C.A.P.E. Estuaries Programme

Estuary Management Plan
for the
Diep Estuary

DECEMBER 2008

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CITY OF CAPE TOWN | ISIXEKO SASEKAPA | STAD KAAPSTAD

CapeNature

Acknowledgements

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We would like to thank all those involved for their very valuable contributions. In addition, we would like to thank Andy Birkinshaw for the photograph on the front cover.

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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 is being addressed through the inclusion of relevant provisions in the National Environmental Management: Integrated Coastal Management Bill, 2007, which is expected to be enacted in 2009. Amongst other things, the Integrated Coastal Management Bill introduces a requirement for Estuary Management Plans.

In parallel with this, 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.

1.2 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.

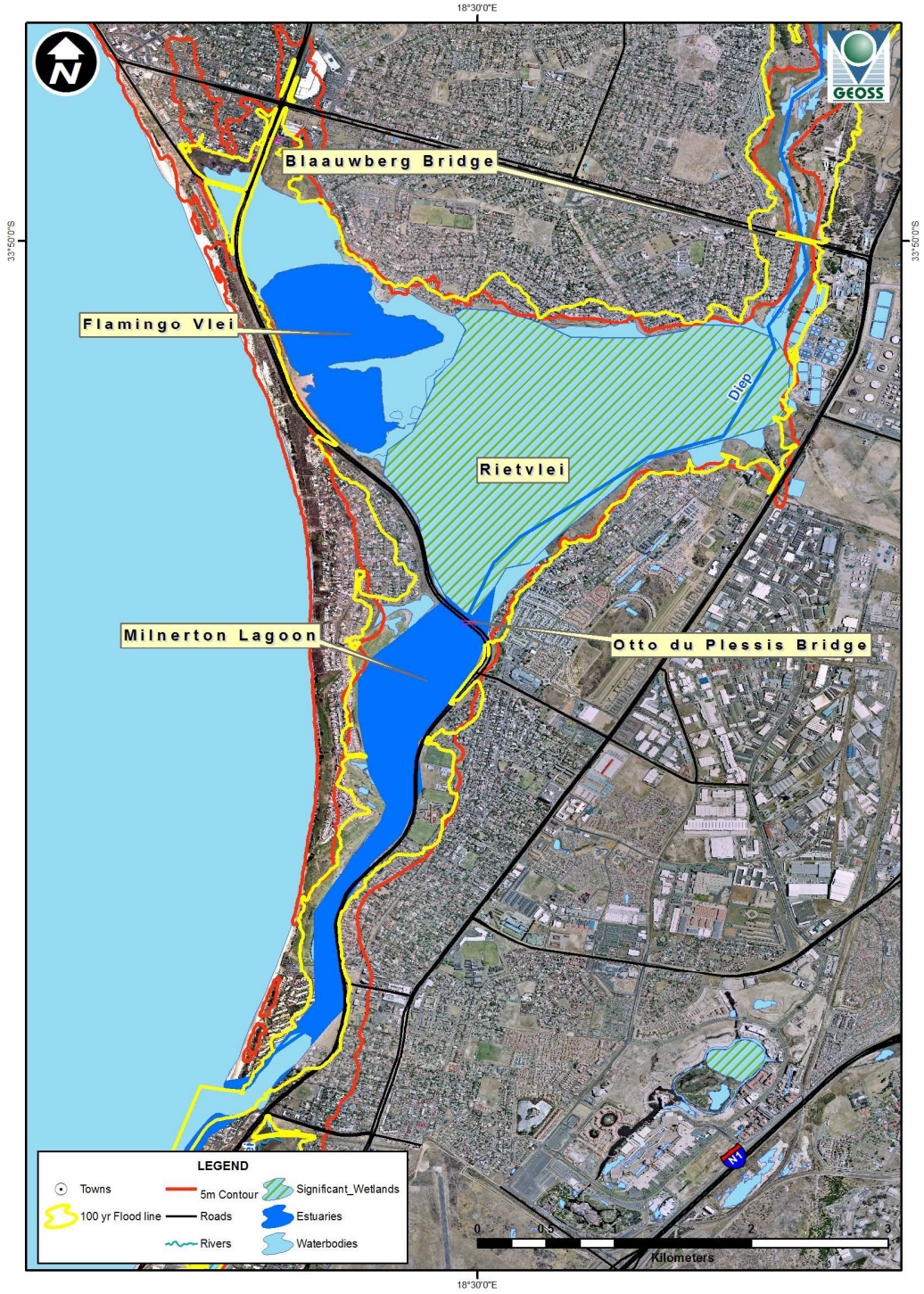


Figure 1: The Diep Estuary comprising Rietvlei and the Milnerton Lagoon.

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 has served to guide management activities to the present.

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 this 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 2009 – 2013 – 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 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 continue to 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: 2009 - 2013

This management plan includes an Action Plan for the period 2009 – 2013 (see section 6). 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 2013, 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 include all City-owned land between Blaauberg Bridge and the railway bridge, 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).

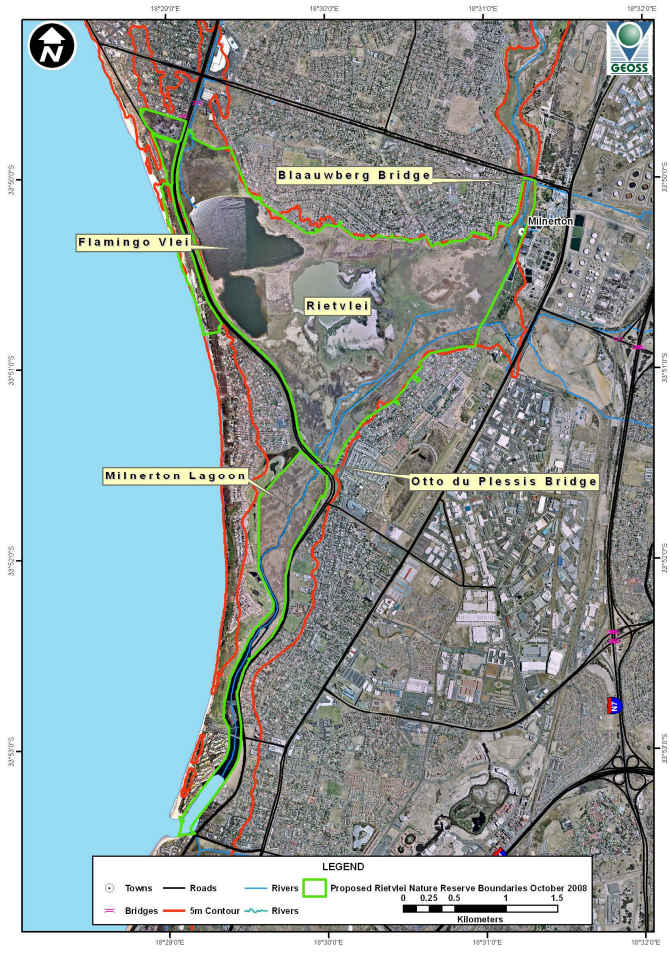


Fig. 2. Proposed new boundaries for the Rietvlei Nature Reserve (excluding area upstream of Blaauberg Bidge)..

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.

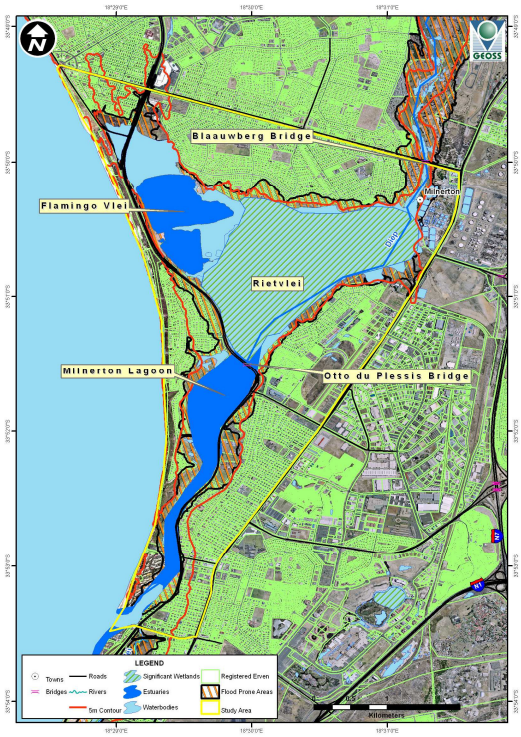


Fig.3 Floodprone areas around the Diep Estuary (based on the 1:100 -year floodline).

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 (eg. from pump station failures) should be reduced by 95% by the end of 2011, and by 100% by the end of 2013;
- 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). They should include the following indicators:
  - 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.
  - *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.
  - *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 5 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

- 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). Since unionised ammonia is responsible for the toxicity of ammonia, it is recommended that the latter be adopted as an interim target.
- 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 considered low enough to limit eutrophication and 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.
- Similarly, the Guideline for Phosphorus is "inorganic phosphorus concentrations should not be changed by more than 15% from that of the local water body under unimpacted conditions". Phosphorus (PO4-P) concentrations are typically between 0.05 – 0.1 mg/l in unpolluted estuaries in South Africa (Taljaard, pers. comm.).
- 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, a target range of 0.5 – 2.5 mg/l for inorganic nitrogen (typical of mesotrophic conditions) and a target of 0.1 mg/l for phosphorus should be adopted.

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." It is proposed that the objective for the greater part of the Diep Estuary follow the latter guideline at least for the interim.
- 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

- From a biological perspective, the water quality should be sufficient to support all biological communities, and more specifically, to 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.*

A target for blue-green algae should also be developed.

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 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.*

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 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 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 the role of wetlands and estuaries. Existing programmes should be expanded and facilities upgraded.

4 ESTUARY ZONATION PLAN

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, 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.

One of the objectives of this management plan is to achieve an appropriate balance between conservation and sustainable use of the estuary. An important tool in achieving this objective has therefore been the creation of zones within the geographic boundaries of the estuary, each of which is intended for a specific category of use.

The zonation plan for the Diep Estuary is shown in Fig. 4 below, which depicts the following:

4.1 Geographical Boundaries

The Diep 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. The greater part of this, excluding those portions which have already been developed, falls within the proposed boundaries of the Nature Reserve.

4.2 Sanctuary and conservation zones

The report on the Development of a Conservation Plan for Temperate South African Estuaries (Turpie and Clark, 2007) recommended that the Diep Estuary be one of the core estuaries in terms of meeting biodiversity targets, that the extent of protection be half, that 50% of the margin remains undeveloped, that it is assigned to class A or B in terms of minimum water requirements (with A being near natural), and that it be considered as high priority in terms of rehabilitation (which needs to be taken into account during the reserve determination).

The total area of the estuary as defined above (and with the north-western arm being limited to the south of Blaauberg Road), is 809.15 ha. Of this, some 237.03 ha (or 23.3%) is already subject to some form of development. Of the remainder, the majority has been included in either the existing, or proposed boundaries of the Rietvlei Nature Reserve and can therefore be regarded as having some level of protection i.e. 76.7% of the estuary is protected. This portion then falls within Spatial

Planning Category A. However, given the fact that it has been substantially modified, it would not qualify for wilderness status, but would fall into Category A.b: Other Statutory Conservation Areas.

On the other hand, there is, effectively, development along all the margins, and even within the boundaries of the estuary, with the remaining Public Open Space along the margins proposed to be incorporated within the new boundaries.

In terms of the level of protection afforded, the area has been divided into a number of categories based on the degree and type of use as follows:

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 a sanctuary for birds. This area comprises 357.94 ha or 44% of the total area of the estuary.

4.2.2 ***Conservation zones***

Conservation zones are areas where human use is allowed on a controlled basis. They are sub-divided into areas of low, medium and high intensity use.

i) Low intensity use areas.

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.

ii) Medium intensity use areas

Within the estuary, there are 3 different types of medium 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.

iii) 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.

*4.2.3 **Buffer Zones***

Most of the land bordering the estuary – as well as some within the estuary boundaries – has already been developed. The few areas where there is some Public Open Space remaining are proposed for inclusion into the Nature Reserve. There are, therefore, no specific buffer zones.

4.3 **Developed Areas**

As mentioned above, and as can be seen in Fig. 4, there has been fairly extensive development within the boundaries of the estuary. The developed areas include the residential areas at Woodbridge Island, Sunset Beach and to the north of Rietvlei; the Potsdam Wastewater Treatment Works; sports facilities such as the Milnerton Golf Course and Theo Marais sportsfields; and the area to the east of Marine Drive between the mouth and Otto du Plessis Bridge. Most of these areas are prone to flooding.

Fig. 5 shows relevant infrastructure, including the stormwater discharges to the estuary.

4.4 **Rehabilitation Areas**

While the entire estuary needs rehabilitation in one way or another, biological restoration work has already been initiated in the area between the two lakes (where woody alien species have been removed, and the strandveld vegetation is being restored). Rehabilitation of aquatic areas will be delayed until water quantity and quality issues have been addressed.

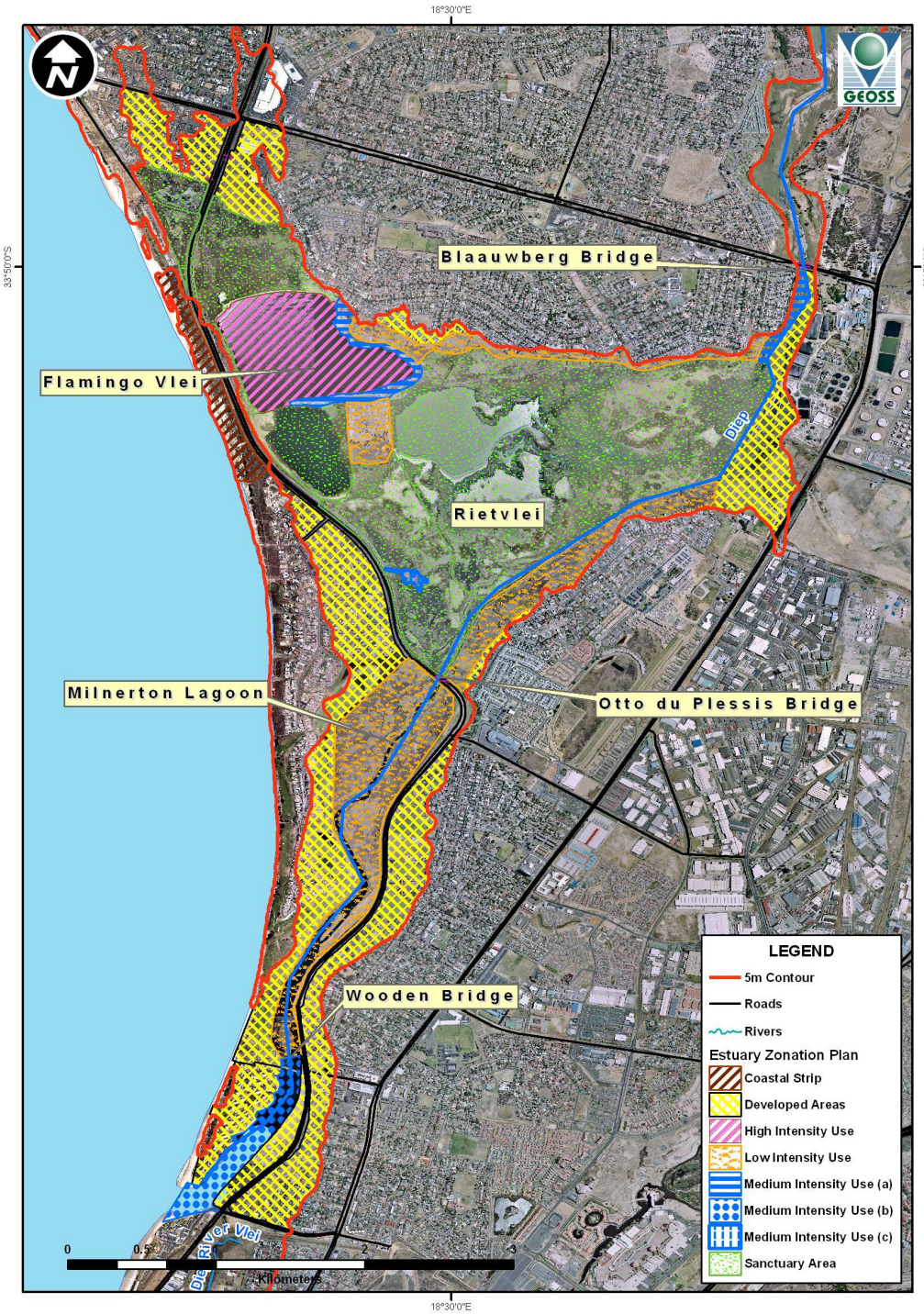


Fig. 4. Zonation Plan for the Diep Estuary.

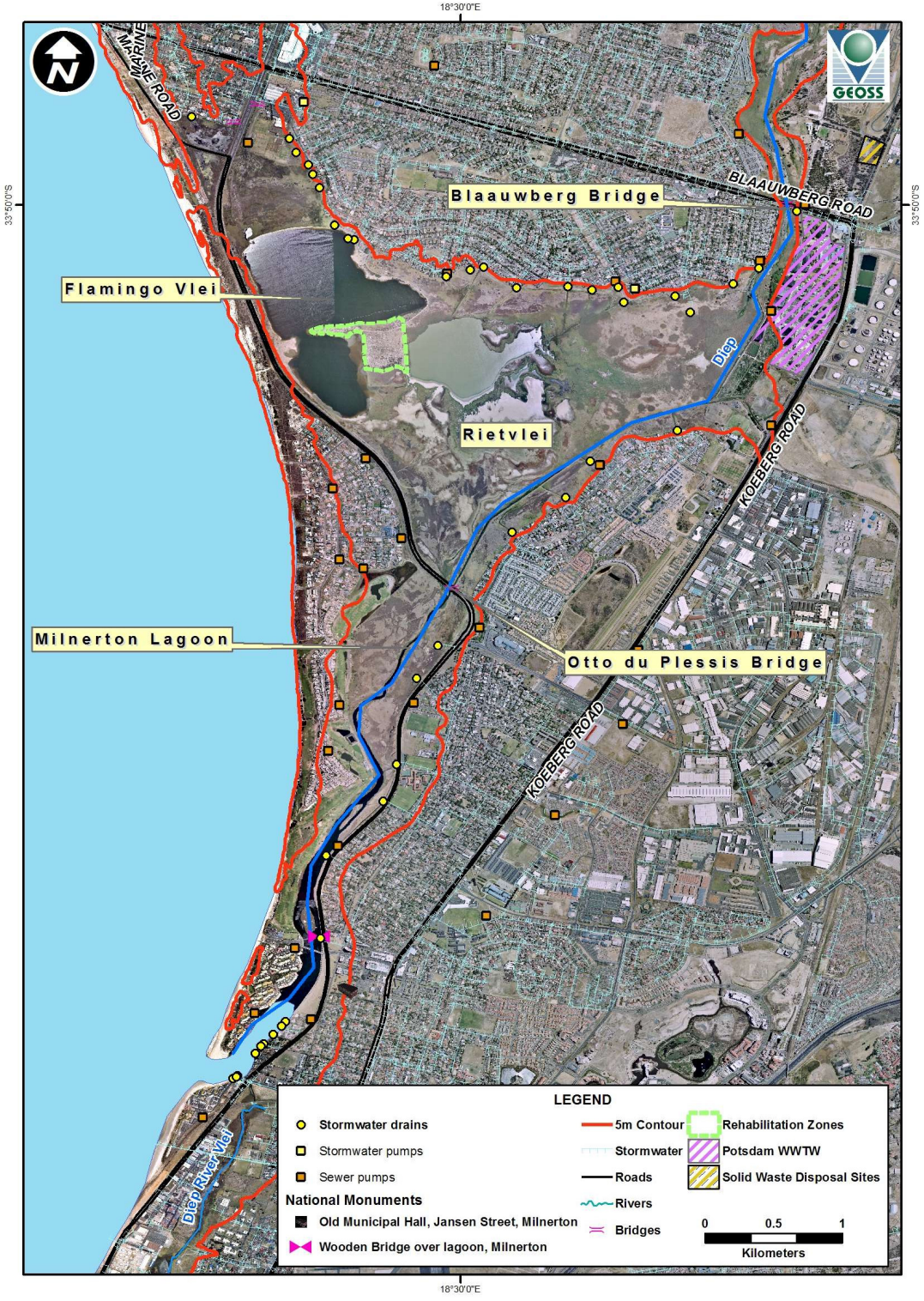


Fig. 5. Infrastructure and rehabilitation areas in and around the Diep Estuary.

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 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 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 DEAT and DWAF 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, and this needs to be addressed as a matter of urgency

5.1.1 Water quantity

There is general consensus that given the history of changes to and around the Diep Estuary caused by ongoing urbanization, the system will never be able to function naturally and that 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 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

In order to obtain the required information, the following studies are proposed:

i) A study of the hydrology 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. The data will be obtained from:
   - Existing DWAF 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 need to be equipped with water level data loggers. These loggers need to be read at regular intervals.
   - The piezometers will have to be accurately surveyed, as well as a number of other features to be able to draw accurate cross-sections across the study area.
   - In addition a once off water quality sampling (with full cation and anion analysis) needs to be completed of all the piezometers.

   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) A topographic survey and development of a digital elevation model (DEM) is required to assist with the determination of surface water circulation patterns and groundwater flow directions and gradients, (as it is assumed the groundwater will occur under unconfined aquifer conditions).

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

vii) 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.

viii) 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.

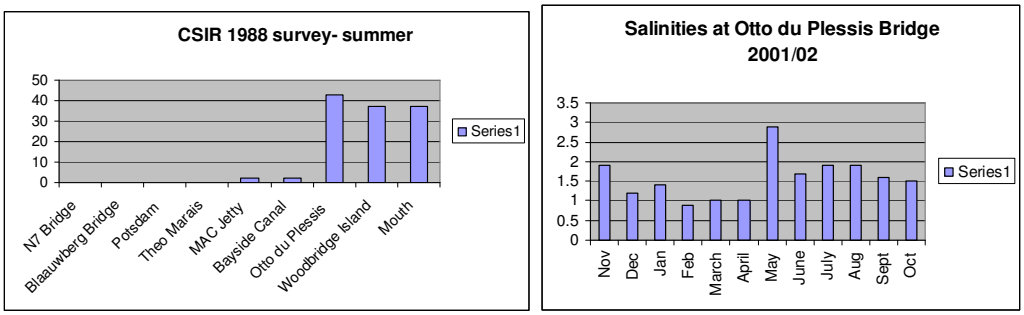
ix) The above data needs to be compiled and collated so that a hydrodynamics model can be established to optimize the various management options available.

Interim management measures

In parallel with the above-mentioned studies, it is proposed to implement some interim measures – some on a trial basis, and others to alleviate current problems until a longer-term solution 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 is currently being increased from 32 to 47 Ml/day. However, 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 reduced to around 15 Ml/day – seemingly without the mouth closing. This supports the conclusions of a 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.

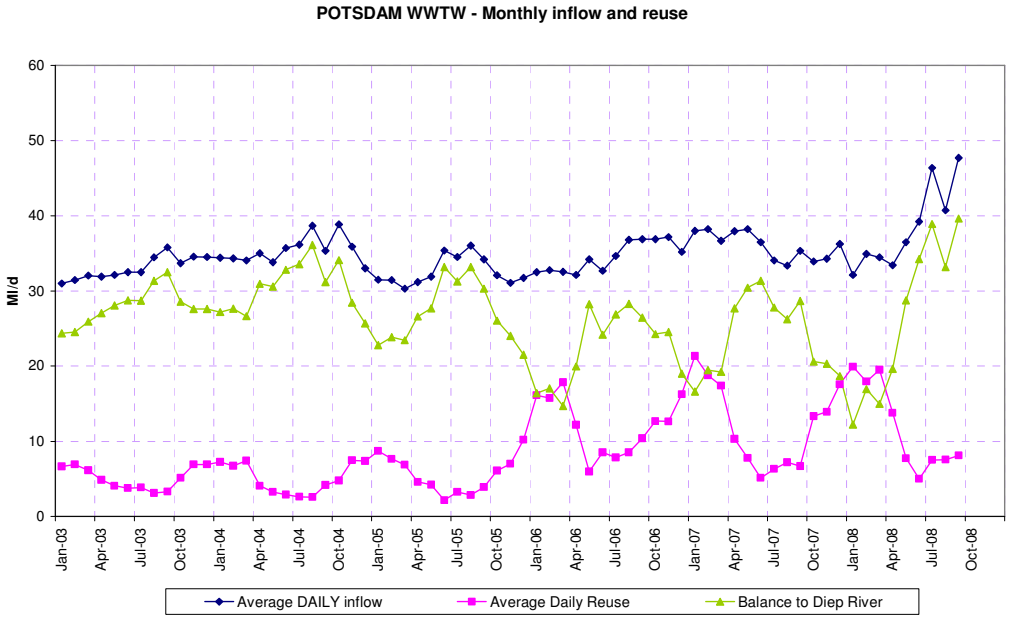


Fig. 7. Average daily flows of effluent from the Potsdam WWTW.

It is therefore proposed that a series of trials be undertaken in collaboration with the Potsdam management to determine the extent of flow reduction required to achieve mouth closure, and thence to develop a programme to manage the balance between re-use of the effluent and meeting the requirements of the estuary. This trial programme will take into account the state of the tides, and will be developed through close co-operation between the relevant departments of the City, and will include a water level, salinity and mouth monitoring programme. When necessary, the mouth could be re-opened not only to prevent flooding, but noting that until water quality has improved, closure should be limited to very short periods. Amongst other things, this programme will result in the production of a Mouth Management Plan.

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.

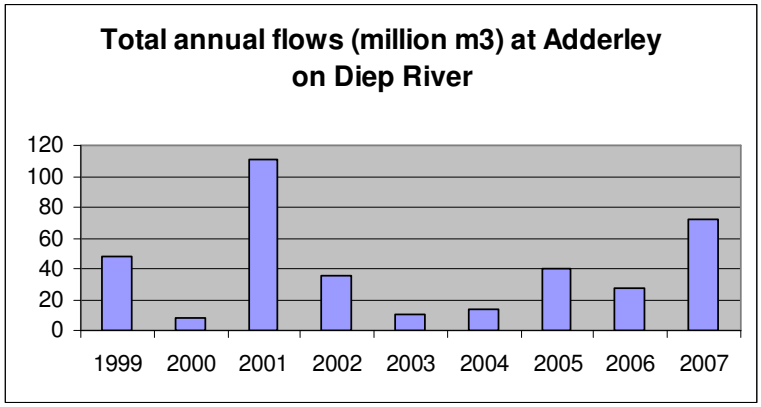


Fig. 8 (a) Variations in annual flow from the Diep River.

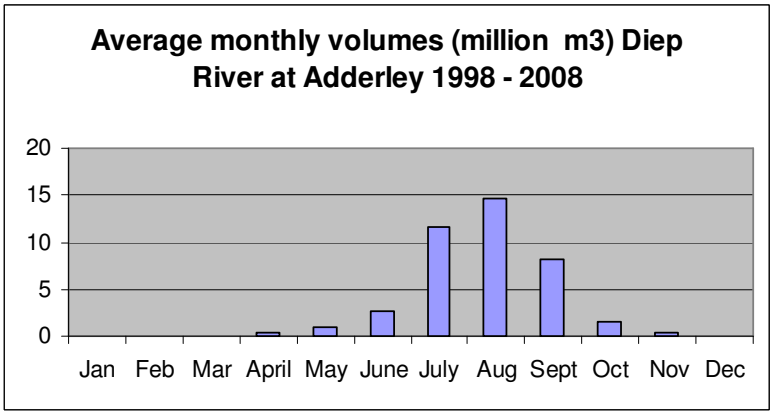


Fig. 8 (b) Seasonal fluctuations in the flow in the Diep River.

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 draft 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 nitrogen samples at the Otto du Plessis Bridge are at levels indicative of eutrophic or hypertrophic conditions. This suggests that current management efforts are inadequate.

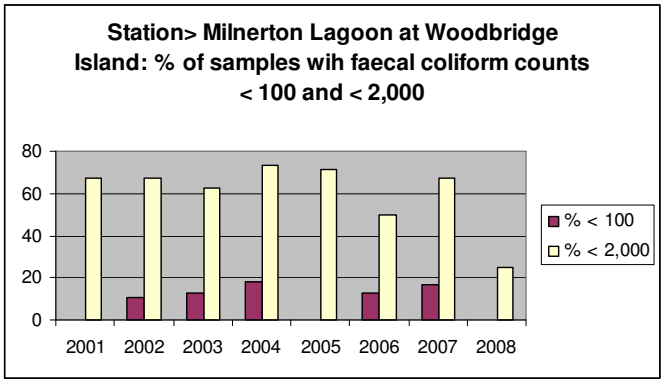


Fig. 9. Bacteriological quality of water at Woodbridge Island.

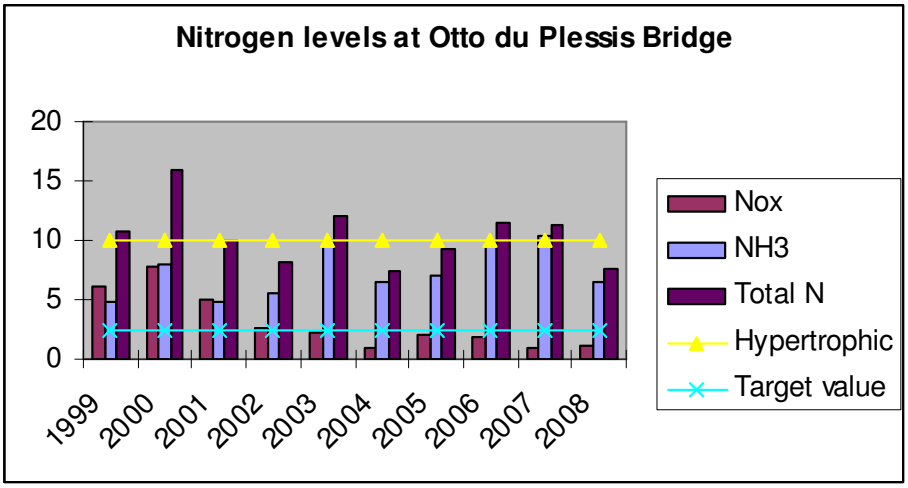


Fig. 10. Levels of nitrates and nitrites (Nox), Ammonia (NH^3) and Total Nitrogen in mg/l at Otto du Plessis Bridge. Values > 2.5 are indicative of eutrophic conditions, and > 10 are indicative of hypertrophic conditions.

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 so as to achieve 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

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.

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 and 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 DWAF 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 DWAF 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.

Over the past few years – during the expansion process – Potsdam has not been able to meet many of these standards, although the situation has improved considerably in the latter half of 2008 (see Figs 11 and 12 below).

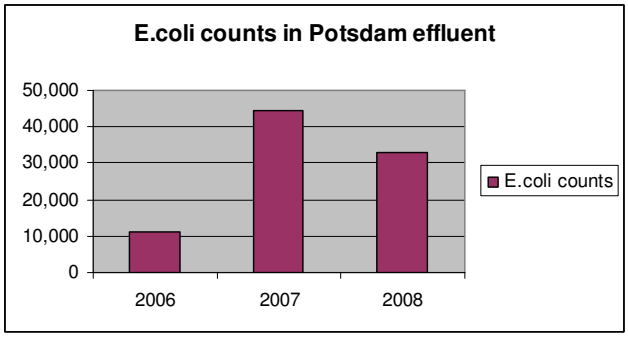


Fig. 11 (a) Average annual E.coli counts in Potsdam effluent.

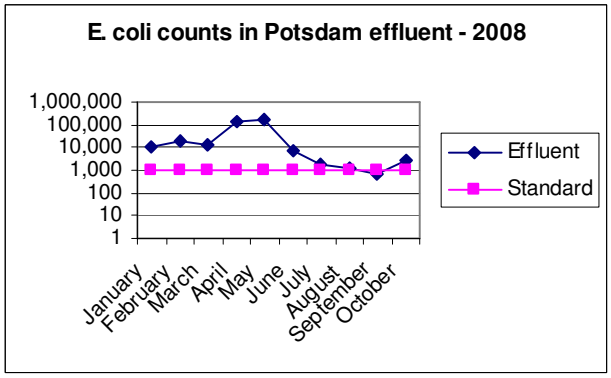


Fig. 11 (b) Average monthly E.coli counts in Potsdam effluent for 2008.

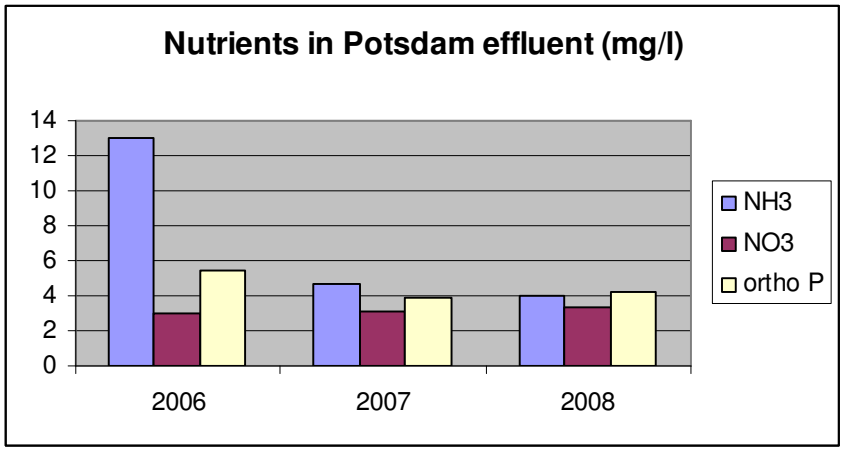


Fig. 12 Average annual nutrient levels in Potsdam effluent.

Given the recent improvements in the effluent quality, the proposals to further reduce the volume of effluent discharged to the estuary (see Section 5.3.1), and the lack of adequate information on other sources of pollution, it is proposed that for the meanwhile the situation should just continue to be monitored. Once there is a better understanding of the relative contribution of Potsdam to the overall pollution load – and should the water quality in the

estuary not improve – there may be a need to review the standards in the permit with a view to implementing a Receiving Water Quality approach.

At the same time, it is noted that as part of an EIA looking at WW Treatment options for the broader Blaauwberg area, consideration is being given to expanding the capacity of Potsdam even further, to 105 Ml/day. Such an expansion would place even further pressure on the estuary unless there was a commitment to maintaining the pollution load at or below current levels (such that the Resource Quality Objectives could be met).

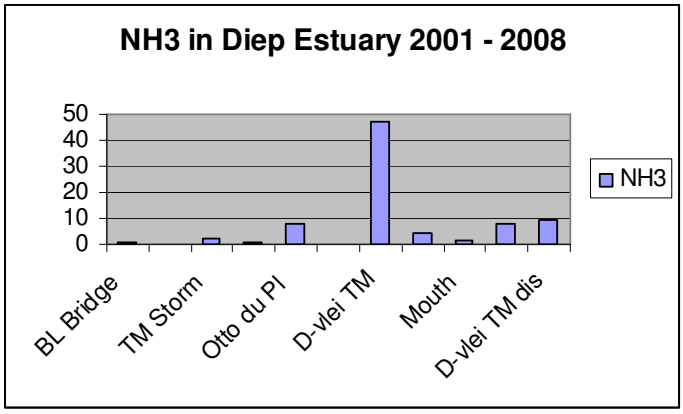
ii) Sewerage infrastructure in the Milnerton/ Blaauberg area.

There have been a number of accidental spills from malfunctioning pump stations directly into the estuary which have had serious consequences for the biodiversity (and have health implications). A survey of all pump stations needs to be completed, and steps taken to ensure that they all have back-up generators, telemetry systems and adequate overflow facilities. This must then be supported by an appropriate reporting system and maintenance regime.

iii) Stormwater drains.

The City's draft 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 finalized and implemented (assuming it is approved by Council). 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 urgently with a view to prioritizing those having the greatest impact. In this context, the proposed study on the stormwater drains along the eastern bank of the estuary, some of which are thought to be highly contaminated with potentially toxic constituents needs to be initiated as soon as possible (see Fig. 13 below, showing high ammonia concentrations in the vicinity of the Theo Marais stormwater outfall). The study involves both quantification of pollution loads, and the development of solutions.



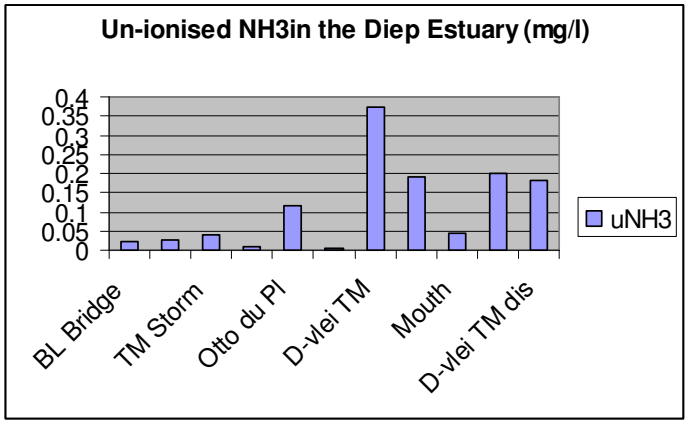


Fig. 13 Ammonia levels at various sampling points in the Diep Estuary ((a) Total Ammonia; and (b) unionized ammonia).

The proposals 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 – need to be implemented as soon as possible, and then 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 will be addressed as part of the proposals for stormwater 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 and Forestry, who have 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.

Monitoring

The City's monitoring programme – funded by the Catchment, Stormwater and River Management Branch - should be expanded to include additional some sampling stations. Proposals in this regard are shown in Fig. 14. These details need to be finalized and catered for in the relevant Service Level Agreement. 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.

Consideration should also be given to initiating ongoing monitoring of sediments and fish. In the case of sediments, sampling could be limited to an annual or bi-annual survey, but should include a broader array of toxic constituents as well as bacteriology. Fish should be sampled annually for toxic constituents such as heavy metals to determine their suitability for consumption.

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.

There should also be a biological monitoring programme with regular monitoring of indicator species such as the sandprawn, other invertebrates, fish and wading birds. This would provide a good measure of overall ecosystem health, and track the recovery of the system.

The results of the monitoring programme would provide a basis against which to evaluate progress towards the achievement of the Water Quality Objectives.

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. Nor has there been any attempt to assess or monitor the quality of the sediments, despite the fact that key benthic species – such as *Callianassa* – have all but disappeared over the past ten years. It is therefore proposed that:

- Sediment quality objectives should be developed and implemented based on current international practice (after guidelines developed under BCLME).
- 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, as well as sediment quality. These could also be used to determine historical patterns of salinity in the system.
- The possibility of closing the mouth in summer and allowing the estuary to backflood, followed by breaching of the mouth in winter to allow it to scour out the accumulated sediments should be investigated.
- Erosion as a result of poor agricultural practices needs to be addressed as part of a Catchment Management Strategy.

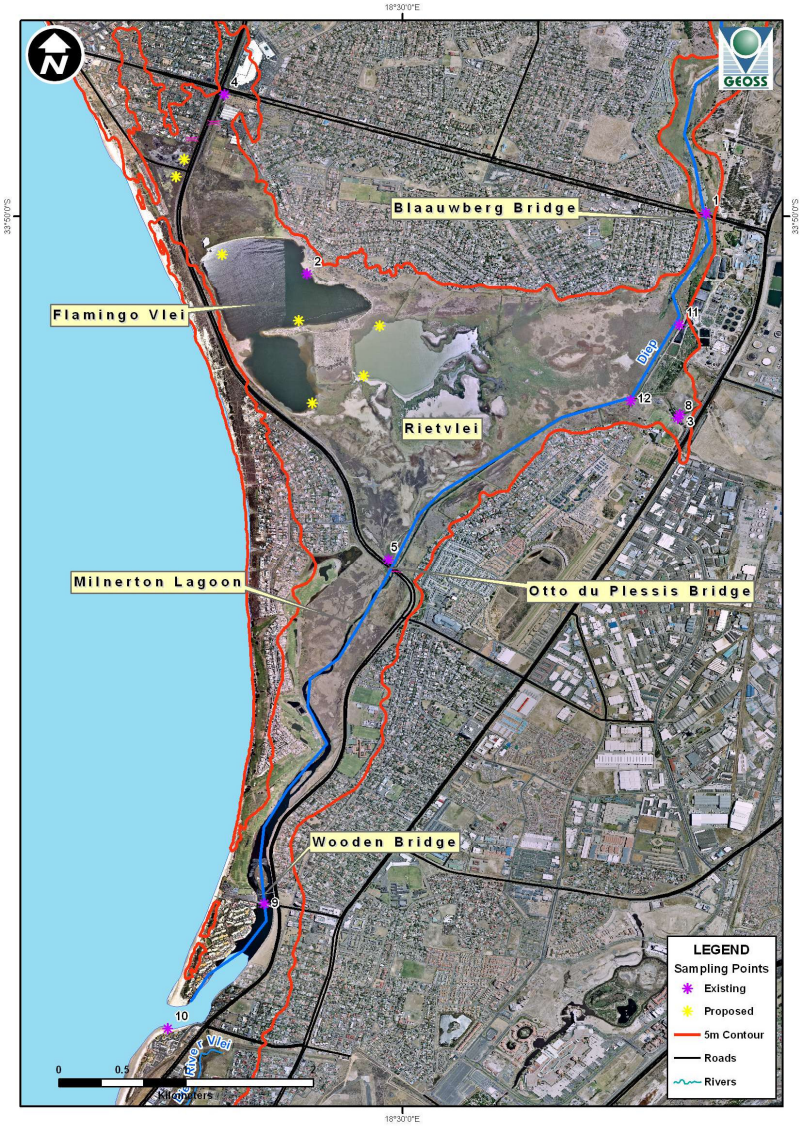


Fig. 14. Sampling points for water quality monitoring.

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.

Despite this, both the estuary and the terrestrial components of the reserve have deteriorated, with further encroachment of urban development, and a decline in water quantity and quality. The question therefore arises as to whether the current legal status of the reserve is the most suitable in terms of providing the required protection and resources. Other alternatives include:

- A Local Authority Nature Reserve.
- A Marine Protected Area.

These and other options need to be further investigated.

In addition, the proclaimed boundaries of the reserve are not in line with the area which is currently being managed. This needs to be rectified to, amongst other things, prevent further development along the margins of the estuary.

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 proposals in the draft policy (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;
- Plans to relocate the model aircraft site in 2014 (when their permit expires) need to be finalized.
- 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. 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. 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 strandveld fynbos in the bird hide 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. Thus, since the number of breeding 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 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***

An invasive alien species management plan should be developed for the reserve, covering prevention and control aspects. This should be in line with both the national policy and the City's strategy on invasive species, and should cover plants and animals in terrestrial and aquatic habitats.

Initial work in the area has focused on woody plants in the terrestrial areas, and as an initial priority should be expanded to include the perennial grasses, kikuyu and couchgrass.

Other priority actions over the next 5 years should include:

- Baseline data collection and mapping of invasive alien plants and identification of priority species for management action;
- Development and implementation of species-specific management strategies for priority species;
- Development and implementation of a long-term clearing plan for alien vegetation in the corridor;
- Identification of areas requiring restoration after alien clearing (and initial restoration of such);
- Establishment of a database of sightings of invasive alien animals and identification of priority species for management action;

- Development and implementation of species-specific management strategies for priority species.

A plan to manage the reedbeds (*Phragmites* and *Typha*) which, although indigenous, are also invasive, 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***

The exploitation of living resources in the Diep Estuary is at present limited to the collection of bait organisms. With the demise of the *Callianassa* population, even this is no longer common. Nevertheless, any exploitation that does take place must be managed on the basis of sustainability.

Exploitation of *Callianassa* should be prohibited with immediate effect until such time as the populations are shown to have recovered sufficiently. Future exploitation should then be controlled through closed areas (as indicated in the Zonation Plan) 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 link should be created between the City's website and that of Friends of Rietvlei.
- 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 clearly insufficient to cope with the additional work which will be required for successful implementation of this Action Plan. It is suggested that an Assistant Reserve Manager be appointed as soon as possible.

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 bringing the expanded Potsdam WWTW into compliance with the DWAF requirements, ongoing pumping of water during the summer from the north lake onto the central pans. Moreover, although an estimated additional amount of just over R 2 million is required for implementation of the Action Plan in the first year[1], around 65% of this is essentially already committed. This means that a further approximately R 750,000 needs to be sourced.

The finances required in later years will, to some extent be dependant on the outcomes of the various studies which have been proposed, and which are planned for the first and second years. Again though, a large proportion of the anticipated actions are likely to be funded by the various responsible authorities.

Nevertheless, it is recommended that options for the establishment of a Trust Fund for the Nature Reserve should be investigated as, if properly constituted, this is likely to make it easier to attract support from the private and non-governmental sectors.

[1] See Action Plan for further detail.

7 ACTION PLAN

The Situation Assessment 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 a large number of proposals aimed at addressing these issues over the period 2009 – 2013 have emerged. These are captured in the Action Plan set out in the tables under Section 7.2. 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.

7.1 Priority Actions

Although it is beyond the scope of this plan, the development of a Catchment Management Strategy is crucial to the effectiveness of management initiatives around the estuary. Some of the issues to be addressed in such a strategy are listed in Annex I.

Priorities more specific to the estuary include:

i) Preliminary Determination of the Ecological Water Requirements and Resource Quality Objectives for the Estuary;
ii) Studies on the hydrology and geohydrology of the estuary;
iii) Topographic survey and development of a Digital Elevation Model;
iv) Study on the stormwater inputs along the East Bank of the estuary and implementation of source reduction measures;
v) Implementation of a collaborative trial programme to restore the salinity regime in the estuary and manage mouth conditions by managing effluent discharges from the Potsdam WWTW;
vi) Expansion of the existing environmental monitoring programme to include additional stations for water quality monitoring, and monitoring of sediments and fish;
vii) Establishment of on-site monitoring capacity for key water quality parameters linked to appropriate management interventions;
viii) Development of an invasive species management plan and implementation of prevention, control and eradication measures for priority species;
ix) Assessment of the current legal status of the reserve and formalization of proposed new boundaries
x) Appointment of an Assistant Reserve Manager.

7.2 Detailed Action Plan: 2009 - 2013

WATER QUANTITY MANAGEMENT				
Steps	**Date**	**Responsibility**	**Estimated Budget**	**Indicator**
Objective A: Re-establishment of a regime more typical of an estuarine system				
1. Development & implementation of a programme for the gradual reduction of discharges from Potsdam during the summer months to a minimum to be determined (based on volumes required to manage mouth conditions as indicated by monitoring).	2009 - 2011	Manager: Water & Sanitation Services (Potsdam Management, Water Demand Management Committee, Reticulation) + Manager: ERMD[2]	R 75,000/year for coordination & monitoring of mouth conditions, salinities etc.	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: Transport, 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.	2009	Manager: ERMD (BM and E & H) + Manager: Transport, Roads & Stormwater (Operational Division)	N/A	Channel depth reduced.
3. Based on recommendations of hydrology & other studies, implement alternative solution.	2011 onwards	Manager: ERMD (BM and E & H)	TBD	Effective management of water levels, especially in the central pans during summer.
4. Development of a Disaster / Flood Management Plan, including the installation of an early warning system at the mouth.	2009	Manager: ERMD (BM & E & H), Head: Disaster Management + Regional Director: DWAF	TBD	Plan in place and water level recorder + extras in place.

[2] ERMD = Environmental Resource Management Department; BM = Biodiversity Management; Rietvlei MWG = Rietvlei Management Working Group.

WATER 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	2009	Regional Director: DWAF	R 200,000	Resource Quality Objectives in place + requirements for Potsdam.
2. Gazetting of Resource Quality Objectives.	2009	Regional Director: DWAF	N/A[3]	Binding Resource Quality Objectives in place.
Objective D : To meet interim water quality objectives				
1. Potsdam to achieve compliance with permit standards (current and future), and flows reduced as per programme to be agreed.	2009 ongoing	Manager: Water & Sanitation Services (Wastewater Branch) (CCT)	N/A	Compliance confirmed by DWAF monitoring
2. Implementation of source reduction measures for contaminants in stormwater (under development).	2010 - 2011	Manager: Transport, Roads and Stormwater (CCT)	TBD	Stormwater complies with recommended quality objectives.
3. Review of Potsdam permit standards and stormwater quality objectives should water quality in the receiving waters not improve.	January 2011	Manager: ERMD (BM and E & H) + Regional Director: DWAF	N/A	Recommendations on further improvements to Potsdam effluent and stormwater discharges.
4. Expansion of water quality monitoring programme and addition of sediment and biological sampling.	July 2009	Manager: Transport, Roads and Stormwater (Catchment Management)	TBD	Improved sampling coverage of various components of the estuary + trend data.
Objective E : Reduction in accidental discharges to the estuary				
1. Complete survey of pump stations & other elements of the sewerage reticulation system in Milnerton.	2009	Manager: Water and Sanitation Services: (Reticulation)	N/A	Report identifying problem areas.
2. Install back-up generators, telemetry systems and adequate overflow facilities as required (+ maintenance programme).	2009/2010	Manager: Water and Sanitation Services: (Reticulation)	TBD	Reduction in frequency of accidental discharges as a result of pump station failures.

[3] 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.

Steps	Date	Responsibility	Estimated Budget	Indicator
3. Inclusion of Reserve Management in incident reporting system, & development of a Response Plan.	2009/2010	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	2009 - 2010	Regional Director: DWAF + 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.	2009	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.	2009	Reserve Management	TBD	Effective response to low oxygen and pollution events.

STUDIES/INFORMATION GATHERING				
Steps	**Date**	**Responsibility**	**Estimated Budget**	**Indicator**
Objective H : To improve understanding of the hydrodynamics of the system.				
1. Appointment of consultants to undertake studies of the hydrology & geohydrology of the estuary (including installation of water level and salinity recorders and piezometers).	2009/2010	Manager: ERMD: BM & Chair: Rietvlei MWG	R 260,000	Improved understanding of water balance in the system, and therefore capacity to manage it..
2. Ongoing monitoring of water levels, salinity etc. at stations established during above study. (Could be done in-house, or by consultant).	2010 - 2013	Regional Director: DWAF + Manager: Transport, Roads & Stormwater (Catchment Management)	R 5,000 per sampling run (if done by consultant).	Database to support management of hydrodynamics.
3. Topographic survey and development of Digital Elevation Model.	2009	Manager: ERMD: BM & Chair: Rietvlei MWG	R 10,000	Map & model of estuary topography available to assist in management.
4. Study of the sediments – rates of sedimentation, source of sediments and sediment quality.	2009/2010	Manager: ERMD: BM & Chair: Rietvlei MWG	R 25,000 + costs of analysis (TBD)	Improved understanding of sedimentation + management proposals.
5. GIS mapping of historical aerial photos to show temporal changes in the extent of drying of central pans.	2009	Manager: ERMD: BM & Chair: Rietvlei MWG	R 20,000	Report on historical patterns in seasonal water level fluctuations.
6. Development of a hydro-dynamics model based on the above data to support management decisions.	2010	ERMD: Manager: BM & Chair: Rietvlei MWG	TBD	Improved capacity to manage hydrodynamics.
7. Comprehensive Reserve Determination in terms of NWA (will provide water quantity & quality objectives etc)	2011/2012	Regional Director: DWAF	Approx. R 1 million (noting that above studies will contribute data).	Resource Quality Objectives in place for Diep Estuary.

Steps	Date	Responsibility	Estimated Budget	Indicator
Objective I : To improve understanding of the ecological requirements of the central pans (wading birds)				
1. Review of relevant literature & expert consultation.	2009	Manager: ERMD (BM and E & H)	R 15,000	Recommendations on management of water levels in central pans.
2. On-site investigations (if necessary)	2010	Manager: ERMD (BM and E & H)	TBD	Recommendations on ecological requirements in management of water levels in central pans.
Objective J : To improve understanding of the relative contribution of stormwater to the deterioration in water quality				
1. Appointment of consultants for the assessment of the stormwater inputs along the Eastern Bank of the estuary & development of management measures.	Jan 2009 – June 2010	Manager: Transport, Roads and Stormwater (City)	R 1 million	Consultants report on flows & contaminants in stormwater, and including recommendations for management measures
2. Mapping and assessment of stormwater drains along the west bank of the estuary..	2009	Manager:Transport, Roads and Stormwater (City)	TBD	Inclusion of stormwater outlets on west bank on GIS map, and report on quantity and quality of flows.
3. Assessment of contribution of stormwater drains on the northern banks	2009	Manager: Transport, Roads and Stormwater (City)	TBD	Report on quantity and quality of flows.
4. Comparative assessment of pollution loads from various sources.	2010	Manager: Transport, Roads and Stormwater (City)	TBD	Comprehensive understanding of the pollution sources to the estuary.
Objective K : To improve knowledge of the biology of the estuary				
1. Identify gaps in the knowledge base and prioritise taxonomic groups, species, habitats etc.	2009	Reserve Manager & Chair: Rietvlei MWG	N/A	List of priority biological studies.
2. Develop a programme to address priorities, through student projects.	2009 - 2013	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.	2009	Reserve Manager & Chair: Rietvlei MWG	TBD	Externally funded projects involving tertiary institutions.
4. Programme on fish populations in the estuary	Ongoing	DDG: MCM	N/A	Improved understanding of the fish populations in the estuary.

Objective L : To improve management of sediments				
1. To develop sediment quality objectives based on international practice.	2009/2010	DDG: MCM (?)	TBD	RSA sediment quality objectives in place.

LEGAL/POLICY MEASURES				
Steps	**Date**	**Responsibility**	**Estimated Budget**	**Indicator**
Objective M : to formalize the expanded boundaries of the reserve				
1. Initiate discussions between the City's Biodiversity Branch and the Roads Planning Department	February, 2009	Manager: ERMD: BM & Chair: Rietvlei MWG	N/A	Agreement on area between Blaauberg Bridge and railway bridge to be included in the expanded reserve.
2. Prepare and submit application for expanded reserve boundaries to the relevant authority (Province/DEAT).	April-May, 2009	Manager: ERMD: BM & Chair: Rietvlei MWG	N/A	Expanded boundaries of the reserve legally recognized.
Objective N : to assess current legal status of the reserve (PNE under NEM:PA) & assess this in relation to other options				
1. Development of TOR & appointment of legal consultants to investigate options.	February, 2009	Manager: ERMD: BM & Chair: Rietvlei MWG	R 35,000	Acceptance of consultants report.
2. Implementation of the recommendations of the report.	2009/2010	Manager: ERMD: BM & Chair: Rietvlei MWG	TBD	Optimal legal status achieved for the reserve/estuary.
Objective O : to formalize the Estuary Zonation Plan				
1.Prepare submission for gazetting of the Estuary Zonation Plan	February, 2009	Manager: ERMD: BM & Chair: Rietvlei MWG	N/A	Estuary Zonation Plan gazetted.
Objective P : approval and implementation of policies on stormwater and floodplain management				
1. Finalise text of policies and circulate as appropriate.	2009	Manager: Transport, Roads and Stormwater (City)	N/A	Policies adopted and implemented.
Objective Q : to improve protection of the reserve from encroachment of private gardens and invasive plants				
1. Development an appropriate by-law (or amend existing one).	July, 2009	Manager: ERMD: BM & Chair: Rietvlei MWG	N/A	By-law approved and implementation initiated.
Objective R : to reach a consensus within the City on WWT options for the Blaauberg area				
1. Convene a meeting of all relevant Departments within the City to try and agree on a mutual approach to Potsdam & WWT requirements for Blaauberg region.	January, 2009	Manager: ERMD (BM and E & H)	N/A	Agreed City approach to WWT requirements in the Blaauberg region.

CONSERVATION AND PLANNING INITIATIVES				
Steps	**Date**	**Responsibility**	**Estimated Budget**	**Indicator**
Objective S : Development and upgrading of Reserve infrastructure				
1. Appointment of architects for detailed design of proposed office block (with adjustments to include a small laboratory).	January, 2009	Reserve Management[4] + City Planners/Works	TBD	Acceptance of detailed design
2. Appointment of building contractors	2009/2010	Reserve Management + City Planners/Works	Approx. R 3 million	Construction of office block completed.
3. Upgrading of recreational & picnicking facilities around north lake.	Jan – June, 2009	Reserve Manager	TBD	Public satisfaction with available facilities.
4. Development of a detailed assessment of fencing requirements, including budget and motivation.	February, 2009	Reserve Manager	TBD	Submission of budget request for at least priority fencing requirements.
5. Installation of fencing in priority areas.	2010	Reserve Management + City Works	TBD	Priority areas fenced & reduction in wildlife kills.
Objective T : 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).	2009	Reserve Management	N/A	Structured approach to development of appropriate facilities, features etc in the estuary.
2. Implementation of the CDF.	2010 - 2013	Reserve Management	TBD	Facilities, features etc. in place.
Objective U : Rehabilitation of biodiversity				
1. Development of biodiversity rehabilitation programme.	2009	Reserve Management	N/A	Structured approach to rehabilitation.
2. Continuation of rehabilitation of strandveld in area between north and south lakes.	2009	Reserve Management	R 50,000	Strandveld established.
3. Rehabilitation of aquatic areas (once water quality has improved).	2011?	Reserve Management	TBD	Aquatic biodiversity restored.

[4] Reserve Management includes the Manager: Biodiversity, the Area Manager: North District, and the Reserve Manager.

Steps	Date	Responsibility	Estimated Budget	Indicator
4. Rehabilitation of salt marsh vegetation.	2011?	Reserve Management	TBD	Salt marsh vegetation restored.
5. Annual discussions with Working for Wetlands on priorities for wetland rehabilitation.	2010/2013	Reserve Management + Working for Wetlands	TBD	Partnership with Working for Wetlands & funding for agreed priorities.
Objective V : Invasive species management				
1. Development of an invasive species management plan for the estuary (terrestrial and aquatic).	2009	Reserve Management + City's Invasive Species Coordinator.	R 35,000	Structured approach to addressing invasive species in the estuary/Nature Reserve.
2. Ongoing clearing of terrestrial invasives (woody plants) in and near the reserve, and control programme on perennial grasses initiated.	Jan – June, 2009 2009/2010	Reserve Management + City's Invasive Species Coordinator. Working for Wetlands	R 33,000 R 133,000	Priority areas cleared of woody plants, and initial work on perennial grasses completed..
3. Annual discussions with Working for Wetlands on priorities to be addressed.	2010/2013	Reserve Management + Working for Wetlands	TBD	Partnership with Working for Wetlands & funding for agreed priorities.
4. Implementation of programme on aquatic invasives.	2010/2013	Reserve Management + Working for Wetlands	TBD	Reduction in aquatic invasives.

EDUCATION AND AWARENESS-RAISING				
Steps	**Date**	**Responsibility**	**Estimated Budget**	**Indicator**
Objective W : 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.	2009	Reserve Manager + Environmental Communications + Friends of Rietvlei	R 50,000	Updated material available for distribution.
2. Establish contact with Intaka re Xhosa-speaking guides.	February, 2009	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.	February, 2009	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.	2009	Reserve Manager + Department of Agriculture (Landcare)	R 25,000	Brochure available for distribution to farmers, miners etc in the catchment.
5. To promote awareness amongst decision-makers of the value of the estuary and Nature Reserve.	2009	Reserve Management	N/A	Political support for estuary rehabilitation programme, & reduction in decisions which could negatively impact on it.
Objective X : To promote awareness of and compliance with the Estuary Zonation Plan				
1. Displays, posters and brochures showing the zoning	July, 2009	Reserve Manager + ERMD (Communications) + Friends of Rietvlei	R 25,000	Awareness of Zonation Plan.
Objective Y : To document and promote awareness of the rehabilitation initiative				
1. Investigate options for the production of a DVD.	January 2009	Reserve Manager + ERMD (Communications) + Friends of Rietvlei	TBD	Partnership with relevant institution.
2. Implement	2009 - 2013	Reserve Manager + ERMD (Communications) + Friends of Rietvlei		DVD documenting rehabilitation process, with clips aired on 50/50 & other relevant programmes

Steps	Date	Responsibility	Estimated Budget	Indicator
Objective Z : To promote awareness of health & sanitation issues around the estuary				
1. Develop brochure in relevant languages	2009	Reserve Manager + Environmental Communications + DWAF	R 25,000	Brochure available for use in community education programme.
2. Meetings with community leaders	2009-2010	Regional Director: DWAF	N/A	Support of community leaders for educational programme.
Objective AA : To promote and market the Reserve				
1. Improve signage	2009	Reserve Manager + Roads Department	TBD	Increased number of visitors
2. Friends of Rietvlei website linked to City website	Ongoing	Friends of Rietvlei	N/A	Increased number of hits on the website.
3. Brochures provided to Cape Town Tourism	2010	Reserve Manager	N/A	Increased number of visitors

RESOURCE REQUIREMENTS				
Steps	**Date**	**Responsibility**	**Estimated Budget**	**Indicator**
Objective AB : To increase capacity of human resources				
1. Appointment of an Assistant Reserve Manager	July, 2009	Manager: ERMD	R 150,000	Assistant Manager in place.
2. Training in estuaries management (C.A.P.E. Training)	2009/2010	Manager: ERMD	R 10,000	Staff capacity increased.
Objective AC : To improve availability of financial resources to implement the Action Plan				
1. Investigate options for the establishment of a Trust Fund for the Rietvlei Reserve/Diep Estuary	2009	ERMD/ Rietvlei Management WG	N/A	Trust established.
2. Identify and target potential sources of funding	2009 ongoing	ERMD/ Rietvlei Management WG	N/A	Funding available for implementation of Action Plan & related activities.

8. FRAMEWORK FOR IMPLEMENTATION

A Management Committee for the Rietvlei Nature Reserve has been in existence since the establishment of the reserve, and it is proposed that this existing committee – with some additional members - also be responsible for overseeing the implementation of the EMP.

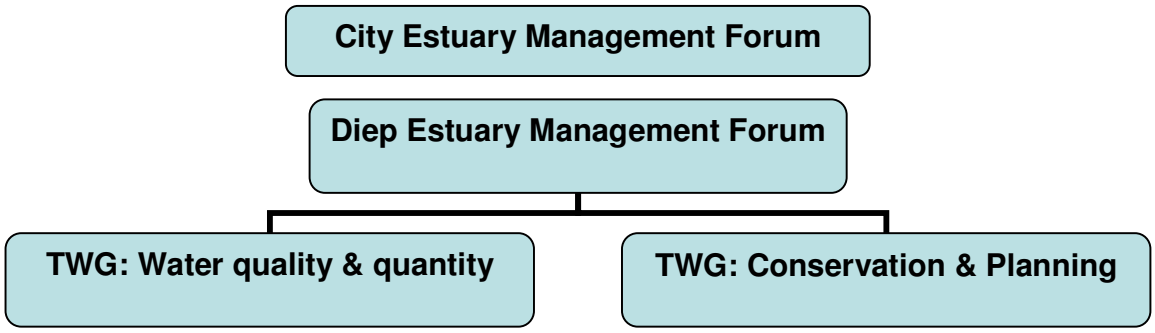
Existing members of the committee include:

- City of Cape Town (various different divisions)
- Department of Water Affairs and Forestry
- Cape Nature
- WWF
- Chevron
- Friends of Rietvlei
- Milnerton Aquatic Club
- Bird expert

Additional members should include:

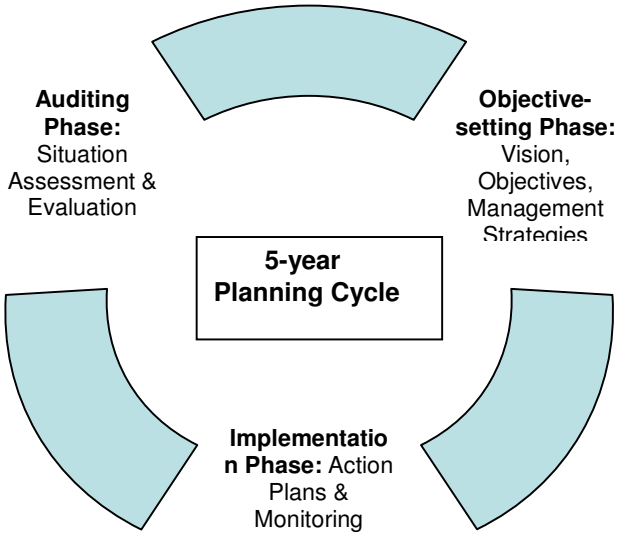
- Marine and Coastal Management (DEAT)
- Department of Agriculture (Landcare)
- Department of Environmental Affairs and Development Planning (W.Cape)
- Ratepayers

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

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.