

MANAGEMENT PROTOCOLS:

- Standardised water quality monitoring to be undertaken at one location within the estuary (XCS17) and at various sites in the greater catchment area once per month (temperature, dissolved oxygen, conductivity/salinity, pH, total suspended solids, total phosphorus, orthophosphate, total nitrogen, soluble ammonia, nitrite & nitrate, faecal coliforms, *Escherichia coli* and enterococcus)

- In the event that excessive poor water quality results are measured that threaten the estuary the management protocols established in OBJECTIVE A may be followed to restore improved water quality conditions

RECORDS:

- All water quality results will be recorded within Scientific Services' Laboratory Information Management System (LIMS) and the monthly Certificate of Analysis will be added to the City's Coastal Management Monitoring and Database System.

GENERAL:

- Estuary water quality management to be implemented in accordance with the Catchment, Stormwater and River Management Branch's City-wide work programme, resources and priorities.

OBJECTIVE (G):

Remove alien invasive species from the estuary

LEGISLATION/STANDARDS:

- Conservation of Agricultural Resources Act, 43 of 1983 (CARA)
- National Environmental Biodiversity Act (NEMBA), 10 of 2004

MANAGEMENT PROTOCOLS:

The City's Invasive Species Unit to prepare an invasive species management plan for the estuary, to include, where relevant:

- Control of established invasive plants
- Control and management of invasive alien birds and animals where necessary
- Control and management of invasive alien fish, if deemed necessary
- Re-introduction of indigenous species where feasible
- Implementation of an early detection and rapid response programme to address new and emerging invasive alien species

RECORDS:

- The invasive species management plan will be appended to this Estuary Management Plan as Annexure A.

GENERAL:

- The estuary invasive species management plan to be implemented in accordance with the Invasive Species Unit city-wide work programme, resources and priorities.

- An integrated invasive species management approach will be followed in partnership with relevant stakeholders

OBJECTIVE (H):

Regulate all recreational use of the estuary

LEGISLATION/STANDARDS:

- DAFF Commercial Fishing Regulations
- DAFF Recreational Fishing Regulations
- DWA, Recreational Water Quality Standards
- Integrated Coastal Management Act
- City's Municipal Coastal Management Plan

MANAGEMENT PROTOCOLS:

- Only recreational fishing will be permitted, with a valid recreational fishing permit, available from the Post Office. This will be communicated through appropriate signage.
- No motorised water-craft of any kind permitted in the estuary or estuary mouth
- City's Marine and Coastal Law Enforcement Unit in conjunction with DAFF Fishery Control Officers to monitor, enforce and regulate

RECORDS:

- Any non-compliance to regulations will be recorded in the City's Coastal Management Monitoring and Database System

GENERAL:

- The estuary recreational use management plan to be implemented in accordance with the Sport, Recreation and Amenities Department's City-wide work programme, resources and priorities.
- Appropriate recreation to be supported in line with the City's Social Development Strategy

OBJECTIVE (I):

Provide public awareness and education through a range of media

LEGISLATION/STANDARDS:

- None

MANAGEMENT PROTOCOLS:

Public education and awareness on the Silvermine Estuary may be provided in the following ways:

1) General catchment and estuary education and awareness through the City's Youth Environmental Schools (YES) Programme
2) General estuary education and awareness as part of the City's Educator Training Programme
3) General estuary education and awareness through the City's Nature Reserve Environmental Education Programme
4) General City communication programmes focusing on awareness raising and education about pollution, its impact on human health and freshwater ecosystems
5) The installation of relevant and appropriate informative signage at the estuary

RECORDS:

- All signs and their locations to be recorded in the City's Coastal Management Monitoring and Database System

GENERAL:

- All signage, regulatory and informative, must comply with the City's Coastal Signage Protocol
- The estuary public awareness and education management plan to be implemented in accordance with the Environmental Resource Management Department's city-wide work programme, resources and priorities.

OBJECTIVE J:

Undertake annual monitoring and sampling of the estuary's biodiversity

LEGISLATION/STANDARDS:

- None

MANAGEMENT PROTOCOLS:

In partnership with DAFF undertake annual estuary biodiversity surveys through:

- Fish sampling through annual seine netting
- Bird counts
- Benthic sampling

RECORDS:

- All sampling results to be recorded in the City's Coastal Management Monitoring and Database System

GENERAL:

- Biodiversity sampling programme and schedule to be determined by DAFF
- The sampling programme is contingent on sufficient resources being made available for this programme

OBJECTIVE (K):

Implement an Estuary Emergency Contingency Plan in the event of a flooding, significant pollution event, oxygen depletion or other emergency events

LEGISLATION/STANDARDS:

- National Environmental Management Act

MANAGEMENT PROTOCOLS:

The following will be considered an Estuary Emergency requiring the Emergency Contingency Protocols to be implemented:

1) A land based (catchment) pollution event
2) Marine oil or pollution spill in False Bay
3) Rapid oxygen depletion
4) Marine / estuarine life die-off within the estuary

Emergency Contingency Protocols:

1) In the event of an emergency the estuary, estuary mouth and beach area (200m either side of the mouth) will be closed to the public and enforced by City Law Enforcement
2) The City's Coastal Co-ordinators will notify officials from DAFF, DEA and the C.A.P.E. Estuary programme manager
3) Where a land based pollution event is contaminating the estuary, the protocol established in OBJECTIVE A will be followed
4) Where there is a marine oil or pollution event, the estuary mouth will be boomed off and the Official Oil and Pollution Contingency Plan as per the City's Municipal Coastal Management Plan will become effective
5) In the event of a rapid oxygen depletion event, the estuary mouth will be breached and opened at low tide to allow high tide ocean water into the estuary, as per OBJECTIVE A.
6) In the event of significant marine life die-off, samples of dead marine life will be provided to DAFF and DEA for analysis. All remaining dead marine life will be recovered from the estuary by the City's Solid Waste Management department and disposed of at Vissershok Landfill site in accordance with City waste management procedures
7) The Estuary, estuary mouth and associated beach area will only be re-opened to public access once it is deemed safe

RECORDS:

- All estuary emergency events as well as the action taken will be recorded in the City's Coastal Management Monitoring and Database System
- DEA and DAFF to make any sampling results from a marine life die off available to the City

GENERAL:

- An emergency will only be declared if it is determined that the scale of the problem is such that it threatens the long term viability of the estuary as a functional ecosystem.
- This determination will be made by the City's Catchment, Stormwater and River Management Branch, in conjunction with the Environmental Resource Management Department. In the event of a biodiversity related emergency, ERMD will be the lead department in terms of decision-making.

OBJECTIVE (L):

Establish an estuary task team with relevant stakeholders

LEGISLATION/STANDARDS:

- Integrated Coastal Management Act

MANAGEMENT PROTOCOLS:

- Task team to be established as part of a city-wide Small Estuaries Task Team, which will include all estuaries except for the Zandvlei and Diep estuaries.
- Small Estuaries Task Team to meet on a quarterly basis

RECORDS:

- Action minutes of all meetings to be maintained as part of the City's Coastal Monitoring Database

GENERAL:

- Small Estuaries Task Team will function as a working group consisting of officials who are involved in management work related to the relevant estuaries
- Public engagement will be facilitated through the existing Sub-Council structure

OBJECTIVE M:

Regulation of Events and Filming

LEGISLATION/STANDARDS:

- City Filming and Events Policy

MANAGEMENT PROTOCOLS:

Any organisation or individual who wishes to hold, host or undertake a commercial or non-profit event or commercial filming of any kind on the estuary, or within the coastal edge surrounding the estuary must:

- Submit a formal application to the City's Events and Filming Office
- The application must be circulated to the Environmental Resource Management Department, Catchment, Stormwater and River Management Branch and Sport, Recreation and Amenities Department for consideration
- Officials from these departments will advise the Events and Filming Office on the suitability of the application and if supported the conditions attached to such support
- If approved, the final event or filming permit with attached conditions must be circulated to the Environmental Resource Management Department, Catchment Stormwater and River Management Branch and Sport, Recreation and Amenities Department at least 48 hours prior to the event or filming taking place

RECORDS:

- Events and Film Office to retain records of all applications, permits and conditions as well as any reported non-compliance

GENERAL:

- Event and filming applications for the estuary must demonstrate meaningful benefit

ESTUARY MANAGEMENT PLAN:

SIR LOWRY'S PASS RIVER ESTUARY

1. VISION

The Vision for the C.A.P.E. Estuaries Programme as a whole is: "Our estuaries are beautiful, rich in plants and animals, they attract visitors, sustain our livelihoods and uplift our spirits."

The Sir Lowry's Pass River Estuary is part of an extensive urban environment and as such the vision for the estuary is:

"To manage the estuary and its catchment in such a manner as to reduce and minimise urban influence and pollutants on the estuary, where possible allow free and natural movement of the estuary mouth, manage alien invasive species, continuously work towards achieving high standards of water quality, recognise the estuary as an important marine nursery and biodiversity habitat and monitor the estuary in such a manner so as to intervene when urban influences have compromised the natural functioning of the estuary"

2 SITUATION ASSESSMENT AND CONTEXT

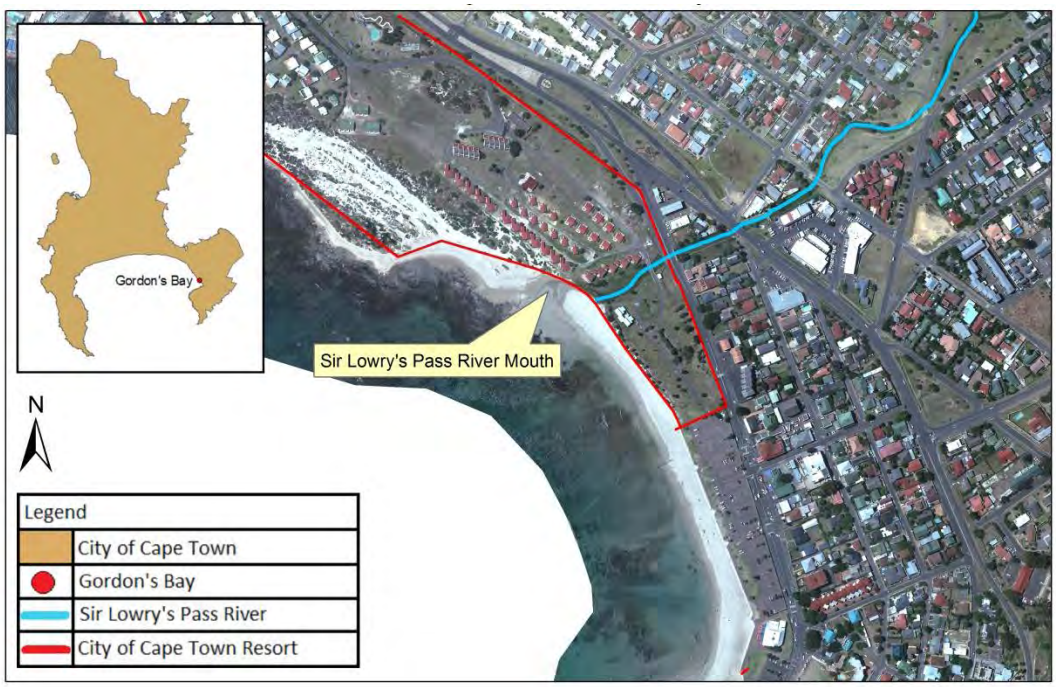

Figure 1: Historic extent of the Sir Lowry's Pass River Estuary

The Sir Lowry's Pass River Estuary is located on the western side Gordon's Bay. The estuary is confined by Hendon Park Resort to the west, Beach Road Bridge to the north, and Hendon Park recreational braai area to the east (see Figure 1).

The Sir Lowry's Pass River originates on the slopes of the Hottentots Holland mountains. Much of the lower part of the river is contained between earth banks stabilised by vegetation, and is partially canalised in places. Flow in the lower channel is sporadic consisting almost entirely of runoff from the local residential area.

An artificial diversion channel which splits the river at the Gordon's Bay Wastewater Treatment Works (WWTW) and delivers the bulk of river flows and treated effluent from the WWTW to the sea at a location west of Harbour Island. Due to this significant change in the hydrology of the original river, few of the original estuarine characteristics remain. The river mouth thus opens only periodically depending on the season.

The estuary has aesthetic and marginal recreational value due to its close proximity to resorts and recreational areas, and as such, the water quality of the estuary must be maintained at a level suitable to facilitate low levels of intermediate contact recreation (wading / walking through the water).

3 WATER QUALITY OF ESTUARY

The quality of the estuary (historic channel) is highly influenced by the Sir Lowry's Pass River Catchment, particularly the residential developments in the extreme lower end of the catchment which mainly results in the following:

- Reduction in seasonal and natural water flow
- Urban pollutants including litter and contaminants

Comprehensive water quality monitoring is undertaken on a monthly basis by the City's Scientific Services Laboratory since 2002, and results indicate the condition of the estuary and the portion of river flowing in the historic channel is fair from a water quality perspective but moderately to highly impacted in terms of ecological functioning. Water quality in the artificial diversion canal is impacted by the discharge of final effluent from the WWTW.

Figure 2: Water quality monitoring points in the vicinity of the Sir Lowry's Pass River catchment and Estuary (historic river channel)

Water quality sample collection points in the Sir Lowry's Pass River catchment:

- Sir Lowry's at Hibiscus Road (SIR07) – diversion canal
- Sir Lowry's at Dolphin Rd (SIR04) – historic channel
- Sir Lowry's at Hendon Park (SIR05) – historic channel

3.1 SPECIES RECORDED IN ESTUARY

Invasive Species

- No Records

Marine Species

- No Records

Freshwater Species

- No Records

4 RECREATION

Recreation in the estuary (historic river outlet) is minimal, as the size and scale of the estuary does not support any recreational activities. As the Sir Lowry's Pass River is diverted upstream this estuary receives minimal quantities of water.

The estuary is located in an intensively used recreational area (camp site and beach) and thus it is the water quality and condition of the estuary has a vital role to play in the health and aesthetics of the area.

Recreation in or at the outlet of the artificial diversion canal is not advisable since it conveys treated effluent to the sea.

5 MANAGEMENT PLAN

The Sir Lowry's Pass River Estuary has to date not had a specific management plan or long term objectives assigned to it, nor have specific roles and responsibilities been previously defined. As part of its new Integrated Coastal Management approach, the City has prioritised the management of small and large estuaries. Based on the situation assessment and the available information a number of management objectives have been defined. For each of these management objectives, a specific operational protocol has been developed.

These specific management protocols are intended to clearly define actions as well as responsibilities across City line departments. As implementation takes place and new information is gathered and understood, operational protocols may be amended and additional objectives and associated protocols added. Estuary management within an urban environment is seen as a long term approach following a principle of striving towards ongoing improvement in both the quality and management of our estuaries.

MANAGEMENT OBJECTIVES

The City has the following management objectives for the Sir Lowry's Pass River Estuary:

A. Allow the estuary mouth to function naturally as part of the local coastal dynamic processes and intervene only under specific defined and documented circumstances
B. Reduce and minimise all sources of urban pollutants to the estuary
C. Regulation and development of infrastructure in or adjacent to the estuary
D. Allow the natural circulation and fluctuation in estuary water quantity to be determined by seasonal rainfall patterns, whenever possible
E. Monitor estuary dynamics and intervene if required
F. Monitor estuary water quality and work towards a high standard of water quality acceptable for public recreation and ecological functioning
G. Remove alien invasive species from the estuary
H. Appropriately regulate all recreational use of the estuary
I. Provide public awareness and education through a range of media

J. Undertake annual monitoring and sampling of the estuary's biodiversity
K. Implement an Estuary Emergency Contingency Plan in the event of a flood, significant pollution event, oxygen depletion or other emergency events
L. Establish an estuary task team with relevant stakeholders
M. Regulate events and filming in the estuarine environment

OBJECTIVE (A) :

Allow the estuary mouth to function naturally as part of the local coastal dynamic processes and intervene only under specific defined and documented circumstances

LEGISLATION/STANDARDS:

Estuary mouth manipulation falls within the National Environmental Management Act Regulations. As such mouth manipulation must be done as either:

a) Part of a pre-approved management plan authorisation from Department of Environmental Affairs and Development Planning (DEADP)
b) In an emergency situation followed by DEADP notification

MANAGEMENT PROTOCOLS:

The following management protocols will be applied:

1) Risk of inland flooding

- Inland flooding is unlikely due to the small amount of water present in the river. However, in the event that a high rainfall prediction is indicative of a possible inland flooding event, the mouth of the estuary may be straightened and opened to address this.
- Determination of this need as well as the responsibility for carrying out the action resides with the City's Catchment, Stormwater and River Management Branch

2) Pollution or toxic event

- In the event of a toxic event in the estuary or catchment, the mouth may be mechanically opened to facilitate flushing of the estuary during high tide or high water levels. This action may also require the trapping of sea water in the estuary through the physical closing of the mouth for a short duration.
- Determination of this need resides with the City's Catchment, Stormwater and River Management Branch in consultation with the C.A.P.E. Estuary Programme Manager as well as the National Departments: Department of Environmental Affairs (DEA) and Department of Agriculture, Fisheries and Forestry (DAFF). Responsibility for carrying out the action resides with the City's Catchment, Stormwater and River Management Branch

3) Potential undermining of infrastructure or critical dune systems by estuary mouth movement.

- Where the estuary mouth moves or meanders in such a manner that it threatens critical dune systems or City infrastructure the mouth may be mechanically straightened or re-aligned.
- Determination of this need as well as the responsibility for carrying out the action resides with the City's Environmental Resource Management Department's Coastal Management Unit in consultation with the Helderberg district environmental office

RECORDS:

- All mouth manipulation, the reason, action and completion will be recorded in the City's Coastal Management Monitoring and Database System
- DEA, DAFF, DEADP and the C.A.P.E Estuary Programme will be informed of all mouth manipulation events

MACHINE ACCESS FOR MOUTH MANIPULATION:

- In all circumstances listed within this management objective, access points and traverse routes for machinery to be used for mouth manipulation will be determined by the Environmental Resource Management Department
- As much as possible, access and traverse routes must adhere to existing road surfaces or previously disturbed areas.
- These access and traverse routes will be strictly adhered to at all times

OBJECTIVE (B) :

Reduce and minimise all sources of urban pollutants to the estuary

LEGISLATION/STANDARDS:

Pollution in the form of industrial waste, human waste, domestic waste and material waste is governed by a wide range of National Legislation and Standards.

- National Environmental Management Act (NEMA)
- National Water Act (NWA)
- National Waste Act
- Integrated Coastal Management Act

However, for practical reasons recognition must be given to the fact that both the catchment that feeds the estuary, the estuary itself as well as the marine environment with which the estuary interacts are all subject to various pollutant sources common within a highly developed and populated urban environment. As such, all means to reduce pollution into the estuary that are practical, cost effective and reasonable will be employed but targeting zero pollution within an urban environment is neither practical nor realistic

MANAGEMENT PROTOCOLS:

To minimise and reduce all forms of pollution the following management protocols will be applied:

1) Regular and systematic litter removal from the greater Sir Lowry's Pass River Catchment area by the City's Solid Waste Management Department
2) Monthly monitoring of water quality along the river by the City's Scientific Services Branch.
3) If deemed necessary, installation, clearing and maintenance of litter traps by the City's Operations and Assets Branch of the Roads and Stormwater Department.
4) On an ongoing basis and as required, implement interventions to reduce water pollution at source, through the application of the City's Water Quality Improvement Strategy and Implementation Plan.
5) Promoting the implementation of Sustainable Urban Drainage Systems in new development applications to limit the direct input of stormwater into the Sir Lowry's Pass River (Management of Urban Stormwater Impacts Policy - 2009)

RECORDS:

1) All major pollution events to be recorded in the City's Coastal Monitoring Database. A major pollution event is defined as any pollution event deemed to be significantly greater than the level of background pollution present in the system. This may be determined either through water quality monitoring (i.e. a set of results that shows a significant spike in pollution), or through observation of an event (e.g. sewer overflow).

GENERAL

- In the event of major water based pollution events, the pollution event will be managed in accordance with the management protocol as set out in OBJECTIVE A.
- In the event of increased levels of litter within the catchment system a litter trap may be established at the upper end of the back pond to reduce and minimise litter into the estuary

OBJECTIVE (C) :

Regulation of development of infrastructure in or adjacent to the estuary

LEGISLATION/STANDARDS:

Development of the building of any infrastructure within or adjacent to the estuary is regulated by the following:

a) National Environmental Management Act
b) City Zoning Scheme
c) Integrated Coastal Management Act
d) Coastal Edge and Setback Line
e) Floodplain and River Corridor Management Policy
f) Management of Urban Stormwater Impacts Policy

MANAGEMENT PROTOCOLS:

a) All development proposals must comply with relevant legislation and policies
b) Development proposals falling within the Coastal Edge/Setback Line or 1 in 50 year flood line should not be supported
c) The building or construction of any permanent or temporary structures that do not trigger NEMA regulations, but are adjacent to or within the estuary, require additional written permission from the City's Environmental Resource Management Department's Integrated Coastal Management Unit or the Helderberg district environmental office

RECORDS:

- Any written permission granted for a permanent or temporary structure to be recorded in the City's

Coastal Monitoring Database

GENERAL:

- Construction of any permanent or temporary structures will in general not be supported unless strong rationale is provided with measurable benefits

OBJECTIVE (D):

Allow the natural circulation and fluctuations in estuary water quantity to be determined by seasonal rainfall patterns, whenever possible.

LEGISLATION/STANDARDS:

- National Water Act

MANAGEMENT PROTOCOLS:

a) At no time should the mouth of the estuary be impeded, diverted, blocked or altered unless under the specific conditions as defined in OBJECTIVE A
b) The estuary mouth may never be canalised or fixed
c) No water abstraction to be permitted from the back pond or estuary mouth
d) Water abstraction from the Sir Lowry's Pass River Catchment to conform to all relevant legislation with strict permit conditions
e) Encourage the re-use of treated effluent from the WWTW

RECORDS:

- Permitted water abstraction from the Sir Lowry's Pass River Catchment as well as permit conditions to be recorded in the City's Coastal Monitoring Database

- Cases and outcomes of an illegal water extraction in the Sir Lowry's Pass River Catchment to be recorded in the City's Coastal Monitoring Database

GENERAL:

- In the event of major flow alteration, the City's Catchment, Stormwater and River Management Branch in conjunction with the Helderberg district environmental office to conduct an investigation to determine cause of flow change and make recommendations to rectify and restore the flow regime

OBJECTIVE (E) :

Monitor estuary dynamics and intervene if required

LEGISLATION/STANDARDS:

- National Environmental Management Act

MANAGEMENT PROTOCOLS:

1) The City's Environmental Resource Management Department will develop an estuary dynamics monitoring programme based on aerial photography, including the establishment of baseline data, with the aim of annual assessment to determine whether changes in dynamics are taking place over time.

2) If the changing dynamics of the estuary are determined to be posing a management problem, the City's Catchment, Stormwater and River Management Branch in conjunction with the City's Environmental Resource Management Department will investigate and attempt to determine the cause. Areas of concern which may require intervention include, but are not limited to, increased rates of sedimentation and significant migration of the estuary or river mouth.

3) If it is determined that changes pose a management problem, the City will:
   a) Inform DAFF, DEA and the C.A.P.E. Estuary Programme Manager
   b) In consultation with DAFF, DEA and the C.A.P.E. Estuary Programme Manager determine the most appropriate plan of action
   c) Ensure compliance to NEMA if remedial action requires environmental authorisation

RECORDS:

- Changes in estuary dynamics to be monitored and recorded in the City's Coastal Management Monitoring and Database System.

GENERAL:

- Recognise that changes in estuary dynamics may form part of the natural variation in the estuary and as such retain a principle of least interference

OBJECTIVE F:

Monitor estuary water quality and work towards a high standard of water quality acceptable for public recreation and ecological functioning

LEGISLATION/STANDARDS:

- Water quality guidelines (DWA and DEA).

MANAGEMENT PROTOCOLS:

- Standardised water quality monitoring to be undertaken at one location within the estuary (SIR05) and at various sites in the greater catchment area once per month (temperature, dissolved oxygen, conductivity/salinity, pH, total suspended solids, total phosphorus, orthophosphate, total nitrogen, soluble ammonia, nitrite & nitrate, faecal coliforms, and *Escherichia coli*

- ERMD to liaise with the Wastewater Department to ensure that data from the monitoring of the final effluent quality from the Gordon's Bay Wastewater Treatment Works is provided to the Coastal Management Monitoring and Database System on a quarterly basis

- In the event that excessive poor water quality results are measured that threaten the estuary the management protocols established in OBJECTIVE A may be followed to restore improved water quality conditions

RECORDS:

- All water quality results will be recorded within Scientific Services' Laboratory Information Management System (LIMS)

GENERAL

- The estuary water quality management plan to be implemented in accordance with the Catchment, Stormwater and River Management Branch City-wide work programme, resources and priorities.

OBJECTIVE (G):

Remove alien invasive species from the estuary

LEGISLATION/STANDARDS:

- Conservation of Agricultural Resources Act, 43 of 1983 (CARA)
- National Environmental Biodiversity Act (NEMBA), 10 of 2004

MANAGEMENT PROTOCOLS:

The City's Invasive Species Unit to prepare an invasive species management plan for the estuary, to include, where relevant:

- Control of established invasive plants
- Control and management of invasive alien birds and animals where necessary
- Control and management of invasive alien fish, if deemed necessary
- Re-introduction of indigenous species where feasible
- Implementation of an early detection and rapid response programme to address new and emerging invasive alien species

RECORDS:

- The invasive species management plan will be appended to this Estuary Management Plan as Annexure A.

GENERAL:

- The estuary invasive species management plan to be implemented in accordance with the Invasive Species Unit city-wide work programme, resources and priorities.
- An integrated invasive species management approach will be followed in partnership with relevant stakeholders

OBJECTIVE (H):

Regulate all recreational use of the estuary

LEGISLATION/STANDARDS:

- DAFF commercial fishing regulations
- DAFF recreational fishing regulations
- DWA, Recreational water quality standards
- Integrated Coastal Management Act
- City's Municipal Coastal Management Plan

MANAGEMENT PROTOCOLS:

- Although the estuary is small, there is the possibility for limited recreation to take place.
- Only recreational fishing will be permitted, with a valid recreational fishing permit, available from the Post Office. This will be communicated through appropriate signage.
- No motorised water-craft of any kind permitted in the estuary or estuary mouth
- City's Marine and Coastal Law Enforcement Unit in conjunction with DAFF Fishery Control Officers to monitor, enforce and regulate
- City Health Department, in conjunction with Catchment, Stormwater and River Management, to determine recreational safety based on water quality results and to inform the public accordingly.

RECORDS:

- Any non-compliance to regulations will be recorded in the City's Coastal Management Monitoring and Database System

GENERAL:

- The estuary recreational use management plan to be implemented in accordance with the Sport, Recreation and Amenities Department's City-wide work programme, resources and priorities.
- Appropriate recreation to be supported in line with the City's Social Development Strategy

OBJECTIVE (I):

Provide public awareness and education through a range of media

LEGISLATION/STANDARDS:

- None

MANAGEMENT PROTOCOLS:

Public education and awareness on the Sir Lowry's River Estuary will be provided in the following ways:

1) General catchment and estuary education and awareness through the City's Youth Environmental Schools (YES) Programme
2) General estuary education and awareness as part of the City's Educator Training Programme
3) General estuary education and awareness through the City's Nature Reserve Environmental Education Programme
4) General City communication programmes focusing on awareness raising and education about pollution, its impact on human health and freshwater ecosystems
5) The installation of relevant and appropriate informative signage at the estuary

RECORDS:

- All signs and their locations to be recorded in the City's Coastal Management Monitoring and Database System

GENERAL:

- All signage, regulatory and informative, must comply with the City's Coastal Signage Protocol
- The estuary public awareness and education management plan to be implemented in accordance with the Environmental Resource Management Department city-wide work programme, resources and priorities.

OBJECTIVE (J):

Undertake annual monitoring and sampling of the estuary's biodiversity

LEGISLATION/STANDARDS:

- None

MANAGEMENT PROTOCOLS:

In partnership with DAFF undertake annual estuary biodiversity surveys through:

- Fish sampling through annual seine netting
- Bird counts

- Benthic sampling

RECORDS:

- All sampling results to be recorded in the City's Coastal Management Monitoring and Database System

GENERAL:

- Biodiversity sampling programme and schedule to be determined by DAFF

OBJECTIVE (K):

Implement an Estuary Emergency Contingency Plan in the event of a flood, significant pollution event, oxygen depletion or other emergency events

LEGISLATION/STANDARDS:

- National Environmental Management Act

MANAGEMENT PROTOCOLS:

The following will be considered an Estuary Emergency requiring the Emergency Contingency Protocols to be implemented:

1) A major land based pollution event
2) Marine oil or pollution spill in the surrounding area
3) Rapid oxygen depletion
4) Marine life die-off

Emergency Contingency Protocols:

1) In the event of an emergency the estuary, estuary mouth and beach area (200m either side of the mouth) will be closed to the public and enforced by City Law Enforcement
2) The City's Coastal Co-ordinators will notify officials from DAFF, DEA and the C.A.P.E. Estuary programme manager
3) Where a land based pollution event is contaminating the estuary, the protocol established in OBJECTIVE A will be followed
4) Where there is a marine oil or pollution event, the estuary mouth will be closed and the Official Oil and Pollution Contingency Plan as per the City's Municipal Coastal Management Plan will become effective
5) In the event of a rapid oxygen depletion event, the estuary mouth will be opened at low tide to allow the coming high tide to bring ocean water into the estuary, as per OBJECTIVE A.
6) In the event of significant marine life die-off, samples of dead marine life will be provided to DAFF and DEA for analysis. All remaining dead marine life will be recovered from the estuary by the City's Solid Waste Management department and disposed of at Vissershok Landfill site in

accordance with City waste management procedures

7) The beach and estuary area will only be re-opened to public access once it is deemed safe

RECORDS:

- All estuary emergency events as well as the action taken will be recorded in the City's Coastal Management Monitoring and Database System
- DEA and DAFF to make any sampling results from a marine life die off available to the City

GENERAL:

- An emergency will only be declared if it is determined that the scale of the problem is such that it threatens the long term viability of the estuary as a functional ecosystem
- This determination will be made by the City's Catchment, Stormwater and River Management Branch, in conjunction with the Environmental Resource Management Department. In the event of a biodiversity related emergency, ERMD will be the lead department in terms of decision-making.

OBJECTIVE (L):

Establish an estuary task team with relevant stakeholders

LEGISLATION/STANDARDS:

- Integrated Coastal Management Act

MANAGEMENT PROTOCOLS:

- Task team to be established as part of the city-wide "Small Estuaries Task Team", which will include all estuaries except for the Zandvlei and Diep estuaries.
- Small Estuaries Task Team to meet on a quarterly basis

RECORDS:

- Minutes of all meetings to be maintained as part of the City's Coastal Monitoring Database

GENERAL:

- Small Estuaries Task Team will function as a working group consisting of officials who are involved in management work related to the relevant estuaries
- Public engagement will be facilitated through the existing Sub-Council structure

OBJECTIVE (M):

Regulation of Events and Filming

LEGISLATION/STANDARDS:

- City Filming and Events Policy

MANAGEMENT PROTOCOLS:

Any organisation or individual who wishes to hold, host or undertake a commercial event or commercial filming of any kind on the estuary, or within the coastal edge surrounding the estuary must:

- Submit a formal application to the City's Events and Filming Office
- The application must be circulated to the Environmental Resource Management Department, Catchment, Stormwater and River Management Branch and Sport, Recreation and Amenities Department for consideration
- Officials from these departments will advise the Events and Filming Office on the suitability of the application and if supported the conditions attached to such support
- If approved, the final event or filming permit with attached conditions must be circulated to the Environmental Resource Management Department, Catchment, Stormwater and River Management Branch and Sport, Recreation and Amenities Department at least 48 hours prior to the event or filming taking place

RECORDS:

- Events and Film Office to retain records of all applications, permits and conditions as well as any reported non-compliance

GENERAL:

- Event and filming applications for the estuary must demonstrate meaningful benefit

ESTUARY MANAGEMENT PLAN:

ZEEKOEVLEI ESTUARY

1. VISION

The Vision for the C.A.P.E. Estuaries Programme as a whole is: "Our estuaries are beautiful, rich in plants and animals, they attract visitors, sustain our livelihoods and uplift our spirits."

The Zeekoevlei Estuary is part of an extensive urban environment and as such the vision for the estuary is:

"To manage the estuary and its catchment in such a manner as to reduce and minimise urban influence and pollutants on the estuary, where possible allow free and natural movement of the estuary mouth, manage alien invasive species, continuously work towards achieving high standards of water quality, recognise the estuary as an important marine nursery and biodiversity habitat and monitor the estuary in such a manner so as to intervene when urban influences have compromised the natural functioning of the estuary"

2.1 SITUATION ASSESSMENT AND CONTEXT

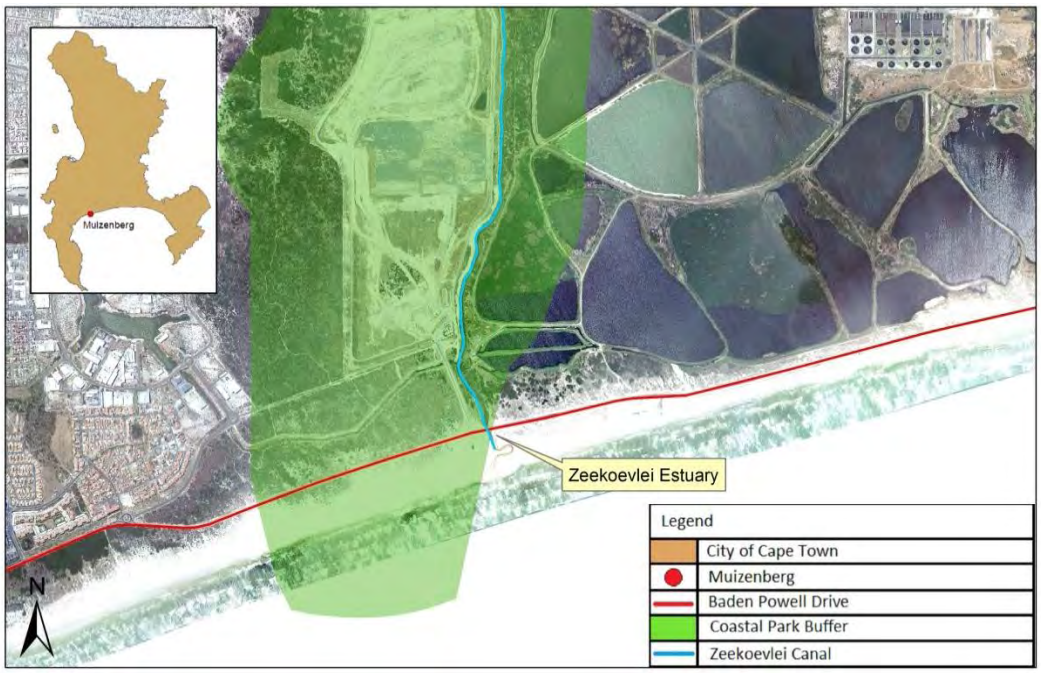

Figure 1: Historical extent of the Zeekoevlei Estuary

The Zeekoevlei River Estuary is the outlet of the Zeekoevlei Catchment drainage area which encompasses the Big and Little Lotus Rivers and Zeekoevlei. The outlet channel extends from the Zeekoevlei weir to the sea (a distance of approximately 3km). The channel also receives final sewage effluent from the Cape Flats Waste Water Treatment Works (WWTW) and, as such, it forms an important component of the City's urban drainage system. The outlet channel is surrounded by City infrastructure - the Coastal Park landfill site to the north and the Cape Flats WWTW to the east. In addition, Baden Powell – a major east-west transport artery - crosses the Zeekoevlei outlet channel a short distance upstream of its entry point to the sea. The Zeekoevlei Catchment and its associated aquatic ecosystems have over many decades become significantly impacted and nutrient enriched and unfortunately do not support any endemic or threatened species.

The Zeekoevlei River mouth, as with all river mouths, is subject to considerable movement. While interventions

have been put in place in the past to prevent the eastward migration of the river mouth, the river is still subject to significant westward migration. This migration is not limited to the east-west plain, but may also move in a northerly direction due to erosion. The rate of this erosion is dependent on other factors such as rainfall events, storm surges and tides. The north-westerly erosion caused by the river's migration poses a significant threat to Baden Powell Drive and therefore requires management intervention to protect this key infrastructure. While the City is mindful of not interfering with dynamic coastal processes, the potential implications of not managing these dynamics within the context of an already altered environment are serious.

It is highly unlikely that this system retains any true estuarine characteristics due to the significant alteration of the flow regime and channel, and the impact of discharges from the WWTW.

2.2 WATER QUALITY OF ESTUARY

The condition of the estuary is influenced mainly by the nearby Cape Flats WWTW and, to a lesser extent, by the Zeekoevlei Catchment. Limited overflows from the upstream Zeekoevlei down the channel towards the sea outlet occur mainly in winter – the flow in the Zeekoevlei estuary is thus overwhelmingly dominated by the discharge from the WWTW.

The condition of the estuary is thus influenced by the following:

- Alteration of natural water flow patterns
- Increased water flow as a result of discharge from the Cape Flats WWTW
- Urban pollutants including litter, contaminants and treated waste water from the neighbouring Cape Flats WWTW

Comprehensive water quality monitoring has been undertaken on a monthly basis by the City's Scientific Services Laboratory since 1981 on the Zeekoevlei waterbody itself but not within the outlet channel.

Fortnightly microbiological monitoring takes place at various coastal locations along the False Bay shoreline.

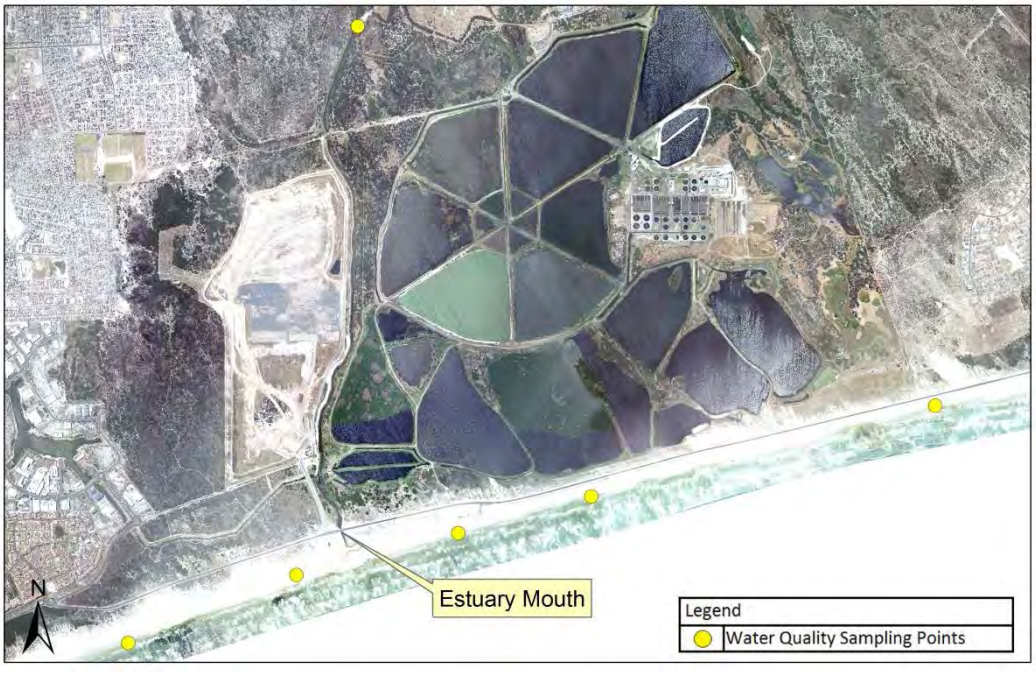

Figure 2: Water quality sampling points in the vicinity of the Zeekoevlei outlet

2.3 SPECIES RECORDED IN THE CATCHMENT

The City of Cape Town's Alien Invasive Unit have recorded the following **invasive species** in the Zeekoevlei Catchment (2012-2013):

Acacia cyclops	Rooikrans
Acacia saligna	Port Jackson
Eucalyptus cladocalyx	Sugar Gum
Layatera arborea	Tree Mallow
Ipomoea violacea	Beach Moonflower
Myoporum tenuifolium subsp. montanum	Manatoka

The Department of Agriculture, Forestry and Fisheries have recorded the following marine and freshwater species in the Zeekoevlei Catchment (2013):

Marine Species	
Mugil cephalus	Flathead Mullet
Myxus capensis	Freshwater mullet
Lithognathus lithognathus	White steenbras
Liza richardsonii	Harder
Anguilla mossambica	Longfin Eel

Freshwater Species	
Clarias gariepinus	Sharptooth catfish
Cyprinus carpio	Carp
Micropterus salmoides	Largemouth bass
Tilapia rendalli	Redbreast tilapia
Tilapia sparrmani	Banded tilapia
Tilapia zillii	Redbelly tilapia
Gambusia affinis	Mosquitofish

2.4 RECREATION

Recreation in the estuary is minimal. Recreational swimming in the back ponding area and in the estuary mouth is not allowed due to the discharge of treated sewage effluent. No commercial fishing is permitted, however limited recreational fishing occurs. The size and scale of the estuary does not facilitate broader recreational use such as boating or sailing.

3 MANAGEMENT PLAN

The Zeekoevlei Estuary has to date not had a specific management plan or long term objectives assigned to it, nor have specific roles and responsibilities been previously defined. As part of its new Integrated Coastal Management approach, the City has prioritised the management of small and large estuaries. Based on the situation assessment and the available information a number of management objectives have been defined. For each of these management objectives, a specific operational protocol has been developed.

These specific management protocols are intended to clearly define actions as well as responsibilities across City line departments. As implementation takes place and new information is gathered and understood, operational protocols may be amended and additional objectives and associated protocols added. Estuary management within an urban environment is seen as a long term approach following a principle of striving

towards ongoing improvement in both the quality and management of our estuaries.

3.1. MANAGEMENT OBJECTIVES

The City has the following management objectives for the Zeekoevlei Estuary:

A. Allow the estuary mouth to function naturally as part of the local coastal dynamic processes and intervene only under specific defined and documented circumstances
B. Reduce and minimise all sources of urban pollutants to the estuary
C. Regulation and development of infrastructure in or adjacent to the estuary
D. Allow the natural circulation and fluctuation in estuary water quantity to be determined by seasonal rainfall patterns, whenever possible
E. Monitor estuary dynamics and intervene if required
F. Monitor estuary water quality and work towards a high standard of water quality acceptable for public recreation and ecological functioning
G. Remove alien invasive species from the estuary
H. Appropriately regulate all recreational use of the estuary
I. Provide public awareness and education through a range of media
J. Undertake annual monitoring and sampling of the estuary's biodiversity
K. Implement an Estuary Emergency Contingency Plan in the event of a flooding, significant pollution event, oxygen depletion or other emergency events
L. Establish an estuary task team with relevant stakeholders
M. Regulate events and filming in the estuarine environment

OBJECTIVE (A) :

Allow the estuary mouth to function naturally as part of the local coastal dynamic processes and intervene only under specific defined and documented circumstances

LEGISLATION/STANDARDS:

Estuary mouth manipulation falls within the National Environmental Management Act (NEMA) Regulations in so far as mouth manipulation involves movement of sand and therefore triggers Activity 18 (Listing Notice 1). As such mouth manipulation may be undertaken either:

a) In terms of a *"management plan agreed to by the relevant environmental authority"*
b) In an emergency situation followed by notification to Department of Environmental Affairs and Development Planning (DEADP)

MANAGEMENT PROTOCOLS:

Due to the presence of the WWTW and the large volumes of effluent discharged into the estuary, it is likely that the mouth remains open for most of the year. However, migration along the coast has been problematic in previous years, and it is therefore essential that protocols for opening and straightening of the river mouth are in place.

The following management protocols will be applied:

1) Risk of inland flooding
- The mouth of the estuary may be straightened and opened in the event that high rainfall prediction is indicative of a possible inland flooding event.
- Determination of this need as well as the responsibility for carrying out the action resides with the City's Catchment, Stormwater and River Management Branch.

2) Pollution or toxic event
- In the event of a toxic event in the estuary or catchment, the mouth may be mechanically opened to facilitate flushing of the estuary during high tide or high water levels. This action may also require the trapping of sea water in the estuary through the physical closing of the mouth for a short duration.
- Determination of this need resides with the City's Catchment, Stormwater and River Management Branch in consultation with the C.A.P.E. Estuary Programme Manager as well as the National Departments of Environmental Affairs (DEA) and Agriculture, Fisheries and Forestry (DAFF). Responsibility for carrying out the action resides with the City's Catchment, Stormwater and River Management Branch

3) Potential undermining of infrastructure or critical dune systems by estuary mouth movement.
- Where the estuary mouth moves or meanders in such a manner that it threatens critical dune systems or City infrastructure the mouth may be mechanically straightened or re-aligned.
- Determination of this need as well as the responsibility for carrying out the action resides with the City's Environmental Resource Management Department's Coastal Management Unit in consultation with the Southern district environmental office

RECORDS:

- All mouth manipulation, the reason, action and completion will be recorded in the City's Coastal Management Monitoring and Database System
- DEA, DAFF, DEADP and the C.A.P.E Estuary Programme will be informed of all mouth manipulation events by the City's Coastal Management Unit

MACHINE ACCESS FOR MOUTH MANIPULATION:

- In all circumstances listed within this management objective, access points and traverse routes for machinery to be used for mouth manipulation will be determined by the Environmental Resource Management Department
- As much as possible, access and traverse routes must adhere to existing road surfaces or previously disturbed areas.
- These access and traverse routes will be strictly adhered to at all times

GENERAL:

- To prevent the movement of the river mouth and the associated risk to critical infrastructure, the City will re-direct the river mouth in a southerly direction so that it follows a straight and direct route to the sea. The proposed activities will be undertaken by the City's Roads and Storm Water Department or their appointed contractor. Environmental Compliance will be managed by the City's Environmental Resource Management Department.

- The operation of re-directing the river mouth will initially require a stretch of beach to be graded open through the use of heavy machinery. In terms of Activity 18, Listing Notice 1, this intervention involves purely the "moving of sand, shells and shell grit". This will avoid the immediate threat of damage to Baden Powell Drive.

OBJECTIVE (B) :

Reduce and minimise all sources of urban pollutants to the estuary

LEGISLATION/STANDARDS:

Pollution in the form of industrial waste, human waste, domestic waste and material waste is governed by a wide range of National Legislation and Standards.

- National Environmental Management Act (NEMA)
- National Water Act (NWA)
- National Waste Act
- Integrated Coastal Management Act (ICMA)

However, for practical reasons recognition must be given to the fact that both the catchment that feeds the estuary, the estuary itself as well as the marine environment with which the estuary interacts are all subject to various pollutant sources common within a highly developed and populated urban environment. As such, all means to reduce pollution into the estuary that are practical, cost effective and reasonable will be employed but targeting zero pollution within an urban environment is neither practical nor realistic.

MANAGEMENT PROTOCOLS:

To minimise and reduce all forms of pollution the following management protocols will be applied:

1) Regular and systematic litter removal from the general Zeekoevlei Catchment area by the City's Solid Waste Management Department.
2) Monthly monitoring of water quality along the river by the City's Scientific Services Branch.
3) If deemed necessary, installation, clearing and maintenance of litter traps by the City's Operations and

Assets Branch of the Roads and Stormwater Department.

4) On an ongoing basis and as required, implement interventions to reduce water pollution at source, through the application of the City's Water Quality Improvement Strategy and Implementation Plan.

RECORDS:

1) All major pollution events to be recorded in the City's Coastal Monitoring Database. A major pollution event is defined as any pollution event deemed to be significantly greater than the level of background pollution present in the system. This may be determined either through water quality monitoring (i.e. a set of results that shows a significant spike in pollution, or through observation of an event (e.g. sewer overflow).

GENERAL

- In the event of major water based pollution events, the pollution event will be managed in accordance with the management protocol as set out in OBJECTIVE A.
- In the event of increased levels of litter within the catchment system a litter trap may be established at the most northern end of Beach Road Bridge to reduce and minimise litter into the estuary

OBJECTIVE (C) :

Regulation of development of infrastructure in or adjacent to the estuary

LEGISLATION/STANDARDS:

Development of or building of any infrastructure within or adjacent to the estuary is regulated by the following:

a) National Environmental Management Act
b) City Zoning Scheme
c) Integrated Coastal Management Act
d) Coastal Edge and Setback Line
e) Floodplain and River Corridor Management Policy
f) Management of Urban Stormwater Impacts Policy

MANAGEMENT PROTOCOLS:

a) All development proposals must comply with relevant legislation and policies
b) Development proposals falling within the Coastal Edge/Setback Line or 1 in 50 year flood line should not be supported
c) The building or construction of any permanent or temporary structures that do not trigger NEMA regulations, but are adjacent to or within the estuary, require additional written permission from the City's Environmental Resource Management Department's Integrated Coastal Management Unit or the Southern district environmental office

RECORDS:

- Any written permission granted for a permanent or temporary structure to be recorded in the City's Coastal Monitoring Database

GENERAL:

- Construction of any permanent or temporary structures will in general not be supported unless strong rationale is provided with measurable benefits

OBJECTIVE (D):

Allow the natural circulation and fluctuation in estuary water quantity to be determined by seasonal rainfall patterns, whenever possible.

LEGISLATION/STANDARDS:

- National Water Act

MANAGEMENT PROTOCOLS:

a) At no time should the mouth of the estuary be impeded, diverted, blocked or altered unless under the specific conditions as defined in OBJECTIVE A
b) The estuary mouth may never be further canalised or fixed
c) No water abstraction to be permitted from the back pond or estuary mouth
d) Water abstraction from the Zeekoevlei Catchment to conform to all relevant legislation with strict permit conditions
e) On an ongoing basis, strive for improvement in wastewater discharge from the Cape Flats WWTW works to comply with permit conditions

RECORDS:

- Permitted water extraction from the Zeekoevlei Catchment as well as permit conditions to be recorded in the City's Coastal Monitoring Database and the City's Catchment, Stormwater and River Management Department as well as the Department of Water Affairs to be informed about the abstraction

- Cases and outcomes of an illegal water extraction in the Zeekoevlei Catchment to be recorded in the City's Coastal Monitoring Database

GENERAL:

- In the event of major flow alteration, the City's Catchment, Stormwater and River Management Branch in conjunction with the Southern district environmental office to conduct an investigation to determine cause of flow change and make recommendations to rectify and restore flow regime

OBJECTIVE (E) :

Monitor estuary dynamics and intervene if required

LEGISLATION/STANDARDS:

- National Environmental Management Act

MANAGEMENT PROTOCOLS:

1) The City's Environmental Resource Management Department will develop an estuary dynamics monitoring programme based on aerial photography, including the establishment of baseline data, with the aim of annual assessment to determine whether changes in dynamics are taking place over time.

2) If the changing dynamics of the estuary are determined to be posing a management problem, the City's Catchment, Stormwater and River Management Branch in conjunction with the City's Environmental Resource Management Department will investigate and attempt to determine the cause. Areas of concern which may require intervention include, but are not limited to, increased rates of sedimentation and significant migration of the estuary or river mouth.

3) If it is determined that changes pose a management problem, the City will:
   a) Inform DAFF, DEA and the C.A.P.E. Estuary Programme Manager
   b) In consultation with DAFF, DEA and the C.A.P.E. Estuary Programme Manager determine the most appropriate plan of action
   c) Ensure compliance to NEMA if remedial action requires environmental authorisation

RECORDS:

- Changes in estuary dynamics to be monitored and recorded in the City's Coastal Management Monitoring and Database System.

GENERAL:

- Recognise that changes in estuary dynamics may form part of the natural variation in the estuary and as such retain a principle of least interference

OBJECTIVE F:

Monitor estuary water quality and work towards a high standard of water quality acceptable for public recreation and ecological functioning

LEGISLATION/STANDARDS:

- Water quality guidelines (DWA and DEA).

MANAGEMENT PROTOCOLS:

- Standardised water quality monitoring to be undertaken at one location within the estuarine environment and at various sites in the greater catchment area once per month (temperature, dissolved oxygen, conductivity/salinity, pH, total suspended solids, total phosphorus, orthophosphate, total nitrogen, soluble ammonia, nitrite & nitrate, faecal coliforms, *Escherichia coli* and enterococcus)

- ERMD to liaise with the Wastewater Department to ensure that data from the monitoring of the final effluent quality from Cape Flats Wastewater Treatment Works (and other relevant WWTWs) is provided to the Coastal Management Monitoring and Database System on a quarterly basis

- In the event that excessive poor water quality results are measured that threaten the estuary the management protocols established in OBJECTIVE A may be followed to restore improved water quality conditions

RECORDS:

- All water quality results will be recorded within Scientific Services' Laboratory Information Management System (LIMS) and the monthly Certificate of Analysis will be added to the City's Coastal Management Monitoring and Database System.
- All final effluent quality results obtained from the Wastewater department will be logged in the City's Coastal Management Monitoring and Database System

GENERAL:

- Estuary water quality management to be implemented in accordance with the Water and Sanitation Department's, and Catchment, Stormwater and River Management Branch's City-wide work programme, resources and priorities.

OBJECTIVE (F):

Remove alien invasive species from the estuary

LEGISLATION/STANDARDS:

- Conservation of Agricultural Resources Act, 43 of 1983 (CARA)
- National Environmental Biodiversity Act (NEMBA), 10 of 2004

MANAGEMENT PROTOCOLS:

The City's Invasive Species Unit to prepare an invasive species management plan for the estuary, to include, where relevant:

- Control of established invasive plants
- Control and management of invasive alien birds and animals where necessary
- Control and management of invasive alien fish, if deemed necessary
- Re-introduction of indigenous species where feasible
- Implementation of an early detection and rapid response programme to address new and emerging invasive alien species

RECORDS:

- The invasive species management plan will be appended to this Estuary Management Plan as Annexure A.

GENERAL:

- The estuary invasive species management plan to be implemented in accordance with the Invasive Species Unit city-wide work programme, resources and priorities.
- An integrated invasive species management approach will be followed in partnership with relevant stakeholders

OBJECTIVE (H):

Regulate all recreational use of the estuary

LEGISLATION/STANDARDS:

- DAFF commercial fishing regulations
- DAFF recreational fishing regulations
- DWA, Recreational water quality standards
- Integrated Coastal Management Act
- City's Municipal Coastal Management Plan

MANAGEMENT PROTOCOLS:

- Only recreational fishing will be permitted, with a valid recreational fishing permit, available from the Post Office. This will be communicated through appropriate signage.
- No motorised water-craft of any kind permitted in the estuary or estuary mouth
- City's Marine and Coastal Law Enforcement Unit in conjunction with DAFF Fishery Control Officers to monitor, enforce and regulate
- Due to the close proximity of the WWTW, no swimming is permitted in the estuary. Signage to this effect will be installed.

RECORDS:

- Any non-compliance to regulations will be recorded in the City's Coastal Management Monitoring and Database System

GENERAL:

- The estuary recreational use management plan to be implemented in accordance with the Sport, Recreation and Amenities Department's City-wide work programme, resources and priorities.
- Appropriate recreation to be supported in line with the City's Social Development Strategy

OBJECTIVE (I):

Provide public awareness and education through a range of media

LEGISLATION/STANDARDS:

- None

MANAGEMENT PROTOCOLS:

Public education and awareness on the Zeekoevlei Estuary will be provided in the following ways:

1) General catchment and estuary education and awareness through the City's Youth Environmental Schools (YES) Programme
2) General estuary education and awareness as part of the City's Educator Training Programme
3) General estuary education and awareness through the City's Nature Reserve Environmental Education Programme
4) General City communication programmes focusing on awareness raising and education about pollution, its impact on human health and freshwater ecosystems
5) The installation of relevant and appropriate informative signage at the estuary

RECORDS:

- All signs and their locations to be recorded in the City's Coastal Management Monitoring and Database System.

GENERAL:

- All signage, regulatory and informative, must comply with the City's Coastal Signage Protocol
- The estuary public awareness and education management plan to be implemented in accordance with the Environmental Resource Management Department's city-wide work programme, resources and priorities.

OBJECTIVE J:

Undertake annual monitoring and sampling of the estuaries biodiversity

LEGISLATION/STANDARDS:

- None

MANAGEMENT PROTOCOLS:

ERMD in partnership with DAFF to undertake annual estuary biodiversity surveys through:

- Fish sampling through annual seine netting

- Bird counts
- Benthic sampling

RECORDS:

- All sampling results to be recorded in the City's Coastal Management Monitoring and Database System

GENERAL:

- Biodiversity sampling programme and schedule to be determined by DAFF
- The sampling programme is contingent on sufficient resources being made available for this programme

OBJECTIVE (K):

Implement an Estuary Emergency Contingency Plan in the event of a flooding, significant pollution event, oxygen depletion or other emergency events

LEGISLATION/STANDARDS:

- National Environmental Management Act

MANAGEMENT PROTOCOLS:

The following will be considered an Estuary Emergency requiring the Emergency Contingency Protocols to be implemented:

1) A land based (catchment) pollution event
2) Marine oil or pollution spill in False Bay
3) Rapid oxygen depletion
4) Marine / estuarine life die-off within the estuary

Emergency Contingency Protocols:

1) In the event of an emergency the estuary, estuary mouth and beach area (200m either side of the mouth) will be closed to the public and enforced by City Law Enforcement
2) The City's Coastal Co-ordinators will notify officials from DAFF, DEA and the C.A.P.E. Estuary programme manager
3) Where a land based pollution event is contaminating the estuary, the protocol established in OBJECTIVE A will be followed
4) Where there is a marine oil or pollution event, the estuary mouth will be boomed off and the Official Oil and Pollution Contingency Plan as per the City's Municipal Coastal Management Plan will become effective
5) In the event of a rapid oxygen depletion event, the estuary mouth will be breached and opened at low tide to allow high tide ocean water into the estuary, as per OBJECTIVE A.
6) In the event of significant marine life die-off, samples of dead marine life will be provided to DAFF and DEA for analysis. All remaining dead marine life will be recovered from the estuary by the City's Solid Waste Management department and disposed of at Vissershok Landfill site in accordance with City

waste management procedures

7) The Estuary, estuary mouth and associated beach area will only be re-opened to public access once it is deemed safe

RECORDS:

- All estuary emergency events as well as the action taken will be recorded in the City's Coastal Management Monitoring and Database System
- DEA and DAFF to make any sampling results from a marine life die off available to the City

GENERAL:

- An emergency will only be declared if it is determined that the scale of the problem is such that it threatens the long term viability of the estuary as a functional ecosystem
- This determination will be made by the City's Catchment, Stormwater and River Management Branch, in conjunction with the Environmental Resource Management Department. In the event of a biodiversity related emergency, ERMD will be the lead department in terms of decision-making.

OBJECTIVE (L):

Establish an estuary task team with relevant stakeholders

LEGISLATION/STANDARDS:

- Integrated Coastal Management Act

MANAGEMENT PROTOCOLS:

- Task team to be established as part of a city-wide Small Estuaries Task Team, which will include all estuaries except for the Zandvlei and Diep estuaries.
- Small Estuaries Task Team to meet on a quarterly basis

RECORDS:

- Action minutes of all meetings to be maintained as part of the City's Coastal Monitoring Database

GENERAL:

- Small Estuaries Task Team will function as a working group consisting of officials who are involved in management work related to the relevant estuaries
- Public engagement will be facilitated through the existing Sub-Council structure

OBJECTIVE M:

Regulation of Events and Filming

LEGISLATION/STANDARDS:

- City Filming and Events Policy

MANAGEMENT PROTOCOLS:

Any organisation or individual who wishes to hold, host or undertake a commercial or non-profit event or commercial filming of any kind on the estuary, or within the coastal edge surrounding the estuary must:

- Submit a formal application to the City's Events and Filming Office
- The application must be circulated to the Environmental Resource Management Department, Catchment, Stormwater and River Management Branch and Sport, Recreation and Amenities Department for consideration
- Officials from these departments will advise the Events and Filming Office on the suitability of the application and if supported the conditions attached to such support
- If approved, the final event or filming permit with attached conditions must be circulated to the Environmental Resource Management Department, Catchment Stormwater and River Management Branch and Sport, Recreation and Amenities Department at least 48 hours prior to the event or filming taking place

RECORDS:

- Events and Film Office to retain records of all applications, permits and conditions as well as any reported non-compliance

GENERAL:

- Event and filming applications for the estuary must demonstrate meaningful benefit