PROVINCE OF THE EASTERN CAPE
IPHONDO LEMPUMA KOLONI
PROVINSIE OOS-KAAP

Provincial Gazette
Igazethi Yephondo
Provinsiale Koerant
(Extraordinary)

Vol. 23

BISHO/KING WILLIAM'S TOWN
1 FEBRUARY 2016
1 FEBRUARIE 2016

No. 3584

PART 1 OF 2

ISSN 1682-4556

Government Printing Works

Notice submission deadlines

Government Printing Works has over the last few months implemented rules for completing and submitting the electronic Adobe Forms when you, the customer, submit your notice request.

In line with these business rules, GPW has revised the notice submission deadlines for all gazettes. Please refer to the GPW website www.gpwonline.co.za to familiarise yourself with the new deadlines.

CANCELLATIONS

Cancellation of notice submissions are accepted by GPW according to the deadlines stated in the table above.
Non-compliance to these deadlines will result in your request being failed. **Please pay special attention to the different deadlines for each gazette**.
Please note that any notices cancelled after the cancellation deadline will be published and charged at full cost.

Requests for cancellation must be sent by the original sender of the notice and must accompanied by the relevant notice reference number (N-) in the email body.

AMENDMENTS TO NOTICES

With effect **from 01 October**, GPW will not longer accept amendments to notices. The cancellation process will need to be followed and a new notice submitted thereafter for the next available publication date.

CUSTOMER INQUIRIES

Many of our customers request immediate feedback/confirmation of notice placement in the gazette from our Contact Centre once they have submitted their notice – While GPW deems it one of their highest priorities and responsibilities to provide customers with this requested feedback and the best service at all times, we are only able to do so once we have started processing your notice submission.

GPW has a **2-working day turnaround time for processing notices** received according to the business rules and deadline submissions.

Please keep this in mind when making inquiries about your notice submission at the Contact Centre.

PROOF OF PAYMENTS

GPW reminds you that all notice submissions **MUST** be submitted with an accompanying proof of payment (PoP) or purchase order (PO). If any PoP's or PO's are received without a notice submission, it will be failed and your notice will not be processed.

When submitting your notice request to submit.egazette@gpw.gov.za, please ensure that a purchase order (GPW Account customer) or proof of payment (non-GPW Account customer) is included with your notice submission. All documentation relating to the notice submission must be in a single email.

A reminder that documents must be attached separately in your email to GPW. (In other words, your email should have an Adobe Form plus proof of payment/purchase order – 2 separate attachments – where notice content is applicable, it should also be a 3rd separate attachment).

REMINDER OF THE GPW BUSINESS RULES

- ❑ Single notice, single email – with proof of payment or purchase order.
- ❑ All documents must be attached separately in your email to GPW.
- ❑ 1 notice = 1 form, i.e. each notice must be on a separate form
- ❑ Please submit your notice **ONLY ONCE.**
- ❑ Requests for information, quotations and inquiries must be sent to the Contact Centre **ONLY**.
- ❑ The notice information that you send us on the form is what we publish. Please do not put any instructions in the email body.

government printing
Department:
Government Printing Works
REPUBLIC OF SOUTH AFRICA

eGazette

ADVERTISEMENT

GENERAL NOTICES • ALGEMENE KENNISGEWINGS

NOTICE 8 OF 2016

NELSON MANDELA BAY COASTAL MANAGEMENT LINES

I, Sakhumzi Somyo, the Member of Executive Council (MEC) for Department of Economic Development, Environmental Affairs and Tourism hereby give notice of my intention to, in terms of section 53 of the National Environmental Management: Integrated Coastal Management Act, 2008 (Act No. 24 of 2008) (ICM Act), adopt the coastal setback lines in terms of section 25 of ICM Act.

Members of the public are invited to submit to the MEC, within 30 (thirty) days after the publication of the notice in the Gazette, with written comments or inputs to the following addresses:

By post to:
General Manager
Environmental Affairs
Private Bag X0054
Bisho
5605

By hand at:
2nd floor, Room 288
Beacon Hill
Corner of Hargreaves Street & Hockley Close
King Williams Town, 5600

By email at: Sandiso.zide@deaet.ecape.gov.za or
By fax to: 043 605 7300

Enquiries: Mr S. Zide, tel. 043 605 7256

Comments received after the closing date may not be considered.

Sakhumzi Somyo
MEC for Department of Economic Development, Environmental Affairs and Tourism

DEPARTMENT OF ECONOMIC DEVELOPMENT, ENVIRONMENTAL AFFAIRS AND TOURISM

ESTABLISHMENT OF COASTAL MANAGEMENT LINES FOR NELSON MANDELA BAY

FINAL REPORT

Department of Economic Development, Environmental Affairs and Tourism (DEDEAT)
Private Bag X0054, Bisho, 5605
South Africa
Beacon Hill Office Park, Cnr of Hargreaves Road & Hockley Close, King William's Town, 5600

Contact Details

Sandiso Zide
Tel: +27 43 605 7256
Fax: +27 43 605 7300
Email: sandiso.zide@deaet.ecape.gov.za

Province of the
EASTERN CAPE
ECONOMIC DEVELOPMENT, ENVIRONMENTAL AFFAIRS AND TOURISM

Study performed by:

Masande Consultants

Afri-Coast Engineers SA (Pty) Ltd

Public participation process facilitators:

Afri-Coast Engineers SA (Pty) Ltd

DISCLAIMER

This review and amendment of the 2012 version of the *Final Draft Report on the Establishment of Coastal Management Lines for Nelson Mandela Bay*, performed by Afri-Coast Engineers SA (Pty) Ltd as the public participation process facilitators, only addressed the structure of the 2012 report subsequent to public review of, and input into the report. The technical methodology for and results of the exercise towards the determination of the coastal management lines for Nelson Mandela Bay remains unchanged.

At the time of the exercise of determining the coastal management lines and updating the coastal protection zone, and the drafting of the original report in June 2012, the legislation spoke of 'coastal setback lines'. The ICM Amendment Bill has since been drafted, which substitutes the word 'setback' with 'management', hence the substitution of the former with the latter throughout the current review of the report.

Executive Summary

Coastal areas are sensitive, vulnerable, often highly dynamic and stressed ecosystems. Increasingly coastal areas will be subjected to climate change impacts, particularly related to rising sea-levels and the potential increase in the frequency and intensity of storm events. Coastal areas therefore require specific attention in management and planning procedures, especially where the coastal areas are subject to significant human resource usage and development pressure.

Recent legislation aims to address issues relating to specific coastal management issues, namely the National Environmental Management: Integrated Coastal Management Act, Act No. 24 of 2008 (ICM Act), which was promulgated on 11 February 2009. **T**he objectives of the ICM Act are:

- to determine the coastal zone of the Republic;
- to provide, within the framework of the National Environmental Management Act, for the co-ordinated and integrated management of the coastal zone by all spheres of government in accordance with the principles of co-operative governance;
- to preserve, protect, extend and enhance the status of coastal public property as being held in trust by the State on behalf of all South Africans, including future generations;
- to secure equitable access to the opportunities and benefits of coastal public property; and
- to give effect to the Republic's obligations in terms of international law regarding coastal management and the marine environment.

Amongst other management tools the ICM Act provides for the establishment of coastal management lines and defines a coastal management line as *"a line determined by the Member of Executive Council (MEC) in accordance with section 25 in order to demarcate an area within which development will be prohibited or controlled in order to achieve the objectives of this Act or coastal management objectives"*. The National Environmental Management: Integrated Coastal Management Amendment Bill, published in Government Gazette No. 35988 on 21 December 2012, substitutes the term "set-back line" with "management line". **T**his report has thus been amended to reflect this change.

Before making or amending the regulations referred to above, the MEC must—

(a) consult with any local municipality within whose area of jurisdiction the coastal management line is, or will be, situated: and
(b) give interested and affected parties an opportunity to make representations in accordance with Part 5 of Chapter 6.

During the process of determining coastal management lines for Nelson Mandela Bay it became evident that it would be advantageous to adjust the "coastal protection zone", as defined in the ICM Act, as part of the process.

In 2010 Masande Consultants, Afri-Coast Engineers SA (Pty) Ltd, was appointed by the NMBM, in partnership with DEDEA**T**, to determine the coastal management lines for Nelson Mandela Bay. **T**he methodology selected was based on a combination of national and international best practice and the consultant's

experience. In addition the methodology was closely aligned with the approach followed elsewhere in the country at the time. A pragmatic approach was selected, using only available data and with limited numerical modelling. The data used included: tide data, wave data, predicted sea level rise (IPCC, 2007) Digital Terrain Model (DTM), bathymetry (SANHO) aerial photographs, cross shore profiles, cadastral data, and the Nelson Mandela Metropolitan Open Space System (NMB MOSS).

The summarised methodology, results and conclusion of the study are presented in the consecutive steps below.

Step 1: Determine 1:10 year storm wave height and period for NMBM coastline

From evaluation of the results of extreme wave statistics it was decided that the predicted 17% increase in wave height due to climate change should be incorporated and thus the extreme 1:10 year return wave conditions to be used are H_o = 9.8 m as calculated for a position at 30m water depth off Cape St Francis.

The coastal set back process which was developed in the Western Cape has chosen the 1:100 erosion risk which is determined using the numerical model SBEACH. This type of modelling exercise was not envisaged at the start of this project. This would entail setting up the model for the entire coast and collecting additional data. In view of this it is proposed that a 1:10 year run up event is combined with a 1:100 year shoreline retreat trend is used as separate parts rather than combining these through the SBEACH model. It must be understood that this is different to the SBEACH analysis however given the additional buffers still to be included in determining the management lines it is unlikely that a significant difference will be found. However, it is recommended that when an SBEACH erosion model is undertaken in this region that the results of this study be re-examined in the light of this new information.

Step 2: Evaluation of the run up model comparisons

The only assumption, which could make a material difference to the results of the comparisons, is the offshore wave heights. Port Elizabeth does not have a wave height recorder and so data for wave height and period, which is used in all run up models, was sourced from NOAA Wave Watch 3 (NWW3) global wave hindcast model. The NWW3 hindcast are run with the archived (historical) wind fields, which provide higher accuracy wave data than the forecast data. Hindcast wave data extracted from a position directly offshore of Cape Recife (34.25°S, 25.75°E) was then used to evaluate the 3 wave run-up models.

The comparison are based on the three proposed models of

- Nielsen and Hanslow 1991;
- Stockdon *et al.* 2006; and
- Mather *et al.* 2010.

The models have been tested for applicability in the NMBM region by applying data gathered from the region at the following sites: Maitlands beach, Pollok beach, Bluewater Bay beach and Wells Estate beach.

Bathymetric data, from the South African Navy Hydrographic Office (SANHO), and beach survey data were utilized to produce all other data for input into the three models. 10 shore normal transects were measured at Maitlands Beach, Bluewater Bay Beach and Wells Estate Beach, only 5 shore normal transects were measured at Pollok Beach due to limited data coverage at this site. Along each transect the following measurements were made: measured runup level, lower-beach level, distance between 0 msl and -15 m depth contour. From the measured runup level and lower-beach level the beach face slope could be calculated.

From this evaluation it was evident that the worse performing model for this area is the Nielsen and Hanslow (1991) model. The best performing model was that of Stockdon *et al.* (2006) which while under predicting did give a tighter distribution of results at all four locations. However, this model requires a significant amount of data, which needs to be provided to populate their equation shown below:

$$R_{\max} = 1.1\left[0.35\beta_f\sqrt{H_0 L_0} + 0.5\sqrt{H_0 L_0\left(0.563\beta_f^2 + 0.004\right)}\right]$$

In order to provide the input data for this model a survey would be required along the entire 102 km of coastline to establish the beach face slope βf. This would entail significant additional costs beyond the scope of the current appointment and therefore while the model provides good results the additional costs involved appear to be excessive in terms of the improved prediction of wave run up.

This leaves the Mather et al. (2010) model that uses readily available data and the simple formula as follows:

$$R_{\max} = CH_0 S^{2/3}$$

In this assessment calibration studies have determined a value of C=6 for the coastline west of Cape Recife, and C=11 for the coastline east of Cape Recife will be used. The wave run up position will be buffered by additional environmental and social requirements and so the position of the set back line will in all cases be inland of this line and therefore it is recommended that the Mather *et al.* (2010) model be used given the constraints to data availability.

Step 2: Determination of inland maximum scour envelope

The wet-line and algal line gives the approximation of the shoreline at the time of the aerial photograph. The wet-line was digitized along sandy sections of beach and the algal line was digitized along rocky sections of coast for 2004 and 2007 aerial photographs. The wet-line and algal line could not be distinguished clearly on the lower resolution 1996 aerial photographs therefore these were excluded from this exercise. All wet-line data and algal line data was then used to create a composite wet-line at the most landward position of all lines along the entire NMBM coastline. Due to the fact that only two data sets 3 years apart were available this data was not considered suitable for shoreline regression analysis. It has been recommended that this step be revised.

The vegetation line was digitized for 1996, 2004 and 2007 aerials and these data were assessed for suitability for regression trend analysis. Several limitations were encountered with this data:

- Limited record of 11 years between 1996 and 2004
- Large tracts of mobile coastal dunefields along the NMBM coastline, where the vegetation line is controlled by aeolian processes rather than wave processes.
- Uncontrolled access across foredunes has destabilized vegetation in many areas and in some instances lead to blow-outs affecting the position of the vegetation line.

For the reasons stated above it was decided that this data could not be used to calculate regression trends with reasonable accuracy, therefore regression trends would not be included in this study at this stage.

The only cross section data available is that collected over the past 12 years as part of the long term monitoring of the affect of the Port of Ngqura by Transnet National Ports Authority (TNPA). Analysis of this data showed no significant trend and the time period was considered too short for use in extrapolating an erosion trend for 100 years. Cross section data was compared with the composite wet-line data to verify the maximum scour envelope.

Step 4: Determination of current HWM in terms of the ICM ACT for sandy portion of coastline

The photogrammetric data from aerial photography conducted in July 2004 for the NMBM had to be processed and interpolated to create a Digital Terrain Model (DTM) for the coastline. In addition the -15m depth contour was digitized from the Navy Chart SAN125 and added to the DTM data.

According to the ICM Act the theoretical HWM is the level reached by storm waves occurring at no less than a 1:10 year return period, therefore in order to calculate the HWM the wave conditions selected in step 1 were modelled using Mather *et al.* 2010. Data points were produced at 20m intervals. Overlaying the outputs of the aerial HWM modelling over the DTM and aerial photographs allowed for model data and DTM verification.

Step 5: Determination of current theoretical HWM in terms of the ICM Act for rocky portion of coastline

For the rocky portions of coast the wave runup was calculated using the 1:10 year wave data (step 1) and the Eurotop manual[1]. The modeling was undertaken along the selected sections of rocky shoreline. The results were supplied as a GIS shapefile.

Step 6: Determination of the predicted future HWM

The regression due to predicted sea level rise associated with global warming was simulated differently for sandy and rocky coastline. For sandy coastline vulnerable to erosion, where greater regression is expected, the Bruun rule was used. This was conducted using the DTM data and three sea level rise scenarios, 300mm, 600mm and 1000mm.

For rocky coastline resilient to erosion, the Eurotop wave runup modelling output surface was shifted vertically by 1000mm and the intersection with the DTM data was calculated in the Auto Cad environment.

Step 7: Determine the environment buffers required inland from the HWM to maintain a functional coastal ecosystem under future sea level rise scenarios.

Step 8: Determine the social buffers required along the coast.

For example allowance for public beach access through and along the coastal frontage or for areas which have cultural significance and will need to be preserved from development.

Step 9: Determine any economic requirements for the coast.

For example, allowance for new beach facilities that will need to be placed closer than normal development to serve the public. Economic demands often require a trade off against environmental aspects at a particular site. Therefore the project team provided an acceptable methodology to deal with the possible conflicts between the desire for environmental protection and the need for economic activities.

In preparation for the workshop, broad steps of the process were followed and provided for to all the participants prior to and during the workshop. Geographic Information Systems (GIS) imagery and shape files determined in the earlier stages of this project were used to facilitate and record the decisions taken at each location. Analysis of data through a live GIS application was also undertaken. The lines that were used for the workshop included:-

- Current HWM
- Maximum scour HWM
- Position of the HWM under 300, 600 and 1000mm of sea level rise
- The NMB MOSS coverage

At each stretch of beach examination of the HWM under the various sea level rise scenarios and determination of the hazard zone and coastal process management line was established. A maximum sea level rise of 1000mm in 100 years combined with a sea storm with a return period of 1:10 years was chosen as a principal determinant for the coastal process management line. This was the first line of importance in determining the zone in which any development placed sea ward of this line is likely to experience direct wave attack within the next 100 years.

Given that the approach in the ICM Act is based around human use and activities along the coast, the balance between the opposing risk extremes of asset loss and the usage of the coast for human purposes was considered. It was agreed that the coastal process management line should be used as the principle determinant of the coastal management line and this line should not be manipulated due to social, economic, ownership or zoning issues.

The process of determining the CPZL took into account environmental and social considerations, with the NMB MOSS being the principle determinant.

Step 10: Determine the coastal management line and CPZL taking into account the information and requirements of the above steps.

The preliminary analysis of the legal frameworks and policies of the coastal management objectives and of the national government shows a lack of a common methodology for coastal managements at the provincial and/ local level, even though the procedure on coastal zone determination through the ICM Act had been promulgated with a clear reference to coastal managements and the coastal protection zone (CPZ).

The results of the preliminary study carried out shows that management lines cannot be based on physical processes alone. Furthermore, the generic application of an arbitrary distance from the coastline (e.g. 100 m from high water mark) ignores the diversity of coastal characteristics and physical processes and should be only applied when more specific information is not yet available. However, it could be the starting point for the definition of a more appropriate management line, based on scientific understanding and local knowledge, taking into consideration natural processes, landscape values, public use and accessibility.

Section 25 of the ICM Act requires that the MEC, before making or amending regulations, must –

(a) consult with any local municipality within whose area of jurisdiction the coastal management line is, or will be, situated; and
(b) give interested and affected parties an opportunity to make representations in accordance with Part 5 of Chapter 6.

The ICM Act allows for the pro-active determination of coastal management lines and the adjustment of the CPZ. Coastal management lines and the CPZ must also at times be re-actively determined when considering development applications in terms of the NEMA EIA Regulations. Due to the uncertainties surrounding the exact impacts of global warming, in terms of sea level rise and increased frequency and intensity of storm events, it is recommended that the whole exercise be conducted using updated input data every 5 years.

Finally as and when funding becomes available the management lines for estuaries within the NMBM should be determined and combined with the coastal management lines established during this study.

DEPARTMENT OF ECONOMIC DEVELOPMENT, ENVIRONMENTAL AFFAIRS AND TOURISM

P7191-T01

ESTABLISHMENT OF COASTAL MANAGEMENT LINES FOR NELSON MANDELA BAY

FINAL REPORT

CONTENTS

Annexure C: Stakeholder register

Annexure D: I&AP Register

Annexure E: Attendance registers and minutes from stakeholder meetings

Annexure F: Attendance registers and minutes from public meetings

Annexure G: Comment and response register

Annexure H: Set of 11 maps showing the coastal management line for the entire Nelson Mandela Bay coastline

LIST OF TABLES

LIST OF FIGURES

DEFINITIONS/ABREVIATIONS

CSL	Coastal Management Line An artificial line, determined by an MEC, in accordance with section 25 of the ICM Act, in order to demarcate an area within which development will be prohibited or controlled in order to achieve the objects of this Act or coastal management objectives; the line determines how much risk is acceptable.
CPP	Coastal Public Property Includes a number of components such as the actual water of the coast, the land below that water, islands, the sea shore, and other state land such as Admiralty Reserve.
CPSLr	Coastal Process Management Line rocky coastline A line demarcating the extent of the physical risk zone along the rocky portion of the coastline, determined from the combination of wave action and sea level rise; the zone characterised by the physical natural processes.
CPSLs	Coastal Process Management Line sandy coastline A line demarcating the extent of the physical risk zone along the sandy portion of the coastline, determined from the combination of wave action and sea level rise; the zone characterised by the physical natural processes.
CPZ	Coastal Protection Zone A continuous strip of land, starting from the HWM and extending 100m inland in developed urban areas zoned as residential, commercial, or public open space, or 1000m inland in areas that remain undeveloped or that are commonly referred to as rural areas.
CPZL	Coastal Protection Zone Limit
CPZLs	Coastal Protection Zone Limit: Sandy Shoreline
CPZLr	Coastal Protection Zone Limit: Rocky Shoreline
DTM	Digital Terrain Model A topographic model of the bare earth i.e. terrain relief.
DEDEAT	Department of Economic Development, Environmental Affairs & Tourism

H_0	Deepwater wave height
HWM	High Water Mark Defined as the highest line reached by the coastal waters, but does not include any line reached as a result of abnormal floods or storm events (1:10 year storms) or estuaries that are closed to the sea.
NMB	Nelson Mandela Bay (geographical area)
NMBM	Nelson Mandela Bay Municipality (local authority)
NMB MOSS	Nelson Mandela Bay Metropolitan Open Space System
POS	Public Open Space
SANHO	South African Navy Hydrographic Office
SLR	Sea Level Rise
TNPA	Transnet National Ports Authority

1 INTRODUCTION

1.1 Objective

All over the world, local managers and planners, public works officials, local and state elected officials, and community development specialists are at the forefront of making decisions that impact the social, political, and economic well-being of their local communities. Specific information and knowledge about the social, economic, and environmental conditions of a community are needed to make decisions that enhance the community's development and well-being while minimizing potentially adverse social and environmental impacts. This holds particularly true now as decision makers in coastal regions and communities worldwide must begin managing their jurisdictions to adapt to a rapidly changing climate and accelerating sea-level rise (Tribbia, 2008).

Increasingly, coastal erosion and flooding of coastal, estuarine and riparian properties has become a very serious problem, costing local and national government as well as the private sector millions of Rands every year.

One of the key mitigation measures is the proactive determination and implementation of realistic coastal management lines (**T**heron, 1994 in **T**heron and Roussow, 2008). Coastal and riparian erosion, increased intensity and frequency of flooding and wind generated storm surges that damage coastal areas must be planned for as a matter of urgency. Realistic coastal management lines have the potential to maintain both the economic and ecological functioning of marine and other aquatic ecosystems and to mitigate the impacts of climate change. They also provide buffers around aquatic ecosystems which can then act as important ecological corridors. Allowing developments to encroach beyond ecologically determined management lines will often necessitate expensive protection of these developments against disasters such as flooding. Construction of structures to protect properties and other infrastructure cannot be considered long term solutions for any existing or future developments (**T**heron and Rossouw, 2008). **T**hese structures can also be unsightly and restrict public access to valuable and popular amenities such as beaches and waterways. Existing buildings and infrastructure that was inappropriately located in the past have no alternative but to attempt to remedy the situation, however future development can benefit from the inclusion of appropriate coastal managements as part of the planning process.

It is for this reason that the Eastern Cape Department of Economic Development, Environmental Affairs and Tourism (DEDEAT), in consultation with the Nelson Mandela Bay Municipality (NMBM), has (in alignment with the ICM Act) set out to determine coastal management lines for the Nelson Mandela Bay metropolitan area and the adjustment of the coastal protection zone (CPZ) limit for the metropolitan area.

Masande Environmental Health and Safety Consultants (hereafter referred to as Masande Consultants) in conjunction with Afri-Coast Engineers SA (Pty) Ltd were appointed to establish coastal management lines for Nelson Mandela Bay. The project team were required to determine the coastal management line as defined in the Integrated Coastal Management Act (ICM Act) of 2008. In the execution of this

work, the team were required to work under the guidance of a project steering committee that was formed between DEDEAT and the NMBM. The objective of this report is to present the background, legal perspective, methodology, results, conclusions and recommendations emanating from this project.

1.2 Context

Roughly two-thirds of the world population lives within close proximity to the ocean and a large proportion of the world's coastline is made up of sandy beaches, which attract thousands of visitors and are economically important to adjacent communities (Bird, 1996). Beach erosion poses a threat to all stakeholders, especially tourism which, according to the World Tourism Organisation (WTO, 2001) is the world's largest industry. Research indicates that 70% of the world's beaches are experiencing coastal erosion (Bird, 1996). Climate change, is expected to exacerbate this problem through: particularly accelerated sea-level rise (IPCC, 2007) and increased frequency and intensity of storm events (Theron & Roussow, 2008).

Whilst coastlines are often viewed as stable permanent assets, in reality they tend to be dynamic, responding to natural processes and human activities (Phillips & Jones, 2006). In many instances man has literally drawn a line in the sand and built infrastructure, with little regard for the dynamics of the highly variable littoral zone, thus when the beach retreats infrastructure is threatened (Clark, (1996)). In numerous instances erosion is caused by man-induced interruption of sediment supply by means of coastal structures such as groynes (Basco & Pope, 2004), harbour breakwaters constructed in longshore dominant sediment transport regimes ((Swart, 1996); (Dean & Dalrymple, 2002)), dune stabilisation (McLachlan, Illenberger, & Burkinshaw, 1994); (La Cock & Burkinshaw, 1994)) and river impoundment (Frihy, Essam, Debes, & El Sayed, 2003). Coastal areas therefore require specific attention in management and planning procedures, especially where the coastal areas are subject to significant human resource usage and development pressure (WSP, 2010). A number of specific motivations exist for the establishment of management lines, several significant motivations are presented below.

Facilitation of Development

At present, an Environmental Impact Assessment (EIA) must be conducted for development of all infrastructure within 100 m of the high water mark in urban areas, in accordance with the EIA Regulations (NEMA, 2010). This "broadbrushed" approach has certain undesirable consequences such as:

- Home owners situated within 100m of the high water mark (HWM) must follow the EIA process to conduct any house alterations;
- Municipalities must follow the EIA process when erecting infrastructure (e.g. toilets, even if temporary) within 100m of the HWM.
- In some instances coastal processes occur landward of the 100 m line, such as windblown sand.

In future, strategic infrastructure planning will be more appropriately informed by strategic environmental assessments and tools such as the coastal management lines, rather than disjointed project level assessments having to be done for different infrastructure projects. The determination of coastal management lines could also enable the improvement of the coarse *"within 100 metres of the high-water mark of the sea"* threshold used in the NEMA listed activities, with the management resulting in improved protection being given to the coast and resulting in unnecessary EIA being prevented (WSP 2010).

Safety of Developments

Developments situated too close to the sea are threatened by erosion (e.g. Summerstrand lifesavers club house and the adjacent parking lot and the New Brighton Beach ablutions and lifesavers facility near the Swartkops Estuary mouth are threatened by beach erosion) and wave attack (the seawall and walkway north of Hobie Beach and the clubhouses at Sardinia Bay) presented in Figure 1-1. Protection of these developments is difficult and often expensive. Taking into account sea-level rise and the coincident increase in vulnerability to storm waves, it is critical that coastal management lines are established so that such problems do not recur.

Figure 1-1: Threat to infrastructure placed too close to the sea through erosion at a) Summerstrand lifesavers clubhouse, b) New Brighton Beach facilities and wave attack at c) seawall and walkway east of hobie beach and d) clubhouse facilities at Sardinia Bay.

Maintenance

The establishment of management lines can avoid problems of maintenance in the form of sand removal and/or storm debris removal. By way of example, the NMBM spends considerable effort and money on the removal of sand, e.g. on the road and parking lot at the Swartkops Estuary Mouth, because these developments are situated within the zone of active nearshore processes (windblown sand). Figure 1-2 provides an example of a maintenance headache at Bluewater Bay parking lot where removal of debris due to high waves during high waters and wind-blown sand is also a major maintenance problem. Establishment of management lines that take into account such coastal processes will avoid this type of ongoing maintenance problem.

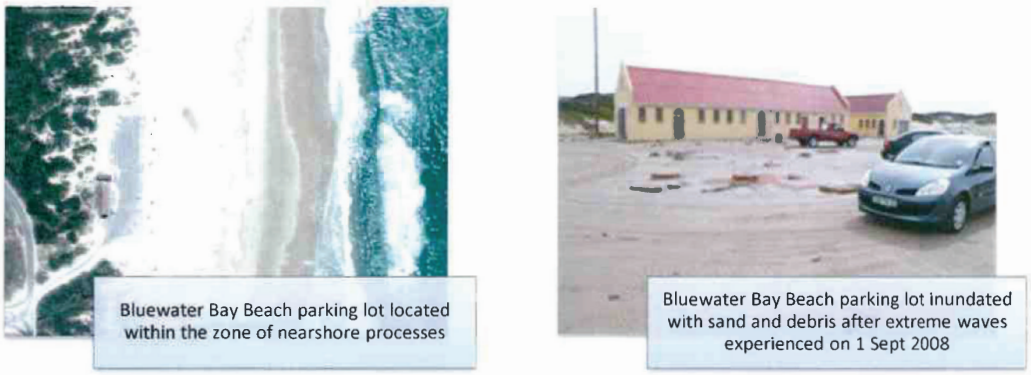


Figure 1-2: left) Blue Water Bay Beach parking lot located within the zone of nearshore processes; right) inundated with sand and debris after the extreme waves experienced on 1 September 2008

Biodiversity

Buffer zones between the high water mark and development must be provided where this is critical to protect and maintain biodiversity pattern and/or processes, and the associated ecology.

Other motivations

There are several other potential reasons to ensure adequate development management. Amongst these are:

- Adequate management to maintain aesthetic features, such as rock formations, and sense of place. An example of the latter is Blue Water Bay where besides the parking lots the houses are well set back behind the primary dune and permanently vegetated retention ridge and the resulting experience of the beach is of a totally natural, unspoilt environment;
- Adequate management to minimise shading of beaches by tall structures; and
- Management to allow for public access, in some instances.

1.3 Site Description

The Nelson Mandela Bay coastline stretches for 102km between the Van Stadens River mouth in the west and the Sundays Estuary mouth in the east. The coastline is dominated by the headland of Cape Recife and the large sheltered area of Algoa Bay which is one of several large southeast facing embayments along the Sunshine Coast of South Africa (Annexure A, Figure A-1). The city of Port Elizabeth is situated on the eastern side of Cape Recife, one of a series of headlands that lie along the coast between Cape Town and Port Elizabeth.

The area has a temperate climate and receives 500 to 650 mm of precipitation per year, with the largest amount of rain occurring between May and October (McLachlan *et al.*, 1994). The coastline in this region is mostly sandy beach (55%) followed by rocky headlands (24%) and wave cut rocky platforms (21%). Algoa Bay and St Francis Bay are the two large bays that dominate the geography of the eastern part of the region.

The area around Cape Recife is composed of a series of cove beaches to the west, the rocky stable headland of the Cape followed by a series of beaches between rocky outcrops in the lee of the Cape and along the shore of Algoa Bay (Annexure A, Figure A-2). A large volume of sand has accreted on the updrift side of the port of Port Elizabeth breakwater since its construction some 80 years ago.

The coast from Port Elizabeth harbour for approximately 8km to the Swartkops Estuary mouth is severely sand depleted and suffering from erosion (due to the presence of the Port), and as a result the majority of this section of the coast is dominated by man-made stone, rubble and dollosse revetments, put in place to protect the road and rail infrastructure (see Annexure A, Figure A-3). North of the Swartkops River, until the Port of Ngqura wide sandy beaches backed by coastal vegetation and sand dunes prevail (Annexure A, Figure A-3). For several kilometers immediately north of the port of Ngqura wave cut platforms and pebble beach environment is dominant (see Annexure A, Figure A-4). However for the further 10 km towards the Sundays Estuary mouth a wide sandy beach is present and extensive coastal dunes are present in the vicinity of the Sundays Estuary mouth (Annexure A, Figure A-5).

The winds in this area are predominantly from the southwest (Annexure A, Figure A-6) and associated with storms traversing from the Atlantic to the Indian Oceans. However, this pattern is dominant only in the winter months. During the spring and summer, easterly winds are dominant (see Annexure A, Figure A-6). A third common wind direction is the north-westerly lands breezes which blow in the autumn months.

Waves emanating from the south westerly quarter are dominant offshore of the NMBM coastline. The coastline west of Cape Recife is exposed directly to waves from this direction; however once these southwesterly waves reach the shore within the bay they are reduced to approximately 1/3 of the offshore wave height due to the processes of diffraction and refraction. Within the bay locally generated short period waves from an easterly direction have a more direct approach and result in bigger waves on the coast within the bay. In addition occasional large long period swell from a easterly to southerly

direction, incurring less diffraction and refraction, results in large waves and significant erosion of the beaches within the bay (see Annexure A, Figure A-7) (ASR, 2008).

Like its neighbor to the west, Cape St Francis, Cape Recife contains examples of headland-bypass dune systems (see Annexure A, Figure A-8). A headland-bypass dune system occurs where sand from beaches on one side of a headland is moved to the other side by wind driven transport through a system of highly mobile, transverse dune fields (McLachlan et al, 1994). In the case of South Africa's Sunshine Coast, predominant winds from the southwest push sand eastward over the headland and into the bays on the eastern side. Sand transport across the headlands in these systems is thought to occur in pulses over a time frame of hundreds or thousands of years rather than continuously across the entire length of the dune field. In the intervening period of time the dunes may be come partially or totally vegetated, especially around wetlands or where the water table is close to the surface.

In a similar fashion to Cape St Francis, the dune fields on Cape Recife have been stabilized to promote agriculture and provide an environment for human habitation that is free of the bothersome, windblown sands. This stabilization, ongoing in South Africa since the mid 19th century, has resulted in a net reduction of sand available to the beaches on the lee of the headlands (McLachlan et al., 1994). It is likely that a major pulse of sand moved across the Cape Recife Driftsands and reached the eastern side of the cape during the middle of the 19th century, roughly coinciding with the arrival of European settlers. This pulse of sand threatened settlements at Port Elizabeth in the 1860"s and resulted in efforts to stabilize the dunes.

The final stabilization effort began in 1890 when the Forestry Department began a systematic plan of spreading the town refuse over the dunes then planting vegetation in the refuse. Using this method the dunes along the shore of Algoa Bay were stabilized by 1897 and the entire Driftsands dune field was stabilized by 1909.

Besides the major dunefield known as "The Driftsands", Cape Recife contains two other smaller headland bypass dune fields. These are the "Noordhoek" and "Cape Recife" dune fields. The leading half of the Noordhoek dunefield was stabilized in the 1960"s and 70"s during construction of a sewage treatment facility in the area. The smallest transverse dune system at the tip of Cape Recife has remained active to this day.

Sand enters Algoa Bay by either Aeolian transport across the headland or by wave transport around Cape Recife. Once deposited into the bay, the sand is moved generally to the north and east forced along by wave generated currents. Currently, only the last remaining dunefield at the south-easternmost tip of Cape Recife is active. With a dune width of 350 m, this system probably moves in the order of 12,000 (McLachlan et al., 1994) to 26,000 (Lord et al., 1985) cubic meters per year into the waters of Algoa Bay to the east.

Wave driven transport, which moves sand around the tip of the cape and to the north along the eastern side of the headland, is the other form of sand input to Algoa Bay. The volume of sand moved around Cape Recife can be calculated based on the accretion observed at Kings Beach, located on the southern side of the Port Elizabeth breakwater, which has experienced consistent accretion since the

construction of the harbour, after the stabilization of the Driftsands in the late 19th and early 20th centuries (see Annexure, Figure A-9).

The first accurate survey of the shoreline in this area was conducted in 1877 and surveys have been conducted consistently since that time. The surveys, as well as casual observations, show that Kings Beach has been steadily accreting, especially since the construction of the harbour breakwater (see Annexure, Figure A-9). Between 1933 and 1979, a total of 850 m of beach accumulated in this area, or approximately 18 m/year. Surveys also showed that the depth of the water offshore of the breakwater remained constant over the same time period, meaning that no sand was bypassing the harbour, but rather that it was all being trapped upstream and therefore represents an accurate estimate of the total longshore transport. This figure was estimated to be 130,000 m^3/yr for the period from 1933 – 1969. After 1969, there was evidence of sand bypassing the breakwater and harbour and the rate of accumulation on Kings Beach was estimated to be 100,000 m^3/yr between 1969 and 1979 (Lord *et al.*, 1985). McLachlan *et al.*, (1994), citing Prestedge (1986)* revise this number slightly higher and give an average value of 150,000 m^3/yr for the accretion at Kings Beach for the period between 1931 and 1985.

Shortly after construction of the main harbour breakwater in 1903, extensive erosion of the beaches on the northern (down-drift) side of the harbour was observed; this confirmed the assumption of a northward littoral drift in the area and has led to the problems currently experienced north of Port Elizabeth Harbour towards the Swartkops River.

North of the Swartkops River, the sites at Wells Estate and Bluewater Bay Beach do not suffer from beach erosion problems. At both Wells Estate and Bluewater Bay there is ample sand, a wide beach (up to 150 m wide) and coastal developments are set back behind the dune line and do not interfere with the natural coastal processes. This is likely to be because these sites lie to the northeast of the Swartkops River and inside a separate littoral cell from Port Elizabeth proper. The volume of sand transported across this section of beach is estimated at 150 – 200,000 m^3/yr (Illenberger & Associates, 1998). The beach itself is a mixed sand and pebble beach with pebbly storm berm deposits that underlie the sand in the back beach. The beach has a transverse bar system, with rip current cells that are generally spaced some 150 to 300 m apart.

Construction of the deepwater port of Ngqura began in 2003 and was completed in 2007, a sand bypass scheme was installed as part of the port construction and this was operational by 2007. Long term beach profile monitoring is carried out on the beaches either side of the port in order to monitor the effect of the port and the effectiveness of the sand bypass system. The results of this monitoring indicate that over the 3 years before the sand bypass scheme became operational accretion was experienced on the updrift side of the port and erosion on the downdrift side. Fortunately a high percentage of rock and pebble substrate on the downdrift side of the port meant that this side was fairly resilient to erosion and shoreline retreat in this area was not significant. In addition the shoreline has remained fairly stable within a few kilometres either side of the port and the sand bypass system seems to be operating effectively (Afri-Coast, 2010).

2 LEGAL FRAMEWORK

Coastal management lines should be considered as a planning tool for National Environmental Management: Integrated Coastal Management Act, 2008 (Act No. 24 of 2008) (herewith referred to as the: "ICM Act") implementation, and their definition should be based on an integrated approach, covering aspects such as physical processes, ecosystem efficiency, coastal safety for economic and recreational activities and landscape protection from a natural and cultural heritage perspective. The objective of this section is (i) to outline the administrative and legal framework at the Provincial and Local Municipal Level, together with some relevant international and national experiences (ii) to provide a common basis for processes, concepts and definitions related with coastal managements, and (iii) to recommend an integrated legal approach for the identification of coastal managements at the Provincial and Local Municipal level in relation to Nelson Mandela Bay coastline (Celliers et al., 2009)

The proposal and the use of management lines can be the origin of strong conflict, both at the administrative level, where criteria and implementation rules are discussed, and at the local level, where the interests between different stakeholders groups are confronted. It is therefore necessary to identify management lines with a strong scientific approach on one hand, which can give a clear vision of the physical, ecological and socio-economic processes, and with a systematic participatory approach on the other hand, which can give a clear vision of the socio-economic implications at the local level and, at the same time, provide support for their implementation in a legally accepted manner (Celliers et al., 2009).

There are various administrative, legal and policy requirements, which DEDEAT and the NMBM will be responsible for adhering to on implementation of the coastal management lines for Nelson Mandela Bay. The remainder of this section highlights the relevance of various pieces of legislation.

2.1 Constitution of the Republic of South Africa, 1996 (Act No. 108 of 1996)

Section 24 of the Constitution states that everyone has the right –

a) to an environment that is not harmful to their health or well-being; and

b) to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that

   i) prevent pollution and ecological degradation;

   ii) promote conservation; and

   iii) secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.

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

As the overarching legislation, all actions taken by the developer must be done in accordance with the overarching policy principles set out in Chapter 1, section 2 of NEMA and the principles applicable to

environmental assessments, as per the Environmental Impact Assessment Regulations published on 18 June 2010 (GNR. 544 – 547).

The setting of regulations for areas delineated by the coastal management lines will have to be aligned with the Environmental Impact Assessment ("EIA") Regulations 2010 (Government Notice No. R. 543, R. 544, R. 545, R. 546 and R. 547 in Government Gazette No. 33306 of 18 June 2010) in terms of the National Environmental Management Act, 1998.

2.3 National Environmental Management: Integrated Coastal Management Act, 2008 (Act No. 24 of 2008) ("ICM Act")

The ICM Act is the principle legislation underpinning the determination of coastal management lines.

The objectives of the ICM Act are:

- to determine the coastal zone of the Republic;
- to provide, within the framework of the National Environmental Management Act, for the coordinated and integrated management of the coastal zone by all spheres of government in accordance with the principles of co-operative governance;
- to preserve, protect, extend and enhance the status of coastal public property as being held in trust by the State on behalf of all South Africans, including future generations;
- to secure equitable access to the opportunities and benefits of coastal public properly; and
- to give effect to the Republic's obligations in terms of international law regarding coastal management and the marine environment.

Section 25 of the ICM Act provides for the establishment of coastal management lines and defines "coastal management line" as –

"a line determined by an MEC in accordance with section 25 in order to demarcate an area within which development will be prohibited or controlled in order to achieve the objectives of this Act or coastal management objectives".

The procedures for establishing coastal management lines are set out in section 25 which states that:

(1) An MEC must, in regulations published in the Gazette—
  (a) establish or change coastal management lines—
    (i) to protect coastal public property, private property and public safety;
    (ii) to protect the CPZ;
    (iii) to preserve the aesthetic values of the coastal zone; or
    (iv) for any other reason consistent with the objectives of this Act; and
  (b) prohibit or restrict the building, erection, alteration or extension of structures that are wholly or partially seaward of that coastal management line.

(2) Before making or amending the regulations referred to in subsection (1), the MEC must—
  (a) consult with any local municipality within whose area of jurisdiction the coastal management line is, or will be, situated: and

(b) give interested and affected parties an opportunity to make representations in accordance with Part 5 of Chapter 6.

A coastal management line may be situated wholly or partially outside the coastal zone.

The ICM Act highlights in sections 27 and 28 that in determining or adjusting the boundaries of coastal areas the following must, inter alia, be taken into account:

- the dynamic nature of the shoreline;
- the need to make appropriate allowance for the periodic natural movements in the high-water mark; and the erosion and accretion of the seashore;
- the importance of ensuring the natural functioning of dynamic coastal processes and of extending the coastal boundaries to include the littoral active zone and sensitive coastal ecosystems, including coastal wetlands;
- the potential effects of projected rises in sea-level;
- the purpose for which a coastal area is to be established;
- the importance for coastal management to incorporate land inland of the high-water mark that should be maintained in, or restored to, a natural or semi-natural state;
- the need to avoid risks posed by natural hazards to people, biodiversity, coastal public property and private property;
- the potential for the number and severity of natural disasters to increase due to the effects of global climate change and other impacts on the environment, and the importance of taking preventive measures to address these threats; and
- the importance of allowing for the movement of the position of the high water mark over time and of protecting the inland coastal boundary by demarcating a continuous strip of land adjacent to it.

While both the amended NEMA EIA Regulations and the ICM Act allows for the pro-active determination of coastal development management lines, coastal development management lines must also at times be re-actively determined when considering development applications in terms of the NEMA EIA Regulations.

The CPZ in essence is a continuous strip of land, starting from the HWM and extending 100 metres inland in developed urban areas zoned as residential, commercial, or public open space, or 1000 metres inland in areas that remain undeveloped or that are commonly referred to as rural areas. There are, however, some provisions in order to justify certain adjustments to this zone. The CPZ is established to manage, regulate and restrict the use of land that is adjacent to coastal public property, or that plays a significant role in the coastal ecosystem (Celliers et al., 2009).

2.4 Marine Living Resources Act, 1998

Chapter 4 of Marine Resources Living Act provides for the Minister to declare an area to be a marine protected area under section 43 in order to protect marine living resources and coastal zones from further deterioration.

43(1) The Minister may, by notice published in the Gazette, declare an area to be a marine protected area—

(a) for the protection of fauna and flora or a particular species of fauna or flora and the physical features on which they depend;

(b) to facilitate fishery management by protecting spawning stock, allowing stock recovery, enhancing stock abundance in adjacent areas, and providing pristine communities for research; or

(c) (c) to diminish any conflict that may arise from competing uses in that area.

Section 43(2) list the activities that will not be allowed, without permissions, within a marine protected area.

2.5 Biodiversity Act

In terms of the National Environmental Management Biodiversity Act (NEMBA, 2004) the developer has a responsibility for:

- The conservation of endangered ecosystems and restriction of activities according to the categorization of the area (not just by listed activity as specified in the EIA regulations).
- Promote the application of appropriate environmental management tools in order to ensure integrated environmental management of activities thereby ensuring that all development within the area are in line with ecological sustainable development and protection of biodiversity.
- Limit further loss of biodiversity and conserve endangered ecosystems.

2.6 Environment Conservation Act and Regulations GN154

- Development must be environmentally, socially and economically sustainable. Sustainable development requires the consideration of inter alia the following factors:
    - that pollution and degradation of the environment is avoided, or, where they cannot be altogether avoided, are minimised and remedied;
    - that waste is avoided, or where it cannot be altogether avoided, minimised and re-used or recycled where possible and otherwise disposed of in a responsible manner;
    - that the use and exploitation of non-renewable natural resources is responsible and equitable, and takes into account the consequences of the depletion of the resource;

- that the development, use and exploitation of renewable resources and the eco-systems of which they are part do not exceed the level beyond which their integrity is jeopardised; and
- that negative impacts on the environment and on peoples' environmental rights be anticipated and prevented, and where they cannot be altogether prevented are minimised and remedied.

- Environmental management must place people and their needs at the forefront of its concern, therefore any environmental impacts resulting from the development activities are not distributed in such a manner as to unfairly discriminate against any persons, particularly vulnerable and disadvantaged persons.
- In terms of section 20, the developer is required to obtain a permit from DWAF in order to establish, provide or operate any waste disposal site within the boundaries of the property.
- The developer is required to undertake Environmental Impact Assessments (EIA) for all projects listed as a Schedule 1 activity in the EIA regulations in order to control activities that might have a detrimental effect on the environment. Such activities will only be permitted with written authorisation from a competent authority.

2.7 Conservation of Agricultural Resources Act 43 of 1983, and Conservation of Agricultural Resources Regulations.

In terms of section 6 of the Act, the Minister may prescribe control measures with which all land users have to comply. The control measure may relate to the following:

- the regulating of the flow pattern of run-off water;
- the control of weeds and invader plants;
- the restoration or reclamation of eroded land or land which is otherwise disturbed or denuded.

2.8 Forest Act 122 of 1984

Protected trees

The **F**orest Act provided for the protection of trees on private land by providing that 'no person may cut, damage, destroy, disturb or remove any protected tree from the land in question, or collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any part or produce thereof'.

The Minister was authorised, in respect of any land not forming part of a State forest, to declare a particular tree, a particular group of trees, or trees belonging to a particular species occurring on that

land, to be a protected tree or trees. Regulations published under the Act list 58 species of protected trees to which these prohibitions apply. Although the NFA has repealed the old Forest Act, the majority or regulations promulgated under the Act still remain in force until such time they are replaced by new regulations under the NFA.

2.9 National Forests Act 84 of 1998

Protected trees

The Minister may declare a tree, group of trees, woodland or a species of trees as protected. The Minister is required to publish a list of all species protected under this Act, an appropriate warning of the prohibitions set out and the consequences of its infringements, annually in the Government Gazette. The prohibitions provide that ' no person may cut, damage, disturb, destroy or remove any protected tree, or collect, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree, except under a licence granted by the Minister'.

2.10 National Heritage Resources Act 25 of 1999

- No person may alter or demolish any structure or part of a structure, which is older than 60 years without a permit issued by the relevant provincial heritage resources authority.
- No person may, without a permit issued by the responsible heritage resources authority destroy, damage, excavate, alter, deface or otherwise disturb any archaeological or paleontological site.
- The protection of archaeological and paleontological sites and material is the responsibility of a provincial heritage resources authority and all archaeological objects, paleontological material and meteorites are the property of the state. Any person who discovers archaeological or paleontological objects or material or a meteorite in the course of development must immediately report the find to the responsible heritage resources authority, or to the nearest local authority offices or museum, which must immediately notify such heritage resources authority.
- No person may, without a permit issued by SAHRA or a provincial heritage resources authority destroy, damage, alter, exhume, remove from its original position or otherwise disturb any grave or burial ground older than 60 years which is situated outside a formal cemetery administered by a local authority. "Grave" is widely defined in the Act to include the contents, headstone or other marker of such a place, and any other structure on or associated with such place.
- A permit will only be granted if SAHRA is satisfied that the applicant has made satisfactory arrangements for the exhumation and re-interment of the contents and reached agreement with the affected communities regarding the future of such grave or burial ground.

2.11 Eastern Cape Environmental Conservation Bill, 2003

To provide for the consolidation and the repeal of certain laws relating to environmental conservation applicable in the Province, including the Sea-shore Act, 1935, Mountain Catchment Areas Act, 1970, and the Environmental Conservation Act, 1989; to provide for the declaration of Provincial protected areas; to provide for the management of biodiversity in the Province; to provide for Provincial coastal management; to regulate air quality and waste management in the Province; and to provide for matters connected therewith.

This bill provides a number of schedules which protect endangered flora and for which a permit is required. According to Chapter 12m *'Miscellaneous provisions relating to endangered flora' 112* –

(1) Subject to the provisions of this Act, no person may – in respect of flora listed in Schedule 4, without a possession permit

i) pick, uproot, damage or destroy any endangered flora.

2.12 Provincial Nature Conservation Ordinance (PCNO)

Protected indigenous plants in general are controlled under the relevant provincial Ordinances or Acts dealing with nature conservation. In the Eastern Cape the relevant statute is the 1974 Provincial Nature Conservation Ordinance. In terms of this Ordinance, a permit must be obtained from the then Department of Economic Affairs Environment and Tourism (DEAET) (now DEDEAT) to remove or destroy any plants listed in the Ordinance.

2.13 Nelson Mandela Bay Municipality's Metropolitan Open Space System (MOSS)

The boundary of the Nelson Mandela Bay Metropolitan Open Space System (NMB MOSS) has been defined for the metropolitan area. Understandably, NMB MOSS has been considered as the blueprint while determining the environmental buffer and it is therefore necessary to determine synergy between this study, MOSS and all other strategic development plans of the NMBM. The NMB MOSS also indicates the major portion of the coastline as one of its important components, along with the nature reserve areas at UPE, Cape Recife and Sardinia Bay, anda very important public open space along Marine Drive. The NMB MOSS plan also indicates a corridor along the coastal area linking the Sardinia Bay Nature Reserve, Cape Recife and the UPE Nature Reserve.

2.14 NMBM Spatial Development Framework, 2009

Consistent with the critical components of the NMBM's Spatial Development Framework (SDF) (NMBM, 2009), coastal management lines determination, as part of sector plans, has identified areas where the Municipality should make decisions and hence trade offs during allocation of its resources by adopting four main elements of the MSDF which include:

- Core economic areas.
- Infill priority areas.
- Strategic development areas.
- Service upgrading priority areas.

3 METHODOLOGY

In order to identify coastal management lines for the coastal zone as a policy option, an analysis of the whole system should be carried out, through the calculation of coastal management lines based on physical processes, which is further guided by ecological and landscape protection criteria. This preliminary analysis identifies a buffer zone as a base for further analysis of existing socio-economic factors, i.e. the legal and administrative framework, the presence of building and human activities, and the local perception of coastal protection and management. A clear formulation of the problem and of the objectives of management lines should be identified in the beginning of the process, and incorporated into the framework of a broader coastal management plan (NMBM, 2009).

Such an **integrated approach** to the determination of coastal management lines, including physical, ecological, and socioeconomic processes, should cover two parts i.e. –

(i) a technical analysis; and
(ii) an analysis of the implication of policy implementation at the local level.

Table 1: Steps of the proposed integrated approach, for the identification of coastal management lines

Phase	Processes	Activity
Technical analysis	Physical	1. Identification of geomorphologic features (type of coast) together with elevation models
		2. Calculation of physical risk lines
	Ecological	3. Identification of ecological and landscape values, buffers and corridors
	Socio-economic	4. Identification of cultural and human landscape values
		5. Identification of public coastal uses
		6. Analysis of transit and accessibility issues
Policy analysis	Socio-economic	7. Analysis and proposal of legal and administrative provisions
		8. Public involvement and discussion on the proposed managements

Phase	Processes	Activity
Policy implementation		9. Regulation of management lines

Given that the approach in the ICM Act is focused around human use and activities along the coast, the balance between the opposing risk extremes of asset loss and the usage of the coast for human purposes must be achieved. If one then reviews the philosophy of coastal management lines it is clear that one single management line is impractical.

There are two real issues which need to inform the development of regulations for coastal management lines i.e.

1. The extent of the hazard zone (the area where the coastal processes are able to play themselves out); and
2. The appropriateness of infrastructure and how close this can be placed to the hazard zone.

Local populations could be willing to accept the risks of flood, erosion and environmental degradation, in a short term perspective, but it is the responsibility of national, provincial and local government departments to maintain a broader perspective of the issue, including the long term consequences and ecological values, under the principles of sustainability.

3.1 GIS Working Procedures & Data Needs for Determining Coastal Management Line for Nelson Mandela Bay

The following steps were undertaken in determining the coastal management line for Nelson Mandela Bay:

Step 1 - Determine the 1:10 year storm wave height and period for the Nelson Mandela Bay coastline using the available wave statistics (required for steps 4 and 5 in the process).

Step 2 – Determine the sandy shoreline wave run up model (required for steps 4 and 6 in the process). In order to ascertain the most suitable model in this region a selection of models were assessed for suitability. The three models that were tested and variables required are shown in

Table 2.

Table 2: Wave run up models and variables required.

Model	Variables required
Nielsen and Hanslow 1991	Wave height Beach shore face slope
Stockdon *et al.* 2006	Wave height Wave period Beach shore face slope
Mather *et al.*, 2009 (as used in the Durban SLR study 2009)	Wave height Bathymetric profile

These models were run at three locations identified by the NMBM. At each location, cross-sections were analysed using the above models. The results from the three models were compared and the most suitable model determined by three criteria, namely: the accuracy of wave run up prediction, the most efficient and cost effective and the model giving 100% coverage of the coastline without the need for additional data.

Step 3 – Determine the inland maximum scour envelope using aerial and or cross section data. This was then used in later steps to buffer the HWM.

Step 4 – Determine the current theoretical HWM in terms of the ICM Act using the 1:10 year wave data and the chosen model for the sandy portion of the NMBM coastline.

Step 5 – Determine the current theoretical HWM in terms of the ICM Act using the 1:10 year wave data and the Eurotop manual for the rocky portion of the NMBM coastline.

Step 6 – Determine the predicted future HWM for the sandy coastline using three sea level rise scenarios, 300mm, 600mm and 1000mm. The Bruun rule coastal regression model was used. Simulate sea level rise (SLR) for the rocky shoreline areas.

Step 7 – Determine the environmental buffers required inland from the HWM to maintain a functional coastal ecosystem under future sea level rise scenarios. A specialist coastal ecologist provided this input.

Step 8 – Determine of social buffers required along the coast. For example allowance for public beach access through and along the coastal frontage or for areas which have cultural significance and will need to be preserved from development.

Step 9 – Determine any economic requirements for the coast. For example, allowance for new beach facilities that will need to be placed closer than normal development to serve the public. Economic demands often require a trade off against environmental aspects at a particular site. Therefore an acceptable methodology to deal with the possible conflicts

between the desire for environmental protection and the need for economic activities is provided.

Step 10 – Determine the coastal management line and the CPZ taking into account the information and requirements of the above steps.

4 RESULTS

4.1 Step 1: Determine 1:10 year storm wave height and period for NMBM coastline

The 1:10 year storm wave height and period for NMBM coastline was determined using available wave statistics. Extreme wave analysis statistics from recent coastal engineering and oceanographic studies were reviewed. The results of several available studies are presented in Table 3 below:

Table 3: Extreme wave analysis 1:10 and 1:100 year return period wave height, period, statistical methods and source.

1:10 H_o (m)	1:10 Tp (sec)	1:100 H_o (m)	1:100 Tp (sec)	Method	Report
8		9.4		Weibull Distribution	(ASR, 2008)
8.4	17.7	9.8	19.2	Weibull Distribution The 95% confidence level to the best estimate is calculated using the Monte Carlo method.	(PRDW, 2009)
9.8	19.2	11.5	20.8	Weibull Distribution as above including increased wave heights due to climate change, which is assumed to increase the heights by 17%	(PRDW, 2009)

From evaluation of the results of extreme wave statistics presented in Table 3 above, it was decided that due to the conservative approach of this study the effects of climate change should be incorporated and thus the extreme 1:10 year return wave conditions to be used are H_o = 9.8 m as calculated for a position at 30m water depth off Thyspunt roughly 100 km southwest of Cape Recife (refer to Annexure A, Figure A-10). The 1:10 year storm wave height is necessary for the determination of the theoretical HWM for both the sandy and rocky shoreline portions of the coastline, as described in Steps 4 and 5 respectively.

4.2 Step 2: Evaluation of the run up model comparisons

The only assumption, which could make a material difference to the results of the comparisons, is the offshore wave heights. Port Elizabeth does not have a wave height recorder and so data for wave height and period, which is used in all the models, was sourced from NOAA Wave Watch 3 (NWW3) global wave model hindcast data.

The NWW3 wave model is the world standard, it is a third generation ocean wave propagation model. NWW3 solves the spectral action density balance equation for wave number-direction spectra. The model domain is the entire globe between 78°N and 78°S with grid points spaced at 1° latitude and 1.25° longitude. The wind fields used to drive the NWW3 wave generation forecast come from the NOAA Global Forecast System (GFS), which combines data assimilation and a forecasting model. The NWW3 hindcast are run with the archived (historical) wind fields, which provide higher accuracy wave data than the forecast data. Hindcast wave data extracted from a position directly offshore of Cape Recife (34.25°S, 25.75°E) (refer to Annexure A, Figure A-10), was then used to evaluate the 3 wave run-up models.

The comparison is based on the three proposed models i.e.

- Nielsen and Hanslow, 1991;
- Stockdon et al., 2006; and
- Mather et al., 2010.

The models have been tested for applicability in the NMBM region by applying data gathered from the region at the following sites: Maitlands Beach, Pollok Beach, Bluewater Bay Beach and Wells Estate (refer to Annexure A, Figure A-11). All oceanographic data used in the model evaluation exercise is shown in Table 4.

Table 4: Oceanographic data used in the model evaluation exercise

Parameter	Value	Source
SWL, (m)	2.45m	SANHO, measured data PE Harbour
Ho, (m)	6.5 m	NWW3, Hindcast
T, (sec)	15 sec	NWW3 ,Hindcast

Bathymetric data (SAN 125) and beach survey data were utilized to produce all other data for input into the three models. 10 shore normal transects were measured at Maitlands Beach, Blue Water Bay Beach and Wells Estate, only 5 shore normal transects were measured at Pollok beach due to limited data coverage at this site. Along each transect the following measurements were made: measured run-up level, lower beach level, distance between 0 MSL and -15m depth contour. From the measured run-up level and lower beach level the beach face slope could be calculated. A schematic representation of this method is shown in Figure 4-1 and transects, beach survey data and contours for Pollok Beach are shown in Figure 4-2.

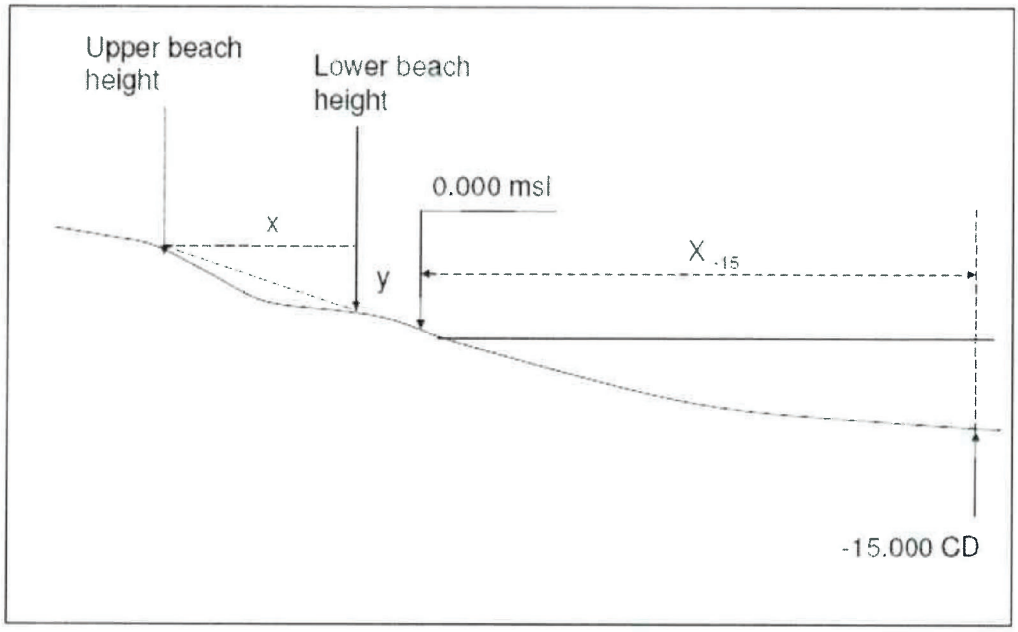


Figure 4-1: Schematic of beach transect measurements for the model evaluation

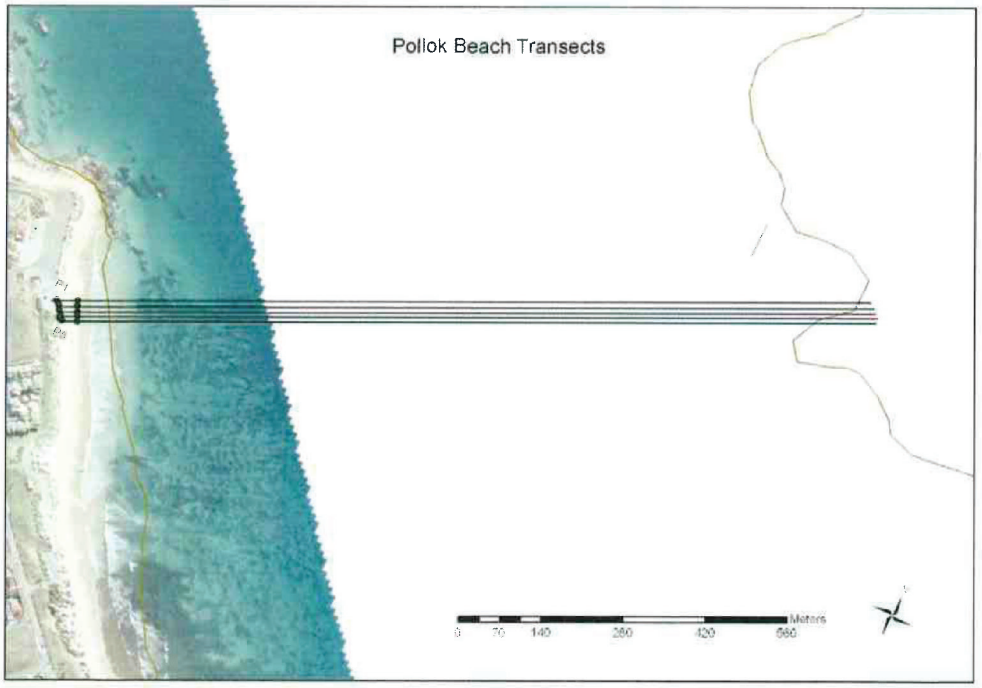


Figure 4-2: Beach transects at Pollok Beach, beach survey measurements in green, 0m msl and -15m depth contour shown in brown.

The first model is that of Nielsen and Hanslow 1991. This model is a two part model and as the slopes in all the study sites are less then 0.1 the Nielsen and Hanslow formulae reduces to a simple formulae which is not dependent on beach slope. The result of this is that when the results are plotted, the model returns the same value for predicted wave run up at all sites (4.814m above MSL) as shown in Figure 4-3.

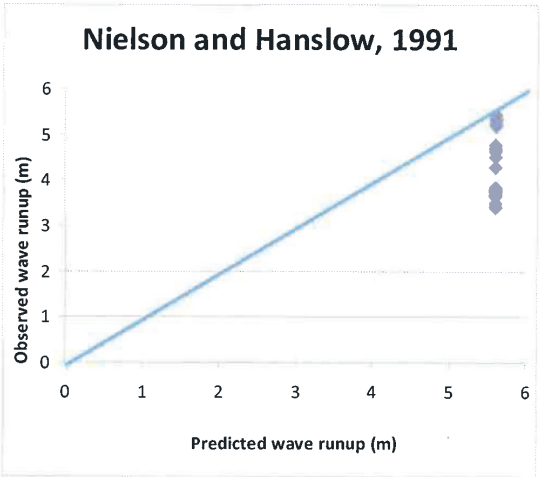


Figure 4-3: Wave run-up results for Nielsen and Hanslow model

The next model evaluated is that of Stockdon et al. 2006. This model performed well as can be seen in Figure 4-4.

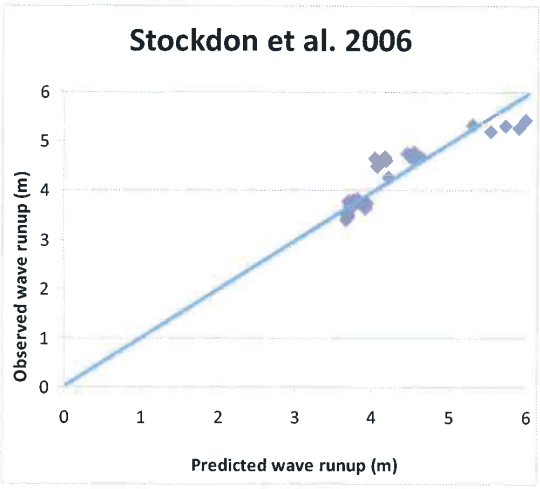


Figure 4-4 Wave run-up results for Stockdon et al. 2006

The last model evaluated was that of Mather *et al.* 2010. This model takes a different approach to the two previous models in that it uses the bathymetric profile of the nearshore as opposed to the beach face slope between low and high water marks. The results for c=10 are shown in Figure 4-5.

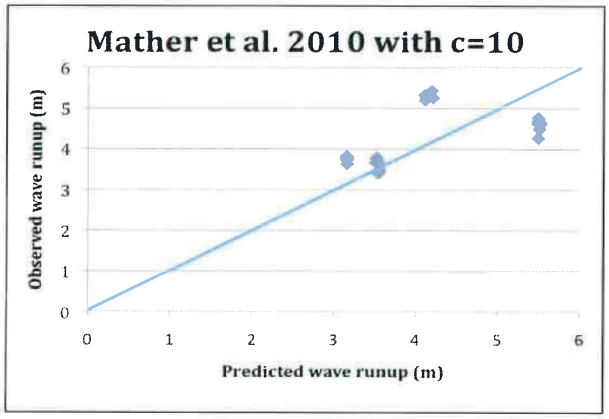


Figure 4-5: Wave run-up results for Mather et al. 2010

The results show that each beach can be identified as a tight cluster of data points. The results are scattered either side of the trend line which passes through the centre of the data. This model produced good predictions at Blue Water Bay, under predictions at Wells Estate and Pollock and over predictions at Maitlands.

As the coastline in question is very different east and west of Cape Recife it was decided to modify the Mather *et al.* 2010 model to deal with the two different types of coastline as opposed to the approach shown on Figure 1-1 above which deals with all the sites examined.

The Maitland site was analysed on its own and the coefficient c calibrated by a best fit as c=6. The observed versus predicted results are shown in Figure 4-6.

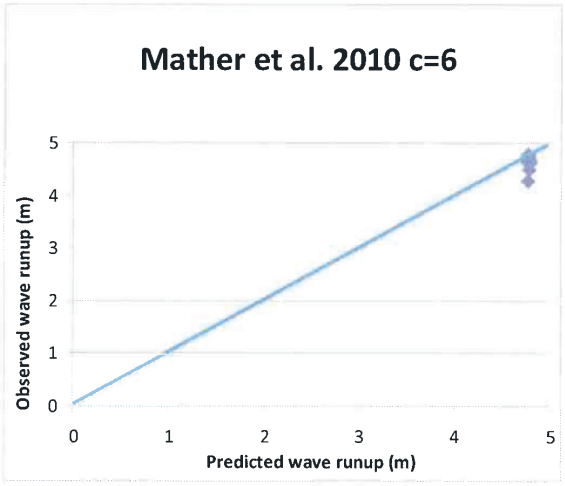


Figure 4-6: Wave run-up results for Maitlands Beach with c=6

Likewise the Pollok, Blue Water Bay and Wells Estate where similarly analysed and the results of the coefficient c determined by a best fit as c=11. The observed verse predicted results are shown in Figure 4-7.

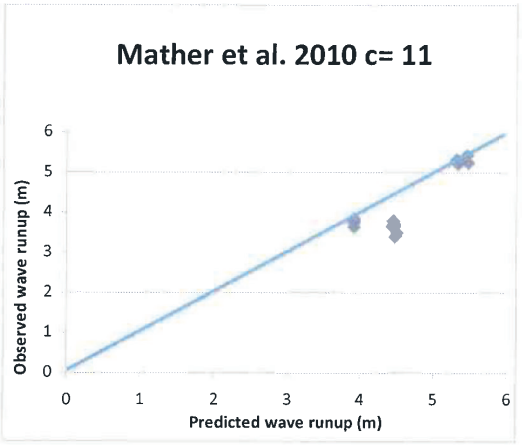


Figure 4-7: Wave run-up results for Pollok, Blue Water Bay and Wells Estate with c= 11

From this evaluation it can be seen that the worse performing model for this area is the Nielsen and Hanslow 1991 model. The best performing model was that of Stockdon *et al.* 2006 which while under predicting did give a tighter distribution of results at all four locations. However, this model requires a significant amount of data, which needs to be provided to populate their equation shown below:

$$R_{\max} = 1.1\left[0.35\beta_f\sqrt{H_0 L_0} + 0.5\sqrt{H_0 L_0\left(0.563\beta_f^2 + 0.004\right)}\right]$$

In order to provide the input data for this model a survey would be required along the entire 102 km of coastline to establish the beach face slope βf. This would entail significant additional costs beyond the scope of the current appointment and therefore while the model provides good results the additional costs involved appear to be excessive in terms of the improved prediction of wave run up.

This leaves the Mather et al. 2010 model that uses readily available data and the simple formulae as follows:

$$R_{\max} = CH_0 S^{2/3}$$

In this study C=6 for the coastline west for Cape Recife, while C=11 for the coastline east of Cape Recife was used. The wave run up position has been buffered by additional environmental and social requirements and so the position of the set back line will in all cases be inland of this line and therefore it was recommended that the Mather *et al.* 2010 model be used given the constraints to data availability.

4.3 Step 3: Determination of inland maximum scour envelope

4.3.1 Shoreline Features

Many shoreline features are distinguishable from aerial photographs on sandy coastlines these include: the seaward vegetation line, high tide wrack line, berm crest, wet/dry interface (wet-line), and beach step. While on rocky inter-tidal areas the algal line can be used as a proxy for the shoreline. The wet-line and algal line give a good approximation of the shoreline at the time of the aerial photograph on sandy and rocky inter-tidal areas respectively (O'Connel, 2003). The wet-line was digitized along sandy sections of beach and the algal line was digitized along rocky sections of coast for aerial photograph from 2004 and 2007. The above mentioned shoreline features could not be distinguished clearly on the lower resolution 1996 aerial photographs therefore these were excluded from this exercise. All wet-line data and algal line data was then used to create a composite wet-line by combining the most landward sections along the entire NMBM coastline.

4.3.2 Shoreline Trends

According to the methodology being developed in the Western Cape: aerials spanning a minimum period of at least 40 years are recommended to determine a long term shoreline trend (WSP, 2010). Due to the fact that only two aerials of suitable quality were available for this study spanning only 3 years it was not possible to calculate regression trends, therefore regression trends could not be included in this study at this stage.

The vegetation line was digitized for 1996, 2004 and 2007 aerials and these data were assessed for suitability for regression trend analysis. Several limitations were encountered with this data:

- Limited record of 11 years between 1996 and 2004
- Large tracts of mobile coastal dunefields along the NMBM coastline, where the vegetation line is controlled by aeolian processes rather than wave processes.
- Uncontrolled access across foredunes has destabilized vegetation in many areas and in some instances leading to blow-outs, affecting the position of the vegetation line.

Cross section data was available for 12 sites within the bay; this data was compared with the composite wet-line data to verify the maximum scour envelope. The data was also evaluated for possible use in identifying and quantifying trends. However the longest data set was only 19 years old and the other data sets were of much shorter duration.

4.4 Step 4: Determination of current High Water Mark in terms of the ICM ACT for sandy portion of coastline

Before work could begin on Step 4, 5 and 6 the photogrammetric data from aerial photography conducted in July 2004 for the NMBM had to be processed and interpolated to create a Digital Terrain Model (DTM) for the coastline. In addition the -15m depth contour was digitized from the navy chart "SAN125" and added to the DTM data.

According to the ICM Act the theoretical HWM is the level reached by storm waves occurring at 1:10 year return period, wave conditions selected in step 1 were modelled using Mather *et al.* 2010. Data

points were produced at 20m intervals along the coastline. Overlaying the outputs of the aerial HWM modelling over the DTM and aerial photographs allowed for model data and DTM verification.

Figure 4-8 below shows the full extent of the NMBM coastline divided at Cape Recife as defined in Step 2 and the input parameters and formula used for this exercise. Examples of HWM modelling output are shown in Figure 4-9 and Figure 4-10.

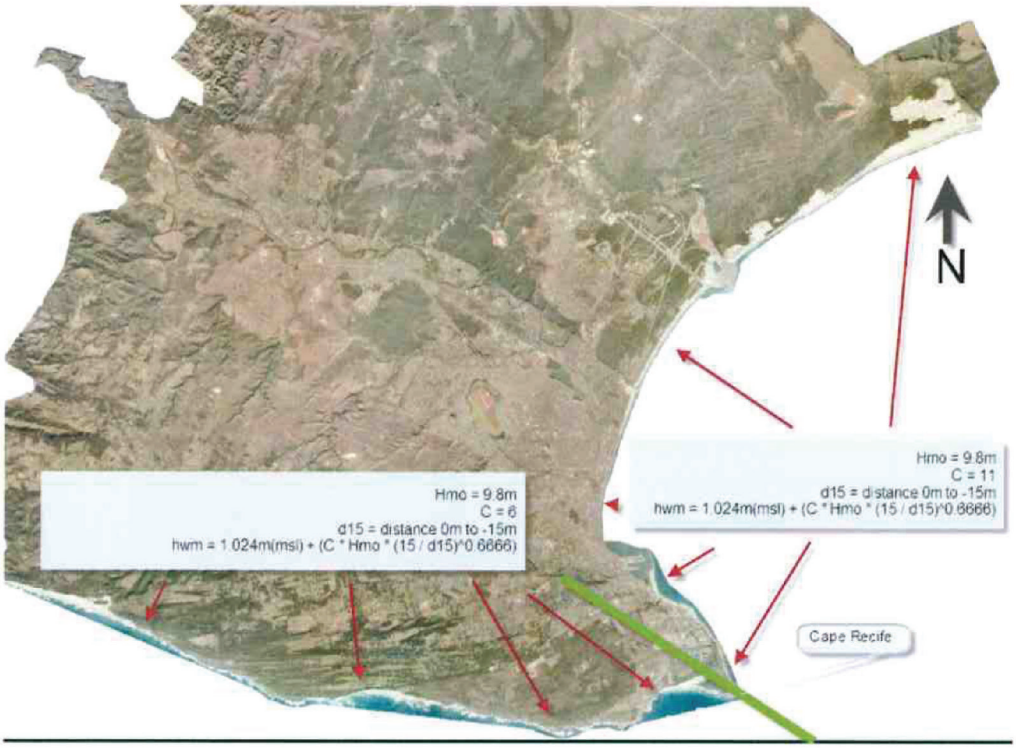


Figure 4-8 Map of the NMBM coastline divided at Cape Recife and the input parameters for the Mather et al. 2010 formula used to model the HWM

Figure 4-9: Modelled HWM at Sardinia Bay west of Cape Recife, the results are verified by the insert in the lower right hand corner showing extreme wave run up during the September 2008 storm event, note the position of run up in relation to the two structures.

Figure 4-10: HWM modelling at Wells Estate, north of the Swartkops Estuary mouth

4.5 Step 5: Determination of current theoretical High Water Mark in terms of the ICM Act for rocky portion of coastline

For the rocky portions of coast the wave runup was calculated using the 1:10 year wave data from step 1 and the Eurotop manual[1].

Wave run up is described by the formula given by the Eurotop manual (2007) on page 75.

$$\frac{R_{u2\%}}{H_{m0}} = 1.75 \cdot \gamma_b \cdot \gamma_f \cdot \gamma_\beta \cdot \xi_{m-1.0} \quad \text{(Eq 1)}$$

with a maximum of

$$\frac{R_{u2\%}}{H_{m0}} = 1.00 \cdot \gamma_f \cdot \gamma_\beta \cdot \left(4.3 - \frac{1.6}{\sqrt{\xi_{m-1.0}}}\right)$$

Where

$R_{u2\%}$ = wave runup height exceeded by 2% of the incoming waves [m]

[1] Eurotop 2007. Wave overtopping of sea defenses and related Structures: Assessment Manual. Archive for research and technology on the North Sea and Baltic Coast.

γ_b = influence factor for a berm

γ_f = influence factor for roughness elements on a slope

γ_β = influence factor for obilque wave attack

$\xi_{m-1.0}$ = breaker parameter = $\tan\alpha\ (s_{m-1,0})^{0,5}$

Rearranging Eq. 1 and substituting γ_b =1.0 yields

$$R_{u2\%} = 1.75 \cdot H_{m0} \cdot \gamma_b \cdot \gamma_f \cdot \gamma_\beta \cdot \xi_{m-1.0} \quad \text{Eq 3}$$

The deepwater 1:10 year wave height was modeled to an inshore wave at the 15m bathy contour using the SWAN model[2]. The roughness factor y_f was applied using the influence factors determined by the previous on-site wave run up measurements and on-site observations as shown in **Table 5**.

Table 5 Slope friction coefficients used to calculate wave runup

Type of coastline	Eurotop friction factor y_f
Predominately sandy with ± 10% rock	1.0 (calculated)
Sandy with ± 50% rock	0.9 (calculated)
Rocky with ± 20% sandy	0.8 (calculated)
Long continuous rocky shoreline	0.45

This can be shown to plot as a a curve of two parts, covering breaking and non-breaking waves, for a particular range of slopes (Figure 4-11).

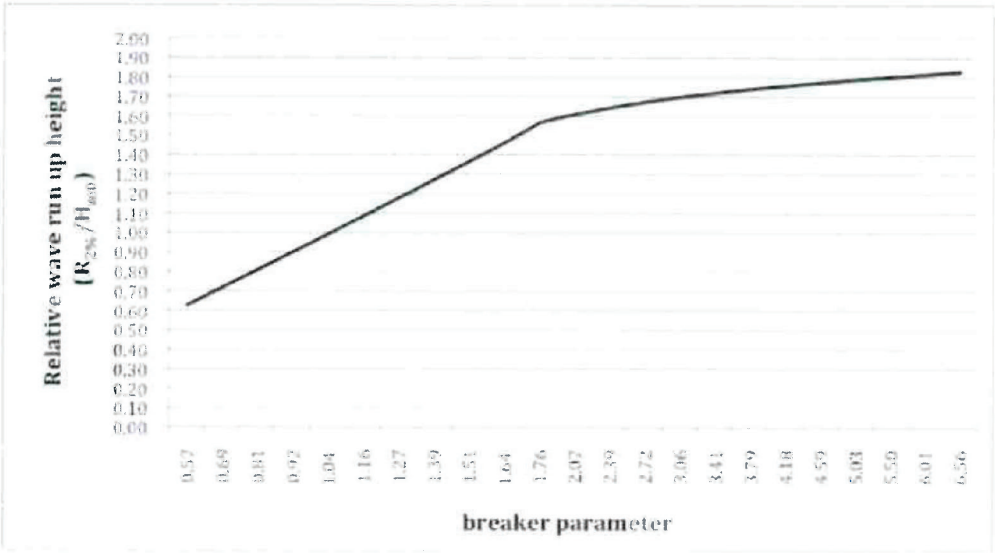


Figure 4-11 Wave run-up curve for rocky shoreline at Port Elizabeth (lambda f = 0.45)

[2] SWAN is a third-generation wave model that computes random, short-crested wind-generated waves in coastal regions and inland water (see www.swan.tudelft.nl).

The modeling was undertaken along the selected sections of rocky shoreline. The results were supplied as a GIS shapefile.

Figure 4-12: HWM modelling using Eurotop manual for rocky coastline at Schoenmakerskop , west of Cape Recife

shows modelled run-up along a rocky portion of coast west of Cape Recife.

Figure 4-12: HWM modelling using Eurotop manual for rocky coastline at Schoenmakerskop , west of Cape Recife

4.6 Step 6: Determine the predicted future High Water Mark for the entire NMBM coastline due to Sea Level Rise.

The regression due to predicted sea level rise associated with global warming was simulated differently for sandy and rocky coastline. For sandy coastline vulnerable to erosion, where greater regression is expected, the Bruun rule was used. This was conducted using the DTM data and three sea level rise scenarios, 300mm, 600mm and 1000mm. The Bruun rule was set up in the Auto Cad environment and the regression calculation process was calculated for the whole coastline with outputs at 20m intervals. In order to incorporate the maximum scour envelope all data was 'lifted' and the 0m contour was placed on the composite wet line (from step 3). This process effectively added the distance between the DTM 0m contour to the composite wet line to all the output HWM and regression lines. The wet-line may be slightly higher than the 0m contour in reality and this exercise described above may result in conservative results, this is considered favourable due to the conservative and precautionary nature of

this study. Examples of Bruun regression shoreline modelling are shown in Figure 4-13 and Figure 4-14 below.

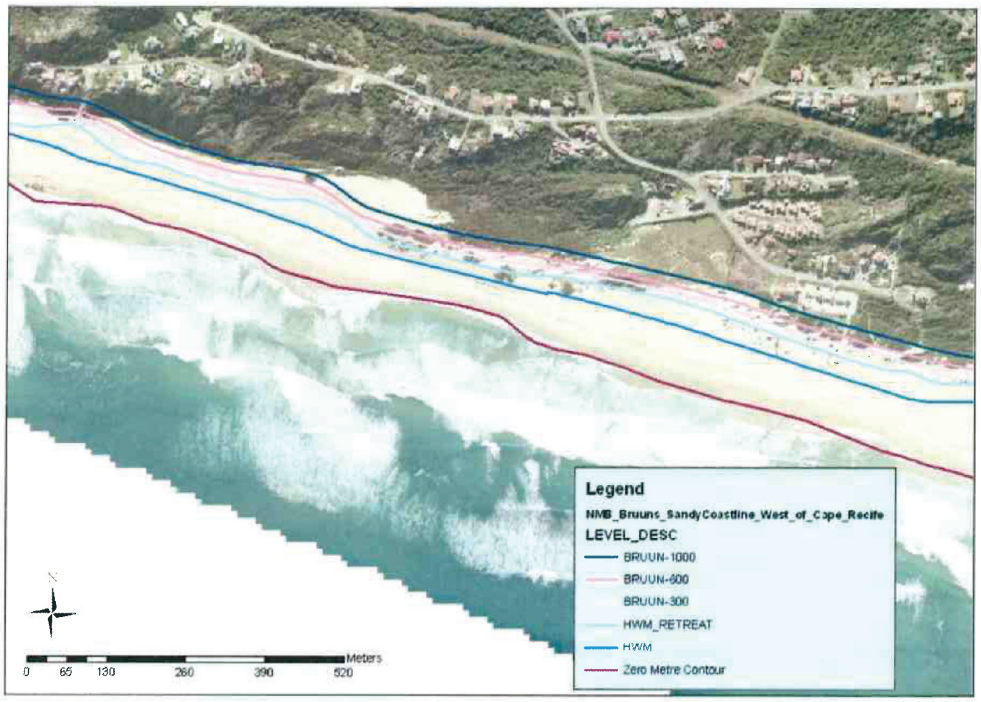


Figure 4-13: Bruun regression modelling for sandy coastline at Blue Horizon Bay.

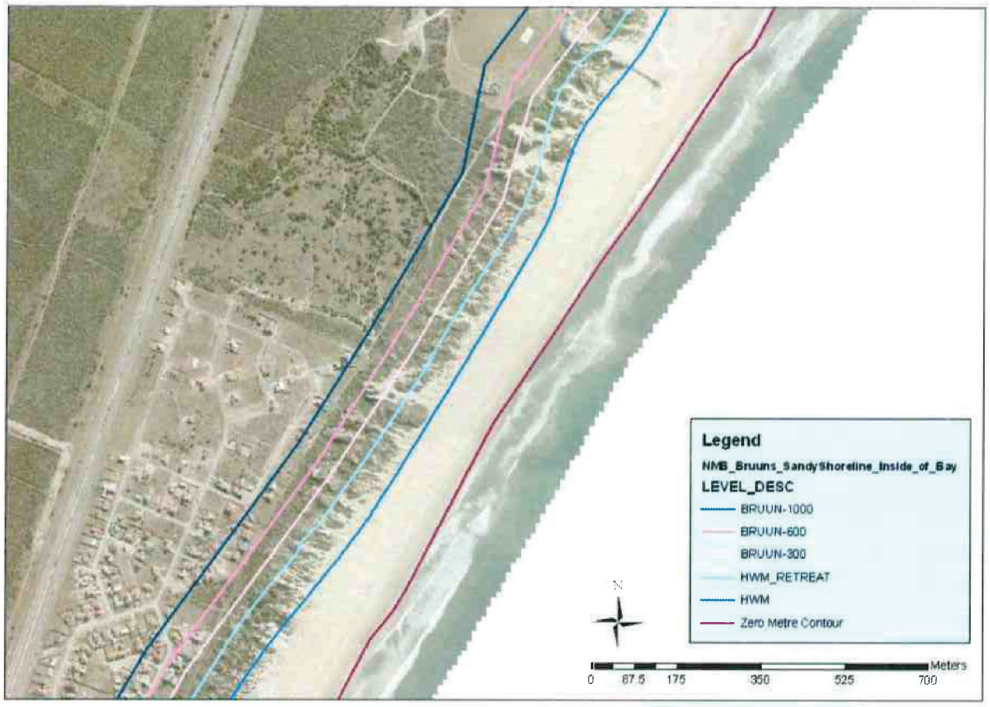


Figure 4-14: Bruun regression modelling for sandy coastline between Blue Water Bay and Wells Estate

The coastal process management line (**CPSLs**) for the sandy coastline was determined by:

CPSLs= A*+B+C

Where, **A*** is the difference between the composite wet-line and the DTM 0m contour (only used for sandy coastline), **B** is the HWM modelled using Mather et al., **C** is the regression due to sea level rise. An example of the CPSLs' output is presented in **F**igure 4-15.

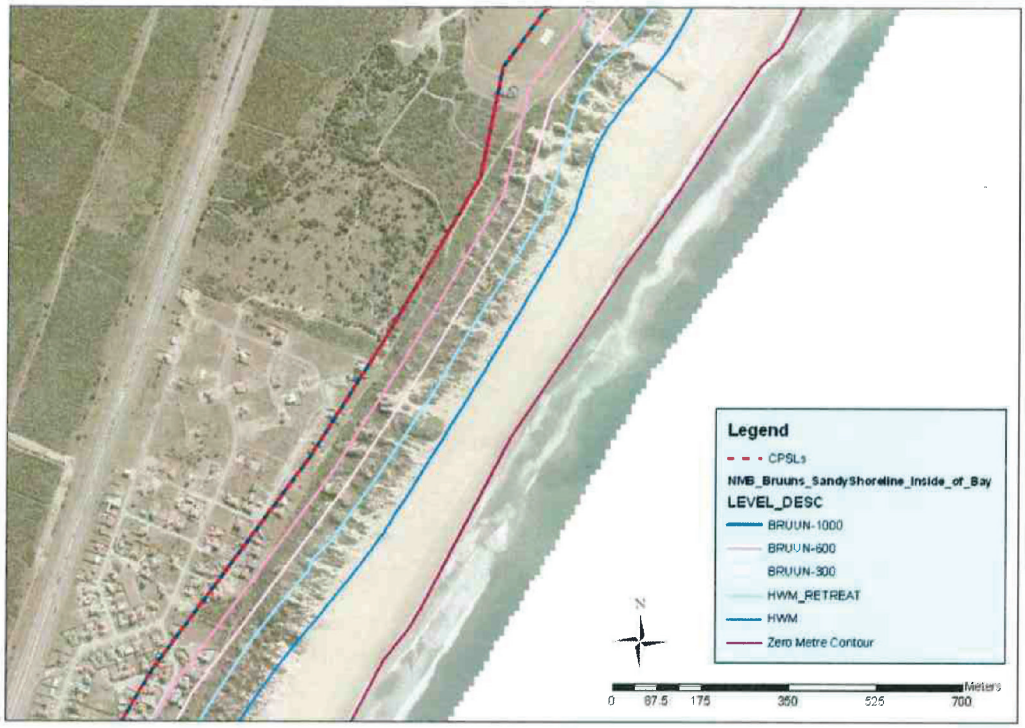


Figure 4-15: Coastal process management line (CPSLs) for sandy coastline.

For rocky coastline resilient to erosion, the Eurotop wave runup modelling output surface was shifted vertically by 1000mm and the intersection with the DTM data was calculated in the Auto Cad environment. An example of sea level rise for rocky shoreline is presented in Figure 4-16.

Figure 4-16: Sea level rise (1000mm) for rocky shoreline area west of Cape Resife.

The coastal process management line (**CPSLr**) for rocky coastline was determined by:

CPSLr = D+E

Where, **D** is the HWM modelled using the Eurotop Manual and **E** is the horizontal intersection of the HWM surface lifted vertically by 1000 mm with the DTM.

An example of CPSLr output is presented in Figure 4-17.

Figure 4-17 Coastal process management line (CPSLr) for rocky shoreline are west of Cape Recife.

4.7 Steps 7, 8 & 9: Environmental Buffers, Social Buffers, and Economic Requirements

Upon the resolution taken during the Project Steering Committee meeting held on the 29th July 2010 it was agreed that the project team should consolidate the following steps into a workshop with relevant stakeholders:

Step 7 – Determine the environmental buffers required inland from the HWM to maintain a functional coastal ecosystem under future sea level rise scenarios.

Step 8 – Determine of social buffers required along the coast. For example allowance for public beach access through and along the coastal frontage or for areas which have cultural significance and will need to be preserved from development.

Step 9 – Determine any economic requirements for the coast. For example, allowance for new beach facilities that will need to be placed closer than normal development to serve the public. Economic demands often require a trade off against environmental aspects at a particular site. Therefore the project team will provide an acceptable methodology to deal with the possible conflicts between the desire for environmental protection and the need for economic activities.

In preparation for the workshop, broad steps of the process were followed and provided for to all the participants prior to and during the workshop. GIS imagery and shape files determined in the earlier

stages of this project (steps 1-6) were used to facilitate and record the decisions taken at each location. Analysis of data through a live GIS application was also undertaken. The data that was used for the workshop included:-

- Current HWM
- Maximum scour HWM
- Position of the HWM under 300, 600 and 1000mm of sea level rise
- The NMB MOSS coverage

Three key decisions were taken at the workshops i.e.

1. For the purpose of this initial determination of the coastal management lines, the NMB MOSS is sufficient in representing both environmental and social considerations required for this exercise as it includes both public open space and undeveloped open space;
2. Based on the overarching aim of establishing coastal management lines i.e. managing coastal risk areas, the location of the coastal management lines will only be based on the physical and ecological processes and will not be altered to accommodate economic activity; and that
3. The CPZL will consider the ecological and social processes contained within the NMB MOSS.

4.7.1.1 Process towards the determination of the coastal protection zone limit

At each stretch of beach examination of the HWM under the various sea level rise scenarios and determination of the hazard zone was done. This was the first line of importance in determining the active hazard zone in which any development placed sea ward of this line is likely to experience direct wave attack. As an aide memoire the table below was provided in order to assist in the discussion of which scenario was appropriate to the development in place/proposed.

Table 6: Decision matrix for risk selection to sea level rise for coastal developments including: infrastructure value, lifespan, impact of failure, planned sea-level rise (Courtesy Andrew Mather, Ethekwini Municipality)

Value of infrastructure	Life of infrastructure	Impacts of failure of the infrastructure	Planned amount of sea level rise
Low (up to R2 million) i.e. Recreational facilities, car parks, board walks, temp beach facilities	Short term Less than 20 years	Low Minor inconvenience, Alternative facilities in close proximity, short rebuild times	0.3m
Medium (R2 million to R20 million) Tidal pools, piers, recreational facilities, sewerage pump stations.	Short to Medium Term Between 20 and 50 years	Medium Local impacts, loss of infrastructure and property	0.6m
High (R20 million to R200 million) Beachfronts, small craft harbours, Residential homes, sewerage treatment works.	Medium to Long Term Between 50 and 100 years	High Regional impacts, loss of significant infrastructure and property	1.0m
Very High (greater than R200 million) Ports, desalination plants, nuclear power stations	Long term In excess of 100 years	Very High Major disruption to the regional and national economy, failure of key national infrastructure	2.0m

4.7.1.2 Extent of environmental buffers

The next issue was to determine the extent of any environmental buffers that may be required in addition to the active hazard zone. Allowance was made for dune systems, coastal forest, etc. to ensure that the coastal zone can remain a functional system. It was important to at least provide a vegetation edge so that re-colonisation of the primary dune vegetation can occur after severe erosion events. NMB MOSS GIS data layer was used as the principle determinant of the environmental buffer and CPZL. The process of determining the CPZL is shown diagrammatically in Figure 4-18.

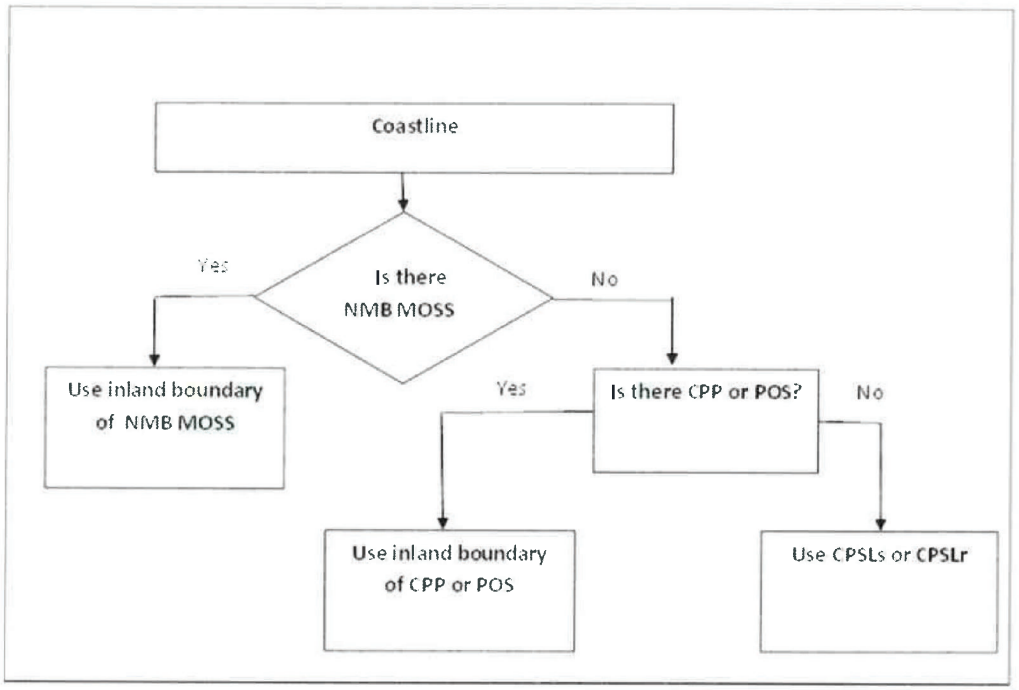


Figure 4-18: Process flow for determination of Coastal Protection Zone

4.8 Step 10: Process of determination of Coastal Management Line and Coastal Protection Zone Limit

Once the two steps above were completed two lines were determined:

- Coastal Protection Zone Limit (CPZL)
- Coastal Management Line (CSL)

4.8.1 Outcomes from the workshop to consolidate steps 7 - 9

Given that the approach in the ICM Act is based around human use and activities along the coast, the balance between the opposing risk extremes of asset loss and the usage of the coast for human purposes, has been considered. The coastal process setback line (CPSL) with maximum sea level rise of 1000 mm in 100 years was chosen as a principal determinant for both the CSL and CPZL.

During the workshop, referred to in section 4.7 of this report, the implications of the CSL and the CPZL were considered in detail with reference to the specifications contained in the ICM Act. In addition outcomes of similar projects to establish coastal management lines in the Western Cape Province were presented and considered when deciding on an approach for Nelson Mandela Bay.

During the workshop (refer to section 4.7 of this report) the representatives of NMBM proposed that the CSL should be situated along the CPSLs and CPSLr, regardless of ownership, zoning or socio-economic issues. The rationale being that the NMBM has an obligation to inform all property owners

and property developers of likely future risk to properties through coastal processes, especially the impacts of sea level rise associated with global warming.

It was also agreed that the CPZL would be situated at the landward limit of the NMB MOSS layer where NMB MOSS was present along the coastline and concurrent with the CSL where NMB MOSS was not present. An example of the CSL and CPZL are shown in the Figure 4-19, Figure 4-20 and Figure 4-21 below.

Figure 4-19: CSL and CPZL for rocky coastal area west of Cape Recife.

Figure 4-20: CSL and CPZL for hobie beach to pollok beach inside Algoa Bay.

Figure 4-21: CSL and CPZL for Blue Water Bay to Wells Estate inside of Algoa Bay.

4.8.2 Sediment Pathways

In certain instances the existing coastal processes such as Aeolian sand transport needed to be considered in more detail and the CPSL adjusted to accommodate features like headland bypass dune fields such as the Noordhoek dunefield at Cape Recife. As discussed in the introduction section, several prominent headland bypass dunefields were actively supplying sediment to the bay prior to development in the area. These features were seen as a nuisance by the residents at the time and the authorities went about actively stabilising the largest "Driftsands" dunefield as early as 1870. The leading portion of the smaller "Noordhoek" dunefield was stabilised when a treatment works and maturation ponds were constructed in the 1960's. The smaller dunefield at the extremity of Cape Recife is still active. It has been calculated that +/- 26 000 $m^3.yr^{-1}$ of sand was transported into the bay via the Noordhoek dunefield prior to stabilisation (McLachlan *et al.*, 1994) (**Error! Reference source not found.**). Several studies have motivated for the reactivation of this supply in order to provide more sand to the beaches of Algoa Bay (Lord D. A., 1985, Klages *et al.*, 2010). Considering these environmental issues it was agreed that the CSL should be situated on the northern landward margin of the bypass dunefield (Figure 4-23) in order to allow for this bypass dunefield to become active again in order to once again provide this "ecosystem service" in the supply of sand to the popular tourist beaches along the southern coastline within the bay (Klages *et al.*, 2010).

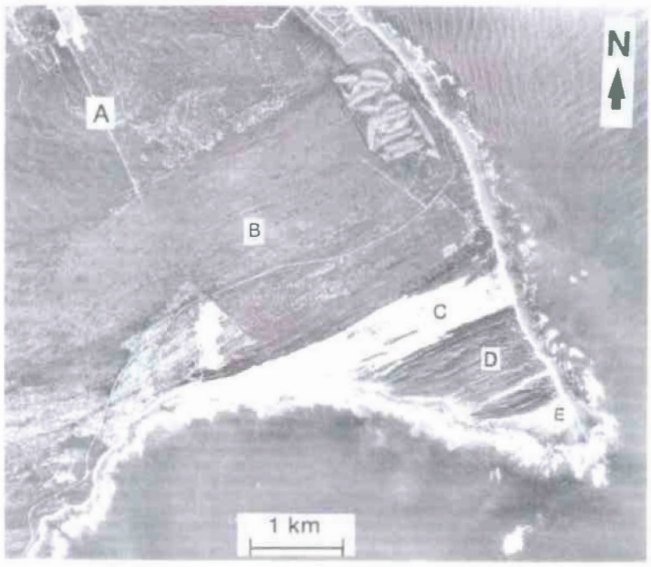


Figure 4-22: Vertical aerial photograph of Cape Recife taken in 1958, showing artificially vegetated transgressive dunes in the Driftsands dunefield (A), naturally vegetated longitudinal dunes (B), the Noordhoek dunefield (C), active hairpin parabolic dunes (D), and active dunes at Cape Recife (E) (from Mclahlan *et al.*, 1994)

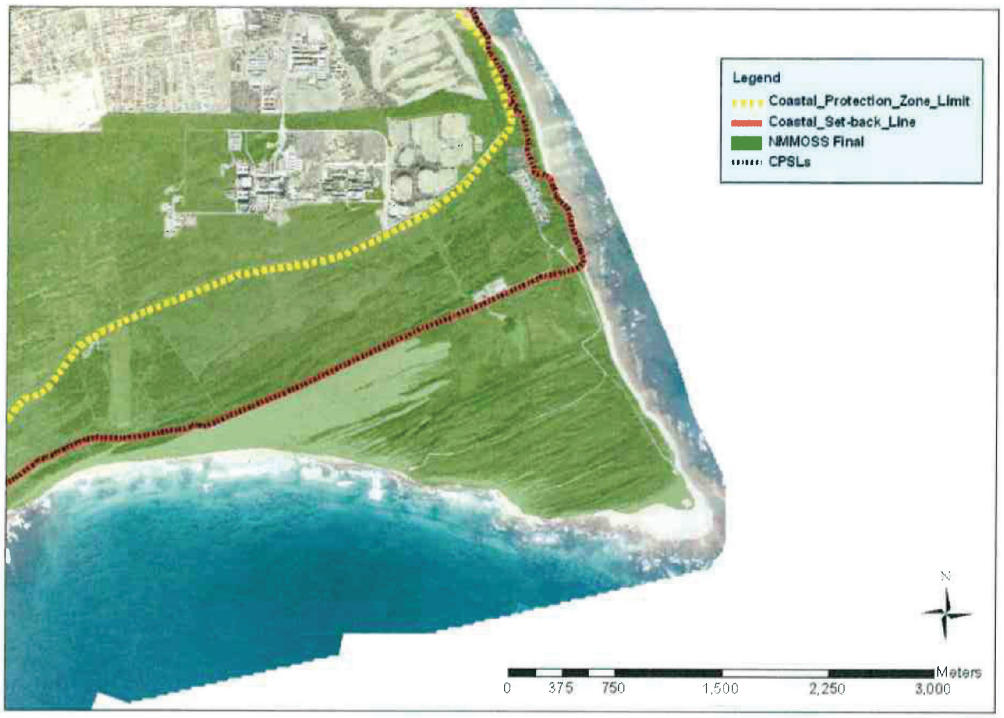


Figure 4-23: CSL and CPZL in the vicinity of Cape Recife, CSL line situated landward of the Noordhoek dunefield.

4.8.3 Port Limits

The DEDEAT presented for consideration the request from the Minister of Environmental Affairs and Tourism that certain land be excluded from coastal public property in terms of Section 27(4) of the ICM Act. When the Act was still a Bill in Parliament, the Portfolio Committee on Environmental Affairs had been opposed to the Lexshell/Transnet proposal calling for the exclusion of the V&A Waterfront and all ports from the Act. Since each of these ports were extensive with larger reserved areas, the Portfolio Committee had felt this proposal could not be permitted.

The Portfolio Committee had felt that there had to be certainty as to what would be excluded. The Portfolio Committee thus introduced Section 27(2) -27(4) which allowed exceptions by ministerial proclamation and ratification by Parliament. There was thus agreement for the exclusion of confined port areas, namely the footprint of ports where the actual work was being done. The exclusion did not include the extended areas.

Since the ICM Act had been enacted, Transnet had submitted a formal application for the exclusion of nine ports with co-ordinates that covered only the footprint of ports where the actual work was being done. The request did not include the extended areas of each port. For example the V&A Waterfront did not form part of the footprint of the area to be excluded. DEAT concluded that the V&A Waterfront would have to come back to Parliament if it wished to be excluded (PMG,2009).

The port areas defined for the port of Ngqura and Port Elizabeth are shown in Figure 4-24. Based on the outcome of the case referred to above, the port operational areas, as submitted by Transnet and approved by parliament, are excluded from the ICM Act and therefore coastal management lines falling within the port limits or concurrent to the port limits have been removed, examples of these edits for the Port of Ngqura and Port Elizabeth are shown in Figure 4-25 and Figure 4-26 respectively.

Figure 4-24: Port Limits for the Port of Ngqura and the Port of Port Elizabeth.

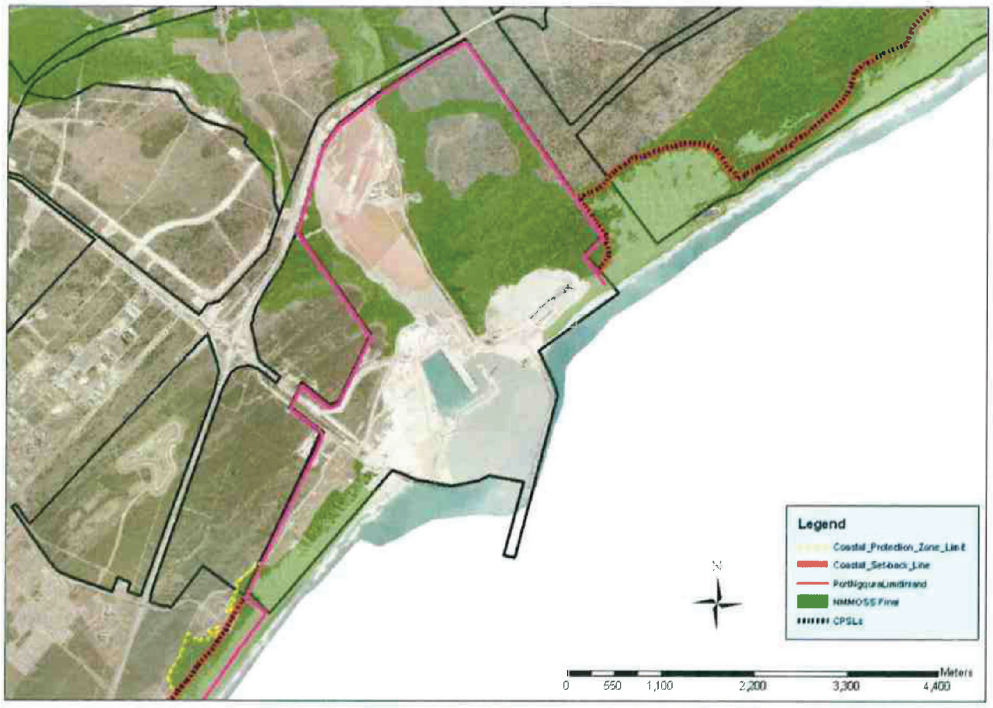


Figure 4-25: Final management lines in the vicinity of the Port of Ngqura.

Figure 4-26 Final management lines in the vicinity of the Port Elizabeth harbour

5 PUBLIC PARTICIPATION PROCESS

Section 25 (2) of the National Environmental Management: Integrated Coastal Management Act, 2008 (Act No. 24 of 2008) (ICM Act) requires that:

Before making or amending the regulations referred to in subsection (1), the MEC must—

(c) consult with any local municipality within whose area of jurisdiction the coastal management line is, or will be, situated: and

(d) give interested and affected parties an opportunity to make representations in accordance with Part 5 of Chapter 6.

In June 2012 the draft report on the establishment of coastal management lines for Nelson Mandela Bay, prepared by Masande Consultants in cooperation with Afri-Coast, was submitted to the Department of Economic Development, Environmental Affairs and Tourism (DEDEAT). In June 2014 the DEDEAT appointed Afri-Coast Engineers SA (Pty) Ltd to facilitate the public participation process with regards to the establishment of coastal management lines for Nelson Mandela Bay.

5.1 Public participation actions

5.1.1 Newspaper notices

At the inception meeting it was agreed that notices will be placed in the PE Express and UD News, as opposed to the PE Herald, based on the fact that they have a wider audience than the PE Herald. The notices were run in the PE Express and UD News on the 18th June 2014 and 19th June 2014 respectively.

For copies of the newspaper notices, please see Annexure B.

5.1.2 E-mail correspondence

A database of stakeholders was compiled prior to the commencement of the public review and comment period. Email correspondence was sent to the following groups of stakeholders:

- Ward Councillors of all the affected wards
- Relevant provincial and local government departments
    - Nelson Mandela Bay Municipality (NMBM)
    - DEDEAT
    - Department of Water Affairs (DWA)
    - Department of Agriculture, Fisheries and Forestry (DAFF)
    - Department of Roads and Public Works (DRPW)
    - South African Heritage Resources Agency (SAHRA)
    - Eastern Cape Provincial Heritage Resources Agency (ECPHRA)
- Organised civil society

All e-mail notifications included the following documents:

- Background Information Document (BID)

- Copy of the public notice

Refer to Annexure C for the register of stakeholders.

5.1.3 Registration of Interested & Affected Parties (I&APs)

I&APs had 40 working days in which to register as such and provide comment/input regarding the proposed coastal management lines for Nelson Mandela Bay. All attendees of the various stakeholder and public meetings were automatically included on the register of I&APs (refer to Annexure D).

5.1.4 Public meetings

Four public meetings in total were held. The first meeting was held in April 2012, shortly before finalising the initial draft of the report on the determination of coastal management lines for Nelson Mandela Bay. This meeting was, however, not part of the formal public participation process.

The official public participation process, which kicked off in June 2014, included, amongst others, three public meetings i.e.

1. Tuesday, 8 July 2014; Time: 18:00pm; Venue: Bluewater Bay Community Church;
2. Wednesday, 9 July 2014; Time: 18:00pm; Venue: PE City Hall Auditorium; and
3. Thursday, 10 July 2014; Time: 18:00pm; Venue: Sea View Community Centre.

Refer to Annexure E for the attendance registers and minutes of the respective public meetings.

5.1.5 Stakeholder meetings

The public participation process included four stakeholder meetings i.e.

1. Juristic (Monday, 7 July 2014; Time: 14:00pm; Venue: Afri-Coast Boardroom);
2. SANParks (Wednesday, 9 July 2014; Time: 10:00am; Venue: NMMU South Campus); and
3. Harbours (Thursday, 10 July 2014; Time: 8:30am; Venue: Port Admin Building);
4. Juristic & harbours (Wednesday, 13 August 2014; Time: 9:00am; Venue: Afri-Coast Boardroom).

Refer to Annexure F for the attendance registers and minutes of the respective public meetings.

5.2 REVIEW AND COMMENT TIMEFRAMES

The mandatory 40 day public review and comment period commenced on 19 June 2014 and closed on 29 July 2014.

All comments received were captured in a comments and response register (Annexure G), with responses formulated during a workshop with relevant government departments as well as the two port authorities i.e. Transnet National Ports Authority and the Coega Development Corporation (CDC). Where relevant, the comments have been incorporated into the amended report.

6 RECOMMENDATIONS

The preliminary analysis of the legal frameworks and policies of the coastal management objectives and of the national government shows a lack of a common methodology for determination of coastal management lines at the provincial and/ local level, even though the procedure on coastal zone determination through the ICM Act had been promulgated with a clear reference to coastal management lines.

The main objective of this preliminary analysis was to identify the risk area along the Nelson Mandela Bay coastline through a process of determining coastal management lines. In order to identify coastal management lines for the coastal zone as a policy option, an analysis of the whole system should be carried out, with the coastal management lines based on physical coastal processes as well as ecological and landscape protection criteria.

The results of the analysis shows that the generic application of the arbitrary line, as is the case with *'100m from the high water mark'* which is applied in terms of the NEMA EIA regulations, ignores the diversity of coastal characteristics and physical processes. Coastal management lines should therefore ideally only be determined and applied based on scientific understanding and local knowledge, and must take into consideration natural processes, landscape values, public use and accessibility. It must be noted that the coastal management lines will, however, not replace any other line in the coastal zone, but will be applied only as indicators of the risk area.

Section 25 of the ICM Act requires that the following process be followed in order to finalise the coastal management lines and CPZ and prepare them for official adoption:

(2) Before making or amending the regulations referred to in subsection (1), the MEC must—

(a) consult with any local municipality within whose area of jurisdiction the coastal management line is, or will be, situated: and

(b) give interested and affected parties an opportunity to make representations in accordance with Part 5 of Chapter 6.

(3) A local municipality within whose area of jurisdiction a coastal management line has been established must delineate the coastal management line on a map or maps that form part of its zoning scheme in order to enable the public to determine the position of the management line in relation to existing cadastral boundaries.

Section 53(1) of the ICM Act specifies the Minister must, before exercising his/her power to establish coastal management lines, must –

(a) consult with all Ministers, MECs or municipalities whose areas of responsibilities will be affected by the exercise of the powers in accordance with the principles of co-operative governance as set out in Chapter 3 of the Constitution;

(b) publish or broadcast his or her intention to do so in a manner that is reasonably likely to bring it to the attention of the public; and

(c) by notice in the Gazette—

(i) invite members of the public to submit, within no less than 30 days of such notice, written representations or objections to the proposed exercise of power; and

(ii) contain sufficient information to enable members of the public to submit representations or objections.

While the ICM Act allows for the pro-active determination of coastal management lines, coastal management lines may also at times be re-actively determined when considering development applications in terms of the NEMA EIA Regulations. Due to the uncertainties surrounding the exact impacts of global warming in terms of sea level rise and increased frequency and intensity of storm events, it is recommended that the whole exercise be repeated using updated input data every 10 years. In addition to this it is recommended that, as and when funding becomes available, management lines for estuaries within the NMBM should be determined and combined with the coastal management lines established during this study. A set of 11 maps, covering the entire Nelson Mandela Bay coastline, and indicating the coastal management line for Nelson Mandela Bay, have been included as Annexure H to this report.

Finally, it has to be emphasised that this initial determination of coastal management lines for the Nelson Mandela Bay coastline is only the first step towards the regulation of coastal management lines for the Nelson Mandela Bay metropolitan area. Only once the lines have been adopted by the MEC and published in the Gazette can the process of setting regulations with regards to the coastal management lines commence. The lines will need to be considered in all development proposals and applications, regardless of whether it has been regulated.

7 REFERENCES

Afri-Coast & SRK. (2004). *Nelson Mandela Metropolitan Municipality Integrated Beachfront Development Plan.* Port Elizabeth: Afri-Coast Engineers SA (Pty) Ltd.

Afri-Coast. (2010). *Port of Ngqura: Monitoring of Updrift and Downdrift Beaches.* Port Elizabeth: Afri-Coast Engineers SA (Pty) Ltd.

ASR. (2008). *Detailed Design Report for Multipurpose Reefs at 4 Locations in Port Elizabeth, South Africa. 2008.* . Raglan: ASR Ltd. Marine Consulting and Research. .

Basco, D. R., & Pope, J. (2004). Groin Functional Design Guidance from the Coastal Engineering Manual. *Journal of Coastal Research* , Special Issue 33: 121-130.

Bird, E. C. (1996). *Beach management.* Chichester, UK: Wiley, 281p.

Celliers, L., Breetzke, T., Moore, L. and Malan, D. 2009. A User-friendly Guide to South Africa's Integrated Coastal Management Act. The Department of Environmental Affairs and SSI Engineers and Environmental Consultants. Cape Town, South Africa

Clark, J. ((1996). *Coastal Zone Management Handbook.* USA: Lewis Publishers.

Dean, R. G., & Dalrymple, R. A. (2002). *Coastal Processes with Engineering Applications.* Cambridge, England: Cambridge University Press.

Frihy, O. E., Essam, A., Debes, E. A., & El Sayed, W. R. (2003). Processes reshaping the Nile delta promontories of Egypt: pre- and post-protection. *Geomorphology* , 53: 263–279.

IPCC. (2007). *IPCC Fourth Assessment Report: Climate Change 2007. Working Group I Report The Physical Science Basis.* Retrieved 11 2007, 20, from http://www. ipcc.ch/ipccreports/ar4-wg1.htm

Klages, N., Smith, G., & Illenberger, W. K. (2010). *Management of windblown sand near the Cape Recife waster water treatment works, prepared on behalf of Nelson Mandela Bay Municipality.* Port Elizabeth: Arcus Gibb.

La Cock, G. D., & Burkinshaw, J. .. (1994). Management implications of development resulting in disruption of a headland bypass dunefield and its associated river, Cape St Francis, South Africa. *Landscape and Urban Planning* , 34: 373-381.

Lord, D. A., Illenberger, W. K., & McLahlan, A. (1985). *Beach erosion and sand budget for the Port Elizabeth beachfront.* Port Elizabeth: Institute of Coastal Research University of Port Elizabeth.

Mather, A. A., Stretch, D. D., & Garland, G. (2010). A simple empirical model for extreme wave run-up on natural beaches. *Journal of Geophysical Research* , in press.

McLachlan, A., Illenberger, W. K., & Burkinshaw, J. R. (1994). Management Implications of Tampering with Littoral Sand Sources. *Journal of Coastal Research. Special Issue on Coastal Hazards* , 12: 51-59.

NEMA. (2010). National Environmental Management Act. National Government.

Nielsen, P. T., & Hanslow, D. J. (1991). Wave Runup Distributions on Natural Beaches . *Journal of Coastal Research* , 1139-1152.

NMBM. (2009). *Metropolitan Spatial Development Framework.* Port Elizabeth: NMBM.

O'Connel, J. F. (2003). *The art and science of mapping and interpreting shoreline change data: The Massachusets experience.* Baltimore: Proceedings of the 13th Biennial Coastal Zone Conference.

Phillips, M. R., & Jones, A. L. (2006). Erosion and tourism infrastructure in the coastal zone: Problems, consequences and management. *Tourism Management* , 27: 517-524.

PRDW. (2009). *Eskom Nuclear Sites Site Safety Reports Numerical Modelling of Coastal Processes, Thyspunt. Report No. 1010/2/101.* Cape Town: Prestedge Retief Dresner Wijnberg (Pty) Ltd Consulting Port and Coastal Engineers.

Schumann, E. (1999). *Pollution status and assimilative capacity of the western sector of Algoa Bay.* Port Elizabeth: SAB Institute for Coastal Resource Management.

SRK. (2009). *Final Conservation Assessment and Plan for the Nelson Mandela Municipality.* Port Elizabeth: SRK.

Stockdon, H. F., Holman, R. A., Howd, P. A., & Sallenger, A. H. (2006). Empirical parameterisation of setup, swash, and runup. *Coastal Engineering (53)* , 573-588.

Swart, D. H. (1996). The History of Coastal Engineering in South Africa. In C. Kraus, *History and Heritage of Coastal Engineering.* United States of America: American Society of Civil Engineers.

Theron, A. K. & Roussow, M. (2008). Analysis of potential coastal zone climate change impacts and possible response options in the Southern African region. Science real and relevant: 2nd CSIR Biennial Conference, CSIR International Convention Centre Pretoria, 17&18 November 2008, pp 10

Tribbia, J. &. (2008). More than information: what coastal managers need to plan for climate change. *Environmental Science and Policy* , (11) 315-328.

WSP. (2010). *Development of a Methodology for Defining and Adopting Coastal Development Management Lines.* Stellenbosch: WSP Africa Coastal Engineers (Pty).

WTO. (2001). Retrieved from http://www.world-tourism.org/aboutwto.html.

ANNEXURES

Annexures A to G can be obtained from the link below:
http://www.dedea.gov.za/Environmental%20Management%20Legislation/Forms/Environmental%20Management%20Legislation.aspx

Annexure A: Supporting figures

Annexure B: Newspaper notices

Annexure C: Stakeholder register

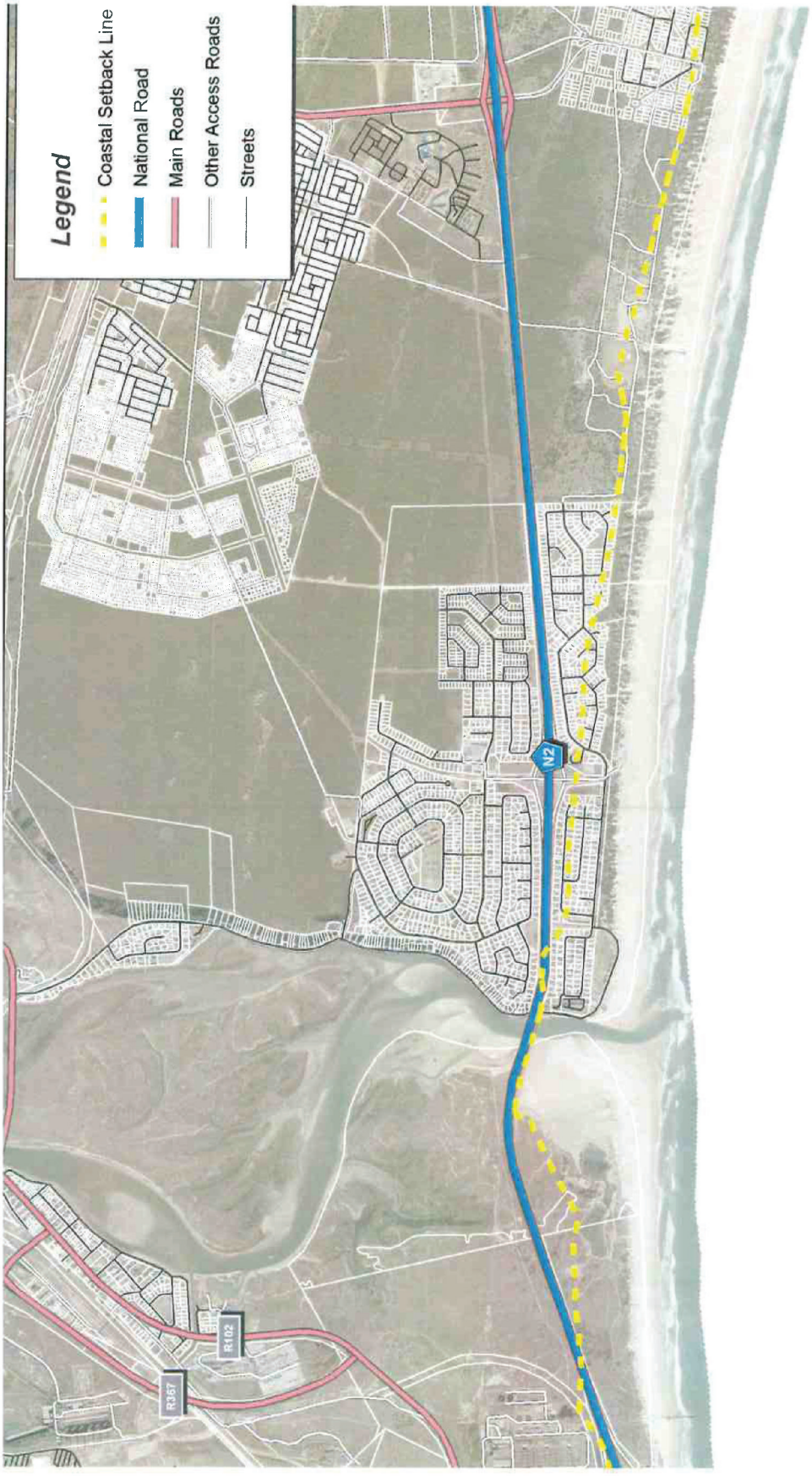
Annexure D: I&AP Register

Annexure E: Attendance registers and minutes from stakeholder meetings

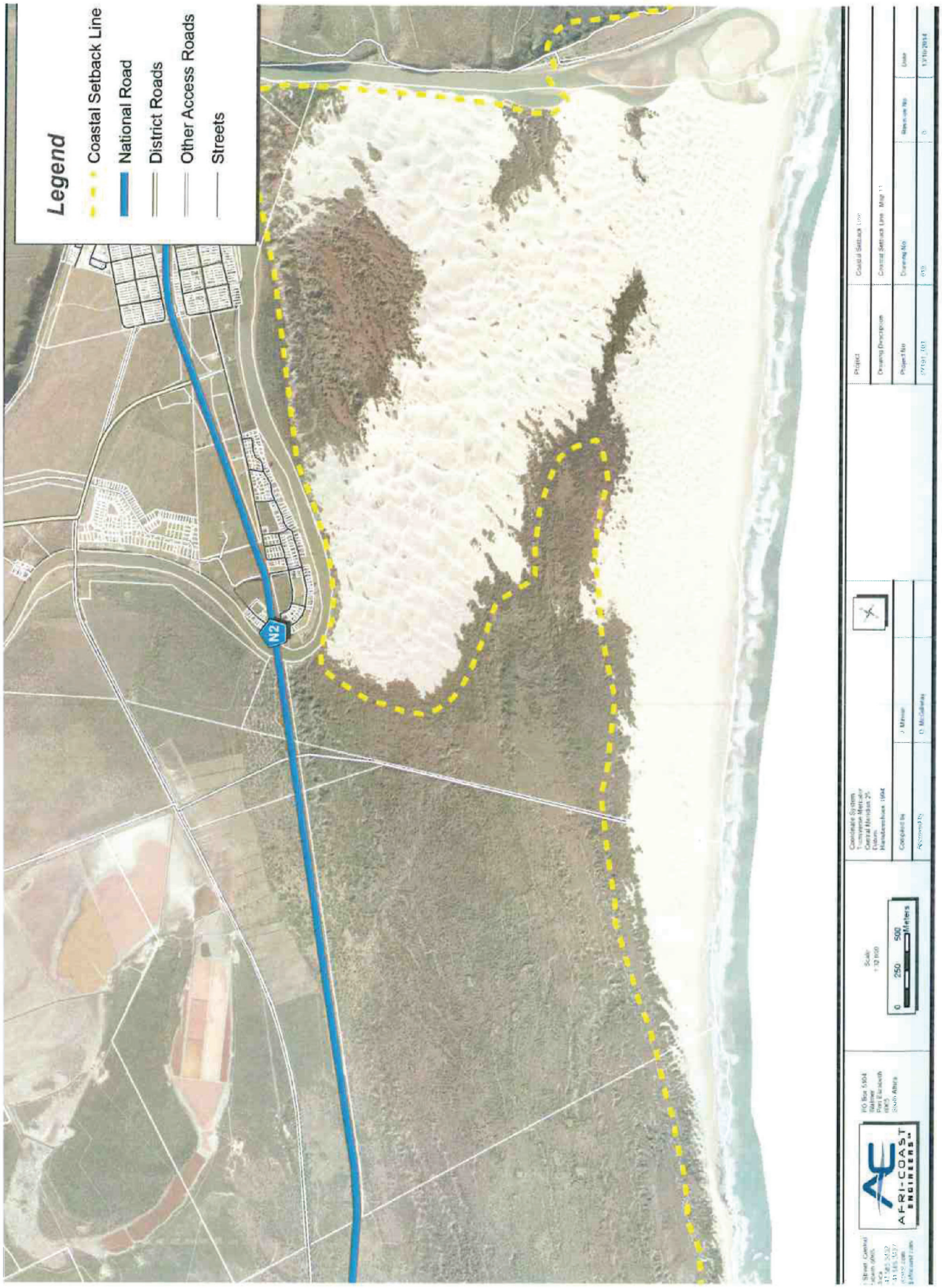
Annexure F: Attendance registers and minutes from public meetings

Annexure G: Comment and response register

Annexure H: Set of 11 maps showing the coastal management line for the entire Nelson Mandela Bay coastline

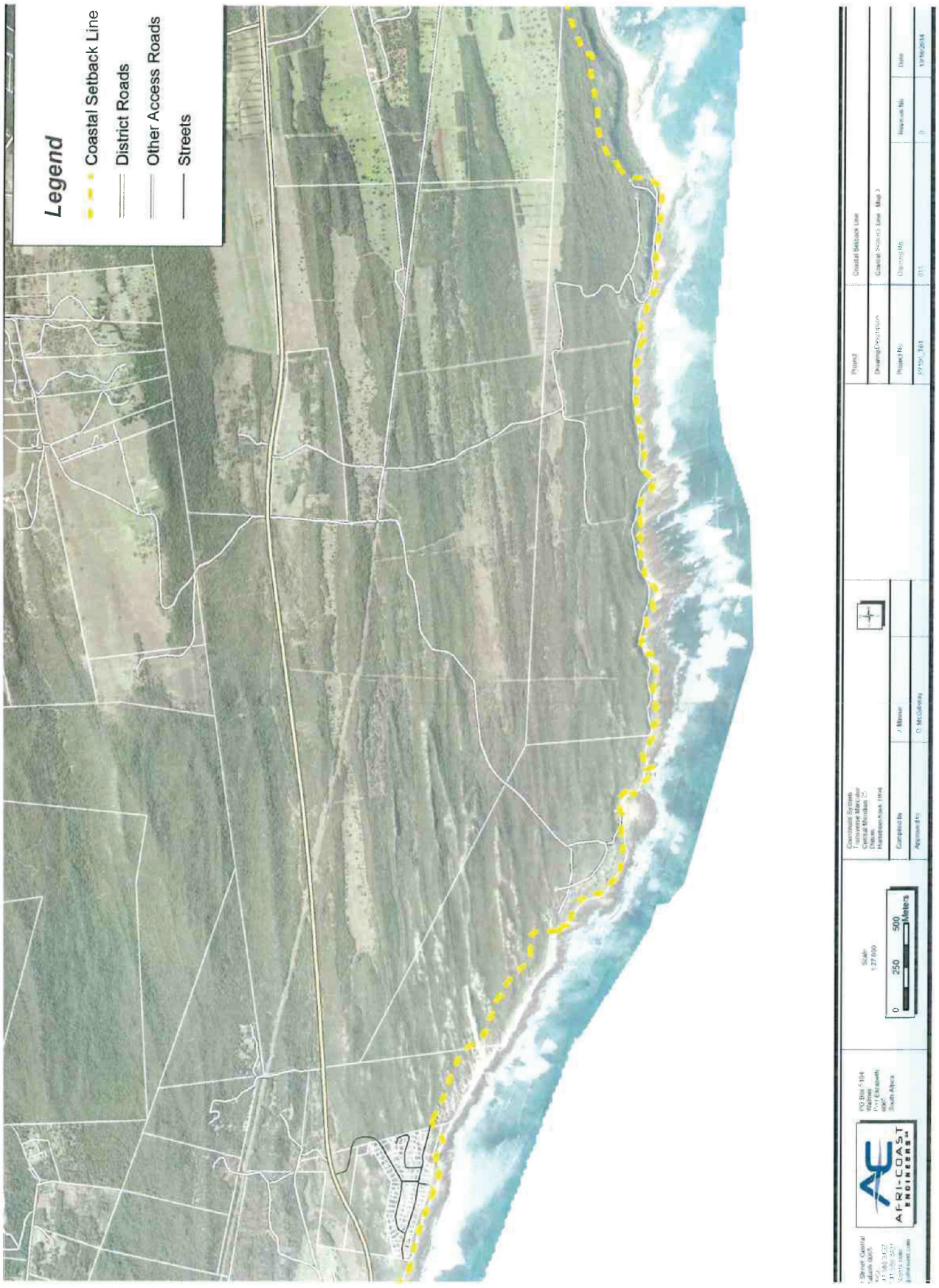

Legend
Coastal Setback Line
National Road
Main Roads
Other Access Roads
Streets
N2
R102
R367

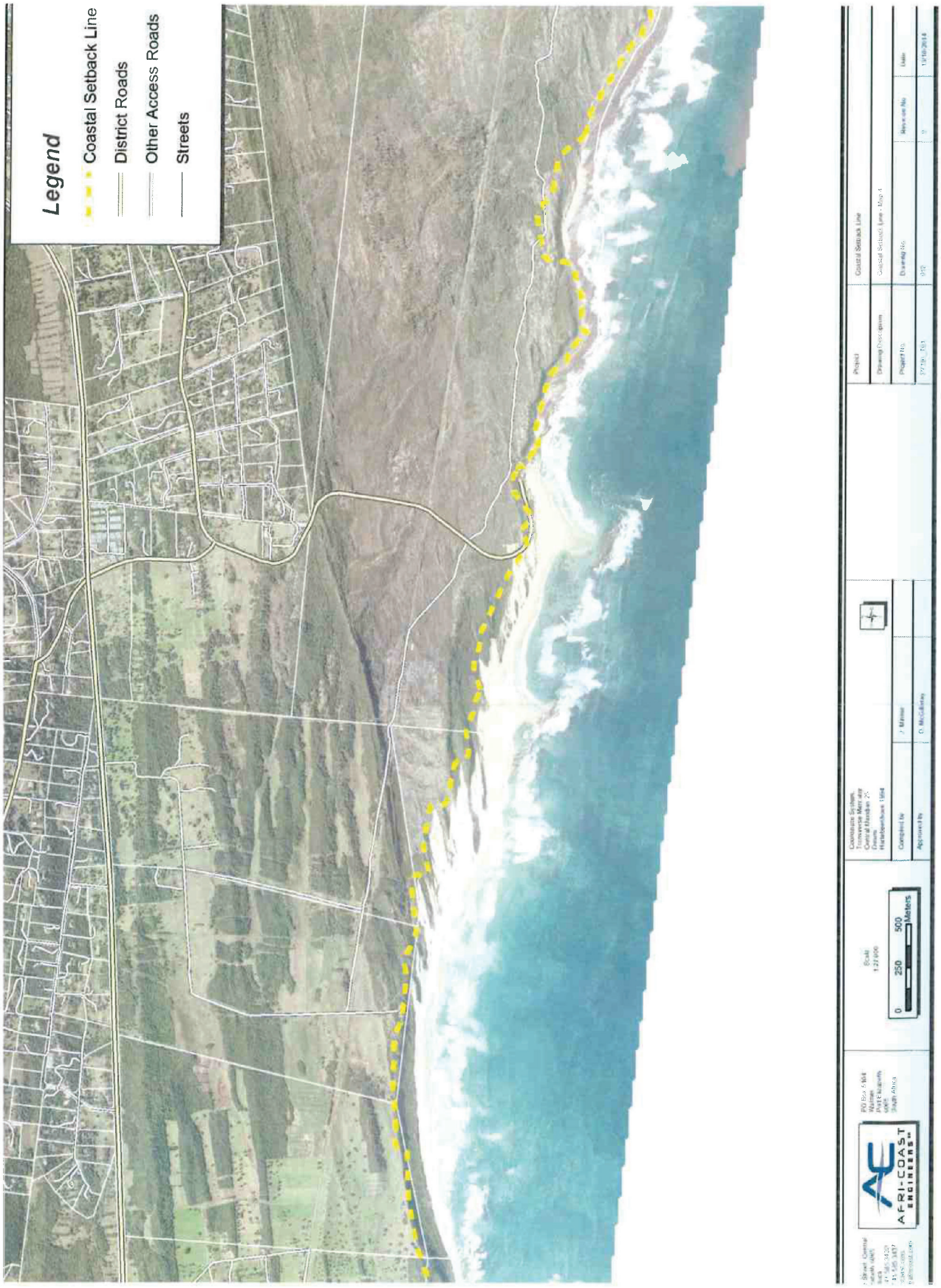

Legend
Coastal Setback Line
National Road
Other Access Roads
Streets
N2
AFRI-COAST ENGINEERS
0 250 500 Meters


Legend
Coastal Setback Line
National Road
District Roads
Other Access Roads
Streets
N2
AFRI-COAST ENGINEERS
Project
Coastal Setback Line
Drawing Description
Coastal Setback Line Map 11
Project No
Drawing No
Revision No
Date
Scale
1:12 500
0 250 500 Meters
Coordinate System
Projection: Mercator
Central Meridian 25
Datum
Hartebeesthoek 1994
Compiled by
J. Mitton
Approved by
D. MacGarvie

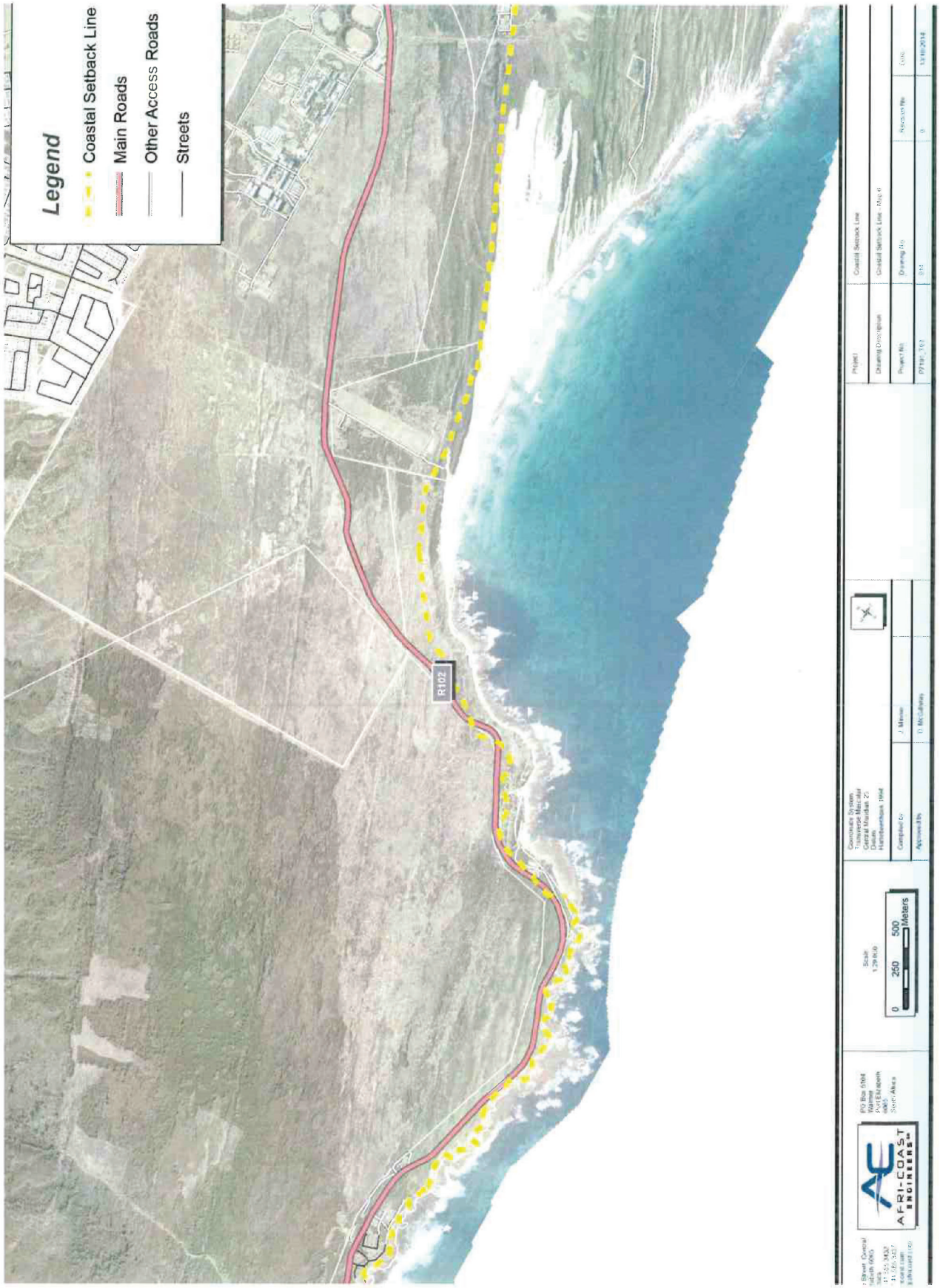

Legend
Coastal Setback Line
District Roads
Other Access Roads
Streets
AFRI-COAST ENGINEERS
0 250 500 Metres


Legend
Coastal Setback Line
District Roads
Other Access Roads
Streets
AFRI-COAST ENGINEERS
Coastal Setback Line
Coastal Setback Line - Map 2
0 250 500 Meters

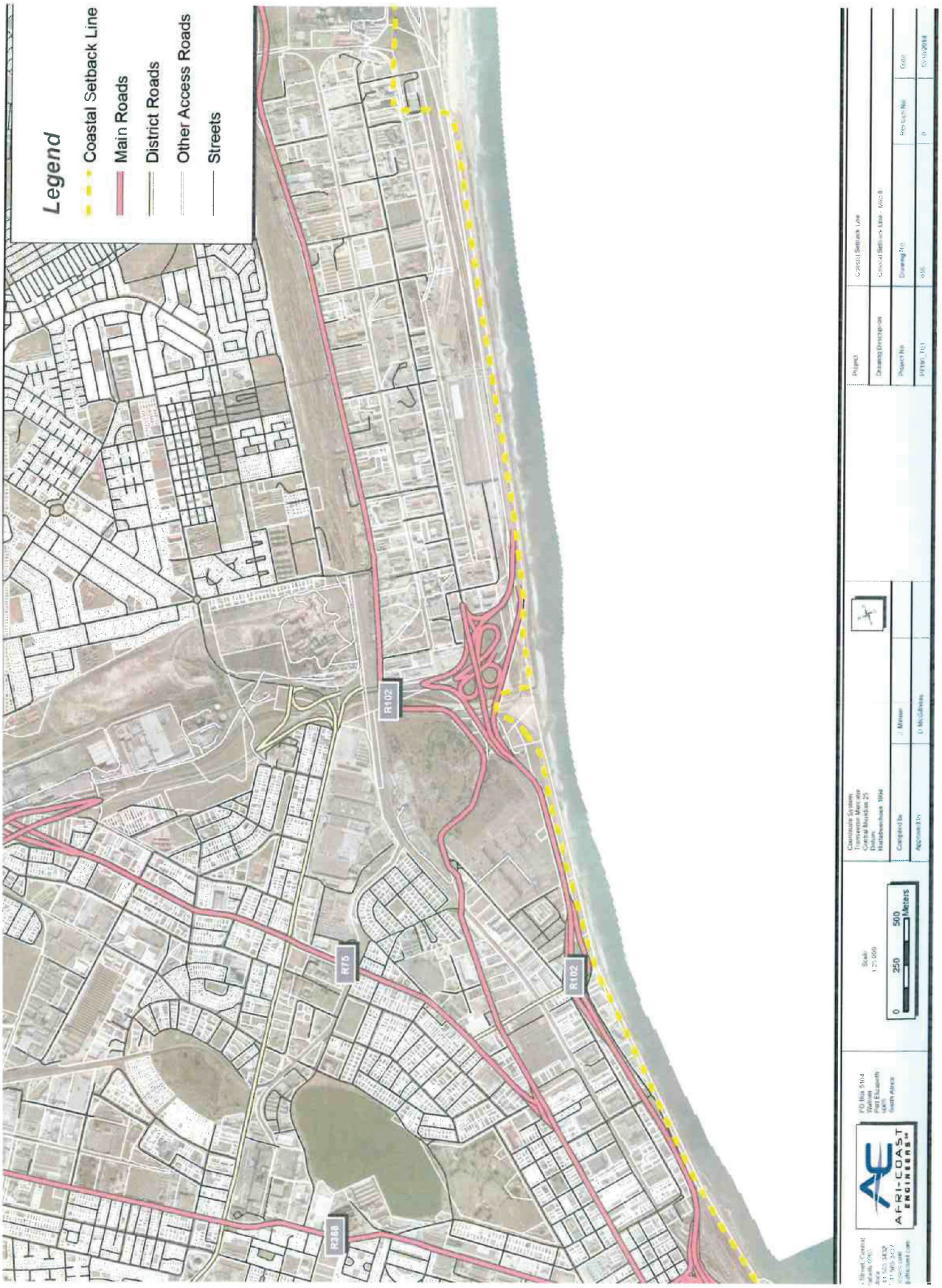

Legend
Coastal Setback Line
District Roads
Other Access Roads
Streets
AFRI-COAST ENGINEERS
Scale
1:27 000
0 250 500 Meters
Coastal Setback Line
Coastal Setback Line - Map 3


Legend
Coastal Setback Line
District Roads
Other Access Roads
Streets
AFRI-COAST ENGINEERS
Coastal Setback Line
Coastal Setback Line - Map 1
0 250 500 Meters


Legend
Coastal Setback Line
Main Roads
Other Access Roads
Streets
R102
0 250 500 Meters
AFRI-COAST ENGINEERING


Legend
Coastal Setback Line
Main Roads
Other Access Roads
Streets
R102
0 250 500 Meters
AFRI-COAST ENGINEERS


Legend
Coastal Setback Line
Main Roads
District Roads
Other Access Roads
Streets
R102
AFRI-COAST ENGINEERS
Scale
1:25 000
0 250 500 Meters
Coastal Setback Line


Legend
Coastal Setback Line
Main Roads
District Roads
Other Access Roads
Streets
R102
R75
R102
R288
AFRI-COAST ENGINEERS
Scale: 1:25 000
0 250 500 Meters

NOTICE 9 OF 2016

DEPARTMENT OF ECONOMIC DEVELOPMENT, ENVIRONMENTAL AFFAIRS AND TOURISM

NAHOON ESTUARINE MANAGEMENT PLAN

I, Sakhumzi Somyo, the Member of Executive Council (MEC) for Department of Economic Development, Environmental Affairs and Tourism hereby give notice of my intention to, in terms of section 53 of the National Environmental Management: Integrated Coastal Management Act, 2008 (Act No. 24 of 2008) (ICM Act), adopt the Estuarine Management Plan for Nahoon Estuary in terms of section 34 of ICM Act.

Members of the public are invited to submit to the MEC, within 30 (thirty) days after the publication of the notice in the Gazette, with written comments or inputs to the following addresses:

By post to:
General Manager
Environmental Affairs
Private Bag X0054
Bisho
5605
By hand at:
2nd floor, Room 288
Beacon Hill
Corner of Hargreaves Street & Hockley Close
King Williams Town, 5600
By email at: Sandiso.zide@deaet.ecape.gov.za or
By fax to: 043 605 7300

Enquiries: Mr S. Zide, tel. 043 605 7256

Comments received after the closing date may not be considered.

Sakhumzi Somyo

MEC for Department of Economic Development, Environmental Affairs and Tourism

PROVINCE OF THE
EASTERN CAPE
ECONOMIC DEVELOPMENT
ENVIRONMENTAL AFFAIRS AND TOURISM

ESTUARY MANAGEMENT PLAN FOR THE NAHOON ESTUARY

FINAL REPORT

ESTUARY MANAGEMENT PLAN FOR THE NAHOON ESTUARY

PARTS I AND II

FINAL REPORT

REPORT J-616-13 **November 2013**

TABLE OF CONTENTS

List of Figures

List of Tables

List of abbreviations

CBD	Central Business District
DEA / DEAT	Department of Environmental Affairs (formerly Department of Environmental Affairs & Tourism – DEAT)
DEDEAT	Department of Economic Development, Environmental Affairs & Tourism
DWA / DWAF	Department of Water Affairs (formerly Department of Water Affairs & Forestry - DWAF
ECPTA	Eastern Cape Parks and Tourism Agency
EMC	Ecological Management Class
EMP –	Estuary Management Plan
GDP	Gross Domestic Product
ICMA	National Environmental Management: Integrated Coastal Management Act, 24 of 2008 (ICMA)
ICZMP	Integrated Coastal Zone Management Plan
IGSC	Inter-governmental Special Committee
MPA	Marine Protected Area
NBA	National Biodiversity Assessment
NEMA	National Environmental Management Act (Act 107 of 1998)
NWA	National Water Act (Act 36 of 1998)
RAM	Rapid Assessment Matrix
RDM	Resource Directed Measures

PART I: Situation Assessment

ESTUARY MANAGEMENT PLAN FOR THE NAHOON ESTUARY
FINAL REPORT

1 INTRODUCTION AND BACKGROUND

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, plus 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. According to the 2011 National Biodiversity Assessment (NBA), 43% of estuary ecosystem types are threatened, representing 79% of the South Africa's estuarine areas. Only 33% of estuary ecosystem types are well protected and 59% have no protection at all.

The Nahoon Estuary is located on the north-eastern side of the Buffalo City[1] Central Business District (CBD). Suburban development which borders the Nahoon Estuary commenced in the early 1950's. "The most serious threat facing our estuaries is a sociological one" (Morris, 1986). Firstly, mankind is attracted to estuaries for their aesthetic values and the wide diversity of recreational opportunities offered. Secondly, the physical attributes of estuaries, when viewed as a resource, are capable of only a limited supply. Thirdly, there is a widening gap between the demand for use of an estuary's resources and the capacity of the system to meet these requirements. Sound management and planning is therefore essential to ensure that the functioning of the estuarine system is maintained in the long-term so that it can continue to meet resource (e.g. bait collection, fishing), recreational and development demands.

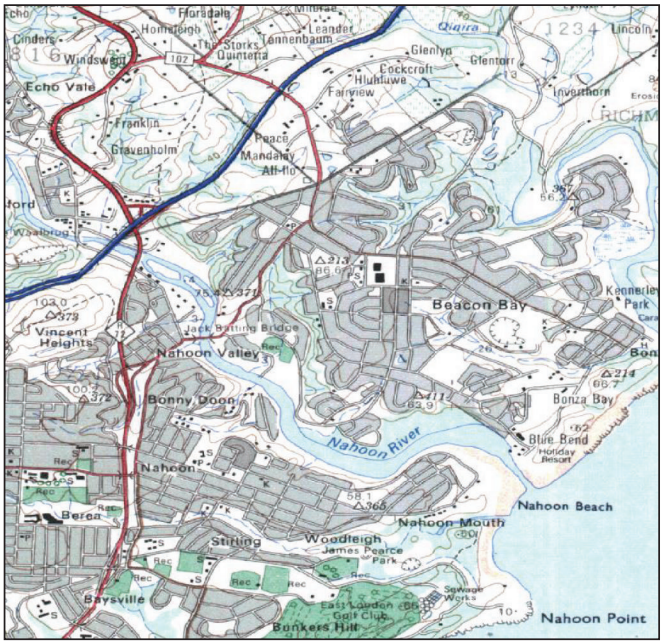


FIGURE 1: General Locality Map

It is a requirement of the National Environmental Management: Integrated Coastal Management Act (Act 24 of 2008) – hereafter referred to as ICMA – that estuaries be managed in a coordinated and efficient manner. The Act makes provision for the development of a National Estuarine Management Protocol which is to provide guidance on the development and implementation of estuarine management plans

[1] East London

(EMPs). This Protocol has been under development for a number of years and was finalised in May 2013 (*after this Nahoon study had commenced*), when it was gazetted (GN 341 of 10 May 2013). The Eastern Cape Department of Economic Development and Environmental Affairs and Tourism (DEDEAT) issued a tender call (SCMU 9-12/13/011) to develop an Estuary Management Plan (EMP) for the Nahoon Estuary. This tender was awarded to the MEGAteam in mid-2012 and the project commenced at the end of August 2012.

The project comprised two phases, in accordance with the aforementioned Protocol (which was in draft form at the time) as shown in the table below.

TABLE 1: Study outline

ACTIVITY	TASKS
SITUATION ASSESSMENT	
Information gathering and synthesis	• Review of legal requirements and institutional structures involved in the management of the estuary. • Review of existing policies and strategies such as Catchment Management Plans, IDP (including SDF and Water Development Services Plan), Ramsar and National Heritage Site Strategies, Protected Area and Conservation Plans, Recreational Water Quality Objectives). • Review of ainformationf the biophysical attributes of the estuary (e.g. present ecological health, physical processes, conservation value). • Review of the socio-economic characteristics (e.g. demographics, economic profile, land-use, cultural and heritage resources etc.). • A description of recreational use patterns and the exploitation of living resources (fishing, bait collection, harvesting of mangroves etc.
Spatial analysis	Provide maps that show (where information is available): • Important biophysical features • Protected/conservation areas • Areas earmarked for rehabilitation • Land-use and planning provisions of adjacent land • Infrastructure (e.g. roads, bridges) • Cultural and heritage sites • Recreational activities (e.g. swimming, boating) • Living resources exploitation (e.g. bait collection, fishing areas, etc.) • Mariculture activities • Wastewater discharges (sewage, industrial), Stormwater drains and solid waste landfill sites
Opportunities and constraints assessment	• Identify the goods and services or human use activities and their impacts or potential impacts on the present ecological state of the estuary. • Consider environmental characterisitics from the perspective of their sensitivity/vulnerability. • Consider the opportunities these natural resources present for human wellbeing (e.g. recreation, livelihoods support, eco-tourism etc.). • Consider opportunities to improve conservation and rehabilitate degraded areas.
ACTIVITY	**TASKS**
MANAGEMENT / ACTION PLAN	
Determine vision and management objectives	• Establish policy framework. • Engage with stakeholders to obtain their inputs on concerns and issues in relation to the estuary and on the future management of the area (i.e. the "desired future state"). • Develop vision and objectives.
Management Plan	• Identify issues where management interventions are required.

	• Develop Action Plan that: – Describe the required taks – Identify the implementing / lead authority – Detemine the applicable timeframe for implementation – Specify the indicator of success – Describe monitoring and evaluation requirements.

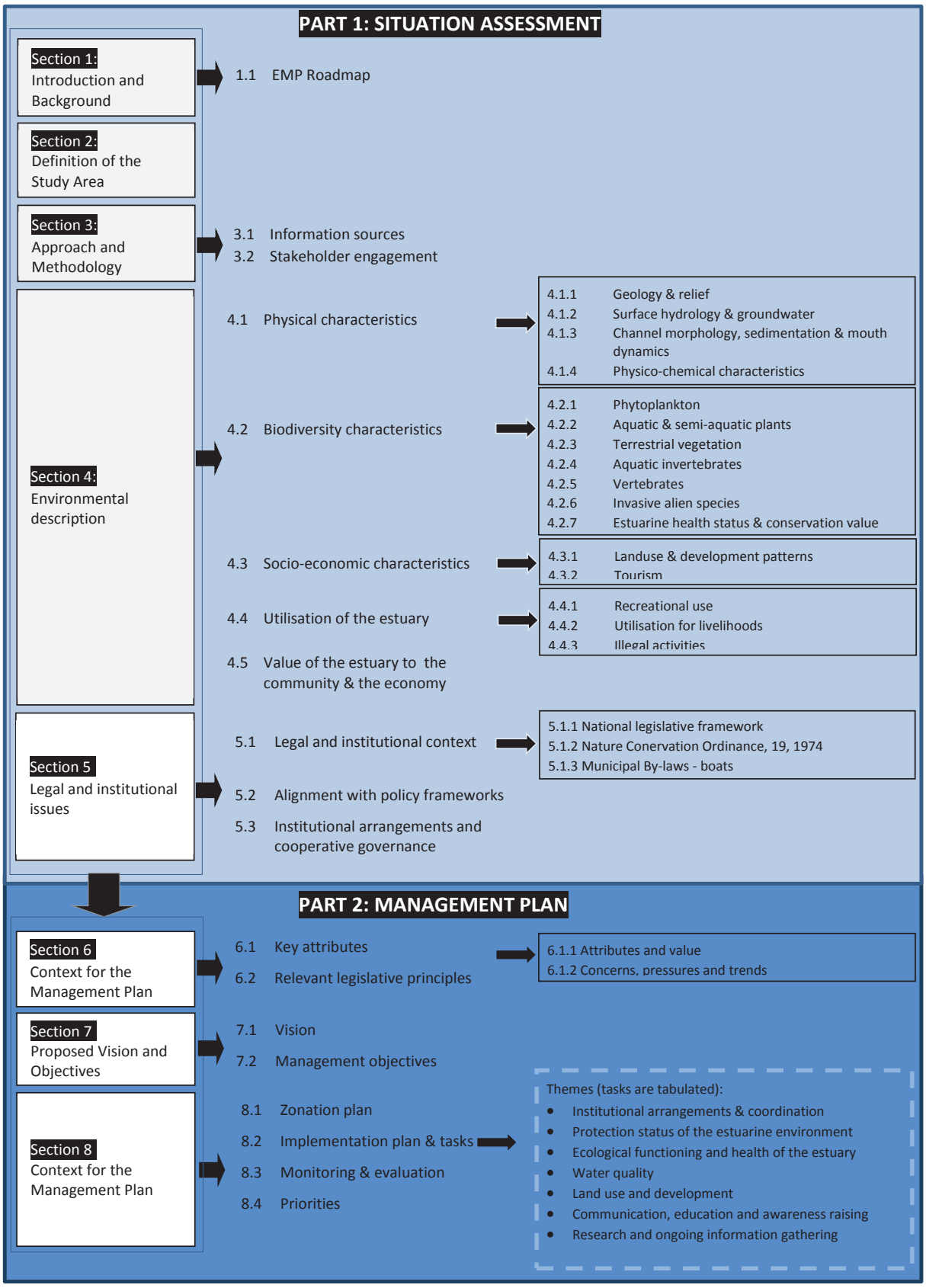
Clearly, the Situation Assessment serves to inform the management plan. This EMP document has been structured into two parts to correspond with the respective phases of the project:

- *Part 1*: Situation Assessment.
- *Part 2*: Management Plan.

1.1 EMP Roadmap

The National Estuarine Management Protocol sets out the minimum requirements for the content of EMPs. In addition, it provides guidance on the procedure for developing an EMP. A roadmap for the Nahoon EMP is provided overleaf.

ROADMAP FOR THE NAHOON EMP



Page 5

2 DEFINITION OF THE STUDY AREA

The National Environmental Management: Integrated Coastal Management Act (Act 24 of 2008) defines an estuary as follows:

> **"estuary"** means a body of surface water—
> *(a)* that is part of a water course that is permanently or periodically open to the sea; 25
> *(b)* in which a rise and fall of the water level as a result of the tides is measurable at spring tides when the water course is open to the sea; or
> *(c)* in respect of which the salinity is measurably higher as a result of the influence of the sea:

Based on this definition, in the case of the Nahoon Estuary, this would mean the tidal portion from the mouth to the Abbotsford Bridge (Figure 2). The EMP is required to focus on the 'estuarine functional zone'. This is defined by the 5 m topographical contour, that is the area within 5 m above mean sea level. The estuarine functional zone therefore includes the open water area of the estuary that is tidal, estuarine habitat (sand and mudflats, rock and plant communities) and floodplain areas. Figure 3 is an enlarged map that shows the 5 m contour – taken from the 1:50000 topographic map for East London.

In the case of the Nahoon Estuary, the study area has been extended to beyond the tidal range of the estuary to include the up-stream section to the Dorchester Heights Bridge (Figure 3). This decision was reached in discussion with DEDEAT, based on the following factors:

- The Dorchester Heights area has developed over the past 25 years and activities within this area could directly affect the estuary.
- Inclusion of the area up to the Dorchester Heights Bridge would enable recreational and use issues to be considered in a more integrated manner than would be the case if only the tidal portion of the river was addressed to the Abbotsford causeway. This is of particular relevance in a recreational context, given the presence of open space adjacent to the river in this upper section.
- Discharges (e.g. stormwater) from this area may have an influence on downstream water qualities. It is for these reasons that it was agreed that the study area would be from the mouth of the estuary, to the Dorchester Heights bridge – see Figure 3 overpage.
- It is possible that if the Abbotsford causeway were not in place that this section of the river would also be tidal. Note: the Abbotsford causeway has been in place for >50 years and formed the original bridge over the Nahoon for what was known as the 'Main Transkei Road'.

FIGURE 2: Map showing the tidal portion of the Nahoon Estuary

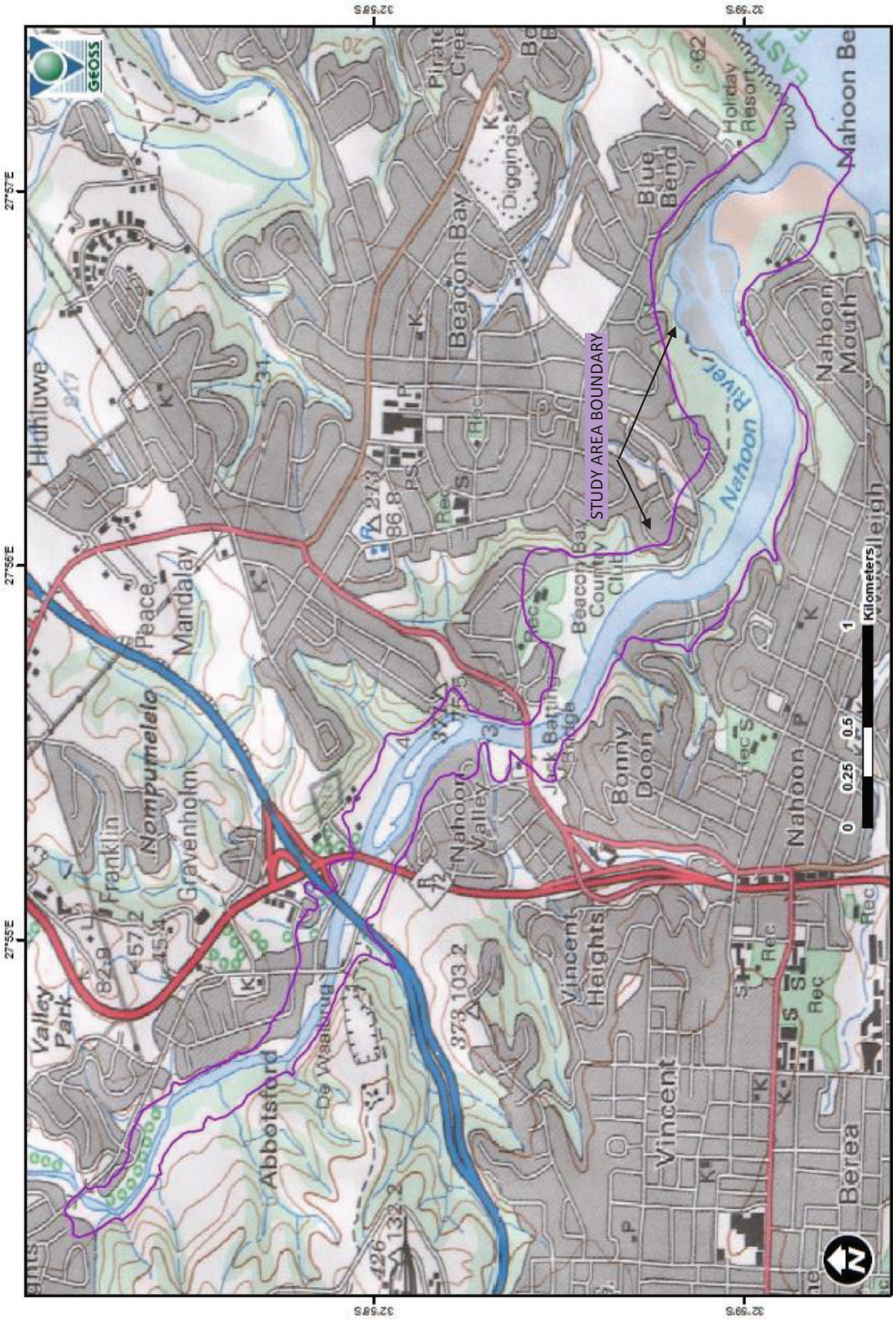


FIGURE 3: Map of the Nahoon Estuary Study Area – as agreed with DEDEAT

3 APPROACH AND METHODOLOGY

3.1 Information sources

Baseline information was sourced from the various reports and documents listed in the references section of this report. In addition, spatial data were also obtained to enable the project team to understand the spatial extent and location of various features and characteristics of the estudy area (biophysical and socio-economic). No primary data gathering or ground-truthing of existing data was undertaken – the project scope and budget did not allow for this[2]. The team did, however, hold discussions with various local experts through the stakeholder engagement process and the resulting information was used to augment the existing information base. A reconnaisance visit was also conducted by the Project Team.

3.2 Stakeholder Engagement

A database of Interested and Affected Parties was collated for the project. The assistance of WESSA in providing their database to the project tream is acknowledged. In addition, an information sheet was circulated at the Beach Clean-Up day organised by WESSA on 15 September 2012 and posters about the project with contact details to register interest were placed in the Border Canoe Club clubhouse. Only two people registered their interest as a result of these efforts.

The following interaction with stakeholders took place during the project:

1. Meetings were held with government officials (municipal, provincial and national) from various Departments during the project initiation phase at the end of August 2012.
2. A meeting was held with WESSA during the project initiation phase at the end of August 2012.
3. A brief introduction to the project was provided at the Nahoon Clean-up Day on 15 September 2012.
4. Various meetings were held over the period 15-16 October 2012, as follows:
   - Representatives from non-government organisations (e.g. residents, recreational and environmental organisations).
   - Representatives from the Buffalo City Metropolitan Municipality and the DEDEA.
   - A Councillor and Ward Committee member representing the Nahoon area. (All relevant Ward Councillors and Ward Committee members were contacted about the meeting).
5. Stakeholders were provided with a draft of Part I Situation Assessment for the period 7 March to 19 April 2013.
6. Stakeholders were provided with a draft of the full EMP for comment and feedback for a period of 5 September to 14 October 2013.
7. A stakeholder workshop was held on the draft EMP during the feedback period on 18 September 2013.

A list of stakeholders and information related to stakeholder engagement can be found in Appendix A.

[2] It must be noted that although the tender call had a project description and Terms of reference (ToR), it was noted in our proposal that it would not be possible to address all the study/project needs as described in the tender call within the indicated available budget. We thus provided a proposal based on what could be achieved to address the key requirements of the Situation Assessment and the EMP within the available budget. This was based on our historical knowledge and previous studies undertaken by the team on the Nahoon Estuary.

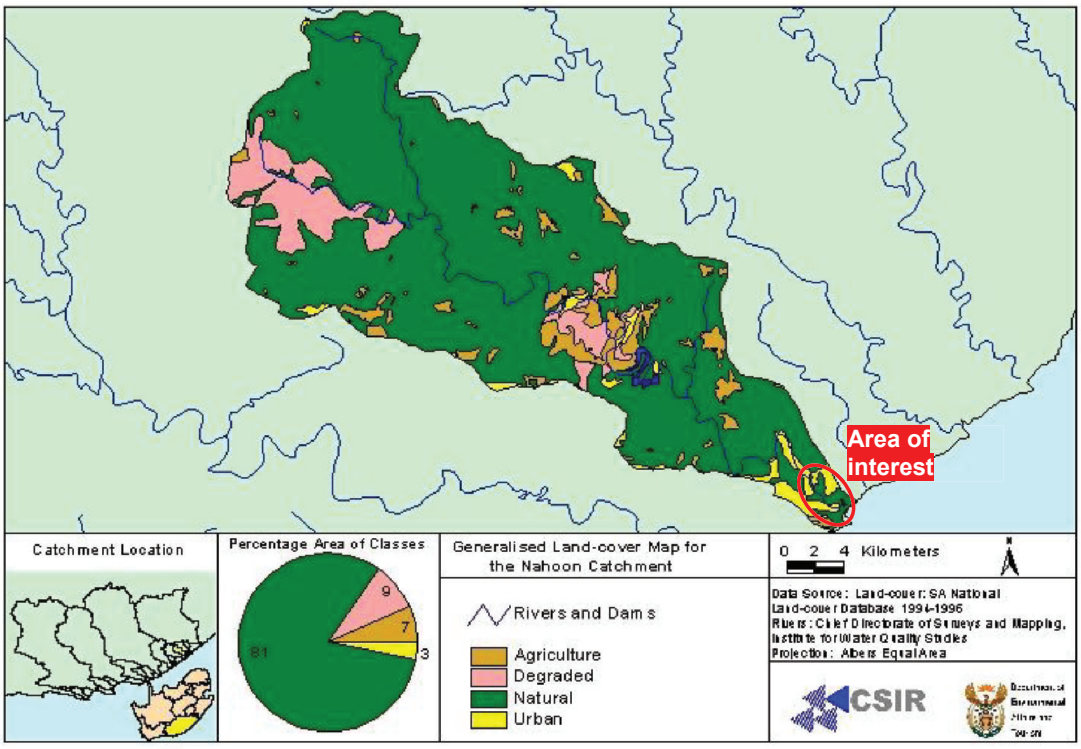
4 ENVIRONMENTAL DESCRIPTION

The environmental description of the study area is based on existing information, observations made during the site reconnaisance and information obtained via the stakeholder engagement process. Both historical and recent information has been considered so as to establish changes and trends that have taken place in the estuary and immediately surrounding areas.

4.1 Physical Characteristics

The Nahoon River system is situated in the Mzimvubu to Keiskamma Water Management Area WMA12). Its source is some 60 km inland of East London in the Hohoberg and it has a catchment of about 564 km^2. Estuaries in South Africa are generally classified according to the system established by Whitfield (1992), which is based on physical characteristics. Five estuary types are recognised, namely (i) Estuarine Bay; (ii) Permanently Open; (iii) River Mouth; (iv) Estuarine Lake, and (v) Temporarily Open. The Nahoon Estuary falls into the permanently open category. A sandspit on the western bank of the inlet merges laterally with the Nahoon beach. Waves occur mainly from the southwest, resulting in longshore sediment movement in a northeasterly direction (Russell and MacMillan 1954, cited in Bursey and Wooldridge, 2002). This factor, together with strong flood-tidal currents, results in sediment transport into the estuary. In turn, sediment accumulation serves to form a flood-tidal delta extending 900m into the estuary (Reddering *et al.* 1986, cited in Bursey and Wooldridge, 2002). After varying periods of sand accumulation, occasional floods of sufficient magnitude remove the delta and the cycle begins again. Along this section of coast, the tidal range is 1.63 m (Naval Hydrographer 1992, cited in Bursey and Wooldridge, 2002).

FIGURE 4: Nahoon River Catchment Area



4.1.1 Geology and relief

The geology and relief of an estuarine area not only influences the morphology and dynamics of the estuary, but also affects habitat (for aquatic and terrestrial fauna and flora). From a socio-economic perspective topography also affects possibilities for development as well as the way in which the estuary can be accessed and used for various activities. However, it is becoming increasingly common for engineering to overcome topographic obstacles so as to realize development opportunities. Consequently, human influences over relief and morphology can have a substantial affect over an estuary's physical and biological health.

The Nahoon study area is underlain by sandstones and mudstones of the Lower Beaufort Group. Sandstone is more resistant to weathering than mudstone, with the result that cliff exposures in the area comprise mainly sandstone. Some dolerite boulders, which have been transported from upstream areas, do occur on the banks of the Nahoon river. Reference to Figure 5, the Geological Map, will show that dolerite (Jd) sheets occur in the middle catchment of the Nahoon and that a dolerite dyke crosses the river at the Abbotsford causeway.

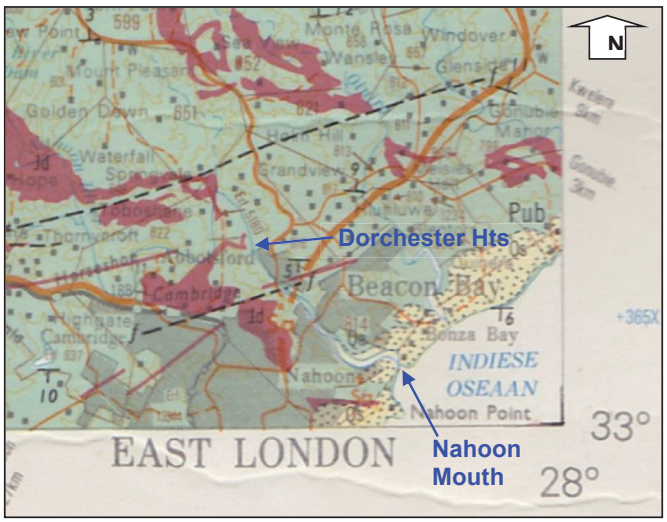


FIGURE 5: Geological Map
(Sheet 3226 King Williams Town 1:250000)

The sandstones and mudstones are overlain in places by alluvium, unconsolidated sand and consolidated sand as dune rock (aeolinite) (Mountain, 1962). Data from a borehole that was drilled at the mouth area (opposite Blue Bend) indicates that the layers of unconsolidated sediment are 45 m thick (Ninham Shand & Partners, cited in Morris, 1986). The lower estuarine portion of the Nahoon River is characterized by a considerable degree of meandering and is deeply incised into the coastal plain.

Since the Nahoon River represents a 'drowned river valley'[3], steep cliffs or slopes occur along certain lengths of the river. Figure 6 overpage shows the relief for the Nahoon study area and the cliff areas are marked. The steep cliffs, which are up to 105 m high in places, limit access to the estuary and to some floodplain areas. Hence, topographically there is substantial variation alongside the Nahoon Estuary (Refer to Fig 6). The formation of the floodplain areas has been attributed to sediment in-filling associated with valley drowning as a result of rising sea levels (Rust, *et al.*, 1985).

[3] A "drowned river valley" is a type of estuary based on geomorphological classification. This form of an estuary has resulted from a rise in sea level which flooded river valleys that were cut into the landscape when sea level was lower.

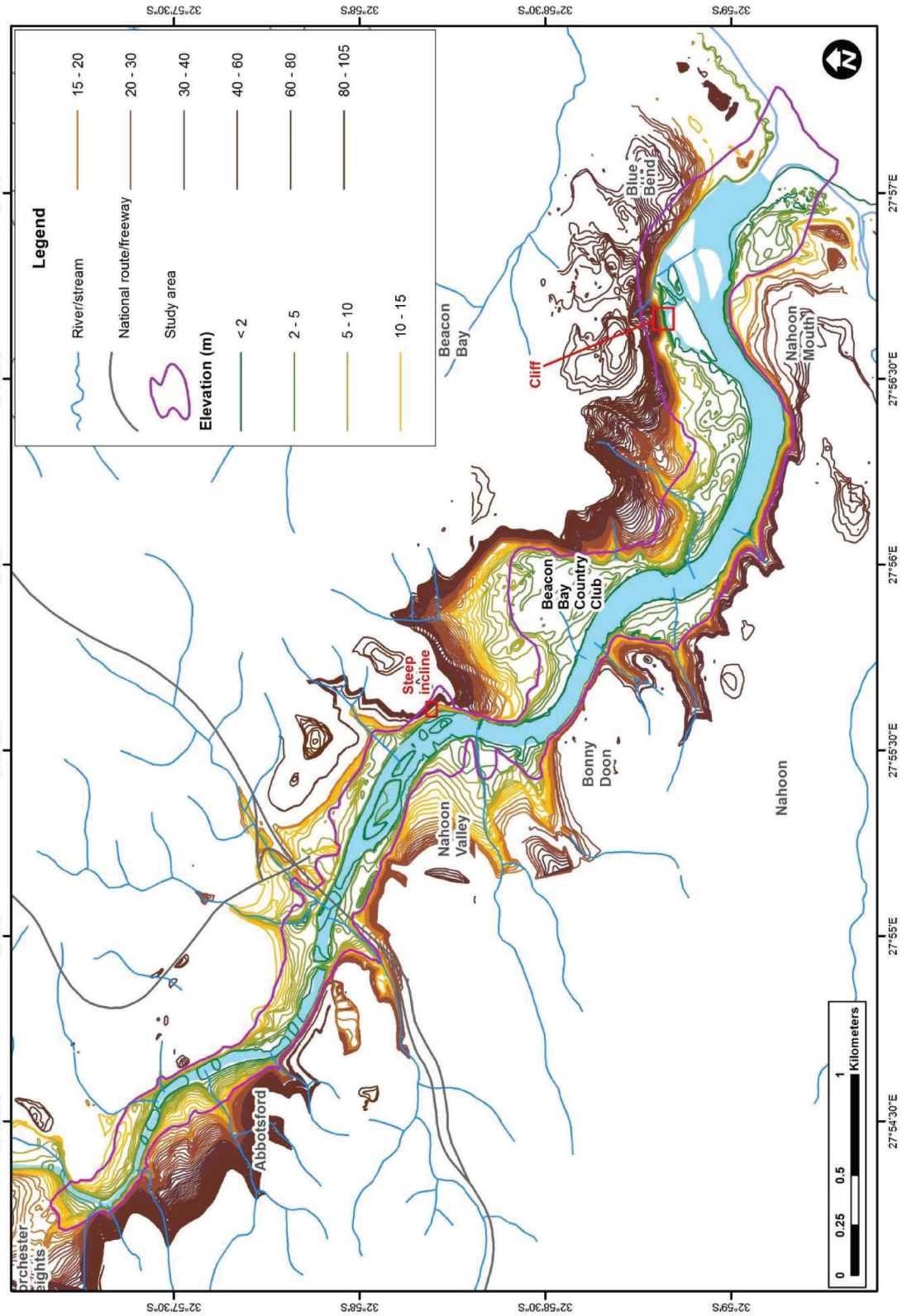


FIGURE 6: Relief of the Nahoon Estuary area (based on 1m contours provided by the BCM)

A number of estuarine landforms have been identified by Heydorn and Tinley (1980). In terms of form and dynamics, the mouth of the Nahoon Estuary has been classified as "Type A - Single Spit with rock on opposite bank". Twelve landforms have been identified as being associated with this type of estuary. Of these, eight are present in the study area. The landforms and their associated characteristics are summarised in Table 1. Of these landforms, four have been identified as being intrinsically unstable: river course, dunes, cliffs and beach (Heydorn and Tinley, 1980).

TABLE 1: Estuarine Landforms within the Nahoon Estuary (after Heydorn and Tinley, 1980)

Landform	Characteristics
River Course	Seasonally modified by floods, scouring and/or sediment deposition.
Tidal Sand/Mudflats	Inundated and exposed daily by tides.
Floodplain	Seasonally flooded particularly with storm and spring tides or flood conditions.
Islands	Lower parts are tidal, higher parts are seasonally or periodically flooded.
Sandspit	Constantly altered due to sediment transport by tidal action, wave action and river run-off.
Dunes	Subject to erosion by wind and water due to human and natural disturbance.
Cliffs	Rockfalls and landslides may occur with prolonged heavy rain; in mouth area, cliffs are on eroding outer bends of meanders.
Beach	Surface reworked daily by tides, waves and wind; beaches and first line of dunes are major buffers on which storm waves expend their energy

4.1.2 Climatic, Estuary Flow and Flooding Characteristics

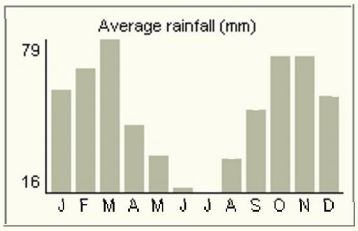
Climate and flooding characteristics need to be considered in terms of the following:

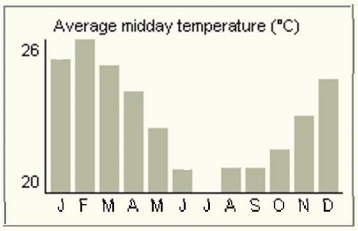
- recreation opportunities are influenced by weather conditions;
- flooding events can cause extensive damage to property;
- occurrence of plant and animal species is affected by prevailing climatic conditions (in terms of habitat requirements) and flood events (in terms of habitat destruction or as a trigger for biological processes such as migration).

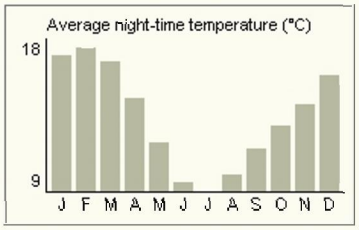
Climate

Climatic data have been obtained from published reports and papers as well as from the Weather Bureau's recording station at the East London Airport (East London WO - 0059572B8). East London falls within the subtropical bimodal summer rainfall region of the south-east coast (Heydorn and Tinley, 1980). Hence there are two peaks in the rainfall season - March and October – see graphs below. In general, however, rainfall during the first part of the summer season (October-December), is greater than that in the latter months (January-March). The annual average rainfall is 920.6 mm and more than 10 mm of rain occurs on an average of 21 days per year. The chart below (lower left) shows the average rainfall values for East London per month. Lowest rainfall (16mm) occurs in July and the highest (79mm) in March.

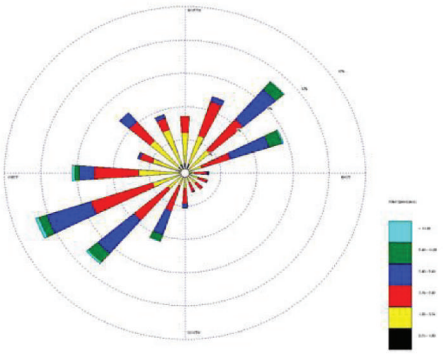
The monthly distribution of average daily maximum temperatures (centre chart below) shows that the average midday temperatures for East London range from 20°C in July to 26°C in February. July is the coldest month, when the mercury drops to 9.3°C on average during the night – see the chart below (lower right) for an indication of the monthly variation of average minimum daily temperatures.







Calm conditions occur in East London only 7.5% of the time. Equally strong winds from the south-west and the north-east occur for the most part (Stone 1988) – see wind rose alongside, with the result that the winds blow approximately parallel to the coastline. Westerly winds predominate in the winter months and are associated with the passage of cold fronts. Average wind speeds vary between 7.4 m/sec and 5.6 m/sec, with greater wind speeds in the summer months.



Flow

The flow characteristics of the estuary have been influenced by a number of factors, among others, the construction of the Nahoon Dam (photo below) in 1966. This dam forms part of the Amatole Bulk Water Supply System (ABWSS), which also services consumers in the Amahlati and Great Kei municipal areas. The ABWSS comprises of the following sub-systems:

- Upper Kubusi (Gubu Dam/outside BCMM);
- Lower Kubusi (Wriggleswade Dam/outside BCMM);
- Upper Buffalo (Rooikrantz and Maden Dams/inside BCMM);
- Middle Buffalo (Laing Dam/inside BCMM); and
- Lower Buffalo (Nahoon and Bridledrift Dam/inside BCMM).

The yield from the Nahoon Dam is calculated as being 8.61 Mm^3/a and with environmental water requirements taken into account, the yield is 7.24 Mm^3/a. Current use is given as 8.863 Mm^3/a (LEDS, 2005). Water can be released from the Wriggleswade Dam into the Nahoon River upstream of the Nahoon Dam if inflows into the dam need to be augmented. According to information in the LEDS, "environmental water requirements are not necessarily being met at present."

Turpie et. al (2004) note that: "The future health and productivity of South Africa's estuaries is dependent on two main factors: management and freshwater inputs." An intermediate ecological reserve referred to as a Resource Directed Measures (RDM) study was undertaken for the Nahoon Estuary under the auspices of the Department of Water Affairs And Forestry (DWAF) in 2001. Cognisance is taken of the Ecological Management Class (EMC) for the estuary in setting the Reserve for water quantity. Whilst water flow is an important aspect in achieving and maintaining the required EMC, it is not the only factor. Thus in setting the ecological reserve the focus is on the management of impacts that are as a result of altered water inflows (e.g. Nahoon Dam and other water abstractions in the catchment), the aim being to rectify

impacts that resulted from previous reductions in freshwater inflows. The re-establishment of a significant River – Estuary Interface REI zone, an important functional area in estuaries, as the key runoff related issue that had to be addressed in order to improve the ecological health of the Nahoon Estuary. It is recognised that the biotic composition in the estuary has been altered by the reduction in river inflows which in turn has decreased the extent of the REI. The presence of an REI is regarded as being particularly important in the summer/spring months when invertebrate and fish recruitment takes place. Accordingly, if the REI could be re-established in the estuary, particularly during the summer/spring months, this would contribute to improving the health of the estuary (Refer to Section 4.2.7).

Flooding

The type and frequency of rain is an important consideration, particularly in terms of flood risk. A well-known feature of the climate in the eastern Cape is that of cut-off lows and associated Three-Day-Rain which generally occurs during the last week of August or the first week of March. These events are characterised by heavy rain over a period of a few days. They are associated either with the passage of a cold front or with a ridging anticyclone to the south of Port Elizabeth, which feeds cool moist air over the East Cape Region.

Should a cut-off low over the interior coincide with this system, devastating floods can occur over coastal areas (Kopke, 1988). Cut-off lows account for many of the flood-producing rains observed over South Africa. The frequency of cut-off lows that produce heavy rain shows a semi-annual variation with peak occurrences in March to May and September to November. Lowest frequencies of cut-off lows occur between December and February (Preston-Whyte and Tyson, 1988).

In the case of the Nahoon Estuary, severe flooding events are usually associated with the coincidence of heavy rainfall and spring tides or stormy seas. In 1970 the extent of the flood was such that the river flow was over the Jack Batting Bridge and the Abbotsford Causeway was about 6 m under water. Some 20 cm of rain fell in 11 hours (Daily Dispatch, 29 August 1970). Properties along Torquay Road, which lies within the 1:50 year flood line, are regularly under threat from flood damage as is illustrated in the photographs overleaf, which show the situation on 10 June 2011 when a flood occurred and the Nahoon dam overtopped its wall. Photographs of the 1985 flood event are also shown.

The Nahoon dam does not have sluice gates to regulate flow, especially during heavy rain and flood events. It does have valves that enables a certain amount of water to be released, but this is insufficeint to control heavy flooding.

In summary, flooding in the Nahoon Estuarine area does occur and floods can have a devasting effect on the low lying residential areas, particularly the Torquay Rd area and the tidal section between the N2 bridges and the Beacon Bay (Batting) bridge. Properties on the eastern bank in the Abbotsford area are also prone to flooding, however, their set-backs and the elevation from the river course serve to reduce the potential for flood damage. Based on the frequency of recent events, it can be said that flooding is occuring more regularly.

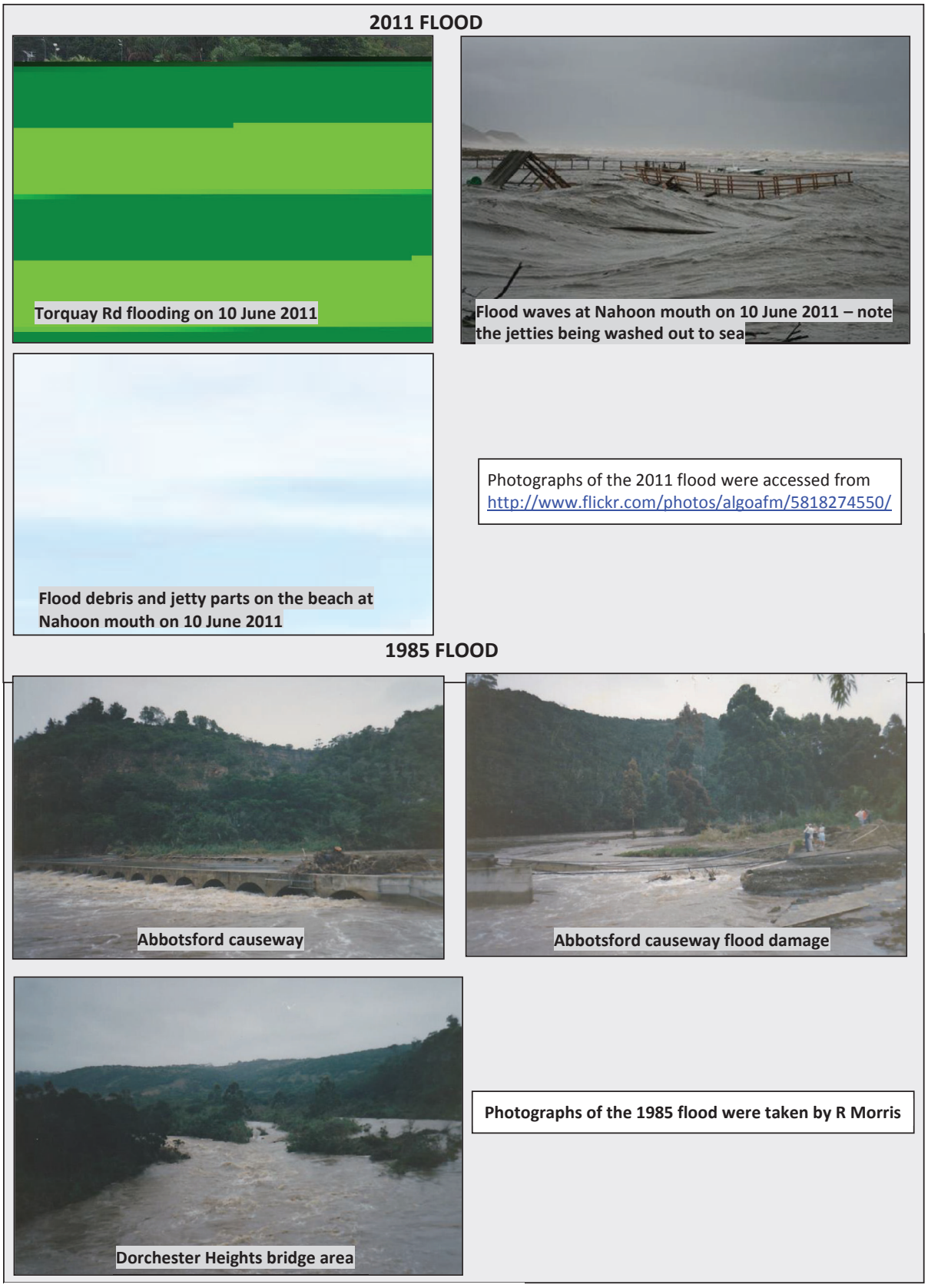


FIGURE 7: Photographic record of flooding events

4.1.3 Channel Morphology, Sedimentation and Mouth Dynamics

It is important to consider the channel morphology as it influences flood areas, bank stabilities and the use of the river for boating and other recreational activities. Bank structure also needs to be assessed in terms of stability and the occurrence of suitable habitats for biota.

The channel morphology of the Nahoon River has been investigated by Rust, *et al*., (1985). In addition the Wiseman *et.al* (1986) investigated river depth in a study of the Nahoon Estuary in 1986, as part of the 'Estuaries of the Cape' Series. The results of these studies are summarised in Table 2 below. Cross-sections of the river from Rust, *et al* (1985) study are shown in Figure 7 overleaf.

TABLE 2: Physical features of the river channel

SITE	LOCATION	DEPTH	SUBSTRATA	BANK MATERIALS
S1	Blue Bend	4.6 m	Black sand/silt	**E** - Sandstone outcrops **W** - Marine sediments
S2	Nature reserve	1 m	Fluvial mud/silt	**E** - Fluvial/marine sediments **W** - Marine sands
S3	Torquay Road	4.4 m	Fluvial mud/silt	**E** - Floodplain muds **W** - Debris boulders/sandstone outcrops
S4	Beacon Bay Country Club	3.3 m	Alluvial mud/fill	**E** - Cohesive muds/silts **W** - Rock/cliff slopes
S5	Downstream of Island I	3.3 m	Fluvial mud/boulders	**E** - Floodplain muds **W** - Rock/cliff slopes

NOTE : **E** refers to the east bank. **W** refers to the west bank. Reference Fig 8 for S1 to S5.

According to Rust *et al*., (1985) channel width is a function of the interaction between discharge and the properties of the materials that constitute the bank. Hence a channel cut in cohesive sediments is generally narrower and deeper than a comparable channel cut in sand, given that the two channels have equal discharges. The following features apply to the Nahoon Estuary:

- The width of the Nahoon mouth varies between 30 m and 40 m and it is permanently open to the sea. It can however be very shallow (<0.5 m) at spring low tide.
- Sandstone outcrops occur on the eastern bank of the mouth, which results in the scouring action of tidal flow maintaining an open river mouth. These features correspond to Estuary Type A - Single spit with rock on opposite bank, as defined by Heydorn and Tinley (1980).
- It has been shown that during periods of prolonged drought marine sediments may be deposited in the lower portion of the estuary up to a distance of 1.2 km from the mouth.
- The widest part of the river channel is in the vicinity of the tidal flats. This can be attributed to the sandy nature of the sediments.
- The river channel becomes narrower in the region of sampling station S2 (Figure 7) as a result of the clayey sediments on the eastern bank, which are more cohesive than the sand close to the mouth, and rocky bank and cliffs on the western bank, which create a deeper channel via erosion on this outer bend.
- Wider channel expanses closer to the estuary mouth may also be attributed to bank erosion by wave action as this area is the most susceptible to wind induced waves.

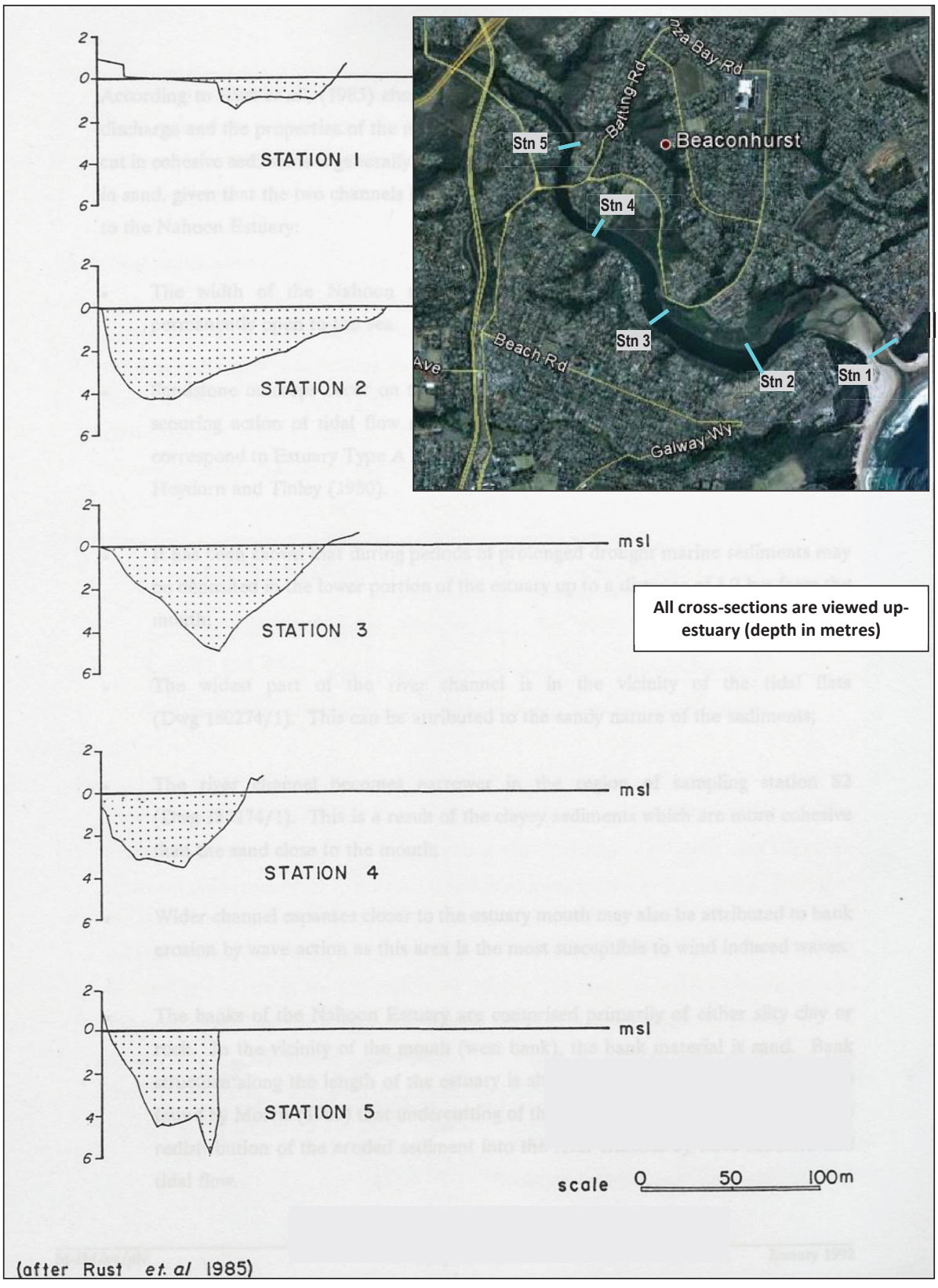


FIGURE 8: Cross- sections of the Nahoon River (from Rust *et.al* (1985))

- The banks of the Nahoon Estuary are comprised primarily of either silty clay or rock. In the vicinity of the mouth (west bank), the bank material is sand. It has been found by Morris (1983) that undercutting of the banks by wave action results in the redistribution of the eroded sediment into the river channel by wave rebound and tidal flow.
- The morphology of the channel in the mouth area alters regularly as a result of changes in tidal ranges, wind conditions and rainfall within the catchment. In general, the location of the river channel in the vicinity of the mouth is along the east bank.

Tidal flow into and out of the estuary has implications for temperature and salinity characteristics, as well as flushing and scouring action. The Nahoon estuary is microtidal and flood dominant with a coastal spring tide range of 1.6 m. Within the estuary itself the average tidal range is 0.76 m (Reddering, 1988). Data from a survey of the dimensions of the estuary using aerial photography and contour maps was conducted at various tide levels are shown in Table 3.

TABLE 3: Dimensions of the Nahoon Estuary

	High Tide	Mid Tide	Low Tide
Surface Area (ha)	58.6	54.2	42.4
Mean Depth (m)	2.64	2.24	1.88

Currently, the tidal limit of the Nahoon Estuary is at the Abbotsford Causeway, which is a man-made physical barrier. Prior to its construction the tidal limit was about one kilometre upstream of this point. Reddering, (1988) has shown that the flow of seawater into the estuary is restricted, because the narrow channel and well-developed flood delta limit the transport of water. This is evidenced by the delay between the time of low tide at sea and that in the estuary. The lag time varies between 140 and 180 minutes and the consequence is that low tide occurs at the coast while water in the estuary is at an appreciably higher level. The estuary is fairly shallow, well-mixed and marine dominated. The mixing interface between marine and estuarine water moves approximately 1.4 km up-estuary with the incoming tide (Reddering, 1986).

Physical modifications

The most obvious modifications within the estuarine area are related to human activity, particularly those associated with the change in land use along stretches of the estuary's banks, mainly for residential purposes. There has also been some development of recreational facilities.

As a result land would have been cleared, which in turn would have resulted in biodiversity loss and changes in river hydrology (e.g. runoff patterns). Other changes have occurred as a result of development alongside the river, such as the construction of jetties and slipways as well as the artificial stabilisation of banks.

Jetties

The DEDEAT report that the issue of illegal jetties and the need for permitting in this regard is receiving attention with notices having been served on the responsible residents. Some examples of jetties that have been erected on the estuary are shown in the photographs below. There are jetties that extend into the estuary to a distance of between 20 m to 30 m from the river bank. In some cases residents have also blocked off their boundary line extending into the river. The use of entertainment boats or barges has become popular on the Nahoon Estuary in recent times (past 10 years) and these too, if left permanently moored can extend the jetty structure out by another 3 to 4 m.

FIGURE 9: Photographic record of jetties on the Nahoon Estuary - 2012

In essence, structures that protrude into the estuary are on State land and are therefore governed by the Sea Shore Act (Act 21 of 1935 – with specific reference to the ammended Act 190 of 1993). Thus jetties are subject to approval in accordance with the stipulated application and registration process under this Act. Through this process, certain restrictions may be imposed on jetty construction, such as its size, length, materials used, etc. This is a common practice with other estuaries throughout the country. It is also possible that jetties and other structures within and adjacent to the estuary would be subject to environmental authorisation as of the time that the legislation relating to Environmental Impact Assessment (EIA) came into effect, namely since March 1998.

Cape Nature has developed a set of draft guidelines for jetties and, for completeness, we include in **Appendix B** to this report a copy of documentation in this regard. Please note that these are draft guidelines. *Pers Comm* with Mr Rhett Hiseman of Cape Nature, who has been involved with the development of these guidelines, is of the opinion that guidelines for jetties and related structures should be developed at a National level, which then can be adapated at the local level as required.

Key points from the guidelines are as follows:

- As a general rule, it is accepted that jetties are constructed for the purpose of mooring boats, but where fishermen and or swimmers trample the riverbank to an unaccepted degree, jetties may be considered in order to protect the riverbank.
- In general not more than one jetty will be supported per dwelling (adjacent to the river) on a riparian property – and then only when the riverbank is suitable. More and preferably communal jetties may be considered if it forms part of a bigger housing or resort development.
- Floating jetties are preferred unless circumstances dictate otherwise.
- Jetties must be constructed of unpainted hardwood and/or building standard treated pine. No metal frames or structures apart from steps to board the boat, will be allowed. If supporting poles for the walkway are needed below the high water mark, fibre cement poles are recommended (Fibre cement pipe driven into the ground and filled with concrete after placement).
- No roofs, rooms or other structures may be attached to or built onto the jetty. Railings may be considered if in keeping with the purpose of the structure.
- In general jetties longer than 6m below the HWM will not be supported although in areas where the reed bed or marsh is wider than 6m, they may not extend more than 1 m beyond the reed line. Longer jetties may be allowed in areas where the nearest open water is a greater distance from the shore.
- Gangways to be no wider that 1,5m (when two gangways are built, not more than 1m each) and the dimensions of the front platform no more than approximately 4 m x 3 m – unless a larger platform is necessary to stop bank erosion as a result of frequent boat landings in specific areas of communal use.
- Pontoons must be made from corrosion-proof material and should be constructed in such a way that if they are ruptured they remain afloat.
- A reflective number plate indicating the property number must be attached to the jetty in such a way that it is visible from the river.

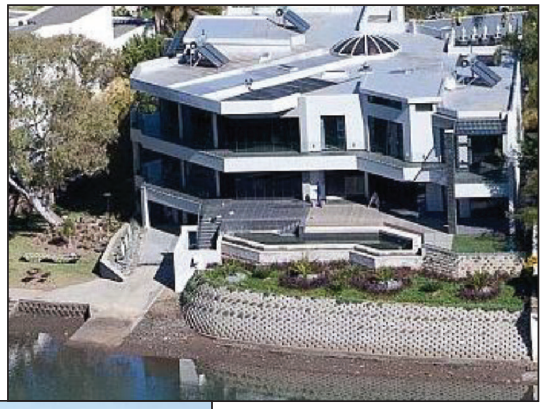
The section on flooding in this report illustrated how jetties that are washed away during floods may end up on the beach or partly submerged in the estuary itself, thereby posing a physical hazard to rivers users. This also results in the need to clean-up the resulting debris. It is primarily for this reason that restictions may be imposed in the approval for a jetty, so that should a jetty be washed away and break-up, the stucture can be easily removed. Another reason for such restrictions is to limit the physical (e.g. erosion) and ecological impacts of jetties.

Concrete slipways and hard surfacing of river banks

Private slipways have been in use for many years by residents having direct access to the estuary. Some new slipways have been constructed in recent years in the upper part of the estuary, near the islands. Slipways are a listed activity in terms of NEMA and thus their installation must be approved.

Hard surfacing of the river banks can have serious consequences to the flow dynamics in the estuary with knock-on effects to adjacent properties. Hard surfacing can increase flow velocity during flooding, which in turn can increase erosion potential. In addition, hard surfacing does not allow for the flood mitigation effect of a vegetated (natural) embankment.

Any hard surfacing would require environmental authorisation. Unauthorised hard surfacing and the consequences thereof will need to be seriously considered. It is recommended that wherever possible areas of hard surfacing should be re-instated back to a natural embankment. Examples of areas where the river bank has been hard surfaced are shown in the photographs alongside. The draft guidelines in **Appendix B** cover hard surfacing



4.1.4 Physico-chemical Characteristics

Water quality of the Nahoon River, and especially the estuarine component, plays an important role in determining both the biological functioning and the recreational use of the estuary. Activities that occur within the catchment could affect the water quality of the estuary. The runoff and leachate from the Round Hill Landfill site has been noted as one possible 'point source' of impact within the catchment. Others include disposal of industrial effluent, runoff from informal settlements and runoff from gardens and agricultural areas where fertilizers, herbicides and pesticides have been applied.

Primary considerations in respect of water quality are:

- the effect of organic and inorganic pollutants on estuarine biota;
- effects of the pollution on the recreational potential;
- possible health risks that residents and river users may be exposed to as a result of bacterial contamination of the estuary or consumption of fish and shellfish from the estuary.

A review of the historical water quality of the estuary, and sampling to confirm previously identified trends, was undertaken by Mr W Selkirk of Pollution Control Technologies in 1992 as part of the SRK investigation. A summary of the principal conclusions of Selkirk's work on the water quality situation within the Nahoon Estuary is shown in Table 4, below[4]:

TABLE 4: Water quality analysis (from Selkirk's work summarised in SRK 1992)

PARAMETER	RESULTS AND COMMENTS
Sediments	• Cohesive sediments are not reworked by tidal action • Organic content of sediments increases with distance upstream • Sediments accumulate between freshwater flood events
Salinity	• Varies between 34 and 37 parts per thousand. • Estuary is marine dominated. • Intermediate floods result in a freshwater/saline interface 1.4 km upstream from mouth • Episodic floods result in system being freshwater dominated for the duration thereof.
Oxygen	• Varies from 7.8 mg/l O_2 at mouth to 5.7 mg/l O_2 in head waters; may drop to 4.5 mg/l O_2 in estuary. • Upstream decrease in oxygen may be due to trapping of organically-rich water upstream of Batting Bridge for extended periods.
Algal biomass	• High level of algae in freshwater flowing into estuary. • Algal blooms have been noted immediately below Abbotsford Causeway and upstream of Playwaters at the estuarine/marine interface.
Bacterial numbers	• Municipal records reflect water is polluted with faecal bacteria upstream of Abbotsford Causeway. • Monitoring in estuary in February/March 1991 showed bacteria in estuary are derived from freshwater inflows.
Chemical composition	• Heavy metal pollution of the estuary is probably derived from above Abbotsford Causeway

At the time it was concluded that there are relatively few factors which affected water quality. Notwithstanding, Selkirk (1992 cited in SRK 1992) identified a number of existing and potential pollution sources as shown in Table 5.

TABLE 5: Potential water pollution problems in the Nahoon Estuary (After Selkirk 1992)

LOCATION	POTENTIAL PROBLEMS
East London side of estuary	
Abbotsford Causeway	• Water flowing through the fish ladder is a point source of organically-enriched and bacterially-contaminated water.
West bank, upstream of Batting Bridge	• Stream draining this area is extensively polluted with organic matter, the source of which may be spillage from sewage pump station.
Playwaters/Lower Nahoon	• Sewerage system is in need of upgrading as some discharge of effluent into the river occurs.
Beacon Bay side of estuary	
Intersection of Beaconhurst Drive and Blue Bend Road	• Sewerage network has a high level of storm water infiltration and occasional pump failures occur; raw sewerage is discharged onto the river bank via emergency overflow and resulting runoff to the river causes organic enrichment, bacterial contamination and local deoxygenation.

[4] Note that these data are related to the 1992 situation. In this context they provide useful background data.

Interestingly the 1992 study notes sewage system discharges as being a problem. In a study on 3 estuaries, including the Nahoon, Wiseman *et. al.*, (1993) note deterioration in water quality in the estuary. This is evidenced by elevated levels of heavy metals and in microorganisms associated with sewage discharges. These trends are particularly noticeable after heavy rainfall events.

It is clear that there have been long-standing concerns about water quality in the Nahoon Estuary. According to information in the water sector plan within the LEDS, the Nahoon River is subject to eutrophication. Water hyacinth has established in the non-tidal reach of the Nahoon River below the Nahoon Dam. This is attributed to high nutrient levels originating from domestic (point and diffuse source) effluent. In turn, this is related to wastewater treatment works within the BCM generally operating at or beyond capacity and inadequate sanitation facilities, particularly in informal settlements. Runoff from informal settlements and the entry of stormwater flow into the riverine and estuarine environment are also regarded as significant contributors to pollution levels. It is noted that this situation is likely to persist in the short to medium-term unless there is significant investment in wastewater infrastructure and the provision of formal housing and sanitation (LEDS, 2005).

Discussion with stakeholders during the course of this study has served to confirm concerns about water quality and pollution sources, particularly from sewage flows into the river. For example, both Border Canoe Club members, as well as with the BCM officials have noted this problem (Refer to Appendix A for more detail in the stakeholder meeting notes). According to stakeholders, the main sources of these flows are from unserviced informal settlements and poorly maintained / undercapacitated sewage infrastructure (pipelines and pump stations). Recent sewage inflows from the pump station on the Beacon Bay side of the river (lower Hillcrest Drive) were noted as well as from the informal township Nompumelelo. In a report on the state of sanitation (Coastal and Environmental Services, 2005) it is noted that the is a 42 % non-compliance rate with SA Water Quality Guidelines for bacteria (Total faecal coliforms) in the Nahoon River, based on 2004 data from the municipality's Scientific Services.

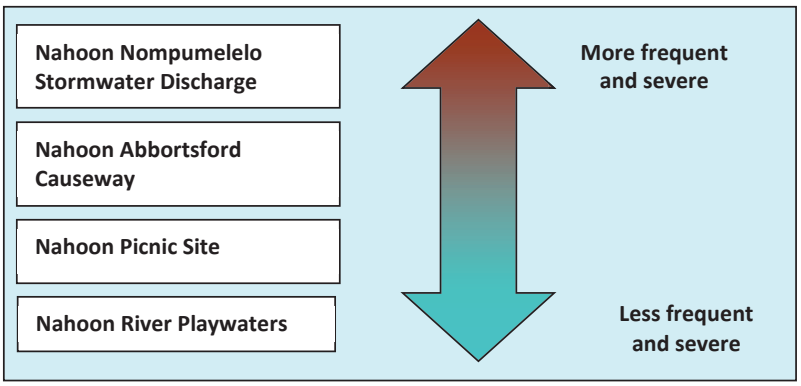
Key water quality variables from spreadsheet data provided by the BCM are summarised in Table 6 below and the sample positions are shown on Figure 10. The location of sanitation infrastructure relative to the study area is also shown in Figure 10.

TABLE 6: Water quality data

Sample Point:	Playwaters	Torquay Stream	Picnic Site	NE Expressway Bridge	Nompumelelo Stormwater Discharge	Abbortsford Causeway	Dorcester Heights
Average E-coli (count per 100ml)	540	453	765	988	8633	1094	770
Maximum value recorded	11000	11000	11000	11000	110000	11000	11000
Frequency of Max value	x5	x1	x6	x1	x11	x8	x1
Averaged values are for the period 8 Sept 2008 to 29 July 2012. Note that not all sample points were sampled an equal number of times.							

It can be seen that there is a high incidence of *E-Coli* pollution in the Estuarine area. Guidelines for Recreational Use (DEA, 2012) have been published as part of the South African Water Quality Guidelines for Coastal Marine Waters. In terms of *E coli*, these Guidelines state that a count of 500 organisms per

100ml constitutes poor water quality and would be regarded as unacceptable. A concentration of less than 250 organisms per 100ml represents excellent water quality. The following diagram shows the frequency and severity of pollution incidents at the various points.



Water quality concerns in the Nahoon Estuary have been sufficiently serious so as to result in questions being posed in Parliament to the Minister of Water and Environment Affairs. The following response was provided by the Minister dated 14 October 2010:
(http://www.dwaf.gov.za/communications/Q&A/2010/NA%20Q%202469.pdf):

(1)(a)	Yes, my Department has investigated the complaints of sewage pollution from the Nahoon River Estuary. As the estuary is located within an urban area (East London), it has a number of pump stations, sewer lines and storm-water drains on both sides. The investigation revealed that the storm water drainage from the Nompumelelo Settlement (Beacon Bay) is the major source of faecal coliform pollution in the Estuary.
(1)(b)	Pollution from Nompumelelo Settlement is a result of diffuse pollution and frequent sewer blockages in the community attributed to mostly foreign materials in the sewer pipes. The Buffalo City Local Municipality (LM), as a Water Services Authority for the area has a maintenance crew which services Nompumelelo Settlement community on a daily basis.

The above coincides with the analytical results shown in Table 6. Local residents have stated that municipal infrastructure (leaks and overflows at pump stations for example) is also a serious concern in terms of releases to the estuary with associated degradation in water quality.

BCM embarked on a process of developing a sanitation policy in 2005. As part of this process, a review of the state of sanitation infrastructure was undertaken. The results of this study confirmed the significant problems associated with sanitation infrastructure (Coastal and Environmental Services, 2005). It was concluded that: "The poor state of existing bulk sewage infrastructure is of great concern, where both raw sewage and noncompliant treated effluent is discharged into fresh and marine water resources causing adverse impacts to the environment and more importantly, **may lead to risks to human health."**

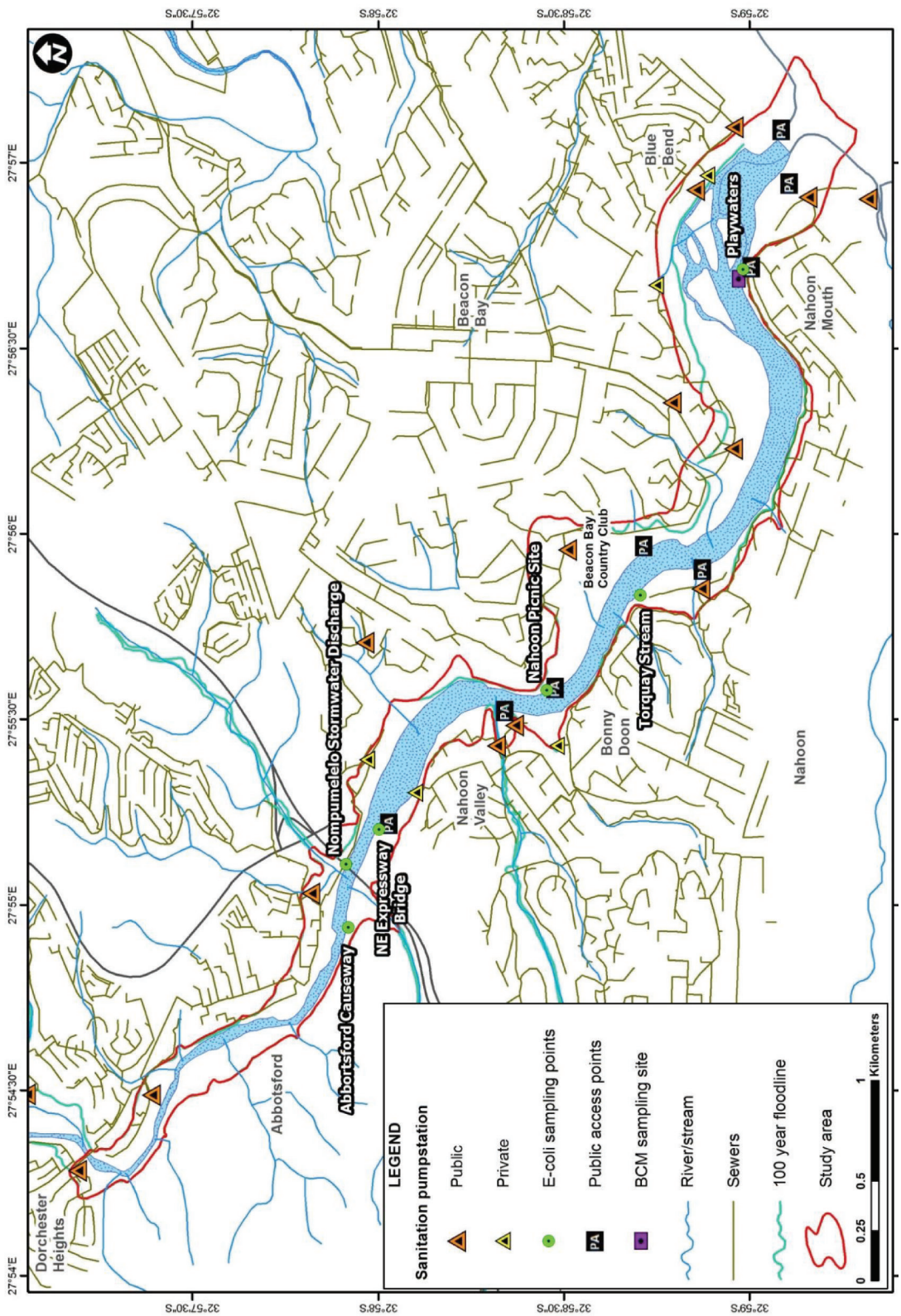


FIGURE 10: Location of sanitation infrastructure and bacteriological sample points

4.2 Biodiversity Characteristics and Estuarine Habitat

Studies of the biology and ecology of the estuary are largely limited to those done in the 1980's and early 1990's, with the most comprehensive being the East London programme – a set of studies on the Nahoon and adjacent coastal areas published in the Institute for Coastal Research Report No. 7 (Wooldridge, T. (ed) (1986). A synopsis of the available information from this time period is provided in Wiseman *et. al.*, (1993). An overview of existing information can also be found in the Report on the Intermediate Reserve Determination undertaken by the DWAF with assistance from the CSIR (DWAF, 2001). This report highlighted the lack of data as a key factor in the low confidence level of its recommendations. Given that there is a paucity of studies since then, the description of the biodiversity below is, of necessity, based primarily on what is probably now outdated information. Based on this, it is submitted i) that the biodiversity of the area is not that well known; and ii) there is no way of accurately determining the current status of the biodiversity without undertaking specialist investigations and fieldwork.

Nevertheless, it can be stated that the Nahoon Estuary is a permanently open, warm temperate estuary in a transitional area between the sub-tropical environment to the east, and a warm temperate environment to the west. This contributes to the relatively high species diversity with species composition of many groups including both temperate and sub-tropical representatives – for example, zooplankton, fish and terrestrial vegetation (Wiseman *et al*, 1993). Estuarine habitat cover was assessed as part of the estuarine component of the National Biodiversity Assessment for various habitat types (Adams *et. al*, 2011). The results for the Nahoon Estuary are shown in Table 7:

TABLE 7: Habitat type and extent

HABITAT TYPE	EXTENT (ha)
Intertidal saltmarsh	2.8
Supratidal saltmarsh	0
Submerged macrophytes	2.3
Emergent reeds and sedges	0.2
Mangroves	0.6
Sand/mud banks	4.5
Open water area / channel	47.5
Rocks	0
Swamp forest	0

There are a variety of habitats in and around the estuary as shown in Figure 8 (after Fig. 33 of Wiseman et al). According to the RDM report (DWAF, 2001), the Nahoon Estuary supports 8 of the possible 9 plant community types which occur in South African estuaries. Of particular importance are:

- The intertidal saltmarsh which only occurs in permanently open estuaries and which can therefore be considered rare.
- The submerged macrophytes, *Zostera* and *Halophila,* which are also confined to the Nahoon in this region and which are important as a habitat and food source.

Aquatic habitats include a sandspit on the western bank of the inlet, a flood-tidal delta, a rocky northern bank, mud and sandflats and salt marsh, while terrestrial habitats include dune forests and thickets although natural areas have been significantly reduced as a result of urbanisation along the margins of the estuary. These habitats and associated plant and animal communities each play a specific role in the ecology of the estuary. For example, the salt marsh areas attenuate floodwaters and act as a sink for sediments and

nutrients. The biodiversity of the estuary is therefore important not only in terms of the conservation of particular species, but for the overall health of the estuary. Some of the aforementioned studies (eg. Wooldridge (1986) quoted in Wiseman *et al*, 1993) already described a number of changes in biodiversity attributed to human influences. For example, surveys of zooplankton undertaken by Wooldridge showed that the reduced freshwater inflow (as a result of the Nahoon dam) had altered the species composition and abundance thereof. Other factors/activities which have impacted on the biodiversity include:

- The presence of the Nahoon dam results in the attenuation of floods which means there is less frequent scouring and increased accumulation of sediments in the mouth and further upstream (marine sediments may be found up to 1.2km from the mouth);
- The Abbotsford Causeway prevents tidal intrusion/estuarine conditions – and thus estuarine species - further upstream of this position, although it is noted that the causeway is close to natural position of tidal head;
- Extensive erosion in the catchment has increasd the sediment load reaching the estuary;
- Poor water quality as a result of informal settlements, sewage spills or oveflows and stormwater runoff;
- The introduction of mangroves into the estuary in 1969 by Dr. Trevor Steinke;
- The encroachment/ introduction of alien and invasive species;
- Infilling of wetlands and marshes to create the area around Beacon Bay Country Club;
- Habitat loss as a result of further urban development, including areas on the floodplain;
- Heavy recreational use of the estuary and surrounds leading to trampling of dune vegetation and intertidal areas, erosion of the river banks, disturbance of wildlife, and over-exploitation of, for example, bait species such as the mud-prawn, *Upogebia africana* and sandprawn, *Callianassa kraussi*.

4.2.1 Phytoplankton

An investigation on the productivity of the phytoplankton, zooplankton (planktonic plants and animals) and aquatic macrophytes of the Nahoon Estuary was undertaken in 1984/85 by the Institute of Coastal Research of the University of Port Elizabeth as part of the East London Programme. The role of phytoplankton in the primary productivity in the estuary was also subsequently studied by Campbell, Bate and others. However, the project team was not able to locate these reports either in hard copy or electronically. References to them in other reports (eg. Wiseman *et. al.*, 1993) do not contain any species information. The RDM Report (DWAF, 2001) reported that: "Chlorophytes and cyanobacteria dominated low salinity water at the head, while centric and pennate diatoms dominated water with salinity close to seawater."

4.2.2 Aquatic and Semi-aquatic Plants

The most common macrophytes in the estuary are the two seagrasses *Zostera capensi,* and *Halophila ovalis*. These, together with two macroalgae – *Codium tenue* and *Hypnea viridis* – made up 90% of the biomass of intertidal and shallow sub-tidal macrophytes in the estuary (Knoop *et. al.,* 1986 – quoted in Wiseman *et. al.*, 1993). Macrophytes play an important role in the ecology of the estuary, amongst others as a habitat for invertebrates and a nursery ground for fish. They were reported to have declined between the mid-1980's and 1992 (SRK, 1992), but covered some 2 ha of the estuary in 1999 (DWAF, 2001). The macroalgae had declined. Other important species are those which occur on the tidal flats, including *Sarcocornia perennis,*

S. decumbens, Chenolea diffusa and *Sporobolus virginicus*, while the reed *Phragmites australis* is present along the banks in the middle and upper reaches of the estuary (Wiseman et al, 1993).

Mangroves were introduced into the estuary in 1969 in the Nature Reserve area on the east bank. They have subsequently spread a significant amount and now cover an area of some 2.2 hectares. They are also present on the west bank in the Torquay Road area. The mangrove community has been studied quite recently by Hoppe-Speer *et al* (in prep). The rate of mangrove expansion was measured over a 33 year period (1978 - 2011) using past aerial photographs and Esri ArcGIS Desktop 10 software. It was found that mangrove cover increased linearly at a rate of 0.06 ha-1 expanding over a bare mudflat area, while the salt marsh area cover also increased (0.09 ha-1) but was found to be variable within the 33 years. It was thus concluded that at present there is no competition between mangroves and salt marsh, but such competition in the future was not precluded – especially under the influence of climate change. Furthermore, it was also concluded that it is not advisable to plant mangroves in non-native areas because long term impacts on these habitats are unknown.

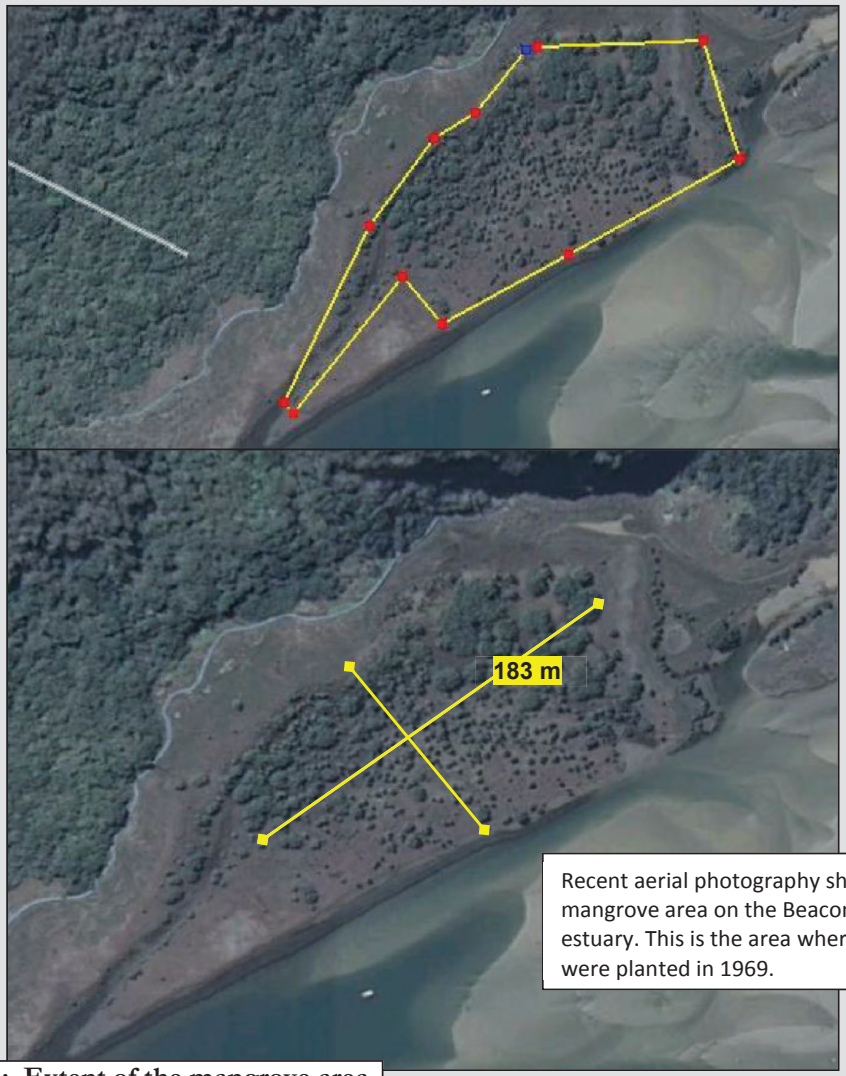


FIGURE 11: Extent of the mangrove area

4.2.3 Terrestrial Vegetation

According to Wiseman *et al* (1993), the terrestrial vegetation in the areas adjacent to the estuary at that time consisted of:

- Xeric Transitional Thicket comprising tree/shrub and herbaceous layers with high species diversity including a number of succulents such as euphorbias and aloes;
- Dune forest and Thicket which is a non-succulent, subtropical thicket type dominated by trees and shrubs with relatively few succulent species;
- Dune Slack and Strand Communities: essentially limited to the dunes seaward of the developed area on the west (south) bank (car park, life-savers club etc);
- Acacia Savanna: limited to the south bank of the upper reaches of the estuary (possibly overtaken by development now);
- Remnants of thicket communities in areas cleared for agriculture: again, these areas may now have been developed;
- Alien and Invasive Vegetation: a dense stand in the middle to upper reaches of the estuary comprising well-known invasive species.

The Xeric Transitional Thicket communities are relatively well preserved where they are present but, according to Wiseman *et. al.* (1993) include a high number of threatened species of all vegetation types (although they do not appear to be on the 2007 TOPS List). The dominant species of the Dune Forest at Nahoon include the red milkwood (*Mimusops caffra*) and the white milkwood (*Sideroxylon inerme*). While they are not endangered, they are protected in terms of the National Forest Act of 1998, which means that they may not be damaged, moved or felled. The Dune Forest communities are important from a biogeographic perspective as they are close to their distribution limits. Those on the eastern side of the Nahoon Estuary fall into the Nature Reserve.

Changes in the distribution of vegetation communities between 1993 is shown in Figures 12 and 13. Figure is from the work of Wiseman *et. al.*, 1993) and Figure 13 is based on aerial photographs. The most obvious change is the further loss of thicket communities to development, and the spread of the mangroves introduced in 1969.

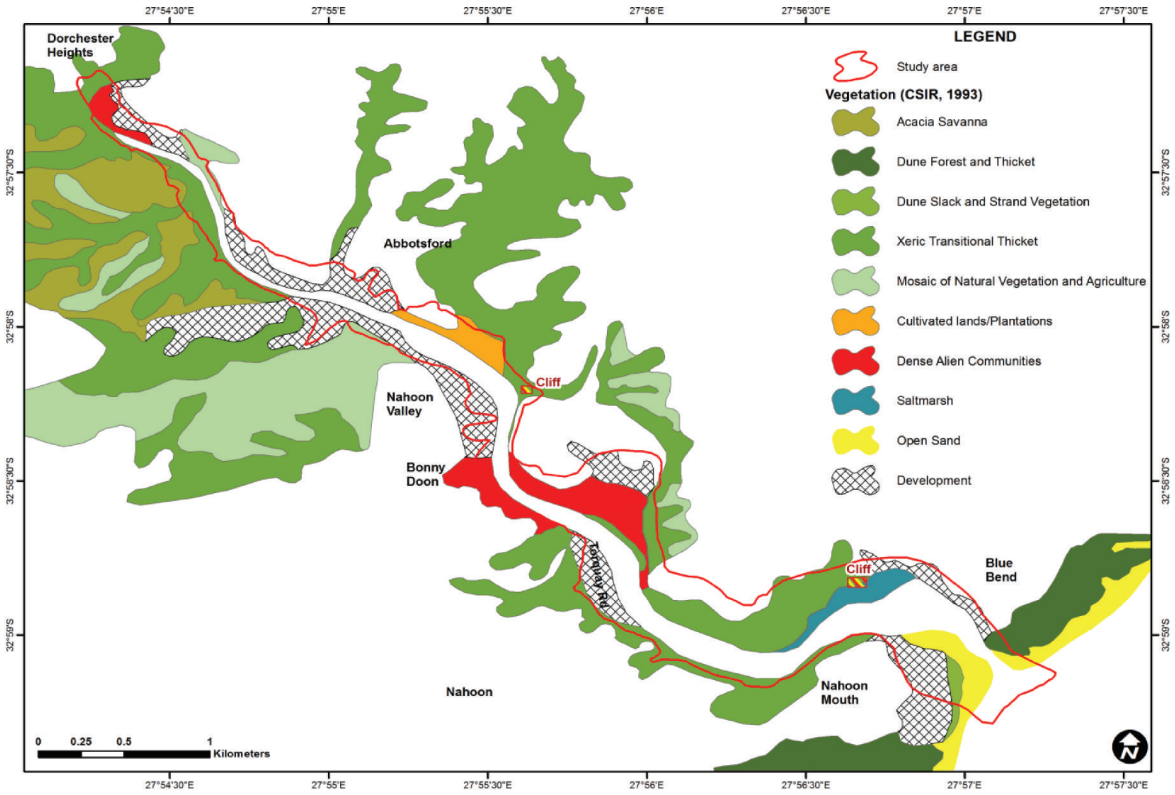


FIGURE 12: Habitats in and around the Nahoon Estuary (1993 – after Wiseman *et. al.*, 1993).

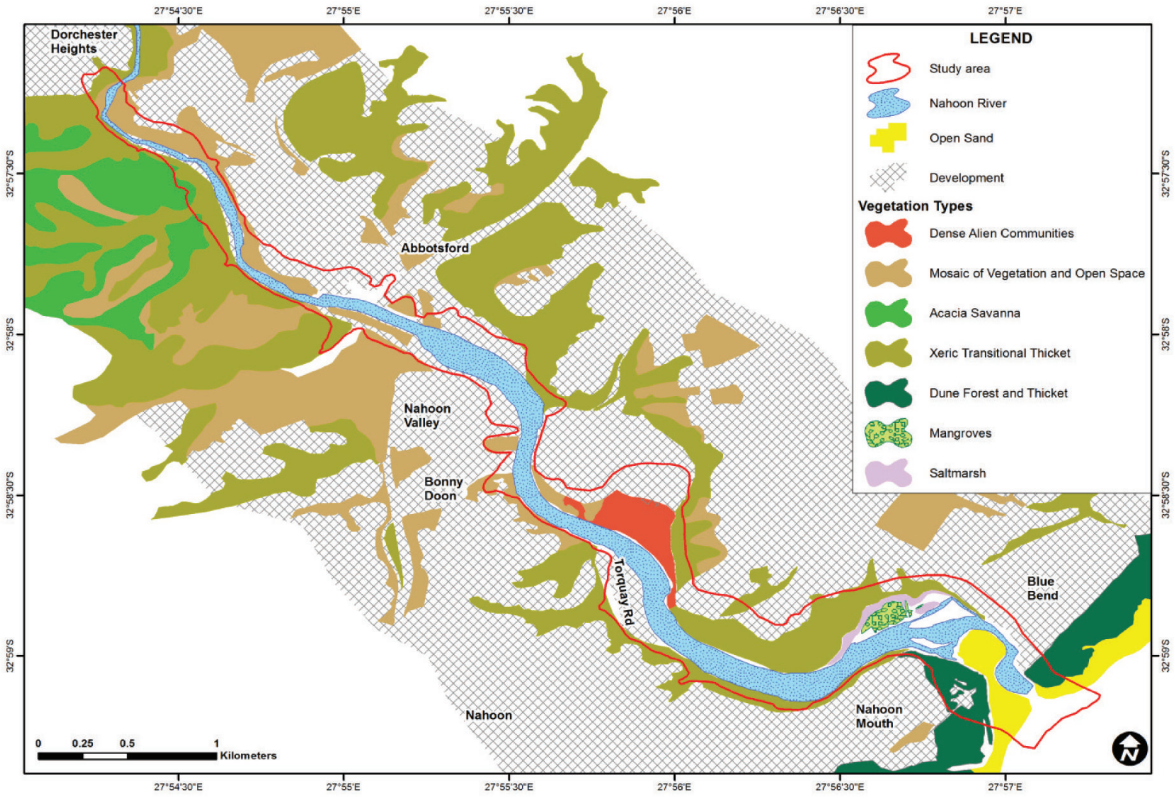


FIGURE 13: Habitats in and around the Nahoon Estuary – based on aerial photos from 2011

4.2.4 Aquatic Invertebrates

The only available information on zooplankton is derived from a study by Wooldridge (1986) (quoted in Wiseman *et. al.*, 1993) which was intended to assess the impacts of sewage and industrial waste on the coastal environment of the area. This study indicated that the population of *Pseudodiaptomus hessei* – identified as a key copepod species in estuarine ecosystems – was less abundant than expected as a result of reduced freshwater inflow. Other copepods identified included *Acartia longipatella* and *Acartia natalensis.* The RDM Report (DWAF, 2001) also reported disruptions to the patterns of seasonal succession in the zooplankton community due to the increased marine influence.

The macrobenthos of the Nahoon was described by Tomalin and Baird (1986) and is considered typical of sheltered coastal areas. However, many species have long had reduced abundance as a result of reduced freshwater inputs, contamination and habitat loss. For example, bivalve populations (*Solen capensis, Psammotelina capensis* and *Eumarcia paupercula*) were reported to have been significantly affected by removal of sand at the river mouth (Sandy Muller, in Wiseman *et. al.*, 1993). A more comprehensive study of the benthic macrofauna of the flood-tidal delta was undertaken by Bursey and Wooldridge (2002). They identified 118 species (including 60 crustaceans, 27 polychaetes and 20 molluscs). A total of 106 species were found in the flood-tidal delta and 36 on the beach. There was a general trend of increasing species richness from the mouth into the estuary.

4.2.5 Vertebrates

The Nahoon Estuary is considered important for small resident fish and as a nursery area for marine fish (Marais, 1986 – cited in Wiseman *et. al.*, 1993). Fish diversity is relatively high due to the presence of *Zostera* beds and the fact that it is permanently open with relatively stable conditions. Species include those that spend their entire lifecycle within the estuary, those which spawn in the sea but use the estuary for other stages of their lifecycle, and those which enter estuaries on an occasional basis. There have, however, been suggestions that the fish diversity has decreased due to the loss of the marsh areas to the Beacon Bay Country Club while the species composition may have changed in favour of marine species due to the reduction if freshwater inflow. In addition, recreational fishing pressure over weekends and holidays is considered to be significant, and likely to increase in future (DWAF, 2001).

Harrison undertook a survey of estuarine fish species. Surveys for the Nahoon Estuary were undertaken from September – November 1996. A total of 24 fish taxa were recorded. The highest abundance of fish recorded were endemic species (80%), with some 14% of the species composition being cosmopolitan species. Temperate, and tropical species comprised about 2 and 4% in terms of the abundance of species (Harrison, 2002 and 2003).

Some fish have specific habitat requirements at certain stages of their life cycle. The Nahoon Estuary is potentially important for small juvenile dusky kob *A. japonicas* less than 1-year old. These juvenile fish have a preference for habitat where there are fine sediments, such as in highly turbid estuaries. They are adapted to finding refuge in a "viscous" environment from which other predatory fish are physiologically excluded. This type of habitat is extremely limited and it is estimated that it comprises less than 5 % of the total estuarine area in South Africa. The following is noted: "Of the 20 largest catchments in the country, only four, the Mbashe, Great Kei, Mzimvubu and Mtata have estuaries with the suitable sediment and turbidity characteristics as do an undetermined number of smaller systems such as the Kwelera and Nahoon." The dusky cob is regarded as a species of special concern and the fishing stock status is reported as "collapsed" (Adams, *et.al.*, 2011).

No specific surveys of amphibians or reptiles seem to have been undertaken, with lists published in Wiseman *et al* (1993) being based on recorded sightings, museum specimens and what was expected to be in the area. Wiseman *et al* (1993) list 32 species of birds recorded from the Nahoon estuary, including 10 waders which are associated with the tidal flats. The diversity and number of birds were considered to have decreased since the 1930's and 1940's as a result of habitat destruction and disturbance resulting from increased human activity (SRK, 1992). A total of 48 species is reported in the RDM Report (DWAF, 2001) based on counts between 1978 and 1999. The bird populations are dominated by small invertebrate feeders – migrants in summer and residents in winter – although piscivorous species are also present. Endemic and red data species that have been recorded are:

- 3 endemic species; Cape Cormorant, Cape Shoveller and African Black Oystercatcher; and
- 3 red data species: White-backed Night Heron, Black Stork and Caspian Tern.

Mammals have largely been displaced as a result of urbanisation although there are small populations in the dune forests.

4.2.6 Invasive Alien Species

A variety of well known terrestrial invasive plants were recorded from the area in Wiseman *et. al.,* (1993). It is highly likely that these have spread further in the intervening years. A Working for Water team was busy removing these species in the Nature Reserve area during August/September, 2012.

In respect of aquatic species, the invasive Australian oyster drill (*Bedeva paivae*) was reported in Wiseman et al, 1993 and the presence of the polychaete worm *Ficopomatus enigmatica* in the upper reaches of the estuary was noted in the SRK report (1992). Water hyacinth is a problem in the river, with substantial amounts being removed by the Working for Water Programme, but it is unclear to what extent this reaches the estuary.

4.2.7 Estuarine health status and conservation value

Whitfield (2000) has undertaken an assessment of the health (based on biodiversity criteria) of all South African estuaries. The health status of the Nahoon Estuary is described as fair (i.e. noticeable degree of ecological degradation in the catchment and/or estuary (moderate impact)) and the priority for rehabilitation as high. In the work undertaken by Turpie and Clarke (2007) the importance index for all temperate estuaries in South Africa was determined. The Nahoon Estuary received a score of 70.9%. In terms of priority, it was rated 64th out of the 258 estuaries included in the study.

The following is reported in the 2001 Intermediate Reserve Determination (i.e. RDM study) undertaken by the DWAF:

- The Estuarine Health Index was determined as 67 resulting in the estuary being categorised as having a C rating (moderately modified) in terms of its Present Status Category.
- The Estuarine Importance Score was determined as being 64%, based on its present state at the time the study was conducted (i.e. 2001).
- Depending on the importance of the estuary and the level of protection or desired protection, the Ecological Management Class (EMC) can be elevated. This is determined on the basis of the Estuarine Health Index. Any estuary with a Estuarine Health Index score of between 60 and 75% is elevated from C to B in terms of the Ecological Management Class.

According to DWAF (2001), where the EMC allocated to an estuary is higher than its Present Status Category, as is the case for the Nahoon Estuary, measures need to be implemented to improve the health of the estuary. This would necessitate management of and reduction in the impacts of human activities on the estuary. The Nahoon Estuary emerged as the top priority within the estuary component of the Integrated Coastal Zone Management Plan (ICZMP) for the BCM with respect to the need for management intervention to secure a healthy estuary (Coastal and Environmental Services, 2005).

Coastal and Environmental Services (2005) have undertaken a review of the Nahoon Estuary as part of the ICZMP developed for the BCM. A Rapid Assessment Matrix (RAM) was used based on the methodology developed by the Institute of Natural Resources for the Eastern Cape Estuaries Management Programme. This RAM tool is used to prioritise estuaries with regard to the degree of management effort required to ensure sustainable resource utilization. The matrix comprises environmental, social and institutional indicators. These are used to assess the current situation which in turn would inform what is needed to ensure appropriate and sound management interventions. Ratings / scores are allocated per criterion on a scale of 0-3. The assessment is based on available information and the knowledge of authorities and researchers in the area (Coastal and Environmental Services (2005). Results for the are shown in the table below:

TABLE 8: RAM results for the Nahoon Estuary (Coastal and Environmental Services 2005)

INDICATOR	DESCRIPTION (as per RAM Methodology)	SCORE
Recreational disturbance (boating)	High levels of use throughout the year	3
Consumptive use	Moderate levels of exploitation, but intensive on weekends and holiday.	3
User conflict	High.	3
Population density	Moderate density, holiday resorts and residential areas close to the estuary banks and the mouth region.	2
Conservation value	Estuaries rated between 1 and 60 (national level). (Score = 3)	3
Illegal activities	Unorganised, generally individuals catching undersize fish or exceeding bag limits, includes spearing and netting of fish during breaching events.	1
Enforcement patrols	Daily	3
State of shallow water habitats	Significant loss of habitat due to marinas, land reclamation (residential, commercial, agricultural and industrial), canalisation of lower reaches, jetties, slipways, pollution and trampling.	3

A desk-top health assessment of all South African estuaries was undertaken, as part of the 2011 National Biodiversity Assessment (van Niekerk *et. al.*, 2011a). The following factors were applied in this assessment, and the results for the Nahoon Estuary are shown in Table 9:

- Factors that place pressure on estuaries expressed as being of very high, high, medium or low level.
- Individual ecological components graded from excellento to poor.

TABLE 9: Results of the desk-top health assessment for the Nahoon Estuary

FACTOR	ASSESSMENT
PRESSURE CRITERIA	
Change in flow	Medium
Pollution	High
Habitat loss	Medium
Fishing effort	High
Fishing effort (catches in tonnes)	2
Bait collection	Yes

FACTOR	ASSESSMENT
HEALTH CONDITION CRITERIA	
Habitat state	
Hydrology	Fair
Hydrodynamics	Very Good
Water quality	Poor
Physical habitat	Good
Overall Habitat State Rating	**Fair**
Biological state	
Microalgae	Fair
Macrophytes	Fair
Invertebrates	Fair
Fish	Poor
Birds	Fair
Overall Biological State Rating	**Fair**
OVERALL HEALTH RATING	
Estuary Health State	Fair
Ecological category	C (from the intermediate DWAF 2001 RDM study)

According to Turpie and Clarke (2007): "Both management and water allocation decisions involve trade-offs between conservation and various types of utilisation. In order to facilitate decision-making in both of these spheres, it is necessary to understand the relative conservation importance of different estuaries." Estuaries have been prioritised on the basis of conservation importance in work undertaken by Turpie et. al., (2002). Updates and revisions of this analysis have been undertaken (e.g. Turpie and Clarke (2007) and Turpie (2012) as part of determining the conservation importance of estuaries (Refer to the National Estuary Biodiversity Plan, which forms part of the NBA documentation).

Various factors are taken into account in determining the conservation importance of estuaries, including ecosystem threat status and estuarine health. Threat status has been considered in for the various types of estuaries. Based on the Whitfield (1992) categorisation or typology, permanently open estuaries in the warm-temperate biogeographical zone are classed as endangered (van Niekerk and Nel, 2011). As noted earlier in this EMP, the Whitfield (1992) estuarine typology is based on physical characteristics. A refined method of defining estuary type was developed for the purposes of the 2011 NBA, which takes account of both physical and biological factors. Based on this classification, all medium sized, permanently open estuaries in the warm temperate biogeographical zone (which includes the Nahoon Estuary) are classed as "least threatened."

The National Estuary Biodiversity Plan of 2012 (Turpie, *et. al.*, 2012) serves to identify which estuaries should be either fully or partially protected. Estuaries were divided into two planning units, where feasible, the idea being that this would allow for partial protection. Each planning unit theoretically represents 50% of the biodiversity features of the estuary. Historically, the approach has been to treat estuaries as a single planning unit, which only catered for protection of the total system. In accordance with this biodiversity plan, fully protected and partially protected estuaries would be designated as Estuarine Protected Areas, whereas all other estuaries should be regarded as Estuarine Management Areas. The Nahoon Estuary is not among those identified as requiring full or partial protection. Notwithstanding, it is identified as an estuary where two planning units would be feasible, and that is an estuary that is considered to be available for partial protection.

Notwithstanding the fact that the Nahoon Estuary was not identified as requiring protection at the national level, it is regarded as being second, behind the **Tyolomnqa** estuary in terms of conservation importance within the BCM. This illustrates its significance in the local context. importance demonstrathas emerged as being the top priority within the BCM with respect to the need for management intervention to secure a healthy estuary. In terms of conservation importance within BCM, the estuary is rated second (Coastal and Environmental Services (2005)).

4.3 Socio-economic Characteristics

The Nahoon Estuary is situated within the urban area of East London, one of the key economic hubs in the Eastern Cape. About 23% to the Province's GDP is contributed by East London and the city provides some 19% of the employment opportunities (IDP 2013-2014). In the 2001 census the municipality was reported to have a population of 702 281 persons and 191 234 households, with these increasing to 724 312 and 208 389 respectively. Based on 2011 census data, the number of households has risen to 223 570.

The BCM is characterised by relatively low economic growth and high levels of poverty. This is evidenced by the fact that of the 39 municipalities in the Eastern Cape, BCM is one of the few where the percentage of households living in informal dwellings is higher than the provincial average of 8%. Based on the 2007 Community Survey 24,5% of households were reported to be living in informal housing. According to 2011 census data there has been a slight decrease (relative to 2007 data) in the proportion of households that live in backyard shacks or informal dwellings to 22%. The high level of informal settlement is attributed to migration from rural areas. In addition, unemployment levels are high with some 53% of the workforce reported as being unemployed in the 2001 census and 56% of the adult population receives no monthly income, and 86% receive R1,600 per month or less.

4.3.1 Tourism

Tourism has also been identified as an important growth industry for East London, given its location on the coast and the natural beauty of the area. To this end, a Tourism Master Plan has been developed – this forms one of the sector plans within the municipality's Local Economic Development Strategy (LEDS). In this context the Nahoon Estuary can be seen as an important economic asset to East London. There is, however, a general lack of facilities for use by tourists. Nonetheless, the estuary is an important recreational resource and according to various stakeholders, it is well utilised for passive activities.

Visitors to the city comprise 95% domestic and 5% international, with the international component mainly being business and backpackers. Tourism Buffalo City state that the domestic market is the City's bread and butter, with the most recent information showing that the Eastern Cape is the second most popular province in SA among domestic tourists. "Sun, sea and sand" and nature-based tourism are two of the tourism products that has been identified in the Tourism Master Plan.

Two tourism nodes have been identified insofar as the Nahoon area is concerned:

- Development of the Nahoon Beach with amenities, facilities and security.
- Nahoon Seaside Resort - The development of a **"low-impact**" high-value tourism concept that does not compete with the environmental richness of the area. This project has not taken place as there are strong objections from residents towards any possible large-scale development on the basis that to some extent such a development would conflict with the Integrated Coastal Management Act (Act 24 of 2008).

4.3.2 Land use and Development Patterns

The main land use in the Nahoon Catchment is that of agriculture in the form of both subsistence and commercial farming. Approximately 80% of the catchment is in a natural condition, consisting mainly of thicket and grassland and 9% of the catchment area is considered to be degraded (DWA, 2008). Urban development accounts for 3% of the land-cover in the catchment and comprises mainly residential development associated with East London.
There are five categories of land use that occur in the study area / estuarine functional zone:

- residential
- infrastructure
- public and private open space
- sporting facilities
- holiday resorts and recreational facilities
- conservation areas.

The predominant land use within the estuarine functional zone is residential, with the first townships being established in the 1950's (Morris, 1986). Low density residential areas occur on both sides of the Nahoon Estuary as it forms the boundary between the suburbs of Nahoon and Vincent (western side and Beacon Bay (eastern side). Stand sizes generally range from ¼ acre to over 1 acre in size and most are occupied by a single large dwelling. This type of residential development exists in Torquay Road, Nahoon Mouth, Nahoon Valley and most of the east bank area. River front private property owners have planted lawns up to the waters edge and in many cases have stabilised the banks.

There has been a trend towards higher density development, as is evidenced by the presence of townhouse complexes. In the early 1970's development of a townhouse complex on the Beacon Bay side of the river off Beaconhurst Drive commenced. Several smaller townhouse complexes have also been developed on the East London side of the river, such as that located in Princess Alice Drive on the site which was formerly occupied by an old age home. There are some flats and townhouses in the vicinity of Riverview Terrace near the Beacon Bay Country Club. Unco-ordinated development and inappropriate land use planning is noted as a particular concern by Setplan in the socio-spatial analysis that was undertaken for the purposes of the 2002 Tourism Sector Plan. This has resulted in environmental degradation through deforestation, erosion, dune denudation, pollution of watercourses, alien invasive vegetation establishment and illegal dumping.

4.4 Utilisation of the Estuary

No detailed surveys on the utilisation of the Nahoon Estuary have been undertaken. Information in this section is primarily based on stakeholder input and the 1992 SRK study on recreational opportunities.

4.4.1 Recreational use

Based on input from stakeholders, it is clear that the Nahoon Estuary is utilised for a variety of recreational opportunities. These include water-based activities such as fishing, canoeing, swimming and power boating to land-based activities such as birding, walking, picnics and braaing. Collection of bait for fishing purposes also takes place. Stakeholders noted that the most popular recreational activities that take place on the estuary are paddling / canoeing, fishing (with associated bait collection), boating, walking and swimming. Current patterns of utilisation are shown on the Zonation Map attached to the back of this document.

CONTINUES ON PAGE 130 - PART 2

PROVINCE OF THE EASTERN CAPE
IPHONDO LEMPUMA KOLONI
PROVINSIE OOS-KAAP

Provincial Gazette
Igazethi Yephondo
Provinsiale Koerant
(Extraordinary)

Vol. 23

BISHO/KING WILLIAM'S TOWN
1 FEBRUARY 2016
1 FEBRUARIE 2016

No. 3584

PART 2 OF 2

ISSN 1682-4556

9 771682 455006 03584

At the time of the 1992 SRK studyon recreational opportunities the following was noted:

- The public perceive the boat launching facilities, car and trailer parks to be adequate during normal times but inadequate in peak periods (ie holidays and weekends).
- Most people expressed a strong view that the surface water area of the Nahoon estuary is overcrowded with boats during peak periods and felt that stricter control of power craft and implementation of legislation (eg. boating by-laws) should be enforced. Overcrowding is particularly evident during the Christmas and Easter holidays, whereas in the July and October holidays, river usage was described as medium to low by most people.

Recreational pressure on the estuary does vary according to the seasonal population influx (ie, weekends, December and Easter holidays, etc). Stakeholders were of the view that the estuary does not become over-crowded. Motorised boats would be of greatest concern in this regard since this activity is relatively space consumptive. Notwithstanding, stakeholders noted that they were not aware of over-crowding in this regard or of boats needing to queue at the launch site to gain access to the river. A key concern that was raised in respect of motorised craft was that of "reckless driving" posing a risk to other users. Enforcement in this regard is generally inadequate.

Whilst over crowding was a concern at the time of the 1992 SRK study, the situation has changed in that this is no longer regarded as a priority issue. Some stakeholders attribute this to the limited availability of boating access points to the estuary. Others are of the view that recreational activities have reduced in recent times due to the deterioration in water quality resulting from sewerage entering the river. This poses a health risk to users of the estuary. Most boating activity is reported to be associated with fishing. Some stakeholders expressed the view that additional boat launching facilities are required.

The need to maintain picnic areas was also noted as being of priority. Concerns about security and the presence of vagrants at such facilities was raised as a concern. The overriding opinion of many stakeholders that have taken part in meetings and workshops in relation to the EMP was that water based recreational activities, especially swimming, had shown a decreasing trend and this is attributed to poor water quality. The water quality is regarded as posing a health hazard to users of the estuary. Regular sewage releases from poorly mainatined infrastructure and from unserviced informal areas was identified as the key reason for this situation.

4.4.2 Utilisation for livelihoods

No published data are available regarding the use of estuarine resources from a livelihoods perspective. This issue was discussed at the various stakeholder meetings. It was noted that small numbers of fishermen from local communities utilise the estuary to catch fish for sale into their community or to feed their own families. Typically, these fishermen fish in the vicinity of Batting Bridge. They also harvest bait on the estuarine mudflats. In their analysis (Turpie and Clarke, 2007) estimate the number of subsistence fishers active on the Nahoon Estuary as between 30 and 40 based on data from Clark *et al.* 2002.

4.4.3 Illegal activities

Illegal activities are described as being unorganised and generally involve the catching undersize fish or the exceeding of bag limits by individuals. Spearing and netting of fish during breaching events also occurs. Whilst the municipality undertake regular patrols, it is reported that enforcement capacity is generally weak.

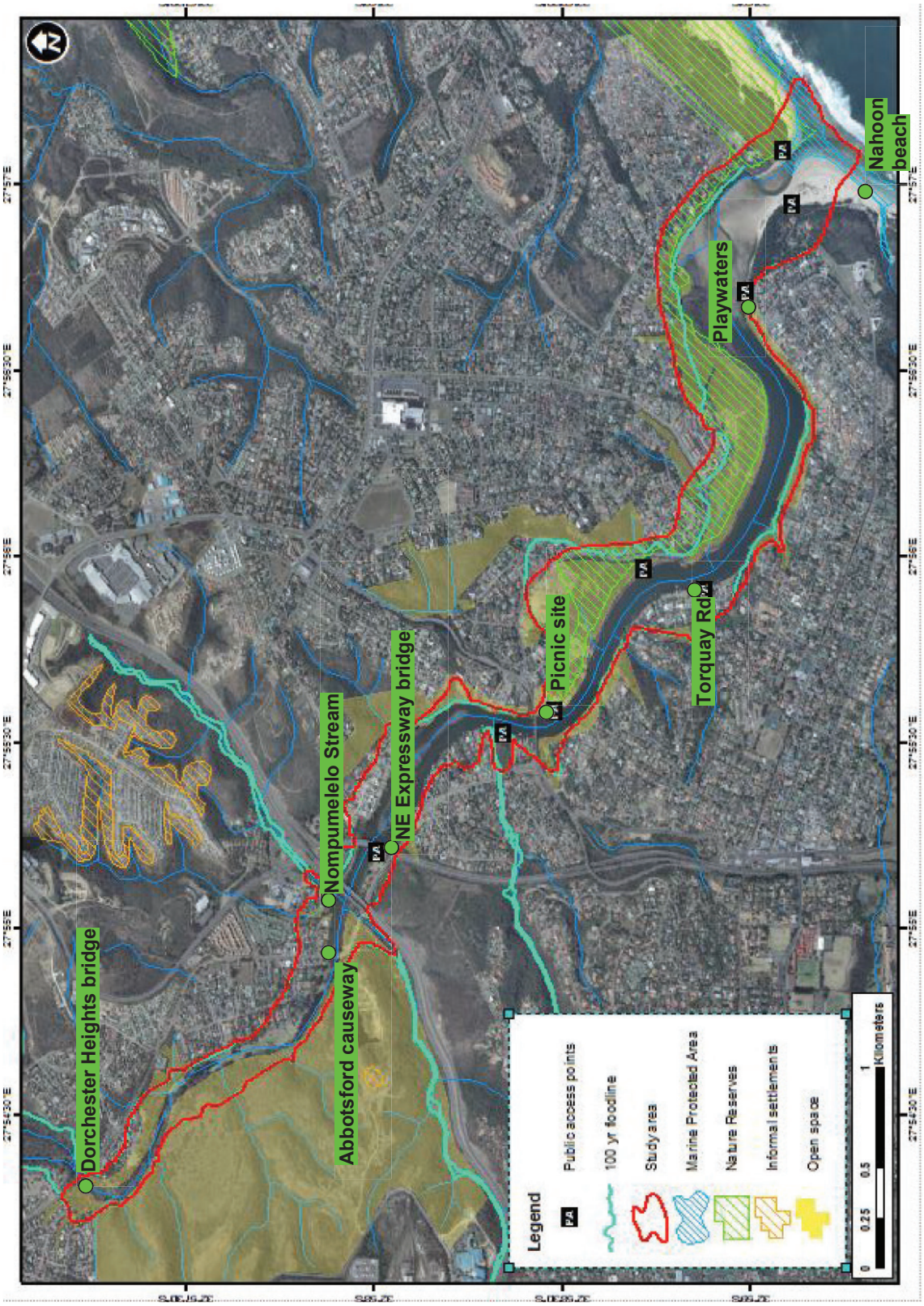


FIGURE 14: Land use and facilities within the estuarine functional zone

4.5 Value of the Estuary to the Community and the Economy

The concept of ecosystem services has developed as a means of expressing the value of natural systems to human wellbeing. An ecosystem service is a product or characteristic from nature that is of value to human wellbeing. Seen in the broadest sense, natural systems are essential to sustaining and fulfilling human life. Four categories of ecosystem services have been identified and the associated ecosystem services ascribed to estuaries within each of these categories is shown in Table 10 below. This information has been derived from an undated report by the Water Research Commission (WRC) on estuarine ecosystem services and from the chapter on the subject in the NBA (van Niekerk *et.al.*, 2011b).

TABLE 10: Typical ecosystem services associated with estuaries

TYPE / CATEGORY	DESCRIPTION
Provisioning Services (Goods)	• Water for subsistence and agricultural use (applicable in fresher / upper reaches) • Plants and animals directly utilised by people. These uses include: – Food (e.g. fish, crustaceans) – Raw materials for craftwork or building materials (poles, building fibres) – Medicinal plants – Ornamental plants (propogated for landscaping)
Regulatory Services	• Climate change (e.g. carbon) • Climate regulation (e.g. moderating temperature extremes) • Soil stability / erosion prevention (vegetation cover) • Sediment supply / conduit (sediment from inland rivers maintains beaches) • Disease control (e.g. assimilation of bacteria by diatoms) • Flood attenuation / storm damage control (floodplain and vegetation) • Ecological regulation / pest control (indigenous natural species) • Fire damage control (serves as natural firebreak)
Supporting Services	• Nurseries and refugia (e.g. nursery areas, habitat for migratory fish and birds) • Waste assimilation (e.g. aquatic plants take up of excess nutrients) • Waste dilution, especially where flushing if facilitated (open estuary mouth) • Genetic resources (e.g. use in medicine, genes for resistence to plant pathogens) • Export of materials and nutients to marine ecosystems.
Cultural services	• Sense of place • Place of cultural or religious value • Cultural heritage / landscapes of heritage significance • Research and knowledge generation potential • Marketing icons (e.g. promotion of coastal towns) • Recreation amenity – active and passive • Tourism amenity / resource.

Whilst some of these ecosystem services have benefits for individuals (e.g. fishing), many of them can be regarded as public goods that benefit to the broader community (e.g. flood attentuation, fish nurseries). The provision of the ecosystem services listed in Table 8 is dependent on the ecological state and functioning of the estuary. If an estuary is degraded, this would limit the associated benefits. For example, if water quality within the estuary becomes so degraded as to effect its ecological functioning, the cleaning ability of aquatic plants would be reduced and a potential human health hazard would result. This in turn would adversely affect the amenity value and tourism potential of the area.

As well as being of value in terms of human wellbeing, estuaries are also important from an economic perspective. Turpie and Clarke (2007) conducted a study on the contribution of estuaries to the national economy. All of South Africa's temperate estuaries were considered in this study. The study was aimed at obtaining a rough first estimate of all the different types of value associated with each estuary. Various

types of value were considered, namely recreational, subsistence, indirect contribution to established economic sectors[5] and existence value[6]. These value measures are linked to estuarine ecosysem services.

The value of the Nahoon Estuary was estimated as follows:

- *Recreational value*: 10-20 million rand/year
- *Subsistence value*: 0.05-0.1 million rand/year
- *Nursery value*: 1-5 million rand/year
- *Existence value*: Medium.

The Turpie and Clarke (2007) study also established the minimum management class, which denotes the future state of health of the estuary. These classes range from A (near natural) to D (functional). The Nahoon Estuary is categorised as a D Management Class estuary. This means that in order for the estuary to continue to provide economic value and benefits, it needs to be maintained in a functional state, at a minimum.

[5] This is measured as tourism value and nursery value. The latter is a measure of the direct use of fish within estuaries and the role of estuaries as a nursery area for inshore marine fisheries.

[6] Existence value is the value of simply knowing that an estuary and its biodiversity are protected

5 LEGAL AND INSTITUTIONAL ISSUES

The review of information relating to legal and institutional matters fromed an important element of the situation assessment phase of the project. Policy and legilsation are important considerations as these set the framework within which the EMP must be developed. Implementation of the EMP is contingent on effective institutional arrangements and thus the current situation in this respect was investigated.

5.1 Legal and institutional context

The policy and legislative framework for estuary management in South Africa is well developed. Its foundation lies in our Constitution[7] which guarantees the right to an environment that is not harmful to human health and well-being and that is "*protected, for the benefit of its present and future generations"*. National and provincial policy and legislation on estuaries is further determined by several international conventions such as the Convention on Wetlands of International Importance especially as Wetland Habitat, the Convention on the Conservation of Migratory Species and the Convention on Biological Diversity. These conventions place international obligations on Government to, among others, ensure the conservation and wise use of coastal and estuarine species and ecosystems. A host of policy frameworks and laws have been introduced at national and provincial level to comply with the Constitution obligations and meet objectives set in international conventions. Key national laws governing the management, protection and use of estuaries are the National Environmental Management: Integrated Coastal Management Act, 24 of 2008 (ICMA) and the National Water Act, 36 of 1998 (NWA). The primary provincial legislation is the Nature Conservation Ordinance, 19 of 1974 and at municipal level the use of the Nahoon Estuary is regulated through the Municipal By-laws for the Control of Boats on all Rivers within the Areas of Jurisdiction of the East London Transitional Council, 2000 (Control of Boats By-laws).

This section of our report builds on the Cape Action for People and the Environment (C.A.P.E.) Estuaries Guideline: legislation pertaining to Management of Environmental Threats within Estuaries and provides a brief overview of the key legislation governing the management, use and protection of the Nahoon Estuary and organs of state responsible for enforcing these laws. This Guideline forms part of the C.A.P.E. Generic Estuarine Management Plan which the Council for CSIR prepared for the C.A.P.E. Estuaries Programme in 2007. Since then various changes have taken place in the policy and legislative environment. In accordance with our terms of reference we reviewed the 2007 legislation guideline and have prepared a revised and updated legislative review which is provided in Appendix C to this report. In the paragraphs below the key legal instruments at national, provincial and municipal level that pertain to the Nahoon Estuary are highlighted.

5.1.1 National legislative framework

ICMA establishes an integrated system for managing and conserving the coastal and estuarine environments. The Act establishes management norms and standards; defines rights and duties and determines the responsibilities of organs of state in relation to coastal areas; it controls pollution in the coastal zone and inappropriate development of the coastal environment; and gives effect to relevant international obligations. The national Department of Environment Affairs (DEA) published a Draft National Estuary Management Protocol in terms of Section 53 of this Act in May 2012. This protocol provides a guideline for developing estuarine management plans and clarifies the process and content requirements of developing and implementing such plans. The National Environmental Management Act

[7] Constitution of the republic of South Africa, Act 108 of 1996

(NEMA), 107 of 1998, provides a framework for cooperative environmental governance by establishing national environmental management principles that apply to the actions of all organs of state that may significantly affect the environment.[8] NEMA also imposes a general duty of care and remediation of environmental damage on everyone that causes pollution or degradation of the environment.[9] Water quality and quantity is regulated by the NWA. This Act includes provisions to ensure that national water resources are protected, used, developed, conserved, managed and controlled appropriately.

5.1.2 Nature Conservation Ordinance, 19 of 1974

The Ordinance provides for the establishment of provincial, local and private nature reserves and related conservation measures. This includes the protection of flora, wild animals and fish in inland waters and the requirement that, subject to various conditions and some exemptions, a permit is generally required to catch fish and for the sale or purchase of bait species.

5.1.3 Municipal By-laws for the Control of Boats

This by-law regulates the registration and operation or use of vessels; the setting aside of bathing areas; the restriction of certain activities on the river and right to reserve admission of persons causing a public nuisance or under the influence of alcohol; and prescribes measures to prevent the pollution of a river.

5.2 Alignment with policy frameworks

Buffalo City Metropolitan Municipality (BCM)'s Integrated Development Plan (IDP) for 2012/13 IDP includes a table indicating high level alignment between the IDP with the Millennium Development Goals, National Spatial Development Perspective, Provincial Growth and Development Plan, and Government's 12 Delivery Outcomes.[10] To ensure alignment with Outcome 10: *Protection and enhancement of environmental assets and natural resources*, the IDP includes the following target: *To enhance and protect all environmental assets and natural resources within Buffalo City Metropolitan Municipality by 2016*.

The IDP contains a high level Integrated Environmental Management Plan as one of its sector plans. This sector plan commits the City to embracing sustainable development principles and accepting integrated environmental management as the cornerstone of all development.[11] The IDP further includes specific reference to the implementation of integrated environmental and coastal management plans as one of the strategies to achieve the strategic objective "*ensure safe and healthy environment"*. The IDP does not clarify whether this specifically includes the development and implementation of the Nahoon Estuary Management Plan as it merely refers to the DEA funded "Working for Coasts Canon Rocks to Great Kei" Project. There also does not appear to be any provision made for the EMP under Section E Budget, Programmes & Projects in the IDP.
Other sector plans which are of relevance are:

- The 2005 ICZMP in which existing environmental pressures are identified and prioritised and specific management recommendations provided to deal with these pressures. It also sets out a framework for improved management of the BCM coastline.
- The 2003 Tourism Master Plan which provides a framework for tourism development. This plan points to the importance of providing amenities and facilities that are secure. The development of a

[8] Section 2
[9] Section 28
[10] BCMM IDP 2012/13, p15
[11] BCMM IDP 2012/13, p230

"low-impact" high-value tourism concept that does not compete with the environmental richness of the area is recognised, specifically in regard to the Nahoon area.

5.3 Institutional arrangements and cooperative governance

Since estuaries are positioned on the boundary between freshwater, terrestrial and marine environments, their management of estuaries requires cooperation from a range of national, provincial and local government agencies each with their own legislative mandate. The key role players responsible for managing and protecting the Nahoon Estuary and regulating its use are the BCM, the Eastern Cape Department of Economic Development, Environmental Affairs and Tourism (DEDEAT), Amatola Water and the regional office of the national Department of Water Affairs.

Within the BCM, the responsibility for various aspects of the Nahoon Estuary is fragmented and there is no dedicated structure responsible for ensuring coordinated action, monitoring and reporting the communication and sharing of information or resources. For example, the management and control of the use of the estuary falls under the Directorate Community Services, and specifically the Amenities and Environmental Services Department and Integrated Environmental Management Unit (IEMP). The Environmental Services division's key functions include the maintenance and hiring of public open space for community functions; and bush clearing and eradication of alien plants and noxious weeds. Marine and coastal management services, including the 68 km of coastline, estuaries, and sandy beaches, however, are the responsibility of the Amenities division. This division is also responsible for enforcing the Control of Boats By-laws and managing the Nahoon Point and Nahoon Estuary Nature Reserves and Footprint Environmental Education Centre at Nahoon Point. Both Reserves are managed by a Management Committee, in the case of the Nahoon Estuary reserve this comprises of private landowners and residents and representatives of the BCM. The Nahoon Estuary Reserve Committee is managed in terms of a Memorandum of Agreement between the landowners/residents and BCM. Both Reserves are funded through the Buffalo City Environmental Trust.

The Directorate Community Services includes the Department Solid Waste Management Services which is responsible for maintaining public conveniences and solid waste removal, including from public amenities and public open spaces. Land use and development planning is the responsibility of the Department Development Planning, in the Directorate Development Planning and Local Economic Development. The Directorate Engineering Services' Department of Water and Scientific Services is responsible for the provision of potable water; management and control of water, waste water operations and services; purification and treatment of potable and waste water; acquisition, storage and distribution of water and the collection of waste water; and scientific services. In addition to their respective line function responsibilities and delivering services, these Directorates and Departments are responsible for sector planning at a strategic level and providing sector objectives for the BCM's IDP.

DEDEAT's mandate includes biodiversity conservation, coastal zone management, the implementation and administration of the NEMA EIA Regulations, compliance and enforcement of environmental legislation and developing a provincial climate change strategy.

The national Department of Water Affairs is the custodian of the country's water resources and exercise oversight in respect of water quality and quantity provided by local authorities. Amatola Water is a state-owned, non-profit making business enterprise created to provide bulk water services to municipalities within its area of jurisdiction. It is accountable to the Minister of Water and Environmental Affairs and its core business is to assist municipalities in the effective development and sustainable operation and maintenance of safe, reliable water supply and waste water services.

Intergovernmental relations, cooperative governance, coordinated action in implementing policy frameworks and legislation, sharing resources and information and the resolution of intergovernmental disputes are governed by Section 41 of the Constitution, Section 4 of the Intergovernmental Relations Framework Act, 13 of 2005, and Section 3 of the Municipal Systems Act, 33 of 2000. Despite these obligations and imperatives, and a general recognition of the importance of cooperating within all affected organs of state, coordination between the responsible organs of state is weak and there is a dearth of effective and functioning cooperative governance structures in the jurisdictional area of the BCM. Intergovernmental structures, such as a Provincial Coastal Committee (PCC) and Intergovernmental Relations Forums have been established but have either ceased to exist or become non-functional. The newly appointed Manager: Coastal Zone Management in DEDEAT has been tasked with setting up a coastal committee for the Province. Law enforcement is coordinated provincially through the Provincial Environmental Crimes Working Group which comprises of provincial and national department and public entity representatives but excludes local government representation. No internal coordinating structures exist within BCMM and communication and cooperation between it and other organs of state are ad hoc, reactive and incident based, such as the combined enforcement action along the Nahoon River in June 2010 involving DEA, DEDEAT and the BCM initiated by DEDEAT.

PART II: Management Plan

6 CONTEXT FOR THE MANAGEMENT PLAN

The context for the EMP is determined by the following:

- The attributes of the estuary.
- The concerns, pressures and trends in relation to the esturine system.
- The legal / policy framework.

6.1 Overview of the State of the Nahoon Estuary

An overview of the key issues, concerns, attributes and trends is provided so as to provide a picture of the current state of the estuary. It is evident from the Situation Assessment that the Nahoon Estuary is subject to several pressures as a result of its location in an urban environment. There is insufficient scientific information to enable a comprehensive evaluation or in-depth analysis of the impacts of human activities on the ecological functioning of the estuary.

The Nahoon Estuary is regarded as a beautiful and valuable natural asset, rich in biodiversity, and valued by the local community as a recreational resource. It is also considered to be a desirable residentail location. Recreational and development demands place pressure on the physical and biotic components making up this estuarine system. Consequently, the Eastern Cape DEDEAT has identified this as a priority estuary and this factor served as the trigger for developing an Estuary Management Plan. Although considered as medium conservation value and an estuarine health index status of fair, the Nahoon is regarded as being a high priority estuary in terms of the need for rehabilitation.

6.1.1 Attributes and value

This section deals with the features or attributes that are valued by stakeholders and that are recognised as being of importance in published documents / reports.

Biodiversity:

- Due to its location in a transitional zone between temperate and sub-tropical areas the estiuary is characterised by high biodiversity.
- The estuary provides a nursery ground for marine fish (although there are no statistics in this regard). The mouth falls within the recently declared Amatola Marine Protected Area, which should assist in the conservation of fish species.
- Dune forests occur in the area which include red and white milkwoods and are thus of biodiversity significance. In addition, the dune forest communities are close to their distribution limits (biogeographic importance).
- The area is rich in bird life, and is thus popular for birding.

Socio-economic:

- The estuary is regarded as a valuable natural asset to the city. It contributes to sense of place.
- The estuary is an important recreational resource and tourism asset.
- Although limited, the estuary serves as a source of food through fishing.

In a study undertaken by Turpie and Clark (2007) the Nahoon Estuary was ranked 64th of the 258 estuaries considered based on size, habitat importance, zonal type rarity and biodiversity importance. The economic value of the estuary is discussed in Section 4.5 and ranges between R11 million and R25 million per annum.

6.1.2 Concerns, Pressures and Trends

The issues, pressures and trends relate to the estuarine conditions (physical and biological) and to management-related / institutional concerns.

Estuarine functional zone:

Key concerns, pressures and trends related to the estuarine functional zone are as follows:

- Deterioration in water quality, with pollution by sewage being a particular concern. Stakeholders regard the water quality situation as posing a health hazard and as a constraint on passive recreational activities such as swimming. The poor condition of municipal sewage infrastructure as well as runoff from unserviced informal settlements are considered to be the major contributors to this problem. Pump stations and sewer lines close to and/or alongside the estuary are particularly problematic; residents report regular incidents of sewerage overflows from this infrastructure. A number of stakeholders also mentioned that there are often overflows due to blockages and to large volumes of stormwater runoff entering the sewer system.

- Water quantity / volume or flow within the estuary is an issue, particularly in terms of ensuring that the environmental (ecological) reserve is determined and adequate flow in this respect maintained. The ecological reserve for the river has not been determined, other than at a preliminary (intermediate) level. Of particular concern is the effect of the Nahoon Dam on river flow. This dam does not have sluice gates but it does have a release valve. Notwithstanding, there does not appear to be consideration of ecological factors in managing releases from the dam. Furthermore, the lack of sluice gates means that there is a limited ability for flood control. The reduction of freshwater input into the estuary was also raised as a concern. In addition, the Abbotsford Causeway limits the extent of tidal intrusion.

- The spread of alien invasive species, particularly from both a terrestrial environment perspective. This is also a consideration in respect of the estuarine environment.

- Changes in bank structure, flow dynamics and ecological habitats due to human activities is a concern. This includes trampling at picnic sites and for bait collection, which is reportedly caused bank erosion / collapse. The construction of hard structures such as jetties and slipways and the implementation of bank stabilisation is also reported to have affected the bank structure and estuarine habitats. The extent of these changes or impacts is not known and has not been assessed.

- Protection of the estuarine environment is regarded as inadequate. Important habitats on the West banks of the river are currently not protected by law and the BCM has not allocated budget or adequate human resources to managing the two reserves that are in place. Loss of biodiversity has been suggested by some stakeholders, but there is insufficient evidence to support or negate these claims. The ongoing expansion of introduced mangroves is a potential concern in that this may pose a risk to the salt marsh areas, resulting in a reduction in this habitat type.

- The functioning of the estuary has been negatively affected by a reduction in freshwater inflows, which in turn has resulted in changes in the biotic component of the estuary. There has also been a significant loss of biodiversity, primarly due to the development of land for residential purposes.

These issues were noted by various stakeholders in meetings held for the purposes of this study. Issues requiring attention have also been documented in the literature (e.g. Turpie and Clarke (2007); BCM's water services sector plan (which forms part of the IDP) and the 2011 National Biodiversity Assessment

– Estuary Component (Volume 3)). Isues identified as requiring management attention include water quality both in terms of pollution and silt levels, alien species control and inappropriate bank stabilisation. Similarly, in the National Biodiversity Assessment (van Niekerk *et. al*., 2011b), water quality is identified as being a factor that places pressure on the Nahoon Estuary in terms of its functioning. In the ICZMP developed by Coastal and Environment Services (2005) it is noted that there has been significant loss of habitat in the Nahoon Estuary related to residential and tourim development, jetties, slipways, pollution and trampling.

A further issue that needs to be considered in terms of the pressures on estuarine systems is that of climate change. According to the National Biodiversity Assessment climate change pressures on include flow modification, sea-level rise and increased temperatures and coastal storminess. As a result changes in physical processes and biological responses can be expected, which in turn could adversely affect the ecosystem services provided by estuaries. Subtropical and cool temperate estuaries are likely to be most effected from a structural and functional perspective. Warm Temperate estuaries (the biogeographic zone into which the Nahoon Estuary falls) are predicted to be most vulnerable to temperature regime shifts. This will result is changes in the spatial range / extent of species (extensions/contractions) and in community composition changes (van Niekerk *et.al*., 2011d).

Institutional capacity and arrangements:

A key concern that emerged during discussion with stakeholders was that of institutional capacity. In general stakeholders expressed a lack of confidence and trust in BCM's capacity and ability to manage the estuary and enforce compliance with management guidelines and legal requirements. Many concerns were also raised about the lack of cooperation and coordinated action between the responsible organs of state in all spheres of government. Stakeholders identified the following key legal and institutional issues and pressures in respect of managing the Nahoon Estuary:

Coordination and cooperation issues	• lack of cooperative governance structures in the Province and poor cooperation between organs of state (mostly reactive and ad hoc)
	• lack of coordination between authorities in enforcing compliance with legislative requirements
	• no mechanism exists for the BCM and Eastern Cape Parks and Tourism Agency to cooperate, communicate and share information regarding protected areas (Nahoon Estuary and Point Nature Reserves and Nahoon Point to Gonubie Point Marine Protected Area)
	• lack of intergovernmental coordination and poor responses from organs of state makes it difficult for public interest groups and residents to cooperate with the authorities
	• BCM operates in silos – communication between directorates, departments and divisions is poor to non-existent, and consequently service delivery is uncoordinated
Institutional issues	• concerns about who will be responsible for implementing the EMP and whether it will be legally enforceable or not
	• lack of confidence in BCM's ability to manage the estuary and regulate activities and development along the estuary as envisaged under ICMA
	• concerns about lack of budget for protecting the estuary and managing the reserves on both sides of the estuary
	• low priority allocated to environmental management and protection by BCM – evident in the lack of clear objectives and targets in the IDP and inadequate budget allocation to these functions
	• concerns were also expressed about a lack of response from DEDEAT to reports of illegal activities/environmental transgressions

	• concerns that BCM lacks accountability when it comes to responding to calls to improve the management of the estuary
	• poor communication and information sharing between authorities, and between BCM and residents
Compliance enforcement and monitoring issues	• approach to controlling development along the river banks and enforcing compliance with environmental legislation is inconsistent; and there is no enforcement along the mud flats. This exacerbates any attempts to enforce compliance along the estuary and furthermore exposes the relevant authorities to the risk of potential litigation by individuals who feel they have been treated unfairly and/or unreasonably further
	• BCM approves building plans (along the Nahoon River) but fails to inform owners that they also need to comply with environmental legislation
	• no guidelines regarding acceptable norms for jetties, slipways, boardwalks and bank stabilisation
	• lack of clarity as to what development can take place within the 100m flood line – no set back line determined yet
	• incidents of illegal poaching (bait and perlemoen) but no regular enforcement activities
	• illegal squatters and vagrants in bushy areas are also not evicted on a regular basis
	• lack of regular, visible enforcement of illegal uses on the river, public nuisances and compliance monitoring of illegal structures along the river banks
	• illegal encroachment onto public land and public open space
Capacity issues	• capacity within BCM to perform the functions and provide the services described above is severely limited and many posts are vacant. Generally stakeholders were of the opinion that BCM was hopelessly under-staffed.
	• BCM does not have any peace officers or Environmental Management Inspectors yet are expected to enforce environmental contraventions & assist SAMSA with enforcing boat safety

6.2 Relevant legislative principles

The legislative principles which govern this EMP and dictate institutional arrangements, plus the manner in which certain management actions should be taken, are found in the Constitution, NEMA, ICMA and NEMPAA and include the following key principles:

- The national and provincial governments must support and strengthen the capacity of the BCM to manage the estuary and exercise its powers and performs its functions in this regard;[12]

- The estuary must be managed cooperatively and in a coordinated and efficient manner. This includes cooperation between all relevant organs of state across all spheres of government and engagement with civil society and private sector;[13]

- Alignment with higher order plans[14] such as the provincial environmental management plan[15], the municipal, provincial and national coastal management plans[16] and the national and provincial protected area expansion plans[17]. To ensure compliance with this principle, the relevant Coastal Committee should evaluate the Nahoon Estuary Management Plan on an on-going basis to ensure alignment with priorities identified in newly introduced higher order plans;

[12] Constitution of the Republic of South Africa, Act 1 of 1996, s154(1) and s155(6)
[13] Chapter 3 of the Constitution places an obligation on all spheres of government to observe and adhere to the principles that relate to co-operative governance and to conduct their activities within the parameters provided in that Chapter. This obligation is also catered for in paragraph 3.2.3 of the Draft National Estuarine Management Protocol, 4 May 2012,
[14] National Estuarine Management Protocol, 4 May 2013, paragraph 6
15 In terms of NEMA s11,
16 In terms of ICMA, s?
17 In terms of NEMPAA, s?

- DEDEAT must monitor implementation of the Nahoon EMP and ensure that it is "undertaken in an integrated, effective and efficient manner and in accordance with the objectives of ICMA",[18]

- Every person who causes or may cause significant pollution or degradation of the estuary is responsible for taking reasonable measures to prevent such pollution and degradation from occurring or, in so far as such harm to the environment is authorised by law or cannot be reasonably avoided or stopped, to minimise and rectify the damage to the estuary;[19]

- The Nahoon EMP must be published in the Provincial Government Gazette to provide it with legal status;[20]

In addition to the above principles, various of the national environmental management principles in Chapter 2 of NEMA are pertinent to the implementation of the Nahoon EMP.[21] These are:

- Sustainable development requires that:
  - the disturbance of ecosystems and loss of biological diversity be avoided or where they cannot be avoided, be minimised and remedied;
  - pollution and degradation of the environment are avoided, or, where they cannot be altogether avoided, are minimized and remedied;
  - the development, use and exploitation of renewable resources and the ecosystems of which they are part do not exceed the level beyond which their integrity is jeopardized; and
  - negative impacts on the environment and on people's environmental rights be anticipated and prevented, and where they cannot be altogether prevented, are minimised and remedied.

- Environmental management must be integrated, acknowledging that all elements of the environment are linked and interrelated, and it must take into account the effects of decisions on all aspects of the environment by pursuing the selection of the best practicable environmental option.

- Responsibility for the environmental health and safety consequences of a policy, programme, project, product, process, service or activity exists throughout its life cycle.

- The participation of all interested and affected parties in environmental governance must be promoted, and all people must have the opportunity to develop the understanding, skills and capacity necessary for achieving equitable and effective participation, and participation by vulnerable and disadvantaged persons must be ensured.

- The social, economic and environmental impacts of activities, including disadvantages and benefits, must be considered, assessed and evaluated, and decisions must be appropriate in the light of such consideration and assessment.

- The environment is held in public trust for the people, the beneficial use of environmental resources must serve the public interest and the environment must be protected as the people's common heritage.

18 ICMA, s 38 (b)
19 In terms of NEMA, s28
20 In terms of ICMA, s?
21 NEMA, s2(4)

- The costs of remedying pollution, environmental degradation and consequent adverse health effects and of preventing, controlling or minimising further pollution, environmental damage or adverse health affects must be paid for by those responsible for harming the environment.

- Sensitive, vulnerable, highly dynamic or stressed ecosystems, such as coastal shores, estuaries, wetlands, and similar systems require specific attention in management and planning procedures, especially where they are subject to significant human resource usage and development pressure.

7 PROPOSED VISION AND OBJECTIVES

7.1 Vision

A vision should be future-orientated and reflect the "desired state" of the estuary. It should be aspirational in nature. The vision provides a departure point for determining objectives. Stated differently, objectives should be set with the vision in mind. They provide more detail to the vision and are centred on what needs to be achieved in order to realise the vision. With this context in mind, the following vision is proposed for the Nahoon Estuary.

Vision statement

An ecologically healthy estuary that the citizens of and visitors to East London can access to enjoy and use in a responsible manner, that does not compromise its social, aesthetic and environmental integrity.

7.2 Management objectives

- *Institutional arrangements and co-ordination*: Ensure cooperation between the responsible organs of state, clarification of roles and responsibilities, and coordinated management actions to secure commitment from the lead agency – the Buffalo City Municipality – to implement the EMP.
- *Protection status of the estuarine environment*: Ensure effective protection and conservation of the estuary.
- *Ecological functioning and health of the estuary*: Restore ecological functioning and conservation value of the estuary (elevate to Management Class B).
- *Water quality*: Ensure that water quality does not pose a threat to human health and wellbeing or to estuarine ecology and functioning.
- *Recreation and resource use*: Ensure that the recreational use of the estuarine area is a high quality experience, offers a diverse range of opportunities, is appropriate to the ecological functioning of the system and does not compromise the safety and rights of any person.
- *Communication, education and awareness raising*: Create a supportive environment for implementation of the EMP through improved communication, education and awareness-raising.
- *Land use and development*: Ensure that development in areas adjacent to the estuary and in the catchment is undertaken in a manner that does not impact on the functioning of the estuary or compromise the rights of other users.
- *Research and ongoing information gathering*: improve understanding of the ecological functioning of the estuary as a basis for management.
- *Institutional capacity and resources*: Build institutional capacity and resources to ensure effective implementation of the EMP.
- *Compliance and enforcement*: Strengthen compliance monitoring and ensure effective enforcement of regulations pertaining to activities in and around the estuary.
- *Monitoring and evaluation*: Ensure effective implementation of the EMP

8 THE ACTION PLAN

It is noted in the National Estuary Biodiversity Plan (Turpie *et.al.*, 2011) that estuaries are by nature resilient systems, because their fauna and flora are adapted to living in conditions of extreme change. To adequately protect an estuary, it needs to be in a formal protected area with effective no-take zonation, and its freshwater requirements must be guaranteed. Ecosystem threat status is one of the two headline indicators reported on in the NBA. Ecosystem protection level indicates the extent to which ecosystems are protected, based on the proportion of each ecosystem's biodiversity target that is met in formal protected areas recognised by the Protected Areas Act or Marine Living Resources Act. For these calculations, targets for protection were set at 20% of theestuarine habitat area of each ecosystem type. Ecosystem protection level is divided into four categories: well protected, moderately protected, poorly protected and not protected.

8.1 Zonation Plan

A zonation plan for the Nahoon Estuary has been developed and a large print copy is included in the sleeve at the back of the report.

The zonation plan has been updated using as a basis the maps developed by Morris (1986 – post-grad thesis) and the SRK (1992) study, whilst taking into account observations made from the recent investigations and public feedback. It covers the following aspects:

- Recreational – picnic, footpaths, high speed boating (skiing), fishing, canoeing, etc
- Public access points
- Protected areas

The zonation plan should not be seen as 'cast-in-stone'. Rather it is a dynamic 'spatial vision' that may need to be amended as recreational patterns and demands (desires) change. It is also not the 'exact plan' that should materialize as the need for additional picnic areas in certain parts fo the estuary still needs to be assessed. Similarly, the practical and land onwership issues around a possible walking trail between the Dorchester Heights area and the Abbotsford causeway requires assessment.

8.2 Implementation Plan and Tasks

The objective of this Estuary Management Plan is to present management strategies and actions aimed at addressing issues and concerns that have been identified during the Phase I Situation Assessment. These are intended to be implemented over the period July 2013 – June 2018 and are outlined in this section. Based on the Situation Assessment and the pressures, trends and opportunities identified, the following elements have been identified as requiring attention within the 5-year timeframe to which the EMP is applicable (2013-2018):

1. *Institutional arrangements and co-ordination*, which covers mechanisms and structures required to facilitate the implementation of the EMP. The monitoring and evaluation requirements that need to be undertaken by implementing authorities is dealt with as a separare item.

2. *Protection status of the estuarine environment*, which covers the process and legislative mechanisms to improve the level of protection of the estuary. As noted in Section 4.2.7, although the Nahoon Estuary has not been listed among those estuaries requiring protection to achieve national conservation targets, it is nonetheless of high conservation importance in the local context. Protection of the estuary is also important in the context of the MPA, which includes the mouth.

3. *Ecological functioning and health of the estuary*, which covers issues that need to be addressed to ensure that the ecological functioning of the estuary is maintained and that the health status / ecological management class of the estuary improves from Class C to B, an objective highlighted in the DWAF 2001 RDM study and which has been acknowledged in the National Estuary Biodivesity Plan (Turpie, *et.al.*, 2012).

4. *Water quality*, which deals with issues related to the need to manage water quality risks. This issue clearly has a bearing on the health status and ecological functioning of the estuary. Water quality has been identified as a significant issue that is having an adverse impact on the estuary. It is therefore dealt with separately, due to its priority.

5. *Recreation and resource use*, which deals with what is needed to better understand recreational and resource use patterns, as well as requirements for managing activities and facilities.

6. *Communication, education and awareness raising*, which deals with interaction with stakeholders and the public in general in terms of awareness raising, reporting on progress and on environmental conditions (i.e. performance – improving trends or not), and environmental education activities.

7. *Land use and development*, which deals with the control of land use and development within the estuarine functional zone.

8. *Research and ongoing information gathering*, which deals with information needed to obtain a better understanding of the ecology of the estuary, the resource and recreational use patterns in the estuarine functional and the impacts of human activities on the estuary.

9. *Institutional capacity and resources*, which covers the resources and capacity required to provide for effective management of the estuary and implementation of this EMP.

10. *Compliance and enforcement*, which covers issues relating to

11. *Monitoring and evaluation*, which deals with tracking of progress in implementing the EMP as well as evaluation of the effectiveness of the EMP.

A series of tables have been developed to cover these elements. The tables provide the following details:

- A problem statement.
- The required actions to address the problem in the context of the management objective.
- The (recommended) responsible party for each action item.
- The proposed time-frame for implementation.
- The indicators of success.

Many of the management actions will be ongoing. Typically it will be necessary to establish the system (e.g. monitoring system) or mechanism (e.g. by-law, strategy, plan). The timeframe proposed in the Action plan tables represent the target date for completion of the system or mechanism that needs to be in place to facilitate the ongoing implementation of these actions.

ISSUE: INSTITUTIONAL ARRANGEMENTS AND COORDINATION				
MANAGEMENT OBJECTIVE: Ensure cooperation between the responsible organs of state, clarification of roles and responsibilities, and coordinated management actions				
PROBLEM STATEMENT	**INTERVENTION/ACTION**	**BY WHOM**	**BY WHEN**	**INDICATOR OF SUCCESS**
Lack of cooperative governance structures in the Province and poor cooperation between organs of state in all three spheres of government (mostly reactive and ad hoc) and lack of coordination between authorities in enforcing compliance with legislative requirements	Establish a inter-governmental Special Committee (IGSC) to oversee the implementation of this EMP. Relevant departments and agencies from the 3 spheres of government must be represented on this Committee. The Special Committee would be responsible for establishing Technical Task Teams to assist with the implementation of specific tasks and priorities. This IGSC should serve under the either BCM Coastal Committee as envisaged in ICMA or Provincial Coastal Committee in order to give it greater statutory standing as opposed to if it were to be located outside of these legilsated structures.	DEDEAT / BCM	June 2014	Inter-governmental Special Committee (IGSC) established, members appointed and at least first meeting held.
Concerns about who will be responsible for implementing the EMP, its legal status and whether the implementing authority will be able to enforce it	Clarify roles and responsibilities of other affected organs of states in respect of proposed management actions in the EMP and communicate BCM's role as lead agent responsible for the day-to-day implementation of the EMP to other organs of state.	IGSC	September 2014	Organs of state's roles and responsibilities clarified and BCM's status as lead agent responsible for EMP implementation communicated. Organs of state take coordinated action and cooperate in implementing interventions identified in the EMP action tables
	Obtain the MEC's approval for the EMP	DEDEAT	June 2014	EMP approved by MEC
	Ensure the approved EMP is formally adopted by the BCM and signed by the Executive Mayor	BCM	December 2014	BCM Council Resolution adopting EMP EMP signed by Executive Mayor within a month of adoption by MEC.
BCM operates in silos – communication between directorates, departments and divisions is poor to non-existent, and consequently service delivery is uncoordinated.	Establish internal communication and information sharing mechanism within the BCM – "Steering Committee"	BCM	June 2014 ongoing	Monthly inter-departmental meetings held in BCM and actions recorded in the Minutes of Meetings are implemented by due dates

ISSUE: INSTITUTIONAL ARRANGEMENTS AND COORDINATION				
MANAGEMENT OBJECTIVE: Ensure cooperation between the responsible organs of state, clarification of roles and responsibilities, and coordinated management actions				
PROBLEM STATEMENT	**INTERVENTION/ACTION**	**BY WHOM**	**BY WHEN**	**INDICATOR OF SUCCESS**
ISSUE: PROTECTION STATUS OF THE ESTUARINE ENVIRONMENT				
MANAGEMENT OBJECTIVE: Ensure the effective protection and conservation of the estuary				
PROBLEM STATEMENT	**INTERVENTION/ACTION**	**BY WHOM**	**BY WHEN**	**INDICATOR OF SUCCESS**
Inadequate protection of the estuarine environment – important habitats on the West banks of the river are currently not protected by law. The two small reserves (Nahoon River and Nahoon Point Nature Reserves) should be consolidated into a single protected area and expanded to include other adjacent sensitive habitats and ecosystems that provide proper biodiversity corridors and ensure sustainable ecosystem functioning.	Strengthen the protection of the Nahoon River and Nahoon Point Nature Reserves. This area should include the estuarine area of interest as including areas which are undeveloped and where there is remaining natural habitat, and taking account of ecological corridors / connectivity. A "no take zone" should be defined as part of this process. The consolidated area should be declared as a local protected area in terms of the NEMPAA. This will require: • Preparation and submission motivation for consolidation and proclamation as local protected area under NEMPAA to Council for adoption. • Motivation made to National Minister / MEC declare consolidated area as local protected area under NEMPAA	DEDEAT / BCM	December 2014 March 2014 June 2014	Nahoon River and Nahoon Point Nature Reserves consolidated and proclaimed as local protected areas under NEMPAA within 12 months of the adoption of the EMP. Council resolution adopted to consolidate and proclaim as local protected area under NEMPAA. Motivation submitted to the National Minister / MEC together with the above-mentioned Council resolution.
BCM has not allocated budget or adequate human resources to managing the two reserves	Allocate adequate funds to manage the two reserves, and where assistance required make special request to DEDEAT / DEA	BCM	June 2014 ongoing	Adequate recurrent budget allocated annually to manage the protected area
Currently there is no mechanism in place to facilitate cooperation and communication between BCM and Eastern Cape Parks and Tourism Agency (ECPTA). This poses a concern in light of the presence of Nature Reserves in the Nahoon Estuary area	Establish Working Group/Task Team under the IGSC that is tasked with information sharing and cooperation, coordinating management action and interventions, and ensuring priorities and conservation objectives are aligned	BCM / DEDEAT / ECPTA or IGSC	June 2014	Working Group/Task Team established and functioning

ISSUE: INSTITUTIONAL ARRANGEMENTS AND COORDINATION				
MANAGEMENT OBJECTIVE: Ensure cooperation between the responsible organs of state, clarification of roles and responsibilities, and coordinated management actions				
PROBLEM STATEMENT	**INTERVENTION/ACTION**	**BY WHOM**	**BY WHEN**	**INDICATOR OF SUCCESS**
(Nahoon Estuary and Point Nature Reserves and Nahoon Point to Gonubie Point Marine Protected Area).				

ISSUE: PROTECTION STATUS OF THE ESTUARINE ENVIRONMENT				
MANAGEMENT OBJECTIVE: Ensure the effective protection and conservation of the estuary				
PROBLEM STATEMENT	**INTERVENTION/ACTION**	**BY WHOM**	**BY WHEN**	**INDICATOR OF SUCCESS**
By definition the estuarine area is the tidal portion up to the Abbotsford causeway bridge. However, there are residential areas, namely Abbotsford and Dorchester Heights, upriver of this that have a direct bearing on the estuary's functioning.	The BCM should expand management responsibilities for the Nahoon Estuary to include the river section up to the Dorchester Heights Bridge.	BCM	March 2014	Motivation document in this regard compiled by Municipal Directorate of Planning, and is adopted. Council resolution passed whereby the estuarine area of interest is defined as extending upstream to Abbotsford and Dorchester Heights.
Monitoring of protection measures along the Nahoon River banks is sporadic and *ad hoc*	Develop and implement a long term monitoring strategy and key performance indicators to measure the effectiveness of consolidating the two reserves as a local protected area under NEMPAA in protecting the estuarine ecosystems	BCM	September 2014 ongoing	Monitoring strategy and key performance indicators adopted and implemented Regular monitoring reports submitted to BCM / DEDEAT

ISSUE: ESTUARINE HEALTH AND ECOLOGICAL FUNCTIONING				
MANAGEMENT OBJECTIVE: Restore ecological functions and conservation value (elevate to Management Class B)				
PROBLEM STATEMENT	**INTERVENTION/ACTION**	**BY WHOM**	**BY WHEN**	**INDICATOR OF SUCCESS**
Reduction in water flows due to abstraction upstream and particularly due to the Nahoon Dam resulting in: • Changes to the river-estuary interface (REI) with consequential changes to the biodiversity • In drought conditions this could potentially result in mouth closure which would also have implications for the biodiversity Only an interim / intermediate reserve determination has been undertaken.	Final Reserve Determination needs to be done (only an intermediate reserve determination was done in 2001 and even then, data was sparse so the level of confidence low).	DWA	June 2015	Comprehensive Reserve Determination completed.
	Determine a programme of water releases from the Nahoon Dam to ensure ecological functioning of the estuary and to assist in maintaining adequate water quality. Undertake salinity monitoring.	DWA BCM	December 2015 ongoing	Structure in place to facilitate ongoing liaison between BCM and catchment management authorities. Mouth stays permanently open, proper tidal cycle maintained. Freshwater inflows meet the requirements of the Reserve Determination. Salinity gradient typical of estuaries re-established Species composition reflects estuarine conditions (rather than being marine-dominated).
There is limited information on the ecological functioning of the estuary.	Establish estuarine species monitoring programme and implement via the museum and aquarium and / or the appointment of an estuarine ecologist. Maintain a database of species diversity, communities and habitats so as to increase knowledge about the ecological functioning of the estuary which in turn must be used to inform management actions.	BCM / DEDEAT	December 2014	Comprehensive species diversity and composition data base established.

ISSUE: ESTUARINE HEALTH AND ECOLOGICAL FUNCTIONING				
MANAGEMENT OBJECTIVE: Restore ecological functions and conservation value (elevate to Management Class B)				
PROBLEM STATEMENT	**INTERVENTION/ACTION**	**BY WHOM**	**BY WHEN**	**INDICATOR OF SUCCESS**
There is potential for loss of habitat, especially saltmarsh, due to expansion of the mangrove area.	A study should be undertaken to see whether and how the mangrove community should be managed to protect the salt-marsh vegetation (eg. controlled harvesting). Implement an ongoing monitoring programme of mangrove and salt-marsh coverage through aerial photography.	BCM / DEDEAT	December 2014	Study on management of mangrove and saltnarsh areas completed. Stable mangrove and saltmarsh communities. No loss of saltmarsh vegetation to mangroves relative to 2013 situation.
There are extensive stands of invasive species in the terrestrial areas of the Nature Reserve adjacent t the estuary which detract from the conservation value of the area.	Existing clearing programmes to be continued.	Working for Water	Ongoing	Reduction in the extent of alien invasive species.
Habitat loss due to transformation of land by property owners (e.g. planting of lawns)	River front property owners must be encouraged to maintain the natural estuarine environment and to not plant lawn right up to the edge of the estuary. In addition, property owners should be encouraged to replace lawn with esturine vegetation and to use natural means to control erosion.	BCM / DEDEAT	December 2014	Reduction in the extent of lawn areas that extend to the edge of the estuary.

ISSUE: WATER QUALITY				
MANAGEMENT OBJECTIVE: Ensure that water quality does not pose a threat to human health and wellbeing or to estuarine ecology and functioning.				
PROBLEM STATEMENT	**INTERVENTION/ACTION**	**BY WHOM**	**BY WHEN**	**INDICATOR OF SUCCESS**
Water quality has been a longstanding problem with leaking sewers and pump station overflows, as well as runoff from the Nompumelelo settlement being primary sources of pollution. In the catchment sources include industrial effluent, runoff from informal settlements, gardens and agricultural areas where fertilizers, herbicides and pesticides have been applied. Poor water quality can impact on: • the biological functioning of the estuary; • recreational use of the estuary (potential impacts on human health).	Conduct a comprehensive audit review of the state of existing sewerage infrastructure and develop a repair and maintenance plan targeting priority areas. Infrastructure that is known (e.g. from public compliants / notifications) to fail / result in releases to the estuary must be prioritised.	BCM Engineering	June 2014	Report available with recommendations. All known problem infrastructure has been repaired. Significant reduction (>80%) in the number/volume of sewage spills relative to the previous 2 years.
	Develop a contingency plan to deal with accidental releases.	BCM Engineering and Disaster Management	September 2014	Contingency plan formally adopted.
	Provide pump stations with a back-up power supply and adequate overflow / containment facilities	BCM Engineering	December 2015	All pump stations have adequate equipment / facilities to cope with contingency situations (e.g. power failure). Significant reduction (>80%) in the number/volume of sewage spills relative to the previous 2 years.
	Assess the feasibility of re-directing stormwater that is likely to contain sewerage to sewer or to sump / holding facility.	BCM Engineering	December 2014	Report available with recommendations. Projects identified and included in budget for 2015/16 financial year.
	Develop and implement an inspection and planned maintenance programme for sewage infrastructure in the vicinity of the estuary.	BCM Engineering	June 2014 ongoing	Inspection and planned maintenance programme for sewaerage infrastructure developed. Repairs of sewerage infrastructure being undertaken timeously and on a pro-active rather than reactive basis.

ISSUE: WATER QUALITY				
MANAGEMENT OBJECTIVE: Ensure that water quality does not pose a threat to human health and wellbeing or to estuarine ecology and functioning.				
PROBLEM STATEMENT	**INTERVENTION/ACTION**	**BY WHOM**	**BY WHEN**	**INDICATOR OF SUCCESS**
Water quality in the Nahoon Estuary is considered to pose a health hazard and water quality does not always meet health standards. Furthermore, monitoring does not appear to be consistent / regular monitoring.	Undertake ongoing monitoring of chemical and bacteriological parameters. Use monitoring data to obtain a better understanding of the relative contributions of the different sources of pollution (e.g. stormwater drains) and to inform management actions.	BCM Scientific Services / DWA	Ongoing	Comprehensive database on water quality is in place. Monitoring data is being used to inform management actions (e.g. upgrade projects and budgets).
	Investigate appropriate mechanisms provided for in legislation for implementing a water quality standard for the estuary based on accepted standards: • *Faecal coliforms* (including *E.coli*) –the target range should be between 0 – 100 counts / 100 ml (1995 South African Water Quality Guidelines for Coastal Marine Waters). To meet this target, 80% of samples should fall within this range (i.e. less than 100 counts); and 95% of samples should be below 2,000 counts. • *E. coli* – target range of 0 –130 counts (based on the DWAF South African Water Quality Guidelines: Recreational Use (2nd Edition, 1996)). *E coli* levels show a high correlation with gastric illnesses resulting from swimming-related. 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 the the Blue Flag Programme and/or World Health Organisation recommendations should be applied.	BCM / DWA / DEDEAT / DEA (Oceans & Coasts)	June 2015	Mechanism for setting water quality standards identified and accepted by relevant authorities. Process to develop the mechanism clarified. Water quality meets the DWA guidelines for recreational activities and natural environment. *E coli* and *faecal coliform* levels meet accepted standards (once mechanism implemented
There is a lack of understanding on the part of the general public about the health problems related to sanitation and the blocking of sewerage pipes	Develop a brochure dealing with sanitation, sewage infrastructure and health issues	BCM	June 2014	Reduction in blockages in sewerage pipes

ISSUE: RECREATION AND RESOURCE USE				
MANAGEMENT OBJECTIVE: Ensure that the recreational use of the estuarine area is of a high quality experience, offers a diverse range of opportunities, is appropriate to the ecological functioning of the system and does not compromise the safety and rights of any person				
PROBLEM STATEMENT	**INTERVENTION/ACTION**	**BY WHOM**	**BY WHEN**	**INDICATOR OF SUCCESS**
The last assessment of recreational activity was undertaken in 1992 and is thus outdated. Thus, current recreational use patterns and potential conflict areas between uses are not well understood. There is growing demand for recreational outlets, yet even existing facilities are poorly maintained	Undertake a survey of recreational activities – types, intensity, patterns at peak holidays periods. This must include both land and water based activities. The survey should include peak holiday periods, during Christmas and Easter periods.	BCM	June 2015 (survey Christmas & Easter holidays)	Survey report complete
	Undertake a detailed study on recreational and tourism opportunities, and potential conflicts. Include a carrying capacity assessment in this study.	BCM	June 2015	Recreational opportunity study complete with identifiecation of required facilities (new and upgrading of existing facilities).
	Revise the Zonation Plan in this EMP on the basis of the recreational use study, as appropriate. Only low intensity use is to be considered for conservation areas areas (e.g. bird-watching and walking).	BCM	September 2015	
	Attend to priority areas as follows: • Upgrade and/or maintain existing public areas, e.g. vicinity of N2 bridges and immediately downstream of Abbotsford causeway; old picnic areas on west bank of mouth on river side of Princess Alice Drive. • Develop new public areas – access points, picnic and walking trails (e.g. upstream of Abbotsford causeway to Dorchester Heights bridge). The area between lower Princess Alice Drive and the estuary – what used to be an overflow area for the Caravan Park – near the Beachbreak Restaurant – has potential for improvement with picnic sites, ablutions and public access. A control boom could be installed with access charge per vehicle.	BCM	December 2014 December 2016	Priority projects included in budget and implemented.
	Determine budget requirements for upgrading existing and establishing new recreational facilities.	BCM	June 2015	Priority facilities included in IDP and municipla budget.
.	Ensure opportunities for community involvement in recreation / tourism opportunities (e.g. trail guides and running of picnic areas).	BCM	June 2015	Opportunities for local community involvement included in Local Economic Development strategy.

ISSUE: RECREATION AND RESOURCE USE				
MANAGEMENT OBJECTIVE: Ensure that the recreational use of the estuarine area is of a high quality experience, offers a diverse range of opportunities, is appropriate to the ecological functioning of the system and does not compromise the safety and rights of any person				
PROBLEM STATEMENT	**INTERVENTION/ACTION**	**BY WHOM**	**BY WHEN**	**INDICATOR OF SUCCESS**
Recreational activities can lead to habitat degradation and/or biodiversity loss.	Institute a monitoring programme for indicator species.	BCM / DEDEAT	December 2014	Reports indicating trends in key species.
	Provide boardwalks in sensitive areas as is current practice. Identify where boardwalks are needed.	BCM	June 2015	Need for boardwalks identified and included in budget.
There is potential for conflicts among users of the estuary, particularly as regards passive (e.g. canoeing, swimming) and active (e.g. power boating) activities.i	Undertake an assessment of potential recreational use conflicts. This should be included in the aforementioned study on recreational opportunities. The results of this analysis should be used to determine whether specific areas of the estuary should be zoned for particular activities and whether other measures such as speed control zones need to be implemented.	BCM / DEDEAT	June 2015	Recreational opportunity study complete with identifiecation of required measures to prevent conflicts between recreational uses.
There are small numbers of fishermen from local communities who utilise the estuary to catch fish in the Batting Bridge areas for sale into their community or to feed their own families. They also harvest bait on the estuarine mudflats. There is, however, no concrete information on this activity and possible impacts.	Undertake a survey of resource use for livelihood purposes, including fishing, bait collection, trapping of animals (snares) and wood harvesting.	BCM / DEDEAT / DEA (Oceans & Coasts)	June 2015	Report on resource use for livelihood purposes available.
	Establish a policy on fishing and bait collection, taking account of the above-mentioned resource use survey, to orevent over-exploitation of these resources.	BCM / DEDEAT / DEA (Oceans & Coasts)	December 2015	
	Provide information and raise awareness among fisherfolk about fishing in the estuary and the role of limits on catch size and the size of fish caught in maintaining fishiing stocks in the long-term.	BCM	December 2014 ongoing	Awareness material / boards posted at main fishing spots. Decreasing trend in cases of non-compliance with fishing and bait collection limits
Public access is a concern and in some cases is restricted by structures on private property.	A public servitude along the high water mark must be maintained and private property must not impede access along this servitude.	BCM	December 2015	Public access to the area within the highwater mark is unrestricted.
Erosion – Uncontrolled trampling of mud banks for bait collection or opposite picnic areas	Re-establish riparian vegetation where necessary. This process should be used as an opportunity to provide employment for local communities. Establish education signage about mud banks and habit preservation.	BCM / DEDEAT	December 2016	Signs are in place. Banks stabilised, and reduced erosion and sediment laden runoff into the estuary

ISSUE: COMMUNICATION, EDUCATION AND AWARENESS RAISING				
MANAGEMENT OBJECTIVE: Create a supportive environment for the implementation of the EMP.				
PROBLEM STATEMENT	**INTERVENTION/ACTION**	**BY WHOM**	**BY WHEN**	**INDICATOR OF SUCCESS**
Poor understanding amongst the public and stakeholders on the role of estuaries and associated habitats, or of the potential impacts of their activities on estuaries. Lack of understanding amongst decision-makers, the public and stakeholders on the role of estuaries in the local economy and benefits to the East London community.	Develop educational/awareness-raising materials for display/ circulation at the Nature Reserve and other appropriate locations. Develop and run an educational programme with school groups. Develop closer links with the Aquarium, EL Museum etc.	BCM in collaboration with eg. WESSA, Canoe Club, Friends of the Nahoon, DEDEAT etc	December 2014 ongoing	Increased public support for implementation of the EMP including "honorary officers". Awareness materials developed and on display at public access points and at facilities in local communities (e.g. community halls / centres, public libraries). Increased number of school visits to the Nature Reserve
	Conduct awareness raising workshops for municipal councillors and officials, as well as ward committees about the importance and value of estuaries to the community and the economy of East London.	BCM in collaboration with eg. WESSA, Canoe Club, Friends of the Nahoon, DEDEAT etc.	September 2014 ongoing	Support from BCM Council for EMP implementation. Support from all BCM departments for EMP implementation.
There is concern about the general lack of feedback and information provided to local communities and users of the estuary.	Establish a mechanism to facilitate regular feedback to stakeholders (e.g. local residents and users of the lagoon). This could take the form of an Estuary Forum / Working Group. It would deal with a wide range of issues, including the involvement of stakeholders in monitoring activities, enforcement activities and would allow for general information sharing. The Terms of Reference (scope, objectives, role etc.) for this structure must be determined.	IGSC	September 2014	Estuary Forum / Working Group which is representative of key stakeholders is in place and its role, scope and objectives have been defined.
	Establish a performance reporting cycle, whereby progress on the implementation of this EMP and the condition of the estuary is described. A State of the Estuary report should be published on an annual basis.	IGSC	June 2015 annually	Annual State of the Estuary report produced.

ISSUE: LAND USE AND DEVELOPMENT				
MANAGEMENT OBJECTIVE: All development is undertaken in a manner that is responsive to the environmental setting and are managed to reduce impact on the estuary's functioning. All development must be within the law and not compromise other user's rights of access to the estuary.				
PROBLEM STATEMENT	**INTERVENTION/ACTION**	**BY WHOM**	**BY WHEN**	**INDICATOR OF SUCCESS**
Historical development has had significant impacts on the estuary. The most obvious modifications within the estuarine area are related to human activity, particularly those associated with the change in land use along stretches of the estuary's banks, mainly for residential purposes. As a result land would have been cleared, which in turn would have resulted in biodiversity loss and changes in river hydrology (e.g. runoff patterns). .	Maintain a register of historical modifications that have occurred. Historical aerial photography can be used, plus photographic records of the estuarine area. This should be compared to recent and on-going modifications and this information should be linked to data on the functioning and health of the estuary so as to improve the understanding of the impact of human activities on the estuarine environment.	BCM / DEDEAT	December 2014 ongoing	Historical development issues that may impact on the estuary are documented, eg bridges, pump and pipe mains, sewers, stormwater discharge points, etc Press release has been made. Feedback letters to public interest groups and residents via Municipal newsletter and accounts
	Guidelines / LUMS for area to be developed for land use and development.	BCM / DEDEAT	June 2015	Development Guidelines published.
	Raise public awareness that illegal structures and development will not be tolerated. Point out reasons why, eg impact to river flow, erosion, biodiversity loss, etc. This can be achieved through notice boards, information on the websites of the authorities and NGOs, tourism facilities	BCM / DEDEAT in partnership with interest groups (e.g. WESSA, Border Canoe Club, Friends of the Nahoon).	June 2014 ongoing	Regular provision of information to public about legal requirements. Timeous provision of information on changes in legislation to estuary users and residents living in close proximity to the estuary.
Inconsistent approach to controlling development along the river banks and there are no guidelines regarding acceptable norms for jetties, slipways, boardwalks and bank stabilisation	Initiate studies to establish the impact of these structures. Develop guidelines on acceptable norms for jetties, slipways, boardwalks and bank stabilisation and development along the river banks There should be no further development of such structures within the boundaries of the estuarine functional zone until such time as guidelines are in place and have been formally adopted.	BCM / DEDEAT	June 2015	Guidelines for development of structures, as well as for stabilising / erosion control purposes are in place. All structures that are built comply with standards set by authorities.

ISSUE: LAND USE AND DEVELOPMENT				
MANAGEMENT OBJECTIVE: All development is undertaken in a manner that is responsive to the environmental setting and are managed to reduce impact on the estuary's functioning. All development must be within the law and not compromise other user's rights of access to the estuary.				
PROBLEM STATEMENT	**INTERVENTION/ACTION**	**BY WHOM**	**BY WHEN**	**INDICATOR OF SUCCESS**
BCM approves building plans (along the Nahoon River) but fails to inform owners that they also need to comply with environmental legislation	Train Building Inspectors and affected BCM officials on environmental legal requirements	BCM / DEDEAT	June 2014 ongoing	All BCM Building Inspectors and other relevant BCM officials trained on environmental legal requirements within 4 months of the adoption of the EMP All new developments appropriately authorised / approved / licensed within 6 months of the adoption of the EMP
Flooding along the Nahoon river, especially the lower estuary, has become a regular problem. The effects are compounded by encroaching residential development close to the river banks. The situation is further exacerbated by changes in stormwater runoff volumes and timing from expanded urban areas within the estuary's adjacent sub-catchments and changes in landuse in the middle to upper reaches of the Nahoon catchment. Properties located on the estuary banks is vulnerable to flooding and flood damage.	Determine setback lines for the Nahoon Estuary.	BCM / DEDEAT	June 2014	Set back line determined within 6 months of the adoption of the EMP No development takes place and is approved within the Gazetted set back line within 6 months of the adoption of the EMP
	Update the !:50 and 1:100 year floodlines in conjunction with the SDP revision/updating process. The floodlines must be determined for the Nahoon river system from the mouth to past the Dorchester Heights residential area.	BCM	December 2014	Floodlines surveyed and report tabled on updated flood lines. Floodlines available from municipality (e.g. on GIS)
	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.	BCM	December 2014	Disaster Management Plan for flood events in place and based on up-to-date floodline information. All residents within the 1:100 year floodline have been notified by the municipality and have received disaster management information.
Lack of clarity as to what development can take place within the 100m flood line – no set back line determined yet	BCM to develop a policy on land use control within the floodline areas. This must take cognizance of the setback line information. These guidelines must also take cognisance of best practice (e.g. public open space, picnic sites within the 1 : 50 flood line are permissible; no built infrastructure, e.g. ablutions, buildings below the 1:50 yr line).	BCM	December 2014	Press release and made available to the public.

ISSUE: RESEARCH AND INFORMATION GATHERING				
MANAGEMENT OBJECTIVE: Improve the understanding of the ecological functioning of the estuary as a basis for management actions				
PROBLEM STATEMENT	**INTERVENTION/ACTION**	**BY WHOM**	**BY WHEN**	**INDICATOR OF SUCCESS**
Limited recent information on the biodiversity/ecology of the estuary and for some groups even the historical data is inadequate (eg. benthic invertebrates).	Baseline surveys of groups where there is inadequate information – for example benthic invertebrates (sandy and muddy substrates), zooplankton and fish. Surveys must be ongoing (i.e. undertaken every 3-5 years depending on the recommendations from relevant experts / specialists.	BCM in collaboration with local organisations (e.g. WESSA, Rhodes University)	December 2015 ongoing	Up to date baseline information available. Information on trends available.
Bird numbers reported to have declined but accuracy of database is unclear.	Annual bird counts to be undertaken	BCM Scientific Services (e.g. in collaboration with local bird clubs)..	December 2015 ongoing.	Up to date information available and trends evident.
Macrophyte communities are critical to the health of the estuary but seem to have fluctuated over time.	Acquire aerial photographs to assess trends in historical and future distribution and assess the impacts of floods, the mangroves and other factors. These aerial photographs could also be used to monitor the Dune Forest Communities.	BCM Scientific Services	June 2014 ongoing	Report on trends and underlying causes of fluctuations available
There is a lack of sufficient data to undertake a comprehensive Reserve Determination and/or data is out of date. For example, the last (known) measurements of the river bathymetry were undertaken by the Wiseman et.al CSIR in the mid-1980's.	Install continuous water level recorders at the Abbotsford Causeway and near the mouth. All recorders must be properly maintained, and data downloaded on a regular basis. Quantify the relationship between river flow and salinity distribution in the estuary Quantify sediment erosion by determining cross section profiles and undertaking sediment analyses every 3 years	BCM / DWA (Could be done in collaboration with Rhodes University)	March 2014 ongoing	Relevant information available
There is a lack of information on trace metals in the estuary.	Initiate a study to quantify levels of trace metals in sediments and biota and to identify sources of these metals.	BCM / DWA (Could be done in collaboration with CSIR).	March 2016	Report on trace metal contamination available and sources identified.

ISSUE: INSTITUTIONAL CAPACITY AND RESOURCES				
MANAGEMENT OBJECTIVE: Build institutional capacity and resources to ensure effective implementation of the EMP				
PROBLEM STATEMENT	**INTERVENTION/ACTION**	**BY WHOM**	**BY WHEN**	**INDICATOR OF SUCCESS**
According to feedback from various stakeholders there is a perceived lack of commitment by BCM to manage the estuary effectively, implement the EMP, regulate activities and developments along the estuary and enforce compliance with legal requirements (in terms of ICMA). Concerns were also raised regarding the BCM showing weak accountability in responding to calls to improve the management of the estuary.	Prepare council submission for the adoption of the EMP, including commitment to implementing and funding the EMP.	BCM	June 2014	Council Resolution adopting EMP and committing funding and staff to implement it
	Identify senior manager responsible for coordinating implementation and Councilor as champion for EMP	BCM	March 2014	Senior Manager and Councillor assigned responsibility for coordinating implementation of the EMP
Capacity within BCM to perform the functions and provide the services related to the management and control of the use of the Nahoon Estuary is severely limited and many posts are vacant. BCM has indicated that it needs support from the provincial government to implement the EMP	Engagement between the Manager Coastal Zone Management in DEDEAT and the relevant managers in BCM to assess and determine what support and assistance is needed from DEDEAT to facilitate the implementation of the EMP and make recommendations to ensure the required support is provided (i.e. needs assessment)	DEDEAT / BCM	June 2014 for 2014/15 financial year	Needs assessment of support needed by BCM with implementing the EMP undertaken Report and recommendations submitted to BCM Council and DEDEAT management structure for approval. Recommendations approved by management
	Secure funding to fill vacant posts in the Directorate Community Services and recruit additional staff, specifically the Amenities and Environmental Services Department	BCM	June 2014 for 2014/15 financial year	All vacant posts funded and filled by the end of the 2014/15 financial year
	Build capacity and provide support with implementation of EMP to BCM	DEDEAT	Ongoing	Recommendations on support required by BCM implemented and agreed outcomes achieved within agreed timeframes
	Enter into formal cooperation agreements with other organs of state (e.g. ECTPA, DWA) to provide support to BCM for the management of the Estuary. This can be done via the IGSC.	BCM	March 2015	Cooperation agreements signed within 6-8 months of the adoption of the EMP by BCM. Implementation of cooperation agreements reported on at BCM Coastal Committee and IGSC meetings.

ISSUE: INSTITUTIONAL CAPACITY AND RESOURCES				
MANAGEMENT OBJECTIVE: Build institutional capacity and resources to ensure effective implementation of the EMP				
PROBLEM STATEMENT	**INTERVENTION/ACTION**	**BY WHOM**	**BY WHEN**	**INDICATOR OF SUCCESS**

ISSUE: INSTITUTIONAL CAPACITY AND RESOURCES				
MANAGEMENT OBJECTIVE: Build institutional capacity and resources to ensure effective implementation of the EMP				
PROBLEM STATEMENT	**INTERVENTION/ACTION**	**BY WHOM**	**BY WHEN**	**INDICATOR OF SUCCESS**

BCM is expected to enforce environmental contraventions and assist SAMSA with enforcing boat safety but the Municipality does not have any peace officers or Environmental Management Inspectors and does not have capacity to undertake regular enforcement activities.	Provide EMI training for municipal enforcement staff	DEA	June 2014	All BCM law enforcement staff have undergone EMI training within 6 months of the adoption of the EMP
	Develop instruments and introduce a system that encourages conservation and voluntary compliance by land owners, residents and users of river	DEDEAT / BCM / ECTPA	June 2015	Voluntary compliance programme developed and introduced within 12-18 months of the adoption of the EMP.
	Prescribe and define the powers and duties of Voluntary Coastal Officers as envisaged in ICMA	DEDEAT (MEC)	June 2014	Provincial Regulations on Voluntary Coastal Officers Powers and duties within 12-18 months of the adoption of the EMP
	Advertise for Voluntary Coastal Control Officers	DEDEAT / IGSC	September 2014	An adequate number of people respond to advert for Voluntary Coastal Control officers.
	Appoint and train Voluntary Coastal Officers (in writing) and issue each voluntary coastal officer with an identity card.	DEDEAT	December 2014	Voluntary Coastal Officers appointed and trained within 12 months of the adoption of the EMP
Concerns about the lack of budget for protecting the estuary and managing the reserves on both sides of the estuary.	Set clear objectives and targets to ensure the implementation of the EMP, and adequate human and financial resources are allocated for its implementation, in the review of the IDP	BCM	June 2014	Clear objectives and targets which support the attainment of EMP management objectives included in the BCM IDP
	Allocate adequate budget to fund vacant posts, implement interventions and actions allocated to BCM in the EMP and fund day-to-day operations needed to ensure the effective management of the Nahoon Estuary and the control of developments and uses along the estuary	BCM	June 2014	Adequate recurrent budget allocated annually to provide services and implement interventions and actions identified in the EMP

ISSUE: COMPLIANCE AND ENFORCEMENT				
MANAGEMENT OBJECTIVE: Strengthen compliance monitoring and ensure effective enforcement of ensure effective enforcement of regulations pertaining to activities in and around the estuary.				
PROBLEM STATEMENT	**INTERVENTION/ACTION**	**BY WHOM**	**BY WHEN**	**INDICATOR OF SUCCESS**
There is an inconsistent approach to enforcing compliance with environmental legislation and lack of regular, visible enforcement regarding illegal uses on the river, public nuisances and illegal structures along the river banks. Concerns about a lack of response from authorities to reports of illegal activities. This exacerbates any attempts to enforce compliance along the estuary and furthermore exposes the relevant authorities to the risk of potential litigation by individuals who feel they have been treated unfairly and/or unreasonably.	Develop a strategy to ensure a consistent and coordinated approach is adopted to compliance monitoring and law enforcement by the responsible organs of state	IGSC	December 2014	Enforcement strategy developed, adopted and implemented by all responsible organs of state Visible enforcement activities undertaken by responsible organ/s of state. An inventory of illegal activities is compiled and maintained. Successful prosecution of transgressions
	Develop and implement measures that encourage conservation and voluntary compliance by land owners, residents and users	DEDEAT / BCM	December 2014	100% improvement in compliance within one year of introducing voluntary conservation and compliance measures
	Develop and implement a compliance awareness raising programme for landowners, interest groups and the general public	DEDEAT / BCM	September 2014 and thereafter at least annually	All land owners and interest groups exposed to compliance awareness raising within 6 of the adoption of the EMP Public compliance awareness raising drives repeated at least annually
	Appoint Voluntary Coastal Officers to support authorities with compliance monitoring	DEDEAT	March 2015	Voluntary Coastal Officers appointed and trained within 6 months of the adoption of the EMP
No enforcement action taken against illegal encroachment onto public land and public open space.	Implement enforcement actions and measures identified in enforcement strategy	DEDEAT / BCM	September 2014 ongoing	Enforcement action taken against landowners who have illegally encroached onto public land and public open space
	Investigate legality and feasibility of leasing public land and public open space to landowners who have illegally constructed jetties on public land and for the income generated from the lease to be ring-fenced to fund conservation projects and management actions along the estuary	DEDEAT / BCM	December 2015	Legal opinion submitted to responsible managers in DEDEAT & BCM Submission to Council on action to be taken in accordance with legal advice provided Council resolution regarding action to be taken implemented

ISSUE: COMPLIANCE AND ENFORCEMENT				
MANAGEMENT OBJECTIVE: Strengthen compliance monitoring and ensure effective enforcement of regulations pertaining to activities in and around the estuary.				
PROBLEM STATEMENT	**INTERVENTION/ACTION**	**BY WHOM**	**BY WHEN**	**INDICATOR OF SUCCESS**
Activities have been undertaken on private properties that are subject to environmental authorization in terms of section 24 of NEMA. These activities are regarded as illegal, since the required environmental authorisation was not obtained. This is particularly relevant to activities (e.g. structures) involving any form of construction within 100m of the high-water mark. The DEDEAT is investigating the illegal jetties and slipways. An inventory has been compiled and notices issued to responsible parties (residents).	Consider the options under environmental legislation for dealing with illegal activities. The potential and relative advantages / disadvantages of using the section 24G mechanism versus that of issuing a directive under section 28 of NEMA should be investigated. A legal opinion in this regard should be sought to provide guidance to the regulatory authorities in this regard.	DEDEAT	March 2014	Legal opinion with recommendations on legal options has been obtained.
	Determine the feasibility of dealing with the illegal activities that have taken place with the affected landowners on a co-operative basis (i.e. landowners work together as a group instead of individually). This would allow for the commissioning of a combined study to investigate the environmental impacts associated with all illegal structures, which in turn would provide a more holistic picture of the impacts than if each landowner undertakes an independent investigation.	DEDEAT	June 2014	A structure to enable a co-operative approach is established. A single study to investigate the impacts of all structures considered to be illegal is commissioned thereby allowing for impacts to be studies on a holistic basis.
	Develop a strategy for dealing with illegal activities based on the abovementioned legal opinion and the impact assessment. Illegal structures that have serious implications for future river functioning must be removed and the river bank re-instated to its natural form by the responsible party.	DEDEAT	September 2014	A strategy for dealing with illegal activities is in place and is being followed. Situation with respect to illegal activities is resolved to the satisfaction of all parties. All new developments appropriately authorised / approved / licensed. Rectification undertaken where needed (based on environmental impacts) either via a NEMA section 24G process or section 28 directive.
No enforcement along the mud flats and no regular enforcement	Investigate extent of illegal resource use (surveys) and implement enforcement actions and measures identified in enforcement strategy	DEDEAT, ECTPA & BCM	June 2014 ongoing	Enforcement action taken against persons who poach and gather bait illegally

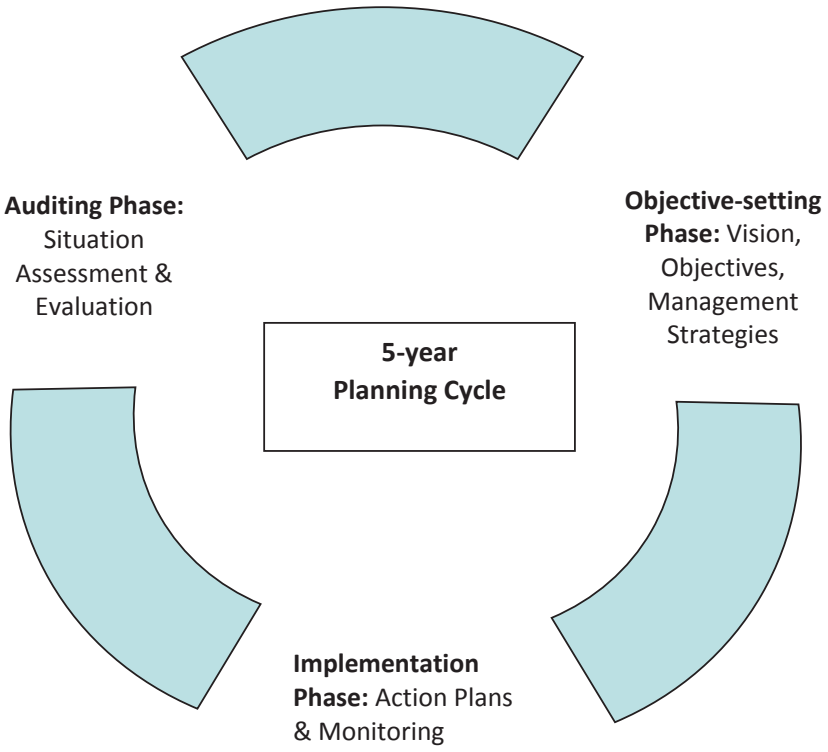
ISSUE: COMPLIANCE AND ENFORCEMENT				
MANAGEMENT OBJECTIVE: Strengthen compliance monitoring and ensure effective enforcement of regulations pertaining to activities in and around the estuary.				
PROBLEM STATEMENT	**INTERVENTION/ACTION**	**BY WHOM**	**BY WHEN**	**INDICATOR OF SUCCESS**
activities are conducted to combat illegal resource use.	Develop and implement a compliance awareness raising programme for fishermen, bait gatherers and the general public	DEDEAT, ECTPA & BCM	September 2014 6 monthly	Fishermen and bait gathers exposed to compliance awareness raising within 6 of the adoption of the EM Public compliance awareness raising drives repeated at 6 monthly intervals
	Appoint Voluntary Coastal Officers to support authorities with compliance monitoring	DEDEAT	December 2014	Voluntary Coastal Officers appointed and trained within 8 months of the adoption of the EMP
Illegal squatters and vagrants in bushy areas are not evicted on a regular basis	Develop and initiate a process to evict illegal squatters and vagrants from bushy areas that meets all eviction legal requirements; and develop and implement a plan that identifies alternative accommodation for squatters and prevents them returning to such areas	BCM	June 2014	Eviction process to remove and resettle all illegal squatters and vagrants initiated within 3 months and completed within 6 months of the EMP being adopted All illegal squatters and vagrants evicted and re-settled within 2 months of the due eviction process being completed. Plan to prevent squatters and vagrants returning to bushy areas implemented within 2 months of the due eviction process being completed.

8.3 Monitoring and evaluation

In accordance with the National Estuarine Management Protocol the effectiveness of the EMP needs to be assessed in terms of the extent to which management objectives are being achieved. The review must include an assessment of:

- The effectiveness of the EMP and success with meeting its objectives, taking into consideration information and monitoring during the preceding years.
- Environmental changes that could affect estuarine resources or the implementation of the EMP.
- Changes (if any) to legislation, landuse planning, goals or policies that may affect the EMP.

Accordingly, the EMP can be seen as a "living document" with the review process serving as a means of ensuring it remains relevant and that it responds to changing conditions and circumstances. The review would consider all of the elements that make up the EMP as illustrated below. The results of the review would determine the need for amendments to the EMP, including possible changes to the management objectives. Public consultation must be incorporated into the review process as input from the public is of value in assessing the effectiveness of the EMP. Once the EMP has been revised, it is subject to the approval and adoption process outlined above in section 9 of the Protocol.



The Protocol requires that EMPs be subject to review by the responsible management authority that developed the plan at least every 5 years from the date it was adopted. In terms of the Protocol the Provincial and Municipal coastal committees are responsibility for monitoring the implementation of EMPs and reporting on progress and achievements related to estuarine management on. If possible, this

review should be aligned with the IDP and SDF review cycle, thereby enabling the EMP's requirements and priorities to be taken into account in determining budgets, plans and projects.

Recommended monitoring actions in respect of the implementation and effectiveness of the EMP are detailed in the table overleaf. These are based on the following principles:

- Ensuring ongoing monitoring of effectiveness of the EMP so that corrective action can be implemented timeously.
- Ensuring that monitoring procedures are feasible and practical in terms of resource requirements (e.g. personnel).
- Ensuring that there is public reporting on progress.

Effectivess of the EMP must be assessed against the vision and management objectives described in Section 7 together with the "indicators of success". 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.

ISSUE: MONITORING AND EVALUATION				
MANAGEMENT OBJECTIVE: Ensure effective implementation of the EMP				
PROBLEM STATEMENT	**INTERVENTION/ACTION**	**BY WHOM**	**BY WHEN**	**INDICATOR OF SUCCESS**
There is a lack of clear monitoring frameworks at provincial and local level. If the implementation of the EMP is not monitored its effectiveness and success cannot be established. This is essential to establish whether improvements or revisions to the plan are needed. It is also an important part of identifying "lessons learnt" so as to strengthen the EMP.	Establish monitoring system (e.g. data gathering mechanisms, indicators / performance standards, performance reporting template).	DEDEAT / BCM	December 2014	Monitoring system is in place / established. Measurable progress is evident from the IGSC meeting minutes. Performance monitoring undertaken against objectives and targets monitored by Provincial Coastal Committee or Intergovernmental Committee established to facilitate implementation of this EMP.
	Monitor implementation of the EMP on an ongoing basis via the IGSC meetings. As part of this process maintain a "running list" of items that require attention / intervention.	IGCS	Ongoing	
	Submit annual report on performance / lack thereof and challenges to implementation to MEC and National Minister, including recommendations to address poor / non-performance and implementation difficulties.	DEDEAT / BCM	From Dec 2014 (thereafter annually)	Annual performance monitoring report submitted to MEC and National Minister by the due date. Corrective actions to address poor / non-performance and implementation challenges identified with implementation plan.
	Communicate annual performance monitoring report to relevant authorities for action.	IGCS	From Dec 2014 (thereafter annually)	Annual performance monitoring report submitted to BCM by the due date Recommendations implemented by due date
	Review the EMP every 5 years in accordance with the National Estuarine Management Protocol	DEDEAT	5 –yearly from 2014	EMP objectives and targets are met within set timeframes

8.4 Priorities

Many of the management related problems which have developed in estuaries are the result of the fact that historically estuaries have not fallen under the jurisdiction of any one department. One of the means for addressing this shortcoming is through the EMP, which in accordance with the National Protocol for Estuary management Plans, must address co-operation and coordination between the relevant authorities. The ICMA makes provision for the establishment of Provincial and Municipal Coastal Committees (PCC and MCC). While the establishment of a Provincial Coastal Committee (PCC) is outside of the ambit of an EMP, it is strongly recommended that the DEDEAT and BCM consider setting up these structures on an urgent basis.

For the purposes of this EMP, action plan tasks in respect of institutional arrangements propose the establishment of an Inter-governmental Special Committee (IGSC) comprising mandated representatives from relevant authorities - including BCM, DEDEAT, the Eastern Cape Parks and Tourism Agency, Amatola Water, DWA, and the DEA's Oceans and Coasts Branch. This structure would be responsible for driving and overseeing the implementation of the EMP. It is envisaged that this committee would operate under the PCC and MCC once these structures are in place. It has also been recommended that an Estuary Forum be established, to facilitate interaction and communication woth key stakeholders. The structure would allow for the exchange of information and ideas, and also for stakeholders to provide their views and inputs on progress being made in respect of the management of the estuary.

Given the number of actions and the substantial resources required, it is considered necessary to identify those of highest priority (Table 11). The focus is on the minimum required to facilitate implementation of the EMP in the first instance. It is envisaged that commencement of actions can be driven through the IGSC and is not dependent on the formal adoption of the EMP. Rather, procedures for the formal adoption of the EMP can be undertaken in parallel with actions required to address priority issues and problem areas.

TABLE 11: Priority issues and actions

DESCRIPTION	LEVEL OF PRIORITY	
Establishment of an Intergovernmental Co-ordinating Mechanism to facilitate implementation of the Action Plan.	1	• Commence actions to implement within 2-3 months (i.e. by February / March 2014). • Target date for completion – September 2014
Establishment of a Forum comprising key stakeholders to facilitate communication, interaction and partnership between governmental and other parties for the purposes of implementing the Action Plan.		
Repair the most problematic / faulty sewerage infrastructure (determined from municipal records of reports of faults and repair schedules/job cards)		
Declaration of the Nature Reserve component of the estuarine functional zone is formalied.	2	• Commence actions to implement within 2-3 months (i.e. by February / March 2014). • Target date for completion – December 2014
Formal adoption of the EMP by the DEDEAT and Buffalo City Municipality.		
Set up monitoring programme (e.g. frequency) and systems (e.g. equipment) for physical and ecological parameters		
Resolve approach to enforcement and to the addressing of illegal activities, especially those subject to environmental authorisation.		

9 CONCLUDING STATEMENT

The EMP for the Nahoon Estuary, East London, comprises 2 parts. The first is the Situation Assessment and the second is the Management Plan. These are located in one document for completeness and to allow for a seamless connection between the Situation Assessment and the Management Plan. This also prevents the nature and significance of the issues identified in the Situation Assessment from being divorced from the solutions recommended in the Action Tables in the Management Plan.

It has been shown that there are numerous pressures and concerns in relation to the Nahoon Estuary, which are associated with human activities. It has also been shown that the estuary is of value to the community of East London and to visitors to the city due to the range of ecosystem services associated with this natural system. The estuary has not been identified as being of importance in the local context and as being of high priority in terms of the need for rehabilitation. A key pressure that has been identified is that of degradation of water quality, which poses both a human health hazard, but which could adversely affect the functioning of the estuary, which in turn would impact on the ecosystem services it provides.

Key priorities for action are to:

1. Establish a structure to enable a co-ordinated approach to the management of the estuary by relevant organs of state.
2. Undertake measures to improve the water quality of the estuary, and in particular actions required to prevent (or at least reduce) the potential for uncontrolled sewerage releases into the estuary.
3. Progress the initiative to increase the formally protected area within the estuarine functional zone.

The EMP should be seen as a "living document" that ought to be revised and updated in response to monitoring results / findings and changes in circumstances (e.g. new legislation). Review of the EMP on a 5-yearly basis is envisaged in the National Estuarine Management Protocol.

REFERENCES

Adams, J.B., Snow G.C. and Veldkornet, D.A. (2011): *Chapter 6*: Estuarine Habitat, In: Van Niekerk, L. and Turpie, J.K. (eds) 2012. South African National Biodiversity Assessment 2011: Technical Report. Volume 3: Estuary Component. CSIR Report Number CSIR/NRE/ECOS/ER/2011/0045/B. Council for Scientific and Industrial Research, Stellenbosch.

Buffalo City Municipality Spatial Development Plan

Buffalo City Municipality (2005): State of Sanitation Report Summary Report (Draft Version 0.02).

Bursey, M. and Wooldridge.T. (2002): Diversity of benthic macrofauna of the flood-tidal delta of the Nahoon estuary and adjacent beach, South Africa. *African Zoology* 37 (2): 231 – 246.

Coastal and Environmental Services (2005): Integrated Coastal Zone Management Plan (2005): Coastal Action Plan 2: Estuaries Management. (Report prepared for BCM).

Coastal and Environmental Services (2005): State of Sanitation – Summary Report, Draft Version 0.02. (Report prepared for BCM).

CSIR (2007): C.A.P.E. Estuaries Guideline series, Legislation pertaining to Management of Environmental Threats within Estuaries

DWAF (2001): Amatole Water Resources System: Environmental Water Requirements (Intermediate determination of resource directed measures for the Nahoon Estuary).

DWA (2008): Biomonitoring of the Nahoon River System.

*En*Act International (2010): Legal Mandate and Strategic Responses for Business Case: Eastern Cape Parks Board

Ithemba Environmental (2003): Analysis of Existing Environmental Characteristics, BCM Tourism Master Plan.

Morris, R. D., (1986): Recreational Capabilities and Zoning of the Nahoon Estuary, East London, BSc Honours thesis, Rhodes University, Geography Department

Reddering, J.S.V., (1988): Coastal and Catchment Basin Controls on Estuary Morphology of the SE Cape Coast. UPE, Port Elizabeth. S.J. Sci, 84 : pp 154-157.
Setplan (undated): Analysis of Sociospatial characteristics, Tourism Master Plan, BCM.

StatsSA (2007): Community Survey – Basic results: Municipalities, downloaded from http://www.statssa.gov.za/publications/p03011/p030112007.pdf.

Steffen, Roberstson and Kirsten (1992): Guidelines for Development and Recreational Use of the Nahoon Estuary, Report 18074.

Steinke,T.D. (undated): A General Review of the Mangroves of South Africa.

Turpie, J and Clarke B., (2007): Development of a Conservation Plan for Temperate South Africa Estuaries on the Basis of Biodiversity Importance, Ecosystem Health and Economic Costs and Benefits, C.A.P.E. Regional Estuarine Management Programme, Final Report.

Turpie, J.K., Wilson, G. & Van Niekerk, L. (2012): National Biodiversity Assessment 2011: National Estuary Biodiversity Plan for South Africa. Anchor Environmental Consultants Report No AEC2012/01, Cape Town. Report produced for the Council for Scientific and Industrial Research and the South African National Biodiversity Institute.

Harrison, T.D. (2002): Preliminary assessment of the biogeography of fishes in South African estuaries, Marine Freshwater Research, Vol. 53.

van Niekerk L *et.al.*, (2011a): *Chapter 9*: Health Status of Estuaries, In: Van Niekerk, L. and Turpie, J.K. (eds) 2012. South African National Biodiversity Assessment 2011: Technical Report. Volume 3: Estuary Component. CSIR Report Number CSIR/NRE/ECOS/ER/2011/0045/B. Council for Scientific and Industrial Research, Stellenbosch.

van Niekerk L., *et. al.*, (2011b): *Chapter 3*: Ecosystem Services, In: Van Niekerk, L. and Turpie, J.K. (eds) 2012. South African National Biodiversity Assessment 2011: Technical Report. Volume 3: Estuary Component. CSIR Report Number CSIR/NRE/ECOS/ER/2011/0045/B. Council for Scientific and Industrial Research, Stellenbosch.

van Niekerk L and Nel J (2011): *Chapter 10*: Ecosystem Threat Status In: Van Niekerk, L. and Turpie, J.K. (eds) 2012. South African National Biodiversity Assessment 2011: Technical Report. Volume 3: Estuary Component. CSIR Report Number CSIR/NRE/ECOS/ER/2011/0045/B. Council for Scientific and Industrial Research, Stellenbosch.

van Niekerk, L. *et.al.*, (2011d): *Chapter 13*: How vulnerable are South African estuaries to climate change Chapter 13.

Water Research Commission (undated): Estuary Ecosystem Services.

Whitfield, A.K. (2000): Available scientific information on individual South African estuarine systems. Water Research Commission Report, 577/3/00.

Wiseman, K.A., Burns, M.E.R and Vernon, C.J. (1986): Estuaries of the Cape Series: Part II: Synopsis of available information on individual systems, Report No. 42, Nahoon (CSE44), Qinira and Gqunube estuaries, CSIR Report No 441 (ed. P Morant).

Printed by and obtainable from the Government Printer, Bosman Street, Private Bag X85, Pretoria, 0001.
Contact Centre Tel: 012-748 6200. eMail: info.egazette@gpw.gov.za
Also available at the Legal Advisory Services, ***Province of the Eastern Cape***, Private Bag X0047, Bisho, 5605.
Tel. (040) 635-0052.