ENVIRONMENTAL IMPACT ASSESSMENT REPORT
OF
THE PROPOSED CONTAINER TERMINAL MODERNISATION PROJECT
FOR
KENYA PORTS AUTHORITY

Prepared by:

H.O. ADALA, LEAD EXPERT &
EARTH MATTERS CONSULTING
CANNON TOWERS, 3RD FLOOR
P.O. BOX 42269
TEL 222861
MOMBASA

Client:

KENYA PORTS AUTHORITY
P.O. BOX 95009
TEL. 2312211/2221211
MOMBASA

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SPECIALISTS

Name	Affiliation	Field of expertise
Hezekiah Adala	Lead expert EIA/EA Cannon Towers, 3rd Floor P.O. Box 42269, Mombasa Tel 222861	Environment Engineer
Patrick Gwada	Cannon Towers, 3rd Floor P.O. Box 42269, Mombasa Tel 222861	Marine Ecologist
Dr. Daniel Munga	Kenya Marine And Fisheries Research Institute (KMFRI), http://www.kmfri.co.ke P.O. Box 81651, Mombassa, Kenya. Telephone 254-11-475154; 472527; Fax: 254-11-475157;	Environmental Chemist/Pollution Expert
Dr. Michael Nguli	Kenya Marine And Fisheries Research Institute (KMFRI), http://www.kmfri.co.ke P.O. Box 81651, Mombassa, Kenya. Telephone 254-11-475154; 472527; Fax: 254-11-475157;	Oceanographer
David Kirugara	Kenya Marine And Fisheries Research Institute (KMFRI), http://www.kmfri.co.ke P.O. Box 81651, Mombassa, Kenya. Telephone 254-11-475154; 472527; Fax: 254-11-475157;	Oceanographer
Saeed Mwaguni	Earth Matters Consulting P.O. Box 2707-80100, Mombassa, Kenya.	Environmental Planner
Jacob Ochiewo	Kenya Marine And Fisheries Research Institute (KMFRI), http://www.kmfri.co.ke P.O. Box 81651, Mombassa, Kenya. Telephone 254-11-475154; 472527; Fax: 254-11-475157;	Socio-Economist
Fredrick Owiti	Cannon Towers, 3rd Floor P.O. Box 42269 Tel 222861 Mombasa	Environmental Scientist

TABLE OF CONTENTS

ACCRONYMS

AIDS	Acquired Immune Deficiency Syndrome
BOD	Biological Oxygen Demand
COD	Chemical Oxygen Demand
DRC	Democratic Republic of Congo
EACC	East African Coastal Currents
EAM	East African Environmental Management Company Ltd
ECD	Empty Container Deport
EIA	Environmental Impact Assessment
EMCA	Environmental Management and Coordination Act
FAN	Forest Action Network
GBHL	Grain Bulk Handlers Limited
GOK	Government of Kenya
IMSR	Inter Monsoon Short Rains
IMLR	Inter Monsoon Long Rains
ITCZ	Inter Tropical Convergence Zone
JBIC	Japan Bank for International Cooperation
JPC	Japan Port Consultants
KESCOM	Kenya Sea Turtle Conservation Committee
KEFRI	Kenya Forestry Research Institute
KARI	Kenya Agricultural Research institute
KMA	Kenya Maritime Authority
KMFRI	Kenya Marine & Fisheries Research Institute
KWS	Kenya Wildlife Service
KPA	Kenya Ports Authority
NEC	National Environmental Council
NEM	North Eastern Monsoon
NEMA	National Environment Management Authority
NGOs	Non Governmental Organisations
NMK	National Museums of Kenya
NWCPC	National Water Conservation & Pipeline Corporation
OSMAG	Oil Spill Mutual Aid Group
OSRAT	Oil Spill Response Action Team

PCI	Pacific Consultants International
RH	Royal Haskoning
RMG	Rail Mounted Gantry
RTG	Rubber Tyred Gantry
SEC	South Equatorial Current
SLP	Sea Level Pressure
SH	Stakeholders
SSG	Ship to Shore Gantry
TDS	Total Dissolved Solids
TSS	Total Suspended Solids
TOR	Terms of Reference
TEU	Twenty-foot Equivalent Unit
TGS	Total Ground Slot
UNEP	United Nations Environment Programme
WWF	World Wildlife Fund
MARPOL	International Convention for Prevention of Marine Pollution

CERTIFICATION

Certification by Lead Expert:

I hereby certify that the environmental impact assessment report has been done under my supervision and that the audit criteria, methodology and content reporting conform to the requirements of the Environmental Management and Coordination Act, 1999.

Signature__________________________ Date ________________________

Name____

Address____

Certificate of Registration No____

Certification by Proponent

We, Kenya Ports Authority hereby confirm that the contents of this report are true and will implement practicable mitigation measures proposed in the report.

Signed for and on behalf of Kenya Ports Authority:

Name____

Signature____________________________ Date _________________________

Official Rubberstamp ____

ACKNOWLEDGEMENT

We the experts would wish to extend our sincere appreciation to all individuals and institutions that offered their cooperation and support in ensuring that we gathered the information required to compile this report. We are grateful for the support we got from the staff of the Kenya Marine & Fisheries Research Institute during collection of the baseline information

We are greatly indebted to the technical expertise of resource persons and institutions as herein mentioned without order of priority. SGS-Kenya (air quality, noise & vibration, water & sediment quality surveys & analyses); Elizabeth Mueni, Rashid Anam & Collins Ndoro (fisheries surveys & analyses); Mwai Muraguri & Ali Mwamutsi (forestry surveys & analyses); Bernard Ogongo & George Onduso (plankton surveys & analyses); Dixon Odongo (marine benthos surveys & analyses, & qualitative visual surveys (intertidal areas)); Alfred Obinga (mangrove surveys & qualitative visual macrofaunal surveys); Samuel Ndirangu, Masudi Juma Zamo & Joseph Kilonzo (divers for underwater surveys & sampling, underwater photography); Port Reitz fishermen (beach seine and traps sampling); KPA coxswains and team aboard MV Rumani (Abud A. Omar; Salilu Badi, and Kange); Other local fishing dhows and boats and crew staff who helped in moving survey staff from one sampling point to the other; Specific persons consulted: Kennedy O. Opiti (KWS), Shakil Visram (CORDIO), Saeed Mwaguni (CDA). We are also very grateful to the many interventions from the various stakeholders – government, private, civil society, NGOS, and community groups (see appendix list) who joined in the discussions during the three (3) stakeholder presentations to air their concerns and raise pertinent issues that informed the EIA process.

We are also indebted to the following institutions for providing valuable comments/information to the experts in the course of their work.

1. Kenya Marine and Fisheries Research Institute, P. O. Box 81651, 80100 - Mombasa, Kenya.
2. Kenya Wildlife Service, Coast Region Headquarters, Research and Biodiversity Department, P.O. Box 82144, Mombasa
3. CORDIO –East Africa, P.O. Box 10135, Mombasa
4. Coast Development Authority, P.O. Box 1322, 80100 - Mombasa, Kenya.

5. Coast Water Services Board, Ministry of Water and Irrigation, P.O. Box 90417, 80100 - Mombasa, Kenya.
6. Kenyatta University, Department of Environmental Sciences, P.O. Box 43844, 00100 - Nairobi, Kenya
7. University of Nairobi, Department of Chemistry, P.O. Box 30197, 00100 - Nairobi, Kenya.
8. Jomo Kenyatta University of Agriculture and Technology, Department of Chemistry, P.O. Box 62000, 00200 - Nairobi, Kenya.
9. Government Chemist Department, Ministry of Health, P.O. Box 81119, Mombasa, Kenya.
10. Coast Water and Sewerage Company Ltd., Mombasa.
11. National Environment Management Authority, P.O. Box 67839, 00200 - Nairobi, Kenya.

Special thanks go to Kenya Ports Authority for providing project briefs and logistical support, including providing access to the site to obtain baseline information, which was crucial in projecting and analysing part of the information contained in this report.

A lot of assistance and information was obtained from members of the public and government officials who may not have been mentioned by name but none-the-less their contribution went a long way in ensuring successful and timely completion of this environmental impact assessment report. We are grateful to them for their spirit of cooperation and support.

EXECUTIVE SUMMARY

Kenya Ports Authority (KPA) in conjunction with Japan Bank for International Corporation (JBIC) intends to construct a new Container Terminal by reclamation of the West Kipevu to create an additional 3 berths. The proposed project includes construction of a new port access road connecting the new Container Terminal with the existing Port Reitz road that leads to the Nairobi and inland bound highways. In parallel with the proposed project, as relevant projects, the expansion of the existing Port Reitz and Airport roads and dredging of the access channel connecting the new container terminal with the open sea and a turning basin in front of the new container terminal are going to be implemented by Kenya's Ministry of Roads and Public Works and KPA respectively.

The proposed access road will consist of two portions: an internal road on the reclaimed land (width 50m x length 1.3 km) and a new access road from the reclaimed land to existing Port Reitz road (width: 30m x length: 1.5 km). The capacity of the new access road is expected to be about 750,000 TEUs per year. There will be a New Railway Station with 4 rail lines for the operation of Rail Mounted Gantry cranes. This will occupy space of approximately 425m x 45m. Access road gate, terminal main gate, container gates, operation buildings and maintenance workshop are some of the facilities incorporated in the project. Empty containers would be secured at the Empty Container Deport, for which space will be secured around the container repair shop/washing area. An area between the main gate and the container gate will be reserved as a waiting zone for external trucks. Weigh in-motion bridges will be installed at the gate of the new yard to enforce axle load controls.

In line with the requirements of the Environmental Management and Coordination Act, an Environmental Impact Assessment (EIA) study was undertaken to identify the possible impacts that would arise as a result of the activities of the proposed projects on both the natural and social environment and to design measures that would mitigate the impacts. The study included a detailed description of the proposed project activities; baseline information defining the project site; justification for the project; consideration of alternatives; Policy, Institutional and Legal Framework; and Public Consultation and Participation. Through this exercise, the impacts of the proposed development were identified; mitigation measures proposed in an Environmental Management Plan; and a Monitoring Plan developed.

An EIA study for the relevant projects (expansion of the existing Port Reitz and Airport roads and dredging of the turning basin and access channel) are going to be carried out by the individual project proponents. However, since the potential impacts of the relevant projects will be similar and closely related to those of the proposed study, they were touched upon in this study as well.

The justification of this project arises from the fact that the current Container Terminal was designed to handle a container volume of 250,000 TEU, but is now handling 400,000 TEU annually. This has stretched the current facility beyond its capability, a situation aggravated by the narrow and inadequate road infrastructure around the port that has caused slow movement of traffic. Conditions are made worse each time breakdown of loaded trucks take place causing complete closure of the roads and a complete halt to vehicular motion affecting port business in the process. Further, increasing competition from neighbouring ports requires the port of Mombasa to improve its efficiency in service delivery. Alternatives to the proposed project were considered including alternative project proposals, alternatives to the access road and alternative disposal sites for the dredged material.

The Kenya Ports Authority (KPA) is a statutory body mandated under the KPA Act. Cap 391 of the Laws of Kenya to maintain, operate and improve all scheduled ports in Kenya. The Mombasa Port is its largest in the country, and the second largest in the continent of Africa in terms of tonnage and containers handled. The Kilindini Harbour, which serves the Port of Mombasa, handles about 1700 ships annually (JBIC SAPROF Study Team, 2006) for both import and export items. The harbour has 16 deep berth; two bulk oil jetties; two container terminals; two bulk cement berths; two lighterage and dhow wharves; and one explosive jetty.

Inland, the harbour extends into the shallow Port-Reitz creek housing extensive areas of mangrove trees, mud flats and banks. The rivers Mwache, Mambone and Chasimba feed into the larger Port-Reitz Creek, and are drawn into the Indian Ocean via the

Kilindini Harbour. The lower Port-Reitz Creek forming the Kilindini Channel have been dredged to deepen the channel providing water depths of 30-40 meters (Kamau, 2002).

Background information informs us that the Port is not a designated conservation area. Its land use is described as a commercial harbour for shipping business. As a result of this designated use, the area suffers both water and air pollution from the activities that take place within its environs. Sources of pollution to both water and air environments originate from both on-shore and off-shores activities of marine vessels, cargo handling operations, waterfront industries, road traffic, and from urban municipal wastes. This notwithstanding the ecosystem of the area, comprising of the creek, the beach, inter-tidal zone and the mainland offer habitats for both flora and fauna, not so significant, but support socio-economic activities that contribute to livelihood means of the neighbouring communities, with fishing, standing out as an important activity. The activities of the proposed project have thus been analysed in light of the environmental conditions of the area identifying the impacts that would arise, and proposing mitigation measures to address the same complete with management and monitoring plans.

The project activities will have both positive and negative impacts with the following identified as positive impacts: a three lane road built will result in improved road infrastructure opening up the Port-Reitz area to many socio-economic opportunities appreciating property values in the area. Small businesses in food kiosks, shops, garages etc springing up. Employment, both directly and indirectly will be created by the project. Environmentally, the aesthetic value of Port-Reitz area will improve. However, associated with the development will also be some negative impacts: Such impacts include the loss of some of the residential buildings, relocation or loss of business as both residential homes and business premises are demolished; the size of the fishing grounds will shrink though not appreciably as the reclamation exercise take place etc. During the construction, there will be the problems associated with dust, smoke, noise, vibrations etc from the moving trucks and equipment; some of which persisting into the operational phase of the project.

Dredging of the turning basin and access channel to be implemented under the relevant projects will cause minimal change in the local current system of the area. The horizontally averaged maximum current speed at spring tide will remain at ~0.4m/s before and after dredging. However, the change in channel configuration will alter the horizontal velocity distribution causing a small decrease in the tidal velocity of 6-8%. This effect is smaller towards the open sea. Dredging will therefore have impact down and upstream depending on tide. It will however not affect the tidal range and temperature regime of the area. Dredge dump materials is affected by water dynamics depending on the density of the materials. Light material is quickly dispersed by wind and surface currents while heavy materials settle at the bottom. Both light and heavy dredge materials have impact on the marine environment. While light materials quickly diffuse and disperse heavy dredge materials have to be managed appropriately. The sediment impact experienced during land reclamation and dredging will not be severe. It is predicted to ape the episodic impact prevalent during maximum flood discharge from the rivers feeding into the creek. To avoid the impact of the heavy dredge materials, it is advisable that it is dumped far off-shore at a depth of about 150m to avoid impacting the coral reef ecosystem and that the dredging and dumping be undertaken during the South East Monsoon period to ensure swift dispersal and locking of the dredge material making them stay at the bottom.

The possible environmental impacts of channel and basin dredging and dumping will be studied carefully in its EIA study by means of numerical simulation.

On the impacts on living and livelihood conditions this study found out that for those to be affected, compensation is acceptable. This therefore needs to be addressed as part of the mitigation measures. However the Project Affected People felt strongly that the proponent should negotiate for compensation with them directly and not through third parties. The EIA study established that structures with religious and cultural significance such as churches, mosques and cemeteries would also be affected by the proposed project.

Vehicular traffic and maritime operations is a feature of this project, hence their impacts and mitigation measures were also considered in this project development. Traffic Volume study was undertaken on the roads expected to be affected by traffic from the proposed terminal such as Magongo Road, Port Reitz Road and Airport Road. The study established that expansion of both Airport and Port Reitz roads would provide adequate exit for traffic from the proposed terminal. However there were fears of this volume of traffic creating a jam at Changamwe roundabout. The study proposes a more elaborate expansion that would seethe three-lane highway extended all the way to Kwa Jomvu on the Nairobi Highway.

A similar study was undertaken on Jomo Kenyatta Highway at Kibarani to look at the viability of the alternative proposal to have an access road from the port joining Nairobi bound traffic just before Changamwe roundabout. The study found that injecting additional heavy trucks onto this road was would suffocate if further, given the road already experiences traffic jam during peak hours. It was therefore advised that this proposal be abandoned.

The environmental management plan for this project addresses issues relating to mitigating the impacts of dredging, vessel traffic, sewage management, oil spills, non sanitary wastes, land restoration, mitigating socio-economic impacts among several measures. For sustainability, the EMP is complete with those responsible for the actions proposed and their costing elements. To this effect an Environmental Monitoring Program has also been developed.

Public consultations and participation meetings were held to sensitize all stakeholders and obtain feedback, which was used to inform the study report. Three such consultations were held. The first meeting was called by KPA to brief stakeholders on key components of the project and the area(s) affected by the project, and also to introduce the EIA Consultancy Team and request for full cooperation with the team from the stakeholders. The second public hearing was called by the Project proponent (Kenya Ports Authority) and the Environmental Impact Assessment consultants to brief Stakeholders (SH) and Project Affected People (PAP) on the preliminary findings of the Socio-economic field study and share with them views and opinions on matters related to land acquisition, compensation and resettlement, while the third meeting was to present to stakeholders findings of the project's Environmental Impact Assessment study.

This study therefore concluded that the most significant adverse effects evident from this EIA study are the need for involuntary resettlement; interference, demolition or relocation of structures with cultural or religious significance such as mosques, churches and cemeteries; and the need for dredging and dumping of dredged material. The study recommends that the proponent should prepare an elaborate Resettlement Action Plan, in accordance with the best international practice to alleviate the adverse effects of involuntary resettlement. Demolition of structures with religious or cultural significance should, as much as possible be avoided but in case unavoidable adequate compensation should be provided. Dredging and dumping should be done taking into account ocean dynamics so that these activities do not effect negatively on coral reefs, mangroves and marine protected areas in general.

This study proposes that the project be allowed to proceed subject to an undertaking by the proponent to implement the proposed mitigation measures, and carry out continuous environmental monitoring during project implementation to ensure effectiveness of the proposed measures.

1.0 INTRODUCTION

Kenya Ports Authority, KPA is a statutory body under the Ministry of Transport set up by an Act of Parliament (Cap 391) in 1978. The Authority's mandate is to maintain, operate and improve all scheduled seaports situated along Kenya's coastline. Scheduled Ports include Mombasa, Lamu, Malindi, Kilifi, Mtwapa, Kiunga, Shimoni, Funzi and Vanga.The Port of Mombasa is Africa's second largest port in terms of tonnage and containers handled, the largest port being Durban of South Africa. Mombasa has experienced considerable growth in the past 5 years in particular in the container segment. Mombasa, after Durban and Port Louis, experienced the largest growth at approximately 17%. It is one of the two international trade ports located along the African East coast together with Dar Es Salaam (Tanzania), and is currently the only ocean-going trade port in Kenya.

Kilindini harbour serves as the main port of Mombasa, with an average annual shipping of about 1700 ships. The port handles various imports and export items. Among the major exports include coffee, petroleum products, meat and meat products, hides and skins, pineapple and tea. Main imports include industrial and electrical machinery, crude petroleum, assembled motor vehicles and chassis, iron and steel, agricultural machinery and tractors, pharmaceuticals, fertilizers, textiles, mineral fuels, chemicals, food and live animals. The harbour has 16 deep water berths with an average of 10 m draft and a total length of 3044 m; two bulk oil jetties and one cased oil jetty; two container terminals with a total length of 964m; two bulk cement berths with cement silos, each with 6000 tone capacity; two lighterage and dhow wharves; and one explosives jetty.

Inwards, the harbour extends into Port Reitz creek, which has extensive areas of mangrove trees, mud flats and banks. The creek is characterized by varying depth, with upper zones being shallow, often less than 10 m deep. The channels fringing mangroves have depths below 5.0 meters. The perennial Rivers Mwache, Mambone, and Chasimba (Pembe) feed into the larger Port Reitz creek, and are drawn into the Indian Ocean via the Kilindini Harbour. The lower sections forming the Kilindini channel where the main harbour is situated have been dredged to deepen the channel and providing water depths that range from 30 – 40 meters (Kamau, 2002)

After Durban, Mombasa is the best connected port in the region, with 17 shipping lines calling and direct connectivity to over 80 ports. Mombasa holds a consistent 80% market share on transit trade to Uganda, Rwanda, Burundi and Eastern Democratic Republic of Congo.

1.1 Requirement for an Environmental Impact assessment Study

As a condition for funding the Japan Bank for International Cooperation JBIC requires that Kenya Ports Authority undertakes an Environmental Impact assessment so that environmental and social considerations are taken into account during project implementation.

This conforms to the requirements of the Environmental Management and Coordination Act which states in Section 58 that '…any person being a proponent of a project, shall, before financing, executing or conducting any project specified in the Second Schedule of the Act undertake or cause to be undertaken at his expense an environmental impact assessment study…'

1.2 Present Environmental Conditions within Mombasa Port and its Environs

1.2.1 Management Structure

Kenya Ports Authority has made significant strides towards developing infrastructure for environmental management. The Authority has a full-fledged Health, Safety and Environment department within the Human Resources Division. The department is headed by a senior manager and is charged with the task of coordinating health, safety and environmental issues within the port. There is a Health and Environment Officer reporting to the HSE Manager who is responsible for implementation and enforcement of all environmental regulations. The Authority also has a Pollution Control Officer within Operations Department who is charged with the responsibility of oil spill and general maritime emergency response and management of ship generated waste.

1.2.2 Water Quality

Water quality within the port has deteriorated due to both onshore and offshore activities. Main sources of pollution include:

Marine Vessels: Both cargo vessels and the ports marine craft pose risk of water pollution discharges (accidental release of fuels or lubricants). This may come as a result of vessel collisions, vessels running aground or vessels colliding with stationary structures.

Operations: Cargo operations especially liquid bulk from port users (oil marketing companies, importers and exporters of edible oils). Spillage may occur during truck loading, pumping or faulty tankers. In most cases the spill finds its way into surface water drain and eventually into the sea.

Dry Cargo releases: There have been complaints of excessive dust releases during offloading of coal or clinker (for Bamburi Cement), soda ash (Magadi Soda, Fig 1.1) and occasionally during discharge of bulk grain (Grain Bulk Handlers Ltd). Some of the material finds its way into the ocean raising the Chemical Oxygen Demand (COD) to levels that may not be conducive for the survival of marine life.

Figure 1.1: Spill of soda ash from Magadi Soda conveyor belt

Water front industry discharges: Industries in the neighbourhood of the port discharge untreated sanitary and industrial wastes into the sea. There is also effluent from the Municipal sewage treatment plant (Fig 1.2) that is currently not functioning, consequently discharging raw sewage into the sea. Unfortunately this situation still prevails.

Figure 1.2: Untreated effluent from Municipal treatment plant discharges to sea

Studies have indicated that the water quality in the area is already poor, rich in nutrients and contaminated with high concentrations of heavy metals. Pollution by faecal matter has also been reported by Mwangi et. al., while that for oil has been reported by Norconsult (1975) and Munga et. al (1993).

Part of the pollution was for a long time attributed to the Municipal Dumpsite at Kibarani near Makupa Creek. The dumpsite was decommissioned in 2002 and is now only used ocassionaly as a holding site for transshipment of waste to the current dumpsite located at Mwakirunge in the mainland north.

High nutrients 0.2-36 mg/l subset nitrates, 0.1-7.7 mg/l subset reactive phosphate and indicator bacteria 13-90,000 coliforms/100ml, 13-17,000 E-coli/100ml, have been reported in the adjacent Makupa Creek, (Mwangi et.al). This water of low quality finds its way into the Kilindini creek, which also receives its own share of untreated sewage. Despite this, the area has shown resilience with an abundance of copepods. It can be predicted with a fairly good degree of certainty that the status quo can be maintained even with the coming up of the proposed container terminal and its operations in the area. This prediction should be understood in the light that the new facility will not handle any nutrient rich materials, will not generate large volumes of human wastes in its operations, nor will it deal with the known heavy metals that have already impacted the area. Similarly, as a result of the complete mixing of the water in the creek due the dominance of tidal currents and the rugged bottom topography (Odido 1987), contaminants, if any, would quickly be diluted, spread and dispersed.

1.2.3 Air Quality

Presently sources of air pollution within the port include:

Dry Cargo Releases: As described above there is release of significant quantity of dust into the environment during offloading of dry cargo. Some of this is released as fine airborne dust, thereby lowering the ambient air quality standards. (See Fig 1.3)

Figure 1.3: A grab discharging clinker into a truck

Road Traffic: Traffic within the port generate fugitive dust from unpaved roads and road shoulders. A considerable number of local delivery trucks are poorly maintained and emit thick black smoke with considerable quantities of carbon monoxide.

Port Equipment: Equipment such as forklifts, tugmasters, trailers also emit pollutants into the environment. Although most port equipment are well maintained they are quite many in numbers and this combined with the frequency (most container handling equipment are used continuously for 24 hours) of use makes the emission from equipment significant.

As part of the EIA process SGS Kenya Limited were contracted to carry out air quality measurements at 19 points along the Kenyan coast at Mombasa on various dates between 4th and 7th October 2006. The measurements were to identify the concentration of pollutant releases in the land based receptor areas. The pollutants targeted in the air quality measurements were Carbon Monoxide (CO), Nitrogen Dioxide (NO_2), Sulphur Dioxide (SO_2), Hydrogen Sulphide (H_2S) and Particulate Matter (PM). SGS Kenya Limited is accredited by NEMA for environmental sample collection and analysis. The results are as shown in the appendix.

On the basis of the measurement results, the survey results were found to be within the World Health Organization Air Quality Guideline Values. The prescribed WHO values for the key pollutants Nitrogen Dioxide and Sulphur Dioxide are 200µg/m^3 per 1hr mean and 500µg/m^3 per 10 minute mean respectively. It was concluded therefore that other than occasional incidents of fugitive releases the air pollution within the port does not present risk to human health.

1.2.4 Sediment Quality

Previous studies have indicated certain areas of the port are contaminated with heavy metals. However samples extracted during the study indicated levels that fall within the targeted values for open water disposal testing values presented in World Bank Technical Reports No 126, 1990. (Ref. Test Reports No. 06-2066 A, 06-2066 B, 06-2066 C). This is discussed in great detail in Chapter 7.

1.2.5 Ecosystem

Habitats and Eco-system along the shoreline in the vicinity of the project site encompasses four different zones. These are: the creek waters, the beach, inter-tidal zone, and the mainland. In the Creek waters the planktonic organisms inhabiting the creek waters are mainly phytoplankton and zooplankton. Of the zooplankton, the most dominant group is the copepods. Copepods are important organisms in the water because of the role they play as food for fish, larvae of prawns and other important crustaceans.

The beach area is predominantly sandy. Dominant organisms in this area are Ghost crabs *Ocypode* spp (Ocipodidae). On the mainland several species of trees and shrubs are found. They are denser at the cliff edge as compared to the proposed site.

Notable conservation areas in the neighbourhood of the Port include:

- The Mombasa Marine Park: Located about 15 km from the proposed site;
- Shimba Hills National Park: This is located in Kwale District, approximately 50 km from the site.

The Ecosystem around Mombasa Port and the project area is covered in greater detail in Chapter 8 of this report.

1.3 Terms of Reference for Environmental Impact Assessment

The following Terms of Reference for the Environmental Impact Assessment (EIA) of the proposed New Container Terminal Project were are adapted in accordance with the World Bank and NEMA environmental impact assessment guidelines.

1. *Introduction – The consultants would identify the development project to be assessed and explain the executing arrangements for the environmental assessment. This chapter of the report would detail the rationale for the development and its objectives. Also to be covered is the context of the proposed project in relation to future plans for development of Mombasa Port.*

   Deliverable: A detailed project outline would be given to familiarize stakeholders on the project objectives and scope.

2. *Background Information – The experts would highlight the major components of the proposed project, the implementing agents, a brief history of the project and its current status including a justification as to whether the project is indeed necessary.*

Deliverable: Major project components will be documented, including current and projected container volumes and project justification made.

3. *Study Area – Specification would be made of the boundaries of the study area as well as any adjacent or remote areas considered to be affected by the project such as dredged material disposal sites, area projected for relocation of displaced persons, reclaimed land etc.*

   Deliverable: Study areas to be clearly identified so that all social and environmental issues are catalogued and analysed.

4. *The following tasks will be performed:*

   Task 1. Description of the Proposed Project - a full description of the relevant parts of the project, using maps at appropriate scales where necessary. This is to include: quality and volume of sediments to be excavated in each area to be dredged; type of dredging equipment to be used and the manner of deployment including handling, transportation, and disposal of dredged material, sediment containment settling and turbidity control measures; alternative dredging methods considered; project schedule; and life span.

   Deliverable: This would include a detailed project description and scope, and the options available for achieving the project objectives.

   Task 2. Description of the Environment - Assemble, evaluate and present baseline data on the relevant environmental characteristics of the study area (and disposal sites), including the following:

   a) *Physical environment: geomorphology, meteorology (rainfall, wind, waves and tides), sea currents and bathymetry, surface hydrology, estuarine/marine receiving water quality, and ambient noise.*

   b) *Biological environment: terrestrial and marine vegetation and fauna, rare or endangered species, wetlands, coral reefs, and other sensitive habitats, species of commercial importance, and species with the potential to become nuisances or vectors.*

c) *Socio-cultural environment: shipping and fishing activities and use of the port, population, land use, planned development activities, employment, recreation and public health, community perception of the development, vulnerable occupants. Field survey would also e conducted on the number of households to be displaced and areas of resettlement and land acquired for the project.*

d) *Hazard vulnerability; vulnerability of area to flooding, hurricanes, storm surge, and earthquakes. Also to be included here is maritime accident survey including ship collision, oil spill from ships and from land based industrial activities.*

The consultants would characterize the extent and quality of the available data, indicating significant information deficiencies and any uncertainties associated with the prediction of impacts.

Deliverable: Baseline environmental information, comprising physical, biological and socio-economic conditions associated with the site will be assembled and evaluated, including assumptions and limitations.

Task 3. Legislative and Regulatory Considerations – A description of the pertinent legislation, regulations and standards, and environmental policies that are relevant and applicable to the proposed project, and identification of the appropriate authority jurisdictions that will specifically apply to the project.

Deliverable; All relevant legislative, regulatory and institutional arrangements applicable to project will be summarized and presented.

Task 4. Determine the Potential Impacts of the Proposed Project –

Identification of impacts related to dredging, spoil disposal and possible land filling. Also to be identified are impacts related to road construction, land reclamation and construction of office buildings and associated facilities. A distinction will be made between significant impacts that are positive and negative, direct and indirect (= triggering), and short and long term. Identify impacts that are cumulative, unavoidable or irreversible. Identify any information *gaps and evaluate their importance for decision-making. Special attention will be paid to:*

- *Effects of the project (dredging and spoil disposal) on water quality and existing coastal ecosystems and resources,*
- *Effects of dredging on the coastal stability of adjacent shorelines,*
- *Effects of dredging works on the existing operations of the port, fishermen, and on the rights/operations of any other stakeholders,*
- *Effects of the project on future port development and the tourism sector,*
- *Effects of the project on maritime, boating and road traffic,*
- *Effects of the project on ambient noise levels, and*
- *Effects of the project on any historical resources.*

<u>Deliverable:</u> All potential impacts (both positive and negative) likely to result from the development will be identified and ranked in an environmental impact matrix.

<u>Task 5. Analysis of Alternatives to the Proposed Project.</u> – A Description of the alternatives examined for the proposed project that would achieve the same objective including the "no action" alternative. This includes dredging vessel types and disposal sites, alternative traffic routes and alternative resettlement plans. Distinguish the most environmentally friendly alternatives.

<u>Deliverable:</u> Project alternatives would be identified and analysed and a justification made as to why the chosen sites, methods and plans constitute the best practicable environmental option.

<u>Task 6. Mitigation and Management of Negative Impacts</u> – The consultants will identify possible measures to prevent or reduce significant negative impacts to acceptable levels with particular attention paid to dredge spoil disposal and dispersal/sedimentation control, as well as measures to minimise disruption to existing port operations. Costing will be made of the mitigation measures and equipment and resources required to implement those measures. Proposals will be made for investigating claims for compensation put forward by affected stakeholders.

<u>Deliverable</u>: A detailed environmental management programme will be developed to reduce the effects of the negative environmental impacts and enhance the impacts considered beneficial to the proponent and the community.

<u>Task 7. Development of a Monitoring Plan</u> – Identify the critical issues requiring monitoring to ensure compliance to mitigation measures and present impact management and monitoring plan for such issues.

<u>Deliverable</u>: An environmental monitoring plan will be prescribed to ensure that the proposed mitigation measures are effected and the desired remediation effects achieved.

<u>Task 8. Assist in Public Participation and Consultation</u>

The consultants would identify appropriate mechanisms for providing information on project activities and progress of project to stakeholders, assist in co-coordinating the environmental assessment with the relevant government agencies and in obtaining the views of local stakeholders and affected groups. (It is anticipated that there will be considerable public interest concerning issues of sediment disposal and turbidity with respect to fishing activities, and the economic benefits to be derived from the project.)

<u>Deliverable:</u> Public consultation will be conducted and stakeholder views documented. Where necessary the consultants would conduct stakeholder workshops to collect and collate stakeholder views.

<u>Report</u> - The environmental impact assessment report, to be presented in electronic and hard copies, will be concise and focus on significant environmental issues. It will contain the findings, conclusions and recommended actions supported by summaries of the data collected and citations for any references used in interpreting those data. The environmental assessment report will be prepared in the format prescribed by NEMA, the outline of which is as follows:

- *Executive Summary*
- *Description of Proposed Project*
- *Policy, Legal and Administrative Framework*
- *Identification of Environmental Impacts*

- *Impact Mitigation Measures*
- *Impact Monitoring Plan*
- *Public Consultation and Participation Process*
- *Appendices/List of References*

2.0 PROJECT DESCRIPTION

Kenya Ports Authority in conjunction with Japan Bank for International Corporation (JBIC) intends to construct a new Container Terminal by reclamation of the West Kipevu to create an additional 3 berths. In parallel with the proposed project, as relevant projects, the expansion of the existing Port Reitz and Airport roads and dredging of the access channel connecting the new container terminal with the open sea and a turning basin in front of the new container terminal are going to be implemented by Kenya's Ministry of Roads and Public Works and KPA respectively. The reclaimed land is estimated to be 100 Ha for the West Kipevu Project.

2.1 Project Components

The proposed project consists of construction/procurement of the following components (Fig 2.1 and 2.2)

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2.1.1 Quaywall

Two proposed berths No. 21 and 22 on the approach side (eastern side) will be constructed with a quay wall of depth of 15m on completion of the project. It has possibility of being deepened by an extra 1 metre in future whenever the demand for this expansion will be justified. The two berths will have a length of 670m. The 3rd berth No. 23 on the western side will have a quaywall of length of 230m and a depth of 12m at the time of completion of the project. It will also have a possibility of being dredged by an extra 4 meters in future. The designed depth of all the quaywalls will thus be 16m.

Two small side berths will also be created. The side berth on the east perpendicular to the 15m quaywall will have quaywall No.20 with a depth of 11m at the time of completion of the project. The inner berth next to the 11m deep berth will have a depth of 4.5m for work vessels. The two berths will have a length of 190m and 80m respectively.

The most possible type of quaywall is a pier structure with a number of steel pipe piles. In order to construct a firm foundation for the quay wall, 0.7 million m^3 of exsiting soft seabed material will be dredged out and replaced by sand which will be harvested from approximately 3km off-shore Shelly Beach. The dredged material (mostly silt) will be dumped at a designated dumping location. The planned harvesting and dumping sites are indicated in Fig 2.2.

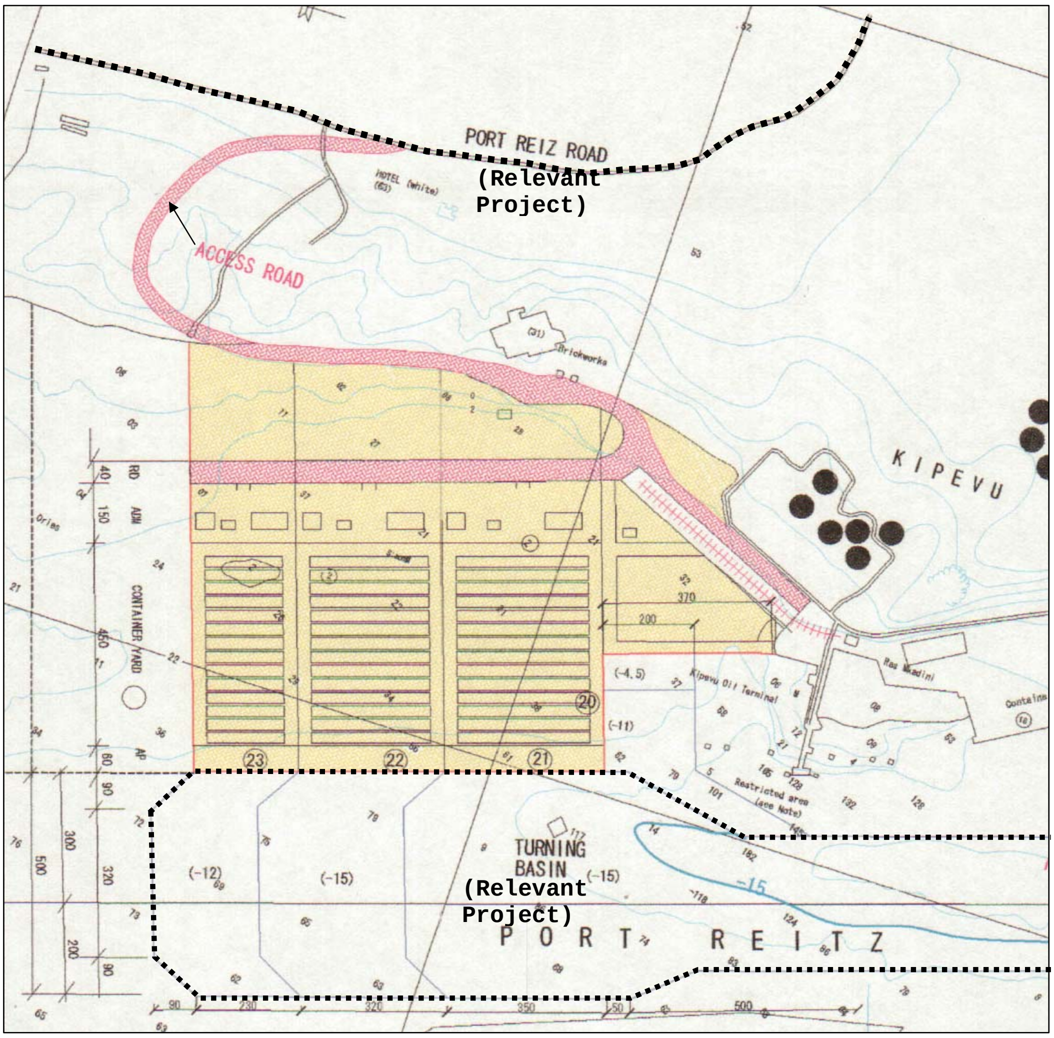


Figure 2.1: Layout of the proposed new container terminal.

2.1.2. Container Yards

The proposed container terminal will have a total area of 100ha, and is planned as described above. The container-stacking yards consist of three berths. Each berth has 14 stacking slips set separately bringing the Total Ground Slot (TGS) to 10,080 Twenty foot Equivalent Units (TEUs). A TEU is unit for measuring container storage such that a space for two 20 foot containers is equivalent to one 40 footer. The apron width would be 60m, 5m of which would be used as the running lane of the yard trucks which load/unload containers when vessels are packed alongside the berth. This lane will also be used by trucks that haul reefer containers so that they would not interfere with operations of other trucks running under the gantry cranes.

Empty containers would be stacked at Empty Container Depot, ECD for which space is secured around container repair shop/washing area.

To handle the forecasted container cargo, primary handling equipment, such as ship Ship to Shore Gantry (SSG) crane, Rubber Tyred Gantry (RTG) cranes will be deployed. To create room for the Container Yards about 100 ha would have to be reclaimed and replaced by about 7.5 million m^3 of sand which will be harvested from the sites indicated in Figure. 2.2.

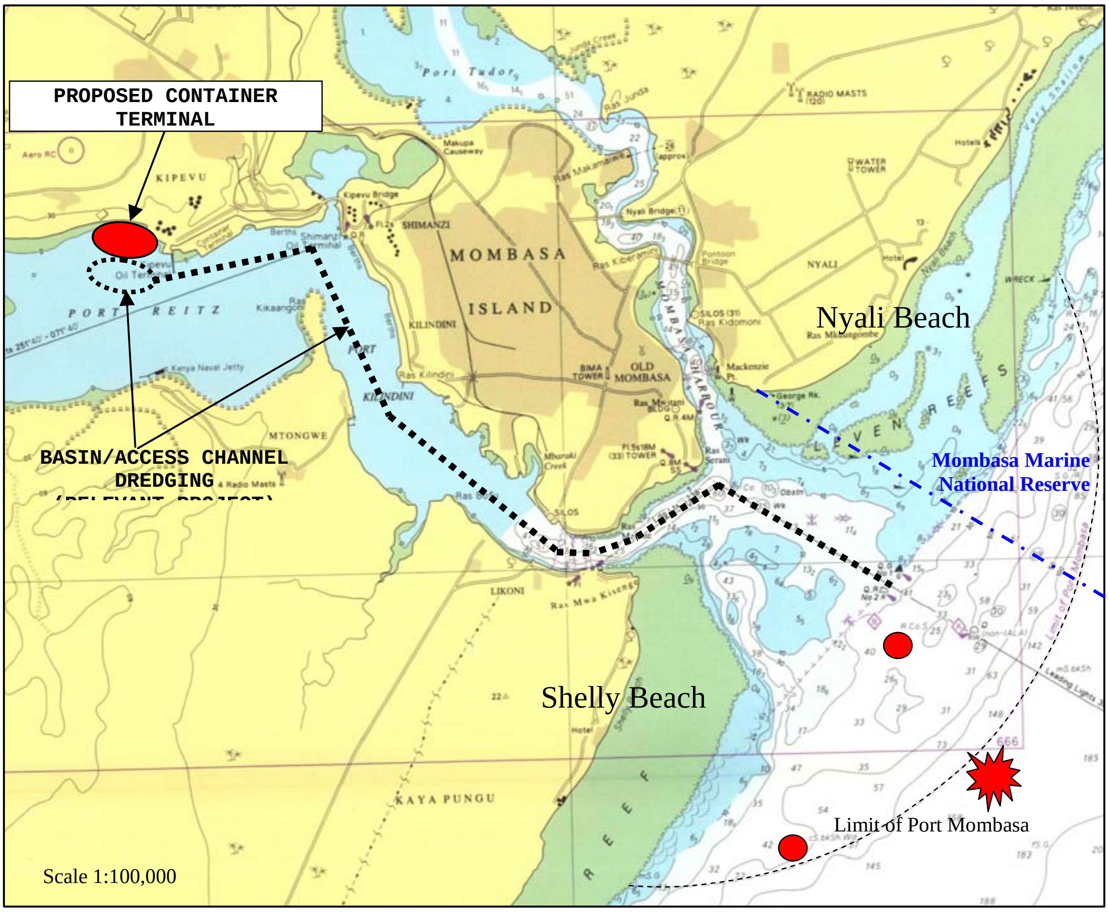


Figure 2.2: Map of tthe project sites (also showing proposed container terminal site, sand harvesting sites (red circles), proposed dumping sites (star banner) and Mombasa port limits

2.1.3 Buildings

Access road gate, terminal main gates, container gates, operation buildings and maintenance workshops are some of the facilities to be incorporated in the Project. The operation building would accommodate all functions of the terminal operations except maintenance. The terminal main gate is the entrance into the container terminal. The container gate is located in the inner side of the main gate. The area between the main gate and the container gate is reserved as the waiting zone of external tractors. All the tractors that enter into and get out of the terminal would pass through the container gate. Five inward lanes and two outward lanes, including one dual lane would be provided.

To enforce the axle load control limits for the trucks leaving the container terminal weigh-in-motion bridges will be installed at the gates of the new yard. This will ensure that overloaded vehicles are restrained from damaging the new road pavement and prevented from joining the road network. The weighing-in-motion system will also ensure speedy weighing and inspection of vehicles. To facilitate the function of the weighbridge an extra parking area will be set aside for offloading overloaded vehicles.

2.1.4 Access Road

In order to cope with the increase in traffic volume expected as a result of the project there is a proposal to develop a new access road at West Kipevu from the New Container Terminal to existing Port Reitz road. The access road has a gentle slope of less than 4% which is planned in consideration of the effect of a steep slope of more than 13% and the frequency of accidents on the already existing access roads. The road would consist of the following two portions:

- Internal road on the reclaimed land (width: 50m x length: 1.3km)
- New access road from the reclaimed land to existing Port Reitz road (width: 30m x length: 1.5km)

The required capacity of the new access road is about 750,000 TEUs per year.

2.1.5 Railway

In the proposed New Container Terminal, there will be a New Terminal Railway Station which has four rail lines for the operation of Rail Mounted Gantry Cranes (RMG). This would occupy space approximately 452m x 45m.

2.2 Relevant Projects

In order to ensure efficient operations of the new container terminal, the following relevant projects are going to be implemented in parallel with the proposed project.

2.2.1 Dredging

The Access Channel, which will lead ships to the New Container Terminal from the open sea, will be dredged to a depth of 15m as a two-way channel with a width of 300m. The turning basin next to the New Container Terminal will also be dredged to a depth of 15m on sections facing the 15m-deep quaywall and to a depth of 12m on sections facing the 12m-deep quaywall. The entire turning basin will have a width of 500m. The total volume of dredged material is estimated at 6 million m^3. This project will be implemented by KPA financed by Belgium Government.

2.2.2 Access Road

The Existing Port Reitz and Airport Roads will be widened in order to ensure smooth connection and traffic flow with the planned access road. This project will be implemented by Kenya’s Ministry of Roads and Public Works.

2.3 Justification for the Project

2.3.1 Rapid Increase in Volume of Containerized Cargo

Existing port facilities for container handling in Mombasa Port are located at the container terminal with 600-m long wharf (berths No.16 - 18) and neighboring general cargo berths of 750-m long (berths No.11 – 14). The port currently handles various cargoes including dry bulk, liquid bulk, conventional cargo and containers. Most of the cargoes are increasing and, among them, the growth of the container cargo is very high recording 380,000 TEU in 2003 and 439,000 TEU in 2004 (Fig. 2.3). There was however a slight decline in container volume to 437,000 TEU in 2005 due to problems with power supply to the quayside container cranes at the Terminal.

This volume of the container cargo already exceeds the estimated capacity of the existing container terminal and neighboring berths of Mombasa Port (berths No.13 – 18, approximately 400,000 TEU/year). It is forecasted that the growth of the container cargo will continue and within ten years, the containerized cargo volume will be doubled. The expansion of the container terminal and the modernization of the container handling operations are urgently needed in Mombasa Port.

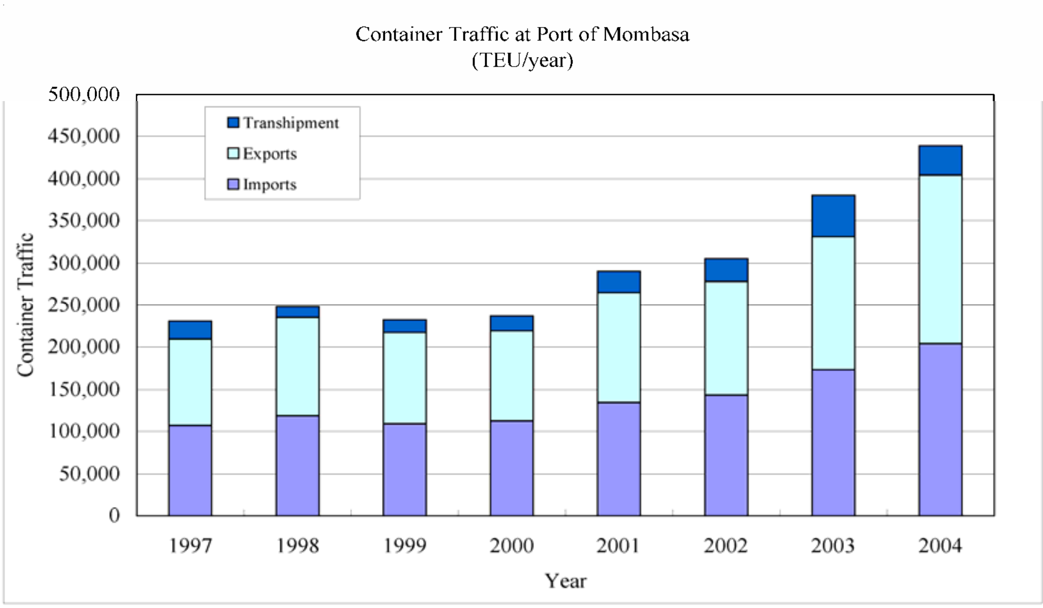


Figure 2.3: Container traffic at the port of Mombasa between 1997 – 2004

2.3.2 Inadequate Capacity of Port Access Roads

The road network around Mombasa Port is not adequate for cargo traffic from the port. There is also heavy traffic jam along all port exit roads due to this inadequate capacity. In addition, heavily loaded vehicles have to climb up the steep hills with about 40 m difference of elevation along the following roads:

In Kibarani, from Makande junction to Changamwe round-about;

Up Kipevu bridge from Kapenguria to KenGen gate within the port;

From gate 18 to Changamwe round-about.

Gate 18 located at the vicinity of the entrance to the container terminal behind the berths No.18 to No.16 is the main entrance for cargo trucks with 80 % of the traffic through this gate is being container trailers. It is in the middle of the steep slope (approximately 5 %) and there is no space for truck parking, so it is always congested. The road has only two lanes despite its being an important access/exit to the port.

2.3.3 Competition from Other Ports

Increasing competition from other ports such as Dar Es Salaam and Durban, among other regional ports calls for better efficiency in service delivery in terms of vessel turn-around time and time taken to haul the cargo to the end users.

2.4 Consideration of Alternatives

In addition to the proposed project there have been two major development plans proposed by Pacific Consultants International (PCI) and Royal Haskoning (RH). These alternatives are as described below:

2.4.1 Plan 1: Proposal by PCI

Pacific Consultants International proposed a triangular reclamation in front of the existing East and West Kipevu Container Terminal of length: 1,100m with water depths of 15m (Length: 900m) and 11m (Length: 200m) as illustrated in Fig. 2.4. The capacities assessed by PCI before and after the project are shown in Table 2.1. The area newly created by this plan is about 15 ha.

It was however noted that the projected expansion would not meet the expected demands in 2020. It would have become necessary to undertake another project after 2015. This would require significant capital injection and KPA have been forced to reapply for further financing. The approval process would take unto 2 years, creating a period of stagnation during this time.

Table 2.1: Container Terminal Capacity under the Project proposed by PCI

Terminal Name	Under present conditions		After Proposed project	
	Total Ground slot (TEU)	Annual Capacity (TEU)	Total Ground Slot (TEU)	Annual Capacity (TEU)
West Terminal	2,163	263,000-296,000	3,666	573,000
East terminal	1,296	158,000-177,000	2,556	398,000
Others	500	50,000-75,000	-	-
Total	3,956	471,000-548,000	6,222	971,000

Source: PCI Report (2005)

It was also noted that the actual storage capacity is presently about 8,000 containers (4 high) at the West Terminal and 3,500 containers at the East Terminal mostly consisting of empty containers. The average dwelling time is 18 days for import containers and 4 days for export containers. The storage capacity is about 10,700 TEU at West and East Terminals respectively, or a total of 15,400 TEU. The annual total handling capacity could be estimated at around 500,000 TEU per year at the present Kipevu Container Terminal. The actual performance was 437,000 TEU in 2005 for all the port including the convectional berths. The dwelling time of 18 days was considered to be too long.

Alongside this proposal came the Makupa Access Road. Under this proposal it was proposed that a new access road be built through Makupa Creek to Kenyatta Avenue near Changamwe Roundabout (Kibarani Area). This proposal was rejected after the EIA study found that:

The proposed construction was going to further congest Kenyatta Highway. Kenyatta Avenue already carries an outbound traffic volume averaging 800 vehicles per hour (see traffic volume survey) and at peak hours heavy traffic jam is experienced at both Makupa Roundabout and Changamwe Roundabout.

The design of Kenyatta Avenue is such that the slope from Kibarani to Changamwe Roundabout is over 50, which is too steep for heavy commercial vehicles. This has resulted into frequent breakdown of loaded trucks causing traffic jams and posing safety risks to other road users. Injecting more port traffic into this road would have worsened this situation.

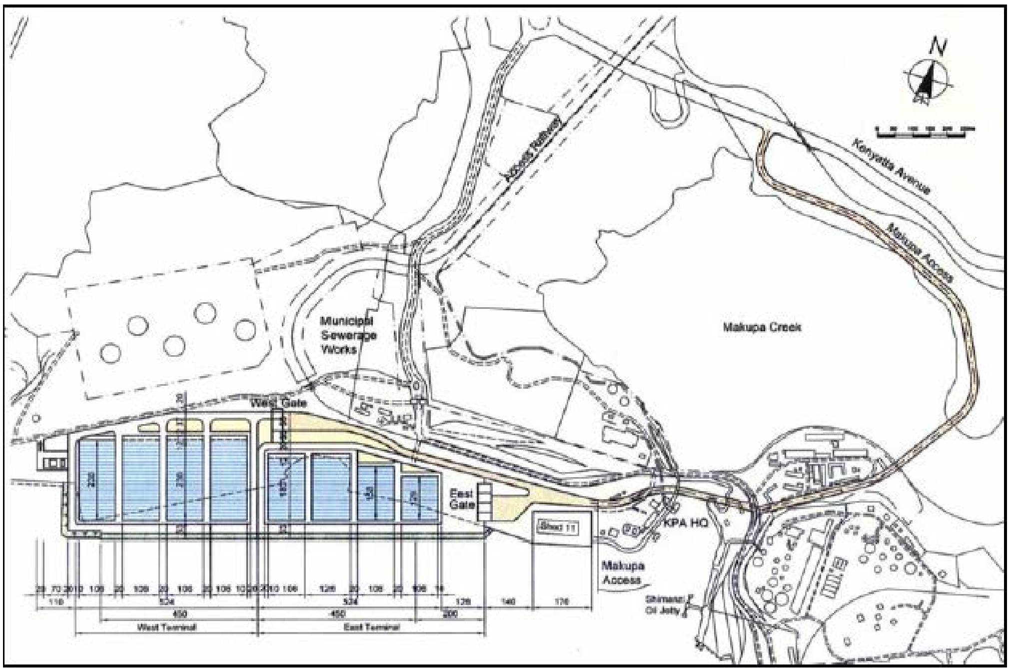


Figure 2.4: Sketch of Terminal Extension proposed by PCI, 2005

2.4.2 Plan 2: Proposal by RH (Master Plan)

Royal Haskoning (RH) proposed a development plan shown in Figure 2.5 below. The proposal adopted the design ship of 4,500 TEU and paid attention on how to rehabilitate the existing facilities and increase the capacity of the overall Mombasa Port. The project components and expected capacity enhancement are as shown in Table 2.2.

Phase 1 of the project has been underway, except reclamation of Berth No.19. The effect of reclamation however does not significantly increase the storage capacity. Phase 2 of the project, which comprises of reclamation and streamlining of the East Terminal also does not provide a significant increase in capacity in consideration of the investment cost. The two phases would however serve to inject additional life to the berths.

Phase 3, or renovation of Kilindini port, has a significant effect in contributing the capacity enhancement. Phase 4 would have included installation of 2 Ship to Shore Gantry (SSG) Cranes on Berth 4 to 6, which effect is also assessed by Royal Haskoning and found to be significant in terms of enhancing turn around time of vessels.

The other disadvantage of this proposal is that it would have significantly interfered with the smooth operations at the port since the affected berths would be closed during the times of rehabilitation making them unavailable for container handling.

It is noted that RH did not propose reclamation of the area of Berth No.15, because:

it would have little effect on adding extra storage area and quay length, and poor seabed soil conditions at the area.

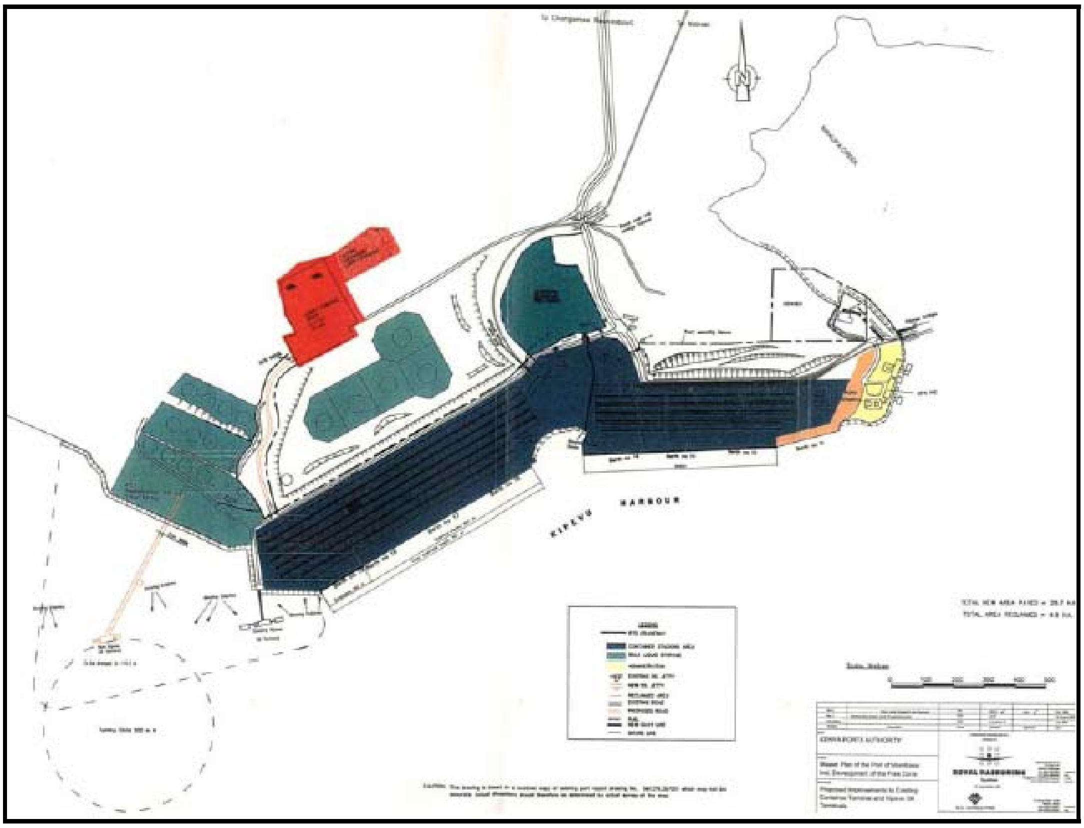


Figure 2.5: Sketch of terminal expansion proposed by Royal Haskoning

Table 2.2: Container Terminal Capacity of the Project proposed by Royal Haskoning

Phase	Time To Be Executed	Terminal Name	Major Project Components	Capacity (TEU pa)
1	As soon as possible by 2008	Kipevu Container Terminal	-Reclamation of Berth No.19 (length 160m) for 2,000 TEU ships (Water depth=12.2 m) (Area: Increase of about 5 ha) -Demolishing Sheds 11 and 12 -Installation of 4 SSG on Berth Nos. 16 to 19	634,000
2	By 2013	Kipevu West Container Terminal	-Straight lining of Berth Nos. 12 to 14 (Length 600m) for 4,500 TEU ships (Draft=13.5m) (Water depth =15m). (Area: No Increase) -Installation of 3 SSG on Berth Nos.12 to 14	251,000 (Accumulated: 885,000
3	By 2021	Kilindini Container Terminal (KCT)	-Renovation of the existing Kilindini Port at Berth Nos. 3 to 7 and (TGS:3,786 TEU) (Water Depth =15m). -Demolishing sheds 3 to 7 and BOP 2-4 -Pavement of berth Nos. 4 to 7 (Area:25 ha) -Installation of 2 SSG on berths 4 to 6.	
4	By 2026	(KCT)	-Installation of 2 SSG on Berth 4 to 6	332,000 (1,753,000)

Source: Master Plan Study by Royal Haskoning (2004)

2.4.3 Plan 3: The Project (Proposed by Japan Port Consultants), 2006

Japan Port Consultants, Ltd. (JPC) proposed the development plan of a new container terminal on the shore to the west of KOT at Port Reitz as shown in Figure 2.6 It is characterized by reclamation of new yards with a total area of 100ha for three deep berths (total length=900m) for container ships of 60,000 DWT and 30,000 DWT, while leaving the existing port areas basically untouched. The main components include the following facilities:

- Three new major berths with depths of 15m (length: 670m) and 12m (length: 230m), and two new side berths with water depths of 11m (length: 190m) and 4.5m (length: 80m);
- Three new marshaling yards behind the berths with a total area of 32.7 ha each;
- Three new administration areas behind the marshaling yards with a total area of 11.7 ha each;
- Access road and railway loading yard, and
- Green belt/parking areas along shoreline.

The major advantages of this plan are:

♦ simple addition of container handling capacity (berthing facilities, yard areas and equipment), while maintaining the existing capacities (facilities),
♦ No hindrance to the existing container terminals and their operations during the construction period, and
♦ Creation of the basis for future expansion to the west.

Technically, this shore area has shallow water depth of 2m to 3m toward the center of the creek, which is suitable for reclamation works.

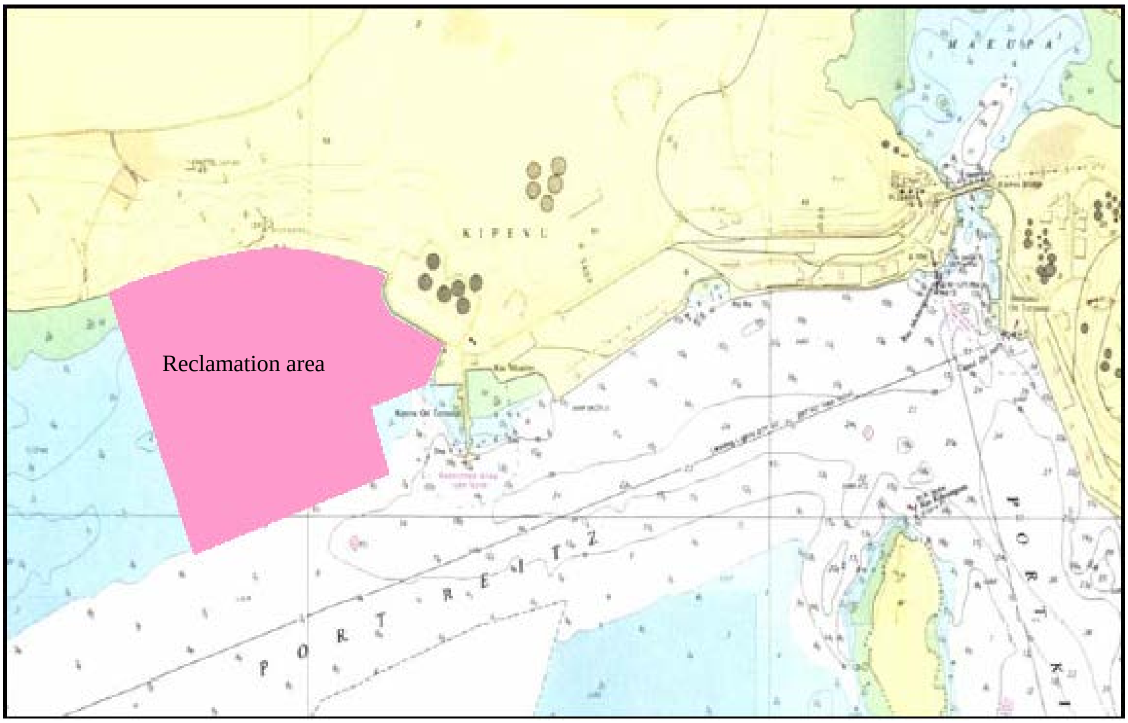


Figure 2.6: Sketch of new container terminal proposed by JPC. Area to be reclaimed is dotted in pink.

The above project alternatives were analysed in terms of their potential environmental impacts and economic benefits and a cost-benefit analysis made. A matrix integrating impacts was used to quantify the impacts of each alternative and a scale of 1-10 used to rate each impact.A high positive value represents a highly beneficial impact while the opposite is also true. Table 2.3 shows the results of this evaluation:

Table 2.3: Analysis of Environmental & Economic Impacts of the Project Alternatives

Impact	Plan 1(PCI)	Plan 2 (RH)	Plan 3 (JPC)
Hindrance to Port Operations	-3	-2	0
Employment	+6	+6	7
Water Quality	-2	-2	-3
Increase in Container Stacking Area	+3	+2	+8
Air Quality	-2	-2	-4
Improvement in General Infrastructure and effect on local community	+3	+4	+7
Requirement for Resettlement/Land Acquisition	-1	0	-2
Traffic Congestion/ Improvement in Traffic Flow	-1	-1	+4
Ecological Impacts	-1	0	-1
TOTAL	+3	+5	+11

It is clear that all the 3 alternatives are beneficial to KPA. However alternative 3 presented by Japan Port Consultants presents the best option interms of trade-off between economic benefits and environmental considerations.

Table 2.4 shows the project elements and construction schedule of the JPC proposal.

Table 2.4: Construction Schedule

Task Name	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	2014
	J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N	J F M A M J J A S O N D	J F M A M J J A S
Phase 1								
Consulting Services								
Detailed Design								
Construction Supervision								
Tender for Construction & Equipment								
Construction								
Container Terminal								
Channel/Basin Dredging								
Access Road								
Cargo Handling Equipment								

Task Name	2007	2008	**2009**	**2010**	**2011**	**2012**	**2013**	2014
	J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N	J F M A M J J A S O N D	J F M A M J J A S
Phase 2 & 3								
Consulting Services								
Construction Supervision								
Tender for Construction & Equipment								
Construction								
Container Terminal								
Channel/Basin Dredging								
Cargo Handling Equipment								

Note: • • • • • • Dotted lines show maintenance period.

2.4.4 Alternatives of Sites for Dumping of Dredged Material

The following sites were considered for dumping of the dredged material:

Alternative – A: Open Water Dumping

A site close to Shelly Beach, approximately 15km from dredging location having -50m as indicated in Fig. 2.7.

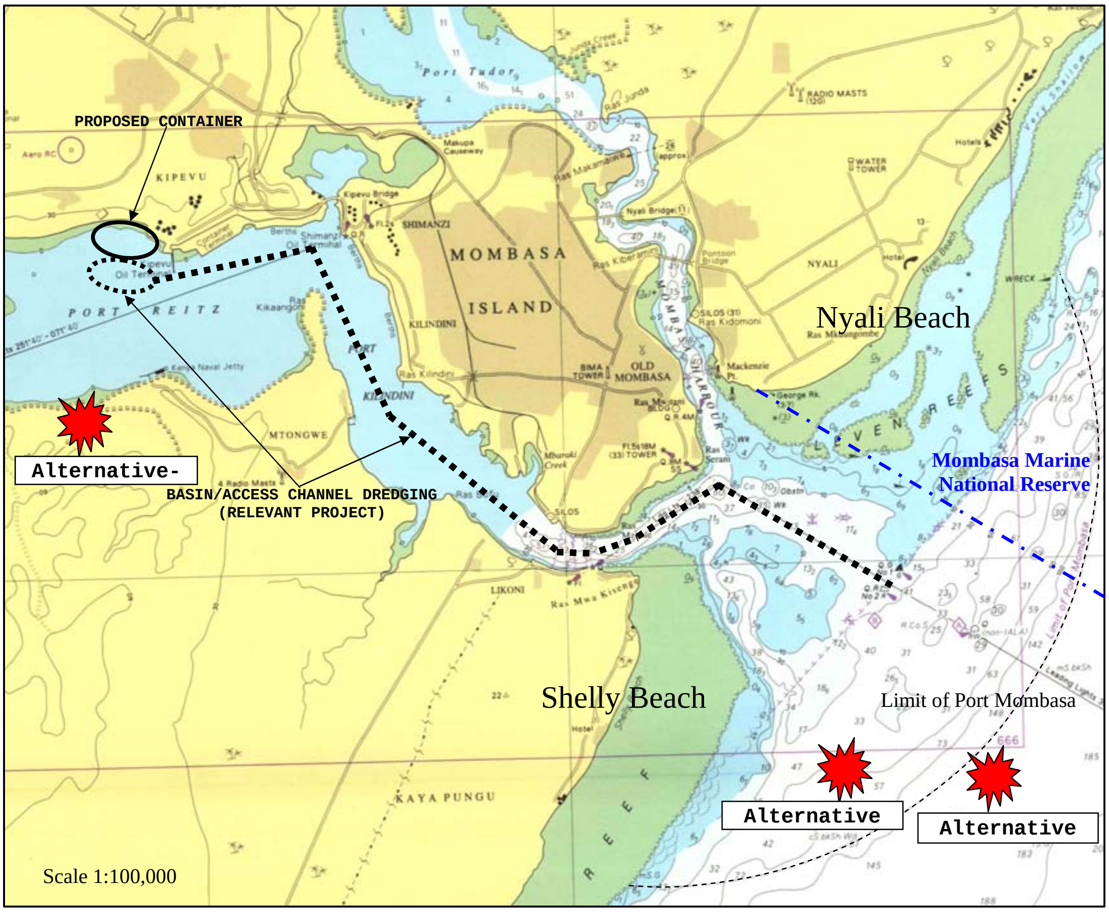


Figure 2.7: Alternative locations for proposed dumping sites

This alternative was discarded because distance from the shore was considered too close to the entrance and might cause plume from discharge material to drift back into the Port with the flood currents. Further, water near the reef at depths 30-60m are too near and not only the plume of the light material but a thin layer cloud of the discharge that is affected by turbulence and ambient tidal currents can be re-suspended and impact on fauna and flora along the reefs and tidal channels. The reason for this is in the behaviour of the dumped material as it is impacted by ambient current and other water characteristics.

Behaviour of the dumped material is affected by water dynamics depending on density of the particles. Light material form the visible plume that is quickly dispersed or spread by wind and surface currents at the site. Heavy material would settle at the bottom, and if at 50m can seriously impact at 50-80m radius. The plume would descend as a convective discharge from the dumping point. When this plume impacts the bottom or arrives at the level of neutral buoyancy the descent is retarded and the plume collapses into thin cloudy layer dominated by horizontal movement, and long-term passive diffusion where the ambient currents and turbulence determine the spreading of the plume. Thus each dumped load is independently convected, diffused and settled according to local conditions. Material concentration impacting at a certain point is the sum of contribution from each amount dumped. It was feared therefore that the impacts would be as far as the adjacent Marine Park, and this would be a recipe for a conservation war locally, regionally and internationally.

Alternative – B: Open Water Dumping.

A site further offshore, depth of 150m and a distance of about 6 km from entrance of the Port as indicated in fig. 2.7.

The advantage of open water site which is 5 km off shelly beach is that the local current at the site is the main East African Coastal Current that travel northward all the year round. The topography is such that the bottom shoals steeply form 200m to 40m depth within a distance of less than 3km away from the fringing coral reef found in this area. Nearer the shore where the topography grades to depth of 10m and tidal currents and waves become important and their impart is such that the effective oftidal excursion is less than 2km. Near the fringing reef is found the coastal front of which ocean ward extension is within the distance due to tidal excursion. This means material disposed beyond the front zone are placed totally in the main coastal current proper and have limited chance of drifting back to the shallow areas and impacting on the ecosystems there such as corals reefs and seagrass beds.

The area considered for disposal is within the limits of the Port and has been used before for dumping of the dredged material from the harbor channel. This time the recommendation is that the disposal be made in deeper water further offshore. No significant fishery is found in this port area.The seabed material at 200m is likely to be fine mud similar to the disposal material and hence would not introduce significant impact. However, this site may prove expensive in terms of distance and the uncertainties of not having base line hydrographic data, which would have been well simulated by numerical model applied to the disposal site.

Considering the large amount of dredged material to be dumped in a relevant project (access channel and basin dredging), detailed study on turbid water dispersion by means of numerical simulations are going to be carried out in its EIA study.

Alternative – C: Land Based Dumping

Another alternative would be to dump the dredged material into the land based disposal site such as Dongo Kundu on the mainland as indicated in Fig 2.7. In such case KPA shall equip the site with containment facilities such as installation of enclosing concrete or steel wall or use of thick plastic sheets such that the dredge material does not contaminate soil or groundwater. This option would involve possible transhipment of sediments from the dredger to trucks for transportation to the dumping site, further inflating the project cost.

2.4.5 The No Action Alternative

The selection of the “No Action” alternative would mean the discontinuation of project proposal and result in the site being retained in its existing form. There are physical, biological and socio-economic implications of this alternative. Physically, the site is unlikely to undergo any major changes from its present condition. Biologically, the vegetation present on the site is unlikely to be severely affected, other than the potential for uncontrolled growth of weeds, bushes and trees introduced by avifauna, wind or other means. Unless the vacant land is fenced off it is likely to continue experiencing an influx of squatters.

The “No Action” Alternative is likely to have the greatest implications on the socio-economic environment of the area and surrounding communities. Due to the proposed quality of the development it is anticipated that it would provide opportunities for employment, benefits associated with the construction industry and potentially significant business opportunities to spring up as a result of opening up of the Port Reitz area. All these benefits would be foregone if the project is not undertaken. If left undeveloped, there is a strong potential for the site to revert to for the illegal dumping of refuse which only serves to bring down property values and promote a negative image of the area.

2.5 Project Cost

Whereas the project is still at the design phase the estimated costs of the project are as shown in Table 2.5 below:

Table 2.5: Estimated Cost of the Project

Item	Cost in Mil. Ksh
A. Construction Cost	12,920
1. Temporary Works	840
2. Wharf & Revetment	3,560
3. Reclamation	2,940
4. Terminal	2,150
5. Soil Improvement	1,600
6. Navigation Aids/Security Measure	340
7. Channel /Basin Dredging	1,080
8. Access Road	410
Total Construction Cost	25,480
B. Consulting Services	1,470
Total Direct Project Cost	27,310

3.0 BASELINE INFORMATION

3.1 Landscape, Topography and Geology

The Mombasa District is situated in coastal lowland with extensive flat areas rising gently from 8 meters above sea level to 100 meters above sea level in the west. It can be divided into three main physiographic belts, namely, the flat coastal plain, which is 6 kilometres wide, and includes the Island division, Kisauni on the north mainland and Mtongwe to the south. Next, are found the broken, severely dissected and eroded belt that consists of Jurassic shale overlain in places by residual sandy plateau found in Changamwe division. Finally, there is the undulating plateau of sandstone that is divided from the Jurassic belt by a scarp fault. Nearer the sea, the land is composed of coral reef of Pleistocene Age that offers excellent drainage. The coral limestone and lagoonal deposit reach a thickness of 100 meters.

3.2 Climate

The Port of Mombasa lies in the hot tropical region where the weather is influenced by the great monsoon winds of the Indian Ocean, which also influences the climate and weather systems that are dominated by the large scale pressure system of the western Indian Ocean and the two distinct monsoon periods. Comparatively dry weather conditions are experienced in the area from November/December to early March, when the North-East Monsoon predominates. Detailed climatic description will be found in the section under description of the physical environment.

3.3 Hydrology

There are no permanent rivers in Mombasa. However, due to favourable geology, groundwater sourced from shallow wells and boreholes is available to supplement the needs of the residents. Otherwise, water to serve the needs of the area is sourced from Kwale through Marere Springs and the Tiwi Boreholes; Malindi through the River Baricho; and from the Mzima springs in Taita Taveta District.

It is however of note to state that there are number of semi-perennial and seasonal rivers such as the Mwache, Kombeni, Tsalu, Hodi-hodi and Nzovuni, which drain into coastal region from arid and semi-arid catchments.

Mombasa has some potential in terms of groundwater resources. This is because of its geological structure that promotes rapid infiltration and percolation of surface run-off to recharge groundwater aquifers. Areas covered with the Kilindini sands have a high groundwater potential so are the areas with Triassic sandstone geology, which have shown high groundwater yields.

Four main types of groundwater have been identified in the Kenya coast according to their anionic content: carbonate, bicarbonate, chloride and sulphate. Mixed types of groundwater composed of the above have also been found in the Kenya coast.

The main factors controlling the quality of groundwater are the permeability of the rock, the rock type and degree of recharge from surface run-off and rainfall. Water of the poorest quality (high TDS) is associated with the Jurassic shale; intermediate water quality is associated with the Triassic sandstones and Pleistocene coral limestone; while the best quality is associated with the unconsolidated sands that receive efficient recharge due to their high infiltration capacities.

Groundwater quality also varies depending on the depth of the borehole/well, nearness to the ocean and proximity to human settlements. Boreholes located near the coast have a problem with salt water intrusion and this problem is exacerbated by over-extraction. Boreholes and wells located in urban areas suffer from the threat of pollution originating from pit latrines and septic tank-soakage pit systems, which are often the source of contamination to otherwise good quality water chemically rendering it unsuitable for drinking purposes.

The exploitation of groundwater in Mombasa has been haphazard with no strict government control on borehole drilling or well development. With the current problem of water supply shortages and increased urban-rural population, people in urban areas, especially Mombasa, are increasingly dependent on groundwater for potable needs.

3.4 Soils

The soil types in the Port of Mombasa area are broadly associated with the geological formations along the physiographic zones in Mombasa district as detailed by the Ministry of Agriculture, Government of Kenya (1988).

Along the coastal lowlands, four soil types predominate:

- On the raised reefs along the shore, well-drained, shallow (< 10 cm) to moderately deep, loamy to sandy soils predominate;
- On unconsolidated deposits in the quaternary sands zone (also referred to as Kilindini sands) are well drained moderately deep, to deep, sandy clay loam, to sandy clay, underlying 20 to 40 cm loamy medium sand;
- In the Kilindini sands zone are also to be found areas with very deep soils of varying drainage conditions and colour, variable consistency, texture and salinity;
- Also found on the Kilindini sands are well-drained very deep, dark red to strong brown, firm, sandy clay loam to sandy clay, underlying 30 to 60 cm medium sand to loamy sand soils;

In the coastal plain, the soils are developed on coral limestone merging to Kilindini sands inland. The coral soils are generally well drained and of sandy clay loam to sandy clay texture. They range from very deep and non rocky to very shallow and extremely rocky.

The soils developed on Kilindini sands vary from excessively drained, very deep, very sandy soils to poorly drained, very deep, heavy clay soils. Extensive areas of imperfectly drained, clayey soils occur in the southern part of the coastal plain.

Most of the agricultural activities in the district occur in the mainland areas, i.e. Kisauni (north mainland), Likoni (south mainland) and Changamwe (west mainland). The low-lying areas are dominated by the coconut-cassava and cashew nut-cassava agro ecological zones (GOK Ministry of Agriculture 1988).

Most of the Mombasa island area and parts of Kisauni and Likoni fall under the coconut-cassava zone. This zone is characterised by a medium to long cropping season and intermediate rains. The rest of the low lying areas in Kisauni and Likoni fall under the cashew nut-cassava zone, which is characterised by medium cropping season, followed by intermediate rains.

Most of the raised Changamwe area falls under the cashew nut-cassava zone. The raised areas in Kisauni and parts of Changamwe, that mainly include the shale areas, fall under the lowland livestock-millet zone. This zone is characterised by a short to medium cropping season and a second season with intermediate cropping.

3.5 Population

According to the 1999 Population and Housing Census (GOK, 1999) the population of Mombasa District stood at 665,000 persons distributed in the four divisions' of the District as indicated in Table 3.1. The projected population for the district in 2005 is also given.

Table 3.1 Population distribution in the Mombasa District

Administrative Division	Size: Area km^2	Population			Population density/ km^2 2005
		1989	1999	2005*	
Island	14.1	127,720	146,334	170,699	12,106
Kisauni	109.7	153,324	249,861	291,463	2,657
Likoni	51.3	67,240	94,883	110,681	2,158
Changamwe	54.5	113,469	173,930	202,889	3,723
TOTAL	229.6	461,753	665,018	775,743	3,379*

Source: GOK (1989, 1999). * Projected

Mombasa district experienced a 44% increase in population between the census years of 1989 and 1999. The Changamwe Division, where the proposed development is to take place has the second highest number of people in the District. Kisauni Divisions' population grew by 63% in 10 years' period. The high increase in population was attributed to natural growth and in-migration, mostly of the labour force from other parts of the country. Generally, the high population in Mombasa has proved to be a serious challenge in the provision of housing and essential services such as water, sanitation and health care.

3.6 Demographic Characteristics

The Island division of Mombasa district is the Central Business District (CBD). It is the most built up area and has the highest population density. High cost low-density settlements within the Island are found in Kizingo and Tudor, while middle cost, high-density settlements are found around the Buxton-Stadium area, Makupa and Saba Saba. Then we have the low cost high-density settlements found around Buxton, Tononoka, and Old Town. Informal and slum settlements found on the Island include

Muoroto California, Muoroto Paradise, Muoroto Kafoka, Kiziwi, Kaloleni, Spaki, Sarigoi/Mwembe Tayari, Mwembe Taganyika and Kibarani.

A land use classification study (Agil Saleh, 1999) indicates that only 31.2% of the total land area in Mombasa district is under residential settlements. The direction of growth in human settlements is found concentrated northwards in Kisauni Division where other socio-economic activities occupy large parcels of land. This has entailed the crowding of many people in small land areas with many implications. For example in the Kisauni division, large beef and dairy farms, the tourist hotels, Shimo La Tewa School and Prison and Bamburi Cement, occupy large tracts of land. The result of this is population concentrations in the sprawling low cost high density settlements of Kisauni Estate, Mlaleo, Barsheba, Mwandoni, Bakarani, Magogoni, Mishomoroni, Mtopanga, Shanzu; and the squatter areas of Ziwa la Ngombe, Kisimani and the Bombolulu slums. Other informal settlements and slum areas are Matopeni (Kengeleni), Mnazi Mmoja, Kisumu Ndogo (Kongowea), Maweni (Kongowea), VOK, Mafisini, Kilimanjaro, Makombeni (Mtopanga), Mwembe Legeza, Utange Giriama, and Majaoni.

A similar situation exists in Likoni and Changamwe divisions, where large pieces of land having been reserved for productive economic activities, people have been left to concentrate on small areas in several informal settlements. Such of the areas include Maweni, Timbwani, Kidunguni, Mweza, Ujamaa/Shika-Adabu, Mtongwe (Shonda) and Jamvi La Wageni all in Likoni division. In Changamwe division, concentrations of human settlements are found at the Chaani conglomerate areas of California, Dunga Unuse, Tausa, Kwarasi, and Migadini. Other informal settlements and slums are found at Kasarani, Fuata Nyayo, Kalahari, Birikani, Kwa Punda, Bangladesh, Gana Ola, Mikanjuni, Miritini Madukani, Vikobani, Mwamlali, Cha Munyu, Magongo-Wayani, and Jomvu Kuu.

These are areas where the sanitation status is poorest: crowded human settlements and generally poor infrastructure facilities resulting in a myriad of environmental problems as a consequence (Gatabaki-Kamau et al., (2000).

3.7 Physical Infrastructure

3.7.1 Sea, Road, Rail and Airport networks

Sea transport in Mombasa is offered by the Port of Mombasa. It is a major port for the whole eastern African region. It has 16 deep water berths with 10.0 metres draft and a total lengths of 3,044 m, two bulk oil jetties and one cased oil jetty, three container berths with a total lengths of nearly 600 m; two bulk cement berths with three cement silos each with a 6,000 tonnes capacity; two lighterage and dhow wharves; and one explosive jetty.

The major exports from the port of Mombasa are coffee, petroleum products, meat and meat products, hides and skins, cement, pineapple, and tea. Main imports include industrial and electrical machinery, crude petroleum, assembled motor vehicles and chassis, iron and steel, agricultural machinery and tractors, pharmaceuticals, fertilizers, textiles, mineral fuels, chemicals, food and live animals.

Most of the **roads** in the Mombasa District converge on the city due to its importance as an industrial and commercial centre. The district is well served by both classified and unclassified roads, although the network is not equally distributed with many of the roads being concentrated on the Mombasa/West Mainland axis. This has left the north/south mainland areas with few vehicular roads and this is a contributing factor in the relative underdevelopment of these parts.

It has been estimated that nearly 75 % of all goods imported and exported through the Port of Mombasa are conveyed by road, underlying the importance of this means of transport. The main exception to this is oil products, which are conveyed by a pipeline into Kenya’s interior.

Rail transport between Mombasa, though important has relatively declined over the years. The main railway line between Mombasa and Nairobi, branches off at Voi to connect with the Taveta Town-ship. Kenya railways has large marshalling yards and depots at Mombasa and lines extend from this into the industrial area and the port Warehouses

Moi Airport Mombasa, is the main airport for the coast region. It is served by the national airline as well as other flights bringing in passengers and cargo. There are frequent flights to Nairobi as well as other less frequent ones to other areas like Malindi and Lamu.

3.7.2 Electricity Supply

Electricity is adequately provided in and around the port of Mombasa. However, the frequent and irritating power failures, which go, unexplained are common. This hurts many sectors of the economy. This has prompted many Mombasa business people men and enterprises to install standby generators in order to minimize business losses.

3.7.3 Water Supply

Mombasa district heavily depends on water sources from outside the district for its poTable needs. It supplements this water need from groundwater sources in the district. The district has a daily water demand of 200,000 cubic meters of water against the available 130,000 cubic meters that come from the traditional supply sources of Kwale, Malindi and Taita-Taveta. There is therefore a water shortfall of 70, 000 cubic meters, (NWCPC, 2000). This 35% shortfall is met by tapping the groundwater sources, which are potential in the district. Also, as the reticulated supplies experience constant breakdowns, groundwater sources, not only supplement the supply, but they sometimes become the major source of water available in the district. In fact, 13,286 out of the 183,540 households in the district are almost permanently dependant on groundwater. These are distributed as follows: - wells- 6,245 households, boreholes- 6,941 households (GOK, Kenya Population Census 1999).

A significant number of the population therefore relies on groundwater for their potable needs. As groundwater is an important source of potable water, it must be protected from sewage pollution.

3.7.4 Housing and Sanitation

The study found that the main systems available for sewage management in Mombasa district include the following: -

- Centralized sewers and treatment plants
- Septic tanks and soakage pits, and
- Pit latrines.

The centralized sewer system serves only a small proportion of the population in the district. The use of septic tanks and soakage pits is largely limited to the planned areas of development. The majority of the population is served by the use of pit latrines.

About one third of the Island is on a centralized sewer system, this serves about 12 percent of the households. The treatment plant serving this system is currently non-functional. Sewage from this part of the Island, which include the catchments areas of Kizingo, and part of the Central Business District is therefore discharged untreated into the waters of the Indian Ocean via an out-fall at Kizingo. The rest of the two thirds of Island depend on either septic tanks or cesspits.

Part of Changamwe Division is sewered, serving a population of about 100,000 people in the residential areas of Chaani Upgrading Scheme, Changamwe Estate, Brollo, and Mikindani Site and Service Schemes.

The treatment plant serving the settlements mentioned above is located at Kipevu. This sewage treatment plant has been re-designed and commissioned to serve a significantly increased size of the population. Additional trunk sewers and extension of the above scheme is planned to serve the existing Changamwe Repooling Scheme. Unfortunately, the project design did not include sewer reticulation in the areas of Changamwe and Port-Reitz. Implementation work on this project had reached near completion and the commissioning dates were already in the minds of the promoters, when unforeseen massive damage occurred during the El-Nino Southern Pacific weather phenomena washing away large parts of the sewage pipe network rendering it non-operational up to this day.

The whole of the Kisauni Division is not sewered. The disposal of human wastes is practiced mainly through the use of septic tanks and cesspits including pit latrines. The use of pit latrines is the highest of all the divisions. The Likoni division, just like Kisauni, is does not have a sewerage system.
As a result of the differences in levels of development, the various housing settlements have different systems for managing human wastes. Some settlements are connected to the central sewer system; others are served by septic tank, soakage pit systems only, some have combined the former with pit latrines, while others rely on pit latrines only.

A great majority of households in Mombasa, (70% of them) use pits latrines. Of the 34,000 latrines found in the district, 5% of them are on the Island Division, in high-density settlements. The Changamwe Division in the west mainland, has 15% of them, 25% are in the south mainland, in the Likoni division; the remaining 55% are found in the mainland north, in the Kisauni division.

The site of the proposed development is therefore well served with the necessary service infrastructure. There is a tarmac road network nearby, there is electricity and water is available from both the Mzima and Marere Pipelines. Housing and sanitation services however, still require upgrading and development in some areas.

4.0 POLICY, INSTITUTIONAL AND LEGAL FRAMEWORK

4.1 Introduction

Development activities have the potential to damage the natural resources upon which the economies are based. A major national challenge today is how to maintain sustainable development without damaging the environment. Among environmental problems being experienced include land degradation, loss of biodiversity, environmental pollution, and water management. This situation is aggravated by lack of awareness and inadequate information amongst the public on the consequences of their interaction with the environment. In addition, there is limited involvement of the local communities in participatory planning and management of environment and natural resources. Recognizing the importance of natural resources and environment in general, the Kenya Government has put in place a wide range of policy, institutional and legislative measures to address the underlying causes of environmental degradation in the country.

4.2 Environmental Policy

The broad objectives of the national environmental policy include:

- Optimal use of natural land and water resources in improving the quality of human environment.
- Sustainable use of natural resources to meet the needs of the present generations while preserving their ability to meet the needs of the future generations.
- Encourage concern and respect for the environment, emphasize on every Kenyan's responsibility in environmental performance and ensure appropriate operating practices and training of generations.
- Integrate environmental conservation and economic activities into the process of sustainable development.
- Meet national goals and international obligations by conserving biodiversity, arresting desertification, mitigating effects of disasters, protecting ozone layer and maintaining ecological balance on the earth.
- Communicate with the public on environmental matters to facilitate improvements in environmental performance.
- Undertake appropriate reviews and evaluations of developmental plans and operations to measure their progress and to ensure compliance with this policy.

4.3 Institutional Arrangements

Some of the key institutions dealing with environmental issues in Kenya include the National Environment Management Authority (NEMA), the Forestry Department, the Kenya Wildlife Service (KWS), the Kenya Forestry Research Institute (KEFRI), the National Museums of Kenya (NMK), the Kenya Agricultural Research Institute (KARI), the Permanent Presidential Commission on Soil Conservation and Aforestation, the Kenya Marine Research Institute (KMFRI), Lake Victoria Environmental Management Program (LVEMP), Regional Development Authorities and Public Universities.

Other than these there are local and international NGOs involved in environmental issues in the country. The main international agencies involved in environmental issues in Kenya include Environmental Liaison Center International (ELCI), International Union for the Conservation of Nature and Natural Resources (IUCN), World Wildlife Fund for Nature (WWF), United Nations Environment Programme (UNEP). The local NGOs include East African Wildlife Society (EAWLS), the Green Belt Movement, Forest Action Network (FAN), African Water Network (AWN), Wildlife Clubs of Kenya (WCK), Environmental Trust of Kenya (ETK) and Friends of Lake Victoria (OSIENALA) among other Non Governmental Organizations and Community Based Organizations. International and regional NGOs active in the coastal area include Coral Reef Degradation in the Indian Ocean (CORDIO) AND Coral Reef Conservation Programme (CRCP). Of these institutions, NEMA plays the regulatory role in the management of environment in the country.

The Oil Spill Mutual Aid Group, OSMAG has also been actively involved in management of spill-related activities. OSMAG is a voluntary association drawing membership from oil companies, the petroleum refinery, Kenya Ports Authority and other government agencies dealing with wildlife, maritime activities and environmental conservation.

4.4 Legal Framework

The following pieces of legislations and regulations are applicable to the proposed project:

4.4.1 The Environmental Management and Co-ordination Act, 1999

Environmental Management and Coordination Act is the main legislation governing environmental management in Kenya. It was enacted in 1999 to comprehensively address the issues affecting the environment in harmony.

The Act harmonizes the sector specific legislations touching on the environment in a manner designed to ensure greater protection of the environment in line with national objectives and the sustainable development goals enunciated in Agenda 21 of the Earth Summit held in Rio de Janeiro in 1992. The ultimate objective is to provide a framework for integrating environmental considerations into the country's overall economic and social development.

To administer the act, two major institutions have been established for the purpose of the administration of the above act. They are the National Environmental Council and the National Environmental Management Authority.

The National Environmental Council (NEC): NEC is chaired by the Minister for Environment & Natural Resources with membership from all relevant ministries as well as a broad range of other interests. It functions to formulate national policies, goals, and objectives and the determination of policies and priorities for environmental protection. The Council also promotes co-operation among all the players engaged in environmental protection programmes.

The National Environmental Management Authority (NEMA): NEMA is the corporate body responsible for the administration of the above legislation. The Director General appointed by the President heads NEMA. NEMA functions include the co-ordination and regulation of various environmental management activities, initiation of legislative proposals and submission of such proposals to the Attorney General, research, investigations and surveys in the field of environment. They also undertake to enhance environmental education and awareness on the need of sound environmental management. In addition, NEMA will advise the Government on regional and international agreements to which Kenya should be a party. NEMA is charged with the responsibility of the execution of the Environmental Impact Assessment (EIA).

The proposed project falls under the second schedule of the Act and due to significant social and environmental impacts from its implementation, it has to undergo a comprehensive Environmental Impact Assessment.

4.4.2 The Environment Impact (Assessment and Auditing) regulations, 2003

This Legal Notice No. 101; stipulates the ways in which environmental experts should conduct the Environment Impact Assessment and Audits in conformity to the requirement stated. It is concise in its report content requirements, processes of public participation, licensing procedures, inspections and any possible offences under the Act.

In line with the requirement of this notice the new facility would require an environmental audit within 12 months of commissioning.

4.4.3 The Water Act 2002 (No. 8 of 2002); Laws of Kenya

The Water Resource Management Authority was established under this Act to:

- Develop principles and guidelines for allocation of water resources
- Monitor and re-assess water resource management strategy
- Monitor and enforce permissions attached to water use
- Regulate and protect resources quality from adverse impacts
- Manage and protect water catchments
- To liaise with other bodies for better regulation and protection of water resources

The Water Act provides for the conservation and controlled use of water resources in Kenya. Under the Ministry of Water the Act prohibits pollution of water resources and controls the discharge of industrial and municipal effluents into the ocean and other water bodies. The Ministry has therefore established the technical mechanisms (including laboratory facilities) for monitoring the quality of various water resources of the country. Through the judicious apportionment of river and lake water resources, the Act also ensures the constant availability of freshwater for communities in Kenya.

The proposed project would impact on sea water due to dredging and disposal of dredged material and additional water requirement for new administration offices.

4.4.4 The Factory and Other Places of Work Act, Laws of Kenya; Chapter 514

The Factory Act makes provisions for the health, safety and welfare of persons employed in industrial places of work. Part IV of the act covers health issues. The state of cleanliness, types of floors and walls of workrooms, refuse management, employee space requirement, ventilation and sanitary conveniences. Part V covers safety; operation and maintenance of machinery, storage of dangerous substances, training and supervision of workers. Part VI deals with welfare issues; drinking water supply, washing facilities, sitting areas and first aid provision. These are all necessary for the continuous running of a facility.

This act affects the proposed project in a number of ways. The construction phase will expose the personnel to a number of occupational hazards such as dust, noise and vibration. Operation of construction equipment also exposes employees to possible injury from accidents. The same applies to operation phase of the project whereby the proponent is expected to employ personnel to operate container handling equipment.

4.4.5 The Factories (First Aid) Rules, Legal Notice No.160, 1977

This prescribes measures to be undertaken in the incidence of minor injuries and specifies the content of the first aid box and first aid training of personnel among other emergency response requirements.

4.4.6 The Physical Planning Act; Laws of Kenya, Chapter 286

This Act provides for the preparation and implementation of physical development plans. They formulate national, regional and local development policies, guidelines and strategies. The Act empowers the Director of Physical Planning to advise the Commissioner of Lands on appropriate uses of land and land management. The Act ensures that use and development of land and buildings is carried out in accordance with the projected development plans of the area.

4.4.7 Local Government Act (Cap 265)

The Local Government Act (Cap 265) provides for local councils to establish and maintain sewage and drainage systems. It has also provisions for the construction of water supply systems and measures for the prevention of pollution in urban areas.

The project site falls within Mombasa Municipality and would hence be governed by the provisions of this act. The waterside structures that would be erected for administrative functions would require connection to the municipal sewerage system. Office activities would generate garbage that require disposal at the local authority dumpsite.

4.4.8 Kenya Ports Authority (KPA) Act

Through the Kenya Ports Authority (KPA) Act, KPA has the responsibility for controlling oil pollution in the Kenyan territorial waters, which include all inshore waters and those extending up to 160km offshore. In fulfillment of this obligation, the KPA together with the Oil Spill Mutual Aid Group OSMAG has developed a National Oil Spill Response Contingency Plan.

4.4.9 Kenya Maritime Authority Act

Kenya Maritime Authority is charged with the responsibility of regulating, coordinating and overseeing maritime affairs. In fulfilling this mandate KMA is expected to:

- Advise the government on the development of international maritime conventions, treaties and agreements as well as their codification into the laws of Kenya;
- Conduct and liaise with other stakeholders in doing research, investigations and surveys relating to maritime affairs;
- Develop and maintain the national oil spill response plan in coastal and inland waterways in liaison with players in the oil industry;
- Serve as coordinators of search and rescue operations in liaison with KPA, Kenya Navy and other relevant bodies;
- Ensure sustainable exploitation of marine resources and rapid response to marine calamities;

KMA therefore provides a forum for which the various players involved in maritime affairs develop maritime policies and integrate these policies into the national development plan.

Further, KPA policy on environmental issues is governed by the provisions of *The International Convention for the Prevention of Pollution from Ships, 1973 (MARPOL 73/78)* to which Kenya ascribes. This is the most important instrument for preventing pollution from arising from marine transportation. It was adopted in 1973 and modified by the Protocol of 1978 relating thereto, hence MARPOL 73/78. It consists of five Annexes as follows:

Annex I: Oil - Ships are prohibited to discharge oil or oily water, such as dirty ballast water and oily bilge water containing more than 15 ppm of oil, within 12 miles of land. Other conditions apply to discharges outside 12 mile limits.

Annex II: Noxious Liquid Substances in Bulk - Chemicals are evaluated for the environmental hazard they may cause if discharged into the sea (Categories A,B,C and D). Discharge into the sea of the most harmful chemicals (Category A) is prohibited and tank washings and other residues of less harmful substances (Categories B, C and D) may only be discharged under certain conditions, e.g., total quantity, distance from the shore, depth of water, prescribed depending on the hazards. There are substances, e.g., water, wine, acetone, ethyl alcohol, for which no restrictions apply.

Annex III: Harmful substances in packaged form - this is principally oriented towards prevention of pollution by regulating packaging, marking and labeling and stowage.

Annex IV: Sewage - It is prohibited to discharge ship-generated sewage unless it is treated with an approved sewage treatment plant or at a certain distance from land.

Annex V Garbage: - Garbage produced on board a ship, food waste, packaging, etc., must be kept on board and discharged either ashore or into the sea under certain conditions, such as the distance from land. Discharge of all plastics is prohibited.

Maritime operations are also regulated by London Convention, 1972 which prohibits dumping of garbage at sea.

5.0 CONSIDERATIONS ASSOCIATED WITH DREDGING AND DREDGED MATERIAL DISPOSAL

The primary objective of a dredging project is to construct or maintain channels for existing and future navigation needs. This should be accomplished using the most technically satisfactory, environmentally compatible, and economically feasible dredging and dredged material disposal procedures.

Some considerations associated with dredging and dredged material disposal are:

- Selection of proper dredge plant for a given project.
- Control of dredging operation to ensure environmental protection.
- Determining whether or not there will be dredging of contaminated material.
- Availability of adequate disposal facilities.
- Long-term planning for maintenance dredging projects.
- Characterization of sediments to be dredged to support an engineering design of confined disposal areas.
- Determining the levels of suspended solids from disposal areas and dredge operations.
- Disposal of contaminated sediments.
- Containment of the disposal area

5.1 Dredging Methods and Equipment*:*

Factors that influence the choice of a dredging method and plant include:

- Characteristics of the dredging location and quantities to be dredged, considering future needs;
- pertinent social, environmental, and legal factors.

There are basically three mechanisms by which dredging are accomplished:

(1) *Suction dredging*: This involves removal of loose materials by dustpans, hoppers, hydraulic pipeline plain suction, and side casters. This method is used mainly for maintenance dredging projects.

(2) *Mechanical dredging*: Removal of loose or hard compacted materials by clamshell, dipper, or ladder dredges, either for maintenance or new work projects.

(3) *A combination of suction and mechanical dredging*: Involves removal of loose or hard compacted materials by cutterheads, either for maintenance or new work projects.

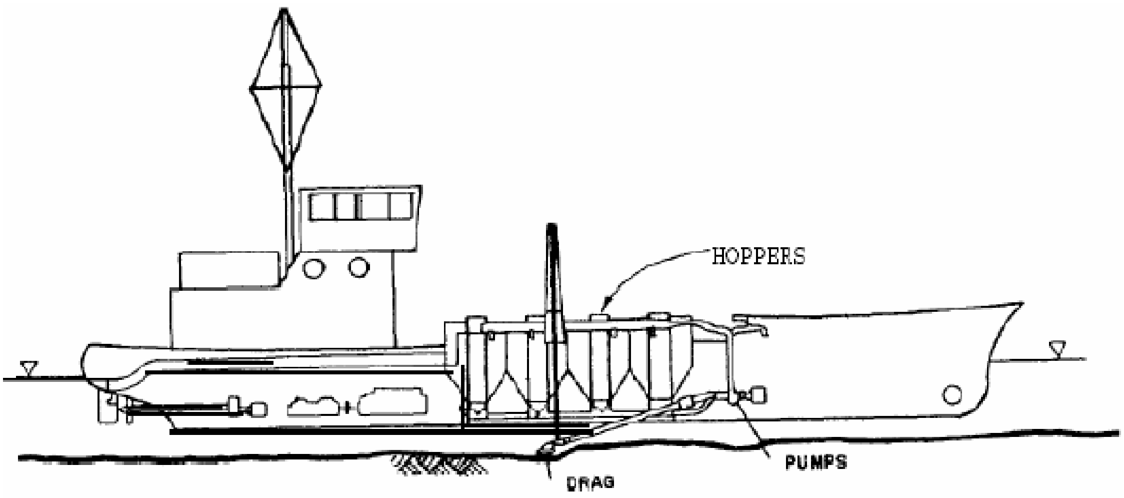
Selection of dredging equipment and method used to perform the dredging operation will depend on the following factors:

- Physical characteristics of material to be dredged;
- Quantities of material to be dredged, taking into account future dredging needs;
- Dredging depth;
- Distance to disposal area;
- Physical environment of and between the dredging site and disposal area;
- Contamination level of sediments;
- Potential disposal alternatives;
- Production rate required.

5.1.1 Hopper Dredges.

Hopper dredges are self-propelled seagoing ships of from 180 to 550 ft in length, with the molded hulls and lines of ocean vessels (figure. 5.1). They are equipped with propulsion machinery, sediment containers (hoppers), dredge pumps, and other special equipment required to perform their essential function of removing material from a channel bottom or ocean bed. Hopper dredges have propulsion power adequate for required free-running speed and dredging against strong currents and excellent maneuverability for safe and effective work in rough, open seas. Dredged material is raised by dredge pumps through drag arms connected to drags in contact with the channel bottom and discharged into hoppers built in the vessel.

Dredging is accomplished by progressive traverses over the area to be dredged. Suction pipes (dragarms) are hinged on each side of the vessel with the intake (drag) extending downward toward the stern of the vessel. The drag is moved along the channel bottom as the vessel moves forward. The dredged material is sucked up the pipe and deposited and stored in the hoppers of the vessel. Once fully loaded, hopper dredges move to the disposal site to unload before resuming dredging. Unloading is accomplished either by opening doors in the bottoms of the hoppers and allowing the dredged material to sink to the open-water disposal site or by pumping the dredged material to upland disposal sites.



Figureure 5.1 Self-propelled seagoing hopper dredge

During dredging operations, hopper dredges travel at a ground speed of from 3 to 5 km per hour and can dredge in depths from about 3m to over 20m. They are equipped with twin propellers and twin rudders to provide the required maneuverability.

Advantages of Hopper Dredges

Because of the hopper dredge's design and method of operation, the self-propelled seagoing hopper dredge has the following advantages over other types of dredges for many types of projects:

- It is the only type of dredge that can work effectively, safely, and economically in rough, open water.
- It can move quickly and economically to the dredging project under its own power.
- Its operation does not interfere with or obstruct traffic.
- Its method of operation produces usable channel improvement almost as soon as work begins. A hopper dredge usually traverses the entire length of the

problem shoal, excavating a shallow cut during each passage and increasing channel depth as work progresses.

- The hopper dredge may be the most economical type of dredge to use where disposal areas are not available within economic pumping distances of the hydraulic pipeline dredge.

Limitations:

The hopper dredge is a seagoing self-propelled vessel designed for specific dredging projects. The following limitations are associated with this dredge:

- Its deep draft precludes use in shallow waters, including barge channels
- It cannot dredge continuously. The normal operation involves loading, transporting material to the dump site, unloading, and returning to the dredging site.
- The hopper dredge excavates with less precision than other types of dredges.
- Its economic load is reduced when dredging contaminated sediments since pumping past overflow is generally prohibited under these conditions and low-density material must be transported to and pumped into upland disposal areas.
- It has difficulty dredging side banks of hard packed sand.
- The hopper dredge cannot dredge effectively around piers and other structures.
- Consolidated clay material cannot be economically dredged with the hopper dredge.

5.1.2 Cutterhead Dredges.

The hydraulic pipeline cutterhead suction dredge is the most commonly used dredging vessel and is generally the most efficient and versatile. Because it is equipped with a rotating cutter apparatus surrounding the intake end of the suction pipe, it can efficiently dig and pump all types of alluvial materials and compacted deposits, such as clay and hardpan. This dredge has the capability of pumping dredged material long distances to upland disposal sites.

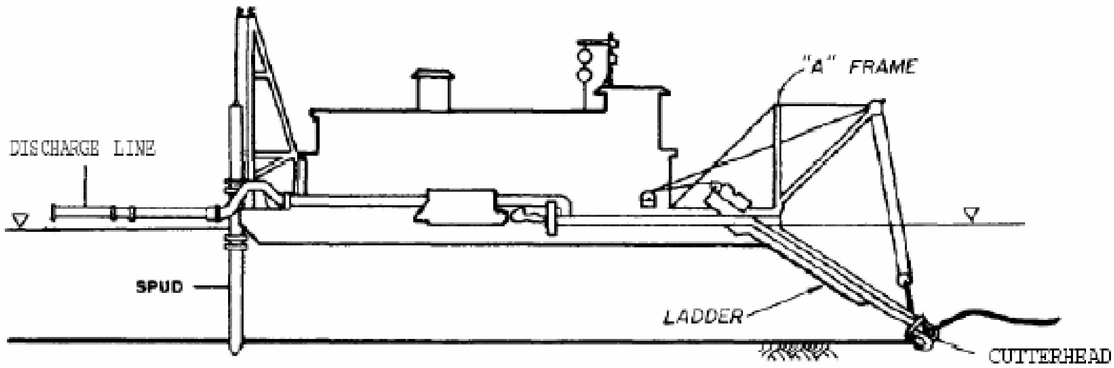


Figure.5.2: Hydraulic pipeline cutterhead dredge.

The cutterhead dredge is generally equipped with two stern spuds used to hold the dredge in working position and to advance the dredge into the cut or excavating area. During operation, the cutterhead dredge swings from side to side alternately using the port and starboard spuds as a pivot. The excavated material may be disposed of in open water or in confined disposal areas located upland or in the water. In the case of open-water disposal, only a floating discharge pipeline, made up of sections of pipe mounted on pontoons and held in place by anchors, is required. Additional sections of shore pipeline are required when upland disposal is used.

The cutterhead dredge is suitable for maintaining ports, canals, and outlet channels where wave heights are not excessive.

Advantages:

The cutterhead dredge has the following advantages:

- Cutterhead dredges are used on new work and maintenance projects and are capable of excavating most types of material and pumping it through pipelines for long distances to upland disposal sites.
- The cutterhead operates on an almost continuous dredging cycle, resulting in maximum economy and efficiency.
- The larger and more powerful machines are able to dredge rocklike formations such as coral and the softer types of basalt and limestone without blasting.

<u>Limitations:</u>

The limitations on cutterhead dredges are as follows:

- The cutterhead dredges available in the United States have limited capability for working in open-water areas without endangering personnel and equipment. The dredging ladder on which the cutterhead and suction pipe are mounted is rigidly attached to the dredge; this causes operational problems in areas with high waves.
- The conventional cutterhead dredges are not self-propelled. They require the mobilization of large towboats in order to move between dredging locations.
- The cutterhead dredge has problems removing medium and coarse sand in maintaining open channels in rivers with rapid currents. It is difficult to hold the dredge in position when working upstream against the river currents since the working spud often slips due to scouring effects. When the dredge works downstream, the material that is loosened by the cutterhead is not pulled into the suction intake of the cutterhead. This causes a sandroll, or berm, of sandy material to form ahead of the dredge.
- The pipeline from the cutterhead dredge can cause navigation problems in small, busy waterways and ports

5.1.3 Dustpan Dredge.

The dustpan dredge as shown in fig 5.3 is a hydraulic suction dredge that uses a widely flared dredging head along which are mounted pressure water jets.

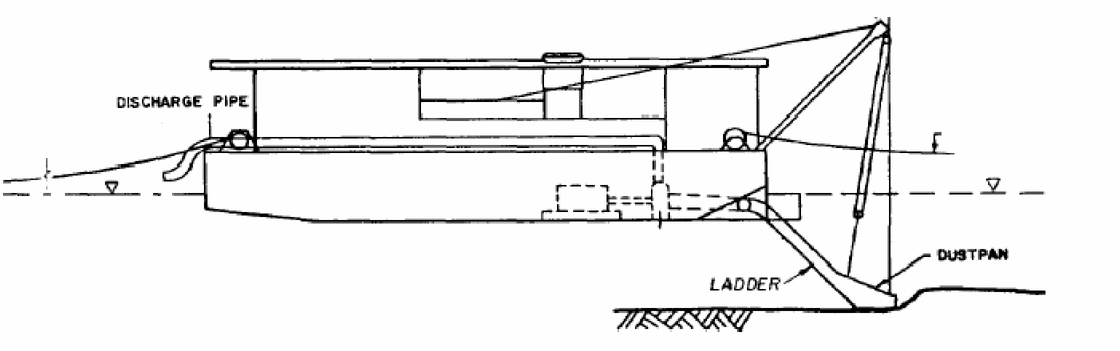


Figure.5.3: Dustpan Dredge

The jets loosen and agitate the sediments which are then captured in the dustpan head as the dredge itself is winched forward into the excavation.

Advantages:

- The dustpan dredge is self-propelled, which enables it to move rapidly over long distances to work at locations where emergencies occur. The attendant plant and pipeline are designed for quick assembly so that work can be started a few hours after arrival at the work site.
- The dustpan dredge can move rapidly out of the channel to allow traffic to pass and can resume work immediately.
- The high production rate and design of the dustpan dredge make it possible to rapidly remove sandbar formations and deposits from river crossings so that navigation channels can be maintained with a minimum of interruption to waterborne traffic.

Limitations:

- It can dredge only loose materials such as sands and gravels and only in rivers or sheltered waters where little wave action may be expected.
- The dustpan dredge is not particularly well suited for transporting dredged material long distances to upland disposal sites; pumping distances are limited to about 300m without the use of booster pumps.

5.1.4 Sidecasting Dredges.

The sidecasting type of dredge is a shallow draft seagoing vessel, especially designed to remove material from the bar channels of small coastal inlets. The hull design is similar to that of a hopper dredge; however, sidecasting dredges do not usually have hopper bins.

Instead of collecting the material in hoppers onboard the vessel, the sidecasting dredge pumps the dredged material directly overboard through an elevated discharge boom; thus its shallow draft is unchanged as it constructs or maintains a channel. The discharge pipeline is suspended over the side of the hull by structural means and may be supported a crane. The dredging operations are controlled by steering the vessel on predetermined ranges through the project alignment. The vessel is self-sustaining and can perform work in remote locations with a minimum of delay and service requirements. The projects to which the sidecasters are assigned for the most part are at unstabilized, small inlets which serve the fishing and small-boat industries.

The sidecasting dredge picks up the bottom material through two dragarms and pumps it through a discharge pipe supported by a discharge boom. During the dredging process, the vessel travels along the entire length of the shoaled area casting material away from and beyond the channel prism. Dredged material may be carried away from the channel section by littoral and tidal currents. The construction of a deepened section through the inlet usually results in some natural scouring and deepening of the channel section, since currents moving through the prism tend to concentrate the scouring action in a smaller active zone.

Advantages:

The sidecasting type of dredge, being self-propelled, can rapidly move from one project location to another on short notice and can immediately go to work once at the site. Therefore, a sidecasting dredge can maintain a number of projects located great distances from each other along the coastline.

Limitations:

The sidecasting dredge needs flotation depths before it can begin to work because it dredges while moving over the shoaled area. Occasionally, a sidecaster will need to alter its schedule to work during higher tide levels periods only, due to insufficient depths in the shoaled area. Most areas on the seacoast experience a tidal fluctuation sufficient to allow even the shallowest shoaled inlets to be reconstructed by a sidecasting type of dredge. A shallow-draft sidecasting dredge cannot move large volumes of material compared to a hopper dredge, and some of the material removed can return to the channel prism due to the effects of tidal currents. The sidecasting dredge has only open-water disposal capability; therefore, it cannot be used for dredging contaminated sediments.

5.1.5 Dipper Dredges.

The dipper dredge is basically a barge-mounted power shovel (Fig 5.4). It is equipped with a power-driven ladder structure and operated from a barge-type hull. A bucket is firmly attached to the ladder structure and is forcibly thrust into the material to be removed. To increase digging power, the dredge barge is moored on powered spuds that transfer the weight of the forward section of the dredge to the bottom. Dipper dredges normally have a bucket capacity of 6 to 9 m^3 and a working depth of up to 15 m. There is a great variability in production rates, but 30 to 60 cycles per hour is routinely achieved.

Figure.5.4: Dipper Dredge

The best use of the dipper dredge is for excavating hard, compacted materials, rock, or other solid materials after blasting. Although it can be used to remove most bottom sediments, the violent action of this type of equipment may cause considerable sediment disturbance and resuspension during maintenance digging of fine-grained material. In addition, a significant loss of the fine-grained material will occur from the bucket during the hoisting process. The dipper dredge is most effective around bridges, docks, wharves, pipelines, piers, or breakwater structures because it does not require much area to maneuver; there is little danger of damaging the structures since the dredging process can be controlled accurately.

Advantages:

The dipper dredge is a rugged machine that can remove bottom materials consisting of clay, hardpacked sand, and glacial till, stone, or blasted rock material. The power that can be applied directly to the cutting edge of the bucket makes this type of dredge ideal for the removal of hard and compact materials. It can also be used for removing old piers, breakwaters, foundations, pilings, roots, stumps, and other obstructions. The dredge requires less room to maneuver in the work area than most other types of dredges; the excavation is precisely controlled so that there is little danger of removing material from the foundation of docks and piers when dredging is required near these structures. Dipper dredges are frequently used when disposal areas are beyond the pumping distance of pipeline dredges, due to the fact that scow barges can transport material over long distances to the disposal area sites. The dipper type of dredge can be used effectively in refloating a grounded vessel. Because it can operate with little area for maneuvering, it can dig a shoal out from under and around a grounded vessel. The dipper dredge type of operation limits the volume of excess water in the barges as they are loaded. Dipper-dredged material can be placed in the shallow waters of eroding beaches to assist in beach nourishment.

Limitations:

It is difficult to retain soft, semi suspended fine-grained materials in the buckets of dipper dredges. Scow-type barges are required to move the material to a disposal area, and the production is relatively low when compared to the production of cutterhead and dustpan dredges. The dipper dredge is not recommended for use in dredging contaminated sediments.

5.1.6 Grab Dredgers

Grab Dredgers are non-propelled barges equipped with a mechanical grab hanged by a crane arm. The grab is dropped into the water to dredge bed materials. The dredged materials are loaded on a transport barge staying next to the dredger. The transport barges with fully loaded are transported by a tugboat to designated dumping location to discharge the loaded materials. Empty barges go back to the dredging site to load next dredged materials. Dredging capacity of the dredgers is widely available depending on the volume and materials to be dredged.

Fig 5.5: Grab Dredge (Contaminated Material Dredging)

Advantages:

The grab dredger has the following advantages:

- Replacing the grab, any materials (silt, sand, rock) can be dredged.
- Accurate dredging work is possible.
- Dreading work in shallow area is possible.
- Using a special grab and surrounding frame with protection curtain, contaminated materials can be dredged and transported to the designated dumping location with minimum environmental impacts.

Limitations:

The limitations on grab dredgers are as follows:

- Hindrance to existing operations due to stretched wires to keep the positions of the dredger.
- Dredging of wide area is not efficient in general.

5.2 Preferred Dredging Method

5.2.1 Dredging of quay wall foundation

Dredging work will be done in shallow areas (3 – 4 m depths) with less exixting port traffic. Therefore the Grab Dredger will be most appropriate (Fig 5.6).

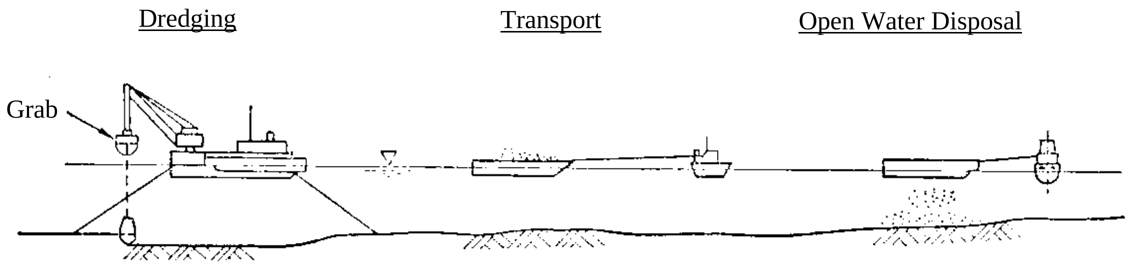


Figure 5.6: Image of Dredging and Dumping by Grab Dredgers

5.2.2 Dredging of turning basin and access channel

Taking account of the wide area and large volume of material to be dredged, and possible tight dredging schedule with the already busy exixting port traffic, the hopper Dredger type will be most suitable (Fig 5.7).

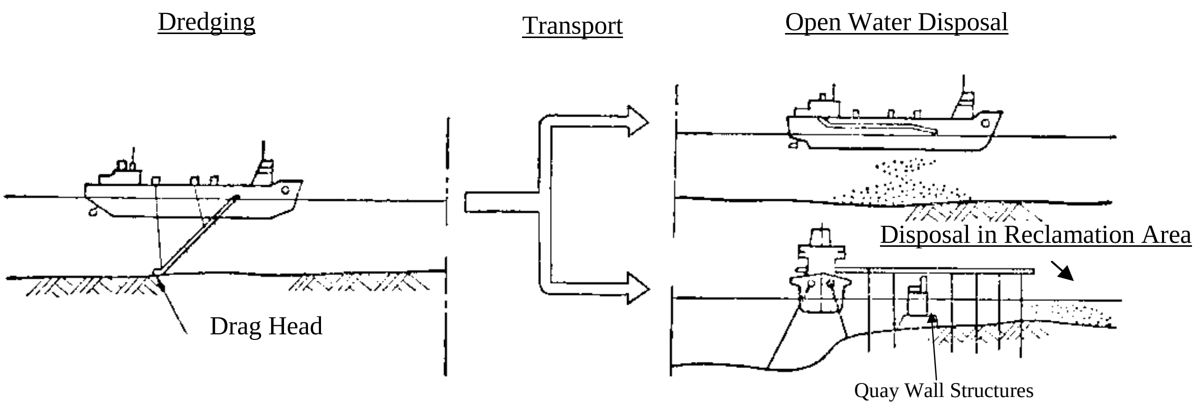


Figure 5.7: Image of Dredging and Dumping by Hopper Dredgers

5.2.3 Dredging of highly contaminated materials

In the event that the materials to be dredged have unacceptable levels of contaminants for open water disposal, the Grab Dredger with special special equipment (see Fig 5.5) will be most suitable.

Since surface layers of seabed in areas to be dredged is likely to be highly contaminated, the contaminated layer will be skimed up and transported to a designated containment (confinement) disposal sites.

Dredged contaminated matriaials will be off loaded at a land baced containment facilities and kept with periodical monitoring at and around the facilitiy.

5.3 Reclamation Method and Equipment

As described earlier, the new container terminal will be reclaimed with sandy materials which are dredged from the access channel and designated sand harvesting areas (see Figure 2.2). The dredged sand is transported by a hopper dredger and discharged into the reclamation area through pipe lines (see Figure 5.7).

Discharged sand will quickly settle on the bottom and excessive water in reclamation area will be released into surrounding water area (Figure 5.8). Since discharged material is expected to be course fragment, the released water unlikely contains high turbidity.

Silt protection curtain will be placed enclosing the exxeccive water release point if necessary.

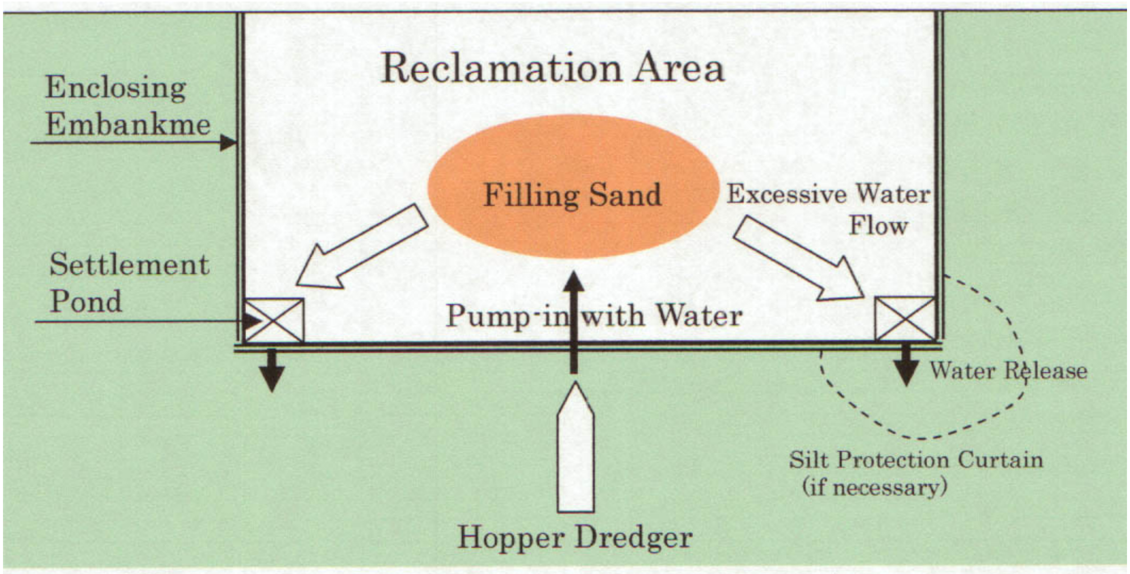


Fig. 5.8: Schematic illustration of an enclosed reclamation design for the proposed container site.

6.0 PHYSICAL ENVIRONMENT OF PORT REITZ ESTUARY AND MOMBASA NEAR SHORE WATERS

6.1 Introduction

The investigations of the physical marine environment are considered of paramount importance to understanding the impact of dredging, land reclamation and dumping of the dredged material the Port-Reitz estuary in the Mombasa. This section permit in addition to brief outline presented earlier, further review of the existing data including some hydrographic surveys at the project sites.

The main purpose of the study is to provide baseline information and data on the current status of the physical environment and assess the impacts and predict the current patterns alteration of the proposed dredging and land reclamation as compared to the original environmental situation, and secondly to provide expert opinion on the implication of the altered current systems in relation to coastal erosion and siltation.

The report starts with objectives, followed by method and tasks, the climate. Section on the marine waters is given where a review on general circulation, near shore and inshore currents, with emphasis on tidal currents is presented. Physical appearance of water in terms of turbidity and the distribution of salinity and temperature are also presented. Lastly a discussion and mitigation analysis and recommendation on monitoring strategy are given.

6.2 Objectives

The objectives of the study were:

1. To undertake a desk top study of coastal climatic condition of the area including wind speed, wind direction, precipitation, relative humidity and temperature.
2. To describe the oceanographic conditions of the area including currents, tides, salinity and temperature etc.
3. Identify activities that lead to adverse impacts.
4. Define the extent of impacts by activity.
5. Give measures to mitigate adverse impacts, including source control and treatment control measures.

6.3 Methods

The key tasks for desk top study included:

- Caring out of literature review and synthesis of meteorological data and information (general climate including specific rainfall, wind speed and direction, air temperature, evaporation information etc (The meteorological data is from the Kenya meteorological department (KMD) especially from Moi International Airport and a few other stations from Kwale District where the main river entering the Port area has its source).
- Carrying out literature review and synthesis of oceanographic data and information (morphology and bathymetry, general circulation of water in the Kilindini-Port Reitz area, tides and tidal currents, erosion aspects of the currents, salinity and temperature conditions, surface hydrology and estuarine conditions (river discharge and sedimentation).

6.4 Prevailing Baseline Conditions

6.4 1 Coastal Climate and Oceanic Circulation

The climate and current pattern occurring off Kilindini-Port Reitz area and along the Western Indian Ocean in general is controlled by patterns of high and low atmospheric pressure cells over the Arabia peninsula and Mascarene Plateau in the South Indian Ocean. The pressure cells give rise to the Indian Ocean monsoon wind regimes that drive the Inter-Tropical Convergence Zone (ITCZ) of low atmospheric pressure north and south of the equator following the overhead position of the sun. Strong winds occurs as air masses rush into the zones of low pressure and enhance the flow of oceanic currents along the coast and cause reversals in response to the wind regimes.

6.4 2 The Monsoon seasons-Wind regime

The coastal climate is characterized by four monsoon seasons, two of which are main (3-4 months long) seasons whereas the other two are short (1-2months) inter-monsoon seasons which are characterized by episodic events in terms of freshwater input and sedimentation in the shallow water mangrove ecosystem that occur in many inlets along the Kenya coast (Table 6.1). There are four monsoon seasons two main seasons ones and are.

The southeast monsoon & northeast monsoon seasons

The Southeast monsoon (SEM) and the Northeast monsoon (NEM) are the two main seasons. The SEM season is well established between June and September when the low atmospheric pressure (ITCZ) and the sun occur in the northern hemisphere. It is generally characterized by strong winds from the south blowing at 15-30km/h, deepening of the thermocline layer due to vertical mixing, and occurrence of cooler ocean water on the Kenya continental shelf and from across the Indian ocean via the South Equatorial Current(SEC). The NEM season occurs between December and March when the low atmospheric pressure and the sun are in the southern hemisphere. The air masses rush to produce light winds from the north of less than 15km/h.

Table 6.1: Wind patterns and their main characteristics and influences in Mombasa

Month	Wind speed (mean) (m/s)	Typical features of wind
January	5-6 (5.5)	Wind blows from N-E direction with speed varying from 5 to 6 m/s. Somali current flows southward at its peak speed.
February	4-5 (4.5)	Wind blows from N-E direction with speed of 4-5 m/s.
March	3-4 (3.5)	Wind speed in the bay reduced, but is still NE trade wind.
April	2-3 (2.5)	Wind blows from the east at low speeds.
May	0-3 (1.5)	The beginning of SM north of the equator. Wind blows from southerly direction causing heavy rainfall and hence flows from Mwache Rivers. Somali current is at its lowest speed and changes direction after meeting EACC as far as Mombasa.
June	7-9 (8)	Wind blows from southwest direction from land hence conditions are dry. EACC flowing northward is well developed.
July	5-10 (7.5)	Wind blows from southerly direction with high speed of unto 10 m/s. Cool conditions results. EACC is well developed.
August	7-10 (8.5)	Wind blows from the south. East Africa Coastal Current (EACC) is also well developed
September	5-7 (6)	Wind blows from the south.
October	1-4 (2.5)	Wind blows from the south but with low speed
November	1-2 (1)	Wind shifting southward and blows from northern and easterly direction. Convergence of NM and SM winds occurs causing rainfall and high flow from Mwache Rivers.
December	3-4 (3.5)	Wind blows from the north in northern direction.

The inter-monsoon seasons or the transient periods

The other two seasons are the inter-monsoon long rain season (IMRS) and the inter-monsoon short rain (IMSR) season which occur in April-May and October-November respectively when the low pressure is established over Kenya and the sun is passing overhead and characterized influx of low salinity water due to precipitation and runoffs and strong local winds (sea breeze). Some of the important meteorological parameters are describe in slightly more details in the sections that follows.

Wind speed and direction

Wind direction in near the Kilindini entrance area (at KMFRI) varied between 145^o and 200^o, with a mean direction of 164^o and a mean velocity of 6ms^{-1}, reaching maximum value of 9.5ms^{-1} (Nguli, 2006). The climatologically monthly mean wind speed at Port Reitz (at Moi International Airport) is shown together with those of from Malindi Airports for morning (0900hrs local time) and afternoon winds (1500hrs local time). Thus, as indicated there is a strong land sea breeze acting on top of the monsoon. The mean wind at the entrance is somewhat higher at the Port Reitz (Figure.6.3). Diurnal variations in direction and speed are strong. Stronger winds during daytime persisting up to late afternoon are caused by a sea breeze. The sea breeze implies that the seasonal variations in the daily mean wind speed are small.

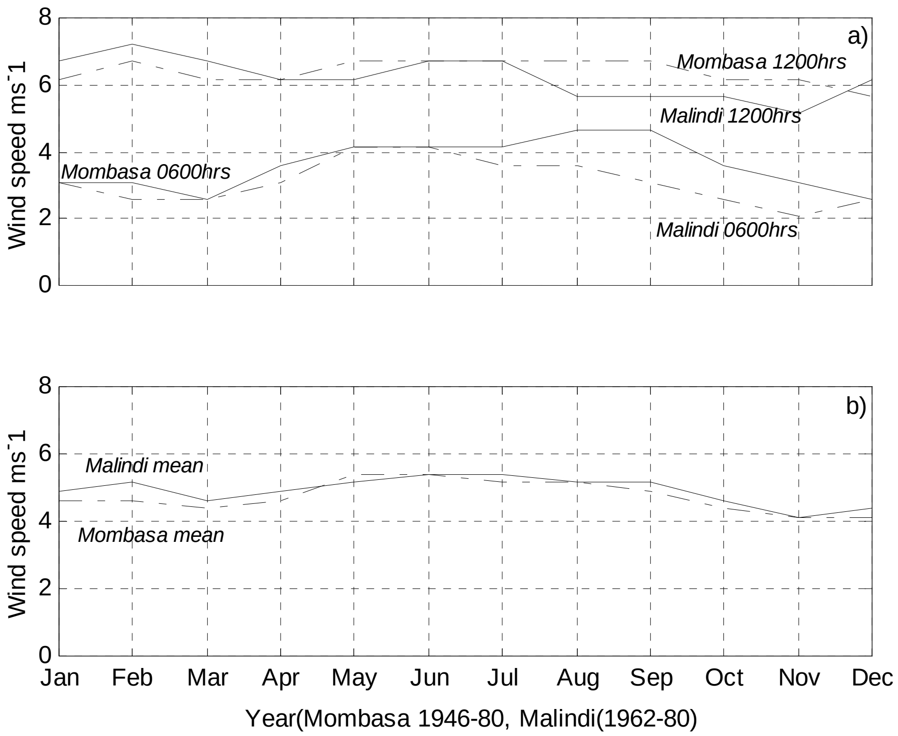


Figure. 6.3. Long-term monthly mean wind speed at (a) Port Reitz(Mombasa) and (b) Malindi Airports twice a day, at 06GMT and 12GMT (Nguli, 2006)

6.4 3 Atmospheric pressure:

The atmospheric pressure or, rather the Sea Level Pressure (SLP) at the entrance to Kilindini-Port Reitz is averaged 1015mb with a maximum of about 1016mb in the second half of July. The Monthly climatology data is also shown near Port Reitz area (Figure.6.4). In this figure the diurnal variation the difference between the morning and the afternoon curves, and the seasonal variation are clearly illustrated. The pressure observed in the morning (0600hrs Local time) is higher than the one in the afternoon (12hrs Local time). The difference, 3-4mb is due to a resonance phenomenon driven by daily heating and cooling of the atmosphere. The time for maximum of the SLP agrees well with the climatology data, but it is 2mb above the mean. The diurnal variations are pronounced with a range of 3-4mb.

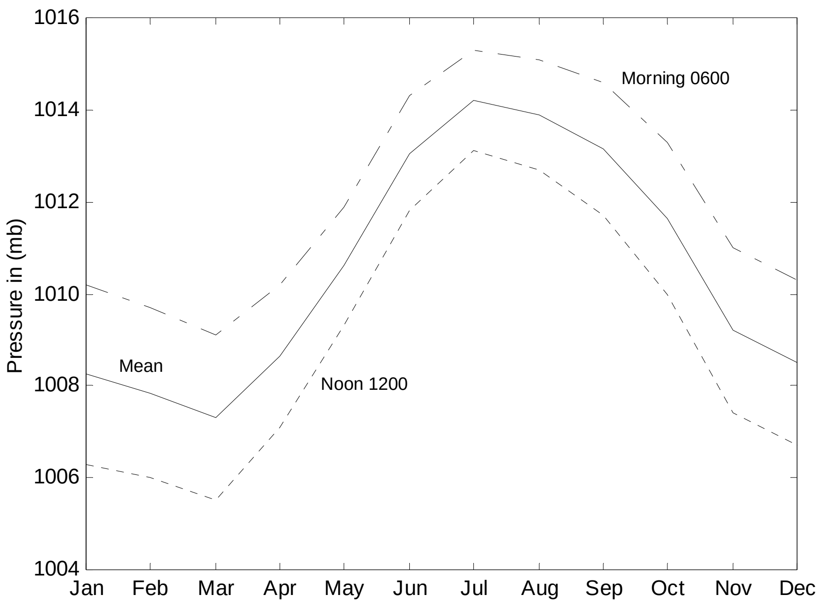


Figure.6.4. Air Pressure Morning (0600hrs Local time) and Noon (1200hrs Local time) are with monthly mean value for near Port Reitz area (Nguli, 2006)

Air temperature

The long term, daily mean temperature has an annual range of 4^{o}C with maximum of above 28^{o}C in February-March and a minimum 24^{o}C in July-August (Figure. 6.5). The daily range is between 7.5 and 10^{o}C, with a minimum in May during the IMLR season. Maximum range in February is correlated with clear skies and dry air. The diurnal range is averaging some 3°C for maximum to minimum during the rain season, although somewhat higher during the dry season.

Evaporation

The evaporation is shown (Figure.6.6). The general trend of coastal evaporation can be seen three places (Kilifi, Tudor and Gazi) along the coast (Figure. 13).

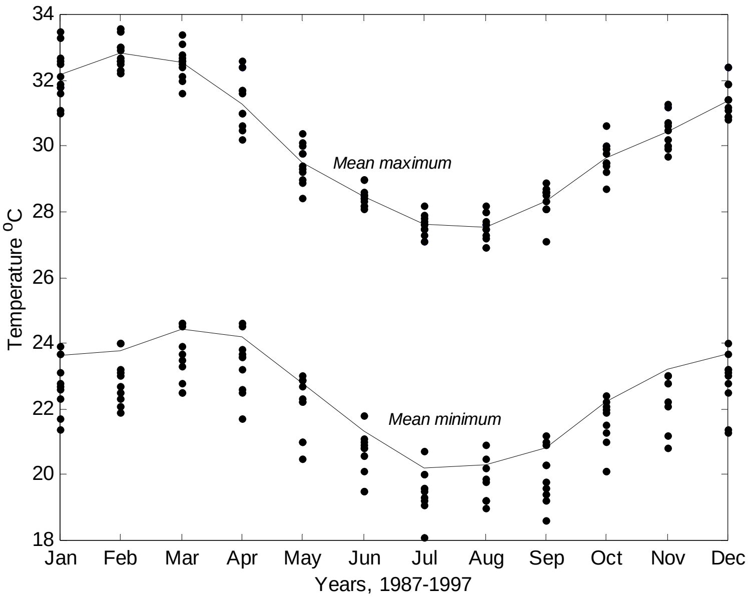


Figure 6.5: Daily maximum and minimum temperatures and monthly mean for 1987-97 in Port Reitz area (Nguli, 2006).

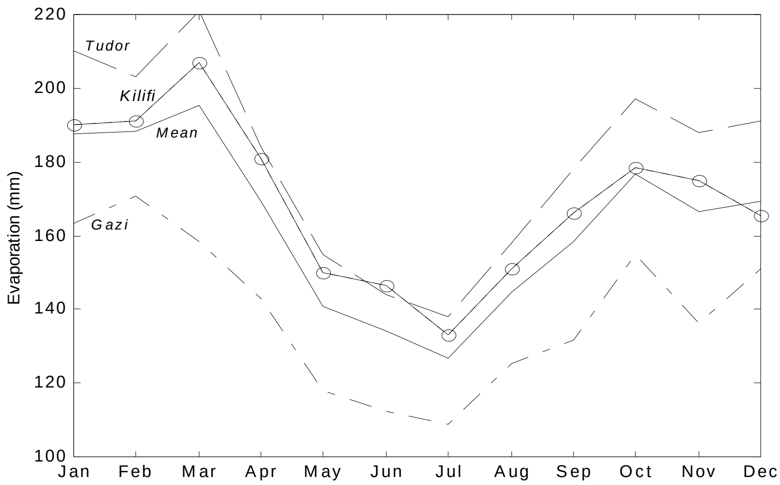


Figure 6.6: Comparison of evaporation from three sites similar to Port Reitz area, the mean evaporation is given for all the three sites for period 1958-97 (Nguli, 2006)

Evaporation rates increases northward along the coast. Evaporation rates in Port Reitz area are shown (Table 6.2), for different monsoon seasons. Highest evaporation occurs during the dry season from December to March (NEM Season), and low during the IMLR season.

Table 6.2: Long-term mean evaporation rates (mm/month) during various seasons

	IMLR	SEM	IMSR	NEM
Port Reitz area	154.3	162.9	188.1	201.5

6.4.4 Rainfall

Monthly rainfall near the Port Reitz area (Moi Airport) for the years 1987-1997 is also shown (Figure.6.7). Rainfall from 1995-97 is highlighted to show the effects of excessive rainfall such as occurred during the El-Nino year of1997. Considerable variations in the annual rainfall peaks values are observed, in the range from 150-850mm. The rainfall pattern is bimodal with the highest amount falling during the IMLR season and in IMSR season is evident. Rainfall varies considerably from one year to another. The year featured a total rainfall of 2175 mm, and coincided with the El-Nino year.

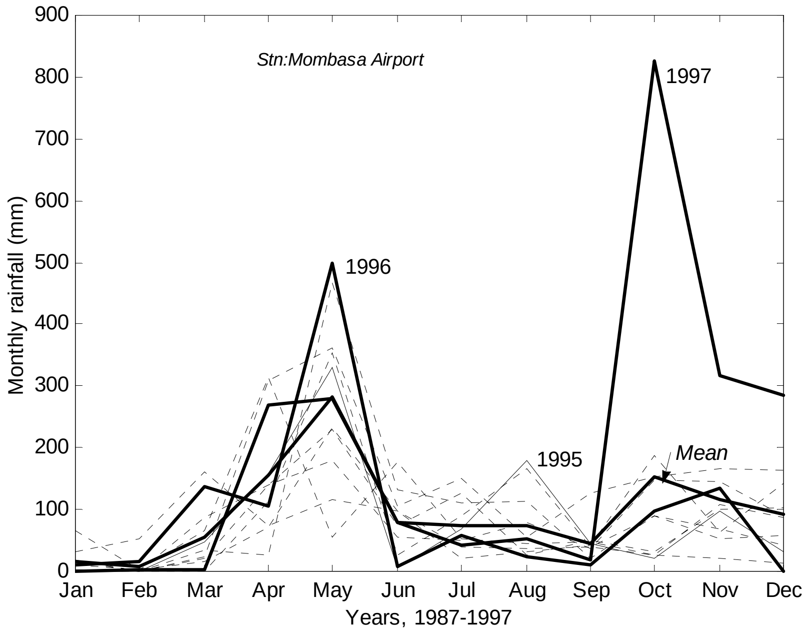


Figure.6.7. Monthly rainfall from (1987 to 1997), rainfall for 1995-1997is emphasized to show above normal rainfall in the El-Nino year of 1997(Nguli, 2006)

6.5 The Marine Waters

6.5.1 The Oceanographic Conditions

The physical marine environment within the area being surveyed in this report can be classified as the near-shore or the water near the Kilindini-Port Reitz entrance area with oceanic influence. This is the water with strong influence of coastal currents. Coastal currents, waves and wind may have a strong influence on characteristics and water transport. The other water inshore water which includes water in the lagoons found north and south of the entrance area and inlet or harbor water which extends landward to the shallow mangrove fringed basins, narrow creeks and estuaries reaches. Water in this shallow inlet areas are considerably influenced by the river and stream flows and the land runoff. Of importance in Port Reitz are the two main rivers Cha Shimba and Mwachi of which freshwater input create estuarine conditions at the port.

Coastal Currents, waves, and surface transport near the entrance

The Kenya continental shelf which is has its large with(15-60Km) north of Mombasa in the Ungwana-Malilindi Bay area and very narrow (2-8km) to the south of Mombasa, with only 2-3km off Kilindini-Port Reitz entrance area, is bathed by the two main coastal current systems, which are the East African Coastal current (EACC) and the Somali Current (SC) (Fig. 6.8). The EACC is the northward flowing branch of the SEC that hits the mainland of Tanzania just south of Mafia Island. Strong prevailing winds during the SEM season enhances flow of the EACC to a maximum velocity of about $2ms^{-1}$ forcing it to move across the Equator to Arabian Sea. During the NEM season when the monsoon winds reverse a southward flow is established causing the EACC to reverse north of the Equator and give rise to the SC. Both the EACC and the SC meet near Malindi and move offshore as the Equatorial Counter Current, although it has been argued that part of the SC extend as far south as off the entrance to Kilindini-Port Reitz area. The effect of the SC is to reduce the velocity of the EACC to less than $1ms^{-1}$.

The water movement within the reefs lagoons at the entrance and the channels is strongly by tidal currents and tend to flow with the prevailing local winds rather than the coastal currents. In addition to causing waves the winds blowing over the water surface exert a shear stress resulting in a surface transport of water into the Channels the water moves in the wind direction with velocities reaching 2-3% of the wind direction. Therefore during the SEM season the wind range of 6-9.5ms^{-1} corresponds to a range of 0.15-0.25ms^{-1} surface transport into Port area, when a drift of 2.5% is assumed. During NEM season when the wind velocity range from 6ms-8.5ms^{-1} water transport is in the range 0.15-0.2ms^{-1}.

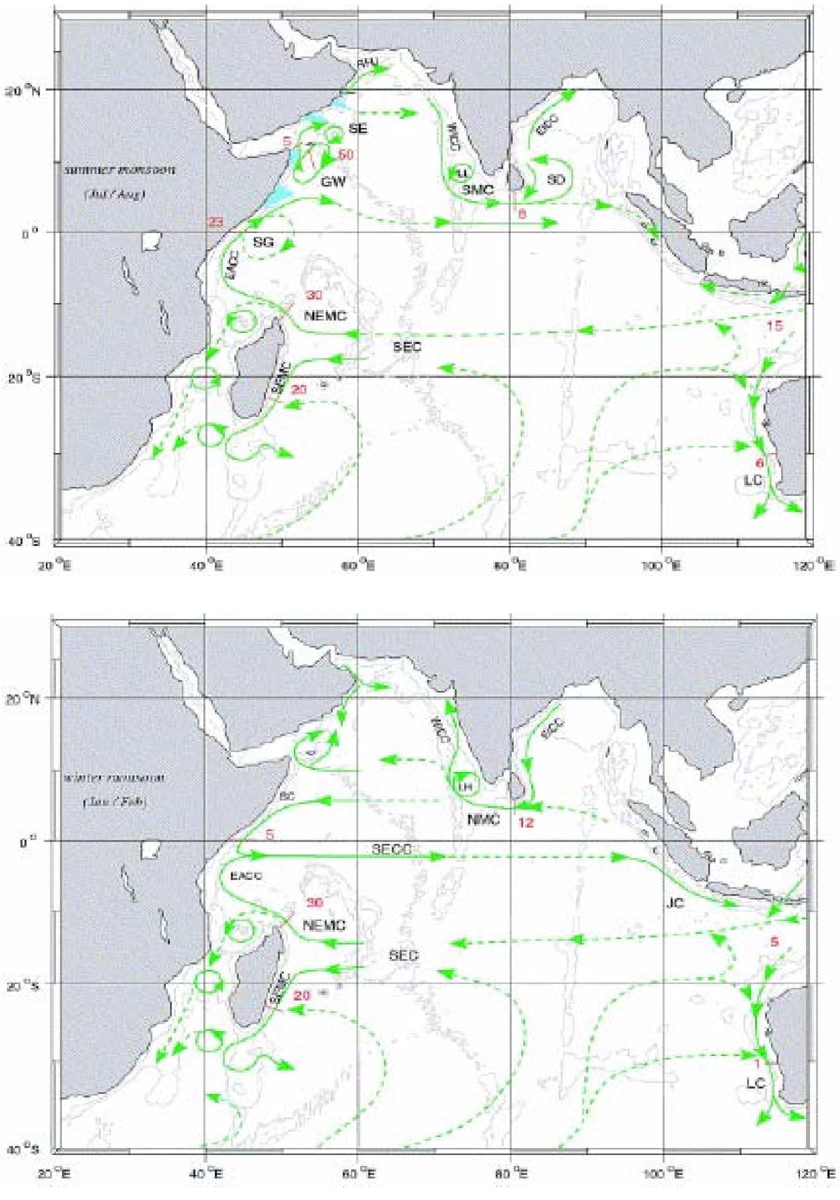


Figure 6.8: Typical Indian Ocean Circulation: note coastal currents (EACC, SC and SECC) during SEM-season (top Panel), and NEM-season (lower panel)

Waves

Waves in the near-shore coastal areas as well as at the entrance to Kilindini-Port Reitz area are mainly of two types. Those that are produced by local winds and last for short period and at increasing wind speed get higher and speeder and finally break. These types of waves reach up to a height of 2m in SEM season and can be seen along the fringing reefs at the entrance. The highest significant wave height is about 3m, with a period of 10-15 seconds. The water in are shielded from entrance or offshore waves, hence much smaller wind waves (<1m) seen in the Port Reitz area. The other types of waves are swells. They are smooth and calm produced by distance storms. The wind waves are of shorter period than the swells.

Transparency

The surface water transparence varies along inlets depending on the amount of suspended matter in the water column. In the shallow areas of Port Reitz where bottom sediment can easily be stirred by tidal currents, wind waves and reach the area as river plume transparence is variable. It may also depend on the tidal stages, since the strong currents during flood tide can bring in more clear oceanic water into the site as well as stir the bottom sediment and vice versa during the ebb tide. Turbid creek water has occasionally been observed during ebb tide as far as entrance area (Anon, 1975).

Tides or Sea level fluctuations

Sea level fluctuations are measured using tide gauges. Tide gauge data from Liwatoni area in Kilindin will later be used to argument tidal data. However, for the purpose of this report, it is pointed out that, that the Kilindini-Port Reitz tides, like those found in, other inlets, along the coast (Tudor Creek, Gazi Bay, Mwache Creek, Mtwapa Creek and Kilifi Creek) are of the semi-diurnal type, having two high and two low waters per day. Tides have been studied in water around Mombasa Isaland by (Nguli 2006) and most of the figures and Tables given here are from that study.Tidal amplitude varies from 1.5m on neap tides to 4.0m on spring tides (Figure.6.9). Table 6.3 and Table 6.4 represents tidal characteristics such as occurs in the area. The average tidal range is 2.3m. The large tidal prism accumulated in the shallow estuarine mangroves areas such as found in the upper reaches of the Port Reitz result in strong currents in the main Kilindini-Port Reitz channels.

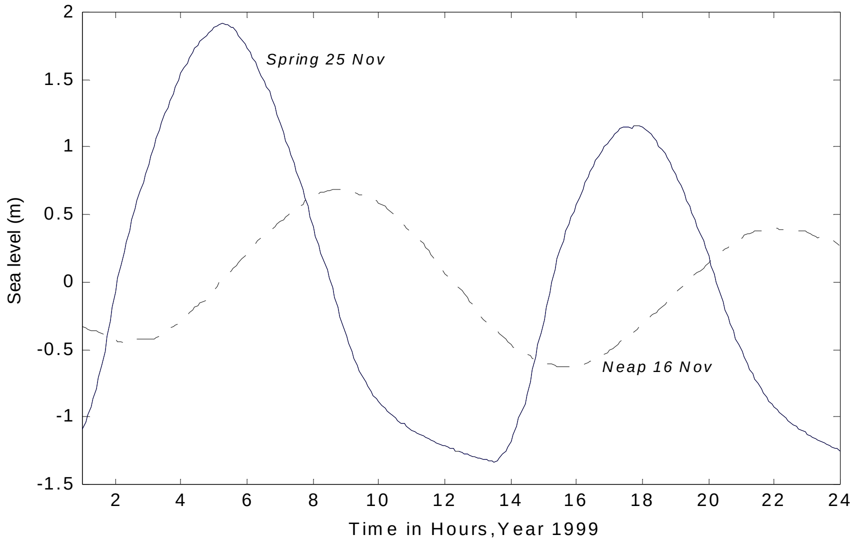


Figure 6.9: Typical neap (16 Nov) and spring (25 Nov) in shallow area (Nguli, 2006)

Table 6.3: Tidal characteristics such as occurs in the area (Anon 1975)

	HW		LW		MW
Location	Mean springs	Mean neaps	Mean springs	Mean neaps	Mean level
Kilindini-Port Reitz	3.74	2.44	0.27	1.28	2.30
Tidal Prism $x10^6m^3$	153	56	81	99	108
Total Volume $x10^6m^3$	341	274	180	220	240

Table 6.4: Amplitude for six principal constituents from the tide gauges deployed in various shallow inlets including Port Kilindini

Constit.	***Period***	***Amplitude***				
		Tudor_MT1	***Tudor_MT2***	***Tudor_MT3***	***Kilifi (bay)***	***Kilindini***
M_2	12.42	1.062	1.097	1.117	1.051	1.055
S_2	12.00	0.519	0.487	0.457	0.455	0.521
N_2	12.66	0.212	0.213	0.214	0.214	0.201
K_2	11.97	0.082	0.143	0.179	0.129	0.139
K_1	23.93	0.224	0.226	0.237	0.163	0.191
O_1	25.84	0.102	0.097	0.099	0.092	0.113
Mean Range	2.46	2.413	2.336	2.119	2.10	2.32
Spring Range	3.148	3.168	3.162	2.858	3.01	3.15
Neap range	1.320	1.220	1.086	0.994	1.19	1.07

Tidal currents at the entrance to Kilindini-Port Reitz area

Tide, near-shore coastal currents and probably the dynamics of the main oceanic current influence the currents at the entrance to Kilindini-Port Reitz area. Tides in shallow water give rise to flood or ebb tidal currents that are influenced by topography of the inlets. At the flood tide the water first enters the main channels at the entrance resulting and in reef openings giving rise to high current velocities. At flood tide strong currents flow through the reef openings and into Port Kilindini area influenced by the tidal range, topography and morphology. Maximum velocities occur in the narrow and deep channel(maximum depth 35m) that forms Port Kilindini reaching flood currents in the range 0.5-1.5ms^{-1} at a depth of 12-20m in spring (Anon, 1975), this similar magnitude of velocity occur in in the entrance channel of Port Tudor (Nguli, 2006). Maximum ebb currents flow close to the surface and are slightly less (<0.75ms^{-1}) in magnitude. In the shallow areas the both ebb and flood currents decrease to low values of about 0.1-0.5ms^{-1} as found by Kitheka (1997) in Mwachi Creek upstream of Kipevu terminal.

Freshwater Discharge

The freshwater discharge arises from the Simba Hills catchment's area and which is the rainiest area in the coast province. There are two main rivers that arise from the Hills, the Cha Shimba River and Mkurumuji River. The Mkurumuji River which drains in Gazi Bay (50km to the south), whilst Cha Shimba river in Port Reitz area. The two rivers have had long period of discharge records each for more than two decades (Nguli, 2006). The discharges are compared in Table 6.5 and it is clear that Cha Shimba River discharges an average of 65% of the two river during the long rain season (April-to May) and 80% in the short rain period (October-November). This % difference is an indication that the rainfall approaches to the hills in the two seasons, it is more to the north than south in rain falls more in the northern part of the Hills. The effect of fresh water is to cause salinity and temperature difference in the Port, which may alter net water flow in the creek and main channels.

Table 6.5: Discharge estimates from Cha Shimba River (CS.R) and Mukurumuji River (M.R)

Yrs	NEM				IMLR		SEM				IMSR	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
M.R	0.14	0.13	0.06	0.26	1.55	1.21	0.22	0.18	0.12	0.22	0.35	0.30
CS. R	0. 354	0. 181	0. 454	2. 764	2. 448	1. 430	0. 397	0. 303	1. 068	1. 008	2. 279	1. 135

6.5.2 Near-shore circulation

a) Wind induced currents, tidal currents and long-shore currents

The near shore circulation, found within the upper 50m of the water column, at the Entrance to Mombasa is a result of wind driven currents and tide. The flow is also influenced by reef configuration and currents in the lagoon channel that flank both the north and south sides of the Entrance. The near shore waters were extensively investigated for both NEM and SEM seasons (Norcosult, 1975). Away from the reef, including the proposed dumping site, the main flow is predominantly northward, in parallel with and keeping distance wit coral reef line, except for very brief period at the end of NEM-season when it reverses. No eddies occur on account of reefs. The wind driven currents have velocities in the range 0.15-0.20ms^{-1} corresponding to the daily wind range of 6-8.5ms^{-1} during the NEM season. The periodic tidal currents are determined by the tidal range and velocities in the open water at entrance are <0.5ms^{-1} and attain largest velocities (>1.0ms^{-1} in the narrow parts of Kilindini-Port Reitz. During NEM the coastal currents are slow, water is warm and of high salinity. During this time stratifies occurs and the thermocline shoals to 40-60m depth (Nguli 2006) which may hinder settling of released fine materials at the planned dumping sites. Density stratification and current patters are important to disposal of dredged material as well as to the fate of plume from the inshore areas.

The wind causes large waves (~ 2m) at the reefs on both sides of the entrance. Water from the harbor flows outward and northward. Studies on the northern Nyali-Bamburi lagoon established that currents in the lagoon channels southward towards the Entrance during ebb and reverse direction during flood (Kirugara et al 1988). Long-shore currents due to wave action vary with the season and are expected to be up to 0.5ms^{-1}. Similar flow can be expected in the lagoon water to the south of the entrance. Wind during the SEM season result in currents in the range of 0.15-0.25ms^{-1}. Relatively strong winds result in swift flow, which may enhance flushing of inshore water. In addition the water is well mixed and the thermocline deepened to 100-120m (Nguli 2006).

b) Salinity and temperature distribution

The information required for describing the proper discharge depth, dumping load and current system is the water density structure, which is given by salinity and temperature. The climate the periodic changes in wind regimes have major influence on the salinity and temperature. Relatively small changes occur in the surface temperature and salinity distribution. The changes are caused by water from Arabia where it originates with of high salinity >36.5 and temperature and transported to Kenya by the SC. The other water arrives as water of slightly lesser salinity through the South Equatorial Current (SEC) from Bay of Bengal where its original salinity is < 32. Off Kenya coast salinity averages 35. In the near shore area where runoff causes modification salinity range is in

34.2 to 34.9 whereas temperature is in the range 26- 28.5^{o}C. The lowest temperatures are found during the SEM season in the month of August. The highest temperatures occur during the NEM season in February-March. In the inshore areas the value of 30^{o}C is easily reached, maximum salinities > 35.5 occur during the dry period in NEM season due to excess evaporation.

Salinity and temperature

Salinity and temperature is influenced surface water of the EACC and freshwater input. At the ocean side salinity range is in 34.2 to 34.9 where as temperature is in the range 26- 28.5^{o}C. The lowest temperatures are found during the SEM season in the month of August whereas the highest temperatures occur during the NEM season in February March where in the shallow areas the value of 30^{o}C is easily reached, maximum salinities occur during this period as well and values close to 35 can be observed in the shallow basin areas. The lowest salinity is found near the mangrove areas and close to the river mouths. During peak rains salinity in the range 20-32 is easily observed in the Port areas, but this are quickly mixed by strong tidal currents resulting in higher salinities. Salinity maxima which may occur as fronts in shallow do create vertical currents that may affect the disposition of sediments and floating matter for sediment suspension dynamics in Mwachi Creek (Kitheka, 1997). Some details of physical oceanographic conditions are shown in Table 6.6

Table 6.6. Season and area-wise mean salinity (S) and temperature (T) in shallow water and oceanic water in Mombasa area

SEASON	*PARAMETER*	*UPPER AREA*	*MID-BAY*	*OCEAN*
IMLR	S; (T)	24.86; (30.41)	32.98; (28.86)	34.76; (28.57)
SEM	S; (T)	35.72; (27.24)	35.57; (25.92)	35.45; (24.94)
IMSR	S; (T)	35.28; (28.72)	35.31; (28.24)	35.20; (27.53)
NEM	S; (T)	35.94; (31.67)	35.93; (30.25)	35.67; (29.01)

Hydrodynamic exchange –Residence time

Current changes in the Port area due to dredging and construction may result in changes in residence time of the water, meaning that the port may not discharge efficiently due to trapped water volume behind new terminal. Residence time can be calculated from the climatic data and also from temperature gradient considerations. The similarity of Port Reitz creek and the Tudor Creek allows us to draw a parallel in calculations. Values of residence times calculated using climatic information and rainfall data over known the catchments area freshwater runoff, and the supply over the Port surface, and evaporation over the Port surface and a retention coefficient are given in Table 6.7.

Table 6.7: Results from calculations of water exchange (q_o, q_{om}), horizontal eddy diffusivity (K_{xm}) and residence time (T_{rm})

	So	S_1	ΔS	q_f	q_{fm}	q_o	q_{om}	K_{xm}	T_r	T_{rm}
				m^3s^{-1}	m^3s^{-1}	m^3s^{-1}	m^3s^{-1}	m^2s^{-1}	*d*	*d*
IMLR	34.76	32.17	2.59	2.01	9.45	25.0	117.4	195	25	5.9
SEM	35.45	35.59	-0.14	-0.18	2.50	--	--	--	--	--
IMSR	35.20	35.31	-0.11	-0.70	6.50	--	--	--	--	--
NEM	35.67	35.93	-0.26	-1.32	-0.48	182.4	66.3	111	3.8	10.5

Similarly residence time can be calculated using the temperature gradient and estimates of climatology net sea surface heat flux. The results of such calculations for shallow water around Mombasa (Nguli, 2006) are shown in Table 6.8, where maps for estimating net ocean sea surface heat flux from are used. These results show high degree of conformity where water exchange during all seasons is between 278 – 314 m^3s^{-1}, with corresponding residence times of between 2-3 days. Thus the heat budget calculations indicate 2-5 times higher water exchange. Considering the differences in residence tome in the two tables the temperature gradient based values indicate more reliable values mainly due to insufficiently gauged rivers that would allow reliable calculations of river discharge.

Table 6.8: Results from calculations of water exchange (q_o), and residence time (T_{rm}) from temperature data and climatology net sea surface heat fluxes

	To	T_1	ΔT	Q_{atm}	q_o	T_{rm}
				Wm^{-2}	m^3s^{-1}	s
IMLR M-J	28.57	29.06	0.49	50	314	2.2
SEM A-S	24.94	26.05	1.11	100	278	2.5
IMSR O-N	27.53	28.29	0.76	75	305	2.3
NEM J-F	29.01	30.55	1.54	150	301	2.3

Disposal of dredge material, dumping site and dispersion of particles

The dredged material requires a large and suitable disposal area to ensure minimum environment impact. The silty[or fine mud] material to be dredged at the proposed site are not significantly toxic (see elsewhere in this report), and can be deposited on land. A site near Dogo Kundu (near Port Reitz) is proposed as an alternative. However, KPA has in the past deposited dredged material in the ocean. This is perhaps the better option and a cost effective one. Given the large volumes that will be dredged and dumped, dumping further offshore is most preferable. That the material be best disposed offshore in deep waters at about 6-7km offshore in waters over 150-200m depth.

Although the dispersion of turbid water arising from the dumped material and subsequent impact can best be described by a dispersion model when the local flow conditions around the disposal site are known, previous dumping by KPA at site closer to the shore (*ca.* 4 km) than the currently proposed site were done without causing damage to the vicinal sensitive environment such as the coral reefs in the Mombasa Marine National Reserve. For the purpose of this baseline EIA-Report it suffices to explain that the local conditions that need to be known for a simple dispersion are the distance from the fringing coral reef within the limit of the Port Area, the depth, the density (salinity) of the water, and the weight and the volume of the dumped material.

It is to be expected the East African Coastal Current (EACC) of with speed averaging $1ms^{-1}$ enhance dispersal. Particles will eventually sink due to the bottom flocculation induced by high salinity[density] at increased depth if the operation is done during the dry months (Jun-Sept and Dec-March) the effect of density is most likely to enhance settling. Low-density water that occur during the wet period (Apr-May, Oct-Nov) have high buoyancy and would enhance transport, however additional of plume from disposal/reclamation site would mean enhanced impact downstream.

Dispersal of dredged material from the reclamation site

Again, the heaviest sediments from reclamation site settling at a known radius away from the fall out and the lighter material in plum form settling down at a distance further from the reclaimed or dredged site will depend on the strength of the current and density stratification. The greatest impact would occur near the site but further from the site the dispersion will depend on currents and salinity hence density. The tidal prism is high such that most of the turbid particles will settle down during flood when water of high salinity from the ocean reaches the dredging and reclamation site.

Mixing by tidal currents during ebb should ensure that all most of the particulate matter settles to the bottom due to progressively high salinity water as one moves towards the entrance. There are no sensitive corals in the port. Live corals occur 3-4km away from the proposed port development site. Using the argument presented above about the impact arising from the 6-7km offshore. The effect of additional sediment load to the ambient plume will have insignificant effect on live corals down stream.

7.0 PHYSIC0-CHEMICAL ENVIRONMENT

7.1 Introduction

The Kilindini/Port Reitz creek is a multiple use ecosystem providing various goods and services of ecological and socio-economic significance. It is recognised that Port Reitz area forms part of the main fishing grounds for artisanal fishers who along the coastal area produce over 80 % of the total marine fish catch. Fringed by mangrove swamps with seagrass beds and coral reefs found in the nearshore areas opening into the sea, such a system is among the most dynamic, productive and resourceful. The Kilindini/Port Reitz creek receives considerable quantities of riverine (from the semi-perennial rivers such as the Mwache and Cha Simba) and coastal watershed discharge which include high nutrient, sediment loads and suspended particulate matter associated with municipal wastewater and agricultural runoff that impact on the productivity and water quality. The Mwache River, drains a semi-arid catchment and discharges about 2.15 million m^3 of water and significant volumes of terrigenous sediments into Port Reitz Creek, which have occasionally caused degradation of the mangrove forest ecosystem within the creek especially during episodes of heavy precipitation (Kitheka et al, 2003, UNEP 1998a).

The Kilindini – Port Reitz harbour creeks, in particular are subjected to environmental perturbation due to shipping and other marine and land-based activities. Shipping activities include bunkering and discharging crude oil and petroleum products and industrial chemicals into shore based receptacles. Operational leakages and accidental spills of these products to the detriment of the aquatic ecosystem are not uncommon. Periodic dredging in the port and approach channels for maintenance and expansion of utilities puts into suspension considerable quantities of particulate material, associated chemicals (e.g. nutrients, heavy metals, persistent organic contaminants etc.) which adversely impact the water quality, affecting the productivity, biodiversity and system functions.

Assessments of the quality of the marine environment along the Kenyan coastal area have largely comprised studies on concentration levels of selected heavy metals, petroleum hydrocarbons, pesticide residues, inorganic nutrients and microbial contamination in sediments, water and biota. It is significant that Mombasa and the immediate environs has been identified as a potential pollution hotspot attributed to the various land-based anthropogenic activities (domestic, industrial, shipping operations, etc.) which make the city the largest contributor of pollution loads into the coastal waters (UNEP 1998b, Mwaguni & Munga 1997).

A rapid survey of the physical and chemical conditions in the Port Reitz area and its environs was conducted with the aim of establishing the environmental status as a prelude to implementation of the Port Container Modernisation Project.

7.2 Methodology

The study site comprised the Port Reitz and Kilindini creeks, with emphasis on the proposed project area, including the immediate terrestrial area, the port entrance and the nearshore areas along Shelly Beach in the vicinity of the proposed dumpsite for dredged material. (Figure 7.1). Within the Port Reitz area sampling points were located along transects across the channel, indicated as T5 – T9, with T5 – T7 covering the reclamation area. Other transects (T1 and T2) were located off the harbour entrance. The distribution of sampling points is as presented in Table 7.1 and Figure 7.2.

Table 7.1: Sampling stations

Transect	**Sampling Points**
T1	NS
T2	E2
T5	RE1, RE2, RE3
T6	RC1, RC2, RC3
T7	RW1, RW2, RW3
T8	IS
T9	IN

In the marine environment, water samples were collected from the sub-surface layer (about 1 m depth) and bottom layer in duplicate. Sediment samples were obtained using a grab sampler. All samples were stored appropriately for analysis at the SGS Laboratories, Mombasa.

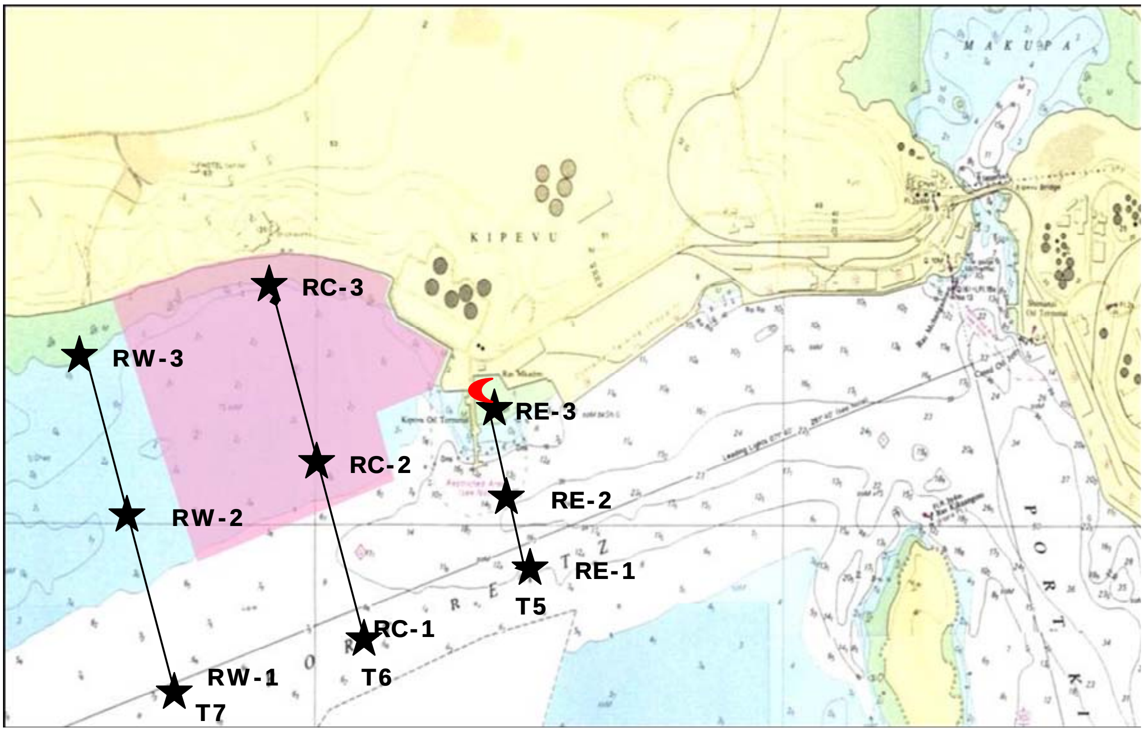


Figure 7.1: Map of the study area showing location of sampling stations. (Oyster sampling site marked in half moon, red colour)

Physico-chemical parameters that were measured *in situ* included water temperature, pH, salinity, total suspended solids (TSS) and DO. In the laboratory samples were analysed for BOD, Oil and grease, Total Petroleum Hydrocarbons (TPH), phenol, ammonia and total phosphorus. Dissolved heavy metals analysed included Cd, Hg, Pb, Cr, Cu, Ni, Fe and Zn. Sediment samples were analysed for the heavy metals Cd, Hg, Pb, Cr, Cu, Ni, Fe, Zn, As and Al. Other parameters determined included pH, total nitrogen, total phosphorus, organic carbon content (loss on ignition) and total petroleum hydrocarbons.

A composite sample of the soft parts of oysters (30 individual animals) was sub-sampled and analysed for the heavy metals Pb, Cd, Fe, Zn, Cu, Hg, Al, As and Cr. The oysters were obtained from the concrete seawalls around the Kipevu Oil Terminal (KOT) at the shoreline infront of RE-3 location at about the mid-tide water mark (Figure 7.1).

Air sampling for hazardous gases, including carbon dioxide, was carried out using a Gas Analyser (Testo AG, T 350 XL). Noise level at selected sites was measured using a sound level meter (Testo AG, Testo 816).

7.3 Water Quality

The observations of water column characteristics with respect to pH, temperature, salinity (as NaCl % wt) and DO in the study area are presented in Figure 7.2. The water pH varied within a narrow range 7.7 to 8.2 indicating an increase towards the open sea (station NS). Water temperature ranged from 27.1 to 32 °C and salinity from 32.1 to 35.1 psu with the higher salinities prevailing in the bottom layer. DO values ranged from 5 to 8.7 mg l^{-1}, with the lowest concentration recorded for a bottom sample from station RE 2. In general, the water column appeared well mixed at the time of sampling.

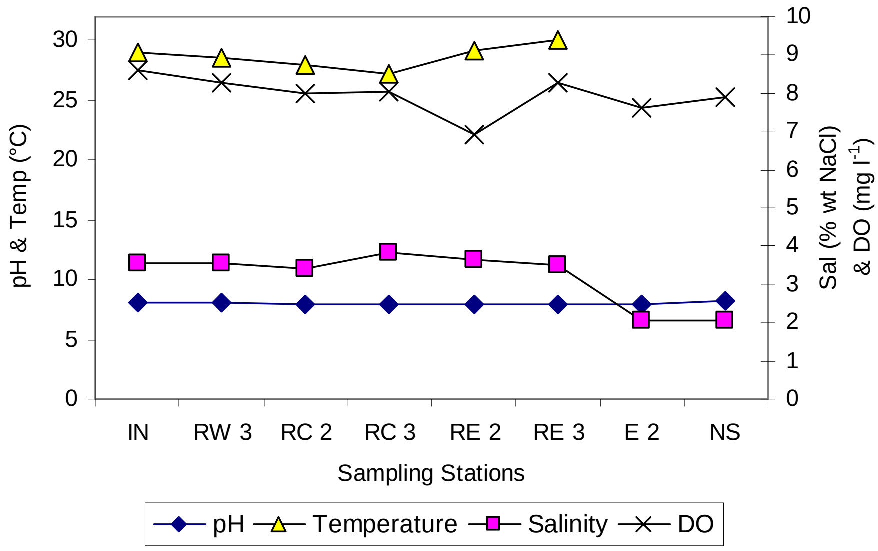


Figure 7.2: Variations of mean pH, temperature, salinity and DO in the water column

In the water column ammonia concentrations were below detection (< 0.03 mg N l^{-1}) which indicated efficient usage by primary producers. Concentrations of total phosphorus expressed as phosphate ranged from 0.15 to 0.20 mg l^{-1}, with generally higher levels found in the bottom water layer (Figure 7.3).

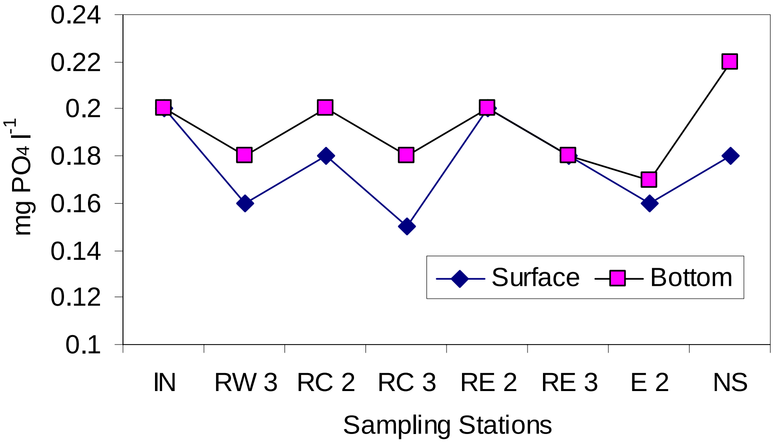


Figure 7.3: Phosphate concentrations in the water column

Dissolved levels of the heavy metals Cd, Cr, Cu, Fe, Pb, Ni and Zn in the water column were low (less than 1.0 mg kg^{-1}) with the exception Pb and Fe. Concentrations of Cd and Pb, the two highly toxic heavy metals ranged from 0.13 to 0.54 mg l^{-1} and <0.02 to 2.6 mg l^{-1}, respectively (Figure 7.4).

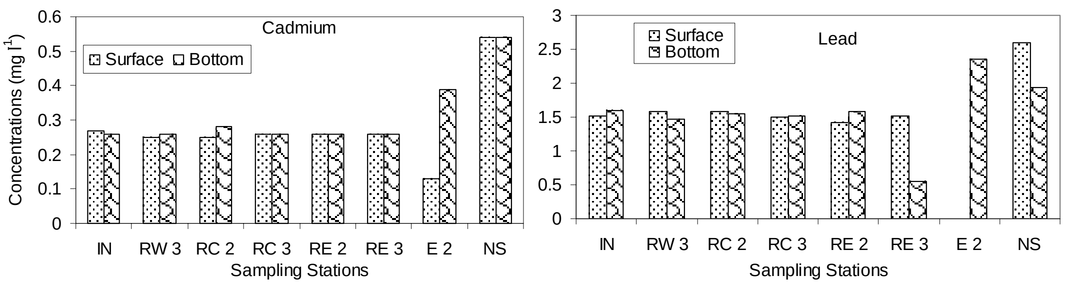


Figure 7.4: Distribution of Cadmium and Lead in the water column

The concentrations of the heavy metals generally increased towards the open sea, except Cr which showed a decreasing trend (Figure 7.5).

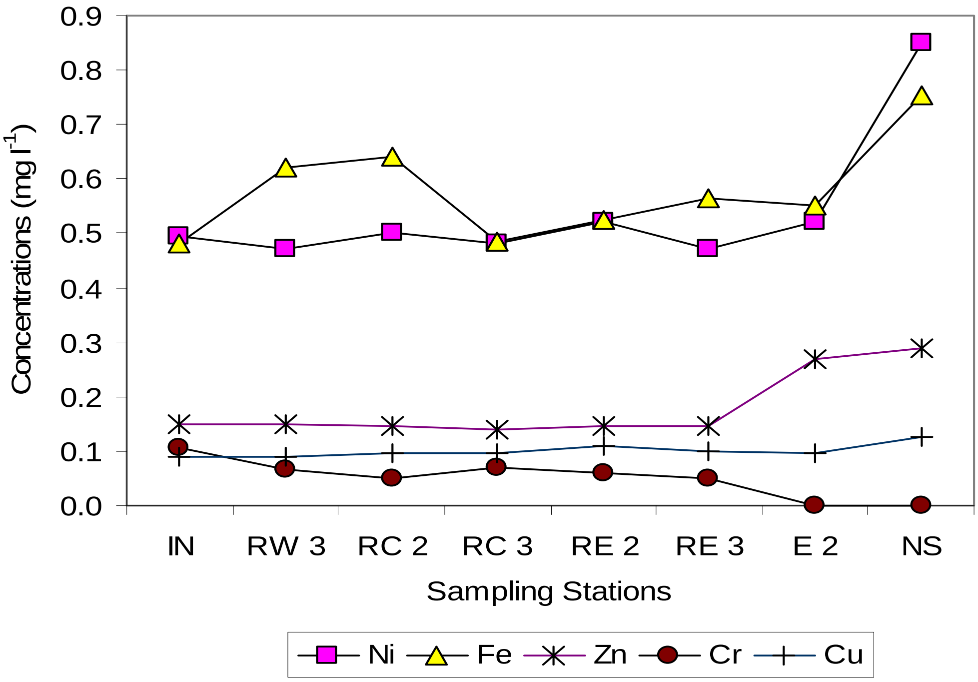


Figure 7.5: Variations of heavy metal concentrations in the water column**.**

The levels of dissolved fractions of the organic contaminants Total Petroleum Hydrocarbons (TPH, <0.4 mg l^{-1}), phenols (nil), and Oils and greases (<0.4 mg l^{-1}) in all the water samples analysed were below detection.

7.4 Sediment Quality

Out of the 8 sediment samples analysed, 5 samples were obtained from Port Reitz in the vicinity of the proposed reclamation site and the rest from the Shelly Beach proposed dumping site (Figure 6).

Figure 7.6 shows the results of the physcico-chemical variables of sediments.Samples from the Port Reitz creek stations had lower pH values (range 7.8 -8.8, mean 8.2±0.4) compared to the Shelly Beach samples (range 9.1 – 9.6, mean 9.4±0.3). Concentrations of total nitrogen in samples from the Port Reitz and Shelly Beach stations were comparable, at 0.09±0.006 mg kg^{-1} and 0.08±0.005 mg kg^{-1}, respectively. Levels of total phosphorus in the Shelly Beach samples (0.240.04 were generally lower than in samples from Port Reitz (0.30±0.04 mg kg^{-1}). A similar trend was observed in the variation of loss on ignition of the sediment samples, which signifies the association of phosphorus with organic carbon content of the sediment. The terrigenous sediments in the Port Reitz creek have higher organic carbon content, compared to Shelly Beach. Levels of TPH in the sediments were below detection (<0.4 mg kg^{-1}).

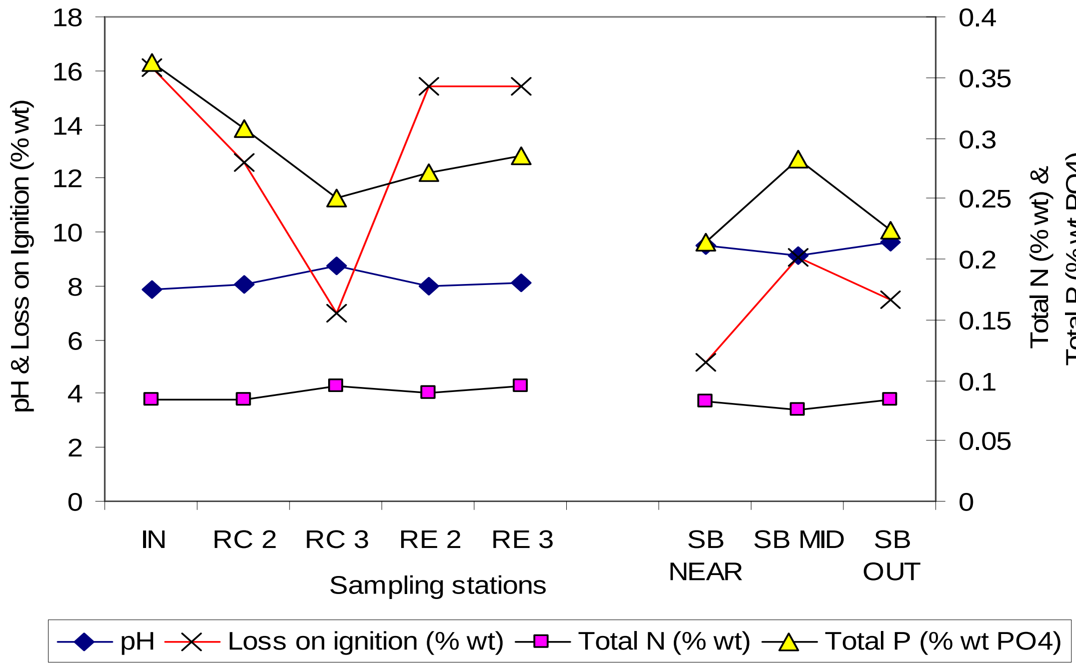


Figure 7.6: Physico-chemical properties associated with sediments. (SB = Shelly Beach).

Presented in Figure 7.7 are the results of the analysis of the heavy metals Cd, Fe, Pb, Zn, Cu and Cr. In addition samples were analysed for concentrations of mercury (Hg). However, Hg levels in the samples were below detection (<0.5 mg kg^{-1}).

The results show generally decreasing trends in the sedimentary concentrations of Fe, Zn, Cu, and Cr moving from the Port Reitz creek to the Shelly Beach stations. The observed trends provide an indication of the association of the heavy metals with the organic carbon content of the sediments. The sediment size distribution in the creek with a relatively high proportion of silt provides higher surface area for sorption of the metal species.

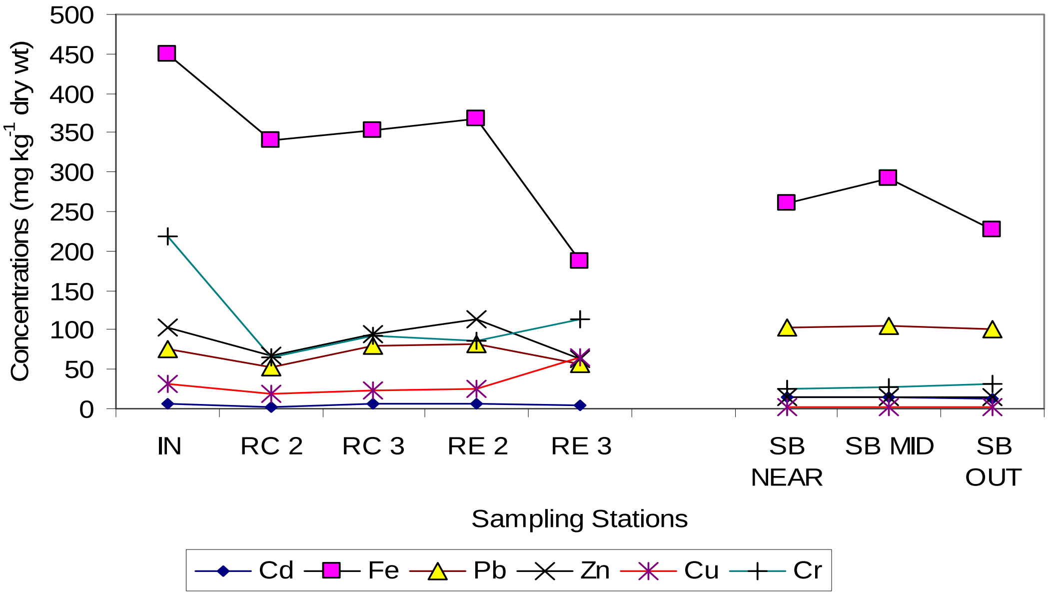


Figure 7.7: Variations of heavy metal concentrations in sediments

The concentrations of Cd found in sediments from sampling points in the general location of the proposed reclamation area in Port Reitz creek ranged from 2.8 – 6.0 mg kg^{-1} (mean 5.1±1.3 mg kg^{-1}). These concentrations were comparable to levels reported by Kamau (2002) which ranged from ND – 9.3 mg kg^{-1} (mean range 0.5 – 6.0 mg kg^{-1}). It is noted that the highest concentration reported by Kamau corresponded to a sampling station in the vicinity of the Kipevu Oil Terminal (KOT) which happens to be near the proposed reclamation area. This is significant because the outfall from the Municipal Sewage Treatment Works, which has been operating at far less than optimal conditions, is located in the same area. Thus, most often inadequately treated to completely untreated domestic sewage and untreated industrial effluent is discharged into the Port Reitz creek, which is a source of Cd contamination to the waterway.

Lead concentrations in sediments from Makupa and Tudor creeks were reported by Mwashote (2003) (range 0.2 – 58 mg kg^{-1}). Williams et al. (1997) reported sporadic enrichment of heavy metals in sediments from the lower reaches of Kilindini creek (maxima 427 mg kg^{-1} Pb), Makupa Creek (maxima 44 mg kg^{-1} Pb), near KOT in Port Reitz (30 mg kg^{-1} Pb) and on the east of Mombasa Island, which they attributed to specific point sources including KOT and the adjacent sewage outfall into Port Reitz, dumpsite at

Makupa Creek, and wastewater outfalls from Mombasa Island into the Kilindini creek and Mombasa Harbour (Old Port). It is noteworthy that Williams et al. observed enrichment of heavy metals in the uppermost 5 – 10 cm of sediment at most sites, with the exception of Makupa creek where corresponding enrichment depths of about 20 cm were attributed to localized catchment disturbances resulting in increased sediment fluxes.

In comparison relatively low levels of Cd and Pb in shallow nearshore (20 m depths) to deep offshore sediments (2,000 m depths) ranging from 0.01 – 0.34 mg kg^{-1} for Cd and 12 – 16 mg kg^{-1} for Pb were reported by Everaarts & Nieuwenhuize (1995). It is evident from the observed concentrations of heavy metals that the levels for particularly Cd and Pb in sediments within the port area are elevated, and this may require special care in the disposal of contaminated dredged material. With reference to observations made by Williams et al. it is the relatively organic-rich surficial sediment layer most probably 5 – 10 cm thick that is the most contaminated and will require special handling.

As shown in Figure 7.7, Cd and Pb indicate high concentrations. However, none of them exceeds the acceptable concentration levels for open water disposal (Testing Values) presented in World Bank technical paper no 126, 1990.

Table 7.2: Quality Standards for Dredged Materials, World Bank Technical Paper No.126, 1990.

Name (mg/kg dry matter)	Reference Value	Testing Value	Signally Value
Chromium	100	480	1000
Nickel	35	45	200
Copper	36	90	400
Zinc	140	1000	2500
Cadmium	0.8	7.5	30
Mercury	0.3	1.6	15
Lead	85	530	1000
Arsenic	29	85	150

NOTE: Sediments lying:

- Below or equal to the reference values can be deposited on the land or in fresh water or sea water without restriction.
- Between the Reference Values and the Testing Values are permitted under certain conditions.
- Above Testing Values must be disposed in controlled containment facilities subject to constant monitoring.

7.5 Biota Quality

The results of the analysis of oyster samples are presented in Table 7.3. The results show elevated concentrations of particularly Pb, Zn and Cu beyond the typical maximum limits of tolerance (TMLT) established for human consumption. Thus, the levels of Pb exceed the maximum allowable limits with a deviation of 258%, Zn levels exceed with the highest percentage (800%) and Cu is slightly above the limit (4.5%). As and Hg are below the detectable limits of 0.05 mg kg^{-1}.

Table 7.3: Concentrations of heavy metals in oyster sample.

Metal	Concentration (mg kg^{-1})	Typical Max. Limit of Tolerance (mg kg^{-1})
Pb	21.45	6
Cd	0.50	2
Fe	54.53	-
Zn	453	50
Cu	31.37	30
Hg	<0.50	0.5
Al	58.52	-
As	<0.05	-
Cr	3.68	1

Oysters were obtained from the concrete seawalls around the Kipevu Oil Terminal (KOT) at the shoreline infront of RE-3 location at about the mid-tide water mark (Figure 7.1)

It is instructive that the concentration levels of the heavy metals in the oyster sample roughly reflect the relative levels in the sediments in Port Reitz. Potential sources of the heavy metals at the site include the adjacent wastewater outfall and industrial activities in the vicinity.

7.6 Air Quality

The results of *in situ* measurements of air quality parameters are presented in Table 7.4. Generally, the recorded levels of all the gaseous contaminants were low. The levels of particularly NO_2 and SO_2 were within the World Health Organization Air Quality Guideline Values (WHO 2005), as indicated below,

Nitrogen Dioxide - NO_2 ……………………200µg m^{-3} – 1 hour mean

Sulphur Dioxide - SO_2 ……………………..500µg m^{-3} – 10 minute mean.

Table 7.4: Air Quality Measurements

Sampling Site		O_2 %	CO_2 %	H_2S ppm	NO_2 ppm	CO ppm	SO_2 ppm
1.	Container Terminal	21.06	ND	ND	0.2	ND	ND
2.	Berth No. 19	21.01	ND	ND	ND	1.0	ND
3.	Reclamation Site (Leeward Side)	21.02	ND	ND	0.2	2.0	1.0
4.	Transit Godown No. 101	21.03	ND	ND	ND	1.0	ND
5.	Along Port Reitz Rd. Near Evengelical Church	21.05	9.42	ND	0.2	2.0	ND
6.	Along Port Reitz Rd. Opp. Transeast	21.05	ND	ND	0.2	1.0	ND
7.	RE2	20.99	ND	ND	ND	1.0	ND
8.	RE3	20.99	ND	ND	0.2	1.0	ND
9.	RE1	21.00	ND	ND	ND	ND	ND
10.	RC1	20.99	ND	ND	ND	3.0	ND
11.	RC2	21.00	ND	ND	0.2	1.0	ND
12.	RC3	20.98	ND	ND	0.4	2.0	ND
13.	RW3	20.96	ND	ND	0.2	2.0	ND
14.	RW2	21.01	ND	ND	ND	2.0	ND
15.	RW1	20.98	ND	ND	0.2	2.0	ND
16.	IN	20.97	ND	ND	0.2	2.0	ND
17.	IS	20.99	ND	ND	ND	2.0	ND
18.	Shelley Beach, SB	20.97	ND	ND	0.2	3.0	ND
19.	Harbour Entrance – E	21.02	ND	ND	0.2	1.0	ND

7.7 Noise Levels

The results of measurements of noise levels at the various sites are presented in Table 7.5. The noise levels measured at all 14 sampling points were below the allowed maximum ambient noise limit indicated by the World Bank for industrial zones of 70 dBA. There are no residential areas in the immediate proximity of the port.

Table7.5: Noise measurements

Measurement Point	Position South	Position East	Elev. (ft)	Time (hrs)	dB (A)* Lmax	dB (A)* Lmin	dB (A)* Leq
4 October, 2006							
Container Terminal	04° 02'	039° 37'	7	15:00 -15:30	69.5	68.5	69.16
Berth No: 19	04° 02'	039° 37'	11	15:35 -16:10	69.9	63.3	68.9
Reclamation site (Leeward site)	04° 02'	039° 36'	119	17:00 -17:30	68.7	67.5	68.10
Along Port Reitz Rd (Near Evangelical church)	04° 02'	039° 37'	154	18:12 -18:42	67.8	66.9	67.37
5 October, 2006							
Reclaimed Center - RC2	04° 03'	039° 86'	19	10:30 -11:00	69	55.1	63.92
Reclaimed Center - RC1	04° 02'	039° 36'	0	11:10 -11:40	60.8	49.8	57.86
Reclaimed Center - RC3	04° 02'	039° 36'	7	11:45 -12:15	67.6	54.1	62.96
Reclaimed West - RW3	04° 02'	039° 86'	88	12:20 -12:50	65.4	52.5	61.20
Reclaimed West - RW2				12:55 -13:25	68.0	55.5	66.12
Reclaimed West - RW1	04° 03'	039° 86'	4	13:30 -14:00	67.9	59.4	66.38
Island North - IN	04° 02'	039° 35'	19	14:05 -14:35	63.0	44.7	59.47
Island South - IS	04° 03'	039° 35'	0	14:40 -15:10	60.0	53.0	57.05
Reclaimed East - RE2				15:15 -15:45	69.3	57.5	64.91
06/10/2006							
Shelley Beach (SB)	04° 05'	039° 40'	11	15:30 -15:50	47.2	41.4	44.7

The measurement results are expressed as follows:

- Lmax - Maximum sound pressure level obtained during the measurement period
- Lmin - Minimum sound pressure level obtained during the period of measurement
- Leq - Value of A-weighted sound pressure level of a continuous steady sound that, within a specified interval, has the same mean square sound pressure as a sound under consideration whose level varies with time. All the measurements were taken in the diurnal schedule.

The port area is dominated by vessel operations and other related activities. The noise sources are at the various quays and wharves, noise generated from the shipping activities and surrounding industries and traffic activities. Background noise levels are higher in the loading areas and next to the railway line attributed to the vehicular and human traffic, and actual loading activities.

8.0 The Biological Environment – Marine and Terrestrial Life

8.1 Introduction

As already mentioned in project components of this EIA report and the scope of the project, major impacts are expected on the aquatic as well as on the terrestrial environments and life-forms. The biological components of the EIA study required assessments and compilations of existing life-forms and ecological processes around the project sites in order to assess and predict the key impacts due to the project activities as compared to the existing environmental situation.

8.2 Specific Objectives

The objectives of the ecological environment study were to:

1. Describe the existing ecological conditions of the area in terms of existing biodiversity and species of special concern (rare, endemic, threatened), including their habitat use;
2. Analyze the projects' potential interference (impact assessment and prediction) on existing biodiversity, sensitive habitats and processes;
3. Suggest mitigation measures that will ameliorate identified impacts and/or can be recommended for monitoring predicted changes in biological conditions.
4. Produce data and information for the publication of a comprehensive report on the EIA survey in accordance with the standard NEMA/JBIC template.

8.3 Methodology

8.3.1 Site description

For the general characterization of the area, the Admiral charts No 616 at a scale of 1:50,000 for the Port of Mombasa were used and it shows much more site details for the critical areas of concern in this study where dredging, reclamation, sand harvesting and dumping will be done (Fig 2.2). These sites were characterized using these maps. In addition, the existing environmental conditions in terms of hydrodynamics (see section 6) were also taken into consideration. Study transects were then selected to reflect on ocean dynamics and biota. Figure 8.1 shows the selected study transect lines for the assessments of biological conditions.

8.3.2 Base data

Prior to the biological characterization at the proposed study sites, existing (secondary) data on the ecological features were sourced and collated. This included literature review, interviews with local agencies and organizations (stakeholders), and visits to technical institutions such as the Kenya Marine and Fisheries Research Institute (KMFRI) and the Coral Reef Degradation in the Indian Ocean program (CORDIO). A full list of persons met and institutions visited is provided in the Acknowledgements section. The defined gaps were noted for inclusion in the primary fieldwork stage. Primary field data collection phase took place during September, October and November 2006. These investigations involved different methods – assessments, characterizing, mapping, and field observation – to get "sight records" using different techniques (Table 8.1 & descriptions below). Specifically, the approach ensured that: -

a) Primary sampling was undertaken in accordance with standard national and international procedures and protocols (adapted to suit local conditions), and embedded proper quality assurance/control requirements;
b) Collaboration between consultants and other stakeholder agencies on the ground with local knowledge (KMFRI, KPA, NEMA, KWS, Fisheries Dept., Forestry Dept., Coastal Forest Survey (CFS/ Coastal Forest Conservation Unit (CFCU), Tsunza community group, Port Reitz fishermen team, and other relevant groups) was attained;
c) Long term monitoring requirements can be met: i.e., a monitoring plan would be possible at specific sites, and at appropriate time scales to be based on baseline data and local knowledge.

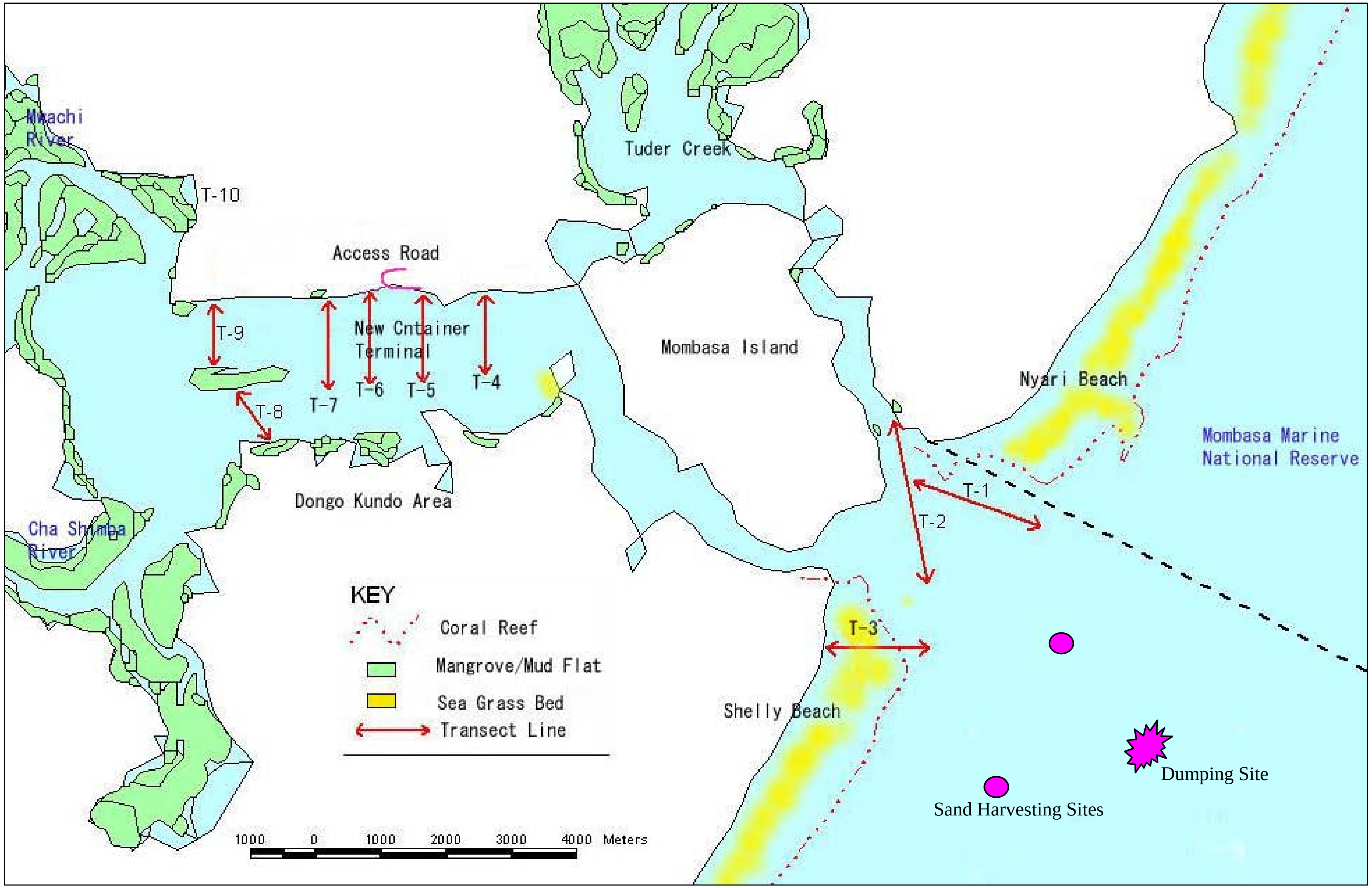


Figure 8.1: sampling transects for marine biological survey.

8.3.3 Field survey plan and design (including equipment description)

a) Marine life and ecological processes

As shown in Figure 8.1, a total of nine (9) water area transect lines were surveyed distributed as follows: three (3) transects (T1 – T3) at the Port Kilindini entrance and Mombasa Harbour, and six (6) within the Port Reitz areas (T4 – T9). Ten (10) additional transects were surveyed for the fringing mangrove biotopes and one U-shaped transect (following access route plan) for the land-based environment at the north banks of Port Reitz creek. The selection of each site sampled was motivated by an increased likelihood of it receiving significant impacts due to the KPA project activities, or acting as control areas.

Within the water environments, a total of 14 sampling locations were further selected to cater for the various project components. Basically at the port entrance area, each transect line had single sampling locations (T1, T2, & T3 had single sampling points at the mid-positions of transects), but at the Port Reitz area 2 to 3 sampling points were allocated to each transect (T5, T6, & T7 each had 3 sampling points at both end points and the mid-positions of the transect lines; while transects T8 & T9 each had single sampling points at the mid-positions of transects). Transect 5, 6, and 7 fall within or very close to the proposed dredge/reclamation sites.

The sampling methodology for aquatic flora took into consideration the physical/hydrographic setting, while those for aquatic fauna were sensitive to the different life-form categories and to the different substrata type. In addition, visual censuses (photo inventory) were used to characterize benthic underwater biota (qualitative descriptions).

Detailed sampling/assessments were done at the intertidal areas; where 10 x 10m quadrat areas were set out and macroalgae/seagrass were assessed at intervals of 50m for species composition, abundance and cover estimates. In the intertidal and supralitoral fringes, mangrove and related wetland communities were surveyed (on belt transects) at intervals of 50m between successive belt-transects. Mangroves were analyzed for species composition, density, adult-juvenile proportions, and phenological state, and macrofaunal densities of bottom dwelling fauna (composition and abundance). All sampling sites were geo-referenced (GPS).

In addition, marine birds visiting/using mangrove areas (trees, mudflats, etc) and beaches were recorded by an experienced observer hired for that purpose and using binoculars and telescopes and standard guides (Brown et al,1986; Urban et al, 1988; Fry et al, 1988; Keith et al, 1992; Zimmerman et al., 1996). This was done by boat rides or foot-walks along the banks (for beach species) and along mangrove water creek fronts (for mangrove-dependent species). This was done twice during the following cycles: low tides, high tides, morning, evening, and twice at two fish-landing sites (Kwa Kanji and Kwa Skembo) during fish landings. Counts were made for sightings only, and where possible identified to species level.

A detailed fishery survey was also undertaken. Working closely with fisheries officers from the Fisheries Department (Mombasa District Fisheries Office), fish statistics from the for the last 3-5 years were investigated and analyzed, in addition to site visits for interviews with fishermen. Additional sampling was commissioned and undertaken by fishermen for the consultants to gain “sight records” and verify catch data for 2 consecutive days and involved day-based sampling and night-based samplings. Fisheries data collected and analyzed paid particular attention to fishery landing sites, crafts used, ecological groups/fish categories (species/taxa and dominant groups represented, including sightings for charismatic fauna – dugongs, turtles, dolphins, sharks, etc), fish production (fish landings, catch trend), and other potential and existing aquaculture/mariculture sites and initiatives.

The existing documented biodiversity at Mombasa Marine Park and Reserve (Mombasa MNPR) is compiled and is compared with data from other national marine parks and reserves to have a feel of richness and distinctiveness of the Mombasa Marine Park and Reserve.

For microscopic life-form, planktons and bacteria, laboratory and computer-based taxonomic analyses followed standard methods; e.g. for phytoplankton – the Utermorhl method was used to identify the phytoplankton. Diatom species encountered were ordered according to Hasle and Syvertsen (1997); Dinoflagellates according to

Steidinger and Tangen (1997); and Flagellates according to Throndsen (1997), both cited in Carmulo (1997). Zooplankton systematic categories were counted under a Wild Heerbrugg Stereomicroscope, and benthic samples were equally treated according to standard national and international laboratory procedures used at KMFRI. Bacteria samples were sampled by and analyzed at the Society General Surveillance (SGS) Mombasa offices using the ISO 9308 PT2 methods.

Table 8.1: Sampling techniques used for the primary survey

Taxa group	Sampling Method	substrata type (common substrates)			
		Soft sediment	Hard substrata	Seagrass/algal beds	Wrack & beach walk
Benthic infauna	Underwater diving – large core (18 cm diam.) or grab; sieving through 0.5mm mesh net	X		X	
Plankton	Vertical & Horizontal tows – plankton nets (100 µm zoo) (200 µm phyto)	X	X	X	
Crab/shrimp	Beach seines Traps (fishermen traps	X	X	X	
Macrobiota	Qualitative visual surveys /Photo survey + diving large core	X	X	X	X
Sedentary biota	Video/Photo transect + diving large core	X	X	X	
Sedentary biota	Photo records, Quadrat scraps		X	X	
Mobile epifauna	Photo records, crab/shrimp traps	X		X	
Fish / mobile epifauna	Beach seine (fishermen nets)	X		X	
Sediment fraction	Transparent plastic corer (6cm diameter, 10cm deep)	X		X	

Note: During the field survey all samples that were collected were 'rough sorted', to allow them to be appropriately preserved prior to transportation to the fine sorting laboratory facility and/or taxonomic survey. A team of KMFRI non-diving field staff was on board boats/beaches for rough sorting of these samples. It was essential that sorters are experienced marine biologists/technologists with local knowledge, such that they can accurately separate samples into rough taxonomic groupings. The sorters were also responsible for fixing all samples once sorted and maintaining appropriate labeling and order throughout the process.

b) Terrestrial life – vegetation surveys

Within the non-marine terrestrial environments, the field sites were assessed by a combination of foot survey (visual) and telescopic binoculars. Survey team comprised leading consultants and resource persons from Forestry Department (FD), Coastal Forest Survey (CFS/ Coastal Forest Conservation Unit (CFCU), who are/have also been involved in similar works for Coastal and Environmental Services (CES/Tiomin project) in south coast. Only tree-forms and shrubs were recorded. In many places, much of the original vegetation has been removed and replaced by agricultural crops such that non-food crop gramineae and herbaceous life-forms are thus likely to be secondary vegetation, opportunistic, generalists and weeds. Plant recordings were continuous with repeated encounters contributing to abundance/cover values. At selected observation/sampling sites, GPS readings were taken for geo-referencing sampling locations. A total of over 50 observation/sampling stops were made and involved sampling at different landscape level (as described in Mueller-Dombois and Ellenberg, 1974, a technique in which no quadrats are laid out and larger areas are sampled).

c) Terrestrial life – faunal surveys

On the same plant transect/observation points and using the binoculars, a survey was undertaken for terrestrial fauna. All observable faunal categories were searched for and documented for species identity and habitat usage. For amphibians, searches were made around the margins of small temporary water bodies at the site, and by turning over leaf litter and logs. An interview was conducted with the local residence to gain insights on nocturnal species seen and areas they frequent (particularly for rodents, bats, insectivores, etc). No surveys were made for soil fauna or for fossorial species. No records of such fauna were obtained by the consultants from the possible repositories visited (see acknowledgement section). Bird records were made by an experienced observer hired for that purpose and using standard guides (Brown et al, 1986; Urban et al, 1988; Fry et al, 1988; Keith et al, 1992; Zimmerman et al., 1996).

All information and data on community structure (species presence/absence, abundance, % cover, etc) were analyzed for descriptive ecology, and, where possible, subjected to statistical analysis. Data from field surveys were then compared with data and information from previous studies for trends and consistency in biodiversity and ecological processes.

8.4 Baseline Data and Conditions – Marine Biological Communities

8.4.1 General Characterization

The general features of the site can be summarized as follows:

- Figure 8.1 shows that the Port Reitz Creek basin is fed by two rivers on the western end – Mwachi (& Mambome) from the northerns side and Cha Shimba River from the southern end. On the other hand, at the entrance to the Port of Mombasa, the Port flushes into the oceanic water.
- Salinity and sediment plumes are thus expected to show a gradient from Port Reitz to open sea sites. This has implications for spartial and temporal locations of estuarine and oceanic species and communities.
- Figure 2.1 and 2.2 shows that the Port Reitz Creek bottom areas are mainly under variable water depths (from less than one meter in the intertidal places to deep subtidal places of about 30 m deep). On the other hand, near the entrance areas to the Port of Mombasa, the water depth is generally much deeper (less than one meter in most intertidal places but also as deep as 50 - 100 m depths);
- This has implications for spartial and temporal locations of benthic, pelargics and demersal species and communities
- The proposed dredge site is generally of shallow depths with a seabed material composed largely of silt. Near the entrance harbour, the seabed material is composed of medium sands and along the shelly beach frontage it is coarse sand with shell/coral fragments. The implication for this is that the intertidal areas of Port Reitz environments are basically made up of mudflats and mangroves (which love silty muds). A further consequence of this is that the areas are expected to offer little for turtle spawning, little for seagrass growth, little for multi-species seaweed development, and little for coral growth.
- On the other hand, the Shelly beach and Nyali environments are basically made up of sandflats and reef flats/creets. The implication of this is that the areas are expected to offer good environments for turtle spawning, seagrass growth, multi-species seaweed development, and coral growth. In addition, at depth (over 50m depths), the proposed sand harvesting sites would thus collect largely coarse sands with a mixture of medium sands in places.

Figure 2.2 is marked in light green for shallow depths (less than 4 m datum depths), which also get exposed at maximum spring tides, and correspond to mudflats and mangroves (within the Port Reitz and Kilindini bay waters), and correspond to shallow lagoons, reef crests or reef flats and sandflats (within the Shelly Beach and Nyali Beach areas; Fig. 8.2).

Figure 8.2: Shelly Beach at maximum spring low. The Intertidal reef flats as shown here correspond to areas marked green in Fig 2.2.

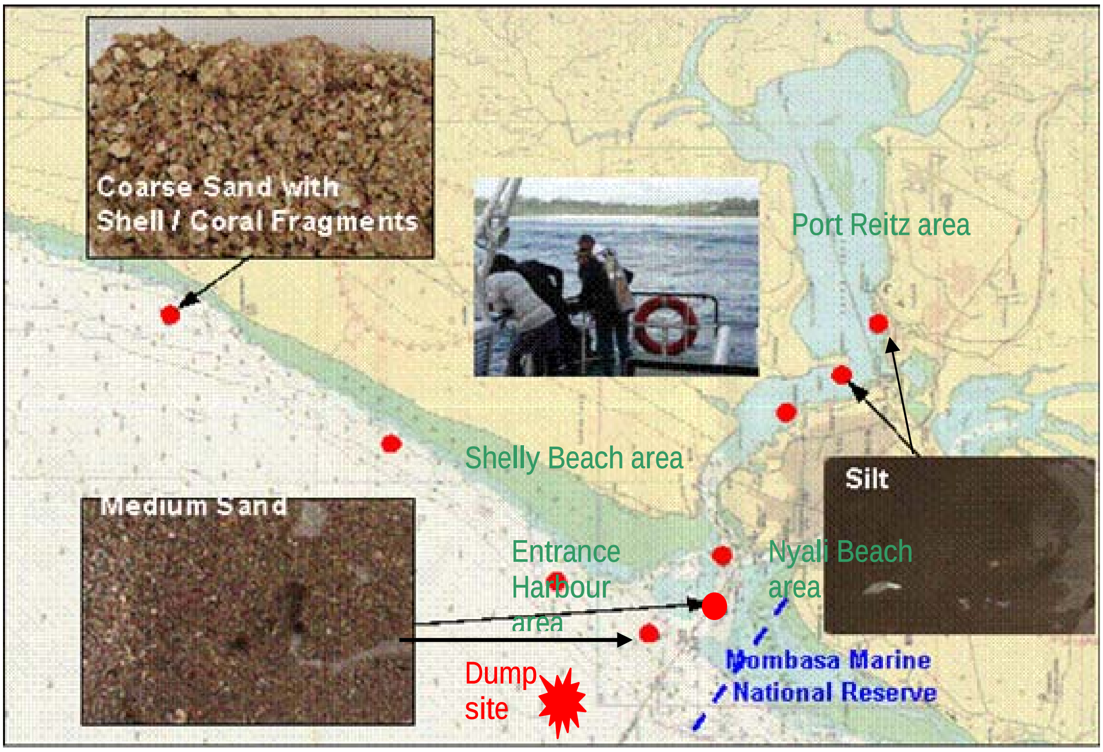


Figure 8.3 Seabed Material Survey as reported in JBIC SAPPROF report to KPA (December 2006)

Areas in light blue are shallow depths (greater than 5 but less than 30 m datum depths) and correspond to deep lagoons and creeks. Within Port Reitz and Kilindini bay waters the basements are composed of silty sediments only (Figure 8.3). Within the Shelly Beach and Nyali Beach areas, the basement is covered mostly by weathered coral fragments/debris and living coral heads at the shallower areas (less than 50m depths, and coral fragments/debris and fine sediments in the deeper areas (over 50 m to 200m depths). At depths below 50m, are the main repositories of sensitive habitats and species groups (corals/seagrass areas). The proposed dumping site (Figure 8.3, star banner) is about 3 km from the sensitive sites and from the limits of the Mombasa MPR boundary.

Figure 8.4 and 8.5 shows the spartial distributions of environmmetally sensitive areas near the two project sites based on an oil-spill sensitivity ranking system atlas developed at KMFRI (Tychsen 2006). The mapping of coastal environments and ranking them on a scale of relative sensitivity was based on three types of features:

Coastal type (A), Biological resource (B), and Human use (C) (Table 8.2) and therefore it integrated a multitude of information on geological properties, wave exposure, biological diversity and productivity, human use and cultural assets. The coastal type feature is derived from the well known ESI-index. The sensitivity index is calculated from the indices for each of the features. The sensitivity index is assigned to an index line running parallel to the shoreline at a distance of 500 m offshore (Tychsen 2006).

Table 8.2: Sensitivity Index Values of features considered in the Mombasa Coastal Resource Maps. The index values were fixed and agreed among all major stakeholders during a KenSea stakeholder workshop

Type	Feature	Index Values	Moderator	Horizontal "impact" of point features
A	Rocky coast	1		
A	Sheltered sand beach	2		
A	Exposed sand beach	2		
A	Tidal mud flat	3		
A	Sheltered rias	2		
A	Coral reef and reef flats	3 - 5	Width: <200m/ 200-1000m/>1000m	
A	Mangrove	3/5/7/10	Width: <50m/ 50-200m/ >200m/ inlet	
A	River mouth or creek	8/10/12	Small/large/creek	
B	Important bird area, IBA	1		
B	Waders	0.2/0.6/1	Low/medium/high 2000 importance	m
B	Turtle breeding site	0.5/1	Low/high density of nests	1000 m
B	Coral reef, priority	1		
C	Hotel	1		500 m
C	Small scale fishery	0.2/0.6/1	Low/medium/high importance	
C	Fish trap	0.5		500 m
C	Fish landing site	1		500 m
C	Harbour	1		500 m
C	Cooling water intake	2		200 m
C	National park	1		
C	Natural reserve	0.5		
C	Proposed natural reserve	0.5		

Source: KenSea (Tychsen 2006)

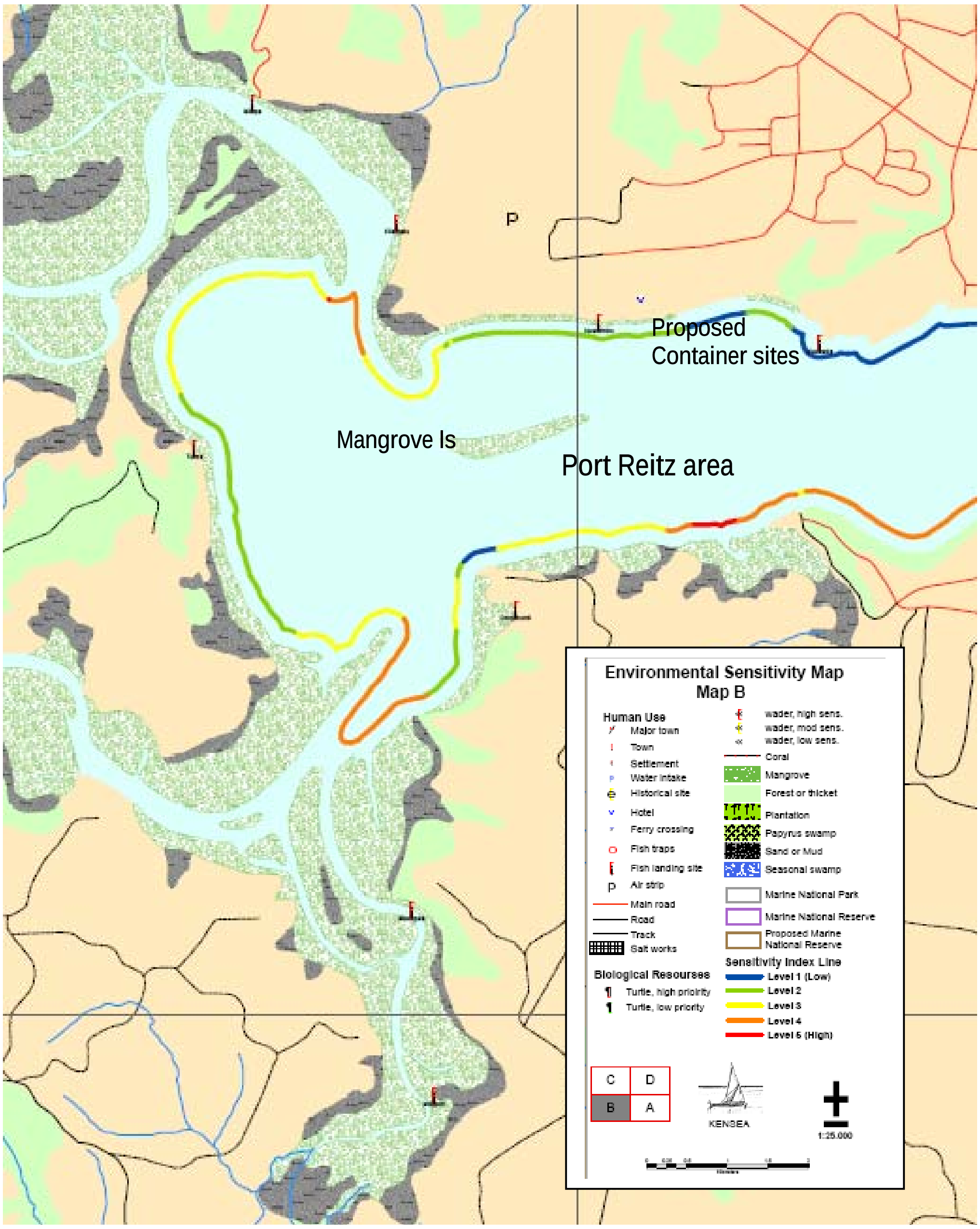


Figure 8.4: Environmental Sensitivity Map of the Mombasa Port Reitz area, (*after KenSea; Tychsen 2006*)

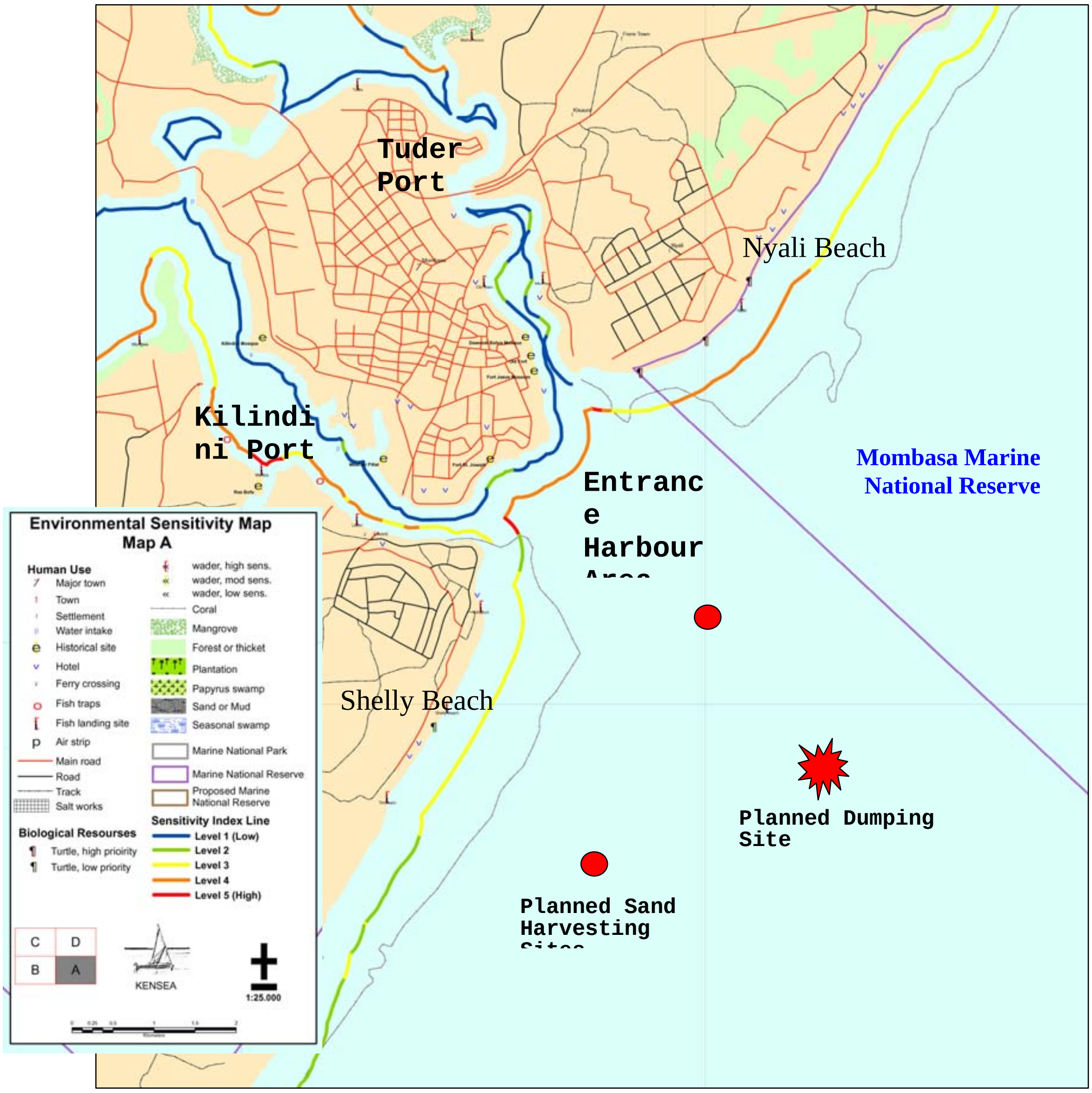


Figure 8.5 Environmental Sensitivity Map of the Mombasa Port entrance area, showing also the sites of the proposed sand harvesting and planned dumping (*modified after KenSea; Tychsen 2006*)

8.4.2 Detailed Characterizations

8.4.2.1 Marine Vegetation

Dominant assemblages

Four types of natural vegetation assemblages and one for man-made vegetation (agricultural systems) were found in the Port Reitz creek, these are shown in Table 8.3 and Figure 8.6 below.

Table 8.3: List of major vegetation assemblages at Port Reitz and Shelly Beach

Vegetation Assemblage	Physical/hydrographic setting
Mangrove forest	Low-lying inter-tidal estuarine and coastal, mostly fringing on Mwache creek, Mueza creek and Bombo creek; also on an island and the center of Kipevu Channel and on the fringes between an abandoned land-based oil tank facility and Mwache creek; and around Dongo-Kundu and Tsunza village. A small Sonneratia mangrove patch occurs near the entrance channel and the English point in Tudor creek
Sea grass beds	Sub-tidal shelf and inter-tidal estuarine & coastal, mostly on the more sandy environments at the southern end of the Kipevu Channel between Ras Kikangoni and Kenya Navy jetty; and at Shelly Beach sites
Seaweed vegetation	Mostly floating mats of vegetation, but few were seen attached on hard rocks, especially at Shelly Beach sites
Beach vegetation*	Isolated patches on beach ridges and beach crests (Port Reitz) and railroad vine *Ipomoea pes-caprae* at both sites; some coral vegetation at Shelly Beach sites
Man-made agricultural systems**	Low-lying coastal plain above tidal reach and on isolated patches on raised headlands

Source of information: Primary field surveys and interviews with staff of KMFRI, Forestry Dept. Coastal Forest Survey (CFS/ Coastal Forest Conservation Unit (CFCU). Beach vegetation* and Man-made agricultural systems** are included for purposes of completing vegetation profile at the site but are treated in detail under terrestrial vegetation section.

Dominant species in each vegetation assemblage

1. Mangrove forest

In Port Reitz area, the most extensive mangrove forest are found in the typical estuarine environment (along major river channels) and at the confluence where the two main rivers (Mwache and Cha Shimba) met on the Kipevu Channel – here an island of mangrove has formed at the center of Kipevu Channel. This type of forest community is dominated by the “true” mangroves, and especially by species in the family Rhizophoraceae.

Seven (7) species of true-mangrove plants and seven (7) typical species of mangrove –associates plants were encountered and are recorded (Table 8.4). There were no mangroves on the shelly beach area, though a relic of small mangrove was observed at the English point comprising mostly of *Sonneratia alba* (this survey Figure 8.7, Ruwa 1993). The community structure here was not investigated as they are far removed from the possible dredge/reclamation impact potential zones based on local knowledge of coastal flushing and hydrodynamics.

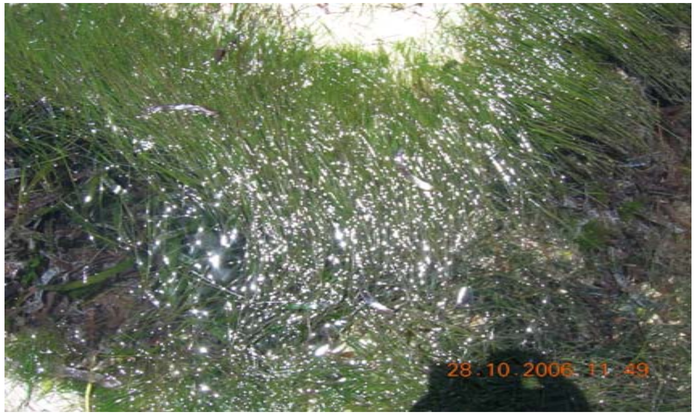
Two previous studies on community structure and zonation in mangroves have been undertaken in Port Reitz area. Kitheka (2002) and CES (2000) observed mangrove forest of Mwache and Dongo-Kundu (of different species or species groups) were “zoned” along a gradient from the shoreline to the inland area. They observed *Rhizophora mucronata, Avicennia marina*, *Ceriops*, *Ceriops-Xylocarpus*, and *Lumnitzera* zones. This study confirmed the same albeit with a slight difference in dominance structure (Figure 8.8 and 8.9). The important species (based on % cover) were *Sonneratia alba, Avicennia marina, Rhizophora mucronata, Bruguierra gymnorhiza* and *Lumnitzera racemosa,* while the important species (based on relative biomass) were *Avicennia marina, Sonneratia alba, Bruguierra gymnorhiza Rhizophora mucronata* and *Lumnitzera racemosa.* About 200 mature (adult) trees will likely be affected by the project (Table 8.5) and several young seedlings of new growth lifeforms.

It is instructive to note that the mangrove trees to be affected here are an insignificant population (few numbers, scattered, stunted growth) compared to the the main vegetation association to be found at Mwache creek and on the mangrove island at the centre of the Port reitz creek. Moreso, the species involved are not endangered or rare.

Rhizophora mangrove trees in an intertidal mudflat at Port Reitz creek 	Mixed shrubs and grass vegetation on the banks of Port Reitz creek 
Dry land tree and shrub thicket on the banks of Port Reitz creek 	Man-made agricultural systems at Port Reitz creek 

Figure 8.6: The main types of vegetation assemblage found along Port Reitz creek

Sub-tidal sea grass beds (mixed species) at Shelly Beach



Sub-tidal seaweed vegetation (brown algae) at Shelly Beach

Beach rail-road vine vegetation at Shelly Beach

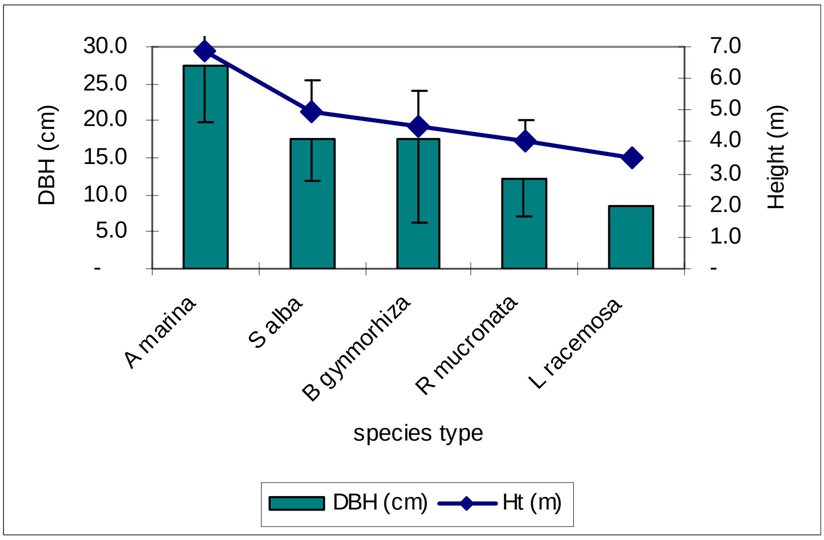
Sonneratia mangrove vegetation at English point, Mkonani

Figure 8.7: The main types of vegetation assemblage found around Shelly Beach and below right lone Sonneratia at Nyali's English point

Table 8.4: Species of true-mangrove and mangrove – associates encountered at Port Reitz

True-mangroves Family	Species ID	Mangrove Associates Family	Species ID
Avicenniaceae:	*Avicennia marina* (Forsk.) Vierh.	Euphorbiaceae:	*Exoecaria agallocha* L.
Rhizophoraceae:	*Rhizophora mucronata* L.	Palmae:	*Nypa fruticans* (Thunb.) Wurmb.
	Bruguierra gymnorhiza (L.) Lamk. (syn = *B. conjugata*)		*Phoenix paludosa* Roxb.
	Ceriops tagal (Pers.) C.B. Robins	Leguminosae:	*Derris spp*
Combretaceae:	*Lumnitzera racemosa* Willd.	Pteridaceae:	*Acrostichum aureum* L.
Sonneratiacae:	*Sonneratia alba* J. Sm.	Malvaceae:	*Hibiscus spp*.
Meliaceae:	*Xylocarpus granatum* Konig	Lecythidaceae	*Barringtonia asiatica* (L.) Kurz.
Sterculiaceae:	**Heritiera littoralis* Dryand. Ex W. Ait.		

Data source: Primary field surveys and interviews with staff of KMFRI, Forestry Dept. Coastal Forest Survey (CFS/ Coastal Forest Conservation Unit (CFCU). **Heritiera littoralis* Dryand. Ex W. Ait. reported in CES (2000) survey was not seen in this survey. Data based on 10 transects within fringing mangrove transects (Figure. 6.2).



	plot size 10 x 10 m		
	DBH (cm)	Ht (m)	form (1-3)
max	43.31	10.0	3.0
min	8.59	3.0	2.0
avg	19.15	5.3	2.8
SD	7.25	1.3	0.4

Statistics for whole area plots

Figure 8.8: Mangrove community structure based on DBH and heights values at Port Reitz. (Data based on 10 plots within 10 transects; n = 150 adult trees[1]; plot size 10 x 10m; Species not observed here were not encountered within the quadrats). Adults[1] description based on UNESCO (1984)

On average, the plots had a DBH averaging at around 20cm which is consistent with the classification for *boriti*. A few were very thick (above 30cm diameter) at the classification of *nguzo,* or very thin (less than 10cm thick) fitting into the classification of *fito.* In addition, majority of trees were bent and crooked (classified as form-3; Kairo, 1995) such that they are not useful as construction material (timber).

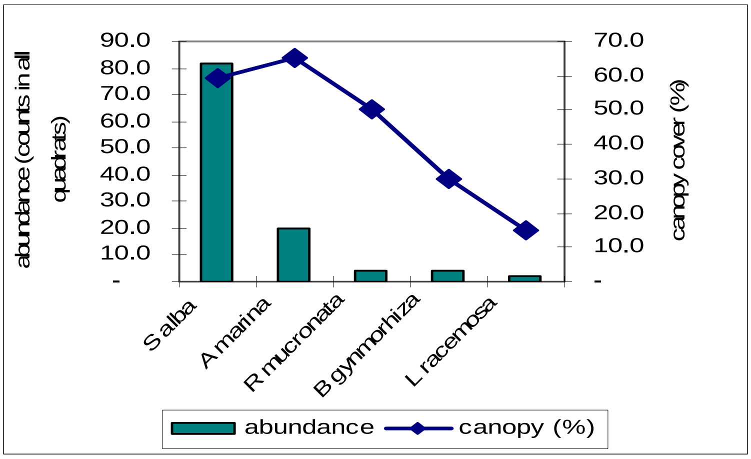


Figure 8.9: Mangrove community structure based on abundance and % canopy cover at Port Reitz. (Data based on 10 plots within 10 transects; n = 150 adult trees[1]; plot size 10 x 10m; Species not observed here were not encountered within the quadrats).

Mangrove seedlings (juveniles) growing under canopy had a high preponderance of *Avicennia marina* and *Rhizophora mucronata* in the recent regeneration classes (regeneration class I and II – RC-I; RC-II), while *Sonneratia alba* and replanted *Rhizophora mucronata* constituted most of the old regeneration classes (RC-II; RC-III) (Figure. 8.10).

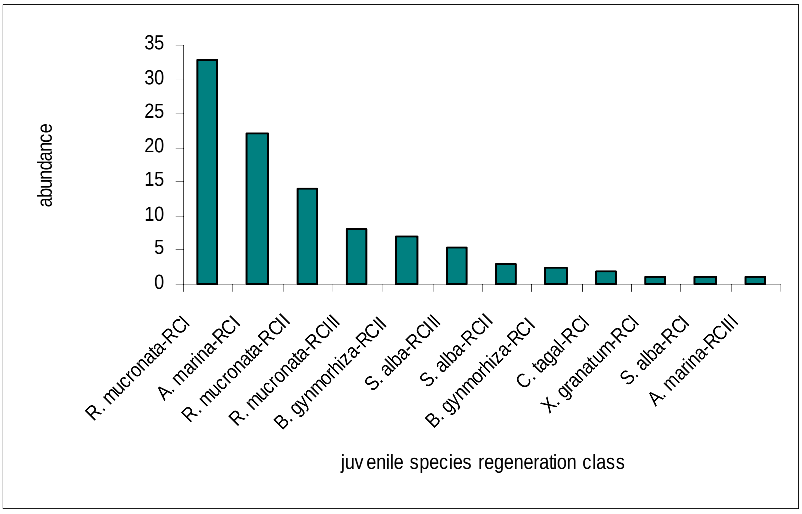


Figure 8.10: Juvenile mangrove community structure based on quadrat counts at Port Reitz. (Data based on same plots for adult community analyses (see Figure 8.8 & 8.9 above) and transects; n = 150 adult trees[1]; plot size 10 x 10m; Species not observed here were not encountered within the quadrats). Adults[1] description based on UNESCO (1984)

Table 8.5: Mangrove adult trees (and seedlings) likely to be lost due to project works

Tree identity	Adults[1]	Juveniles[2]	Setting
Avicennia marina	156	453	Area between Kwa Skembo landing site and KOT. Most juveniles are from current year's produce, though still significant numbers from previous years also exists.
Sonneratia alba	12	25	Area around Kwa Skembo landing site
Rhizophora mucronata	4	300	Area around Kwa Skembo landing site. A lot of re-planting effort was put here and around 300 spp can be seen.
Lumnitzera racemosa	3		Area between Kwa Skembo landing site and boat repair site
Ceriops tagal	2	6	Area between Kwa Skembo landing site and boat repair site
Xylocarpus granatum	2	2	Area around Kwa Skembo landing site

Data source: Primary field surveys and interviews with staff of KMFRI/ Forestry Dept. Coastal Forest Survey (CFS/ Coastal Forest Conservation Unit (CFCU). Adults[1] and Juveniles[2] description based on UNESCO (1984). Data based on 1km transect along land fringing ocean to be reclaimed.

2. Sea grass beds

There were hardly any sea grasses found on transects of Port Reitz area. More recent research information was gathered from an IMO'S Globallast survey of invasive alien species (KMFRI, 2005), suggested limited seagrass cover (patchy distribution) in some areas near the Kenya Navy jetty and quays. All seagrass species reported in this study were found at the Shelly Beach areas, where a total of eight species were recorded, in particularly high densities were encountered at the entrance areas of the Port (Shelly beach), and these are listed in Table 8.6.

Table 8.6: Sea grass species at two sites of the Port of Mombasa

S. no	Species ID	Shelly Beach (relative species % cover* of species encountered)[1]			Port Reitz (KN jetty/quay)[2]	
		Transect-1 180-m	Transect-2 220-m	Transect-3 210-m	presence	cover (not studied)
1	*Cymodocea serrulata*	15	25	20		
2	*Cymodocea rotundata*	20	20	10	X	?
3	*Halodule uninervis*	20	10	20		
4	*Syringodium isoetifolium*	15	15	10	X	?
5	*Thalassia hemprichii*	10	10	20		
6	*Thalassodendron ciliutum*	10	5	10		
7	*Halophila ovalis*	5	10	5	X	?
8	*Halodule spp*	5	5	5		

Species % cover* relative only for seagrass on defined transect distance; [1] = this study; [2] = Globallast survey (KMFRI, 2005).

3. Seaweeds

The seaweeds structure of Port Reitz comprised mostly blue-greens on silty sediments. Patches of *Enteromorpha crassa* on sediment surfaces, and scattered *Padina, Ulva* and floating *Sargassum* were commonly encountered. Some species were found epiphytic on mangrove roots (e.g., *Enteromorpha, Bostrychia & Murrayella* spp. on *Avicennia*) (Figure 8.11).

At Shelly Beach, several species were found that grow attached on reef front, reef crest, reef flat, and on dead coral debris & sandy pools: *Padina, Cystoseira, Dictyosphaeria, Digenia, Avanthophora, Pseudovalonia, Laurencia, Hypnea, and Dictyota* and some forms of Calcerous algae were some common genera encountered. For a full list of occurrence by transect points, see Table 8.7

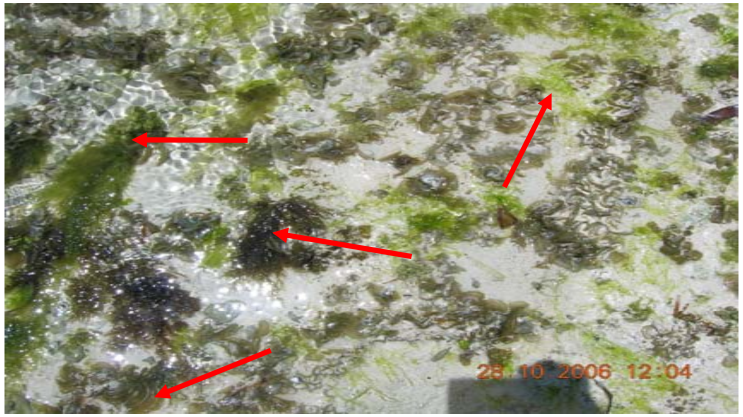
Enteromorpha sp underwater at bottom of areas to be reclaimed (Port Reitz) at high tide 	*Enteromorpha* sp mat to the frontage of the Brick factory (Port Reitz) at low tide in front of brick factory 
Mixed seaweed community at Shelly Beach 	Encrusting seaweeds on mangrove roots/trunks factory (Port Reitz) 

Figure 8.11: Types of seaweed community assemblages found in the Port Reitz creek & Shelly Beach

Table 8.7: Main seaweed genera at two sites of the Port of Mombasa

S. no	Genus ID	Shelly Beach (species occurrences on defined transects)1			Port Reitz (occurrences of species at 3 circular quadrats (about 5-m radius) along transects)1						
		Transect-1	Transect-2	Transect-3	Transect-4	Transect-5	Transect-6	Transect-7	Transect-8	Transect-9	Transect-10 (mangroves)
		180-m	220-m	210-m	10m diameter	10m diameter	10m diameter	10m diameter	10m diameter	10m diameter	10m diameter
1	*Enteromorpha crassa*		X	X		X		X	X	X	X
2	*Sargassum polyphyllum*	X	X			X				X	
3	*Sargassum vulgare*	X		X	X						
4	*Bostrychia*			X							
5	*Murrayella*	X		X							
6	*Padina*	X									
7	*Cystoseira*			X							
8	*Turbinaria*		X								
9	*Acetabularia*	X	X								
10	*Caulerpa*			X	X						
11	*Gracilaia*	X	X	X			X				
12	*Gelidium*			X		X					
13	*Dictyosphaeria*		X								
14	*Digenia*	X	X	X							
15	*Avanthophora*			X							
16	*Pseudovalonia*	X									
17	*Laurencia*	X									
18	*Hypnea*			X				X			
19	*Dictyota*		X								
20	*Calcerous algae*	X	X	X							
21	*Euchemia*	X	X	X							
22	*Halimeda*	X	X	X							

Mostly seaweed genus taxon are given to avoid taxonomic ambiguity at species level unless the species identity is obvious. Transects 4 – 10 based on 3 observations at 10 m distances

8.5.2.2 Marine Fauna

1. The fauna drifting in water – plankton

a) Phytoplankton

In this survey, 22 sample identities from 11 sites yielded a total of about 40 species (Table 8.8) out of which a few potentially toxic forms (dinoflagellates – *Alexandrium* and *Dinophysis*) responsible for algal blooms, fish kills and human intoxication were also present. All the types sampled were represented in the following 3 major categories in proportions as shown in Figure 8.12). The different taxa found at different locations along sampling transect are shown in annexe-4. A detailed multi-spectral survey undertaken earlier in 2004 under the Globallast program for the Port of Mombasa waters had produced a comprehensive list of taxa. A total of over 350 sample identities were described and over 80 different species recorded in 17 sites for the entire port of Mombasa, including Port Reitz, Kilindini, Mombasa harbour and Tudor Ports (KMFRI 2005).

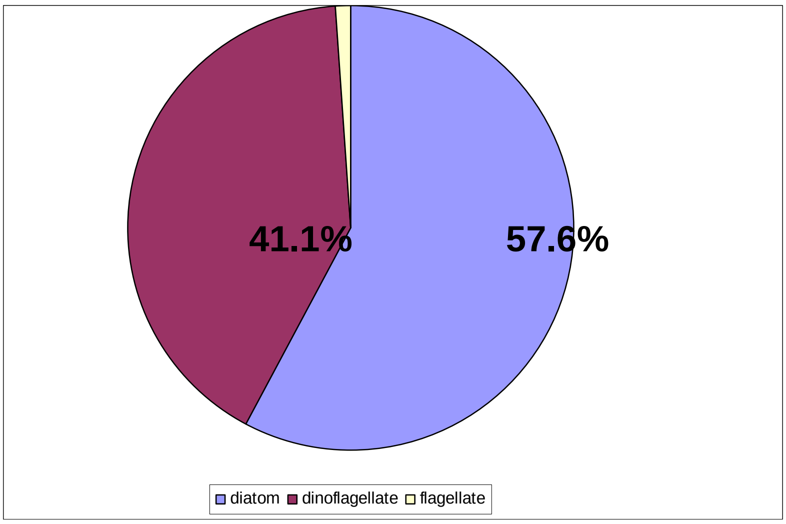


Figure 8.12: Proportions of major phytoplankton groups in the samples analyzed.

Table 8.8: Phytoplankton assemblages at the Port Reitz waters based on 22 samples from top and bottom samples (September – November 2006)

S. no	Division	Species types	Abundance (unit plankton)	
			horizontal	vertical
1	diatom	*Chaetoceros spp*	20.0	16.0
2		*Coscinodiscus eccentrica*	17.0	17.0
3		*Coscinodiscus spp*	17.0	16.0
4		*Ditylum brightwelli*	2.0	0.0
5		*Dictyocha fibula*	9.0	13.0
6		*Ditylum brightwelli*		1.0
7		*Eucampia cornuta*	1.0	
8		*Guinardia striata*	28.0	14.0
9		*Licmophora ehrenbergii*		3.0
10		*Navicula spp*	1.0	4.0
11		*Nitzschia closterium*	4.0	1.0
12		*Nitzschia sigma*	2.0	
13		*Nitzschia spp*	1.0	1.0
14		*Odentella spp*		1.0
15		*Pleurosigma capense*	2.0	6.0
16		*Pleurosigma directum*	3.0	6.0
17		*Pleurosigma normanii*	1.0	3.0
18		*Pseudonitzschia pungens*	9.0	4.0
19		*Pseudonitzschia spp*	6.0	2.0
20		*Rhizosolenia imbricata*		1.0
21		*Skeletonema costatum*	37.0	35.0
22		*Striatella unipunctata*	2.0	4.0
23		*Thallasionema nitzchoides*	18.0	19.0
24	dinoflagellate	*Alexandrium catenela*	26.0	17.0
25		*Ceratium furca*	43.0	43.0
26		*Ceratium fusus*	6.0	8.0
27		*Dinophysis caudata*	6.0	9.0
28		*Preperidinium meunieri*	2.0	2.0
29		*Protoperdinium spp*	8.0	7.0
30		*Protoperidinium obtusum*	3.0	
31		*Prorocentrum micans*	12.0	8.0
32		*Protoperidinium coinicoides*	1.0	9.0
33		*Protoperidinium depressum*	3.0	3.0
34		*Protoperidinium obtusum*	6.0	1.0
35		*Protoperidinium pyriforme*	3.0	9.0
36		*Protoperidinium spp*	3.0	5.0
37	flagellate	*Scrippsiela trochoidea*	1.0	5.0

Table 8.9: Zooplankton assemblages at the Port Reitz waters based on 22 samples

Taxa	Species identity	abundance vertical	(unit plankton) horizontal
Amphipoda	Hyperia	4	2
Appendicularia	Fritillaria	4	0
	Oikopleura	335	160
Brachyurae	Porcellanid larva	1	1
Calanoida	Acartia	104	192
	Calanopia	0	7
	Candacia	183	160
	Centropages	37	24
	Eucalanus	79	80
	Euchaeta	20	15
	Paracalanus	56	117
	Pleurammama	0	23
	Tortanus	7	4
	Rhinocalanus	0	1
Chaetognatha	Sagitta eaflata	2	1
Cirripied nauplii	Cirripied nauplii	67	114
Cladoceran	Evaldin tergestina	1	1
Copepod nauplii	Copepod nauplii	126	107
Copilia	Copilia	8	5
Cyclopoida	Corycaeus	7	5
	Oithona	178	216
	Oncaea	249	291
	Sapphirina	157	273
Decapoda	Caridean larva	10	3
	Caridian larvae	18	1
	Lucifer	9	9
Euphauceacea	Euphasid nauplii	24	0
	Euphasiid	36	74
Foraminifera	Foraminifera	60	37
Harpacticioda	Enterpina	0	2
	Euterpina	0	1
	Macrosetella	62	43
Isopoda	Isopod	1	
Mollusca	Bivalve	238	201
	Brachyurian larva	21	14
	Brachyurian megalopa	11	5
	Gastropod	21	15
	Heteropoda	2	2
Monstrilloida	Monstrilloid	24	9
Nematoda	Nematoda	20	7
Penaidae	Penaecid larvae	1	0
Pisces	Fish eggs	103	17
	Fish larva	54	27
Polychaeta	Polycheata	50	60
	Spionid larva	13	8
	Trochophore larva	1	1
	Sagitella	3	1
Tornaria larva	Tornaria larva	0	10

b) Zooplanktons

A total of 22 sample identities from 11 sampling points were analyzed for major taxonomic groups represented. Cyclopoida and calanoida were the most abundant, followed by mollusca, appendicularia and copepod nauplii. Pisces, cirripied nauplii, and polychaeta were present in intermediate numbers (Figure 8.13). Over 60 specimen samples yielded over 55 different species types (Table 8.9). Collections described from the Globallast survey and recorded from 17 sites including Port Reitz, Kilindini, Mombasa harbour and Tudor Ports yielded about 150 different species (KMFRI 2005; 17 sites, *Mrabu et. al., in preparation*). The difference between the two is purely based on spatial sampling and not efforts. More details of sample identities by transect and sampling locations is given in annexe-5

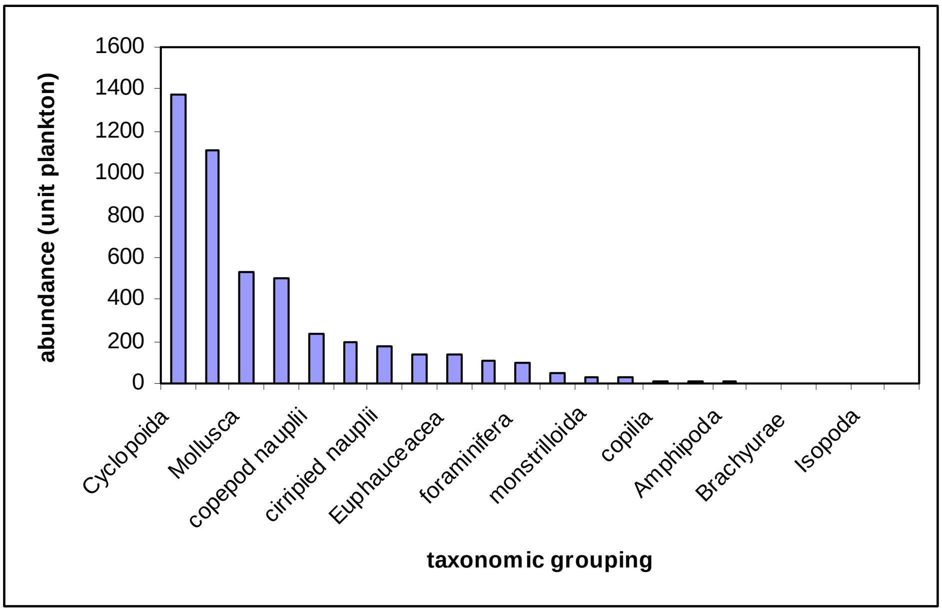


Figure 8.13.: Occurrence of zooplankton taxa in benthic samples from Port Reitz survey

b) Coliform bacteria

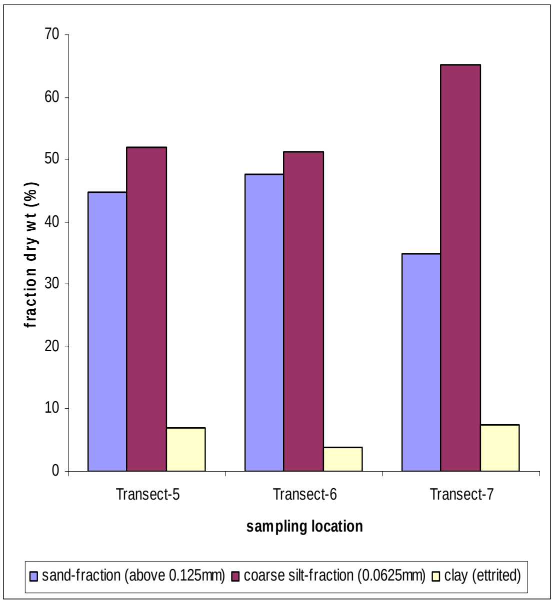
For the coliforms composition, there were no differences between the various forms enumerated. All fecal coliforms present were comprised by E. coli. The mpn values in 100ml were similar at 23mpn/100mls or undetected.

2. The fauna of sediments

a) The near-shore environment

(i) Sedimentary environment

As stated earlier, sediments from Port Reitz were siltier than those from Shelly Beach. The detailed characteristics are shown in the two graphs below (figure 8.14). Some limited silty sediment at Shelly Beach was found in association with seagrass beds.



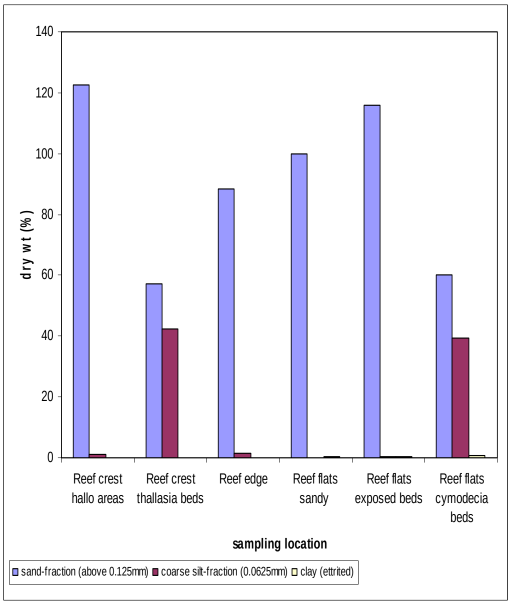


Figure 8.14: characteristics of sediments of Port Reitz (left) and Shelly Beach (right)

(ii) Sediment macrobenthos

The macrobenthic community had about 20 different species identities from Port Reitz alone (15 samples) and about 16 from Shelly Beach (15 samples) (Figure 8.15 and 8.14). In terms of dominance, Port Reitz area was dominated by *Nassarius coronatus* and *Oliva bulbosa*, though several unidentified *Nereidae* and *Epitoniidae* sp were also dominant as were oligochaetes (Figure 8.15). At Shelly Beach, *Nassarius coronatus, Baseodiscus unistriatus* and *Terebra nebulosa,* were the dominant groups. *Platorchestia platensis* and *Paratanaidae* sp were also encountered in moderate numbers. In comparison, Port Reitz areas had more macrobenthos per unit area than Shelly Beach (Figure 8.15 and 8.16). Around berth-19 where a concrete wall exists, were oysters and barnacles growing attached to these concrete-substrata. Some samples were collected from here for use in biochemical assay as reported earlier (see chapter 7). Details of sample identities by transect and sampling locations is given in annexe-6

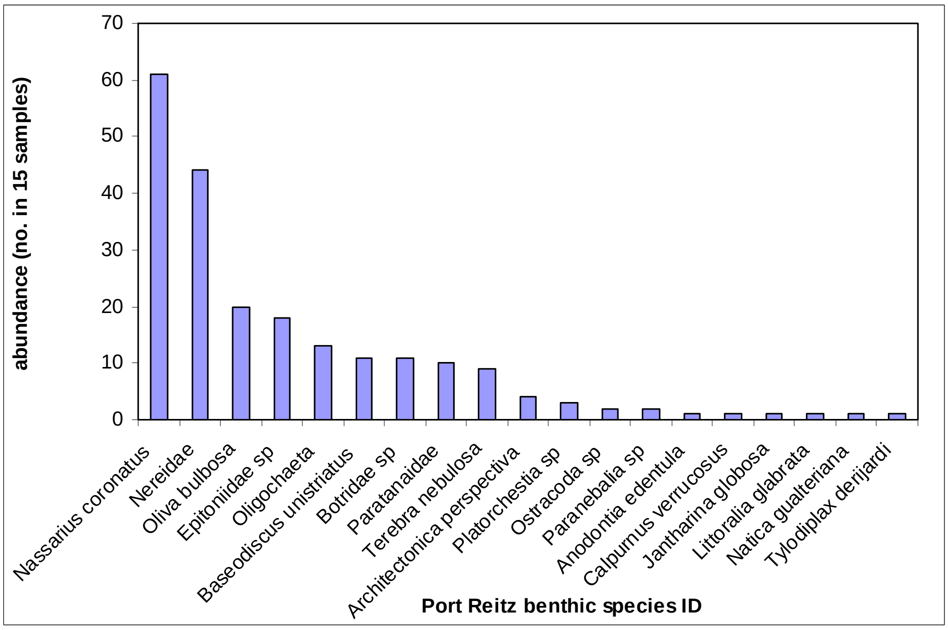


Figure 8.15: Macrobenthos from Port Reitz

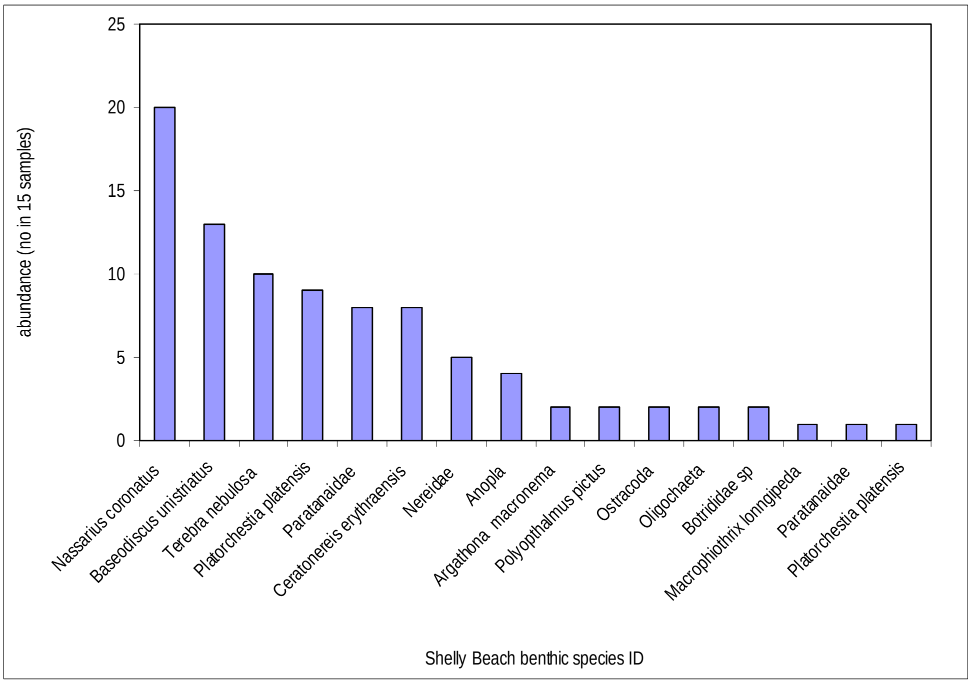


Figure 8.16: Macrobenthos from Shelly Beach

Data from the Mombasa port survey (Globallast Port Survey 2004, KMFRI, 2005) where over 700 specimen were collected (31 sites, 10 sampling methods), showed dominant groups present in the Port waters were represented by polychaetes, sipunculids, sponges, oysters, ascidians, barnacles, solitary corals, hydrozoans, crabs, algae, and fishes. About 70 general groups and common names belonging to a wide range of Phyla, Classes, Orders and Families of classification were thus estimated (Figure 8.17).

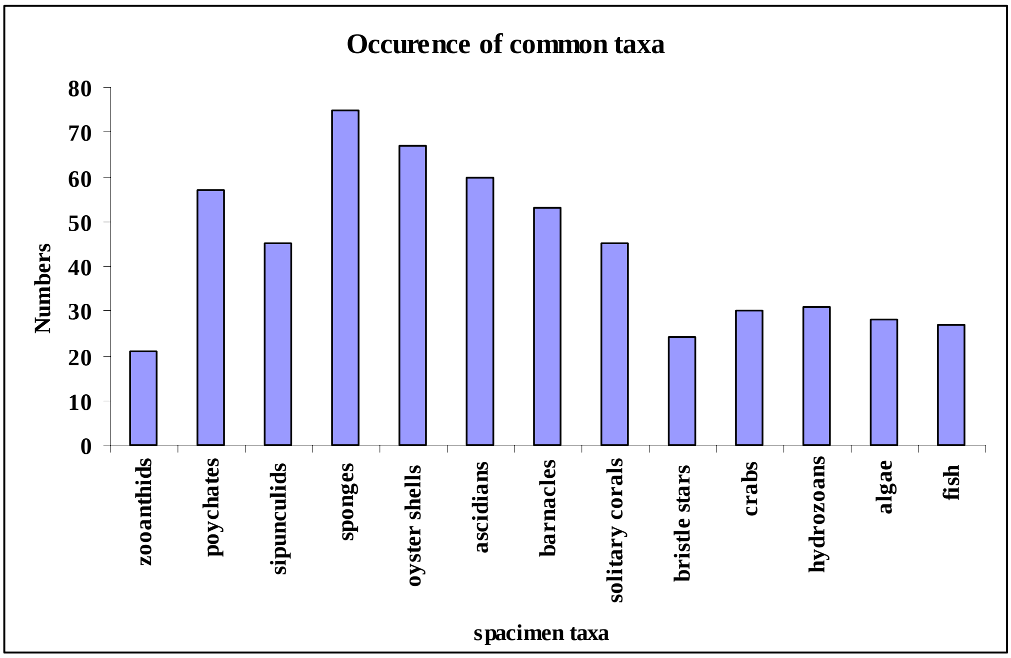


Figure 8.17: Occurrence of common taxa in benthic samples from Globallast survey (Source - KMFRI 2006)

iii) Coliform bacteria

The coliform bacterial community composition was similar to the water samples values. All fecal coliforms present were comprised by E. coli. The mpn values in 100ml were around 23mpn/100mls or undetectable.

iv) Mangrove benthos

From the mangrove areas, most ground macrobenthos were burrowers and burrows per meter square quadrats averaged at 47, with a maximum of 96 and a minimum of 4 burrows/meter square (Table 8.10). The dominant mangrove species were *Sesorma,* and *Uca* species.

Table 8.10: Dynamics of mangrove benthos at Port Reitz areas based on 30 quadrats observations in 10 transect (September – November 2006)

Animal burrows in 1 x 1m plots		Species and abundance values	
Variable	Value	Species	Cumulative counts (30 quadrats)
Max	96.0	Sesorma	316
Min	4.0	Uca spp	193
Avg	46.9	Uca spp inverse	85
Sd	29.0	Bernacles	64
No. of quadrats counted	30.0	Uca spp vocans	62
		Minerti	29

v) Epiphytic benthos

Several epiphytic communities (on seagrass) were reported in previous studies around shelly beach and the adjacent Nyali beach (Aleem 1988; Uku 2005). These include the species *Ulva, Caulerpa, Colpomenia, Hydroclathrus, Pocockiella, Jania, Amphiroa, Codium, Gracilaria, Padina, Stypopodium, Enteromorpha, Galidiella, Sphacelaria, Psedovalonia,* and Calcerous algae. Also included in the epiphytic communities are epibonts (faunal) – hydroids, sponges, ascidians and several mangrove epiphytes (e.g., *Balanus, Amphitrite & Ostrea sp* on *Rhozophora* trunks and prop roots)

vi) Sustrata benthos and slow invertebrates

Other benthic inveretebrates that were captured in photo-imagery and from quadrat field observations included the following groups (Table 8.11 and Figure 8.18).

Table 8.11: Benthic invertebrate assemblages at the Port Reitz and Shelly Beach waters based on 10 transect observations (September – November 2006)

Site	Benthos	Comments
Port Reitz	Oysters Crabs (mostly mangrove types and few sandy types – see table below) Barnacles	Oysters and barnacles growing mostly on hard substrata off the seawall at berth-19 (Kilindini Oil Terminal)
Shelly Beach	Corals – hard and soft Sponges Acanthanster Sea urchins – *Diadema, Echinometra, Tripenestus*	Corals and sponges species sedentary; Acanthanster (rare) and sea urchins (common) are predatory species indicating some ecological imbalances

vii) Rocky reef flats and sandy beaches – Shelly Beach

These comprised the wide reef flats in front of the high-raised cliffs. Rocks in the upper part of intertidal zone had a sparse biological activity, with mostly unicellular algae and fleshy alga, and a fauna of chitons and limpets and some amphibian crustaceans. Some sub tidal rocks have developed a richer flora and fauna resembling the conditions found on coral reefs. In the survey areas, we did not get good coral life forms. Hard and soft corals were found in discrete patches, surrounded by algae and seagrass beds. Benthic invertebrates were seen varying in cover from zero to about 30% (mostly for sea urchin colonies) and some of these are presented in Fig. 8.18.

Following the major 1998 El Nino, most corals in these areas must have been killed as seen from dead tops of most hard corals here. Thee few hard corals encountered (*Porites* and assemblages *Platygra* mostly; few forms of *Acropora, Montipora* and *Astreopora* were also seen) comprised less than 5% of the total benthic cover, and are not yet in a state of recovery as seen in evidence of breakages, erosion of newly dead corals and increased dominance by fleshy/tuft algae. Some scleractina corals, in particular *Horastrea indica*, which is listed as endemic to the western Indian Ocean was not seen in this survey even though it has an occurance potential.

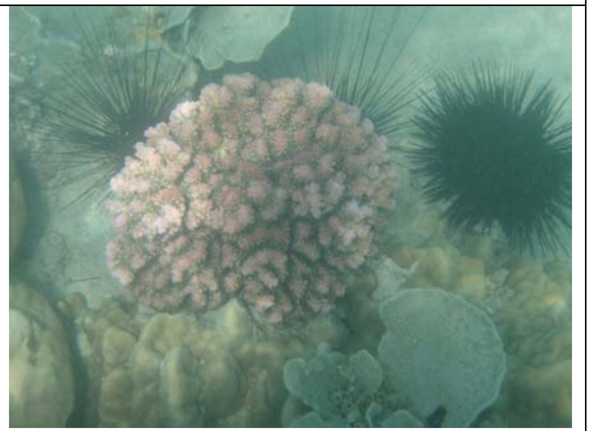
Oysters on concrete wall around Beth-19

Pits & depressions with benthos on seafloor of Port Reitz

Mixed benthos & slow sessiles on seafloor of Shelly beach

Sponges, seaweeds and benthic fauna at Shelly beach

Eel on seagrass (Halodule) at Shelly beach



Diadema Sea urchins, mixed corals at Shelly beach

Figure 8.18: some of the common or occasional benthos seen during EIA, and missed out on quadrat and/or core sampling tools

b) Deep sea benthos

Information and data for deep-sea benthos was synthesized from secondary sources, in particular data from the Netherlands Indian Ocean Program (NIOP) 1990-1995 (NIOP, 1992, 1995) and based on four transect points at Kiwayu, Tana, Sabaki and Gazi, and at depths: 20m, 50m, 500m, 1000m, and 2000m. Nematode groups are chosen in this report an indicator species (based on analysis by Muthumbi, 1998).

Based on depths and genus composition (200 genera described (Muthumbi, 1998)), abundance and species composition can be predicted at specific depths. The most dominant genera common in all the five depths were *Monhystera, Sabatieria, Halalaimus* and *Daptonema. Acantholaimus* was also dominant but was absent in the shallowest station. About 55 species were represented in these main 4 -5 families. The general trend in Tyro transects was high nematode density at shallow depth which decreased upto 1000m, then increased slightly or decreased slightly upto 2000m. The trend was similar in oxygen concentration, and therefore oxygen was thought to be influencing nematode density.

Also based on depths and genus composition, ecological groups can be categorized for deep sea benthos. Using the nematode indicator index, four ecological groups were categorized, with nematode similarities coinciding with the depths of (i) 20, 50 and 200m; (ii) 20 and 50m; (iii) 500 and 1000m; (iv) 1000 and 2000m). This showed the significance of depth in structuring ecological groups.

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3) Avifauna (Birds)

Majority of bird species encountered belonged to brackish species as shown in Table 8.12. All data are based on repeated observations between September and November 2006. From about 115 bird observations made, about 18 species were noted to use/visit /reside in this area. A comparison was made in this data with those of the east African coastal and marine environment resources database and atlas (UNEP 1998) and KMFRI database (Okemwa and On'ganda personal communication). It was noted that the current field-work observations yielded fairly good representative information for birdlife in the area. KMFRI records have 26 species counts for Tudor and Port Reitz area.

Table 8.12: Avian species at the Port Reitz based on 12 repeated observations (2 x low tides, 2 x high tides, 2 x mornings, 2 x evenings, and twice at two fish-landing sites (Kwa Kanji and Kwa Skembo) during fish landings (flooding tides) between September – November 2006.

Bird type	Species ID	Bird abundance (cumulative numbers observed in					
		Low-tide	High-tide	Morning	Evening	Kwa Kanji	Kwa Skembo
Pelican – pink-billed	*Pelecanus rufescens*	1		1		1	2
Egret - big	*Bubulcus ibis*	1	2	1	1	1	1
Egret - small		2	2	1			
Egret - yellow-billed		2	2		1		2
Egret - great	*Egretta alba*			2	1		1
Heron - green	*Butorides striatus*		2				
Heron - black	*Egretta ardesiaca*	2					
Heron cormorant			2		2		
Stork - yellow-billed	*Myctaria ibis*		2	2		2	
Stork - woolly necked	*Ciconia episcopus*	3	2				
Sacred ibis	*Threskiornis aethiopica*	4			2	2	1
Kites - black	*Milvus migrans*	3	4	2	5	5	6
Fish-eagle	*Haliaetus vocifera*						1
Sand-plover	*Charadrium leschanaultii*	2		2		2	
Grey-plover	*Pluvialis squatorola*	1	1	2	2	2	2
Sand-piper	*Xenus cinereus*		5		2	2	
Gull-billed tern		2			3		1
Kingfisher				1			1

Data for Port Reitz sandy beaches, mudflats, mangrove areas (especially Mangrove Island at the centre of Port Reitzbay) and northern banks. Only at Port Reitz area was a detailed bird watch commissioned. Shelly beach was omitted as there was to be no long-term activity taking place there

4. The marine turtles

Information and data from the Kenya Sea Turtle Conservation Committee (KESCOM) and other relevant literature indicate that five species of sea turtles have been documented as occurring within Kenyan waters (Frazier 1975): the green turtle (*Chelonia mydas*), hawksbill turtle (*Eretmochelys imbricata*), loggerhead turtle (*Caretta caretta*), olive ridley turtle (*Lepidochelys olivacea*) and the leatherback turtle (*Dermochelys coriacea*). Of these, green, hawksbill and olive ridley turtles are known to nest in Kenya.

The marine habitats of the Kenyan coast, which include coral reefs, seagrass meadows, mangrove swamps and sandy beaches provide diverse habitats for sea turtles. An aerial survey conducted in 1994 found that sea turtles are widely distributed along the coastline within the 20m isobath in areas mainly associated with seagrasses and coral reefs, implicating the presence of a significant foraging turtle population (Wamukoya *et al*. 1996). Notable concentrations were observed at certain areas particularly Mpunguti/Wasini, Takaungu, Watamu, Ungwana Bay, and Lamu and the adjacent offshore islands.

The Kenya government has put in place legislation to protect sea turtles i.e., the Wildlife Act (Cap 376) and the Fisheries Industry Act (Cap 378). The laws prohibit hunting, removing, holding, moving and trafficking sea turtles and their products whether dead or alive. However, there is no legislation protecting key nesting and foraging habitats utilized by sea turtles except for those falling within Marine Protected Areas (MPAs). As a result, turtle fishing, turtle by-catch in fishing operations, and poaching of sea turtles and turtle eggs continues unabated compounded by poor enforcement due to a lack of personnel and facilities

To address the plight of marine turtles, KESCOM was established in 1993 under the patronage of various government institutions: Kenya Wildlife Services (KWS), Fisheries Department (FD), Kenya Marine and Fisheries Research Institute (KMFRI), Coast Development Authority (CDA) and National Museums of Kenya (NMK) and Wildlife Clubs of Kenya. Various non-governmental organizations, WWF-Kiunga, Baobab Trust, Watamu Turtle Watch (WTW) and Colobus Trust, have given extensive on-ground support towards the KESCOM cause. KESCOM therefore represents a national integrated approach to sea turtle conservation promoting community participation in various conservation activities that include research and monitoring, public awareness and advocacy.

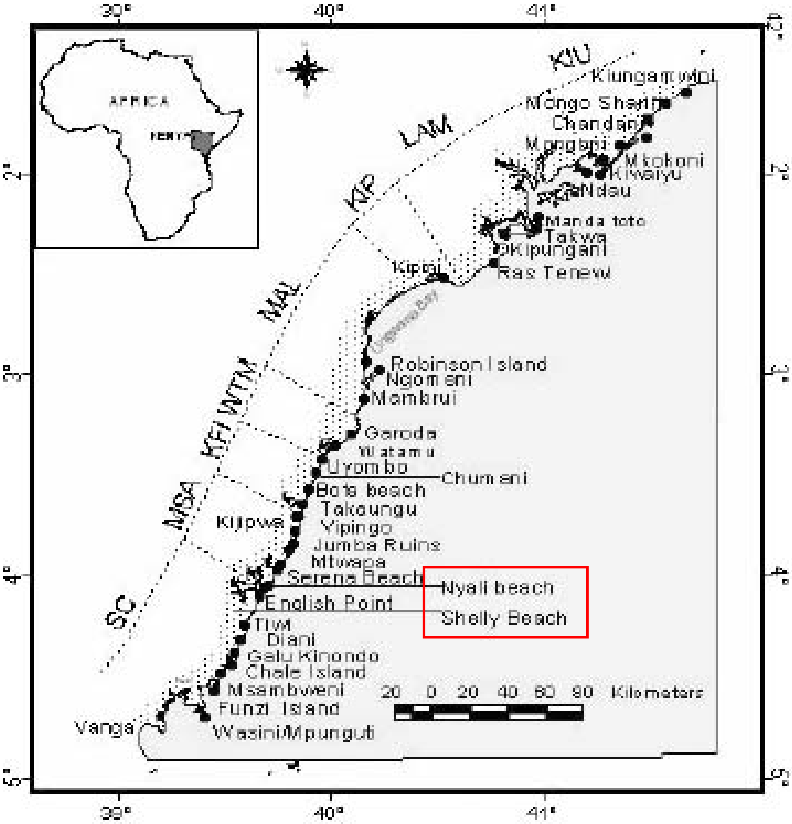


Figure 8.19: Map of the Kenya coast highlighting KESCOM study sites which included Shelly and Nyali beach (near the entrance to the port). South Coast (SC), Mombasa (MSA), Kilifi (KFI), Watamu (WTM), Malindi (MAL), Kipini (KIP) Lamu (LAM), and Kiunga (KIU). (Source: KESCOM: *Marine Turtle Newsletter* 105:1-6, © 2004)

Between 1997 – 2000, an intensive survey was carried out by KESCOM at the sites shown in figure 8.19 which also included the sites near the proposed port project activity sites. Identification of key nesting sites is an ongoing process. From this survey, the nesting and mortality data reported to KESCOM showed that

a) Key nesting sites included Shelly beach and Nyali along the Mombasa beach stretch (see figure 8.19)

b) the proposed dredge/reclamation sites were not identified as nesting sites or foraging grounds;
c) the nesting season in Kenya is year-round;
d) The green turtle is the most common species nesting and foraging along the Kenyan coast.
e) Despite the fact that sea turtles have been reported to nest/feed at Shelly Beach, data is still incomplete for specific turtle habitats, nestling and feeding areas, size and status of turtle populations, including breeding populations and migrations, factors affecting the survival of egg clutches and hatchlings (especially factors associated with people, such as presence of feral animals), and harvest and trade regimes. This makes room for precautionary principle in management regulations (e.g., fishing) and not science-based data driven. These shortcomings are being addressed through an integrated management of marine turtle population, of which KESCOM is playing a pivotal role.

5. The Fisheries Fauna

a) Port Reitz Creek

General description of fishery in Port Reitz Creek

The Port Reitz creek is one of the major fishing grounds shared by fishers from both Mombasa and Kwale districts. There are 7 seven landing sites along the Creek out of the 28 landing sites of Mombasa district (Frame survey; Fisheries Department 2006). These landing sites are shared between the four locations; Gandini, Likoni, Port Reitz and Miritini. Two landing sites (Kwa Kanji and Kwa Skembo) fall within the project area and fishers will have to relocate in order to land their fish.

Fishing along the Creek is small scale and supports a total of 416 fishers, which is 32% of the total number of fishers landing in Mombasa district. The fishers are spread within the three main areas of the Creek mainly; Mkupe/Miritini (75), Port Reitz (79) and Tsunza (227) and contribute to fish landings reported in Miritini, Port Reitz and Mtongwe -Likoni as well as Tsunza (Frame survey 2006). However the number of fishers may increase as the many people opt for fishing with increasing population. Fishing is done along the Creek with fishers sharing most of the fishing grounds depending on target species or fishing method and especially during the South East Monsoon (Kusi) when fishers fish in sheltered areas.

The most widely used craft is dugout canoe propelled using paddles since they are cheap, and most fishers cannot afford bigger motorised boats to access open sea. There are 219 boats landing fish in the Port Reitz Creek with Tsunza (120), Port Reitz (58) and Miritini/Mkupe (41). The main gear types used are gillnets, cast nets/marine seines and handlines/longlines targeting mullets/scavangers, prawns and snappers/trevallies respectively. Gillnet is the main gear used by fishers in Kwa Skembo areas and marine seine net targeting prawns mainly used in Kitanga Juu area. The artisanal fishers depend heavily on the sea during the N.E monsoons and the short rainy period, which also coincides with heavy fishing of prawns hence the high number of fishers targeting prawns during this period.

Ecological groups/Fish categories of Port Reitz area

The Kepevu terminals lie in the proximity of Kwa Kanji, Kwa Skembo and Kitanga juu of Port Reitz area. Fishers in this area target mainly Mullets and prawn especially in Kitanga Juu area as small streams join the sea in the uppermost parts of the Creek.

Ecological groups of fish reported in the landings from the three important landing sites near the project area are shown in Table 8.13. This ecological grouping has been based on diet, habitat, estimated trophic level and local information about a particular species. Ecologically the creek is important breeding and feeding ground owing to the extensive mangrove cover past the Kipevu container area, which is a brackish water ecosystem due to fresh water influx. Like the Tudor Creek in Mombasa, the Port Reitz Creek is a breeding ground for squids and cuttlefish, as well as nursery grounds for majority of demersal fish species and crustacea landed. Fish landed in the Port Reitz area also include open water fish species indicating the ecological importance of the Creek in terms of food.

Table 8.13: Species composition of landed fish/crustaceans (including target species for the area- frame survey data 2006) at Port Reitz

Ecological groups	Species/taxa included
Sharks, rays	*Carcharhinus sp* and manta rays
Large pelagics	King fish *(Scomberomorus spp),* queen fish *(Chorinemus tol),*
Small pelagics	Little mackerel *(Rastrelliger spp),* baracuda *(Sphyraena spp*) Trevallies (commonly referred as cavalla jacks) Sardines (*Sardinella spp)*
Bentho pelagics	Mullets (Mugil spp), milk fish (*Chanos chanos*)
Demersal predators	Snappers (Lutjanus spp) catfish (Tachyurus spp), grunter (Pomadasys spp) Pouters, Scavengers (lethrinus spp)
Other demersals (Herbivores)	*Siganus spp*
Crustacea	Prawns (*Penaeus indicus, Penaeus monodon,* Lobsters (Palinuridae), crabs (Portunidae)
Squids, cuttlefish	*Loligo spp,*

Data source: Fisheries Department statistics (Mombasa District) frame survey data 2006

The Fisheries and fish production

Fish species exploited in the Creek depends largely on the habitats and seasons and can be categorized as estuarine fish, small pelagic (coastal) and crustacea. Other species landed are the sharks and rays occurring in large amounts and also could be as a result of some fishers accessing the open sea during northeast monsoon (kazikazi). Twelve families are represented from the landings data although some of the fish species like the rabbit fish (*siganus spp)* are not reported in the landings of Kwa Kanji, Kwa Skembo and Kitanguu landing sites. This could be as a result of landings from the trap (*Uzio* and *Lema*) fishers being recorded in different landing sites along the Creek other than Port Reitz landing.

The catch trend over the last 3 years is shown (Table 8.14; Figure 8.20 – 8.23). A total of 113,677 kg of fish was landed in 2003 while 112,775 kg and 99,366 kg of fish was landed in 2004 and 2005 respectively. The highest species catches are for mullets and sardines and the rest of the species range between 4 to 9 tons per year. The seasonality of the fishing activities can be related to the seasonality of the landings (Table 8.14) which can be used as an indication of the level of dependency on the marine resources by the fishermen of the Port Reitz area. Comparatively, landings for most species indicate little or no change in the three-year data with variation among species. Rabbit fishes targeted using traditional traps (*Lema*) are not landed in Port Reitz sites but such records are in adjacent sites. However the statistics indicate an increasing trend in landings of fish not identified to species level and commonly reported as mixed demersals, mixed pelagics or mixed others.

Table 8.14: Fish landings (kg) at Kwa Kanji, Kwa Skembo and Kitanga Juu landing sites in 2003, 2004 and 2005

Species/groups	Total wet weight (Kg)		
	2003	2004	*2005*
Sharks/Rays	6,112	6,040	*4,904*
Scavenger	6,854	5,926	*4,772*
Grunters	9,456	7,968	*8,250*
King fish	4,270	3,302	*3,438*
Little Mackerel	9,092	9,398	*7,220*
Sardines	10988	11,110	*15,388*
Mullets	10,288	12,037	*11,896*
Pouters	9,062	9,932	*8,886*
Queen fish	6,358	5,332	*5,194*
Crabs	4096	4,942	*3,344*
Prawns	*9,892*	*8,938*	*6,916*
Others	*27,209*	*27,850*	*19,158*

Data source: Fisheries Department statistics (Mombasa District)

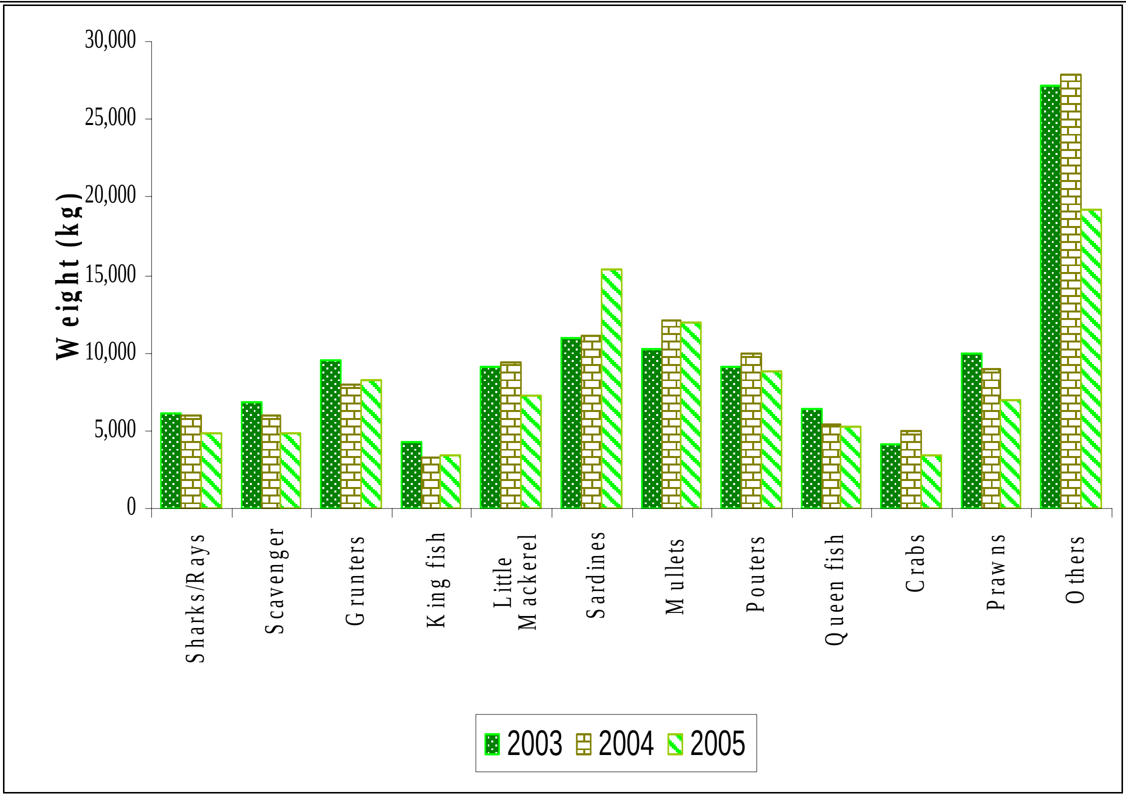


Figure 8.20: Three year landings of the major species in Port Reitz area (2003 – 5)

The highest landings of most pelagic and demersal fish species are between June and August, while grunters, kingfish are highly harvested in December, January and February. High landings of sardines occur in the months of January through to May. High prawn catches are after the short rains. However it is important to note that most of these species are landed throughout the year with varying quantities depended upon the prevailing season and the fishing grounds. Also, it should be noted that there are a number of sources of error in the fish landings by artisanal fishers and in most cases data in under reported. Due to inaccessibility of some landing sites some data may not be reported, especially when catch is sold directly to consumers since no designated landing sites which is a conflict issue while others land elsewhere due to use of illegal gear or depending on the proximity of social/religious amenities like a mosque.

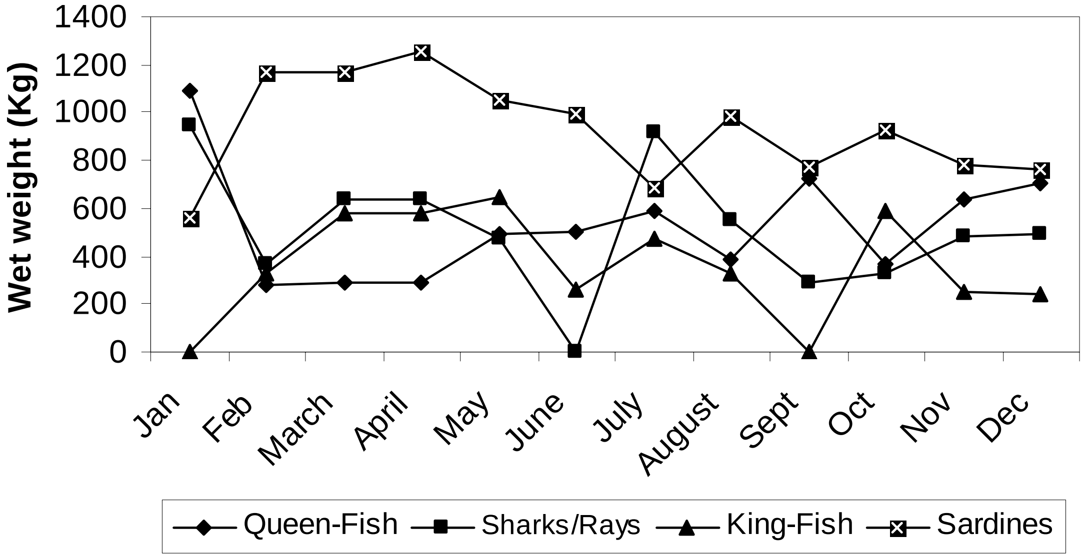


Figure 8.21: Monthly landings of key pelagic fish species (averages 2003 – 5)

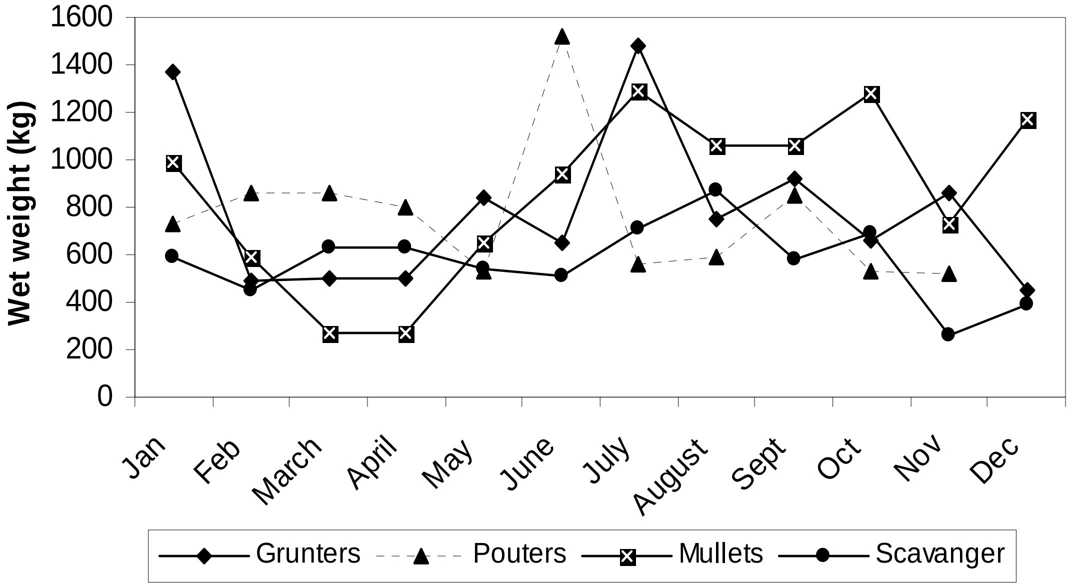


Figure 8.22: Monthly landings of key demersal fish species (averages 2003 – 5)

For the last three years the fish landings at Port Reitz area earned the fishers Kshs. 9,027090 in 2003, while in 2004 the value of the fish was Kshs, 8,1,75340. Some of these fish species are sold cheaply at an average of KShs. 30/kg with more than 50% of the landings recorded, as mixed species are juveniles of important commercial species, which as well play an important ecological role in this Creek. These fish of low commercial value include the ribbonfish, sole fish and juveniles with an example of goatfishes. The major landed species like the scavengers, grunters and mullets, cavalla jacks are sold between KShs. 60 to 80/ kg during NE monsoons and in the SE Monsoons a kilogram is sold between KShs 120 -150/ kg while the prawns are sold for over KShs 100-120 /kg. The statistics (Fisheries Department 2004), indicate that the fishery earn the fishers of Port Reitz area over 8 million shillings, and this is depended on factors such as the climatic conditions within a particular year

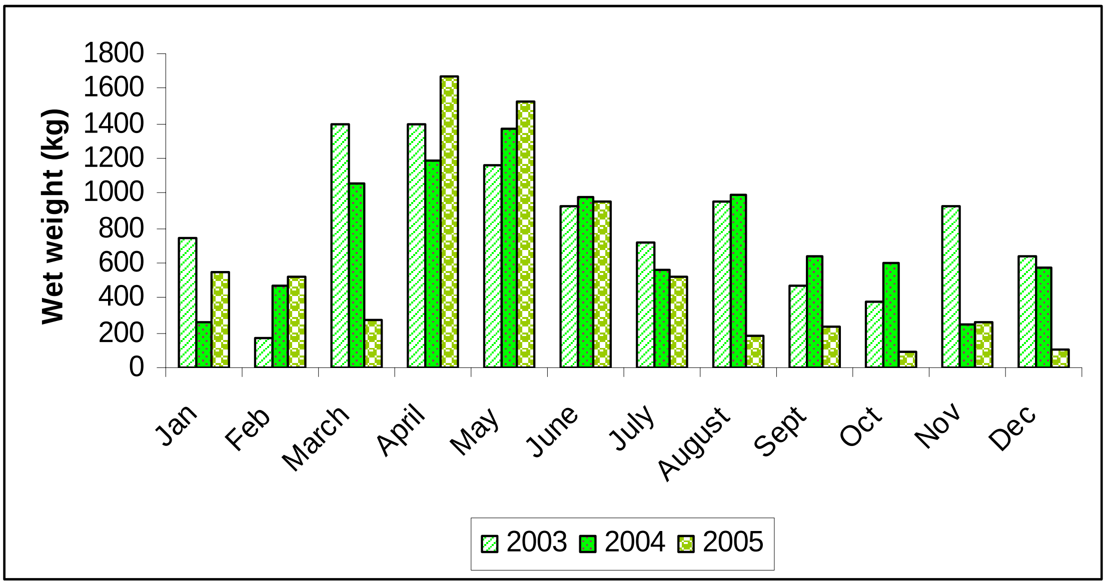


Figure 8.23: Monthly landings of prawns in Port Reitz area (averages 2003 – 5)

Prawns earn the fisher between 1.1 – 1.2 million Kenya shillings, an indication of high productivity in terms of crustacea and a major source of food protein to residents of Mombasa.

Other ecological important species

In order to quantify the ecological importance of the Port Reitz landing sites, other groups not harvested commercially such as oysters/clams should also be considered. Squids and cuttlefish breed in this area an indication of an ideal habitat for these valuable seafoods targeted for exports markets. Sharks and rays and among most species reported to occur in this creek although not identified to species level and may include catches of white tip shark and Manta rays recently included IUCN Red list (www.iucnredlist.org). No records of catches of the saw fish (*Papa upanga*) listed as endangered. No records of introduction of alien species to this part of the Creek although the possibility of introductions can not be ruled with the areas been adjacent to a Kilindini Harbour which is a busy port and ballast water has been reported as one way of alien species introductions. Several bird species are reported either as residents or visiting the creek in certain period of the year. Although the birds are not identified to species level, their presence in the creek is of ecological important and any impact to the ecosystem will greatly affect them.

The potential and existing Aquaculture/ Mariculture

The Port Reitz creek which surrounds the Island town of Mombasa in the southwest has a total coastline area estimated at 2250 ha (Fulanda 2002). Suitable mariculture sites have been estimated to cover over 60% in the swamp areas in the mangroves (Fulanda 2002). Two community crab farming projects exist in Tsunza and Kwa Skembo area. Fresh water fish ponds rearing Tilapia and catfish also exists along the creek which may be affected if any construction is extended on the mainland. Therefore there is a high aquaculture potential along this Creek and any development should the lost aquaculture opportunity an alternative to capture fisheries and hence enhancement of food security in this area. There are three access routes to the three landings sites which should be considered if any land development is to take place. Some of the actual species sightings were recorded during the reconnaissance surveys (Figure 8.24).

Estuarine edible eel (Muraenesocidae) captured at P. Reitz 	Edible crabs (Portunus spp) captured at P. Reitz 
Mixed species (Carangidae, Pomadysidae, Mugilidae, Scombridae) at P. Reitz 	Juvenile of *Penaeus indicus* shrimp (harvested at Port Reitz) 

Figure 8.24: some of the primary resources exploited from the Port Reitz creek showing a rich fisheries biodiversity during a commissioned survey by fishermen

b) Shelly Beach area

General description of fishery in Shelly Beach and Likoni area

Shelly beach landing site is within the Likoni division of Mombasa District, in the south of Mombasa Island. There are 9 landing sites in Likoni division namely; Likoni ferry, Old ferry, Shelly beach, Mavovoni, Kibuyuni, Mtongwe, Mwangala, Dongo kundu and Mwakuzimu. A total of 162 fishers are reported to land fish in the 6 landing sites but majority of fishers land in Old ferry (30%), Mtongwe (22%) and Shelly beach (19%) and the others less than 10% (Frame survey 2006). According to frame survey report (2006), 29 fishers have no boat and access fishing ground on foot and they mainly targeting octopus. Shelly beach has the least number of foot fishers with majority of then in Old Ferry and Kibuyuni landing sites. The most commonly used fishing crafts are the dug-out canoes (34) with only three motorized boats.

Fishing in Shelly beach area is depended on the reef and most reef fish species are targeted from the adjacent fishing grounds. Gears commonly used in this area include the gill nets, Handline and basket traps targeting, rabbit fish, snappers and lobsters among others.

Ecological groups/Fish categories landed in Shelly beach area

The fish landings comprise 27 groups of fish from 12 families. Most fish groups are harvested throughout the year although some of the pelagic species like kingfish are highly targeted from December to April which is also a high season for tuna species. Fishing in this area is highly depended on demersal species most of which are reef fish species. The fishing ground off Shelly beach landing sites is a major feeding ground for most fish species as well as a spawning area according to the fishers. The fishing ground is also rich in marine shells and this should be considered before the project is started.

Table 8.15: Species composition of landed fish/crustacea (including target species for the area- frame survey data 2006) at Shelly Beach

Ecological Groups	Species/ Taxa Included	Dominant Groups
Sharks, rays	*Carcharhinus sp and manta rays*	Sharks , Rays
Large pelagics	*Scomberomorus spp, Thunnus spp, spp, Chorinemus tol*	King fish, Tunny fish, queen fish
Other pelagics	*Rastrelliger spp, Sphyraena spp, Trevallies*	Baraccudas, little mackerel, trevallies, sardines
Demersal predators	*Cephalopholis spp, Epinephelus spp, Lutjanus spp, lethrinus spp, Upeneaus spp. Tachyurus spp, Pomadasys spp, Geterin gaterinus*	Scavangers, Rock cod, goat fish, grunters and black skin
Other demersals	*Siganus spp, Callyodon guttatus*	Rabbit fish, Parrot fish, Unicorn and surgeon
Benthopelagics	*Mugil cephalus, chanos chanos*	Mullets , Milk fish
Crustacea	*Penaeus spp, Palinuridae*	Prawns, lobsters
Squids, octopus	*Loligo spp, Octopus spp*	Squids , Octopus

Data source: Fisheries Department statistics (Mombasa District) frame survey data 2006

The Fisheries and fish production

Fish species exploited in the Likoni areas demersal, pelagic species, lobsters, octopuses and squids Table 8.15. In the last three years ~ 221,604 kg of fish was landed and more than 50% is landed in Likoni landing site. The catch trend over the last 3 years is shown (Figure 8.25 – 8.28). A total of 66,087 kg of fish was landed in 2003 while 81,510 kg and 74,007 kg of fish landed in 2004 and 2005 respectively including the miscellaneous catches. The highest catches are for sharks/rays, rabbit fish, and scavengers. Most of other species yearly catches range between 2 and 3 tons. The seasonality of the landings (Table 8.16) is an indication that the fishers heavily depend on the sea during the North east monsoons although some species do occur in large quantities in the South East season. Catches of catfish, mullets and milkfish is relatively low an indication coastal fish groups hence fishers depend largely on the reef.

Table 8.16: Fish landings (kg) at Likoni landing sites for three years (2003 – 5)

Species/Fish Groups	Total Fresh Weight (Kg)		
	2003	2004	2005
Rabbit fish	6779	6835	8641
Scavengers	5947	8960	8740
Snappers	913	1929	3165
Grunters	1688	2503	1956
Parrot fish	2582	2239	3771
Surgeon fish	1232	3542	2529
Unicorn fish	3764	2826	1330
Black skin	889	1721	1265
Rock cod	1054	1749	1273
Mullets	1024	1470	996
Sardines	3238	4779	4822
Barracudas	1033	1033	1758
Cavalla Jacks	2409	1446	1820
Tunny fish	4511	4417	2261
Little mackerel	2425	1336	1360
Sharks/Rays	6754	9423	12034
Octopus	6476	8200	7579
Squids	1011	1828	1042
crustacea	3568	4401	2753
Others	8790	10873	4912

Data source: Fisheries Department statistics (Mombasa District) frame survey data 2006

There is no seasonal trend in fishing of most pelagic species unlike with the demersals whose highest landings coincide with rainy seasons (Figure 8.25 & 8.28). High landings of sardines occur in the months of January to May. High prawn catches are after the short rains. However it is important to note that most of these species are landed throughout the year with varying quantities depended upon the prevailing season and the fishing grounds. Also, it should be noted that there are a number of sources of error in the fish landings by artisanal fishers and in most cases data in under reported. Due to inaccessibility of some landing sites some data may not be reported

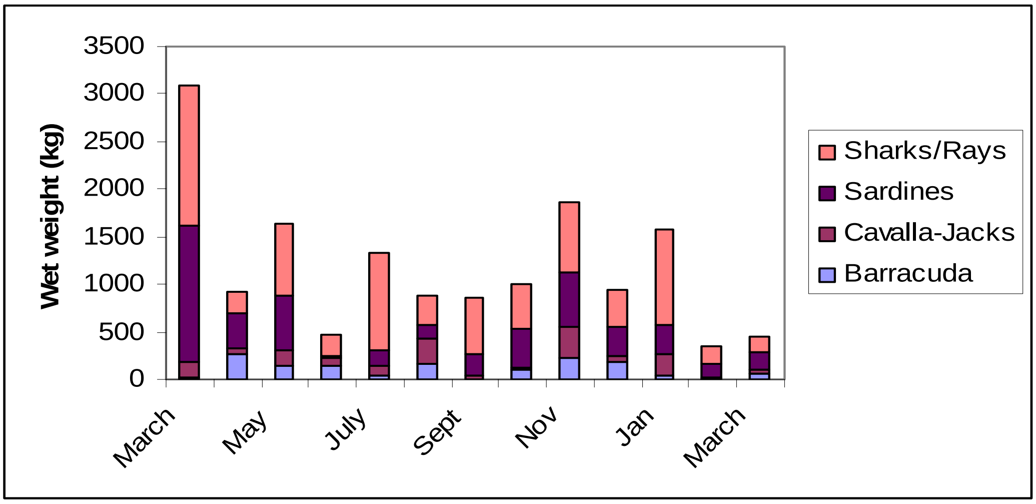


Figure 8.25: seasonality in landings of key pelagic fish species

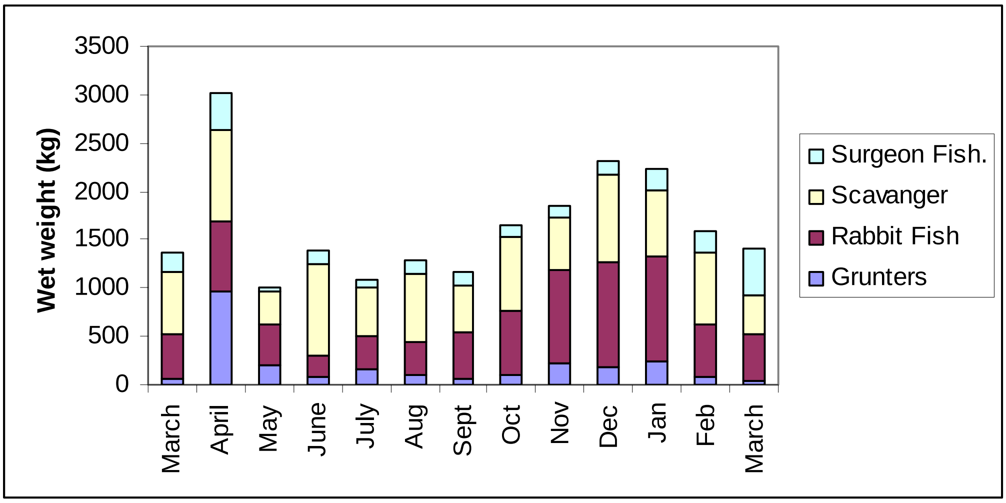


Figure 8.26: Seasonality of landings of key demersal fish species

Octopus landings are high in south east monsoon winds from June through to October while prawns landings are highest during the short rains (Figure 8.27). There are high catches of fish not identified to species level recorded as mixed others, mixed demersals and mixed pelagic species. The landings from these groups are 1 to 2 tons per year.

Due to the limitation in fishing vessels to access the fishing grounds there is a clear indication of high dependency on fisheries resources during the calm sea period.

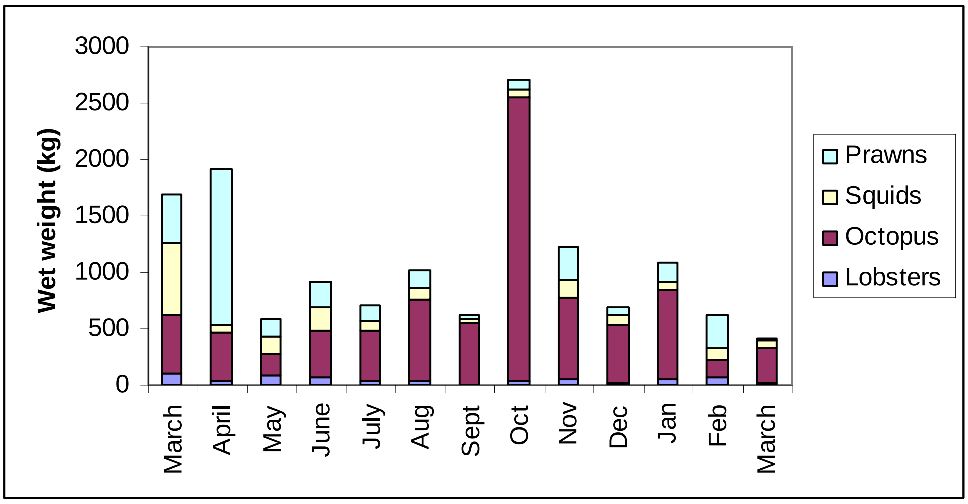


Figure 8.27: Seasonality in landings of octopus, squids, prawns and lobsters

Most fish species cost Kshs. 70 to 80/kg and for the last three years fishing in the Likoni area earned the fishers over 20 million with an average of 7 million shillings per year.

Other ecological important species

Sharks and rays harvested in this area are not reported to species level and there a need to monitor the species as some shark and ray species are listed as threatened in the IUCN red list.

Kenya has a management regime under the national laws for controlling the exploitation and promoting the conservation of its marine life. The Fisheries Act and the Kenya Wildlife Act, amongst many acts mentioned under the legal, policy and institutional framework, are very clear on these issues. Kenya is also a signatory to the major treaties and conventions that recognizes and demands conservation/protection of certain habitats and species. Amongst the major ones are the Nairobi Convention for the Protection, Management and Development of The Marine Environment and the Coastal Areas of the East African Region; the Convention on Trade in Endangered Species of Wild Fauna and Flora (CITES); the Convention on Biological Diversity (CBD), amongst others and is in the process of ratifying the Bonn Convention (Convention on

Conservation of Migratory Species of Wild Fauna). Within the treaties and frameworks, the research and monitoring components of these ecologically important species (charismatic animals) can be achieved, even within this EIA on these less understood species.

6. The Biodiversity at Mombasa Marine Park and Reserve (Mombasa MNPR).

According to records by KWS (Nyawira, 2001; Weru et al. 2001), the Mombasa Marine National Park and Reserve (MNPR) was gazetted in 1986 under the Wildlife Conservation and Management Act Cap 3726 of 1977 (revised in 1985). This marine protected area (MPA) is managed by the Kenya Wildlife Service and lies between Tudor Creek to the south and Mtwapa creek to the north, of Mombasa District, Coast Province, Kenya (latitudes 40^o 43' and 40^o 15' and longitudes 30^o 55' and 4^o 12' N.E; Figure 6.1). The MNPR is zoned into two main management areas, the Mombasa Marine National Park which is 10 km^2 and is encompassed within the larger Mombasa Marine National Reserve with an area of 200 km^2 (Chebures 1989; Weru et al. 2001). The MNPR lies within 20km of Mombasa Island, and Kilindini Harbour.

The Mombasa Marine Protected Area (MPA) consists of the following main ecosystems and habitats:-

a. A sand dune and sandy beach extending 20 — 50m from shore. In some areas, sand dune vegetation including sedges, grasses and palms can be found. These areas are important nesting grounds for sea turtles (KESCOM 1996).
b. In some areas sand flat extends approximately 100-150m from the beach that is usually exposed during low tide (4m tidal range). This tidal sand flat is rich with benthic organisms including tube worms, molluscs, crabs and other benthic crustaceans making this an important feeding area for shore birds including great herons, egrets, terns, and various species of seagulls (Seys et al 1995).
c. A lagoon separates the sand flat from an extensive fringing reef. The lagoon is mainly covered by seagrass beds composed mainly of the species *Thalassodendron ciliatum, Thalassia hemprichii, Syringodium isoetifolium, Halodule wrightii* and *Halophile ovalis* (GROFLOW 1998). These species are also common throughout the Kenyan coast. The seagrass beds within the marine reserve serve as the primary site for artisanal fishing by the local communities

d. Beyond the lagoon lies the coral reef composed of an inner shallow reef, a reef flat that is commonly exposed during low tide and a fore reef facing the open sea. The inner reef is dominated by massive and branching forms of the hard coral *Porites* (Hamilton and Brakel 1984) and interspersed by areas of the fleshy algae *Sargassum, Turbinaria, Padina* and calcareous algae *Halimeda*. Many species of coral reef fishes, echinoderms and shells occur within this lagoon (McClanahan 1990, 1994; Muthiga and Ndirangu 2000). The fore reef has a high percent cover of hard and soft coral species and large schools of coral reef and pelagic fishes. Sea turtles are often seen foraging in these waters.
e. Beyond the reef in the open ocean, large schools of pelagic fishes, whale sharks, dolphins and sea turtles are common, while humpback whales are occasionally sighted on their southward migrations.
f. Shoreward from the high tide mark, a riparian area occurs that has a varied community of plants and tree species. Although this area is not part of the MPA, it is the home to a wide range of terrestrial fauna including mammals, birds, reptiles and insects.
g. Two mangrove fringed creeks (Mtwapa and Tudor) border the northern and southern boundaries of the Mombasa MPA and the seasonal Mtopanga creek drains into the MPA during the long rains that occur from April through June. Theses creek are important fisheries areas but are also a major source of sediments and solid waste pollution into the MPA (Mwangi et al 2001).

Data from the monitoring programs undertaken by KWS and CORDIO on fish, invertebrates and benthic cover in the marine parks indicate that the Mombasa MPA has a fairly low fisheries diversity and abundance relative to the other MPA’s, but a fairly high invertebrate cover (Table 8.17 & 8.18). Mombasa MPA also has on average lower hard coral cover; the algal turf being the dominant benthic cover (Table 8.19).

Table 8.17: Average densities of fish and standard deviations for the four marine parks. 12 transects of 250 m^2 in each park in two seasons

		NE Monsoon		
Common name	*Kisite*	*Malindi*	*Mombasa*	*Watamu*
Angelfish	9.00 ± 6.26	1.5 ± 1.87	1.00 ± 1.41	1.58 ± 1.61
Barracuda	0.58 ± 1.93	-	-	-
Butterfly fish	12.83 ± 6.52	7.13 ± 4.2	2.50 ± 3.84	2.75 ± 1.74
Emperors	17.5 ± 26.36	4.63 ± 9.68	2.50 ± 5.48	0.67 ± 0.94
Fusiliers	26.66 ± 44.22	13.3 ± 29.8	-	-
Goatfish	3.92 ± 2.43	1.00 ± 1.32	1.00 ± 2.00	0.92 ± 1.32
Groupers	5.50 ± 7.91	0.63 ± 0.86	0.25 ± 0.83	1.25 ± 2.35
Grunt/Sweetlips	20.75 ± 26.20	5.13 ± 5.90	2.83 ± 4.84	9.25 ± 8.83
Jacks	1.83 ± 2.37	0.75 ± 1.3	-	-
Parrotfish	17.42 ± 8.85	13.5 ± 6.54	4.83 ± 4.45	6.83 ± 5.62
Rabbitfish	5.25 ± 5.60	1.50 ± 2.35	1.25 ± 2.42	0.58 ± 1.19
Sharks	-	-	-	-
Snappers	64.0 ± 108.14	14.38 ± 15.6	3.00 ± 2.68	2.08 ± 2.18
Surgeon fish	24.58 ± 21.39	54.38 ± 15.1	5.00 ± 5.89	28.83 ± 47.79
Triggerfish	2.58 ± 2.25	6.75 ± 4.24	0.58 ± 0.86	2.00 ± 2.58
Wrasses	19.00 ± 8.84	11.75 ± 6.9	3.25 ± 2.13	4.00 ± 3.11
		SE Monsoon		
Angelfish	5.08 ± 5.77	0.08 ± 0.28	1.08 ± 2.06	0.42 ± 0.49
Barracuda	2.25 ± 5.51	-	-	-
Butterfly fish	5.25 ± 3.06	2.83 ± 2.51	4.75 ± 3.59	2.92 ± 1.32
Emperors	8.33 ± 12.19	-	0.83 ± 1.28	0.92 ± 2.06
Fusiliers	78.57 ± 192.46	3.67 ± 8.20	-	75.33 ± 89.86
Goatfish	7.92 ± 15.48	5.00 ± 6.61	1.25 ± 1.59	2.33 ± 3.25
Groupers	19.75 ± 58.93	1.25 ± 2.24	0.58 ± 0.95	1.08 ± 1.32
Grunt/Sweetlips	14.25 ± 14.01	2.42 ± 3.43	5.83 ± 8.15	19.33 ± 17.61
Jacks	7.75 ± 14.83	0.08 ± 0.28	-	-
Parrotfish	13.17 ± 7.77	5.58 ± 4.66	4.75 ± 5.28	11.08 ± 8.33
Rabbitfish	19.00 ± 46.01	4.67 ± 4.46	0.42 ± 0.76	5.92 ± 6.73
Sharks	1.42 ± 4.70	-	-	-
Snappers	12.58 ± 17.09	0.67 ± 1.18	2.92 ± 3.77	1.92 ± 2.33
Surgeon fish	22.00 ± 26.10	30.67 ± 33.34	11.67 ± 7.54	24.75 ± 16.32
Triggerfish	5.58 ± 9.35	5.83 ± 4.63	1.33 ± 1.37	0.92 ± 2.02
Wrasses	18.25 ± 23.68	10.67 ± 3.82	22.50 ± 17.22	9.00 ± 8.52

Source: Kenya Wildlife Service & CORDIO Ecological Monitoring Report; 2005.

Table 8.18: Average densities of invertebrates and standard deviations for the four marine parks. The data was collected in 12 transects of 250 m^2 in each park in two different seasons

				NE MONSOON				
0	Common name	Kisite	**0**	Malindi	**0**	Mombasa	**0**	Watamu
1	Clams	28 ± 3.08	1	12 ± 1.35	1	30 ± 3.34	1	16 ± 0.98
2	Crown of thorns	1 ± 0.29	2	-	2	5 ± 0.67	2	-
3	Lobsters	-	3	-	3	1 ± 0.30	3	7 ± 1.73
4	Octopus	3 ± 0.62	4	5 ± 0.51	4	1 ± 0.29	4	-
5	Sea anemone	-	5	-	5	-	5	-
6	Sea cucumber	45 ± 3.14	6	11 ± 1.24	6	83 ± 3.40	6	5 ± 0.51
7	Sea stars	37 ± 3.70	7	15 ± 1.54	7	15 ± 1.66	7	2 ± 0.39
8	Sea urchins	712 ± 49.71	8	100 ± 10.65	8	1031 ± 56.59	8	305 ± 42.76
9	Shells	23 ± 1.16	9	10 ± 0.72	9	18 ± 1.73	9	11 ± 1.08
				SE MONSOON				
10	Clams	017 ± 1.24	10	8 ± 1.07	10	19 ± 1.74	10	19 ± 2.19
11	Crown of thorns	1-	11	-	11	12 ± 1.51	11	-
12	Lobsters	2-	12	-	12	4 ± 0.83	12	1 ± 0.29
13	Octopus	39 ± 2.05	13	-	13	-	13	1 ± 0.29
14	Sea anemone	45 ± 2.04	14	-	14	-	14	-
15	Sea cucumber	551 ± 4.39	15	9 ± 1.25	15	85 ± 3.43	15	3 ± 0.62
16	Sea stars	618 ± 2.11	16	2 ± 0.76	16	13 ± 0.83	16	-
17	Sea urchins	71389 ± 173.95	17	27 ± 4.02	17	461 ± 19.14	17	97 ± 19.19
18	Shells	823 ± 1.73	18	16 ± 2.75	18	18 ± 1.98	18	5 ± 0.67

Source: Kenya Wildlife Service & CORDIO Ecological Monitoring Report; 2005.

Table 8.19: percentage benthic cover per 10 m transect and the standard deviation.

	Kisite	Mombasa	Malindi	Watamu	*Chi-Sq.*	*p*
Coralline algae	0.21 ± *1.44*	5.00 ± *6.15*	56.70 ± *16.44*	28.83 ± *49.92*	26.86	0.00*
Halimeda	0.00 ± *0.00*	0.58 ± *0.90*	5.70 ± *4.62*	2.00 ± *2.70*	10.63	0.01*
Dead Coral	3.42 ± *4.85*	2.50 ± *4.01*	6.40 ± *4.30*	2.75 ± *1.82*	23.29	0.00*
Soft Coral	1.75 ± *3.41*	0.00 ± *0.00*	8.00 ± *25.30*	0.00 ± *0.00*	3.81	0.28
Fleshy algae	0.50 ± *1.24*	2.83 ± *5.06*	4.10 ± *5.97*	9.25 ± *9.23*	7.08	0.07
Sand	1.48 ± *4.83*	3.25 ± *2.22*	10.50 ± *7.53*	4.00 ± *3.25*	22.53	0.00*
Hard Coral	48.62 ± *16.62*	2.50 ± *5.73*	3.80 ± *9.30*	0.67 ± *0.98*	12.07	0.01*
Rubble	15.80 ± *15.74*	3.00 ± *2.80*	11.80 ± *15.71*	2.08 ± *2.27*	17.51	0.00*
Algal Turf	28.19 ± *14.58*	1.00 ± *1.48*	1.60 ± *2.01*	1.58 ± *1.68*	20.58	0.00*

Source: Kenya Wildlife Service & CORDIO Ecological Monitoring Report; 2005.

Terrestrial Communities – Baseline Data and Conditions

Terrestrial Flora

The area of Port Reitz north of the creek does not have original vegetation formations as discussed in Moomaw (1960), White (1983), Robertson & Luke (1993) and Burgess *et al* (1998). The original forest land (as inferred from Dongo-Kundu community structures in the southern areas of the Port Reitz creek; CES 2000) have largely been replaced by few secondary wooded trees, scrub forest, and grasslands and cultivated land (Figure 8.28). In the CES 2000 survey, 221 records were made for Dongo-Kundu. Of these, only 3 were recorded as rare in Kenya (and included a mangrove *Herritiera littoralis*, a convolvulaceae – *Seddera suffruticosa*, and a cyperacae – *Fimbristylis ferruginea* ssp *ferruginea*); and only 1 was recorded as possible Kenyan endemic.

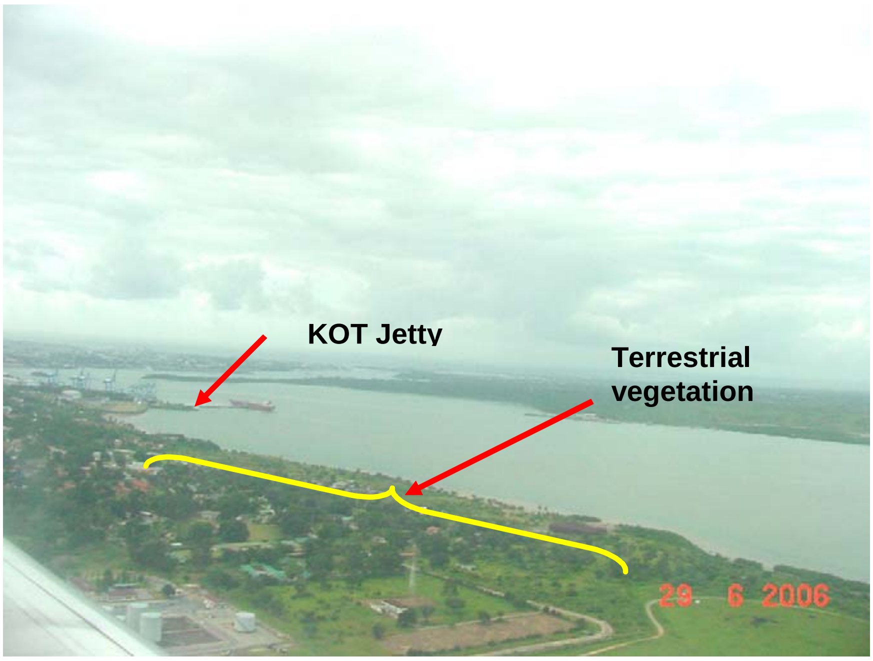


Figure. 8.28: Aerial view of terrestrial area to be affected by project area. Notice the high level of urbanization and already degraded vegetation

From a total of over 50 sampling points, a total of 370 sight records were made at Port Reitz north banks comprising about 30 species of terrestrial trees and shrubs (Table 8.20). This is in addition to the 10 species recorded as mangrove associates (Table 8.3). A checklist developed in 2000 by CES for the Dongo-Kundu area, which is at the opposite side of the Port Reitz north bank (CES, 2000) revealed over 200 species records. This implies that alpha diversity (=within habitat diversity) at Port Reitz banks is low compared to Dongo-Kundu area. It is possible these banks had a similar vegetation species composition years before human intrusion, but today much has been removed to create room for settlements, infrastructure, and other socio-economic engagements, so that there is an almost total extirpation of forests. This argument is well articulated in similar works on plant ecology of Kenyan coastal forests (Moomaw 1960; Robertson and Luke 1993).

Two types of vegetation physiognomy can therefore be said to occur here – secondary savanna and mangrove forest (already treated under marine). Some of the obvious vegetation encountered belonged to the genera *Panicum, Heteropogon, Hyperthelia, Setaria*. Two types of climbers were encountered of the genus *Clitoria* and *Vigna*.

Terrestrial Fauna

The four main habitats housing terrestrial fauna are sandflats (beaches), mudflats, soil, secondary savana, and mangroves. As obvious from the near complete extirpation of forests habitats, not much in terms of terrestrial fauna were encountered. The few that were recorded is presented in Table 8.21.

A note on rare, threatened/endangered species and critical habitats of concern in and around the project sites.

There is no critical habitat / nesting ground of rare, threatened or endangered species sited within the proposed project sites (new container terminal, dumping sites, or sand harvesting sites). However, dumping and sand-harvesting operations of the proposed project may have short-term temporary impacts on the migrations of migratory species. Thus, continous attention in the specified species listed on Table 8.22 shall be paid during the dredging, dumping and sand-harvesting operations of the proposed project. In addition, particular attention will be paid to scleractina coral – Horastrea indica – which is listed as endemic to the western Indian Ocean.

Table 8.20 Terrestrial forest/woodland community bordering the north banks of Port Reitz creek.

Scientific name	Common name	Abundance (no of trees)
Adasonia digitata	Mbuyu	4
Acacia drepanolobium (shrub size)		17
Azadirachta indica	mwarubaine	17
Araucaria equisetifolia		1
Acacia seyal		7
Albizia sp		4
Cocos nucifera	mnazi	9
Cassia didymobotrya		15
Casuarina equisetifolia		5
Euphobia candelabrum		1
Ficus sp		7
Jacaranda mimosifolia		1
Kigelia africanum	muratina (kikuyu)	2
Psidium guajava	mapera	3
Mangifera indica	maembe	4
Syzgium sp	mzambarua	5
Terminalia catapa	mkungu	3
Mkula		1
Mkwakwa		2
Senna siamea		7
Terminalia mantaly		2
Terminalia spinosa		11
Tamarindus indica	mkwaju	1
Melicia excellsa	mvinje	1
Morya		1
Phoenix	palms	235
TOTAL		369

Source –This survey based on observations from the U-shaped belt transect (see also Figure. 6.2) along the proposed access road and immediate environs.

Table 8.21: Faunal species catalogue

Category	Family/genus	Habitat use	Reference and site
Arachnida – spiders		generalist	This survey – between some tree branches
Insecta – moths, butterflies, flies, bees, black ants on trees		generalist	This survey – hovering all over
Mollusca – snails		generalist	This survey – on some tree branches, on floor, on grass
Millipedes		generalist	This survey – on floor, on grass
Toads	Bufo	specialist	This survey – damp log CES 2000
Chameleon	Chamaeloeo	generalist	This survey – stone outcrop CES 2000
Gecko		generalist	This survey – stone outcrop CES 2000
Ambibians	Several genera	specialist	Loveridge, 1932, 1936 – at changamwe
hyperoliids	Several genera	generalist	Schiotz, 1974; Kosen 1968 – at Mombasa
Changamwe caecilian	Boulengerula changamwensis	specialist	Nussbaum & Hinkel (1994) damp soil beneath a mango tree in changamwe
Reptiles	Mostly snakes	generalist	Spawls, 1978 – at Mombasa
Mangrove waders -		specialist	This survey – mangrove forest and adjacent woodlands CES 2000
Birds	Mostly herons, long-tailed shrikes, wolley-necked stork	generalist	CES 2000 – at Dongo-Kundu
Doves		generalist	This survey at the old brick house
Mammals	Mostly bats, insectivores, rodents, elephant shrew	generalist / specialist	Fitzgibbon 1994, 1995 – Dongo-Kundu-Mombasa
Mammals	Mostly pest rats and hedgehogs	generalist	This study – by interview

Most species recorded in literature were not seen (this survey/interviews). These are either extirpated as a result of local extinction of species due to habitat losses

Table 8.22: Rare/threatened/endangered/species of special concern at or near the project sites.

Species ID	Prefered Habitat (reported sitings)	IUCN Status (2004)	Threat Level	Justification of categorization	Reference source
Marine environment:					
Corals (mostly of the genera *Porites Platygra*; & few forms of *Acropora, Montipora* and *Astreopora*)	Intertidal water pools and small shallow lagoons	Keystone species *Horastrea indica*, is endemic	MEDIUM	Apart from *Horastrea indica*, (WIO endemic), the rest are well represented. Corals are keystone species and thus comprise several species of special concern. Corals are also very sensitive to water turbidity and the projected turbidities over coral growth areas (Table 11.1) are expected to be less than the critical levels for coral growth	Obura (in CORDIO 2000)
Mangrove tree - *Herriteria litorallis*	fringing mangrove on fresh water river banks (seen in Dongo-Kundu	Rare	LOW	*Herriteria litorallis* was only spotted on the opposite side of the proposed container terminal at Dongo-Kundu; project on Port Reitz side has no spp of Herriteria litorallis	CES 2002; Robertson & Luke (1994)
Turtles - Green (*Chelonia mydas*) and hawksbill (*Eretmochelys imbricata*)	nestling at Shelly Beach has been reported	Endangered	MEDIUM	Shelly Beach will not be directly impacted by project; off-shore turtle routes may be temporarily disrupted by sand harvesting / dumping operations; turtles are highly migratory and can change routes	KESCOM 2004
Dugongs	Shallow coastal waters (night feeding) and off-shore deeper waters (daytime)	Endangered	LOW	Waters off Shelly Beach is potential habitat and feeding area(though records are not conclusive still) as a large herds were seen in the early 1960's in Mombasa. No recent records on these	Jarman, 1966
Whales	deep sea - 20m isobath	Threatened	LOW	migratory species; no observations exist in the project area	Wamukoya et al 1996
Dolphins	deep sea - 20m isobath	Endangered	LOW	migratory species no observations exist in the project area	Wamukoya et al 1996
Elasmobranchii - white tip shark and Manta rays	deep sea - migrating to Port Reitz waters	Endangered	LOW	migratory species no observations exist in the project area	Frame survey, 2006
Fish - saw fish (*Papa upanga*	Shallow & demersal waters	Endangered	LOW	migratory species no observations exist in the project area	Frame survey, 2006
Ballast water - alien species	Port waters and hard structures - pylons, etc	Unknown	MEDIUM	Increased calling of ships in operation stage	Globallast 2005; This survey
Terrestrial environment:					
Changamwe caecilian (Boulengerula changamwensis)	damp soil beneath a mango tree in Kipevu, Changamwe	Unknown (restricted distribution)	LOW	Changamwe caecilian can migrate to new damp soil sites	Nussbaum & Hinkel (1994)
Birds: waders - plovers, storks & egrets	mangrove forest and adjacent woodlands and mudflats	Unknown	LOW	reclamation of container area will decrease feeding grounds within Port Reitz; but birds can also use Tudor Port & Dongo-Kundu mudfalst/mangrove; moreover population of waders few here	This survey Seys et al., 1995

9.0 SOCIO-ECONOMIC ASPECTS OF THE PROJECT

9.1 Introduction

This report presents an assessment of the socio-economic conditions of the Port Reitz-Kipevu-Kwahola area, which is the focus of the proposed construction of a dual carriage access road and modernization of the container terminal. It also identifies the likely impacts of the proposed project and the necessary mitigation measures that should be put in place. The socio-economic assessment is part of the Environmental Impact Assessment for the proposed modernization of container terminal and construction of a dual carriage access road by the Kenya Ports Authority (KPA). It is anticipated that the proposed project will improve maritime transport and raise the contribution of the transport sector to the Kenyan economy.

Transport is a strategic and productive economic sector that provides a vital link between the producers and the consumers of goods and services in Kenya. It contributes significantly to local income and livelihoods of coastal dwellers especially in Mombasa which is a major urban centre with a big resident population. It is important to note that among the principal economic activities in terms of employment and contribution to economy of the Coast province, port and shipping activities account for 15%. The other important economic activities contribute as follows: tourism - 45%, non-agricultural industries - 8%, agricultural production and processing - 7%, fisheries - 6%, forestry - 4%, mining - 2% and other services – 13%.

9.1.1 Maritime Transport

The Port of Mombasa is the largest sea port in Kenya as well as one of the largest and most important ports along the East African Coast. It is located within the Kilindini channel that adjoins the Port Reitz creek. The other small ports are at Shimoni, Kilifi, Mtwapa, Kipini, Vanga-Funzi area, Malindi and Lamu which has catered for dhow trade for over 200 years. The Kenya Ports Authority manages all these Kenyan ports and some are still attracting dhows following the monsoon winds from northern points in East Africa and the Arabian Gulf. Mombasa Port, which provides connection to landlocked neighbouring countries, is connected to world’s major ports with over 200 sailings per week to Europe, North and South America, Asia, the Middle East, Australia and the rest of Africa.

Total cargo traffic handled at the Mombasa port over the past four years has been on a steady increase, a trend which is likely to continue. Between 2001and 2004, cargo handling increased by 5% while docking ships experienced an average growth rate of 3% over the same period as indicated on the Figure. 9.1 below.

Out of the ships docking at the Port, an average of 40% are container specialized, 22% are general dry cargo, 18% are bulk oil tankers, 3% are passenger's ship and the remaining 12% are other ships. Total import of cargo also has been on increase over the years with 2004 recording an increase of 19.8% over the 2003 performance and exports increased by 14.2% during the same period. Container traffic went up by 24.5% to stand at 380,353 in 2004 compared to 305,427 in 2003 (Republic of Kenya, 2005).

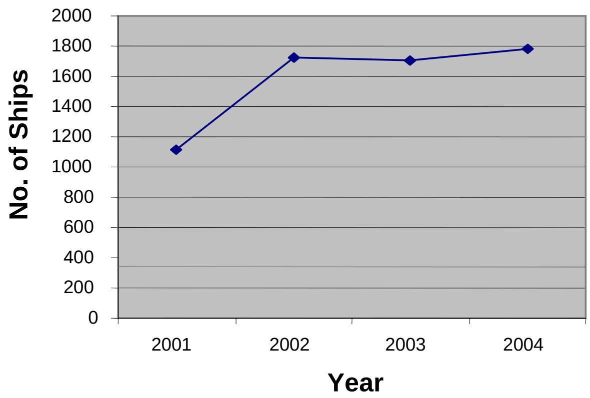


Fig 9.1: Trend of Ships docking at port of Mombasa

Since the capacity of the current container terminal has remained fixed over along period of time, the volume of containers being received has increased beyond the current carrying capacity hence the need for expansion and modernization of the container terminal.

9.1.2 Road Transport

Road transport system plays a central role in the development of all sectors of the economy and in promoting the integration of the national economy internally and internationally. It has been estimated that over 70% of all container traffic into and out of the port of Mombasa are conveyed by roads thus underlining the critical importance of road transport. It is only the refined oil products that are currently transported through pipeline system from Mombasa to Western Kenya especially to Kisumu and Eldoret. This therefore underscores the need for the proposed construction of access road. Currently, the main Portretz-Kwahola road which was initially tarmacked is in a horrible state. During the survey, all the respondents complained that road maintenance was none-existent hence making the Portretz-Kwahola road almost impassable even during the dry season.

9.1.3 Air Transport

Air transport is a key sub-sector in the development of tourism, transportation of high value exports and perishable goods and for promotion of regional integration. The Moi International Airport is located close to the site of the proposed KPA Container modernization project, in the Changamwe division of Mombasa city. The proposed three lane access road will join the airport road about 0.5-1 km from the airport. Moi International airport handles both domestic and international flights associated with tourism. Kenya Airways (KQ) manages domestic flights and the airport is capable of handling 1.5 million passengers per year and can accommodate large aeroplanes. The airport has a capacity to accommodate 30 light air crafts at any one time.

9.1.4 Railway Transport

Rail transport which was being provided by the Kenya Railways (KR) is in transition due to the on-going privatization. It is has now been handed over to the Rift Valley Railways to run it as a private business and it forms the second most important mode of transport after road transport. It accounts for 30% of container traffic into and out of the port of Mombasa. This mode of transport is particularly important for the carriage of bulky goods especially from the Mombasa Port to the hinterland. The railway distribution within Mombasa town is concentrated mainly in the industrial areas; railway deports and port warehouses.

9.1.5 Energy

Energy is a basic prerequisite for the development of industrial, commercial and agricultural sectors and is also important for domestic use. Currently the major sources of energy in Kenya are petroleum fuels, electricity, wood fuel and, to a lesser extent, solar energy, wind, ethanol, coal and biogas. Petroleum fuels and hydro-electricity are currently the major sources of energy for industrial and commercial establishments.
The distribution of the power in the Coast of Kenya is concentrated in the urban centres where the demand is relatively high. So far renewable sources of energy such as wind, solar, geothermal, biogas and local production of micro-hydropower have not been widely exploited in Coast Province.

9.1.6 Water Supply

Coast Province is supplied with freshwater from Tiwi boreholes, Mzima pipeline from Mzima springs in Taita-Taveta, Marere pipeline from Marere springs and Baricho pipeline from Baricho treatment works at Sabaki River. In Mombasa, 80% of the population has access to piped water, Kilifi – 50%, Malindi – 52% and in Taita Taveta – 57%. Efforts have been made to meet the deficit through boreholes, dams, wells, ponds etc. Statistics for the total population found in Coast Province shows that 11% have access to well water, 10.7% - Stream/river water, 9.2% - pond; 6.4% - Boreholes and 5.8% - Dam water (Republic of Kenya, 1999). This implies that about 50% of the population in Coast Province have access to untreated water and therefore are at high risk of contracting water-bone diseases.

9.1.7 Sanitation

Wastewater treatment has not been given adequate attention in Mombasa. Presently, only 30% of the population in the Island and 15% of the population in the Mainland West is connected to the sewer, while the rest is either served by septic tanks or cesspit including pit latrines. None of the wastewater is being treated, but is discharged to the Ocean causing localized pollution. Over 65% of the coastal population is served by pit latrines, around 6% have a water closet and a mere 2% have a flush toilet. Over 25% have no provision for domestic wastewater whatsoever. These data contrast somewhat with national averages where 6% have a flush toilet and only 16% have no provision for sewage whatsoever (Republic of Kenya, 1999).

9.1.8 Population

The proposed access road will be constructed in the Portreitz-Kipevu-Kwahola area in Changamwe division, Mombasa Muncipality. Changamwe division has 53,012 households with total population of 173,930 people as shown in the Table 9.1 below.

Table 9.1: Population distribution by sex, households and density in Changamwe division

Place	Population size			No. of households	Population density
	Male	Female	Total		
Changamwe	6,031	5,315	11,346	2,923	2,986
Kipevu	25,710	19,010	44,720	15,022	10,164
Portreitz	30,252	23,832	54,084	16,765	5,634
Mikindani	17,692	14,793	32,485	9,637	5,078
Miritini	17,412	13,883	31,295	8,665	1,033
Total	**97,097**	**76,833**	**173,930**	**53,012**	**3,191**

Source: GoK 2001 - Population and Housing Census 1999

It is evident from this Table that Portreitz, Kipevu and Changamwe areas that will be directly affected by the project, especially the access road, have a total population of 110,150 people with the male population exceeding female population.

Table 9.2: Employment by Sector in Urban Centres

No.	Sector	Total Number	Percentage
1.	Agriculture & Forestry	2,134	0.6 %
2.	Mining & Quarrying	2,491	0.7%
3.	Manufacturing	67,232	18.9%
4.	Construction	13,873	3.9%
5.	Wholesale/Restaurants and Hotels	57,983	16.3%
6.	Transport & Communication	66,876	18.8%
7.	Finance, Insurance &Real Estate	29,525	8.3%
8.	Community, Service & Personal services	111,698	31.4%
9.	Electricity & Water	3,913	1.1%
10.	Total	355,725	100%

Source: CBS Statistical Abstract, 2004

According to the 1999 Population and Housing Census, the economically active population (15-64 years) in Coast Province that houses Mombasa Municipality was 1,100,080 people. This economically active population shows an increase of 47.8% over 1989 figureure of 744,246. Coast Province recorded a population of 928,170 being engaged in various economic activities in both rural and urban areas. 281,646 of these were found in the rural areas employed mainly in the primary production sectors of the economy like agriculture, fisheries, forestry and mining, and 355,725 people in the urban areas of which only 33% were women. The distribution of the labour employment in various sectors in the urban areas of Coast Province is as indicated below. Employment in the Community, service and personal services which accounts for 31.4% include employment in the public service and household help assistance.

9.1.9 Fisheries

Traditionally, the coastal communities have depended on fisheries and mangrove exploitation. Currently it is estimated that about 10,000 fishermen are directly engaged in artisanal fishing in the Kenyan coast. Since the fishery is a common property resource, fishing effort has increased with increase in the number of artisanal fishermen over the years.

The fish production from the inshore areas is determined by among other factors, the amount and quality of effort that is applied in the fishery and the availability (abundance) of fish stocks (Ochiewo 2004a and Ochiewo 2004b). Effort is limited for many reasons including lack of information on fisheries potential; little institutional support for fisheries development; lack of investment interest in the fisheries sector due to the perceived poor returns in investment in this sector compared to alternatives such as tourism; malpractices in the fish market; and use of small inefficient traditional fishing vessels, most of which are un-motorized, wooden-planked canoes that are either wind propelled or paddled limiting the scale of fishing operations. In addition, fishing is difficult for a significant part of the year (May-September) when the sea is rough and winds are high. Infrastructure for the marine fisheries sector has also not been adequately developed.

Since the fishery is a common property resource, fishermen lack a sense of ownership in it. At the moment, the Kenyan reef fishery shows signs of over-exploitation. It is evident that fish catches have been declining over the years with a decline in aggregate fishery revenues, while the fishing effort has not only remained high but is increasing especially in the artisanal sector.

The Government has responded to the problem of bad fishing practices that result into over-exploitation of fisheries by adopting co-management and has consequently created Beach Management Units (BMUs) made up of people from the fishing communities. The BMUs are expected to participate in fisheries management by ensuring registration of all boats operating in the fisheries, prevention of banned and destructive fishing gear from being used in the fisheries, protection of fish breeding and recruitment grounds, construction of fish bandas and access roads, monitoring and control of illegal and migrant fishers, gear and methods, collection of fisheries data, and resolution of conflict among others.

Artisanal fishermen land over 80% of the fish annually from the coastal and marine waters. The difference is produced by the commercial trawlers operating in the inshore prawn fishery. The annual catch landings from the marine sector (**Figure. 9.2**) show a downward trend between 1998 and 2000. After 2000, there was a gradual increase between 2000 and 2003 but the increase never reached the catch levels of 1998. It has however been observed that the actual fish catches may be much higher than the recorded catches because many fish landing sites are not accessible to the data recorders and the fish landing times vary making it difficult for all the data to be recorded even in the accessible sites.

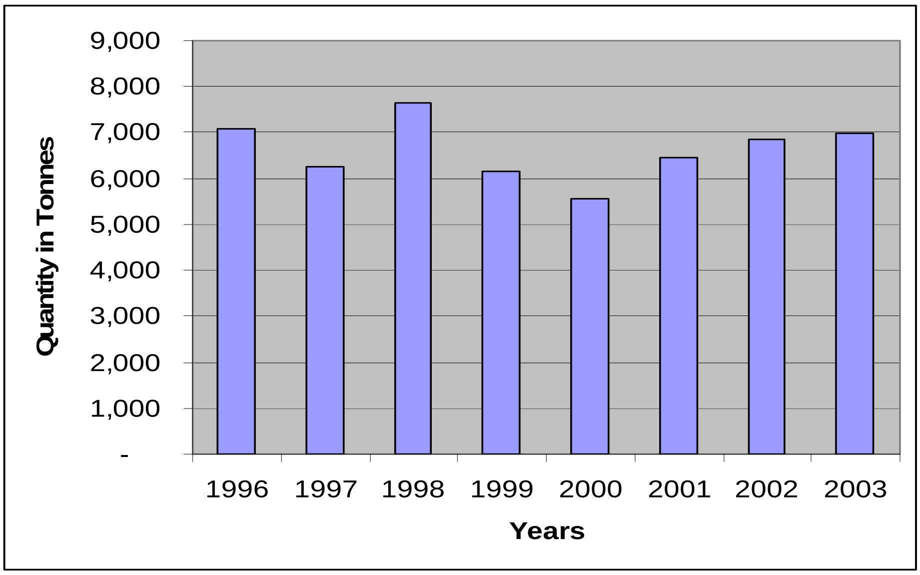


Figure 9.2: Trends in fish landings in the Kenyan Coast (1996-2003)

Little domestic fishing is conducted outside the reef. Some foreign vessels from Europe have instead been licensed by Kenya to fish for tuna with purse-seine gear.

9.1.10 Mining

Kenyan Coast is endowed with numerous minerals that include sand and limestone, which is used in construction and building industries and is currently being mined at uneconomical rate by use of crude technology. The two resources are non – renewable and if the mining continues by using crude tools will result in environmental degradation of a wide area. The activity has left many un-rehabilitated holes, which has become breeding ground for mosquitoes during the rainy season.

9.2 Objectives

The objective of this component is to assess the socioeconomic conditions and impacts of the proposed Container Terminal and construction of the access road.

9.3 Methodology

9.3.1 Study area

The study has been conducted at the Portreitz-Kipevu-Kwahola area in the west mainland of Mombasa city and at the fishing area around Shelly beach in Likoni. The Portreitz-Kipevu-Kwahola area will be impacted by both the proposed modernization of container terminal and the construction of an access road which is a three lane dual carriage way by the Kenya Ports Authority (KPA). The people who will be affected directly by the proposed project are those residing in Baharini estate at the sea-front, Mwingo, Lilongwe and Kwahola areas. Apart from human settlement with a variety of residential houses, the area that will be directly affected has a number of transport companies, clay works and maize millers, small scale businesses, and community services such as a mosque, churches, a cemetery, a district hospital, an orphanage, a dilapidated road, to mention a few. The proposed sand harvesting will impact the fishing area around Shelly beach.

9.3.2 Data collection

Both secondary and primary data were collected during the study. A desktop review was done to gather the existing secondary data and information. Primary data were collected using a combination of socioeconomic data collection techniques namely semi-structured interviews, observation, and key-informant interviews. Most of the time, observation and semi-structured interviews were used simultaneously. Field assistants were hired and trained on these socio-economic assessment techniques before the data collection began. 109 people were interviewed out of who 25 fishermen. Out of the 25 fishermen, 20 were interviewed in the fishing area around Shelly beach. The respondents consisted of residential property owners, residents, companies, and religious leaders.

Semi-structured Interviews

Interviewees were randomly selected and included the following categories: land/property owners in this area, local residents, people with a say on religious and cultural structures, marine resource users in the area, managers/institutional stakeholders and local leadership. Semi-structured interviews were conducted using interview guides/semi-structured questionnaires with open-ended questions (**see**

appendix I). Some respondents were interviewed in their homes while others were interviewed in their places of work and business premises. In most cases, interviews were conducted on the spot while in some cases; appointments were booked for interviews to be conducted at a time that was convenient to the respondents. These appointments followed a clear explanation of the objectives of the study. Using this method, it was possible to probe for answers, follow-up the original questions and pursue new lines of questions. It created room for two-way interaction and exchange of information between the interviewer and the respondent. During the interviews, the questionnaires were field and notes were taken on issues that emerged but that were not exhaustively captured by the questionnaires. At the end of each day, the research team sat together to review and harmonize the results.

Observation

Direct observation of activities and unique features in the area under consideration was carried out. Events from the surrounding were attentively watched and recorded by the research team. This method provided first hand information about the area. The information then formed a basis for detailed interviews with the respondents. It was also useful in confirming some issues that came up during the semi-structured interviews. During observation, questions were asked about issues that are relevant to the variables under investigation. The questions concentrated heavily on issues that could not be observed. At the end of each day, the research team sat to review the quality of data and information collected.

Key-informant Interviews

Key-informant interview was used to extract information from the opinion leaders in the affected areas. These key-informants (opinion leaders) were people who held some respected positions in the society. The key informants included the religious leaders, some businessmen who command respect in the local community, local leadership, and fishermen’s association chairman. The key informants gave insight on many issues that needed further clarifications and helped in the validation of information collected using the other research methods.

9.3.3 Data analysis

Qualitative data have been coded to allow statistical analyses to be undertaken. After coding, both quantitative and qualitative data have been analysed using descriptive statistics. Descriptive analysis has been undertaken with the help of excel and SPSS.

9.4 Results and Discussion

9.4.1 Living and Livelihood Conditions

Household Roles

As evident in Figure. 3 below, most of the respondents were heads of households. This implies that they are responsible for taking decisions on issues that are likely to affect the welfare of their households both in the positive and negative aspects. The household heads consisted of both men and women. Among the 109 respondents interviewed, house-wives formed the second big category of respondents that were interviewed. While they provided vital information about their respective households, discussions on sensitive matters such as compensation in the case of displacements/resettlement should be taken up with their respective household heads.

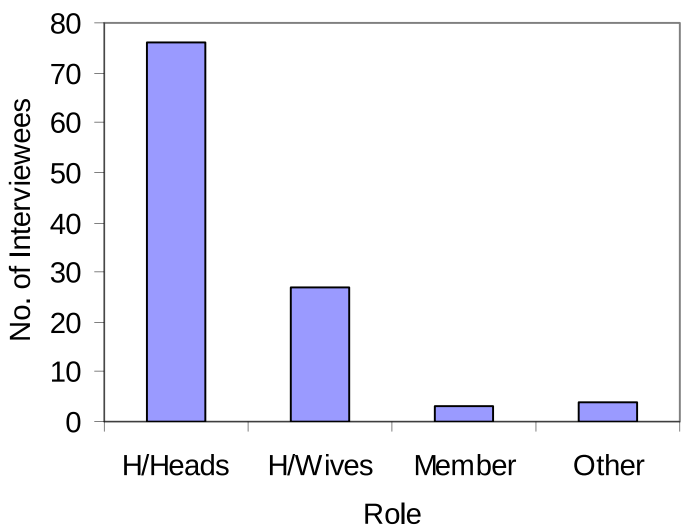


Figure 9.3: Roles of respondents in households

Housing

About 50% of the respondents surveyed built their own dwellings. Among the 102 surveyed households, 47 permanent structures were counted. The walls of these structures have mainly been built with stones and the roofs are built with iron sheets or tiles. Most of these structures had more than one living unit (see plate 1 below) and therefore had tenants living with the property owner in the same building. 21 semi-permanent structures were counted. The walls of these structures have been built with poles and mud and then plastered with cement, while the roofs are built with iron sheets. Just like the permanent structures, most of the semi-permanent structures had more than one living unit and therefore had tenants living with the property owner in the same building. 34 temporary structures were counted. The walls of these structures have been built with poles and mud and the roofs are built with iron sheets (see plate 2). Like the semi-permanent structures, most of the temporary structures had more than one living unit and therefore had tenants living with the property owner in the same building. It is worth noting that the traditional roofing material, *makuti*, has not been used in the area since majority of the residents in this area are from upcountry where they have not appreciated the comfort that a *makuti* roof creates in a hot environment.

Plate 1: Permanent residential property at Mwingo. This structure was formerly used as a private school.

Plate 2: Semi-permanent residential structure at Lilongwe

The Figure 9.4 below shows that property owners and tenants who live or conduct businesses in rented property were equally represented in the sample. Only a few squatters were identified during the survey. Almost all property owners along the proposed access road were interviewed.

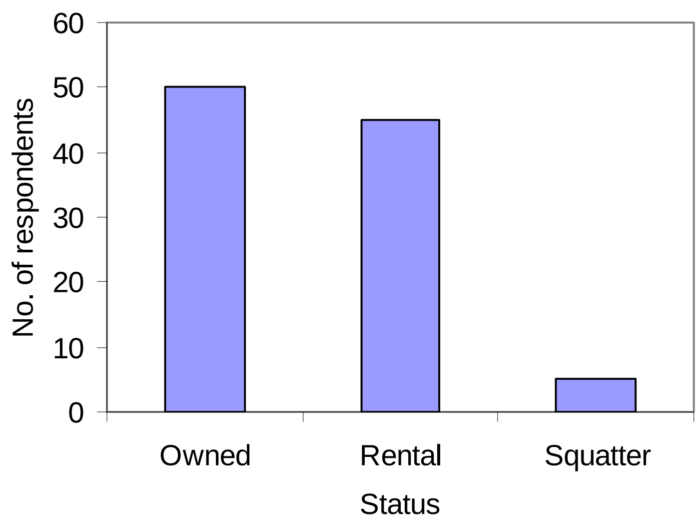


Figure 9.4: Status of house occupied

Occupational/Employment Structure

Figure 9.5 below presents the occupational structure of the Portreitz-Kipevu-Kwahola area which is going to be affected by the proposed construction of a three-lane access road. It is evident from this Figure 5 that 52% of the respondents are involved in business activities as a means of earning livelihood. The business activities in the area are varied and range from the small-scale food-selling kiosks (see plate 3) to the medium scale shops that sell household items, workshops and garages (see plate 4). The small-scale business activities are carried out by both men and women. Some of the small and medium scale businesses in the area have obtained credit facilities from the micro-credit schemes that have been initiated to promote small and medium scale enterprise developments. This is in line with the Government’s commitment to promote micro-small and medium scale enterprise development as a means of creating self-employment and alleviating poverty. The second largest occupation is employment. Regarding employment, many people are employed as security guards by different firms while others are teachers, nurses, etc. Depending on the number of people involved in each occupation, artisanal fishing and the informal “jua-kali” sector come third in the ranking list.

Plate 3: Small-scale food kiosk at Lilongwe.

Plate 4: A workshop at Mwingo

Farming came fourth, but it is important to note that it provides part of the food that is consumed in this area. Livestock especially cattle, goats and poultry are kept by some of the residents. Crop farming is also carried out but on a limited scale since this is an urban area where agricultural land is scarce. The crops grown include coconut and maize that are grown at the Baharini area. Cassava and vegeTables are grown in the area between the Portreitz road and the Moi international airport.

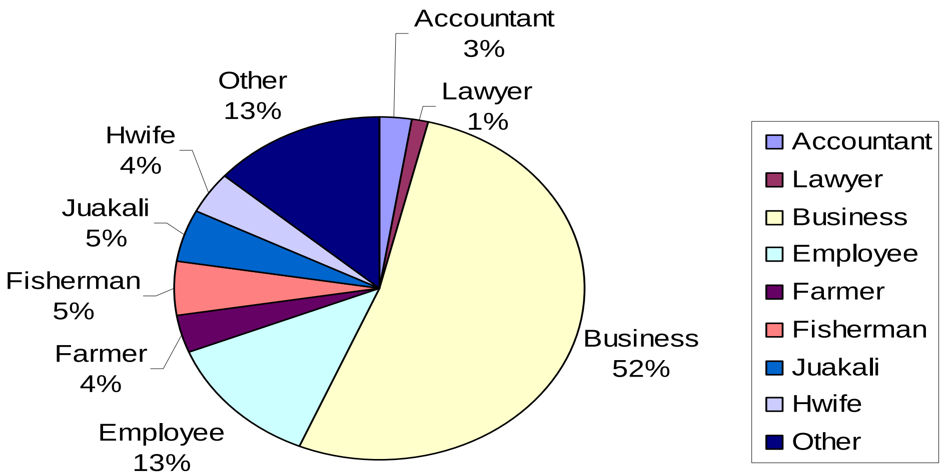


Figure 9.5: Occupation Structure in the Portreitz-Kipevu-Kwahola site

Since relocation of the local residents will affect their present living conditions as well as business activities, it is important to consider organizing specialized business training to the affected people as a means of enhancing recovery.

9.4.2 Community Services

A number of community services are available in the Portreitz-Kipevu-Kwahola area. These include the health amenities, education/schools, public transport, religious services (churches and a Mosque), pipe water, electricity, telephone, shops, banks and security/police.

Health Facilities

The Portreitz District hospital, a Government hospital, which is located in the area provides both out-patient and in-patent medical services to the residents. The area also hosts the School of Clinical Medicine (a medical training college) just adjacent to the Portreitz District Hospital. Furthermore, a few private clinics that offer out-patient services are available in the area. As population grows, there has been a tendency to open new private clinics to cater for increasing demand for health care. While a section of the population could also be depending on traditional healers for their health needs, no traditional healers were seen during the study.

Education

Four public primary schools are located within the area namely Umoja, Chaani, Kipevu, and Migadini Primary schools. A number of private nursery and primary schools and a children's rehabilitation centre called Onesmus Boys Centre also exist in the area. Furthermore, there are a number of secondary schools in the area some of which include Portreitz Academy, Seaside Academy, High Achievers Academy, and St. Teresa Girls Secondary School. The first three are located between Lilongwe and Portreitz while the fourth one is located at Kwahola. In addition, the Dickson Children's Centre which is an orphanage is located at Baharini and caters for the orphaned children. Portreitz School for the Physically Handicapped and the Mombasa Educational Assessment and Resource Centre for Children with disabilities are also located in the area. The research team encountered no complaint about education services that are available.

Public transport

The Portreitz-Kipevu-Kwahola area is served by van (*matatu)* services as the main mode of transport. This public transport however suffers from the poor condition of the road between Portreitz and Kwahola (**see plates 5 and 6**).

Plate 5: A *matatu* van maneuvers on the dilapidated Portreitz road.

Plate 6: The Portreitz road in its current state.

Religious services

There is one Mosque at Mwingo just adjacent to the main Portreitz-Kwahola road (**see plate 7**). Three Churches are also located next to the main road starting with the Redeemed Gospel Church at Lilongwe (**see plate 8**), Deliverance Church and Miracle Evangelistic Ministry both at Kwahola. In the second row there are a number of Churches, an Islamic religious school (*Madrassa*) and a Mosque. These religious sanctuaries have grown in tandem with the growing population.

Plate 7: The Mosque at Mwingo adjacent to the dilapidated Portreitz road.

Plate 8: Redeemed Gospel Church at Lilongwe.

Pipe water

Generally, 80% of the population in Mombasa has access to piped water. However, according to reports from the Mombasa Water & Sewerage Company (2006), the water supply to Mombasa currently stands at about 72,000m^3/day against a demand of 160,000m^3/day. This translates to 45% of the demand being met. The 72,000m^3/day water received s supplied to consumers through rationing. Being part of Mombasa, the Portreitz-Kipevu-Kwahola area is also affected by this rationing.

Electricity

The entire Portreitz-Kipevu-Kwahola area is served with electricity with the main electricity line running parallel to the Portreitz-Kwahola road (**see plate 9**).

Plate 9: Electricity line running parallel to the dilapidated Portreitz road

Telephone

The entire Portreitz-Kipevu-Kwahola area is served telephone lines. The area is also well covered by two mobile phone networks, celtel and safaricom.

Shops

A number of small shops exist in the area selling different types of consumable goods. Besides these shops, there are kiosks that operate on very small scale.

Banking services

The Post Bank branch located at Chaani, less than 1km from corner Kwahola, has addressed the banking needs of the local people for many years.

Security/police

The Changamwe Police Station provides security to the residents including those in Portreitz-Kipevu-Kwahola area. In addition, the Changamwe District Officer, the location

Chiefs and Assistant Chiefs work together to ensure there is security in the area. The District Officer and the chiefs have administration police officers with whom they work.

9.4.3 Community's Perception of the Development

Community's perception about the planned project has been presented in figure. 9.6 below. It is evident here that 10% of the respondents (i.e. 11 households) perceive the project to be bad. They are however willing to accept compensation if the project has to be implemented. 7% of the respondents (i.e. 8 households) felt that the project is bad but if certain concerns are addressed adequately then their perception about the project will change to be positive. 50% of the respondents (i.e. 54 households) felt that the project is out-rightly good since in their view, it will create employment opportunities to the youth who reside in the area, will open up the area for increased business and will generally improve transport situation in the area. 30% of the respondents (i.e. 33 households) felt that the project is good but the welfare of the affected people should be adequately catered for and appropriate mitigation be put in place to curb any negative impacts. 3% of the respondents (i.e. 3 households) did not have any comment.

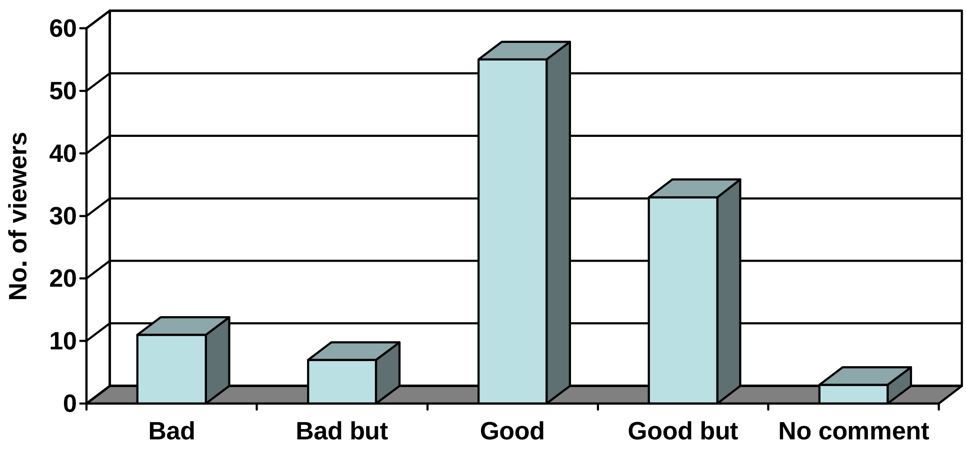


Figure. 9.6 Community's perception of the development

Views about compensation

98% of the respondents want adequate compensation to be given to then before they are asked to vacate to give way for the project. Out of the 109 people who had been interviewed 76 people prefer cash compensation, 6 people prefer to be given property that are equal to their current property and 2 people stated that they would not want to move out of their current residence. 20 fishermen emphasized that they need compensation in the form of motorized boats and fishing gears, while 5 fishermen prefer to be given employment in the project so that they could eke a living from a different source.

Table 9.3: Views about compensation

Property owners and other residents			**Fishermen**	
Want cash compensation	**Want actual plot and/or house**	**Does not want to move**	**Want motorized boat & fishing gears**	**Want employment**
76 people	6 people	2 people	20 people	5 people
90.6%	7%	2.4%	80%	20%

Issues emphasized by the local communities

Need for employment creation*:* There was general concern that employment has previously not been given to the affected population. There is unemployment among the youth. Most of the affected respondents expressed optimism that their youths will be given first priority if more jobs are created by the project.

Compensation: All the affected persons emphasized that they should be paid directly without involvement of a third party. They prefer to be present or be represented by people whom they have nominated from their respective areas in the negotiations with KPA over compensation.

Displacement*:* Displacement should be avoided as much as possible.

10.0 TRAFFIC VOLUME AND NOISE SURVEY

10.1 Land Traffic Survey

The project will result in more vehicular traffic, hence the increases and their impacts had to be evaluated. Land traffic survey was done from 20th to 29th September 2006 along the three roads likely to be impacted on by the project namely Port Reitz road, Airport road and Magongo road. As part of the assessment to the alternative proposal by Pacific Consultants International traffic survey was also done on Kenyatta Avenue at Kibarani on 31st October and 1st and 2nd November 2006. The traffic observation points are indicated in Fig. 6.1.

Figure 10.1: Traffic volume survey along Port Reitz road. Note the dilapidated state of the road

Background data included quantification of present traffic loads and their periodicity, accident data with indication of severity (casualty losses, deaths and injuries), and any special characteristics of traffic (trucks, taxis, buses--frequency, routes, etc.).

Table 10.1: Total Daily Flow of Motor Vehicles along Port Reitz Road

Date (Sept 2006)	Buses	Cars	Motorcycles	Minibuses	Large Trucks	Small Trucks	Totals
29th	13	349	15	160	462	285	**1284**
28th	25	331	41	147	581	299	**1424**
27th	23	326	60	224	533	402	**1568**
26th	21	379	97	172	525	387	**1581**
25th	13	338	59	176	635	304	**1525**
22nd	16	290	52	187	478	337	**1360**
21st	10	308	71	221	518	346	**1474**

20th	13	279	48	140	641	346	**1467**

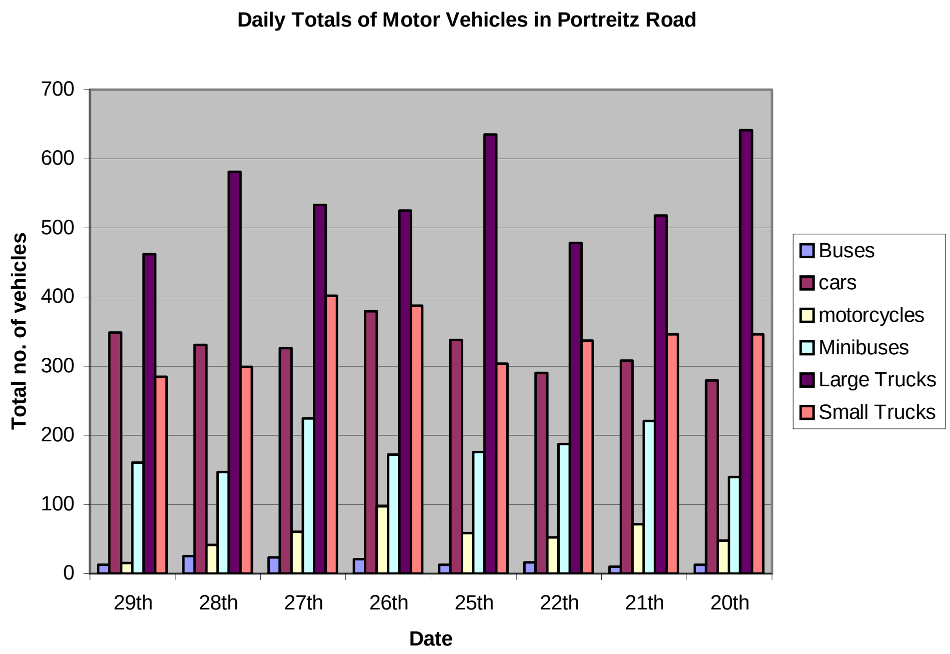


Figure. 10.2: daily totals of motor vehicles in Port Reitz

Table 10.2: Total Daily Flow of Motor Vehicles along Airport Road

Date **(Sept 2006)**	Buses	Cars	Motorcycles	Minibuses	Large Trucks	Small Trucks	Totals
29th	56	2095	159	1923	223	640	5096
28th	58	1757	224	1947	236	755	4977
27th	50	1870	205	1956	307	709	5097
26th	62	1965	217	2092	233	722	5291
25th	31	1743	233	2835	345	751	5937
22nd	71	2131	252	1843	306	739	5342
21st	38	1985	228	1958	272	813	5294
20th	60	1938	201	1756	294	745	4994

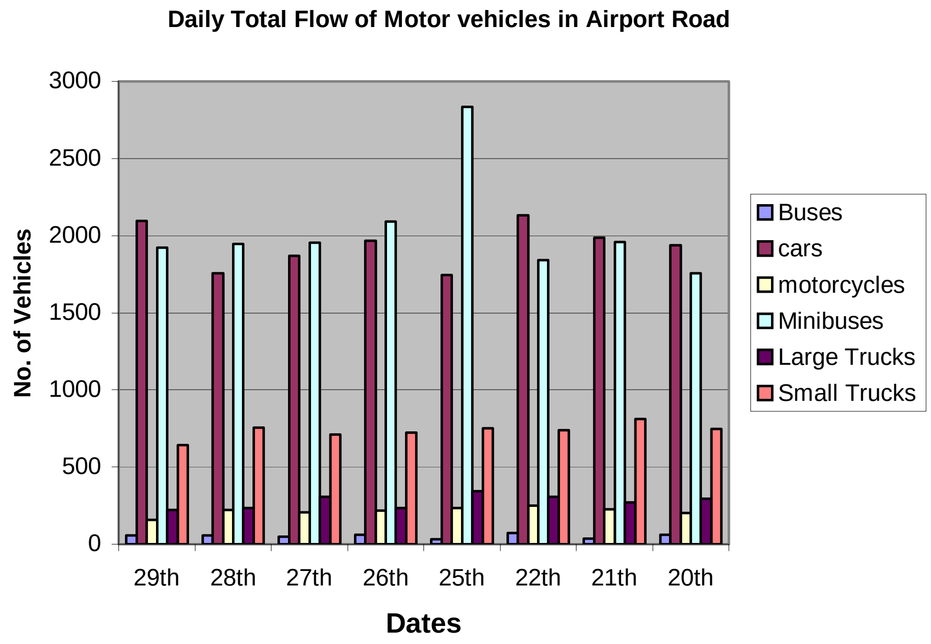


Figure 10.3: Daily totals of motor vehicles along Airport Road

Table 10.3: Total Daily Flow of Motor Vehicles Along Magongo Road

Date	Buses	cars	motorcycles	Minibuses	Large Trucks	Small Trucks	Total/hr
29th	28	948	161	1085	716	199	3137
28th	16	977	279	1054	783	222	3331
27th	21	1027	172	1146	859	232	3457
26th	24	1078	163	1181	774	245	3465
25th	35	1149	152	1196	848	245	3625
22nd	23	1169	137	1134	829	210	3502
21st	25	1316	267	1083	799	363	3853
20th	13	1059	113	899	615	266	2965

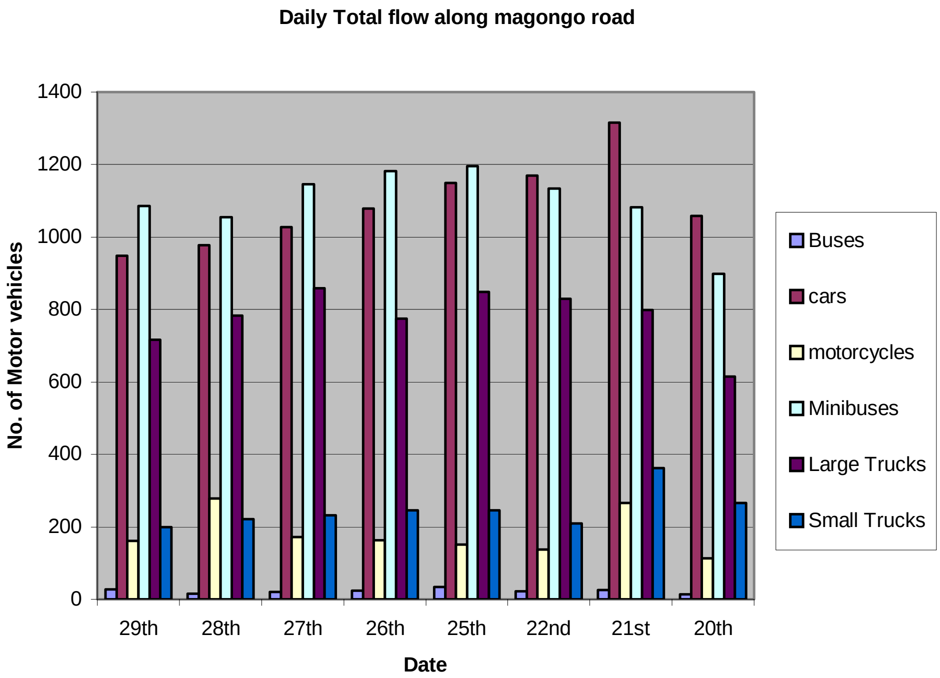


Figure 10.4: Daily totals of motor vehicles on Magongo road

Table 10.4: Hourly Motor Vehicle Frequency Along Kibarani Road on 31st Oct. 2006

Hours/Vehicle	Car	Large Truck	Small Truck	Motorcycle	Buses	Minibuses	Total
7am -8 am	185	105	90	16	11	285	692
8am -9 am	240	125	120	9	5	165	664
9am-10 am	302	115	100	11	21	300	849
10am-11 am	240	135	145	15	4	420	959
11am-12 pm	240	160	125	21	5	390	941
12am-1 pm	270	165	150	8	3	420	1016
1am-2 pm	215	145	155	9	1	345	870
2pm-3 pm	245	150	85	12	4	321	817
3 pm-4 pm	405	155	120	8	6	390	1084
4 pm-5 pm	255	123	100	8	8	350	844
5 pm-6 pm	140	100	105	24	18	255	642
6 pm-7 pm	130	90	95	12	13	420	760
Total	2867	1568	1390	153	99	4061	10138

Fig 10.5: Motor vehicle frequency in Kibarani Rd

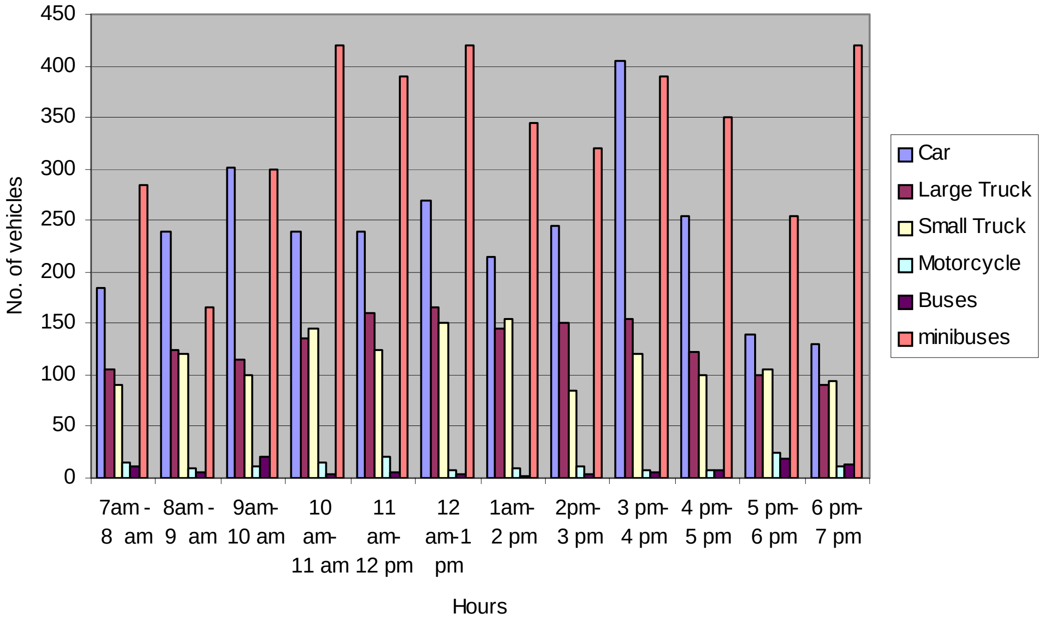


Table 10.5: Hourly Motor Vehicle frequency along Kibarani Road on 1/11/06

Hours/Vehicle	Car	Large Truck	Small Truck	Motorcycle	Buses	Minibuses	Total
7am -8 am	285	120	80	20	13	520	1038
8am -9 am	320	115	85	34	10	450	1014
9am-10 am	310	130	125	18	26	520	1129
10am-11 am	216	140	135	7	5	735	1238
11am-12 pm	285	180	160	15	3	310	953
12am-1 pm	225	185	145	12	5	150	722
1am-2 pm	195	195	180	7	4	295	876
2pm-3 pm	255	190	185	21	7	220	878
3 pm-4 pm	250	210	180	21	1	165	827
4 pm-5 pm	300	150	150	26	9	422	1057
5 pm-6 pm	240	140	165	18	7	270	840
6 pm-7 pm	220	125	140	11	4	430	930
Total	3101	1880	1730	210	94	4487	11502

Fig 10.6: Motor vehicle Flow in Kibarani Road

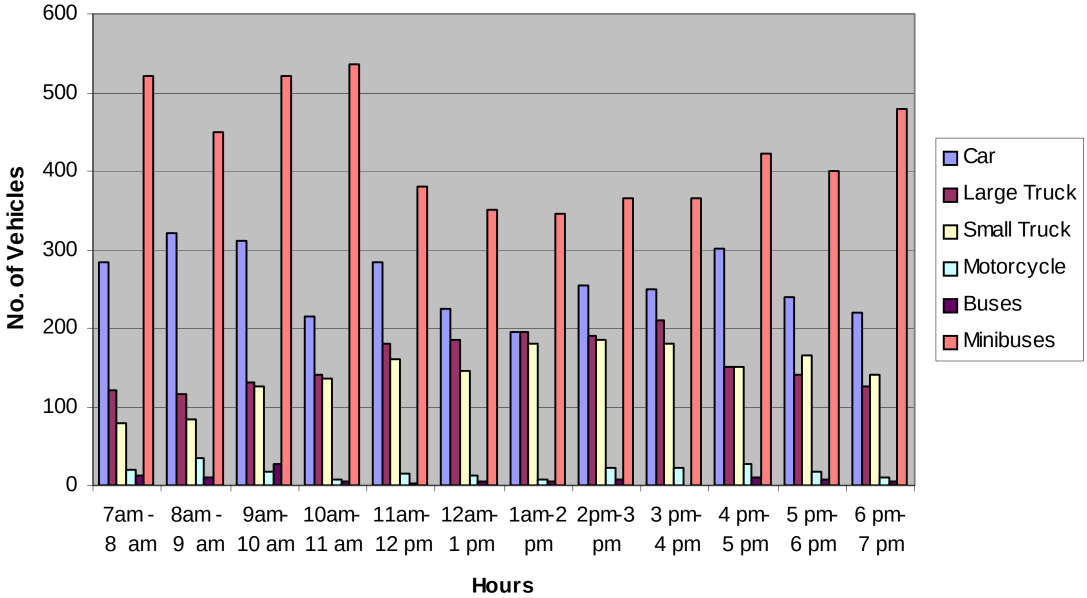


Table 10.6: Hourly Motor Vehicle Flow Along Kibarani Road on 2/11/2006

Hours/Vehicle	Car	Large Truck	Small Truck	Motorcycle	Buses	Minibuses	Total
7am -8 am	305	175	160	12	20	720	1392
8am -9 am	340	225	210	21	13	570	1379
9am-10 am	255	215	235	17	11	520	1253
10am-11 am	287	240	240	27	15	360	1169
11am-12 pm	307	265	270	15	17	265	1139
12am-1 pm	297	210	215	28	11	285	1046
1am-2 pm	327	200	200	41	10	290	1068
2pm-3 pm	260	195	185	20	8	240	908
3 pm-4 pm	280	145	180	26	6	360	997
4 pm-5 pm	350	215	175	17	15	210	982
5 pm-6 pm	255	125	110	5	12	415	922
6 pm-7 pm	255	105	105	10	11	349	835
Total	3518	2315	2285	239	149	4584	13090

Fig 10.7: Motor vehicle Flow in Kibarani road

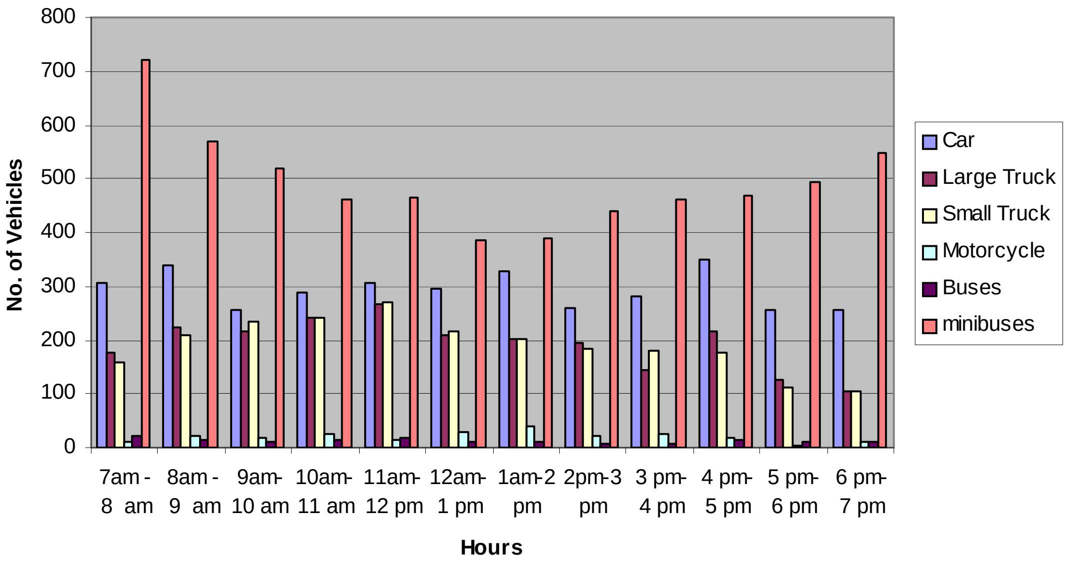


Table 10.7: Total Motor vehicle frequency during the sampling period

Date/Vehicle	Car	Large Truck	Small Truck	Motorcycle	Buses	Minibuses	Total
31/10/06	2867	1568	1390	153	99	4061	10138
1/11/2006	3101	1880	1730	210	94	5133	12148
2/11/2006	3518	2315	2285	239	149	5924	14430
Total	9486	5763	5405	602	342	15118	36716

Fig 10.8: Total motor vehicle flow during sampling period

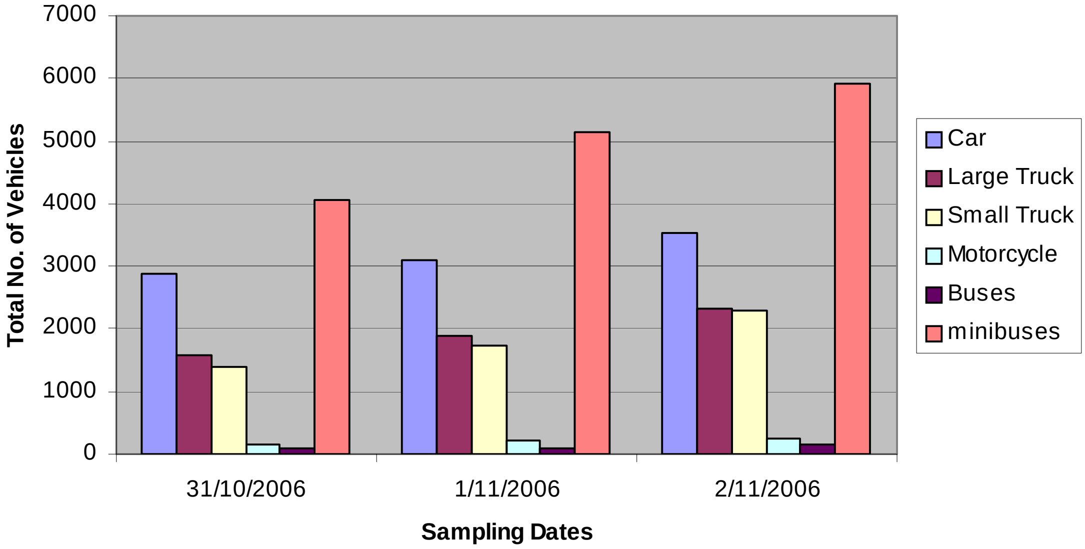
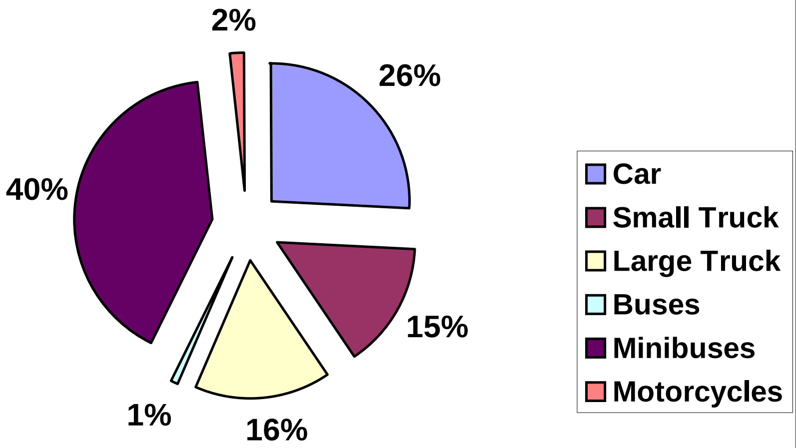


Fig 10.9: Percentage Traffic Volume Along Kibarani Road



The traffic survey conducted along Jomo Kenyatta road at Kibarani established that most of the traffic (40%) comprises of minibuses (Public Service Vehicles) that ferry passengers from Mombasa town to the residentials located in Mainland West. However large commercial trucks also form a significant percentage (16%) and if this were converted into an equivalent length of minibuses then the large trucks would comprise approximately 48%, outstripping the minibuses by some 8%.

During the study it was observed that there were traffic jams at Changamwe roundabout daily in the morning (between 7.30 am and 8.15 am) and in the evening (between 5.30 pm and 6.30 pm. This situation is worsened by heavily trucks that stall up the steep slope from Makupa Causeway to the roundabout. Injecting a further 300,000 from TEU onto this road would make traffic jams unbearable. The study therefore recommended that the proposed Makupa Access be abandoned.

Fig 10.10: Percentage Values of Motor vehicle Flow Along Port Reitz Road

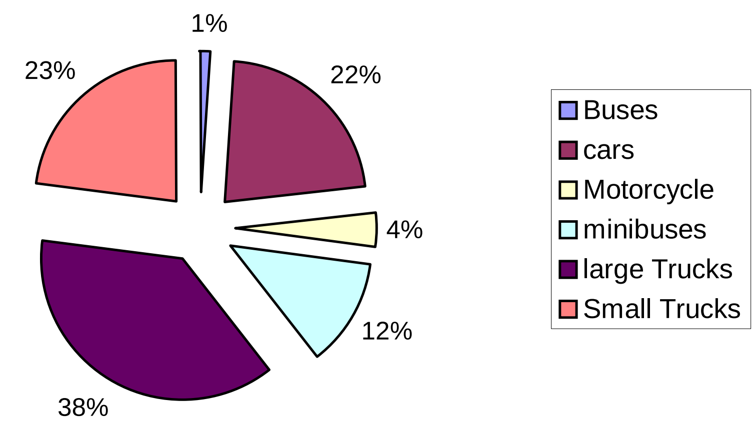
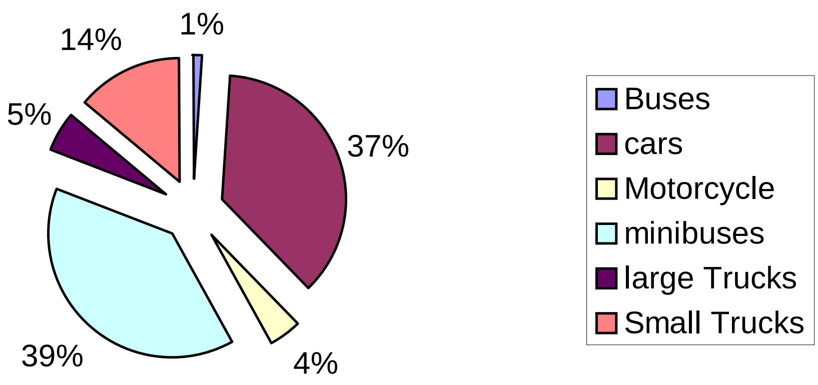
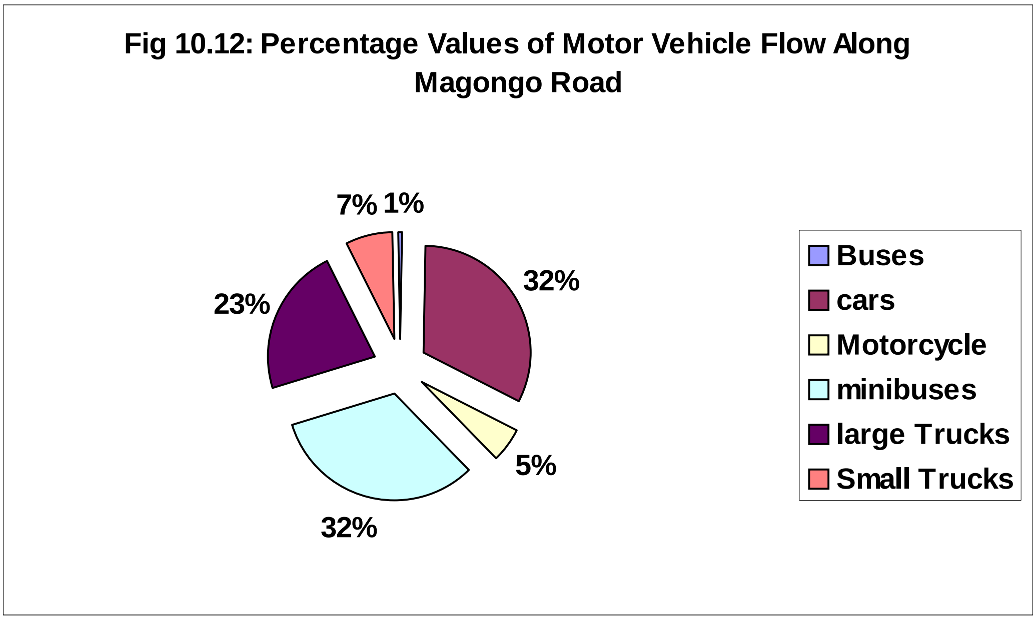


Fig 10.11: Percentage Values of Motor Vehicle Flow Along Airport Road



Along Airport Road the bulk of traffic comprise minibuses. About 30% of these are tour vans belonging to tour firms that shuttle tourists to and from Moi International Airport. 37% of the traffic was found to be passenger cars, and again 30% of these were observed to be taxis ferrying tourists and businessmen between the Airport and Mombasa Island. Long traffic jams were observed on this road even during off peak hours, especially near the BP Junction. According to the current plan the proposal is to widen this road to a 3-lane highway up to Changamwe roundabout. Whereas this proposal would be expected to decongest airport road the additional traffic from the proposed container terminal would most likely create additional congestion at Changamwe roundabout. It is proposed that a more elaborate plan be developed, widening the road at least up to Kwa Jomvu. At Kwa Jomvu most of the minibuses would already have terminated at Magongo, Mikindani or diverted to Mikanjuni – Miritini estates via the Magongo road.



10.2 Maritime Accident Survey

The project is going to increase the number of vessels calling at the port of Mombasa, thereby increasing the possibility of vessel collisions and/or vessels running aground. Such incidents have the potential of causing oil spills that may cause significant damage to marine environment if not well managed.

KPA together with the Oil Spill Mutual Aid Group has developed a National Oil Spill Response Contingency Plan. The Plan recognizes three levels of potential oil spill incidents within Kenyan territorial waters. These are classified into Tiers one to three.

Tier one incident, which involves spillage of up to 100 tonnes of oil, is dealt with primarily by the operators' responsible, if within their own installations. Only spills into the sea will activate the Plan and the OSMAG.

Tier Two spillage will comprise up to 1000 tonnes of oil and are the level of spill, which the Plan will focus on most. These moderate size spills are beyond the capability of any one single operator and the co-operative effort provided by the Plan will be applied. Depending on the extent of the spill, climate and other conditions at the time of the spill and the resources threatened, a Tier Two spill may be treated as a Tier Three incident.

Tier Three incidents involve larger spills, probably over 1000 tonnes and those greater than 10,000 tonnes. In such cases, OSMAG will provide "first aid" but will be unable to cope with the problem within its own resources and will therefore require external assistance, which too is already detailed in the Plan.

The potential magnitude of any spill having been identified in the Kenyan waters, acknowledging its own limitations, the Plan identifies the resources that are at risk, assesses the level of risk involved and provides guidelines for shoreline cleanup depending on the type of the shoreline contaminated.

Finally, the Plan provides a list of what needs to be done when an oil spill is discovered, outlines who is responsible for particular tasks; the chain of command to ensure coordination of effort; and the directory of equipment, contractors, suppliers, experts, and maps of sensitive areas. This capacity makes port adequately prepared to deal with oil spills.

To strengthen its position in managing oil spills, the Kenya Ports Authority has a pollution control boat *Mv. Fagio* with three modern skimmers. There is a 500 metre fence boom to maintain oil pollution along the coast should they occur. The port also has a hot jet machine for cleaning the beach in case of any oil spills on this environment. As a result of this effort in building oil pollution mitigation, Kenya has been chosen by IMO to be the leading regional centre for monitoring oil spills and environmental degradation. Tiomin Incorporated can therefore join this existing arrangement for oil spill mitigation.

Table 10.8: Vessel Collision incidences at the Port

No	Period	Vessels Name	Description of Incidence	Vol. Of Split Oil
1	6th July 1994	Ascot Bunkering Vessel (ALSECO)	Collision with oil Jetty at Shimanzi Oil Terminal	
2	28th May 1994	Ascot Bunkering Vessel (ALSECO)	Collision with oil Jetty at Shimanzi Oil Terminal	
3	May 1994	Lucy 1 Bunkering Vessel (ALBA)	Three accident collisions with jetty at Shimanzi Oil Jetty	
4	29th April 1994	Mtongwe Ferry	Sinking accident at Kilindini Harbour where most passengers died	Unknown
5	27th April 1994	Lavest (Cargo Vessel)	Sinking after Msa-refloating 40 miles off the Malindi Coast	700Mt oil spill and 17,000Mt coal
6	August 1991	Noreen-Oil Tanker (ALBA)	Collision with oil Jetty at Shimanzi Oil Terminal	15000Mt
7	February 1990	Alpha K Oil Barge	Collision with cased oil Jetty at Shimanzi Oil Terminal. Facilities.	500Mt
8	August 1984	Agia Marina (Cargo Vessel)	Fire Sinking accident at Port Reitz	150Mt
9	September 1983	Sosco 1 (Oil Barge)	Fire Sinking accident at Kilindini Harbour	150Mt
10	November 1981	Raphaela (Cargo Vessel)	Fire Sinking accident at Kilindini Harbour	1625Mt
11	June 1981	Ngamia (Tug Boat)	Sinking at Dock Yard	400Mt
12	May 1972	Chenad (Cargo Vessel)	Fire Sinking accident at Kilindini Harbour	1,5000Mt

Source: Kenya National Oil Spill Contingency Plan – 2002

Table 10.9: Grounding Incidences at the Port

No.	Period	Vessel Name	Description of Incident	Vol. of Spilt Oil
1	7th April 2005	Ratna Shalini	At 1700hrs punched on her starboard side while berthing, spilling crude oil at KOT.	
2	8th July 2003	KN boat Zadoic	At 1035 KN boat Zadoic capsized and rescued while in operation to unground Tug Faru.	
3	7th July 2003	Rubber Dinn	At 1200hrs Rubber Dinn sunk while in operation to rescue the Tug Faru.	
4	6th July 2003	Tug Faru	At 2345hrs Tug Faru went aground while trying to assist boat Tangulizi around the turning buoy.	
5	8th May 2003	MV Transcargo 4	At around 2355hrs aground near the green buoy outside	
6	22nd Sept 2002	Rahamat	At 1940 went aground near the green buoy outside	
7	29th Dec 2001	MV Samar	At 1540hrs went aground at Mtongwe	
8	24th Dec 2001	MV Samar	At 1330hrs went aground at Mtongwe	
9	23rd Dec 2001	MV Samar	At 1810hrs went aground at Mtongwe	
10	22nd Jan 2001	MV Banuso	At 0035 hrs went aground at Mtongwe	
11	27th June 1998	MV Mirage	At around 1755hrs grounded to at berth No.4/5	
12	19th Jan 1998	MV Asean Explorer	At 2200hrs went aground near buoy No. 7	
13	17th July 1997	SECO	At 0245hrs went aground near buoy No. 7	
14	6th July 1997	Fishing boat Alphae Ufunguo	At 1110 hrs grounded near shelly beach	
15	5th May 1997	MSC Adele	MSC Adele at 1130hrs touched the muddy bottom while unberthing from berth No. 17	
16	4th May 1997	MSC Adele	At 1145hrs sat on the ground at berth No. 17	
17	10th March 1997	MV Prodigy	At 2050hrs touched bottom between buoy No. 8 while entering the port.	
18	17th Feb 1995	Dhow Al Nasr	At 0800 hrs – Dhow Al Nasr sunk between buoy No. 3 and buoy No. 4 after experiencing mechanical problem	
19	18th April 1994	Lavest (Cargo-Coal Vessel)	Leven Reef	

No.	Period	Vessel Name	Description of Incident	Vol. of Spilt Oil
20	June 1993	Sunneta (Crude oil tanker)	Leven Reef	575Mt
21	May 1993	Ong Brothers (Cargo Vessel)	Mbaraki Creek	81,000Mt
22	Nov 1992	Khalaf (Cargo Vessel)	Leven Reef	75Mt
23	July 1990	Benora (Crude oil tanker)	Leven Reef	67,000Mt
24	Feb 1989	Aspia (Cargo Vessel)	English Point	1750Mt
25	Dec 1988	Atlantic Maru (Crude Oil Tanker)	Andromache Reef	77,000Mt
26	Nov 1987	Silago Express (Cargo Vessel)	Leven Reef	750 Mt
27	Nov 1983	Apulia (Cargo Vessel)	Ras Mzimili Reef	700Mt
28	Aug 1983	Mtwara (Cargo Vessel)	Florida Night Club	500Mt
29	May 1983	Sanko Cherry (crude oil tanker)	Ras Serani	79,000Mt
30	May 1982	Eva (Crude Oil Tanker)	Ras Serani	80,000Mt
31	July 1981	Alpha Mayor (Fishing Trawler)	Andromache	200Mt
32	April 1980	Chtysovalandou D. (Cargo Vessel)	Ras Mzimili Near Florida Night Club	850Mt
33	Nov 1979	Visva Tet (Cargo Vessel)	Leven Reef	250Mt
34	July 1978	Fortune Star (Cargo Vessel)	Leven Reef	250Mt
35	June 1978	Olga Ulyanova (Cargo Vessel)	Ras Mwakisenge (Likoni)	1225Mt
36	July 1977	Mango (Cargo Vessel)	Leven Reef	750Mt
37	April 1973	Global Star (Cargo Vessel)	Leven Reef	1000Mt

Source: Harbour Masters Office, KPA

10.3 Noise Level Measurement

10.3.1 Introduction

On various dates between October 4th and 6th, 2006, SGS Kenya Limited carried out total Noise Level. Measurements at both the mainland and the coast of the Kenya Ports Authority located at Mombasa. The Measurements were carried out at 14 points; 4 located at the mainland, and 10 in the ocean. All measurements were conducted while the port was in operation. The purpose of the measurements was as part of a wider analysis for the Environmental Impact Assessment for Container Terminal Modernisation Project. SGS Kenya Limited is accredited by NEMA (National Environmental Management Authority) for environmental emission measurements.

10.3.2 Legislation and Standards.

World Bank/WHO Guidelines indicate that for residential, institution and educational areas, noise levels should not exceed 55 dBA during the day (07:00 to 22:00 Hrs) or a maximum increase in background noise levels of 3 dB(A) where background noise already exceeds the guideline figure. The maximum allowed limit for industrial zones is 70 Db(a).

10.3.3 Methodology.

The noise measurements was carried as per the ISO 1996 Parts 1, 2 and 3 Standards, entailing the following:

- Inspection of the measurement area and the implicated activities.
- Identification of perimeter points.
- Verification/Calibration of the sound level meter before and after the measurements.
- Meteorological conditions during the measurement/measurement of temperature, wind speed and relative humidity were taken before the noise level measurements.
- A measurement of the noise levels while the plant was in operation.
- The ISO Standard only advises on the advises on the measuring time that covers the changes in operation of the noise source. For our purposes, the total measurement period was 30 minutes for each of the points measured.
- Level sound noise is expressed in decibels, A-weighted sound pressure level.

10.3.4 Instrumentation.

The following instruments were used during the measurement:

- Sound Level Meter, Testo T 816
- Open Field Microphone, Testo 816

The measurements results are expressed as follows:

- **Lmax**, Maximum sound pressure level obtained during the measurement period
- **Lmin,** Minimum sound pressure level obtained during the period of measurements
- **Leq,** Value of A- weighted sound pressure level of a continuous steady sound that, within a specified interval, has the same mean square sound pressure as a sound under consideration whose level varies with time.

All the measurements were taken in the diurnal schedule, and the results are as attached in the annex.

10.3.5 Remarks and Conclusion.

The measured diurnal noise levels fulfill in all 14 measurement points with respect to allowed maximum ambient noise limit indicated by the World Bank for industrial zones (70Dba). There are no residential areas in the immediate proximity of the port.

The port is dominated by vessel operations and other related activities. The noise sources are at the various quays and wharves, noise generated from the shipping activities and surrounding industries and traffic activities. Background noise levels are higher in the loading areas and next to the railway line influenced by the traffic and human and actual loading activities.

11.0 POTENTIAL IMPACTS AND MITIGATION MEASURES

11.1 Socioeconomic Impacts

11.1.1 Positive Impacts

On the positive, it is anticipated that the proposed project will result in improved welfare in the form of increased economic activity, improved infrastructure, employment creation, and improved air quality.

Increased economic activity

Many businesses will come up to support the large number of resident and migrant workers at the project site. The anticipated increase in the flow of money will create a suitable environment for micro and small-scale enterprises.

Employment creation

The project will create employment at inception, construction and operational phases as follows:

- During inception consultants will be commissioned to undertake services such as engineering and architectural design, land and quantity survey, environmental impact assessment and development of procurement specifications. At the construction stage many contractors would be hired who will employ site engineers, technicians and equipment operation personnel alongside hundreds of unskilled workers. At this stage professional services would also be required for contractor supervision.
- On commissioning of the project Kenya Ports Authority would be expected to hire additional staff to manage the new terminal and berths. This would create additional jobs in engineering, operations and administration. Increased operations would also require additional support personnel in security and accounts. This will address the unemployment problem in the short-term and will trigger more economic activity since demand for goods and services will increase. Once the construction phase is completed and the volume of business increases, employment will be created through the linkage effects especially in

the area of road transport since more trucks may have to come in to clear the containers from the new container terminal.

Reduction in Container Traffic Accidents

The proposed project would result in decongestion of both the existing berths and the existing terminals. As a result of this it is expected that there would be reduction in numbers of vessel collisions as well as accidents involving container handling equipment at the terminals.

11.1.2 Negative Impacts

On the negative, it is anticipated that the project will result in displacement/resettlement, loss of fishing ground to local fishers, noise and dust during construction and behaviour change.

Displacement

About 30plots of land and 22structures will be affected by the proposed access road (existing Port Reitz Road – new Container Terminal). Out of 22 structures, about 10 structures are for residential use and others are for business use. About 10 households need relocation.

Impacts on fisheries

There are about 150 fishermen who operate in the Portreitz creek on the west of the project area with about 35 dug-out canoes. The fishermen who were interviewed at Kipevu indicated that Kipevu has 14 fishermen. These fishermen will loose part of their fishing ground to the new container terminal. Disruption to normal fishing activities as a result of restricted access due to dredging and construction activities may be both a short tem and long-term impact. Since these fishermen currently use dug-out canoes which can hardly take them to the distant fishing grounds, there is need to empower them with motorized boats that can enable them fish far without difficulties. Furthermore, since a number of fishermen operate from a beach at Kipevu, it is important to preserve their beach and access route.

Noise and dust during construction

People's health will be affected by noise and dust especially from the construction of the dual carriage access road. This will raise the cost of health care as residents may have to seek treatment more often.

Interference with movement of goods and people in Port Reitz area

During the construction phase there would be interference with traffic flow along Port Reitz road as construction equipment would obstruct roads rendering them either impassable or blocking part of the road. Sections of this busy road would also be closed for repair. This would cause traffic jams and delay in movement of people and cargo.

Behaviour change

It is anticipated that during the construction phase, a big population of immigrant workers will be employed at the site. This new population of workers who have money may influence behaviour change negatively and may accelerate the spread of communicable diseases such as HIV/Aids. It is therefore necessary that the HIV/Aids awareness campaigns be promoted in the area alongside other medical services.

11.1.3 Requirement for a Resettlement Action Plan (RAP)

It is clear from the foregoing that the project would involve Involuntary Resettlement.
This can have a dramatic impact on the lives of the people affected by the project. It can cause a sudden break in the social continuity of their lives, resulting in the impoverishment of the relocated people. It may disrupt settlement patterns and means of livelihood, and generally diminish people's sense of control over their lives.
Given the magnitude of the predicted resettlement impacts, KPA shall prepare a Resettlement Action Plan so that the programme is implemented in an orderly manner mutually acceptable to both the proponent and the Project Affected People. The Resettlement Action Plan should be guided by the following best practices:

♦ Involuntary settlement should be avoided, or minimized where unavoidable;
♦ Where resettlement is unavoidable resettlement plans and activities should be seen and executed as development programmes;
♦ Resettled persons should be provided with sufficient investment resources in order to restore their livelihoods;

♦ Project Affected People should be meaningfully consulted and participate in planning and implementation of resettlement programmes;

♦ Displaced persons should be compensated for their losses at full replacement cost prior to the move;

♦ Resettled persons should be assisted with the relocation and be provided with support during the transition period;

♦ Resettled persons should be assisted in their efforts to improve or at least restore their former living standards or income earning capacity.

11.2. Impacts of Construction Works

11.2.1 Impacts of Dredging

Impacts on sediment transport and biology in the Port areas

It has been observed by Kitheka (2002) that the study area for the proposed project is characterized by low suspended sediment concentrations in the range 0.01 – 0.08 g/l. The tides and associated tidal currents control the resuspension and transport processes. Most of the sediments are re-suspended during flood tide enter the mangroves upstream and are trapped so that the suspended sediment concentrations during ebb tide are usually low. This is mainly the case during the dry season. Kitheka (2002) calculated mean suspended fluxes in the Mwache mangrove creek in spring and neap as 1,215 and 400 kg/s respectively.

Disruption of bottom sediments can cause a variety of environmental impacts. Toxics or contaminants released from the disturbed soils can go into solution or suspension and contaminate or cause severe mortalities among important marine resources. Particles resuspended may be redeposited on bottom life either smothering it or forcing it to move elsewhere (if sufficiently mobile). Organics in the suspended material can deplete available oxygen from the surrounding waters and temporarily create stressed conditions for many aquatic animals. If suspended sediments are sufficiently concentrated and persist through extended operations, light penetration into the water column may be reduced, causing damage to light requiring photosynthetic algae, corals and other aquatic organisms.

During the wet season, freshwater discharge lowers density and causes siltation in Port Reitz. The density driven circulation is manly confined in upper areas within the creeks and at the river mouths but high suspended sediment concentration are observed throughout the entire Port area. The maximum discharge of freshwater and sediments increase the turbidity of water in the entire basin and lower the density of the sea water.

It is most likely that the sediment impact experienced during dredging and land reclamation will not be severe. Most likely it will be like episodic impact that is prevalent during maximum flood discharge from Cha Shimba and Mwachi rivers.

Effects of Altered Bathymetry

Deepening of the channel can alter patterns of tidal flow. Should these patterns evidence high flows, eddies, etc., hydrographic studies and modelling may be advisable to find ways to avoid creating undesirable situations. These situations can range from unsafe vessel maneuvering to requirements for frequent dredging or to disturbance of valuable fisheries resources.

In the relevant project, access channel and basin dredging, siltation and ship maneuvering simulations will be carried out to ensure safe port operations and to minimize the requirements for maintainance dredging works, considering bathymetric changes after dredging.

Loss of Bottom Habitat, Shellfisheries, Fisheries, Fishery Food Sources

Dredging of soft bottom can remove important bottom-living aquatic life. However this bottom will readily be recolonized by replacement benthic organisms within a few seasons. As the original habitat will probably have changed due to the dredging operations (e.g., sediment type, topography, water depth, current pattern etc.), and the new population might differ from the original one. It is advisable to determine whether possible current pattern changes will jeopardize or encourage resettlement of the original bottom life and associated fishery resources. This study should be done after project implementation.

Altered Groundwater Flows

Subsurface groundwater flows near the land-sea interface can be altered by dredging. Should there be extensive freshwater flow toward the estuary, the dredging could accelerate the flow and lower water Table levels in the adjacent upland. If freshwater flows are minimal or slow, dredging and blasting could increase saltwater intrusion into nearby water supply aquifers. However there is no aquifer or any source of fresh water in the vicinity of the project area.

11.2.2 Impacts of Dredged Material Disposal

Water-Column Turbidity

A small percentage of the fine-grained dredged material slurry discharged during open-water disposal would be dispersed in the water column as a turbidity plume; however, the vast majority rapidly descends to the bottom of the disposal area where it accumulates under the discharge point in the form of a low-gradient fluid mud mound overlying the existing bottom sediment.

Under normal conditions, more than 98 percent of the sediment in the mudflow remains in the fluid mud layer at concentrations greater than 1%, while the remaining 2 percent may be resuspended by mixing with the overlying water at the fluid mud surface. These conditions may persist for the duration of the disposal operation at the site and for varying times thereafter as the material consolidates to typical sediment density.

Presented below (Table 11.1) is a simple calculation of preliminary understanding of extent of turbid water dispersion. The most sever conditions are in the case of high-efficiency large-size hopper dredger. Assuming a hopper capacity, *V,* of 8,000 m^3 and a concentration, *C*, of 40% silt and clay (w_0 = 40 kg/m^3), the instantaneous load at the dumping site, *M* (kg/once), becomes:

$$M = w_0 VC = 40 \times 8000 \times 0.4 = 128{,}000 \text{ kg}$$

The density of suspended solids, SS (g/cm^3), at a distance of r (cm) from the dumping site after a lapse of time , *t* (sec), under a average current speed of *u* (cm/sec) can be calculated by the following Fick's formula for each dumping work:

Fick's Formula $\quad$ $SS\ (mg/l) = M / (4\ л\ H\ T)\ \exp(-(R\text{-}U\ T)^2 / (4KT))\ 10^6$

Where:

Instantaneous Load at Dumping site: M (g) = 128,000,000

Water Depth at dumping site: H (cm) = 15,000

Diffusion Coefficience: K (cm^2/ sec) = 100,000

Mean current as dumping site: U (cm/sec) = 100

Table 11.1: Estimated SS Concentration at Distances from Dumping Site

Elapsed Time T (hour)	Distance r (m)		
	1000	2000	3000
0.2	0		
0.4	1.8		
0.6	4.4	0	
0.8	0.7	0.2	
1.0	0	2.1	
1.2		2.0	0
1.4		0.5	0.6
1.6		0.1	1.7
1.8		0	1.3
2.0			0.4
2.2			0

The above table indicates that locations, 3.0km away from the dumping site, will hardly receive turbid plum exceeding suspended solid (SS) levels of 2.0 mg/l.

However, considering the large amount of material to be disposed at the proposed dumping site for the access channel and basin dredging project (relevant Project), KPA will conduct a comprehensive numerical simulation exercise in detailed design stage of the dredging project.

Water Contamination

Although the vast majority of heavy metals, nutrients, and petroleum and chlorinated hydrocarbons are usually associated with the fine-grained and organic components of the sediment there is no biologically significant release of these chemical constituents from typical dredged material to the water column during or after dredging or disposal operations. Levels of manganese, iron, ammonium nitrogen, orthophosphate, and silica in the water column may be increased slightly for a matter of minutes over background conditions during open-water disposal operations. However there would be no persistently higher levels of dissolved metals or nutrients greater than background concentrations.

Impact on the Benthos

The dispersal of fluid mud dredged material is expected to have a relatively significant short-term impact on the benthic organisms within open-water disposal areas. Open-water disposal of fine-grained dredged material may result in a substantial reduction in the average abundance of organisms and a decrease in the community diversity in the area covered by fluid mud. Despite this immediate impact, recovery of the community apparently begins soon after the disposal operation ceases.

11.2.3 Impacts of Reclamation

Land reclamation of the planned container terminal will reduce the water area within Port Reitz causing alteration of water circulation patterns of it. However, as reclamation site is located in shallow beach area (av. CDL-2.0m) and next to the existing port facilities, the alteration of the current water regime will be minimal.

Blockage of tidal water circulation due to the reclamation will be compensated by the dredging (deepening) of the tuning basin in front of the proposed container terminal.

During the reclamation work, large volume of filling material will be transported from water side and pumped into the reclamation area mixed with water. Excessive water will over flow through settlement pond. Since filling material is expected to be sand dredged from the access channel dredging work and designated harvesting sites, no highly turbid water will be released from the enclosed reclamation site (Fig 5.8).

11.3 Impacts on Particular Ecological Species/Processes

11.3.1 Key issues

Reviews of likely impacts were assessed from the understanding of background effects (the existing state, etc) and the scientific knowledge of species and population dynamics in space and time (Table 11.2). The presumed impacts were thus assessed through:

1. predicting the assumed changes that will occur from the activity on the composition and abundance of species lists generated in the baseline survey
2. determining the known and assumed habitat associations of the species present
3. predicting the likely effects the proposed project activities will have on habitats within the project areas, and in turn on the survival and biology of habitat specialists, and
4. Assessing the likely consequences these impacts will have on the known and presumed species of conservation concern.

11.3.2 Marine environments

1. Loss of mangroves habitats
2. Loss of mangroves trees (species fringing along the site to be reclaimed – about 200 individuals
3. Loss of muddy benthic habitats
4. Loss of benthic fauna (about 20 species)
5. New surfaces for colonization of fouling communities (sessile benthos) and fish aggregating devises
6. Changes in water circulation may change particulate transport and thus dispersal patterns of juveniles and recruitment patterns; changes in feeding regimes; changes in water exchange regimes
7. Changes in water column community structure due to water quality degradation (contaminants and turbidity). Impacts will be temporary, localized, & not significant
8. New species invasions by ships – ballast water invasions. Impacts may be permanent, localized, & significant
9. Altered primary productivity, altered fishing pressure, and altered species composition may affect the fisheries of Port Reitz
10. changes (may be more) in fisheries (coral reef mostly) communities due to new aggregation devises

11.3.3 Impacts on Terrestrial environments

1. Loss of agricultural potential areas

2. Loss of vegetated areas (resulting in increased run-off, reduction in evapo-transpiration
3. Increase in erosion hazards (with cascading impacts on sea-water contamination, secondary impacts on marine habitats/biota). Impacts will be temporary, localized, & not significant as they will be limited to construction stages only
4. Reductions and loss in habitats (including bird feeding areas, sandflats, mudflats, soil, secondary savana, mangroves)
5. Reductions and loss in bio-diversity.
6. Loss/imbalances of ecological processes (habitat fragmentation, introduction of alien species, etc.
7. Loss of alternative service option (services such as eco-tourism are unlikely as current habitats is not pristine)
8. Impacts on freshwater ecosystems and life

Currents-state	Project Activities	Projected Impacts
On benthic habitats Shallow channel basin; area has mudflats, with anthropogenic river influence. Mangroves; mangrove associates common species on intertidal areas; on subtidal flats, some macroalgae seen; no seagrass seen; no coral reefs seen	• Channel/Basin dredging/and reclamation volumes o Dredging surface area (access channel and turning basin – relevant projects) – ca 2 x 10^6 m^2 o Dredging Water Depth of Basin: CDL -15 m for Berth Nos. 21 and 22; CDL – 12m for Berth No. 23; Length: 1000m) + Diameter of turning circle: ca 500m o Dredging Volume: Quaywall = ca 700,000m^3 ; access channel & turning basin = ca 6,000,000m^3 o Reclamation surface area: 100ha o Reclamation Volume: ca 7,500,000m^3 • Construction of new berths; access roads, rails, and other shipping related activities • Altered hydrodynamics, water movement, water exchange and oxygenation	• Loss of mangroves habitats o Sensitive but small area involved o Impacts will be permanent, localized, & of moderate significant (small scales; 3 past oil spills at site and extensive cutting by brick factory reduced cover; mangrove habitats better developed further west – R. Mwache & Tsunza; crab communities significant; avian communities few) • Loss of mangroves trees (species fringing along the site to be reclaimed – about 200 individuals). (See Table 8.5 for species composition to be lost) o Sensitive but small individuals involved o Impacts will be permanent, localized, & low significant (small scales, mangrove habitats better developed further west; burrowing communities few; avian communities few) • Loss of muddy benthic habitats. Impacts will be permanent, localized, & not significant. o Low beta diversity as only muddy bottom exist. (No other habitats of special concern (seagrass/corals)) • Loss of benthic fauna (about 20 species). (See Figureure 8.15 & Table 8.10 for species composition to be impacted). Impacts will be temporary, localized, & not significant. o species involved not keystone and generalists (no special concern) o The few existing are mostly widely distributed in other biotopes with high reproductive ability for regeneration; o Small no of types involved (about 20 species) • New surfaces for colonization of fouling communities (sessile benthos) and fish aggregating devises. Impacts will be permanent, localized, & moderately significant. o Changes in biodiversity resulting in changes in fisheries communities o Coral reef fisheries may use some new structures (pylons, dolphins, etc) increasing aesthetic appeal, but on few surfaces • Changes in water circulation may change dispersal patterns of juveniles and recruitment patterns; changes in feeding regimes; changes in water exchange regimes. This will result in changes in community structure. Impacts will be temporary, localized, & not significant (same rules as loss of benthic fauna applies) • Oil spill impacts from construction works and in the future.

Currents-state	Projected Activities	Projected Impacts
On water column organisms Plankton diversity about 50% of total numbers recording during Globallast survey.	• Dredging will result in re-suspension of sediments, some may have been contaminated; • Storm water surges and waste-water from new facilities or spillages from construction equipment or from facilities during operations into the water surface	• Changes in water column community structure due to water quality degradation (contaminants and turbidity). Impacts will be temporary, localized, & not significant. o Plankton species involved not keystone and generalists (no special concern) o Moderate no of individuals involved (about 40 species). (See Table 8.8 & 8.9 for species composition to be impacted); o The existing types are mostly widely distributed in other biotopes with high reproductive ability for regeneration; o Changes in community structure may result proliferations of some toxic algae which already exists here; • New species invasions by ships – ballast water invasions. Impacts may be permanent, localized, & significant. o Changes in community structure may result proliferations of some new forms with consequences to human health, food security and environmental degradation • Changes in water circulation may change dispersal patterns of juveniles and recruitment patterns; changes in feeding regimes; changes in water exchange regimes.. This will result in changes in community structure. Impacts will be temporary, localized, & not significant • Oil spill impacts from construction works and in the future from operations.
Fisheries: Fisheries potential is fairly significant Species of commercial interest Rare species	• Dredging and reclamation sites – affecting fishing grounds, • Construction of pylons, etc, – creating new fish aggregating sites • acquisition of present fishing grounds – lowering of fishing pressure • access roads – more fishing pressure due to improved accessibility	• Altered primary productivity, altered fishing pressure, and altered species composition may affect the fisheries of Port Reitz. • More new fisheries (coral reef mostly) due to new aggregation devises • Disruptions in fish species composition with potential loss of some species of commercial value andrare species (table 8.13 – 16; Fig. 8.24) • Loss of fishing grounds & f landing sites (*Kwa Kanji* and *Kwa Skembo*) • Impacts may be permanent, localized, & significant, but these cannot be quantified now as the changes in fisheries dynamics will need to be monitored for a long time. • Oil spill impacts from construction works and in the future from operations
Dumping sites: Areas designated for dumping are currently characterized by deep sea benthos and pristine clear water conditions (pH 8, DO 8mg/l; TSS<0.4M/l ; Air quality – O_2=21%; CO_2, H_2S, SO_2=all ND; CO=1ppm; NO2=0.2ppm)	• Dumping of silted materials into water at 3-4 km from MPA & habitats of special concern (coral reef seagrass beds) with species of special concern	• Open-water disposal of fine-grained dredged material may result in a substantial reduction in the average abundance of organisms and a decrease in the community diversity in the area covered by fluid mud..Impacts will be temporary, localized, & moderately significant. • Loss of deep sea benthic fauna (mostly nematodes). (See section 8.4.2 ii 2d for details). Disposal of fluid mud dredged material is expected to have a relatively significant short-term impact on the benthic organisms within open-water disposal areas. Despite this immediate impact, recovery of the community apparently begins soon after the disposal operation ceases • Interruptions in migration routes and feeding areas for large sea mammals and other charismatic fauna. Impacts will be temporary, localized, & low significant as these groups (turtles, dugongs, whales & dolphins, and sharks & rays) are highly migratory and can change areas. • Potential impacts on adjacent communities of special concern (MPA, corals, seagrass) Impacts can be temporary, localized, & moderate significant as the projected intensity and severity of TSS levels (Table 11.1) are much lower to cause irreversible community changes and mortalities.

Currents-state	Projected Activities	Projected Impacts
On land and land-use Current land-use: unfavourable topography (steep slopes) and soil erodibility, low density farming	• Considerable earthworks required for leveling and fillings for road construction;	• Loss of agricultural potential areas. Impact will be localized & permanent & not significant (small scales subsistence);
On vegetation Low diversity of plants at site (30 tree spp); secondary vegetation, opportunistic, generalists and weeds	• Considerable earthworks required for leveling and fillings for road construction; • removal of existing soils or in-fillings to create room for access road • removal of existing vegetation to create room for access road	• Loss of vegetated areas (resulting in increased run-off, reduction in evapo-transpiration). Impact will be localized & permanent, & not significant (small scales) • Increase in erosion hazards. impacts likely to be permanent, localized and of medium significance (sea-water contamination, secondary impacts on marine habitats/biota), • Reductions and loss in habitats (sandflats, mudflats, soil, secondary savanna, mangroves) • Reductions and loss in bio-diversity. o Impacts on within-habitat diversity (alpha-diversity) will be permanent, localized, & not significant (small scales, and on secondary vegetation, opportunistic, generalists and weeds) o Impacts on between-habitats diversity (beta-diversity) will be permanent, localized, & not significant (small scales, none of the habitats listed are unusual/uncommon; burrowing communities few; avian communities few) o There were no species of special concern (rare, endemic, threatened, or with unique functionalities) • Loss/imbalances of ecological processes (habitat fragmentation, introduction of alien species, etc, unlikely as vegetation is degraded and does not support significant wildlife). Impacts on ecological processes localized & permanent, & not significant (small scales) • Loss of alternative service option (services such as eco-tourism are unlikely as vegetation is not pristine). Impacts on ecological services localized & permanent, & not significant (small scales)

Currents-state	Projected Activities	Projected Impacts
On fauna: Associated fauna have low diversity (less than 10 small vertebrate sightings); few invertebrates. Most are habitat generalists; life history strategies and mobility high in vertebrates, low in invertebrates	As above	• Reductions and loss in bio-diversity. o Impacts on within-habitat diversity (alpha-diversity) will be temporary, low localized, & not significant (small scales, generalists) o Impacts on between-habitats diversity (beta-diversity) will be permanent, low, localized, & not significant (small scales, none of the habitats listed are unusual/uncommon; burrowing communities few; avian communities few) o Impacts on species of special concern (Changamwe caecilian, elephant shrew (IUCN's red-list) recorded here long past – was not seen in this survey). • Loss/imbalances of ecological processes (habitat fragmentation, introduction of alien species, etc, unlikely as current habitats are degraded and do not support significant fauna; and strong urbanization in the neighbourhood). Impacts on ecological processes low, localized & permanent, & not significant (small scales) • Loss of alternative service option (services such as eco-tourism are unlikely as current habitats is not pristine). Impacts on ecological services are low, localized & permanent, & not significant (small scales)
On fresh-water systems: None present		• Impacts on freshwater ecosystems and life low to non-existent.

11.4 Impacts Related to Construction of Quaywall and Other Waterside Structures

11.4.1 New Habitats Formed by Structures (Especially Pilings)

Erection of piers usually provides an abundant supply of new attachment surfaces, i.e., habitats for marine/estuarine organisms. Marine structures possessing quarried rock also supply shelter for mobile aquatic animals. Organisms occupying these habitats (both attached and sheltered) may be desirable or undesirable.

11.4.2 Disturbances from Pile Driving and Other Construction Activities

Pile driving and other waterfront construction activities cause considerable noise and vibration easily transmitted to the adjacent waters. This disturbance may temporarily cause displacement of fisheries and other mobile marine animals. However these animals will usually return to the area once the disturbance ceases.

11.4.3 Dispersal of Suspended Sediments

Construction of quaywall, especially dredging for foundation improvement, can disturb bottom sediments, increasing turbidity adjacent to the work site. Should examination of bottom conditions and hydrographic patterns indicate this might be a matter of concern, preventative measures to minimize impacts should be considered. Otherwise, bottom organisms may be smothered by sediment deposition, light penetration in the water column may be reduced, and fisheries can be temporarily displaced during the construction period.

11.4.4 Piling-Supported Structures - Effects

Structures extending into harbour waters and supported by pilings driven into the bottom can impose several impacts on the site and vicinity. Piling Installation will disturb the bottom beneath the proposed structure, destroying some of the bottom habitat and temporarily displacing the mobile bottom animals and local fisheries. In addition, the structure, when completed with decking, will shade the area underneath and possibly diminish survival by attached algae and other aquatic plants. Presence of piling clusters will alter the habitat to some extent and may encourage the presence of either desirable or undesirable species. Pilings will also slow existing tidal flows, thus increasing sediment deposition at some locations beneath the structure. This shoaling tendency may extend to nearby navigation zones, necessitating more frequent maintenance dredging.

11.4.5 Dust (Fugitive Emissions)

Dust sources can include unvegetated areas open to weathering and wind, drilling operations in quarries and truck traffic hauling from excavation sites. Construction equipment on site can also be a source of dust.

11.4.6 Loss of Usable Uplands to New Access Road

In addition to wetlands being filled to provide additional waterfront space, various other types of landforms and land uses (i.e. farmlands, croplands, grazing lands, residential areas, and commercial properties) can be eliminated by construction of the access road. Loss of each type can incur considerable environmental impact. The extent and magnitude of these impacts depends on the unique value of each area type and the extent to which other locations would supply suiTable replacement by involuntary resettlement of inhabitants and their activities.

11.5 Impacts of Port Operations

11.5.1 Discharge of Garbage and Litter

Discharge of garbage into the waters, if not controlled will result in unsightly conditions on the shoreline owing to accumulation of non-biodegradable materials such as plastics, glass and metal containers. Plastic bags and sheets can block cooling water intakes or foul propellers of vessels and small craft using the port.

11.5.2 Accidental Spills

Accidental spills can and do occur owing to marine casualties (collisions, groundings, fires, etc.), failure of equipment (pipelines, hoses, flanges, etc.) or improper operating procedures during cargo transfer or bunkering. Such spills can involve crude oils, refined products or residual fuels, noxious liquid substances and harmful substances in packaged form.

The more volatile oils are generally less harmful to the environment because they rapidly evaporate but they can present the hazard of fire or explosion. The more viscous oils remain on the water surface where they will move under the influence of wind and current. Chemical spills can result in the introduction of water-soluble toxic substances into the marine environment, which can have a damaging effect upon marine organisms. Those substances that sink can smother benthic species and eventual recovery may be difficult.

11.5.3 Dry Cargo Releases

Most such releases are likely to be wind-blown particulates from vessels loading or offloading or from waterfront deliveries. Engineering/planning should be done prior to project implementation to determine the feasibility of requiring enclosed storage or loading/offloading facilities. At the moment dry cargo within the port are handled by a private company, Grain Bulk Handlers Limited who have leased berth no. 3 for this purpose. This is a state-of-the-art bulk terminal with enclosed conveyor systems complete with dust extractors. Further, it is expected that the effect of dry cargo releases will be minimal as the proposed berths will be used only for container handling.

11.5.4. Sanitary Wastes

Treated and untreated sanitary wastes may be discharged to sea water from buildings in planned container terminal. This will increase organic matter concentration in vicinal water area which can be a main source of eutrophication processes in the adjacent waters.

11.5.5. Noise from Port Traffic and Terminal Operations

Port activities such as clamping and loading/offloading of containers and movement of cargo handling equipment may generate noise above levels of comfort to the operators. Noise would also be generated by trucks hauling containers to and from the terminal. It was however noted that there are no residential locations in the vicinity of the project area, the nearest being at Port Reitz mainland approximately 2km from the proposed terminal.

11.5.6 Effects of Dust and Other Airborne Emissions

Dust sources include various port operations such as construction activities, outdoor storage of raw materials and other particulates (ranging from coal and limestone to grain and wheat storage, for example).

Smoke is expected from increased traffic along the proposed access road during the operation stage. If vehicles and equipment are not well maintained exhaust fumes can be a safety hazard as the fumes obstruct vision, increasing the potential for accidents. Smoke and airborne combustion products can present serious problems primarily because of the potential for distributing toxic or hazardous substances and for the greater capacity for dispersal.

11.5.7 Traffic Burden Projections

The proposed access road to the new terminal is a 3-lane highway with most of the traffic expected to be heavy commercial vehicles. According to the proposal this road will join the Airport Road (C110) at BP Petrol Station in Changamwe. Road C110 is already congested with an average traffic volume of approximately 600 vehicles per hour. It should be noted that this road is the gateway from Moi International Airport, the country's 2nd largest airport and indeed the most important one in terms of facilitation of tourism activities – it serves as the access/egress airport for the country's tourist city of Mombasa. It is clear therefore that injecting further traffic into this road will significantly interfere with the airport traffic flow, impacting negatively on tourism, which is a major source of income for the country.

However it has been proposed that the Airport Road be expanded into a 3-lane highway in anticipation of the increased volume of traffic. This proposal is still under consideration by KPA, the Ministry of Transport and the Ministry of Roads and Public Works.

Additional problems include over parking for trucks and drivers, trucks waiting for port access, damage by trucks to roadways, and spillages from trucks. Further there would be secondary traffic impacts - traffic increases not directly attribuTable to the project but expansion of residential, market and commercial areas due to the enlarged industrial employment base.

11.6 Evaluation of Significance - Impact Analysis

The evaluation of the significance of an impact is based on its magnitude, likelihood of occurrence, spatial and temporal extent, possibility of recovery and its effect on the concerned public was done using the matrix method. The expected significance and magnitude of the impacts to the proposed project were analyzed and assessed by giving a quantifiable value. The quantifiable values given were based on the best available industrial studies and research. A matrix integrating impacts and project cycle was used to quantify the impacts of this project. A scale of 1-10 was used to rate each impact. A low negative value depicts an impact with minimal negative effect and vice-versa. A high positive value represents a highly beneficial impact while the opposite is also true. The Table 11.1 shows the results of this evaluation.

The total values are:

- ♦ Magnitude = 6
- ♦ Significance =9

From the figureures, the positive impacts have outweighed the negative impacts so the proposed project is beneficial with no adverse effects to the environment. Therefore the study proposes that the proponent be allowed to proceed with implementation while carrying out the recommended mitigation measures.

From the evaluation of the significance on anticipated environmental impacts and suggested mitigations measures, an environmental management plan is recommended to mitigate their effects

Table 11.1: Evaluation of Significance - Impact Analysis

IMPACT	Environmental impacts						Socio-Economic impacts					Total severity
Project Activities	Air quality	Effect on Flora and Fauna	Physical Environment	Water Demand	Increased Traffic	Solid\effluent waste	Noise	Employment	Public health and safety	Improved infrastructure	Involuntary Resettlement	
Planning and Designing	S=0 M=0	S=0 M=0	S=0 M=0	S=0 M=0	S=0 M=0	S=0 M=0	S=0 M=0	S=4 M=3	S=0 M=0	S=0 M=0	S=0 M=0	S=0
Construction Phase	S=-3 M=-3	S=-2 M=-3	S= -2 M=-3	S=-2 M=-2	S=-3 M=-2	S=-2 M=-2	S=-4 M=-3	S=9 M=8	S=-2 M=-2	S=4 M=4	S=--7 M=-5	S=-13
Operational Phase	S=-1 M= -1	S=4 M=3	S=-1 M=0	S=-1 M=-2	S= 2 M=-2	S=-3 M=-2	S=-1 M=0	S=6 M=5	S=3 M=1	S=8 M=9	S=6 M=7	S=22
Total (Magnitude)	M=-4	M=0	M=-3	M=-4	M=-4	M=-4	M=-3	M=13	M=-1	M=13	M=2	S=5 M=5

12 Mitigation Measures for Key Potential Impacts

In order to minimize following negative impacts predicted in the EIA, the project proponent, KPA, will take following mitigation measures during design, construction and operation phases of the proposed project.

12.1 Mitigation Measures for Socio-economic Impacts

Based on the results of the study, the following mitigation measures shall be undertaken:

♦ KPA shall establish a comprehensive compensation and/or resettlement plan to avoid any conflicts with the affected parties. The compensation or resettlement (whichever is applicable according to expressed preferences) should be appropriately worked out so that property owners and affected tenants are compensated or resettled according to the magnitude of effect in each case. KPA shall administer the compensation directly with the help of a professional consortium.

♦ The affected local artisanal fishermen shall be compensated / empowered to venture into the deeper waters. Motorized boats and appropriate gears shall be provided to the affected fishermen so that they are able to venture into the more distant fishing grounds.

♦ Measures shall be put in place to minimize off-site effects of the construction activities. Noise and dust will be a nuisance during construction phase. Dust would be minimized by watering the access roads while construction activities would be limited to day hours in the neighbourhood of residential areas.

♦ Arrangements shall be made for the affected persons to be given some training on how to cope with change. This is very essential in view of the fact that most of the affected persons prefer cash compensation as opposed to direct resettlement.

♦ KPA shall promote HIV/Aids awareness campaigns to sensitize local residents about the dangers of having a big population of migrant workers at the project site especially during the construction phase. KPA Peer Educators shall work alongside the project managers and the contractors to create high level of HIV/Aids awareness in the area. In addition a Voluntary Counseling and Testing (VCT) station shall be set up in the vicinity of the site.

12.2 Mitigation Measures for Physical Impacts

12.2.1 Degradation of Water Quality

Primary sources of degradation of water quality during construction stage are dredging, disposal of dredged materials and reclamation works.

<u>Dredging Work</u>

In the EIA Study, quality of water-bed material to be dredged was confirmed that concentration of key heavy metals in it are below Testing Values (presented in World Bank's Technical Paper No. 126), thus acceptable for open water disposal. However, possible variation of concentration levels at times and locations, during design and just before starting the dredging work, concentration analysis of the key parameters of water and sediment in dredging areas, such as Cd, Pb, Hg, organic maters, nutrients will be conducted to avoid significant impacts on vicinal eco-system.

Taking account of possible dredging methods/equipment, hopper dredger for access channel and grab dredger for foundation improvement work of quay wall, no significant increase of surrounding water turbidity is expected. However, if unacceptable level of suspended solid (SS) concentration is monitored around the dredging site, following measures will be taken immediately:

- Restrict overflow operation during dredged material loading
- Reduce dredging volume per day
- Installation of silt protection curtain surrounding grab dredger
- Use special dredging equipment to minimize agitation of bed material if the material is significantly contaminated.

Disposal of dredged materials

Dredged materials will be disposed at designated open water dumping site keeping a distance more than 3km from biological sensitive areas, such as existing coral reef, sea grass bed and Mombasa Marine National Reserve. Disposal period will be mainly during SE Monsoon Season (from April to September) considering preferable local current system which could avoid significant impacts on the biological sensitive areas due to turbid water dispersion from the dumping site.

According to the simple calculation of turbid dispersion conducted in the EIA, turbid water column will not reach beyond 3 km from the dumping location. However, if unacceptable level of SS concentration is measured at the monitoring points which are placed at said biological sensitive areas, following measures will be taken immediately:

- Reduce disposal volume per day
- Relocate dumping site further offshore

In case that dredged material is unacceptably contaminated, thus can not be disposed at the offshore dumping site, the material will be disposed at a land based dumping site in Dongo Kund area (on the opposite bank of the proposed container terminal) with proper care and containment facilities.

It is noted that in the detailed design stage of the access channel and basin dredging project, numerical simulation on turbid water dispersion from dumping site will be carried out taking account of local current regime obtained from comprehensive field survey works.

Reclamation

Since filling material for reclamation work is expected to be sand dredged from the access channel dredging work and designated harvesting sites, no highly turbid water will be released from the reclamation site equipped with enclosing temporary revetments and settlement pond for excessive water discharge. However, if unacceptable level of

SS concentration is measured at the monitoring points, following measures will be taken immediately:

- Place additional settlement pond
- Reduce filling volume per day
- Place silt protection curtain around the excessive water discharge point

In addition to the above, potential source of the water quality degradation will be effluent discharge from calling ships, land based facilities and accidental oil spill.

Effluent discharge from calling ships

After commencement of port operation, increased number of ships will call the container terminal. Prior to permitting the ships to offload cargo, KPA will inspect the ships and/or liaise with the ship administration to establish weather there is any waste on board. Any waste found will be received at the designated facilities such as East Africa Environment Company (EAM).

Effluent discharge from land based facilities

Hundreds of people will be work in the proposed container terminal, that will produce sanitary and organic effluents. In addition, equipment maintenance facilities will source of oily effluent likely contains some toxic substances.

In order to avoid direct discharge of above effluents to the ambient water, sufficient treatment facilities will be designed, installed and maintained in the planed container terminal.

Accidental oil spill

The most potential occasion involving the oil spill is ship collision and landing. This risk will be raised by increased number of water traffic due to operation of new container terminal. In order to decrease the risk, following measures will be taken:

- Evaluate future traffic volume for design of sufficient port facilities
- Special short-based radar and/or reflectors will be installed for safe navigation and collision avoidance
- Updated pilot qualification or additional training will be undertaken
- Additional tugs, lighters and mooring and pilots requiring special skills will be make available

In order to response possible accidental oil spill, the Port of Mombasa already has an emergency response program. This emergency contingency plan will be enhanced to the proposed container terminal, clearly indicating authority and responsibility for dealing with such incidents. Reporting and altering mechanism will established to ensure that any spillage is promptly reported to the Port Authority.

In addition, specialized oil spill response equipment will be available in the proximity of the proposed container terminal to deal with small to medium spillages. This equipment will include containment booms, recovery devices, oil recovery or dispersant application vessels. The equipment operators will be trained in deployment of the equipment, and the contingency plan regularly exercised to test reporting and altering procedures.

KPA shall borrow a leaf from the Oil Spill Mutual Aid Group (OSMAG) that has worked well. OOSMAG, established in conformity with the International Maritime Organization (IMO) Conventions, is very active at the Port of Mombasa. The port management and stakeholders from the oil industry and the Kenya Navy founded OSMAG to make the port compliant with internationally accepted norms in safety and preparedness. OSMAG has in response to this requirement formed the Oil Spill Response Action Team (OSRAT), whose members undergo training and thorough drills on oil pollution prevention and on safety aspects at the port every three months. Membership to OSRAT is drawn from the oil industry, the Kenya Navy and KPA.

As such KPA shall liaise with stakeholders such as Kenya Maritime Authority (KMA), Kenya Marine & Fisheries Research Institute (KMFRI), KWS, Kenya Navy, local residents and other private sector stakeholders to ensure these impacts are properly managed. KPA shall organize periodical meetings (say every 3 months) where any accidents and incidents would be reviewed. Also to be discussed at these meetings would be the effectiveness of control measures implemented by KPA and any further proposals for improvement. This liaison body shall be called the Multi-Sectoral Forum for new Terminal (MSFT).

It is noted that ship maneuvering simulation will be conducted to ensure safe operation of the calling ships sailing the access channel.

12.2.2 Degradation of Air Quality

A primary source of degradation of air quality during construction stage is dust dispersion from the number of tracks transporting construction materials (especially sand aggregates).

To avoid this, following mitigation measures will be taken.

- Periodical watering on the route of transportation and material stock yards
- Covering of construction materials on tracks and stock yards
- Selection of transportation routes avoiding sensitive areas, such as hospital, school, residential areas, etc
- Transport construction materials by barges from waterside as possible
- Provide constriction related workers in extreme conditions with dust protection equipment

Regarding noise disturbance, following measures will be taken.

- Selection of transportation routes avoiding sensitive areas, such as hospital, school, residential areas, etc
- Transport construction materials by barges from waterside as possible
- Provide constriction related workers in extreme conditions with noise protection equipment
- Avoid night time construction works near the sensitive area

12.3 Mitigation Measures for Biological Impacts

Mitigations relating to water column turbity and contamination that may affect resident slow motile or benthic flora and fauna arising from dredge works reclamation and disposal of dredged materials and other operational activities have already been addresses in sections above. The following additional components will be done for key biological attributes.

12.3.1. Hindrance on Sea Turtle Migration

Planned sand harvesting sites are located near (about 3km) Shelly and Nyali Beaches, which are potential nesting ground of sea turtles. The sand harvesting operation will not affect directly these beaches but may hinder their migration route to those beaches. However, according to Kenya Sea Turtle Conservation Committees (KESCOM), their migration routes and periodicity here are rare events.

But nevertheless, in such circumstance, Figure12.1 illustrates a possible mitigation measure. This is the turtle deflection device similar to what was used in Florida USA, which should be used in order to avoid accidental entrapment of the sea turtles.

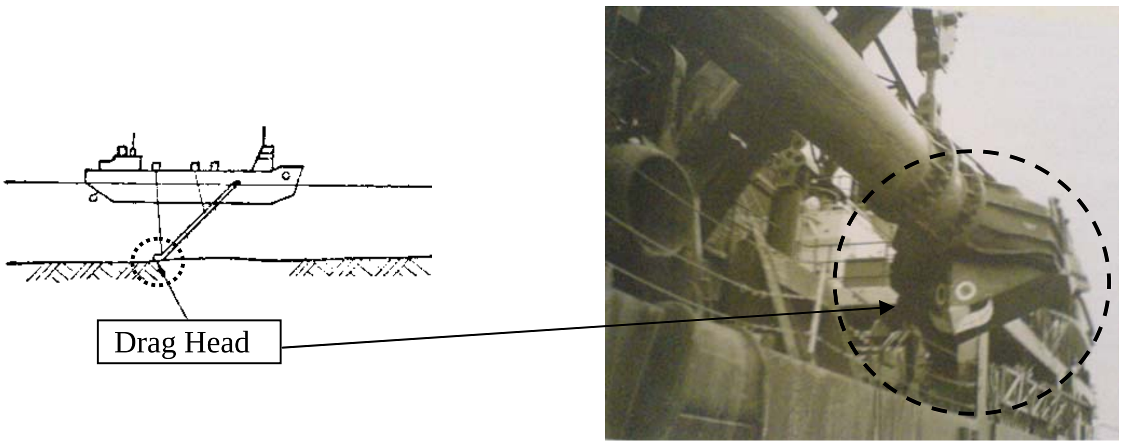


Figure 12.1: Sea Turtle Deflection Device attached to Drag Head of Hopper Dredger

12.3.2. Re plantation of Mangrove and adjacent terrestrial vegetation

- Mangrove trees to be lost: Replant mangroves to cover equivalent surface area of 2.5 ha in degraded sites of Port Reitz. This will compensate for habitat use and tree replacements of the numbers to be cleared.
- Afforestation in adjacent sites of access road with indigenous tress to be felled and other tree species to maintain tree cover and improve on aesthetic value
- Apply appropriate erosion control mechanisms during road construction to minimize sediment loss and contamination of marine life with terrigenous materials.
- Long term monitoring programs for water, sediment as discussed in nvironment management program.

12.3.3. Re location of rare species before construction if found

During the entire phase of the project, a number of species which are known to be rare, threatened, or endangered will be given particular attention. Whenever encountered these will need to be carefully relocated to other similar biotopes if on the path of the project or the project phase will need to be temporarily halted (time-out) to allow the rare / endangered / threatened species time for migration/reproduction/ completion of their natural life cycle.

12.3.4. Monitoring of state of the environment of the key critical habitsts

Environmental assessments of critical habitats (corals, seagrass beds, and mangrove areas, and including mudflats) will be undertaken for purposes of monitoring changes in biological communities which may be impacted by the project works.

12.3.5. Monitoring of stocks of biological species of concern

Stocks assessments of commercial species harvested by fishermen, keystone species and species of conservation significance (turtles, dugongs, dolphins, whales, wader birds) will be undertaken for purposes of monitoring changes in biological communities which may be impacted by the project works.

12.3.6. Land restoration

Especially in the terrestrial environment, land restoration will be undertaken alongside management of soil erosion. Areas which are excavated or filled up will be planted with vegetation. Restored areas will be monitored for sustainability and predictability of recovery patterns.

13.0 ENVIRONMENTAL MANAGEMENT PLAN (EMP)

13.1 Introduction

This chapter deals with the management plan for the mitigation of anticipated adverse environmental impacts while enhancing beneficial impacts of the proposed project. The project's environmental management plan has been drawn in accordance with legislative and regulatory frameworks on environmental and socio-economic aspects. Estimated costs for the mitigation measures have also been included in this chapter, alongside an environmental monitoring plan to ensure that the proposed measures are implemented and the desired remediation achieved

It is noted that this Environmental Management Plan has developed with planned sketch and scope of the project, thus, necessary modification shall be made during detailed design stage based on the final project scope, and most possible construction methods and schedule.

13.2 Mitigation Measures

A number of mitigation measures have been proposed in the previous chapter.

Table 13.1 shows summary of the mitigation measures for key impacts:

Table 13.1 Summary of Mitigation Measures for Key Impacts

Impact	Design stage	Construction Stage	Operation Stage
Possible degradation of living conditions of residents of Port Reitz area as a result of displacement	Prepare a Resettlement Action Plan (RAP) with adequate compensation and support programme for PAP KPA shall enhance public consultation with PAP and SH and include their opinion in project design	♦ PAP to be given priority in employment where they qualify. Use local construction material wherever possible ♦ Initiate vocational training programmes for PAP to acquire skills for self reliance	Hold periodical consultation with relocated people to ensure they are comforTable in their new locations PAP to be given priority in employment where the qualify
Increase in prevalence of HIV/AIDS	Provide a budget for HIV/Aids awareness, programs such as Peer Educator, budget for operation of a Voluntary Counseling and Testing (VCT) centre	♦ KPA peer educators and NGOs to work alongside the contactors to ensure implementation of programme ♦ KPA to facilitate a VCT centre within the site ♦ Monitor environmental parameters prescribed in this report	Monitor efficiency of the proposed programmes
Water quality degradation arising from dredging, disposal and reclamation	♦ Use of numerical modeling to predict extent of propagation of sediments ♦ Sampling and analysis of sediment quality before dredging ♦ Careful selection of filling material source to limit impacts ♦ Propose lss turbidity construction methods.	♦ Monitor environmental parameters prescribed in this report ♦ Careful schedule of construction activities with consideration of local hyrographic and seasonal conditions ♦ Proper maintenance of dredging equipment to avoid leakages	Undertake mitigation measures proposed in construction stage during maintenance dredging works
Possible degradation of air quality as a result of dust during construction and haulage trucks during operation	Schedule construction activities close to residential areas for day time only Propose less dust and noise construction methods	♦ Provide suitable Personal Protective Equipment ♦ Sprinkle water on roads to reduce dust ♦ Monitor environmental parameters prescribed in this report ♦ Provide construction materials from waterside as muchas possible	♦ Periodical sampling and analysis of air quality around the terminal; ♦ Monitor effectiveness of mitigation measures proposed
Increased risk of Vessel traffic accidents due to increased Port usage	Evaluate current and future traffic volumes and patterns Review emergency response procedures in line with traffic projections	• Installation of special shore-based radar and/or radar reflectors may be desirable. • Consultative meetings between contractors, port management and other port users to discuss safety arrangements	• Enhance spill response and emergency response training • Provide additional pilot training
Loss and degradation of flora, fauna and their habitats	Use sensitivity mapping to select project sites that would ensure minimum degradation	• Monitor water quality and community dynamics to assess and understand changes	Replant some mangroves and other flora to cover equivalent surface area of 2.5 ha in degraded sites of Port Reitz.

13.3. Estimated Costs of Mitigation Measures

Table 13.2 Estimated Costs of Mitigation Measures

Impact	Mitigation Measures	Time Frame	Responsible	Estimated Cost (Ksh)
Planning Phase Involuntary Resettlement of Project Affected Persons	Prepare a Resettlement Action Plan that would identify all Project Affected Persons, what they stand to lose and the level of compensation	As soon as practicable	KPA	10,000,000.00
	Provide adequate and accepTable compensation to Project Affected People	Before Construction	KPA	Approx. 600m
Construction Phase I) Noise	Limit Construction close to residential premises activities to day hours	During Construction	Contractor	-
	Provision of hearing protection such as ear plugs and earmuffs	During Construction	Contractor	500,000.00
II) Dust Emission	Sprinkling of water to avert dust	During Construction	Contractor	750,000.00
III) Loss of Biodiversity	Land Restoration after construction	During Operation	KPA	1,000,000.00
IV) Safety Risks	Training on safe working procedures	During Construction.	Contractor/ KPA	500,000.00
	Provision of personal protective equipment such as safety shoes, hand gloves	During Construction	Contractors	2,000,000.00
Operation Phase I) Waste Generation	Installation of waste treatment plant for administration buildings	During Construction	KPA	3,500,000.00
	Hiring of a waste management contractor	During operation	KPA	500,000.00 Annually
II) Increased Water demand	Installation of additional pipelines	During Construction	KPA	1,000,000.00
III) Fire Risks	Installation & provision of fire fighting equipment	Operation	KPA	2,000,000.00
	Training on Fire drills	During Operation	KPA	50,000.00 Annually
IV) Security	Hiring of a reputable security firm	Operation phase	KPA	500,000.00 Annually
Decommissioning Phase i) Loss of jobs	Train employees on Enterprise development	Before retrenchment	KPA	200,000.00
ii) Safety Risks from abandoned building	Carry out a comprehensive due diligence environment and safety audit	On decommission	KPA	400,000.00

13.4 Environmental Monitoring Programme

The project-monitoring programme will involve measuring and recording of physical social and economic variables associated with the development impacts. This practice will provide information on the characteristics of environmental variables, in particular on the occurrence and magnitude of impacts predicted in this study report. This will go along way in improving the environmental performance of the project as it would act as a gauge for continual improvement in project operations.

The monitoring programme will be undertaken at all stages of the project to ensure all environmental, social and economic impacts as a result of the development are dealt with as stipulated in sub section 69 of the EMCA 1999.

Table 13.3 shows Environmental Monitoring Schedule:

Table 13.3 Environmental Monitoring Schedule

Monitoring Item	Responsible	Monitoring Frequency	Monitoring Parameter	Monitoring Target
Socio-economic Impacts				
Land acquisition / Resettlement	KPA	D: monthly C: annually	Completion of compensation, recovery support and state of well being of PAP	Completed / Satisfied
Fishery constraints	KPA/ Contractor/ Fishery Dep.	D: once before construction C: annually	Completion of compensation and recovery support	Completed / Satisfied
HIV/AIDS & STD's prevalence	KPA/ Contractor	C: biannually O: annually	Awareness, prevalence and no. of cases handled	Favorable change
Land traffic congestion/accident	KPA/ Contractor	C: monthly O: biannually	Degree of congestion and number of accident	Maintained / Improved
Water traffic congestion/accident	KPA/ Contractor	C: monthly O: biannually	Degree of congestion and number of accident	Maintained / Improved
Physical Impacts				
Ambient water quality	KPA/ Contractor	C: during dredging / dumping / reclamation – daily (turbidity only) other - monthly O: during dredging / dumping – daily, other - monthly	Temp, pH, Salinity, Organics, Nutrients, Heavy metals, Coliforms, Turbidity	Maintained
Ambient sediment quality	KPA/ Contractor	C: once before dredging O: biannually	Organic, Heavy metals, Grain size	Acceptable for open water for disposal
Ambient air quality	KPA/ Contractor	C: biannually O: biannually	O_2, CO_2, H_2S, NO_2, CO, SO_2	Maintain / Improved
Ambient Noise/vibration level	KPA/ Contractor	C: biannually O: biannually	Lmax, Lmin, Leq Levels	Maintain / Improved
Effluent quality	KPA/ Contractor	O: biannually	BOD, Dissolved Oxygen, COD	Acceptable for discharge
Biological Impacts				
Abundance/diversity of vicinal terrestrial eco-system	KPA	C: biannually O: biannually	Presence / absence / coverage	Maintained/ Improved
Abundance/diversity of vicinal marine eco-system	KPA	C: biannually O: biannually	Presence / absence / coverage	Maintained

Note) D: Design Stage, C: Construction Stage, O: Operation Stage

Table 13.4 Environmental Monitoring Schedule for Key Fishery Issues

Impacts	**Mitigation Measure**	**Type**	**Implementing Organization**	**Time Frame**
Loss of fishing ground	Empower fishermen by providing motor boats to enablethem venture into deeper water.	Operational	KPA	During construction Operational
		Operational	KPA/Fisheries Department	Operational phase
	Community participation in solving insecurity issues through Beach management unit (BMU)	Operational	KPA/Fisheries Department	Operational; phase
Loss of landing site	Provision of a landing facility for the fishers and if possible improve the landing facility	Operational	KPA	Construction phase
Oil spills	Monitoring of fish catches and fish mortality cases	Monitoring	KPA/contractor	Construction, operational
Loss of biodiversity	Monitor fish catches, rare species and corals	Monitoring	KPA/Contractor	Before, during and after construction

Possible monitoring locations of physical environmental qualities are presented in 13.1

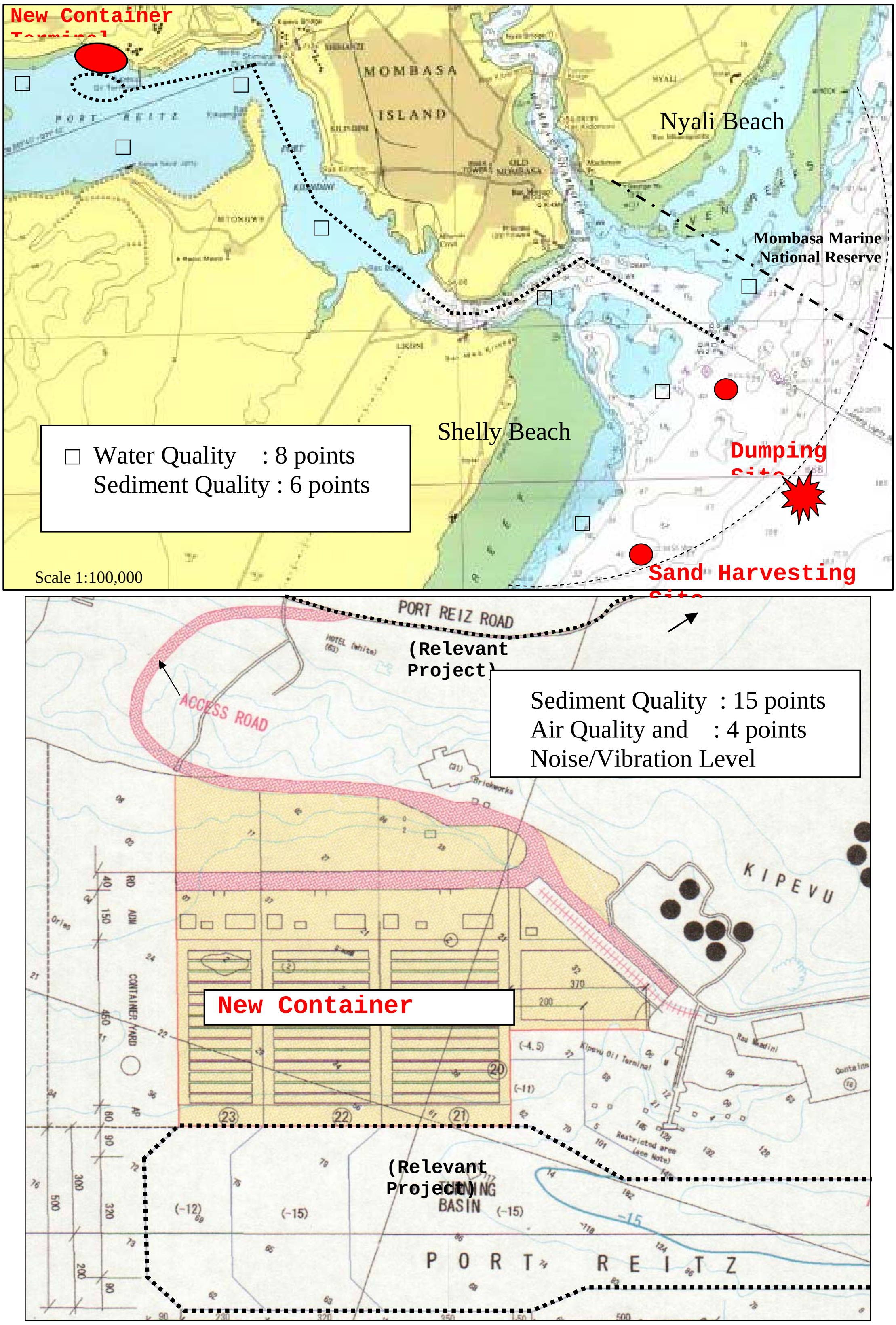


Figure 13.1 Monitoring Location of Physical Environmental Qualities

13.5 Feedback Action

To ensure the successful and effective implementation of mitigation measures, a feedback system needs to be adopted, as in Figure 13.2 below, which allows for public consultation and if necessary, improvement of the mitigation measures.

By involving the public, the project establishes transparency and also builds good public relations between the proponent and stakeholders.

The system also allows for improvement/adjustment of mitigation measures that are deemed inadequate, after which it will be made public again.

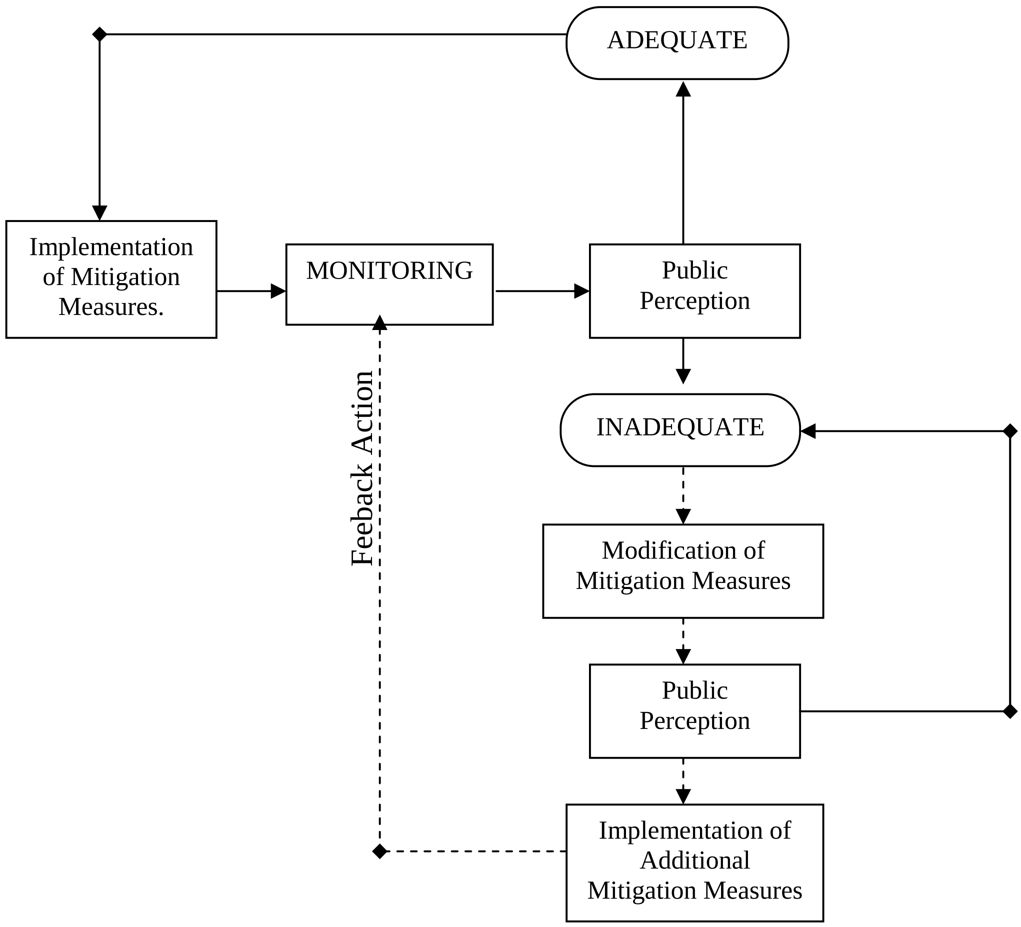


Figure 13.2 Feadback Actions in Environmental Monitoring Program

13.6 Cost Arrangement for Environmental Monitoring Plan

During the construction of the proposed container terminal, Contractors will conduct the environmental monitoring measurement on ambient environmental qualities, such as water quality, sediment quality, air quality, noise/vibration levels and fishery constraints, which are likely degraded by the construction activities. The necessary costs for these measurements will be properly allocated into the contract amount of the construction works. The necessary cost will vary based on the actual construction time schedules and methods, however, preliminary estimation was made as shown in Table 13.5. Measurement frequencies are shown in Table 13.3

Table 13.5 Cost Arrangement for Environmenal Monitoring by Contractors

Measurement Item	Measurement Duration	Estimated Cost (Ksh)
Water Quality	3 years	3,000,000
Sediment Quality	Once before dredging work	200,000
Air Quality	4 years	2,000,000
Noise/Vibration levels	4 years	500,000
Fishery Constraints	4 years	1,000,000
Total		6,700,000

13.7 Personnel Arrangement for Environmental Monitoring Plan

With strong initiative of KPA's Health Saftey & Environmental (HSE) Department, this Environmental Monitoring Plan will be executed. The organizational personnel arrangement of the management staff in KPA is shown in Figure 13.3 below.

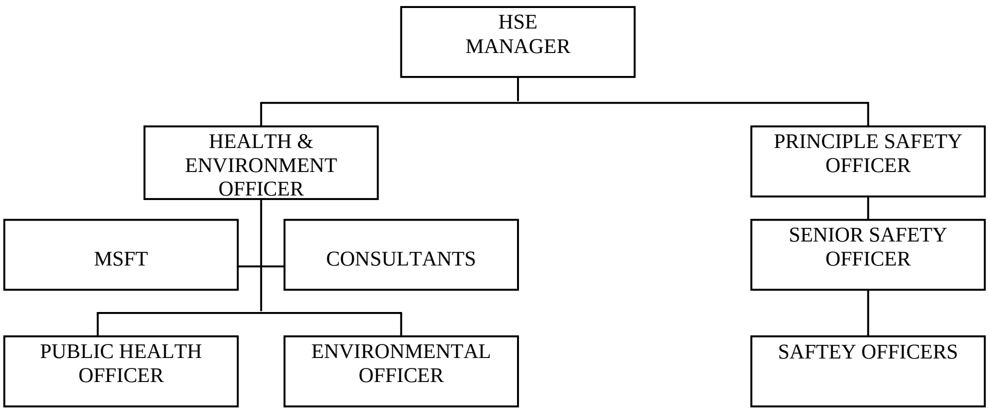


Figure 13.3: Personnel Arrangement of KPA for Environmental Monitoring Plan

13.8 Reporting System (Audit)

EMCA 1999 states that “..an environmental Audit as a systematic evaluation of activities and processes of an ongoing project to determine how far these activities and programmes, conform with the approved environmental management plan of the specific project and sound environmental practices”

Environmental auditing is the assessment of the compliance of environmental administration and performance of an operating business with environmental protection requirements; with sound environmental practice in general, and with the principles of sustainable development. According Part V, Environmental (Impact Assessment and Audit) Regulations, 2002, it is mandatory for every proponent on all new projects after the completion of a Environmental Impact Assessment Report. The first audit to be undertaken within 12 omnths after project commissioning.

Environmental audits are being used as a tool and an aid to test the effectiveness on environmental efforts stipulated in the EMP. An environmental audit is a systematic, independent internal review to check whether the results of environmental work tally with the targets. An environmental audit also focuses on whether the methods used to achieve goals are effective. To be more precise, the work of an environmental audit is to assist the regulatory body (NEMA) to study of documents and reports to see whether there are any deviations between targets and results. An environmental audit will confirm whether or not the environmental targets have been attained.
The concept of environmental auditing is closely related to monitoring, norms and standards.

For this project, the proponent will carry out an annual Environmental Audit

13.9 Internal Audit

During the operation phase, the management will undertake internal environmental auditing for consitent operation of the environmental management system. The manager will follow the monitoring system that will assist in observation, evaluation assessment and reporting on the performance of different/ various variables.

Aspect	Location	Frequency
Bathymetry	At dredging and disposal sites	Done after dredging, reviewed every 2 yrs
Noise/Vibration	Along access road and at new terminal	Twice a year
Water Quality	At dredging and disposal sites	Monthly
Biological Conditions (Flora, Fauna, habitats)	At dredging and disposal sites	Twice a year
Air Quality	Along access road and at new terminal	Quarterly
Community Issues (welfare, fisheries, security	♦ At new locations of PAP ♦ In and around project site	Annually
Emergency Preparedness(Fire fighting equipment, Fire drills, Spill control equipment)	At new terminal	Quarterly for fire figurehting equipment, Twice a year for spill control equipment. Fire drills to be conducted annually.

13.10 Review of the Environmental Management Plan

To ensure continuous effectiveness of the environmental management plan the Multi-sectoral Forum (MSFT) mentioned in 13.8 above would review the overall plan and make recommendations for improvement based on construction schedule, outcomes of facility design and monitoring results. KPA shall undertake to correct any non-conformities within 3 months of notification, failure of which the MSFT would petition NEMA to take appropriate action as provided in the Environmental Management and Coordination Act 1999.

This forum would also act as an avenue for address of disputes between KPA and Stakeholders.

14.0 CONCLUSIONS AND RECOMMENDATIONS

This environmental impact assessment study has been carried out in line with the guidelines provided in the second and third schedules of the Legal Notice No 101, The Environmental (Impact Assessment and Audit) Regulations, 2003; World Bank Guidelines and JBIC Guidelines. It has given strong emphasis on the socio-economic impacts of the proposed project on the neighbouring communities and the measures to be undertaken by the proponent to mitigate the negative impacts. The study has looked at the effects of the proposed project, especially dredging and construction of the access road on marine and terrestrial environment.

The project is expected to contribute positively to national development by making Mombasa Port competitive in the global maritime industry. Implementation of the project would make the port suitable for call by Post-Panamax Ships that bring in much more cargo, thereby generating more revenue for the country. Implementation of the project is expected to create employment during design, construction and operation stages, while the construction of access road and expansion of Port Reitz and Airport roads would improve infrastructure and general accessibility to Port Reitz area currently hampered by the dilapidated state of the Port Reitz road. Consequently the project would open up Kipevu West area for future development.

This study has identified a number of aspects of the project that would have adverse environmental and socio-economic impacts. About 10 households of West Kipevu area would have to be relocated from their current settlements due to the construction of proposed container terminal and access road connecting the terminal and existing Port Reitz Rd. These people are currently using these structures either as business or residential premises. Those whose businesses are to be relocated may temporarily lose sources of livelihood as they seek alternative business premises while those whose residential structures are to be demolished are expected to resettle in new areas with which they are not yet familiar. Relocation would have adverse negative impacts that would occur for a long term, but if the proposed mitigation measures are implemented the effects would be remediated and reduced to low. With adequate compensation the Project Affected People would eventually resettle in their new locations and continue with their livelihoods.

Approximately 100 hectares are to be reclaimed from the sea hence fishermen would lose part of their fishing ground. Temporary interruption of fishing activities could occur during dredging and disposal of sediments.

The EIA Study established that the dredge material other than having significant quantities of heavy metals is structurally weak and can not be used as fill material for reclamation. It was therefore proposed that material disposed offshore in an area 5 km off Shelly Beach at a depth of approximately 150m. The study further recommends that dredging and dumping should be done in the months of the SE monsoon season to prevent wide dispersion of the fine material during dumping. Dredging should be done taking into account ocean tides and current patterns so that during dumping of dredged materials loose sediments do not cause turbidity and effect negatively on coral reefs, mangroves and marine protected areas in general.

Alternative areas for dumping were evaluated and the suiTable one chosen. The study also looked at the available dredging equipment and methods, and highlighted their advantages and disadvantages, so that the proponent can opt for the set of methods and equipment that causes least damage to the environment. Further, the study catalogued species that would be lost and those that would be temporarily displaced as a result of the project, and proposes a trade of in terms of importance of the affected communities vis-à-vis the need for the development, given that most of the affected species would return to their habitats once the project is completed.

The most significant adverse effects evident from this EIA study are:

- The need for resettlement;
- The need for dredging and dumping of dredged material.

This study proposes that the project be allowed to proceed subject to an undertaking by the proponent to implement the proposed mitigation measures, and carry out continuous environmental monitoring during project implementation to ensure effectiveness of the proposed measures.

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ANNEXES

Annex 1: Public Consultation and Participation

The environmental Management and Coordination Act requires that views of people affected by the project be taken into account during project implementation.

First Public Hearing

The first public hearing was conducted on Wednesday, 13th September 2006 at the Royal Court Hotel, Mombasa. Letters inviting Stakeholders were delivered by hand to their offices on September 7, 2006, giving them one week to prepare for the meeting:

Table 30: Attendance list of first public hearing on Wednesday, 13th September 2006 at the Royal Court Hotel, Mombasa:

NAME	FIRM REPRESENTED	CONTACT
Eustace Gitari	KMA	Box 95076 Msa 0722369875
Eng. Joseph Atonga	Kenya P Orts Authority (Kpa)	0726446686
Cllr. Milton Kaleve	Councillor (Kipevu Ward)	Box 83315 Msa 0722671936
Maurice Otieno	Nema- Coast Province	Box 80078 Msa 0733740133
Okayana J.S.	Physical Planning Dept	Box 82876 Msa
Cap. T. A. Hamisi	KPA	tkhamis @ kpa co.ke
Ms MWANAMAKA MABRUKI	KPA	mmabruki@kpa.co.ke
Mr.Hezekiah Adala	H. Adala & Earth Matters Consulting	041-2222861
Fredrick Owiti	H. Adala & Earth Matters Consulting	041-2222861
Jacob Ochiewo	H. Adala & Earth Matters Consulting	0733804395
Simon Mwangangi	Min. Of Roads And Public Works	Box 90350 Msa 0722421879
Dr. Jared Bosire	Kmfri	Box 81651 Msa 0733781534
Colonel D.K Muvaa	Kenya Navy	Box 95350 Msa
David K. Rotich	Mombasa Municipal Council	0722361037
Joel Lesale	Kws Mombasa	salehjoe@yahoo.com
Mohammed Hassan	KPA	0722369747
Julius Maghanga	KPA	0721787587
Francis Kombe	KPA	0721820335
Eng.Nuru	KPA	nbwanakobo@ kpa.co.ke

Bwanakombo		
Patrick Gwanda	H. Adala & Earth Matters Consulting	pgwada@kmfri.co.ke
S.M Maneno	Earth Matters Consultants	0733739846
Hyder Darani	KPA	hyderdarani@gmaigmail.com

The purpose of the first public hearing was to get together key stakeholders so that the project proponent, Kenya Ports Authority could brief them on key components of the project and the area(s) affected by the project, and also to introduce the EIA Consultancy Team and request for full cooperation with the team from the stakeholders. The meeting was also to brief the stakeholders on key impacts anticipated in the project.

Figure 30: KPA's Technical Services Manager Eng J.O. Atonga briefs Stakeholders on project details during the first public hearing

During the meeting KPA's Technical Service Manager Eng J.O. Atonga provided a historical chronology of events that had justified the need for the Second Container Terminal and its designated site at Kipevu. He noted that initially the current Container Terminal was designed for 250,000 TEU. However currently the facility had outstretched its services and handling over 400,000 TEU. He noted that the Mombasa port was second largest port in Africa after Durban but unless expanded Mombasa risked becoming a feeder port. He told the meeting that the need to expand the terminal led to a study commissioned by KPA and Japan International Cooperation Bank (JICB). An international consulting firm- *Pacific Consulting International* undertook a feasibility study and recommended that the port could be expanded to handle 750,000 TEU within the current port setting.

The engineer explained that the initial plan ran into bottlenecks such as the traffic congestion that could be experienced at Kibarani and Changamwe roundabout. He reiterated that the recent acquisition of gantry cranes made the outcome of the feasibility study by *Pacific Consulting International* to *be* overtaken by events, as was most aspects of the Master Plan.

Engineer Atonga indicated that in order to overcome the bottlenecks Japan Port Consultants in their study proposed the development of a new container terminal to the west of Kipevu Oil Terminal, KOT. He said this would involve idea of dredging and reclamation of the area to get one kilometer for three berths, dredging of the main channel to a depth of fifteen metres that could accept Panama Ships (380 metres in length). This would create need to build a new 30 metres wide 6 lanes highway access roads of 1.8 km from the project site to the Port Reitz road as part of this project.

Figure 31: Some of the stakeholders who attended the first public hearing

The KPA Health and Environment Officer Mr. Francis Kombe indicated that scoping was done with KPA, Japan Bank for International Cooperation and National Environmental Management Authority (NEMA) which helped them to come out with the Terms of Reference (ToR) for the Environmental Impact Assessment study.

He indicated that Mr. Hezekiah Adala and his team were selected through competitive bidding and expressed optimism that the team of environmental experts selected will come out with anticipated impacts and mitigation measures. He said he expected the consultants to prepare environmental inventory through biological survey, fisheries survey, land traffic survey and socio-economic survey, and expain how the project will affect the area.

Figure 32**:** Stakeholders on site visit as part of public hearing

The Provincial Director of Environment (PDE) Mr. Maurice Otieno thanked KPA for embracing the law. He rejected the notion that NEMA was interfering with development activities and stressed that for sustainable development it was important that all projects go through appropriate environmental regulations. Representation from KMFRI Dr. Bosire requested to know the ways NEMA was dealing will compensation of negative environmental development projects. The PDE noted that still it was hard to gauge payment for environment due to the intrinsic value one could attach to it. Mr Adala the

Consulting Experts Team Leader noted the need to look for cost benefit analysis when looking at compensations of damaged / disturbed environment.

Second Public Hearing

The second public hearing was held at Bandari College on Friday October 13, 2006. Invitation letters were hand delivered on Monday October 9, 2006. The meeting had been called by the Project proponent (Kenya Ports Authority) and the Environmental Impact Assessment consultants (Hezekiah Adala and Earth Matters Consulting) to brief Stakeholders (SH) and Project Affected People (PAP) on the preliminary findings of the Socio-economic field study and share with them views and opinions on matters related to land acquisition, compensation and resettlement. PAP in this case was taken to mean those who would be displaced by the project and those to be affected by adverse impacts of the project such as fishermen and those living close to the project site. This followed another stakeholders' meeting that was held on 13th September 2006 at Royal Court Hotel, and which was attended by mainly lead agencies.

Table 30: Attendance list of second public hearing held on October 13, 2006.

No	Name	Residence/Firm Presented	Contact Address/Tel.
1.	Hezekiah Adala	E.I.A Consultant	0722-752696
2.	Benson Onyango	E.I.A Consultant	0726988579
3.	Fredrick Owiti	E.I.A Consultant	0721-730652
4.	Charles Muthama	E.I.A Consultant	0721 852358
5.	Jacob Ochiewo	E.I.A Consultant	0733 804395
6.	S.M Mwangangi	Ministry Of Works	0722421879
7.	Paul Katana	Resident Kwahola	41421 Msa
8.	Peter N. Wananu	Resident Mwingo	0720758023
9.	Singo K. Singo	Resident Lilongwe	0722610841
10.	Musa Abura	Resident Mwingo	0734864296
11.	Abdalla Mohammed	Residence Lilongwe	0726 077402
12.	Muhidin Husein	Plot Mwangaza	0722343347
13.	Muhammed Husein	Plot Mwangaza	0722343347
14.	Moyo Abdalla	Resident Kwahola	P.O Box 96631 Msa
15.	Philipina C. William	Resident Lilongwe	P.O Box 92310 Msa
16.	Okumu Makogola	Fisheries Department	P.O Box 90423 Msa
17.	Anna Kahaso	Resident Kwahola	0722369349
18.	Kevin Magotsi	Plot Port Reitz	0721494155
19.	Mary Otieno Magotsi	Plot Port Reitz	0720 475729
20.	John M. Kahacho	Panai E.A Ltd	0722 986848
21.	Mriha Mukira	Fisheries District Officer	0733 736704
22.	Bedan D. Mwakio	Fisherman	---------------

23.	Billiah Nyabole Ondima	Resident	0721631523
24.	Elphas Ochieng	Resident	Box 93535 Msa
25.	Clarice Ochieng	Resident	Box 93535 Msa
26	John Mwangu	Resident	Box 97834 Msa
27.	Solomon N. Muteru	--------------	Box 80519 Msa
28.	Margaret Nyaga	Resident	Box 604 Msa
29.	Ongubo Keradi	Resident	Box 98264 Msa
30.	Duncan Mbengo	Jua Kali Work Shop	Box 92710
31.	Charles Okioga	Resident	0733 813294
32	Luke Omollo	Scrap Metal Dealer	0735184946
33.	Debora Achieng	Resident	0736 456422
34.	Francis Omondi	Resident	-------------
35.	Mike Ochieng	Port Reitz	-------
36.	Stephen N. Karanja	Resident	0723146334
37.	Josiah D. Mangi	Port Reitz	0727 961426
38.	Nashon M. Timona	A.K Abdallani	Box 82553 Msa 0722579990
39	Mohammed Omar	Fisherman	0734643467
40	Mbwana Mwijuma	Fisherman	
41	Abdalla Bausi	Fisherman	
42	Musa Abud Ali	Mahadhy Transporters	0722796969
43	Nassor A. Ali	Businessman	0724315810
44	Okoth Nicholas	Resident	0721466646
45	Husein Makasi	Transporter	0722412994
46	Francis Halowe	Poshomill	
47	Jackson Otieno	Master Garage	0721465950/0734466044
48	Consolata Achieng	Business Mwingo Area	0733513937
49	Emma Kemboi	Business Woman	0722814835
50	Joyce Chebole	Housewife	0724 030940
53	Polly Wahito	Business Woman	0722172405
54	Naomi Masila	Business Woman	0722172405
55	Stephen Kinyoa	House Wife	072129245---
56	Sharriff	Transporter	0722806229
57	Samson Kavoi	Resident	0722591158
58	Abdalla Kombo	Resident	0725242236
59	K.	Chairman Fishermen	---------------
60	Salim Abdalla	Fisherman	0725242236
61	Omar Juma		
62	Pastor Safari Daniel	Lilongwe	0721648110
63	Evans Nyamwaro	Resident /Transport Business	0733558387
64	Rev. Musyoka Nzui	Port Reitz/ Kwahola	0722901556
65	Bundi Mangale Bundi	Business / Port Reitz	0723570121
66	Wilson Okanga	Resident/ Businessman	Box 81830 Msa
67	Eliakim Owino	Employee	0723570121
68	Wachira Mwangi	Mwanganza	0725739267
69	Keziah Kale	Dickson Children Home	Centre 0723237916
70	P.J. Mwangi	Kwahola	0735906811
71	Mohammed	Port Reitz	0733729249

73	Nicholas Kimani	Business	0720491714
74	Goku Mutula		0721348389
75	Simon Mutua	Kwahola	0722276226
76	Sauba Njengo	Kwahola	0723417180
77	Godfrey Momani	Port Reitz	0725886040
78	Isaac M. Kithoka	Baharini	0720860471

The Chairman KPA's Technical Services Manager Engineer Joseph Atonga opened the meeting by welcoming members to the second stakeholders' meeting. He thanked the members for accepting their invitations to attend the meeting. He informed them that although the District commissioner (Mombasa), District Officer (Changamwe), the Chief (Chaani) and the assistant Chief had not attended the meeting all had been invited.

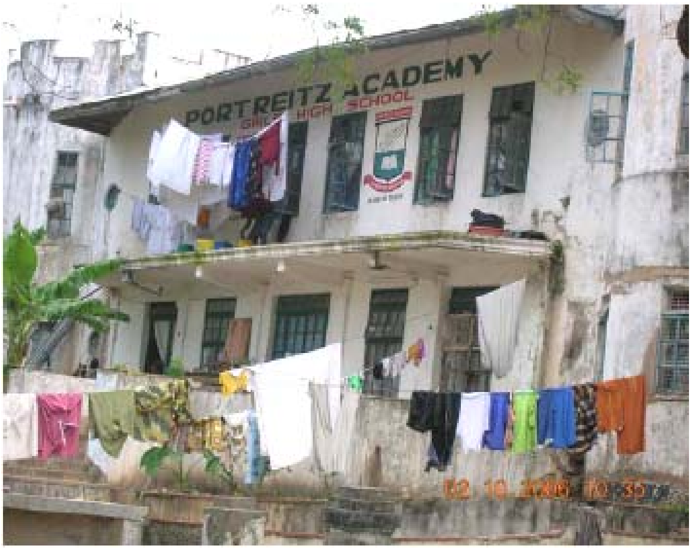
The project proponent informed the stakeholders that the proposed project site was in Kipevu West and would be funded by a loan from the Japan Bank of International Cooperation (JBIC). He said it would be a container terminal that will be created by reclaiming 100 acres from the sea for three new berths followed by dredging the main channel to a depth of 15 metres from the current 8 metres. By doing so, he said the port would be able to handle bigger ships (Panama ships) hence increase its container handling per year. He indicated that all these activities were to take place in the sea area already under the jurisdiction of KPA hence would have little effects on people.

However he noted that there would be need for an access road from the new proposed container terminal to Port Reitz road. The proposed new road (1.8 km) he said will be three-lane highway on the port exit side (the ascending side) while the port approach side would have two lanes.

He noted further that the Ministry of Works for demolition has already marked business premises, fenced plots and residential houses, which are on the road reserve. However houses or business premises within the area earmarked for the proposed road would also have to be relocated. He said all the people to be relocated will be compensated and other contentious issues documented by the EIA consulting team would also be addressed.

The Lead Consultant Mr. Adala introduced his team and explained that the Environmental Management and Coordination Act 1999 became effective in 2003 after the regulatory body, National Environmental Management Authority (NEMA) appointed experts authorized to conduct EIA studies. In a nutshell, he said his team carried out an environmental study by basing their scope on: project description, project justification, consideration of alternatives, impacts identification and mitigation, environmental management plan and finally they would provide an environmental monitoring plan. The lead consultant then briefly presented to the members the anticipated impact predicted from their field surveys.

Due the delicate weight of the socio-economic issues and which the team of experts looked into, the lead consultant invited the team socio-economist Mr. Jacob Ochiewo to present the preliminary findings of the socio-economic field study to the stakeholders.



Former Port Reitz Academy currently being used as residential rental flat
Is one of the structures to be affected

Mr. Ochiewo took the meeting through the various methods his team had used to collect data. He explained that most of the respondents were heads of households and this implies that they are responsible for taking decisions on issues that are likely to affect the welfare of their households both in the positive and negative aspects. He further explained that among the people to be affected by construction of the proposed three-lane highway 52% are involved in business activities as a means of earning livelihood. Some of the small and medium scale businesses people in the area have received credit facilities from the micro-credit schemes that have been initiated to promote small and medium scale enterprise developments.

He explained to the meeting that there would be positive and negative impacts as already highlighted by the lead consultant but specifically he identified the homes, businesses and structures to be affected by the proposed access road. About 10 companies (mainly transport) have premises bordering the Port Reitz road and would have to be displaced. About 45 residential properties of different sizes & value are going to be affected by the proposed access road. About 360 tenants will be affected by the proposed access road. Many small-scale businesses will be affected resulting in loss of livelihood. These small-scale businesses include food selling kiosks, fixed shops, garages, and a posho-mill, among others.

A mosque along Port Reitz Poad to be affected by the expansion

Mr. Ochiewo explained that the project would affect Structures with Religious, Socio-Cultural and Other Values as follows:

- The Mosque at Mwingo will be affected by the proposed access road. Some of the Mosque facilities in the open section adjacent to the current dilapidated Port Reitz road will have to be relocated according to the survey by the Ministry of Roads and Public Works.
- 3 Churches (Redeemed Gospel, Deliverance and Miracle Evangelistic Churches) will be affected. The Deliverance Church at Kwa Hola next to corner airport is too close to the road. The Redeemed Gospel Church at Lilongwe is also located too close to the road.
- Cemetery between the Mosque and a Container Depot/yard at Mwingo may be affected. This cemetery is a heritage site that the local people value dearly. Attempts should be made to avoid it as much as possible since there is a very strong belief surrounding it and the local people may oppose any interference with it.
- The Dickson Children's Centre may be affected by the proposed access road. This centre began its operations about one year ago and a lot of expenditure was incurred in setting it up.
- Electricity line that runs parallel to the Port Reitz road may have to be relocated to create room for the proposed expansion of the current Port Reitz road.

Power line along the entire road will have to be relocated

The Socio-Economist took the meeting through his findings of community's perception of the development and explained that during the field study 10% of those interviewed considered the project to be bad. They were however willing to accept compensation if the project has to be implemented. 3% of the respondents felt that the project is bad but if certain concerns are addressed adequately then their perception about the project could change. 52% of the respondents felt that the project is outright good since in their view, it will create employment opportunities to the youth who reside in the area, will open up the area for increased business and will generally improve transport situation in the area. 31% of the respondents felt that the project is good but the welfare of the affected people have to be adequately catered for and appropriate mitigation be put n place to curb any negative impacts. 2% of the respondents did not have any comment.

One of the PAP, Mr Shariff Abdallah his concerns during the 2nd public consultation

On compensation the Socio-Economist noted that of the people interviewed 98% of the respondents want adequate compensation to be given to then before they are asked to vacate to give way for the project. Out of the 75 people who had been interviewed at the time this draft report was being prepared 68 people prefer cash compensation, 6 people prefer to be given property that are equal in value to their current property and 1 person stated that he would not want to move out of his current residence. However all the affected persons emphasized that compensation should be paid directly without involvement of a third party. They prefer to be present or be represented by people whom they have nominated from their respective areas in the negotiations with KPA about compensation.

In his recommendations the Mr. Ochiewo proposed that:

- There is need for appropriate compensation to the property owners and affected tenants according to the magnitude of effect in each case
- Structures with religious and socio-cultural values should be avoided if possible. However, if completely unavoidable, they should be relocated with adequate compensation
- KPA to administer compensation directly with the help of a professional consortium.
- Arrangements should be made for the affected persons to be given some training on how to cope with change. This is very essential in view of the fact that most of the affected persons prefer cash compensation as opposed to direct resettlement.
- There is need to promote HIV/Aids awareness campaigns to sensitize local residents about the dangers of having a big population of migrant workers at the project site especially during the construction phase.

Alternatives to the proposed project were considered including alternative project proposals, alternatives to the access road and alternative disposal sites for the dredged material.

FINAL PUBLIC HEARING

Final public hearing took place on 9th November 2006 at Bandari College. The meeting was called by the proponent KPA and the EIA Consultants to present to stakeholders (lead agencies and those to be affected in the proposed project) findings of the project's Environmental Impact Assessment study. It was attended by a total of 159 people comprising of 40 fishermen from Likoni and Port Reitz areas, representatives from 3 NGOs, Government Officials from the Forestry and Fisheries Departments and officials from Lead Agencies such as the Coast Development Authority, National Environment Management Authority, Kenya Marine & Fisheries Research Institute, Physical Planning Office and the Chief, Changamwe location.

The proponent represented by KPA Technical Services Manager Eng. Joseph Atonga took the stakeholders through a detailed description of the proposed project. He explained that in the process of project implementation residents of the area and the fishermen community were going to be affected by the project hence the need for an EIA. He then invited the Lead Consultant Mr Hezekiah Adala to brief the meeting on the findings of the EIA study.

Mr Adala introduced the EIA consultancy team and said his team carried the study by basing their scope on: project description, project justification, consideration of alternatives, impacts identification and mitigation, environmental management plan and finally they provided an environmental monitoring plan. On justifying the project, he indicated that the volume of the container cargo already exceeds the estimated capacity of the existing container terminal and it is forecasted that within ten years, the containerized cargo volume will be doubled. He also explained that the existing access road network around Mombasa Port was inadequate and required upgrading.

He said that the team looked at project alternatives such as those done by Pacific Consultants International as well as studies by Royal Haskoning (RH). The last proposal which has appeared feasible and which the current E.I.A study was done was carried out by Japan Port Consultants that proposes the development plan of a new container terminal on the shore to the west of KOT at Port Reitz. The Lead Consultant indicated that after thorough study of the proposed project, a number of positive and negative impacts were identified.

The lead consultant later invited the team Oceanographer Dr. Nguli to present findings of the current study. Dr. Nguli said that the previous and current studies done on oceanography could be used to give an insight on the effects that will occur during the dredging period and how such effects could be mitigated. He took the meting through findings regarding ocean current patterns and wind patterns and explained how these results were used to predict the effects of dredging and disposal of dredged material. He indicated that the Somali Current comes with lot water, which carries fish. During this time (spring) the fishermen have a lot of fish harvest. It would therefore be unfit to dredge during this time as fishermen will be greatly affected. He proposed that dumping should be done in the month of August during the SEM season when the temperature is low and hence the rate of up welling is minimal.

The Lead Consultant then invited the team's Physico-chemical consultant Dr. Munga to present the physico-chemical and other findings of the EIA study. Dr Munga indicated that the study carried out comprehensive sample survey and analysis of physico-chemical parameters such as coliform counts, heavy metals and nutrient analysis. Among the physico-chemical parameters analysed were turbidity, conductivity, Total Suspended Solids (TSS), PH (in-situ) Biological Oxygen Demand (BOD) Chemical Oxygen Demand (COD) and Total Dissolved Solids (TDS). Heavy metals (toxic metals that cause effects to organisms) like lead (Pb), cadmium (Cd), Chromium (Cr), copper (Cu), zinc (Zn), cadmium (Cd), manganese (Mn) and iron (Fe) and mercury (Hg) were also analysed both in the water and sediments. Analysis was also done of these heavy metals in oyster as a biological indicator and also for future comparisons, they were also analysed in fish species. The nutrients such as phosphorous and nitrates were also analysed in water and sediments. This nutrients cause eutrophication and hence algae bloom that may have deleterious effects on the oceanic ecosystem hence there was need to have a baseline data before finally the project takes effect. Dr. Munga indicated that the results indicated elevated levels of Pb in both water and sediment (1ppm or 1μg/l) while other heavy metals their levels were found to be less than one (<1 ppm). The bioindicator organism (oyster) also inhibited these high levels of lead but less of other heavy metals.

Dr. Munga recommended that due to elevated levels of heavy metals (Pb), the dredged material is not suiTable for use in other environments except safe disposal in deep sea where it cannot seep back and be recycled.

The lead consultant then invited Mr. Patrick Gwada the Marine Ecologist to provide briefs of his findings. Mr. Gwada indicated that a total of 16 primary faunal sampling sites along defined transect lines were sampled during this EIA process within the areas of Port Reitz and associated habitats, and 4 in the Port Kilindini and Mombasa Harbour areas. Within the same transect, visual census (photo inventory and counts) were used to characterize benthic underwater flora (submerged macrophytes). The major types of vegetation found were:

- mangrove forest (seven species were identified),
- sea grass (eight species were identified),
- beach forest,

- beach vegetation and
- Man-made agricultural forests (coconut).

Fish identified were sharks, rays, large pelagic like king fish, small pelagic like mackerel, benthos like milkfish and mullet fish. Dermasal predators were also identified like snappers, catfish and grunter. He said the study also found squids and cuttlefish to breed in this area but the landings records were too low. Although sharks are landed here they have not been identified to species level. No records of introduction of alien species to this part of the creek was found, although this possibility can not be ruled out given that ballast water has been reported as one way of alien species introductions. Other species to be considered are the sea birds in this creek.

Lastly, Mr. Gwada presented trade-off matrix decision between ecological importance of shelly beach and Port Reitz area. And indicated that Shelly beach is a source of shell harvest and other marine species like prawns not found abundantly in Port Reitz area. In conclusion, he said he extended gratitude to different people who had made the survey a success.

Because of the weight socio-economic issues had on the affected persons the lead consultant invited Mr. Saeed Mwaguni, the team's Environmental Planner who had a worked alongside the team socio-economist Mr. Ochiewo, to present findings of the socio-economic study. He explained to the meeting that there would be positive and negative impacts as already highlighted by the lead consultant but specifically he identified the homes, businesses and structures to be affected by the proposed access road. About 10 companies (mainly transport) have premises bordering the Port Reitz road and would have to be displaced. About 45 residential properties of different sizes & value as well as about 360 tenants will be affected by the proposed access road. Many small-scale businesses will be affected including food kiosks, shops, garages, and a posho-mill, among others, resulting in loss of livelihood.

On compensation the Mr Mwaguni noted that of the people interviewed 98% of the respondents want adequate compensation to be given to them before they are asked to vacate to give way for the project. Out of the 75 people who had been interviewed, 68 people prefer cash compensation, 6 people prefer to be given property that are equal in value to their current property and 1 person stated that he would not want to move out of his current residence.

The chairman invited the Project Proponent and Team of Consultants to answers questions on issues to be raised by the stakeholders

Issues Raised

- Concerns about the tremendous effects that would be caused by dumping six million tones of dredged materials at Ras Kizingo basing on the effects it will cause to sea turtles that lay eggs at the site. Further, he demanded to know what would happen to Shelly Beach goers who use the site for recreational purposes.

- Concern on the possible effects on the sea turtles which are now CITES' list of endangered species

- Wastes could affect the corals and as part of the food web; the impact on a member of the ecosystem may affect fish, which was their source of livelihood. Fishermen should be compensated for the loss of their livelihood.

- Some of the residents had their children going to school while others worked near their living areas and the said the proposed project was causing a lot of anxiety on them and their families. They want to be given adequate notice to get new schools and business premises.

- An area resident wanted to know where exactly the road was to pass and what compensation people will be given for the effects of noise and vibration.

Response from proponent and EIA Consultants

- Dumping would be done in deep sea (approximately 150 metres), and about 5 km from the shore. Turtles do not breed inside the sea but at the seashore hence would not be affected by the dumping activities. Dumping will be done carefully and following laid down laws and convention (United Convention on the Laws of the Sea (UNCLOS) of 1972), and during the North East Monsoon (NEM) wind when the water is going back fast at 200 km/hr and little or no sand will come back.

- The levels of heavy metals in the sediments were too high for it to be used as fill material, and dumping it 150 deep m was the best solution.

- Due diligence will be observed when executing the project and the background levels of noise and vibration will be taken to note any future increment to ensure levels that levels do not affect human health.

- Fishermen will only be affected during construction and later things will move back to normal. Only a small area will be affected hence fishing will still go on in other areas while construction proceeds. However discussions will be held with the Fisheries department to mitigate against any adverse effects.

- The proponent would prepare a Resettlement Action Plan (RAP) where further views will be collated.

- The Lead Consultant gave out his address and office location for any person with further questions to forward their views. PAP were also invited to send any further questions by Post Office to the Managing Director, KPA.

Details of the deliberations are as in the minutes attached in the Appendix.

In line with the requirements of the Environmental Management and Coordination Act KPA in liaison with NEMA has published an invitation from members of the public to give their views on the proposed project. This notice is valid for 60 days and it appeared in the press on

Annex 2: Public Consultation Form

PUBLIC CONSULTATION FORM

THE PROPOSED KPA NEW CONTAINER TERMINAL PROJECT & CONSTRUCTION OF NEW ACCESS ROAD
SOCIO-ECONOMIC ASSESSMENTS

QUESTIONNAIRE **ID NO. …………………**

1. Name of respondent: ……………………………………………………………………
2. Sex of respondent: Male (……) Female (…..)
3. Age of respondent: …………… years:
4. Marital status: Single … Married …. Divorced …. Separated …. Other ……..
5. Religion: Muslim ……. Christian …………
6. Household size: Adults: No. of spouses ……. No. of children below 18 years………..
   No. of children aged 19 years & above …Any other relatives you support.................
7. What is your role in the household? …………………………………………………….
8. I. (a) Area of residence: ……………………………………………………………………
   (b) House/plot number: ……………………………………………………………..
   (c) Are you a permanent resident here? Yes………. No …………………….
   (d) How long have you been living here? …………………………………………….
   (e) Is your dwelling rented or owned? ……………………………………………….
   (f) If rented, who is the owner and where is he/she found? …………………… ……..
   ………………………………………………………………………………… …
   (g) How many people occupy the house/facility …………………………………..…

8. **II. If Company**

(a) Name of company ……………………………………………………………..
(b) Location of the company ……………………………………………………….
(c) Plot number: ………………………………………………………………………
(d) How long has the company been here? ……………………………………………….
(e) Is the premise rented or owned? ……………………………………………………
(f) If rented, where is the owner? ………………………………………………………
(g) How many employees work in the company? ……………………………………..
9. What is your main occupation: …………………………………………………………
10. What other activities provide livelihood to you? ……………………………………

11. What are your views about the proposed construction of a container terminal by KPA? ……………………………………………………………………………………….
…………………………………………………………………………………………….
12. What are your views about the proposed construction of new access road from Kipevu by KPA? ……………………………………………………………………

13. (a) How would the project affect you personally? ………………………………
……………………………………………………………………………………. (b) What actions should be taken to minimize the negative impacts if any?
……………………………………………………………………………………...
14. (a) If you are to be displaced by the proposed construction of the new access road, how much compensation would you expect? Kshs. …………………………………
(b) Please justify the proposed amount ………………………………………
…………………………………………………………………………………….
15. Do you think the project is beneficial if all precautions are taken? Yes …… No……
If not, please give your comments: ………………………………………………….
……………………………………………………………………………………..
16. Do you have any objection for approval being given to this project? Yes …. No …..
17. If yes, explain why: ……………………………………………………………….

FISHING SPECIFIC INFORMATION

1. Location of the fishing ground? …………………………………………………..........
2. How many fishermen visit the fishing ground regularly? …………... ……………..
3. Where do these fishermen come from? ……………………………………………..
4. (a) Why are you a fisherman? ……………………………………………………….
   (b) Do you have pride in your work? ………………………………………………...
5. How long have you been a fisherman? ……………………………………………
6. Did your father/mother fish too? …………………………………………………….
7. (a) How long does it take to reach the fishing ground? …………………………….
   (b) Why? ………………………………………………………………………....
8. (a) How do you fish? ……………………………………………………………….
   (b) What fishing vessel do you use? ………………………………………………
   (c) Who owns the vessel? ……………………………………………………
   (d) Size of the fishing vessel i.e.

(i) How many fishermen does it carry (Boat passenger capacity)? ……..

(ii) Does it have an engine? Yes (………..) No (………..)

(iii) If yes, what is the size of the engine? ……….. Horse power

(iv) Name of the vessel/ID No: …………………………

9. (a) How has the catch trend been in the last ten years?

Increasing (…………) Decreasing (……………..)

(b) What causes the trend? ………………………………………………………..

10. Who owns the fishing grounds? …………………………………………………..

11. How do you organize your fishing activities (e.g. do you fish alone or in groups or employed)? ....………………… ………………..

What are your future economic diversification options? …………………………

………………………………………………………………………………………..

12. What do you need in order to improve your activity? ………………………………

Annex 3: Questionnaire for Stakeholder Consultation

STAKEHOLDER CONSULTATION

THE PROPOSED KPA NEW CONTAINER TERMINAL PROJECT & CONSTRUCTION OF NEW ACCESS ROAD

SOCIO-ECONOMIC ASSESSMENTS

QUESTIONNAIRE FOR RESOURCE MANAGERS

1. Name of officer: ……………………………………………………………………..
2. (a) Organization: ……………………………………………………………………..
   (b) Position held: ……………………………………………………………………...
3. What are your views about the proposed construction of new container terminal by KPA? ....………………………………………………….
   …………………………………………………………………………………………
   ………………………………………………………………………………………..
4. What are your views about the proposed construction of a new dual carriage access road to link the proposed new container terminal with the main road? ....…………………………………………………………………….

5. (a) How would the project affect you personally? …………………………………...
   …………………………………………………………………………………….....
   ……………………………………………………………………………………….
   ………………………………………………………………………………………..
   (b) What actions should be taken to minimize the negative impacts if any?
   ………………………………………………………………………………………….

5. Do you think the project is beneficial if all precautions are taken? Yes …… No……

   If not, please give your comments:
   ………………………………………………………………………………………..
   ……………………………………………………………………………………….
   ……………………………………………………………………………………….

6. (a) Do you have any objection for approval being given to this project? Yes …. No ……

(b) If yes, explain why: ………………………………………………………………....

…………………………………………………………………………………………….

Date: ……………………………………………………………………………

Signature: …………………………………………………………………….

Annexe – 4: Biological Characteristics: Phytoplankton

	Species types	Phytoplankton - vertical profiles (abundance (unit plankton))											
	Transect no	Transect-5			Transect-6			Transect-7			Transect-8	Transect-9	
	Sample location	RE - 1	RE - 2	RE - 3	RC - 1	RC - 2	RC - 3	RW - 1	RW - 2	RW - 3	IN	IS	TOTALS
1	*Alexandrium catenela*		6		6	3	5			1	5		26
2	*Ceratium furca*	2	6	2	8	8	9	4	2	2			43
3	*Ceratium fusus*				4	2							6
4	*Chaetoceros spp*		2	1	2			3	1	8	3		20
5	*Coscinodiscus eccentrica*		1			5	4		3	4			17
6	*Coscinodiscus spp*	2	1	1		3	3			2	5		17
7	*Ditylum brightwelli*			1		1							2
8	*Dictyocha fibula*	1						4	2	1		1	9
9	*Dinophysis caudata*					3	1	2					6
10	*Eucampia cornuta*									1			1
11	*Guinardia striata*	2	3	2	2	2		13	4				28
12	*Navicula spp*										1		1
13	*Nitzschia closterium*	1							3				4
14	*Nitzschia sigma*	1				1							2
15	*Nitzschia spp*								1				1
16	*Pleurosigma capense*						1				1		2
17	*Pleurosigma directum*			1							2		3
18	*Pleurosigma normanii*								1				1
19	*Preperidinium meunieri*								2				2
20	*Protoperdinium spp*	2						4	2				8
21	*Protoperidinium obtusum*							3					3
22	*Prorocentrum micans*	2	4	1			1			1	3		12
23	*Protoperidinium coinicoides*	1											1
24	*Protoperidinium depressum*		1		1					1			3

25	*Protoperidinium obtusum*		1	1						4			6
26	*Protoperidinium pyriforme*								1	1		1	3
27	*Protoperidinium spp*						1					2	3
28	*Pseudonitzschia pungens*		1		1		1	1	1	4			9
29	*Pseudonitzschia spp*	1		1						3	1		6
30	*Scrippsiela trochoidea*								1				1
31	*Skeletonema costatum*	3	5	1	3	4	3	8	4		5	1	37
32	*Striatella unipunctata*	1				1							2
33	*Thallasionema nitzchoides*		1	1	5	6	2	2			1		18
	COUNTS per sample points	12	12	11	9	12	11	10	14	13	10	4	33

	Species types	Phytoplankton - vertical profiles (abundance (unit plankton))											
	Transect no	transect-5			transect-6			transect-7			transect-8	transect-9	
	Sample location	RE - 1	RE - 2	RE - 3	RC - 1	RC - 2	RC - 3	RW - 1	RW - 2	RW - 3	IN	IS	TOTALS
1	*Alexandrium catenela*		5	6	6								17
2	*Ceratium furca*	1	4	1	15	10	1	2	5	2	1	1	43
3	*Ceratium fusus*				3	3	1	1					8
4	*Chaetoceros spp*	2		1	1	1	3			7	1		16
5	*Coscinodiscus eccentrica*			2	5	2	3		2	1	2		17
6	*Coscinodiscus spp*	4	2		2	1	1	1		1	3	1	16
7	*Ditylum brightwelli*												0
8	*Dictyocha fibula*	1		1		2	1	3	1	3	1		13
9	*Dinophysis caudata*				2		4		3				9
10	*Ditylum brightwelli*									1			1
11	*Guinardia striata*	2		4	1		1		6				14
12	*Licmophora ehrenbergii*										3		3
13	*Navicula spp*						1			1	2		4

14	*Nitzschia closterium*								1				1
15	*Nitzschia spp*									1			1
16	*Odentella spp*						1						1
17	*Pleurosigma capense*					3	2				1		6
18	*Pleurosigma directum*				1	2					2	1	6
19	*Pleurosigma normanii*								1	1	1		3
20	*Preperidinium meunieri*								2				2
21	*Prorocentrum micans*	3	2	1				1				1	8
22	*Protoperidinium conicoides*	2	1					3		3			9
23	*Protoperidinium depressum*	1	1									1	3
24	*Protoperidinium obtusum*		1										1
25	*Protoperidinium spp*							2	1	4			7
26	*Protoperidinium pyriforme*	1	2		2				1			3	9
27	*Pseudonitzschia spp*	1						1				3	5
28	*Pseudonitzschia pungens*								1	3			4
29	*Pseudonitzschia spp*									1		1	2
30	*Rhizosolenia imbricata*					1							1
31	*Scrippsiella trochoidea*								3	2			5
32	*Skeletonema costatum*	3	3	1	5	3	2	7	2	5	2	2	35
33	*Striatella unipunctata*		2								2		4
34	*Thallasionema nitzchoides*	1	1		5	6	4	1			1		19
	COUNTS per sample points	12	11	8	12	11	13	10	13	15	13	9	34

Annexe – 5: Biological Characteristics: Zooplankton

	Species types	Zooplankton - vertical profiles (abundance (unit plankton))											
	Transect no	Transect-5			Transect-6			Transect-7			Transect-8	Transect-9	
no	Sample location	RE - 1	RE - 2	RE - 3	RC - 1	RC - 2	RC - 3	RW - 1	RW - 2	RW - 3	IN	IS	total
1	Acartia	11		1	1	13	16	22	18	12		10	104
2	Bivalve	100	9	34	1	25	13	5	12	5	14	20	238
3	Bivalve												0
4	Brachyurian larva	1	2	2	1	2	2	1			8	2	21
5	Brachyurian megalopa	1				3			7				11
6	Calanopia												0
7	Candacia	24	18	20	43	2	32	11	4	5	20	4	183
8	Caridean larva				1						9		10
9	Caridian					14							14
10	Carridean											1	1
11	Carridean larva												0
12	Centropages	2			5	1	8	6	5		10		37
13	Cerripied nauplii				9	2	4	5			12	35	67
14	Copepod nauplii	15	4	10		9	5	54	6	6			109
15	Copilia			2	1						5		8
16	Corycaeus				3						4		7
17	Enterpina												0
18	Eucalanus	23	10	18	6		13			2	7		79
19	Eucalanus nauplii			3	5		9						17
20	Euchaeta	1			9	1					6	3	20
21	Euphasii nauplii					5	5		12	2			24
22	Euphasiid					1		5	6				12
23	Euphasiid larva	8						5					13
24	Euphasiid nauplii											11	11
25	Euterpina												0
26	Evaldin tergestina					1							1
27	Fish eggs	9	2	5	20	5	39	6	2	1	8	6	103
28	Fish larva	23	5	2		9	4	8	2			1	54

29	Foraminifera	3	3	4	1	9	13	4	10	11		2	60
30	Fritillaria					1						3	4
31	Gastropod	1	1	1		1	6	4	4	2		1	21
32	Heteropoda											2	2
33	Hyperia					4							4
34	Lucifer		1		2	1	4			1			9
35	Macrosetella	9		1		15		14	12	3	3	5	62
36	Monstrilloid	3	6	1			3			2	7	2	24
37	Nematoda				1	8	3			1	7		20
38	Oikopleura	105	20	60	8	38	20	18	7	21	20	18	335
39	Oithona	15	7	19	24	18	23	21	13	10	20	8	178
40	Oncaea	16	2	14	51	51	2	9	4	13	33	54	249
41	Paracalanus	12	4	8	5	1	9	4	1	4	8		56
42	Penaecid protozoa					1							1
43	Pleurammama												0
44	Polcheata	12	3	1	3	1	2	10	6	4	6	2	50
45	Porcellanid larva	1											1
46	Sapphirina	7	5	4	20	12	15	12	14	30	12	26	157
47	Spinoid larva	3	2	2	1	1	3		1				13
48	Tornaria larva												0
49	Tortanus				3						4		7
50	Trochophore larva			1									1
51	Rhinocalanus												0
52	Isopod			1									1
53	Sagitta eaflata		1	1									2
54	Sagitella			3									3
55	Caridea							1	1				2
56	Carridacea							1					1
	COUNTS per sample points	405	105	218	224	255	253	226	147	135	223	216	2407

no	Species types	Zooplankton - horizantal profiles (abundance (unit plankton))											
	Transect no	Transect-5			Transect-6			Transect-7			Transect-8	Transect-9	
no	Sample location	RE - 1	RE - 2	RE - 3	RC - 1	RC - 2	RC - 3	RW - 1	RW - 2	RW - 3	IN	IS	total
1	Acartia	5	12	9	16	25	10	12	20	2	51	30	192
2	Bivalve	20	16	28		78		22	17	8	2	6	197
3	Bivalve										2	2	4
4	Brachyurian larva	3		1	5	3		1	1				14
5	Brachyurian megalopa	2	1	1					1				5
6	Calanopia										7		7
7	Candacia	9	36	13	2	8	15	30	12	3	22	10	160
8	Caridean larva											3	3
9	Caridian												0
10	Carridean												0
11	Carridean larva												0
12	Centropages	3			1	3		5	8	3	1		24
13	Cerripied nauplii	1		2	4	14		21	3	2	17	50	114
14	Copepod nauplii	4	6	1		5	14	60	10	7			107
15	Copilia				4							1	5
16	Corycaeus										4	1	5
17	Enterpina						2						2
18	Eucalanus	15	23	11	6	2	15				2	6	80
19	Eucalanus nauplii		2	1									3
20	Euchaeta				5	3					2	5	15
21	Euphasii nauplii												0
22	Euphasiid		3		11								14
23	Euphasiid larva												0
24	Euphasiid nauplii	2			3	29	1	20		1	4		60
25	Euterpina											1	1
26	Evaldin tergestina		1										1
27	Fish eggs		4	3		2		1	1		6		17
28	Fish larva	3	5						4			15	27

29	Foraminifera	2		1		8	6	10	4	3		3	37
30	Fritillaria												0
31	Gastropod		2	1				2	4	2	4		15
32	Heteropoda					2							2
33	Hyperia	1								1			2
34	Lucifer	3				1	4					1	9
35	Macrosetella	1			6	5			8	2	12	9	43
36	Monstrilloid		3	1							2	3	9
37	Nematoda	2				1		1			2	1	7
38	Oikopleura	18	5	13	4	36	10	26	16	8	11	13	160
39	Oithona	12	12	15	21	28	20	16	22	21	22	27	216
40	Oncaea	41	15	12	12	40	10	22	8	1	65	65	291
41	Paracalanus	12	15	9	5	13	7	5	17	2	32		117
42	Penaecid protozoa												0
43	Pleurammama		13			9					1		23
44	Polcheata	11		5	3	1	6	5	16	1	10	2	60
45	Porcellanid larva											1	1
46	Sapphirina	6	16	4	26	26	20	34	33	11	52	45	273
47	Spinoid larva	2		1		2	2			1			8
48	Tornaria larva				10								10
49	Tortanus										4		4
50	Trochophore larva											1	1
51	Rhinocalanus	1											1
	COUNTS per sample points	179	190	132	144	344	142	293	205	79	337	301	2346

Annexe – 6: Biological Characteristics: Macrobenthos (including infauna)

		SHELLY BEACH SITES			
		Transect-1	Transect-2	Transect-3	
CLASS	SPECIES ID				
Polychaeta	*Nereidae*	3	1	1	5
	Ceratonereis erythraensis	4	3	1	8
	Polyopthalmus pictus	1		1	2
Oligochaeta	*Oligochaeta*	1	1		2
Anopla	*Baseodiscus unistriatus*	5	3	5	13
	Anopla	2	1	1	4
Ophiuroidea	*Macrophiothrix lonngipeda*			1	1
Malacostraca	*Parabenalia sp*				0
Amphipoda	*Platorchestia sp*				0
Malacostraca	*Paratanaidae*	3	3	2	8
Ostracoda	*Ostracoda sp*	1	1		2
Cumacea	*Botridae sp*	2	1	1	4
	Tylodiplax derijardi				0
	Argathona macronema		1	1	2
	Platorchestia platensis	4	3	2	9
	Natica gualteriana				0
Gastropoda	*Nassarius coronatus*				0
	Jantharina globosa				0
	Nassarius coronatus	5	8	7	20
	Terebra nebulosa	10			10
	Architectonica perspectiva				0
	Littoralia glabrata				0
	Calpurnus verrucosus				0
	Oliva bulbosa				0
Bivalvia	*Epitomiidae sp*				0
	Anodontia edentula				0
	Epitomiidae sp				0
		41	26	23	90

		CONTAINER YARD	PORT REITZ SITES													
		Transect-4	**Transect-5**			**Transect-6**			**Transect-7**			**Transect-8**	**Transect-9**	**Transect-10**		
CLASS	SPECIES ID	B-19	RE1	RE2	RE3	RC1	RC2	RC3	RW1	RW2	RW3	IS	IN*	DT	DF	totals
Polychaeta	*Nereidae*	3	3	1	5		1	4	2		1	2		12	3	37
	Ceratonereis erythraensis															0
	Polyopthalmus pictus															0
Oligochaeta	*Oligochaeta*							4			1				2	7
Anopla	*Baseodiscus unistriatus*	1	1	1	1	1			1						5	11
	Anopla															0
Ophiuroidea	*Macrophiothrix lonngipeda*															0
Malacostraca	*Parabenalia sp*							1	1		2					4
Amphipoda	*Platorchestia sp*								1	1		1				3
Malacostraca	*Paratanaidae*	1					3	3		1	1					9
Ostracoda	*Ostracoda sp*							1		1						2
Cumacea	*Botridae sp*							4			7					11
	Tylodiplax derijardi							1								1
	Argathona macronema															0
	Platorchestia platensis															0
	Natica gualteriana								2							2
Gastropoda	*Nassarius coronatus*					2			2	15	15	7				41
	Jantharina globosa								1							1
	Nassarius coronatus	20														20
	Terebra nebulosa					1				7	1					9

	Architectonica perspectiva									1	1	2				4
	Littoralia glabrata											1				1
	Calpurnus verrucosus											1				1
	Oliva bulbosa	10	10													20
Bivalvia	*Epitomiidae sp*	4		4	4											12
	Anodontia edentula								1							1
	Epitomiidae sp										5	1				6
		39	14	6	10	4	4	18	11	26	34	15	0	12	10	203

Annexe 7: Other Specialists

Specialists involved in providing additional baseline data/information and/or undertaking primary field measurements

Name	Affiliation	Field of expertise	Sections contributing
Elizabeth Mueni M.Sc. (Marine Biology)	Fisheries Department (Coastal & Marine), - Assistant Director of Fisheries Office P.O. Box 90423 Mombasa	Fisheries biology Bird identification	Fisheries and birds data and information (Chapter 8)
Collins Ndoro B.Sc. (Marine Biology)	Fisheries Department-Mombasa District Fisheries office P.O. Box 90423 Mombasa	Fisheries biology	Fisheries data and information (Chapter 8)
Rashid Anam M.Sc.student (Marine Biology)	Kenya Marine and Fisheries Research Institute (KMFRI), http://www.kmfri.co.ke P.O. Box 81651, Mombassa, Kenya. Telephone 254-11-475154; 472527; Fax: 254-11-475157;	Fisheries biology Bird identification	Fisheries and birds data and information (Chapter 8)
Bernard Ogongo H.Dip. (Marine Biology)	Kenya Marine and Fisheries Research Institute (KMFRI), http://www.kmfri.co.ke P.O. Box 81651, Mombassa, Kenya. Telephone 254-11-475154; 472527; Fax: 254-11-475157;	plankton surveys & analyses	Phytoplankton data and information (Chapter 8)
George Onduso H.Dip. (Marine Biology)	Kenya Marine and Fisheries Research Institute (KMFRI), http://www.kmfri.co.ke P.O. Box 81651, Mombassa, Kenya. Telephone 254-11-475154; 472527; Fax: 254-11-475157;	plankton surveys & analyses	Zootoplankton data and information (Chapter 8)
Dixon Odongo H.Dip. (Marine Biology)	Kenya Marine and Fisheries Research Institute (KMFRI), http://www.kmfri.co.ke P.O. Box 81651, Mombassa, Kenya. Telephone 254-11-475154; 472527; Fax: 254-11-475157;	marine benthos surveys & analyses, & qualitative visual surveys	Macrobenthic data and information (Chapter 8)
Mwai Muraguri M.Sc. (forestry Biology)		forestry surveys & analyses Bird identification	Forestry and birds data and information (Chapter 8)
Ali Mwamutsi B.Sc. (Forestry Biology)		forestry surveys & analyses	Forestry data and information (Chapter 8)
Alfred Obinga H.Dip. (Marine Biology)	Kenya Marine and Fisheries Research Institute (KMFRI), http://www.kmfri.co.ke P.O. Box 81651, Mombassa, Kenya. Telephone 254-11-475154; 472527; Fax: 254-11-475157;	forestry surveys & analyses	Forestry data and information (Chapter 8)
SGS – Kenya (several specialists persons)		air quality, noise & vibration, water & sediment quality surveys & analyses	air quality, noise & vibration, water & sediment quality surveys & analyses
Samuel Ndirangu, Masudi Juma Zamo & Joseph Kilonzo (H.Dip. (Marine Biology; Certified divers –	Kenya Marine and Fisheries Research Institute (KMFRI), http://www.kmfri.co.ke P.O. Box 81651, Mombassa, Kenya. Telephone 254-11-475154; 472527; Fax: 254-11-475157;	Underwater PADI divers, underwater photography	Specialist PADI divers for underwater surveys & sampling, underwater photography

rescue/scientific divers))			
Port Reitz fishermen			
Kennedy O. Opiti	KWS		
Charles Muthama, Benson Rege and Richard Angwenyi H.Dip. (sales & marketing; conflict resolutions)		Socio-economic surveys	

KENYA PORTS AUTHORITY

MOMBASA PORT DEVELOPMENT PROJECT

ENVIRONMENTAL IMPACT ASSESSMENT: ADDENDUM 2

October 2013

NEMA EIA License No: 0001206

EXECUTIVE SUMMARY

An Environmental Impact Assessment (EIA) study report for the on-going New Container Terminal Modernisation Project at the Port of Mombasa was done and submitted to the National Environmental Management Authority (NEMA) in 2007. NEMA subsequently issued the license for the project (License No: 0000173) on 7th August 2007.The licence was issued with thirteen (13) conditions to be fulfilled by the proponent. An extension for 24 months was later issued on 26th January 2011 under new license number 0001206 following an application made by the proponent.

Due to the cost implications and complexity of the project the implementation was phased as follows:

Item	Berth(s)	Year
Phase I	20	2011 to 2016
	21	
	Small Berth	
Phase II	22	2014 - 2020
Phase III	23	2014 - 2020

Mombasa Port Development Project Implementation Plan

The EIA study undertaken in 2007 indicated that approximately 100 ha would be reclaimed from the sea in order to create room for the proposed terminal. To achieve this, the proponent intended to harvest sea sand from two offshore locations adjacent to Shelly Beach. However, detailed design of the project has since established that these locations would not yield the required sand volumes.

Addendum 1 presented the necessity for the project to harvest sand from a larger area in order to attain the required 7.5million cubic metres of material for the construction of Phase I.

The proponent now proposes to harvest a further 8.3 million cubic metres of sea sand for the construction of Phase II and III from the same sand harvesting area. This report (Addendum II) covers the predicted effects of the activity on the surrounding environment based on monitoring and evaluation data collected during Phase I. If necessary the monitoring and mitigation measures will be maintained or amended.

This overall project will be significantly beneficial to the country as a regional trading block and transhipment zone. Competition from other regional international ports creates the necessity for expansion of the port in order to meet global demands and to steer the country towards Vision 2030. That said, the EIA study together with this addendum will ensure minimal environmental impact to the rich coastal ecological belt.

Monitoring data (water quality, marine flora & fauna and corals) during Phase I gave an indication that the net effect of sand harvesting in the borrow pit remained within permissible limits. This report proposes to utilise the same methodology but will however increase the monitoring locations for the various parameters.

The Environmental Monitoring Plan for Phase I covered water quality monitoring including turbidity levels twice a day on a daily basis for the duration of the activities. These results showed that the sand harvesting activities did not exceed the target values set in the EIA relative to the baseline levels, which are internationally accepted. Elevated levels were shown in the turbidity results in the month of February 2013, but this was attributed to a combination of spring tide and torrential rains along the coast line at the time of monitoring.

Other parameters such as pH and COD were monitored and results showed levels that would not lead to unhealthy waters. Daily dissolved oxygen (DO) results remained within the range known to be characteristic for supporting aquatic life of above 3 mg/l. At no point did DO levels go below the target level.

The analysis of the data collected from the Fisheries Department shows that the average catch data actually increased compared to the average catch in the previous year when the project was yet to commence.

The activity of sand harvesting was proposed and potential impacts studied in the same area. This addendum, although proposing the activity to be carried out over a larger area, is not increasing resource demand as the sand volume remains the same but spread over a larger area. It thus does not increase the resource demand. It is also felt that by spreading the harvesting over a larger area, the concentration of any negative impacts will be spread out hence reducing the concentration of turbidity in any particular location.

The sand harvesting technique (suction), as well as the depths of the borrow pit and the nature of sea sand reduces the impact of turbidity on critical habitats. The unavoidable impact that will occur is the loss of sea bottom habitat at depths greater that -30m. However, these habitats are not critical and will re-colonise and regenerate in approximately one (1) year.

Local fishermen have raised a number of concerns such as dwindling fish catches as a result of turbidity, damage of fishing gear by the sand harvesting vessel, death of fish as a result of waves and noise from the dredger and risk of small fishing vessels colliding with the sand harvesting vessel. Results of monitoring and investigations outlined in this Addendum negate these allegations. These results have been shared with representatives of fishermen, community leaders, government officials and Lead Agencies at stakeholder meetings convened by KPA. However KPA undertakes to continue holding dialogue with community leaders and representatives of fishermen (BMU heads) with a view to identifying a project that would be of benefit to the fishing community and financing the agreed project as part of the Authority's Corporate Social Responsibility (CSR).

TABLE OF CONTENTS

1. INTRODUCTION

An Environmental Impact Assessment (EIA) study for the proposed construction of a new Container Terminal at the Port of Mombasa ("the Project")was carried out in 2006-2007 by Heztech Engineering Services, *Adala et al*, on behalf of Kenya Ports Authority. The study covered the possible impacts of the construction of three (3) berths and associated dredging works at the Port of Mombasa to the west of Kipevu Oil Terminal (KOT) in Port Reitz. This project is funded by the Japan International Corporation Agency (JICA) under Overseas Development Assistance (ODA) loan. A further study, EIA for the Dredging Works at the Port of Mombasa, was carried out in 2009 by *Adala et al.* Both these studies looked at two components of an initiative dubbed Mombasa Port Development Project (MPDP).

The direct aim of the Project is to develop a new container terminal in Mombasa Port with an area of about 110 ha at the western side of the existing *Kipevu Oil Terminal* over three (3) phases. The Port of Mombasa is one of the main ports in east Africa. It serves landlocked countries such as Uganda, Rwanda and Burundi. Over the years, cargo volumes have increased therefore raising the necessity for the port to increase its container handling and storage capacity as well as have the ability to accommodate larger vessels. Failure to do this means the port would become less competitive in the region and eventually become a feeder port.

The EIA report was submitted and a subsequent license was issued by National Environmental Management Authority (NEMA) under license No: 0000173. The licence was issued on 7th August 2007 with thirteen (13) conditions to be fulfilled by the proponent during implementation of the project. An extension of 24 months was later issued on 26th January 2011 under new license number 0001206. See **Attachment 1**.

Addendum 1 was prepared in February 2012 due to the necessity for the project to harvest sand from a larger area in order to attain the required 7.5 million cubic meters of material for the construction of Phase I.

This report (Addendum II) proposes use of the same sand harvesting area for a further 8.3 million cu. m of sea sand for the construction of Phase II and III. This addendum report covers the predicted effects of the activity on the surrounding environment based on results obtained from monitoring and evaluation data during Phase I.

Summary of impacts of the entire project were predicted as follows in the EIA:

Positive:

1. Improved Infrastructure will open up economic growth and increase business opportunities in the area.
2. Employment opportunities will be created both directly and indirectly.
3. The country and the economy will improve due to greater competitiveness of the port in the region and international maritime industry.

Negative:

1. Loss of residential and commercial property.

2. Loss of fishing grounds.
3. Dust Emissions.
4. Loss of Biodiversity.
5. Noise and vibration.
6. Safety risks.
7. Waste generation.
8. Security risks.
9. Hazardous material handling during the operations phase.
10. Increased traffic.
11. AIDS/HIV prevalence.

On 27th May 2011, Kenya Ports Authority contracted Toyo Construction Ltd (Japan) through competitive bidding to execute **Phase I** of the construction works. Construction of Phase I is currently at 50% completion with sand harvesting works undertaken from November 2012 to May 2013 (7 months). The expected completion of Phase I is February 2016.

The proponent intends to procure the services of a construction company to construct Phase II & III of the original plan from 2014 to 2019.

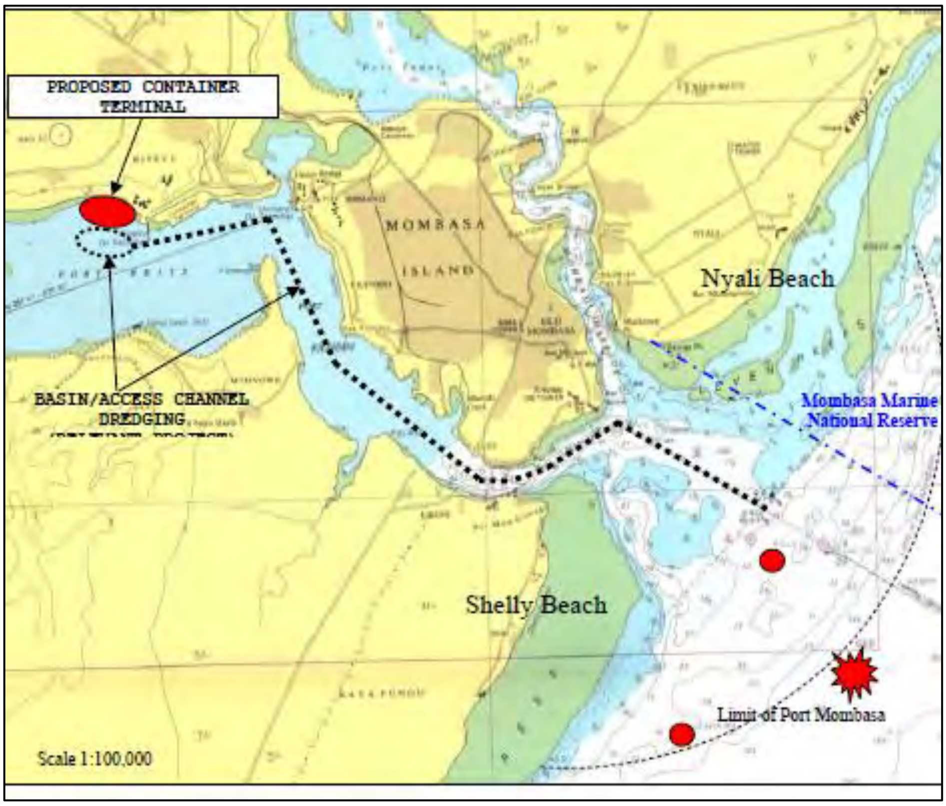


Figure 1.1: Map Illustration of the proposed sand harvesting sites (red circles)
Source: EIA Report, 2007, *Adala et al*

The EIA study undertaken in 2007 indicated that approximately 100 ha would be reclaimed from the sea in order to create room for the proposed terminal. To achieve this, the proponent proposed to harvest sea sand from two offshore locations adjacent to the ecologically rich coast of Shelly Beach, see **Figure 1.1** above. Investigations during the detailed engineering design revealed that sand resources at these locations would not yield the required volumes for construction and that a larger area would need to be considered to ensure adequate sand volumes.

An EIA Addendum report was prepared and approval issued for the same from NEMA on 8th March 2012 **See Appendix 1.**The addendum report presented the necessity for the project to harvest sand from a larger area in order to attain the required 7.5million cubic metres of material. The report highlighted the effects of the activity on the surrounding environment as well as the monitoring and the mitigation measures that would be implemented.

With the planned commencement of Phase II of the project, there is need to harvest a further 8.3 million cubic metres from a larger area but in the same location as shown in **Figure 1.2**. This area will provide the required amount of sand with little environmental impact, particularly to the critical habitats and environmentally sensitive areas around the Mombasa Coast.

This report seeks to justify the need, predict impacts, present the results of previous monitoring data and amend the Environmental Monitoring Plan (EMP) accordingly.

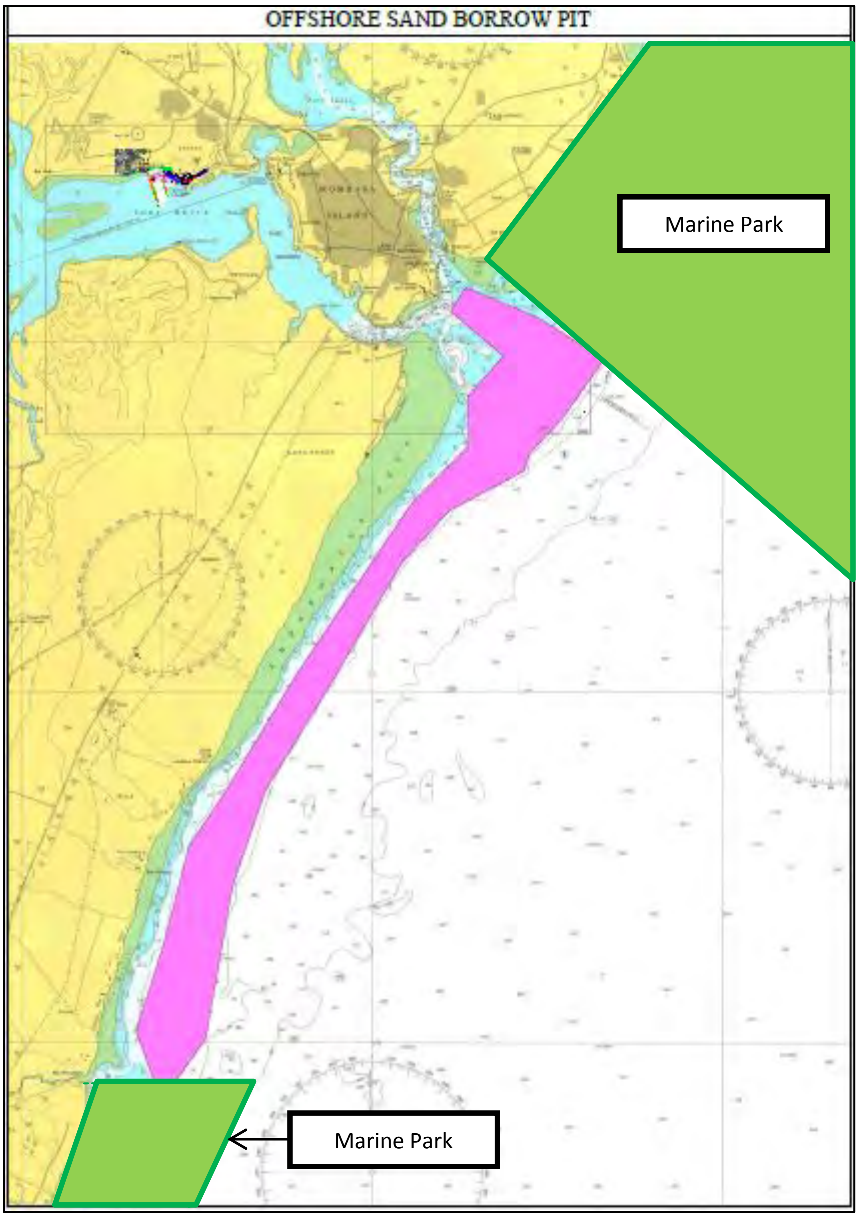


Figure 1.2: Revised Sand Harvesting Location (Sand Borrow Pit)
Source: MPDP

2. PROJECT DESCRIPTION

2.1. Introduction

The Project (Phase II and III) consists of the construction of the following facilities:

1) Construction of two main berths, i.e. Berth No. 21 (Water depth: -15m) and No. 22 (water depth: 15m).

2) Construction of the Apron, Container Yard and Yard Roads/Rails tracks behind the berth.

3) Construction of Utilities for supply of water and electricity, communication, sewage, security, etc.

4) Other Miscellaneous Works. These include extension of the railway and road in the existing container terminal to the New terminal.

5)

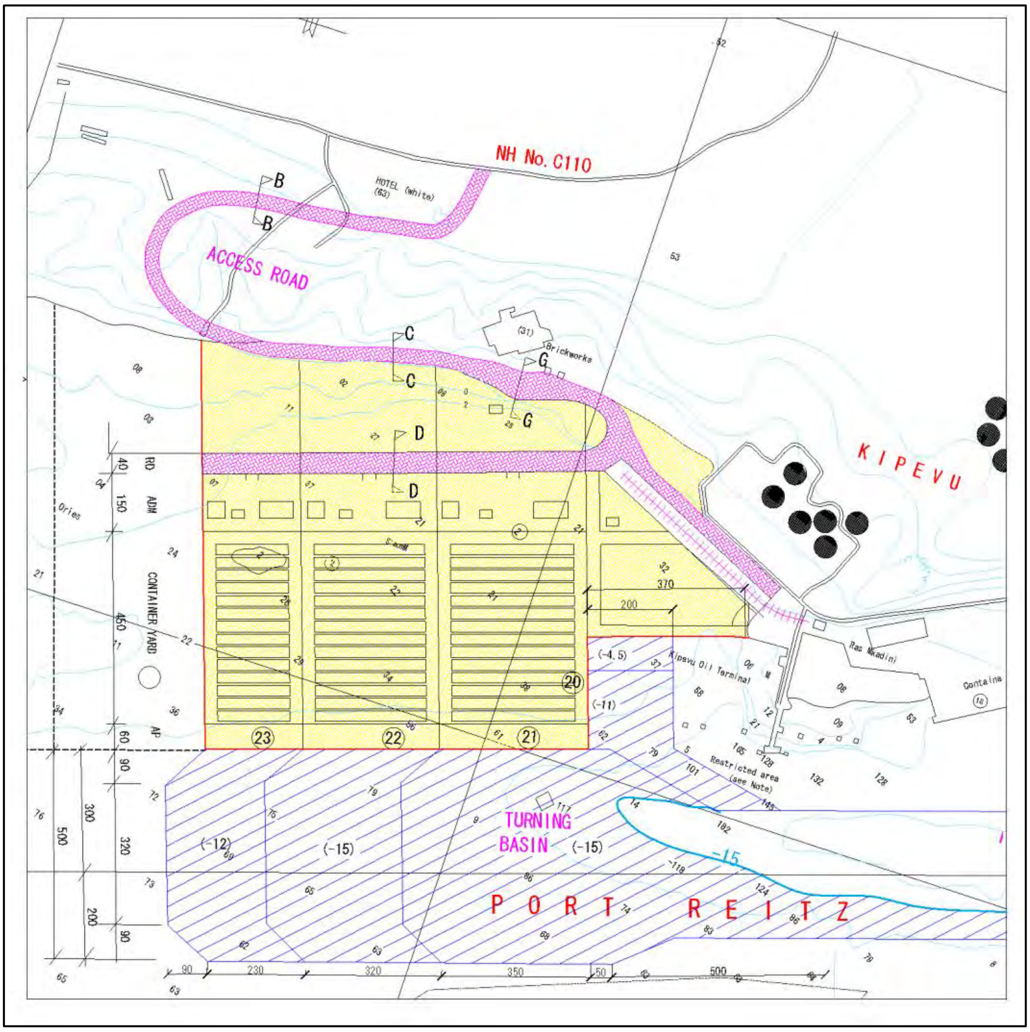


Figure 2.1 –Layout of Proposed Container Terminal
Source: MPDP

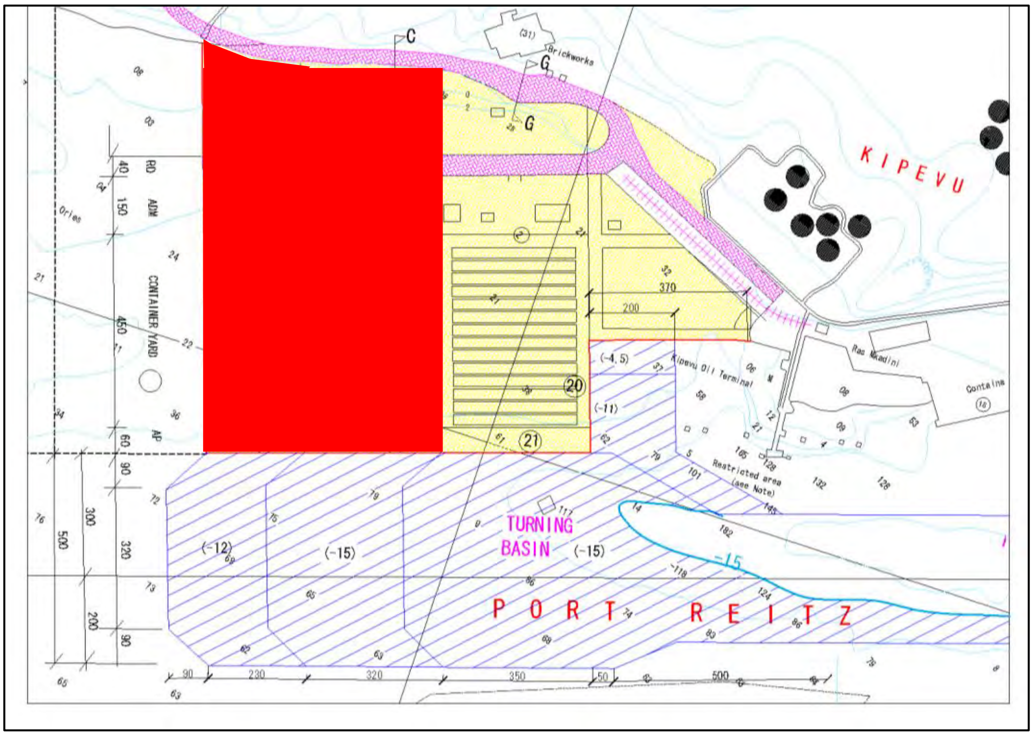


Figure 2.1 – Phase II & III (Red)
Source: MPDP

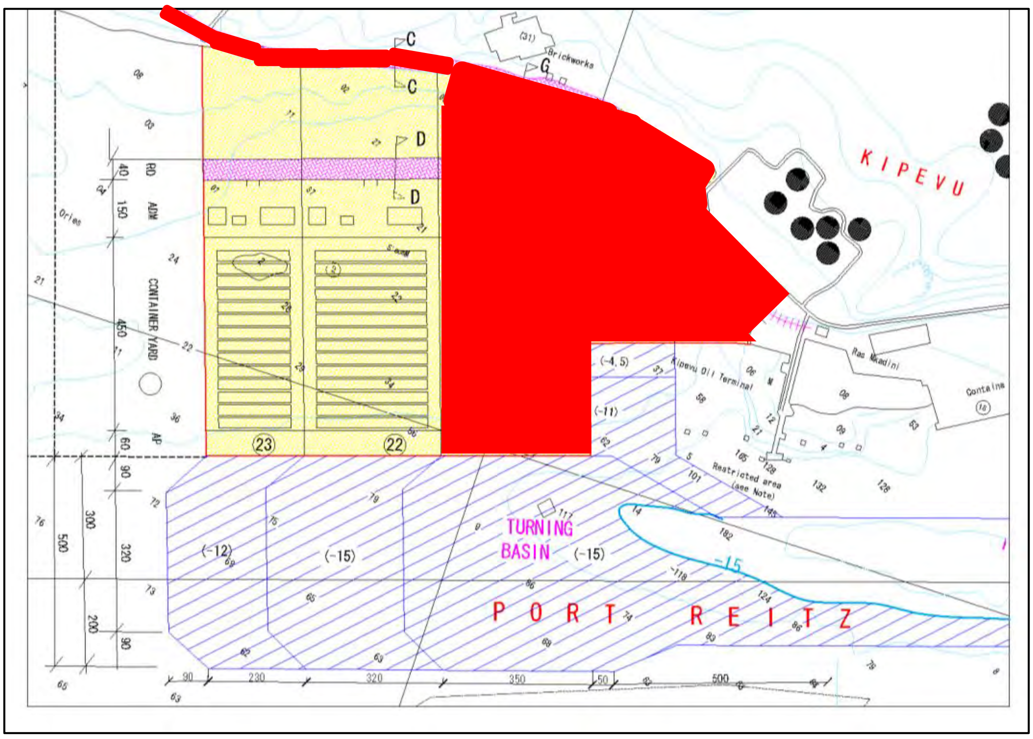


Figure 2.2- Phase I (Red)
Source: MPDP

2.2. Project Implementation Schedule for Phases II and III

No.	Category	Unit	Q'ty
A	Civil Works and Buildings		
	Preparatory Works	Ls.	1
	Sand Replacement		
	Excavation	m3	1,250,000
	Sand Filling	m3	1,300,000
	Reclamation	m3	5,200,000
	Revetment & Retaining Wall		
	Rock Placing	m3	270,000
	Coping Concrete	m	700
	Berth 22 Construction		
	Steel Pipe Pile Driving	Nos.	462
	Superstructure	m2	11,200
	Berth 23 Construction		
	Steel Pipe Pile Driving	Nos.	336
	Superstructure	m2	8,050
	Soil Improvement		
	PVD Driving	m	575,000
	Surcharging Sand Filling	m3	1,500,000
	Pavement Works (Yard)	m2	320,000
	Flood Water Drainages	m	3,600
	Trunk Road and Backyard	m	550
	Buildings	Ls	1
	Utilities	Ls	1
B	Equipment	Ls	1

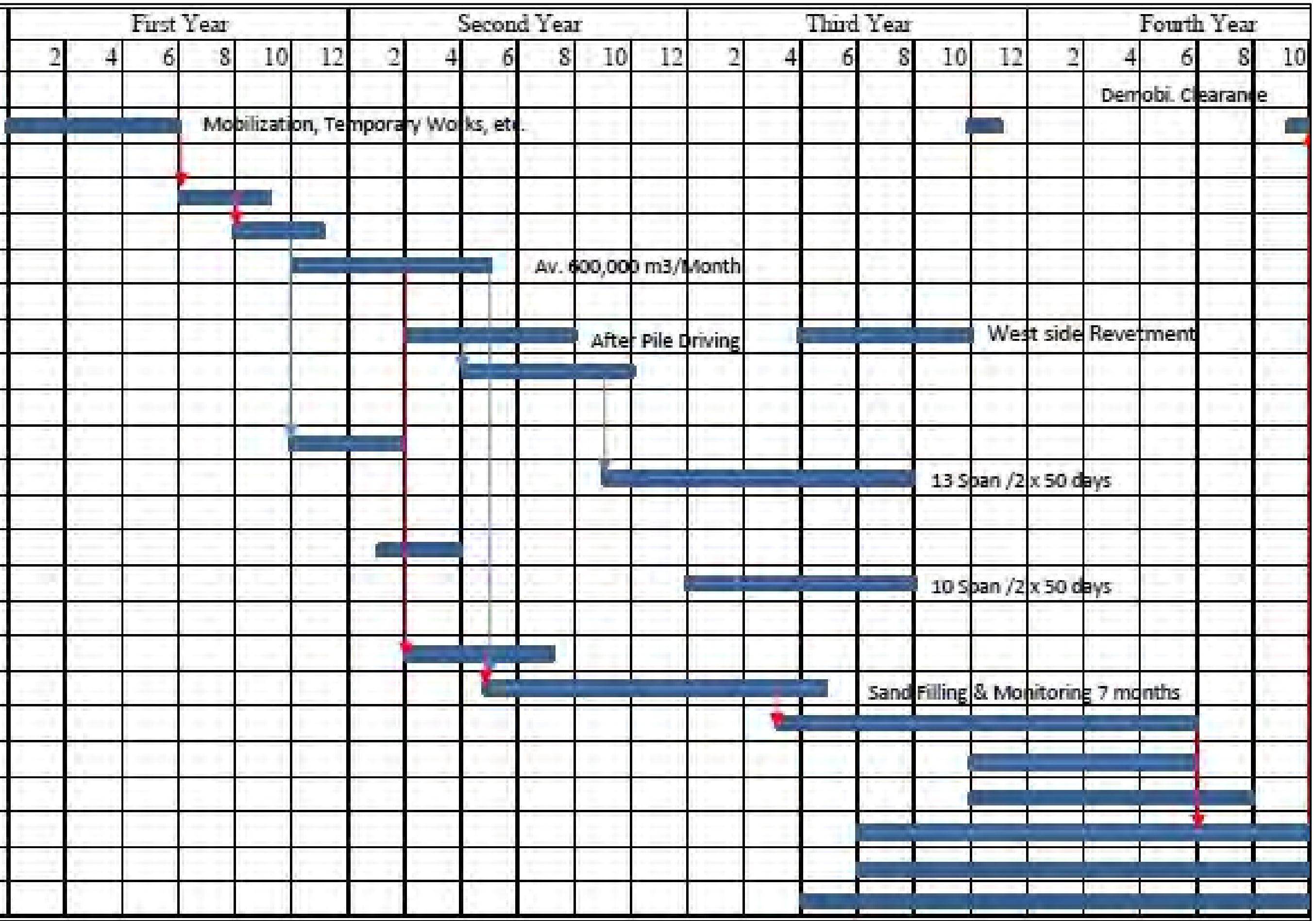


Figure 2.3 – Implementation Schedule
Source: MPDP

3. NATURAL CONDITIONS

3.1. Meteorological Conditions

Mombasa is located at Longitude $39^0$40” E and Latitude $4^0$4’’ S (KPA Headquarters) on the east coast of Kenya, facing the Indian Ocean. Mombasa is located on the tropical monsoon area.

3.1.1 Wind

The *Northeast Monsoon* (NE) typically occurs from December to February, which is “the dry season” and the *Southwest Monsoon* (SW) from April to October, “the rainy season.” There are also the *Inter Monsoon Seasons* (March-April and September-November).

During the NE Monsoon, according to UNEP (1997), 50% of wind is blown from the East (maximum: 7.7m/sec, average: 5m/sec), 29% from Northeast (maximum: 4m/sec, average: 3m/sec) and 21% from the North (maximum: 2m/sec, average: 1m/sec). In the SW Southwest monsoon 75% of wind blow is from the South (maximum: 9.0m/sec, average: 5m/sec) and 25% from the Southwest (maximum: 5m/sec, average: 4m/sec).

The maximum wind, ever recorded at Moi International Airport during a period of 10 years from 1995 to 2005, was **22.5m/sec** from 120 degrees (counted from the North), i.e. from the **ESE** direction, which occurred in the months of July and August.

The above wind data implies that the operations at the Port of Mombasa are seldom affected by wind.

3.1.2 Temperature

According to UNEP, in Mombasa, the highest average temperature of 33° occurs in February, and the minimum temperature occurs in July, of about 20°.

3.1.3 Rainfall

The maximum rainfall occurs in May, 240mm/month, and minimum in January and February, less than 20mm/month.

Rainfall intensity is one of the most important design conditions in a container terminal project. This is because a container terminal requires a broad yard area, and its drainage system becomes an important consideration. At Moi International Airport, according to the Kenya Meteorological Department, the rainfall intensities recorded in the past 10 years from 1995 to 2005 are as follows:

- Rainfall per hour : **50mm/hour**,
- Rainfall per day : 206mm and 233.3mm/day,
- Rainfall per week : 552.8mm/week, and

- Rainfall per month : 825.7mm/month.

The above extremes occurred during the months of *El Nino* from October 1997 to February 1998.

3.2. Geographical Conditions

The Port of Mombasa in Kenya is located at S 4°3.1’and E39°36.8’on the east coast of Africa, neighbouring Somalia to the north and Tanzania to the south. It has borders to Ethiopia, Sudan and Uganda on the land. Rwanda, Burundi and D.R. Congo have access to the Port of Mombasa through the bordering countries and Lake Victoria.

The major ports along the east coast of Arabia and Africa are, from the north, Salalah in Oman; Djibouti in Djibouti; Mombasa in Kenya; Zanzibar and Dar es Salaam in Tanzania; Beira and Maputo in Mozambique; and Durban, East London and Port Elizabeth in South Africa. On the Indian Ocean there are the ports of Port Victoria in Seychelles and Port Louis in Mauritius. Mombasa constitutes the gateway of the so-called “Northern Corridor” of East Africa from Kenya to the above mentioned landlocked countries in Central Africa. Dar es Salaam is the gateway port of the Southern Corridor, linking with Zambia, Burundi, Rwanda, D.R. Congo through Lake Tanganyika, and to Uganda and Kenya through Lake Victoria.

4. ENVIRONMENTAL CONDITIONS (BASELINE)

4.1. Introduction

The proponent, through the contractor for Phase I, carried out baseline surveys in October 2012 to ascertain the conditions of the environmental parameters prior to the commencement of the construction activities. The results of this report will be used to form a baseline for this addendum on the natural conditions of the project area of the proposed sand harvesting area.

Other terrestrial parameters such as air, vibration, traffic will not be covered as the sand harvesting activity (the addendum) will be primarily marine based. The other parameters remain as per the original EIA and are managed in line with the EMP approved with the ESIA report in 2007.

The coast of Mombasa is diverse and rich environmentally, economically and socially. The *EIA Report for Container Terminal Project, 2007* describes in detail the nature and location of all the critical habitats relevant to the project area. The following are the key environmental issues and critical habitats that were considered relevant for this report. Further details of each of these considerations can be found in the main EIA report and the *EIA Report for the Proposed Dredging Works at the Port of Mombasa (Adala et al) 2009*.

4.2. Marine Protected Area (MPA)

Mombasa National Park and Reserve (MNPR) is one of the five nationally gazetted MPA's in the country and extends to approximately 200km^2, lying between Tudor Creek and Mtwapa Creek. Within the reserve exists a Marine Park of approximately 10 km^2. The Government of Kenya has mandated Kenya Wildlife Service (KWS) to manage these protected areas. Mombasa Marine Park and Reserve contains reefs and diverse species of fish and marine life. Sandy beaches are also found in the park such as Nyali Beach. A lagoon separates the sand flats of the Marine Park and the coral reefs (*Leven reef*) which contain seagrass beds, a source of fisheries for artisanal fishing. The Marine Park also contains a coral garden.

One Marine Reserve can be found to the south of the proposed sand harvesting site and the other to the north. There are no proposed national parks or reserves in the immediate area of the proposed sand harvesting site.

4.3. Sea Turtle Nesting Grounds

Five species of sea turtles have been documented as occurring within Kenyan waters (Frazier 1975). The Green turtle. Hawksbill turtle and Olive Ridley turtle are known to nest in Kenya. There have been sightings of sea turtles in the area and the beaches on the North Coast of Mombasa, within the Mombasa National Park.

4.4. Mangrove Forest

Mangrove vegetation can be found in the coast of Mombasa. Areas of Port Reitz have the most extensive coverage where rivers *Mwache* and *Cha Shimba* converge – an island of mangrove has also been formed in Kipevu Channel, Port Reitz. Anywhere that mangrove exists is classified as a Mangrove Forest area and thus protected by the Forestry Act. Common species are *SonneratiaAlbo, RhizophoriaMucronate, AvicenniaAmrina* and *CeriopsTagar*.

4.5. Coral Reef and Rocky Platform Communities

EIA for Access Channel Dredging, 2009 by *Adala et al* carried out LandSat Imagery which showed that algae and sea grass are the dominant cover in the areas studied relevant to the project. Coral cover varied with the Shelly Beach sampling location showing the lowest coral cover. The other sampling sites were along Reefs which are adjacent to Nyali Beach which is considered important for hard coral. The Shelly Beach sampling site also had high algal cover, dominated by turf alga and the *Sargassum macro* algae. Coral reefs are important as they provide shelter for numerous species of fish. Reef fish and molluscs are sources of food to millions of people. Coral are also important as they react with CO_2 to form limestone shells thus controlling the CO_2 levels in the sea water.

4.6. Fisheries

Marine fishing is a major source of livelihood, with the coast of Kenya accounting for 10% of the total fish catch in Kenya. Along the Kenya coast, rich inshore marine fishing grounds are found around Lamu Archipelago, Ungwana Bay, North Kenya Bank and Malindi Bank (Kensea).

A total of approximately 1,349 fishermen are registered to fish and land at 28 landing sites of Mombasa District, of which Port Reitz has 324, Changamwe has 313, Likoni has 324 and Old Port with 58 (Marine Fisheries Frame Survey, 2006). Traditionally, the coastal communities have always depended on fisheries as a major source of income and food. To control bad fishing practises, the government, through its agencies, has established Beach Management Units (BMU's) which comprises of people from fishing communities tasked with managing fishing activities in their locality and related fishing grounds.

The Major Fish caught in the Diani Area are as follows:

Demarsalas:

Rabbit Fish (Siganidae)
Scavengers (Linthridae)
Snapper (Lutjanidae)
Parrot Fish (Scaridae)
Surgeon (Acanthuridae)
Unicorn (Nasobrevirosyris)
Grunter (Haemulidae)
Pouter (Caphalopholisargus)
Black Skin (Gaterinsordi)
Goat Fish (Mulidae)
Streaker (Aprionvirescens)
Rock Cod (Serranidae)
Cat Fish (Aridae)
Mixed Demarsals

Pelagics:

Cavalla J. (Euthynnuspelamis)
Mullets (Mulilidae)
Mackerel (Kanaguta)
Barracuda (Sphyranidae)
Milk Fish (Scombridae)
Queen Fish (Chorinemustol)
Sail Fish (Istiophoridae)
Bonito/Tuna (Arangidae)
Dolphin/ Dorado (Colyohaenidae)
Mixed Pelagics

Custacea:

Lobsters (Penulirusspp)
Prawns (Paenusspp)
Crabs (Scyllaridae)

Miscelleneous:

Sharks/ Rays (Carcharhinidae/other)
Sardines (Clupeidae)
Oysters
Bech-de-Mer (Holothuroidae)
Octopus (VugarisSpp)
Squids (Sepia Oligo)

4.7. Seagrass Beds.

Seagrass is an important source of food for many organisms such as juvenile fish, crustaceans and shellfish. Seagrasses are also a nursery ground for organisms such as lobsters, shrimp, etc. Seagrass species can be found along Shelly Beach and Nyali Beach areas. Port Reitz has no significant seagrass species. The species found at Shelly and Nyali beaches include *Cymodoceaserrulata, Cymodocearotundata, Haloduleuninervis, Syringodiumisoetifolium, Thalassiahemprichii, Thalassodendronciliutum, Halophilaovalis*and*Halodule spp.*

5. ENVIRONMENTAL PERFORMANCE

5.1. Environmental Monitoring Plan (EMP)

An environmental monitoring plan was prepared based on recommendations of the EIA study report by *Adala et al*. The EMP will ensure that during construction environmental quality parameters do not exceed prescribed target limits.

The main objectives of the EMP are to:

i. Monitor compliance with prevailing regulations, specifically; ensuring that the conditions of approval of the EIA are adhered to;
ii. Monitor whether the environmental aspects predicted at the EIA are significantly affected and to measure changes that occur;
iii. Assess the adequacy of the environment monitoring such as locations, schedule, methods etc and make adjustments to improve the performance of monitoring if required;
iv. Monitor the effectiveness of the adopted EMP to ensure compliance with laws; and
v. Prescribe mitigation measures to eliminate or minimize adverse impacts.

Table 5.1: Parameters Monitored Regularly

Item	Frequency	Parameters	Target
Water Quality	Twice Daily	Turbidity	+50 mg/l (harbor) +3 mg/l (offshore)
	Monthly	Temp, PH, Salinity, organics, Nutrients, Coliforms	World Bank
Sediment Quality	Once before excavation	Heavy Metals, Grain Size and Organics	World Bank
Air Quality	Quarterly	0_2, CO_2, H2S, NO_2, CO and SO_2	EMCA 1999
Noise	Quarterly	$L_{max,}L_{min}$, Leq Levels	Noise and Vibration Regulations
Vibration	Quarterly		Noise and Vibration Regulations
Terrestrial Ecosystems	Biannually	Absence/ presence and abundance	Maintained
Marine Ecosystems	Biannually	Absence/ presence and abundance	Maintained

Source: MPDP EMP

5.2. Water Quality Monitoring

5.2.1. Sources of Water Quality Degradation

Monitoring of water quality is a major component of the EMP. Primary sources of degradation of water quality during construction stage are **excavation/ sand harvesting**, **disposal** of materials and **reclamation** works.

1) Excavation Work & Sand Harvesting

Taking into account the possible **excavation and sand harvesting** methods/equipment i.e. trailer suction dredger for foundation improvement work of quay wall, no significant increase of surrounding water turbidity was is expected. However, if unacceptable level of suspended solid (SS) concentration is found around at the excavation site, the following measures will be taken immediately:

- Restrict overflow operation during dredged material loading;
- Reduce excavation volume per day;
- Use special excavation equipment to minimize agitation of bed material if the material is significantly contaminated.

2) Disposal of Excavated Materials

Excavated materials will be disposed at a designated open water dumping site keeping a distance more than 3km from biological sensitive areas, such as existing coral reef, sea grass bed and Mombasa Marine National Reserve.

According to the numerical simulation conducted by KPA, the turbid water column will not reach beyond 3 km from the dumping location. However, if monitoring results show unacceptable levels of SS concentration measured at the monitoring points which are placed at said biological sensitive areas the following measures will be taken immediately:

- Reduce disposal volume per day
- Relocate dumping site further offshore (agreement with NEMA required)

3) Reclamation

Since filling material for reclamation work is expected to be sand, no high levels of turbid water is expected at the reclamation site as opposed to other types of material such as mud. The discharge areas will have enclosures of temporary revetments and a settlement pond for excessive water discharge. This should reduce the dispersal of turbid water plumes. However, if unacceptable levels of SS concentration are measured at the monitoring points, the following measures will be taken with immediacy:

- Place additional settlement pond
- Reduce filling volume per day
- Place silt protection curtain around the excessive water discharge point.

5.2.2. Baseline Water Quality Conditions

A robust testing regime was adopted in line with the EIA in order to monitor the quality of water throughout the construction phase. The objectives of monitoring were twofold:

a. To assess the variation in water turbidity and Total Suspended Solids (TSS) due to project activities which could alter the physical and chemical characteristics of the area in the Mombasa Port harbour, dumping area and offshore sand borrow pit.

b. To assess the effectiveness of environmental management programs designed to minimize surface water contamination.

Water quality monitoring was undertaken at 10 monitoring points using a multi-parameter water quality meter WQC-24 (**Appendix 4**) which gives in-situ readings for pH, dissolved oxygen, conductivity, temperature and turbidity. **Table 4.1 or 5.1** below:

Table 5.1: The GPRS of the Water Quality Monitoring Points

Monitoring Points at Construction Site	
T1	x – 0568029, y – 9552956
T2	x – 0568155, y – 9552577
T3	x – 0568281, y – 9552197
T4	x – 0568408, y – 9552133
T5	x – 0568740, y – 9552244
T6	x – 0568729, y – 9552591
T7	x – 0568072, y – 9552354
Monitoring Points Offshore	
Point 1	x – 0574512, y – 9544349
Point 2	x – 0575905, y – 9546601
Point 3	x – 0579822, y – 9549056

Source: MPDP EMP

For baseline monitoring, water quality monitoring was done continuously for 30 days prior to the commencement to determine both turbidity and chemical properties. Water samples were also collected and tested for Total Suspended Solids to determine the correlation between turbidity in Nephelometric Turbidity Units (NTU) and TSS in mg/l.

The results of the baseline survey indicated that turbidity is potentially a viable surrogate measurement for determining TSS. Based on these results the monitoring limits were set as follows:

	Baseline Average	**Target value**
Harbour Waters	10mg/L	70 mg/L
Offshore	1 mg/L	3 mg/L

5.2.3. Monitoring Objectives

i. To assess the variation in water turbidity and TSS due to project activities which could alter the physical or chemical characteristics of the area in the Mombasa Port Basins, offshore dumping area and offshore sand borrow pit;

ii. To assess the effectiveness of environmental management programs designed to minimize surface water contamination.

5.2.4. Monitoring Methodology

Water quality monitoring was undertaken at the prescribed monitoring points at the project site using a water quality meter model **WQC-24**. Baseline monitoring was conducted between the 18th day of July 2012 and 16th day of August 2012. Direct reading for turbidity was done using the turbidity meter for points T1 to T7 for 14 days while samples were collected from points T2, T4 and T7 for 30 days. Sampling was done simultaneously with direct reading of other required parameters at 50cm, 3m and 6m. Samples were then taken to the NEMA approved laboratory for testing of TSS.

A relationship between turbidity and TSS was determined from the water samples collected. The Model WQC-24 (See Attachment 2) is the latest development in DKK TOA's range of multi-parameter water quality meters. Available parameters include: pH, DO, Conductivity, Salt, Total Dissolved Solids, Temperature and Turbidity.

Figure 5.1: Water Quality meter and Sensor Module (WQC 24)

Figure 5.2: Sampling

Water quality monitoring was done continuously for 30 days prior to the commencement of works for both turbidity and chemical properties.

There were 10 monitoring stations for water quality monitoring categorized as onshore and offshore points. There were seven (7) onshore points (T1 to T7) while offshore points were three namely (1, 2 and 3). The GPS coordinates and the maps for the locations are as follows:

Table 5.2: Water Monitoring Locations

Location	Coordinate
T1	X=0568029, Y=9552956
T2	X=0568155, Y=9552577
T3	X=0568281, Y=9552197
T4	X=0568408, Y=9552133
T5	X=0568740, Y=9552244
T6	X=0568729, Y=9552591
T7	X=0569072, Y=9552354
Point 1	X=0574512, Y=9544349
Point 2	X=0575905, Y=9546601
Point 3	X=0579822, Y=9549056

Points 1, 2 and 3 were for offshore monitoring. Points T1 to T7 were located within the harbor.

5.2.5. Data Analysis

a) Relationship between turbidity and TSS using Excel

Water samples were primarily collected for determining the correlation between total suspended solids and turbidity levels. It was established that there exists a linear relationship between the concentration of TSS and turbidity, which varies between differing environmental conditions.

This relationship may be influenced by the type of sediment in suspension. If there is a wide scatter, it can be an indication that samples contain different types of material. The overall average graph from week one to week five was done to show the results as illustrated in **Figure 5.3.**

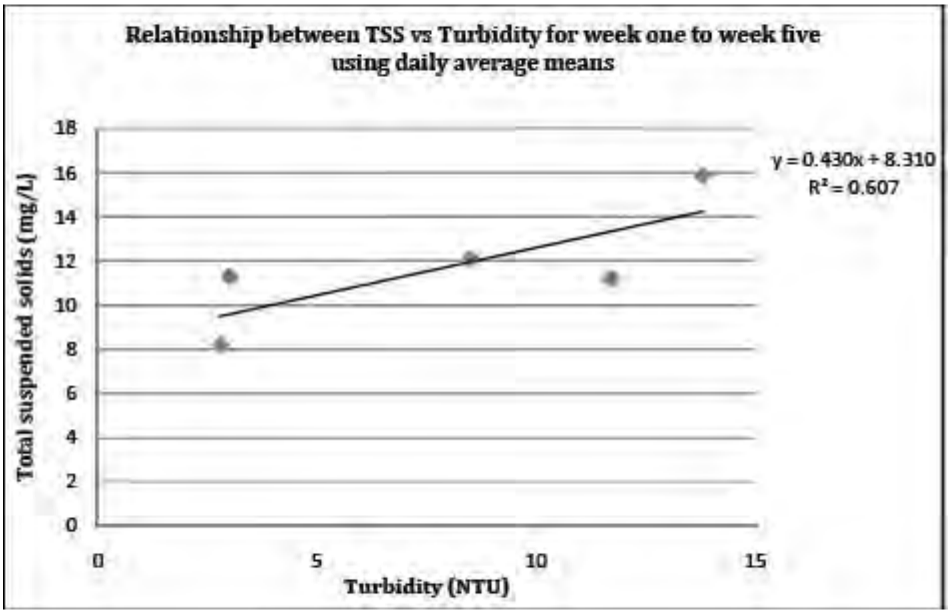


Figure 5.3: Relationship Between TSS and Turbidity using daily average means.

Note: Thee R^2 value is an indication of how well the fit is: 1 is for perfect; 0 is no fit at all

From the above graph, the line of best fit is shown and a high R square value is achieved. However this does not give any information on how adequate or inadequate the fit is per location nor does it give any information on the probability that a new data point will follow this equation. Furthermore these built-in trend lines are based on linear regression.

b) Data Analysis using Statistical Package for Social Sciences (SPSS).

		Turbidity (NTU)	Total Suspended Solids (mg/l)
Turbidity	Pearson Correlation	1	.779
	Sig. (2-tailed)		.120
	N	5	5
Total Suspended Solids	Pearson Correlation	.779	1
	Sig. (2-tailed)	.120	
	N	5	5

The correlation of TSS and Turbidity is 0.779 with an exact significant level of 0.120 which is a very good significant level. A two tailed test of significance was requested.

Five sets of averaged weekly data were used to obtain the correlation coefficient which was displayed in a matrix format. The diagonal of the matrix consists of the variable correlated with it giving a perfect correlation of positive 1 thus proving there is a significant positive relationship between turbidity and total suspended solids. Therefore, an increase in TSS results to increase in turbidity and vice versa.

c) A Relation Mean Plot of TSS (mg/l) against Turbidity (NTU)

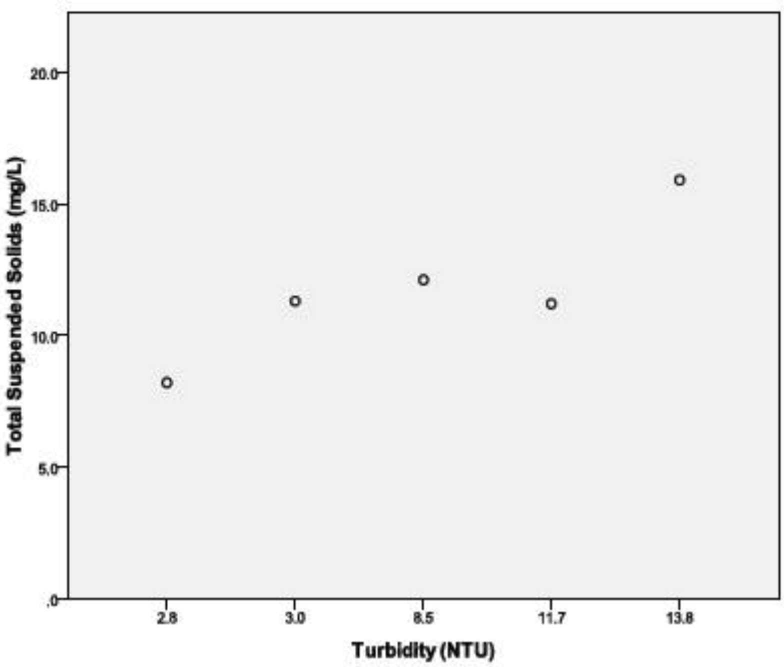


Figure 5.4: Relation Mean Graph

The scatter of points is relatively narrow, indicating that there is a reasonably high correlation. It is observed that the slope of the scatter lies in a fairly straight line. When the relationship between TSS and Turbidity was examined, there was no evidence of a curvilinear relationship or the undue influence of outliers.

5.2.6. Discussions of the Findings

The results of this survey indicate that turbidity is potentially a viable surrogate measurement for determining total suspended solids (TSS) concentrations. Data collected from the three scheduled locations for one month show a relatively strong positive linear correlation. (R2=0.6072) between turbidity and TSS. The utility of this model will be important in predicting the TSS levels (e.g., suspended solid estimates from dredging activities) from continuously measured turbidity levels during the construction works. Such a method is feasible because changes in TSS concentration have large effects on a turbidity reading. The relationship shows a scatter plot, this is probably due to natural variability in size, shape, and composition of the suspended solids as well as water colour. Other environmental parameters such as dissolved oxygen (DO), pH and salinity were often constant with little or no variation in the readings taken.

5.2.7. Results and Discussions of Offshore Monitoring

The variation in water turbidity during the baseline depended on the location of the monitoring station. Much variation was often observed at point 3. There were times when the turbidity readings were high at this location. Point 3 is virtually away from the channel. It is characterized by shallow waters in comparison to other locations. This fact might be responsible for the great variation in NTU. Point 1 was near the reef. This point recorded the least averaged turbidity readings. The levels of Dissolved Oxygen at this point also varied. This can be attributed to the fact that there is coral presence. Corals are under threat from a number of factors including climate change, ocean acidification, blast fishing, cyanide fishing for aquarium fish, overuse of reef resources, and harmful land-use practices, including urban and agricultural runoff and water pollution, which can harm reefs by encouraging excess algal growth. They therefore grow best in warm, shallow, clear, sunny and agitated waters thus explaining the conditions of chemical characteristics of water at point 1.There was little variation at Point 2 which is also within the vicinity of the reef but located more to the continental slope.

In-situ water monitoring has since been carried out twice a day, every day of marine construction activities with the WQC-24 and water samples collected every ten days for laboratory analysis at a NEMA accredited laboratory.

Results of daily monitoring are sent on a weekly basis to environmental agencies to promote transparency. Reports are sent to NEMA, KMA and Fisheries regularly. All monitoring visits were inspected by the project consultant, verified and cross referenced for quality control purposes.

Results were primarily within the target limits with isolated cases of elevated levels which could be attributed to instrumentation and varying baseline conditions. These incidences were observed and if following monitoring visit showed similar results, mitigation would be considered. The main graph in **Figure 5.5** below shows the average TSS levels for offshore monitoring since November 2012 through to May 2013.

5.2.8. Total Suspended Solids (TSS) Monitoring

As per TSS monitoring data, shown in **Figure 5.5,** the target limits were maintained. Elevated levels were seen in the month of February 2013 but this is attributed to a scenario where torrential rains and spring tide at the coast combined to lead to an elevated baseline. The project introduced a control monitoring point located in Tudor Creek to monitor fluctuations in natural baseline conditions.

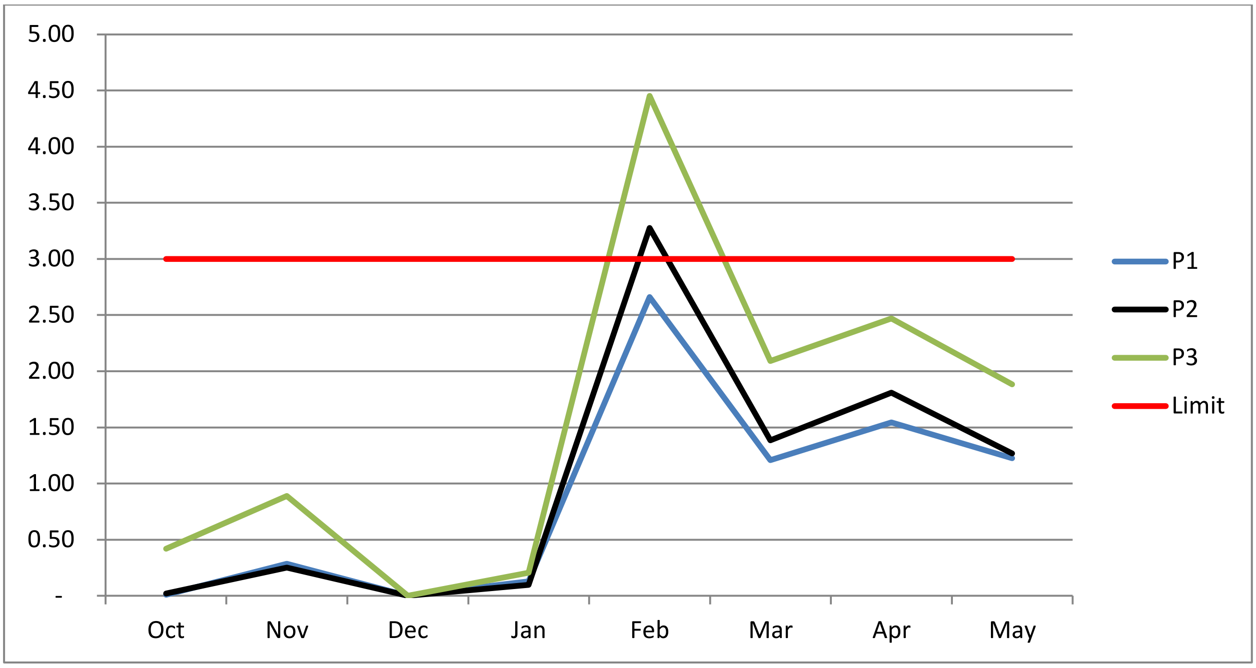
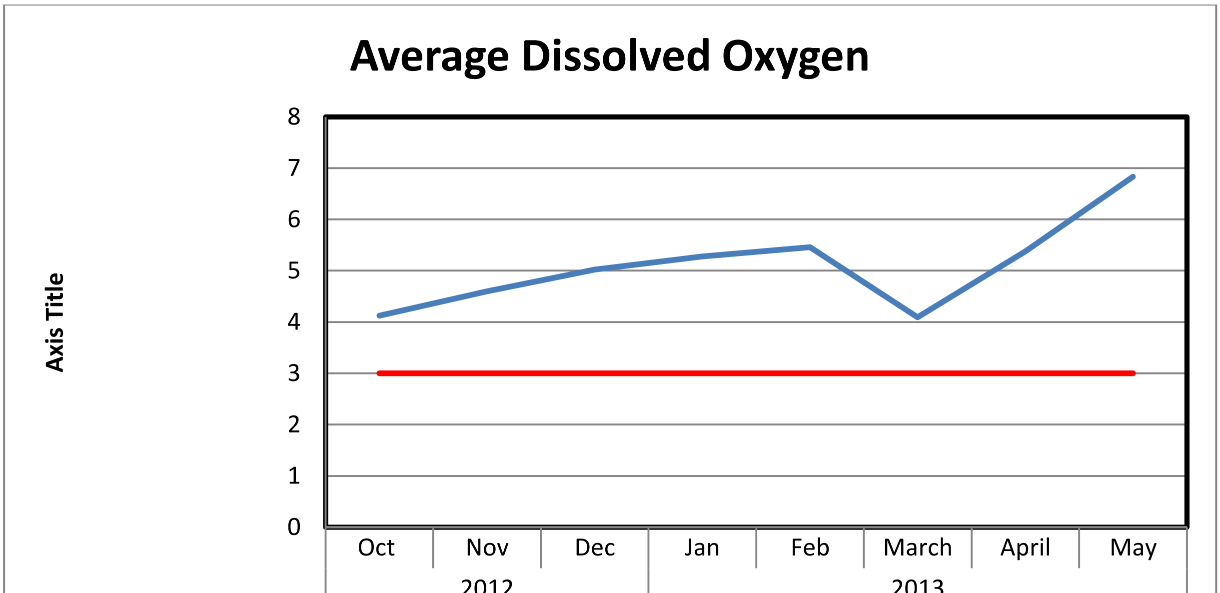


Figure 5.5: Average TSS mg/l per month

5.2.9. Dissolved Oxygen

Dissolved Oxygen (DO) results were looked at from October 2012 to May 2013. A summary of DO monitoring data is shown in **Figure 5.6** below:



	Oct	Nov	Dec	Jan	Feb	March	April	May
		2012				2013		
Average DO	4.12	4.60	5.02	5.28	5.46	4.09	5.38	6.83
Lower Limit (mg/L)	3	3	3	3	3	3	3	3

Figure 5.6: Average DO mg/l per month

Daily dissolved oxygen results remained within the range known to be characteristic for supporting aquatic life of above 3 mg/l. At no point did DO levels go below the target level.

5.3. Marine Ecosystems (Coral & Sea Grass)

Monitoring of coral reef benthic communities is done to understand ecological drivers of natural differences in community structure or to observe direct and indirect shifts in benthic community composition related to major disturbance. Population processes such as recruitment; competition, predation and mortality fluctuate naturally in response to environmental conditions and levels of disturbance (Connell et al. 1997; Connell et al. 2004) and can produce very different benthic communities that support different fish assemblages. Disturbance of coral reef benthic communities can be as a result of tropical storms, floods, overfishing, coral bleaching or a combined response of several of the above categories.

A survey on marine vegetation and fauna is carried out at 5 monitoring points (see figure 4.1 and Table 4.2) of ecological interest to monitor the effects of the project on marine activities. The frequency of the monitoring is twice a year for the duration of construction works. The sampling is carries out monitoring using Underwater Visual Census (UVC).

Figure 5.7: Flora & Fauna Monitoring Locations

Coordinates of the sites are as follows:

Table 5.3: The GPRS of the Water Quality Monitoring Points

Flora and Fauna Monitoring	
Site-1	x – 0577311, y – 9550254
Site-2	x – 0578556, y – 9550596
Site-3	x – 0576613, y – 9550388

Site-4	x – 0575363, y – 9548361
Site-5	x – 0579528, y – 9552420

Monitoring of coral reef is important in order to maintain aquatic ecosystems. While the definitions of coral reel health vary based in location and context, a healthy coral reef is generally one that has moderate to hard coral cover in the range of colony sizes and species; low macro algal cover and abundant fish populations across all trophic and functional groups (Connell et al 1997).

Once baseline conditions were established, subsequent monitoring surveys compared the presence and abundance of marine flora and fauna.

5.2.1. Results

The results for change in colonies/numbers of marine flora and fauna in relation to baseline survey data is shown in **Table 5.4** below.

Table 5.4: Abundance of Marine Flora & Fauna (March 2013)

Item	Site 1	Site 2	Site 3	Site 4	Site 5
Corals	-14	-4	+6	+15	+10
Sea Urchins	-57	0	+62	+235	-42
Starfishes	-2	+1	-1	-60	0
Fishes	+19	+2	0	-14	+649
Crustaceans	-1	+1	+3	-35	+11
Molluscs	0	+3	+1	-45	+2

Key: 0 = No Change

+ = Increase

- = Decrease

5.4. Fishing Industry

5.4.1. General

During the implementation of Phase I, concerns were raised by fishermen that the activities of sand harvesting were reducing the fish catch along the Coast of Kwale County. The Fishermen put forward their concerns to The County Fisheries Officer, Fisheries Department in a letter received 8th January 2013 in which they stated the following:

1. The waves and noise being generated by the dredger vessel is leading to the death of fisheries in the area and is also chasing away certain species of fish.
2. The propeller of the vessel has damaged fishing gear in particular fishing nets.
3. The proximity of the borrow pit is a safety hazard to the fishermen and small fishing vessels are at risk of collision with the sand harvesting vessel.
4. The suspended sediment from the activity has caused the surrounding water quality to be deteriorated (muddy). This has impacted on spawning grounds and overall fish catch has been reduced by 98%.
5. The socio-economic impact has resulted in children unable to go to school as fees cannot be raised.

6. An EIA needs to be conducted and a MOU signed between the BMU's and the proponent (KPA) to compensate for these losses.

5.4.2. Stakeholder Meetings

In response to the above letter a meeting was held at the Office of the County Commissioner on the **21st January 2013** with representatives from all stakeholders present.

The agenda of the meeting was to address the issues raised in the complaint letter from the fishermen, to ascertain the significance of impacts of sand harvesting activities on the fishing community of Diani-Waa Area and to agree on the way forward.

The fishermen explained their letter in detail and suggested forms of compensation sought. They pledged to not interrupt the activities based on the goodwill that the proponent and government agencies would look into their plight.

KPA presented a brief letter in response to the fishermen's complaints in which they clarified that:

- An EIA had been carried out and no significant adverse impacts for fisheries were predicted
- Water Quality was being monitored and results shared with all stakeholders;
- Based on site observations and monitoring data set out in the Environmental Management Plan (EMP) there had been no indication that the impacts are adverse thus far.

It was unanimously agreed that there was need for a wider sensitization forum to be held.

With over 250 participators in attendance, a stakeholder forum was held at Kikanda Beach, Waa on the **21st February 2013**. The meeting was organized by KPA.

The fishermen expressed concerns similar to those in the first stakeholder forum. In addition they stated the following:

1. Corals and sea bed vegetation were being extracted and damaged by the vessel;
2. It would take 10 years to recolonize the lost sea bed habitats;
3. There was loss of fishing gear and equipment.

KPA explained the scope of the project and the nature of works and pledged to take these concerns seriously as environmental management is core to any development project.

The meeting resolved that a technical team would look into these concerns and make recommendations to be adopted by all parties.

5.4.3. Investigation

A joint investigation exercise was carried out by the proponent along with input from the fishing community and the Fisheries Department to ascertain whether project activities would lead to the reduction of fish numbers. The following was studied to substantiate the concerns raised:

1. Part Research – Literature Review;
2. Legal Status of the project – NEMA licence;

3. Monitoring Data;
4. Field Observation;
5. Fisheries Statistical Data,

5.4.4. Conclusions

The findings of the report were presented to stakeholders on **4th October 2013** with the following salient findings. (See **Attachment 2** for minutes of the meeting)

i. Fish Mortality

The fishers in close proximity to the sand harvesting area alleged that the vessel was killing fish and that the propeller was also leading to fish death. Inspection from on board the dredger during daily operations did not reveal any physical evidence of dead fish on the surface or washed up at the shore.

Scientific research says that at very high levels of turbidity, there can be an effect on fish gills and lead to mortality. Similarly, precariously low levels of Dissolved Oxygen can lead to death of fish in a water column. However, this project put in place an EMP that monitored water quality including turbidity levels twice a day on a daily basis for the duration of the activities to observe these critical parameters. The results showed that the sand harvesting activities did not push water quality parameters to exceed the target values set in the EIA relative to the baseline levels. Turbidity results showed elevated levels on the month of February 2013 but this was attributed to a combination of spring tide and torrential rains along the coast line at the time of monitoring.

Other parameters such as pH and COD were monitored and results showed levels that would not impact on water quality.

Conclusion: Probability of impact is remote and if at all of very insignificant level.

ii. Damage of Corals

It was alleged that the sand extraction activities were damaging coral reef habitats which are critical to fish numbers. The report established that the construction working method will not allow for this impact to occur. The trailer suction method uses a suction technique on an established flat bed of sand based on the sand resource study carried out prior to commencement. Sand was only harvested from areas that had a continuous bed of a minimum of 3-4m of sand. Furthermore, coral would damage the gear on the vessel itself and thus has to be avoided.

Monitoring of coral reef abundance and condition was carried out. This showed no significant change. Reduction of coral abundance during monitoring was due to the coral most likely being covered by sea grass (which increased) or by sand.

Conclusion: No probability of coral damage due to work method. Water quality target limits were maintained. No visual impact.

iii. Disturbance

Establishing the effect of noise is a difficult exercise. However it is known that fish use sound to hunt, avoid predators and choose mates. The sheer taxonomic and environmental diversity of fishes and invertebrates has made understanding the effects on these species a much more onerous task than for marine mammals (Popper and Hawkins 2012). It is plausible that the sand harvesting activities generated noise that would affect fish catch in the nearby areas. However, due to fishermen not being licensed to fish in the year in question, no catch data supports this probability.

Conclusion: Possible, but no supporting data.

iv. Loss and Damage of Fishing Gear

It is alleged that the movement of the vessel leads to damage and loss of fishing gear. However this report could not confirm this impact as none of the damaged gear was made available for inspection.

Conclusion: Possible, but no supporting data.

6. SAND SOURCE SURVEY

6.1. Introduction

To create the area for the port development large quantities of fill materials are required for reclamation of the container terminal area and filling for sand replacement at the foundation of the revetment and L-shaped concrete wall. The total quantities estimated are 4.70 million cubic metres for the reclamation and approx. 1.40 million cubic metres for the sand replacement due to consolidation of clay/silt layers. Subsequently, it is estimated that required quantities of filling sand for settlement and pre-loading are approximately 1.40 million cubic metres in consideration of settlement of the salty clay layer, as a result of the soil improvement by prefabricated paper drains.

Therefore, the total required filling quantities are approximately **8.3 million cubic metres**. The filling materials required for this exercise should be suitable for reclamation and sand replacement with silt content of less than 5 %.

A detailed design survey and study was executed by the proponent in 2009-2010 to establish whether the offshore area adjacent to *Andormache reef* from *Shelly Beach* to *RasMwachema* has the required quality of sand.

6.2. Survey Methodology

The sand source survey was carried out in the offshore area as shown on **Figure 6.1** of an approximate area of 1,850 ha. This area is believed to contain sand deposits by the said river.

6.3. Survey Parameters.

1. Scope and objectives of the Survey.

The sand source survey works involved the following activities which were carried out:

1) To conduct a bathymetric, shallow seismic and side scan sonar surveys on the outer channel.
2) To carry out seabed material sampling.
3) To assess the specific gravity and particle size distribution of the seabed material through laboratory testing from samples.

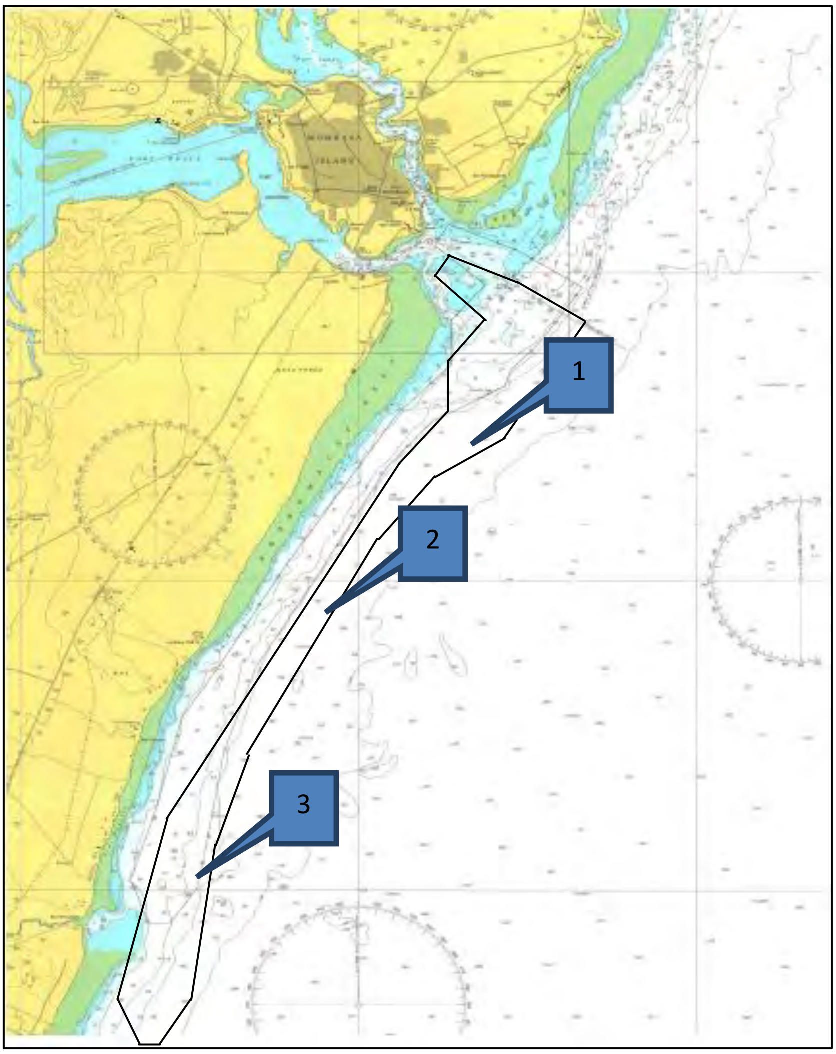


Figure 6.1: Sand Resource Survey Area showing Survey Blocks

Source: Detailed Design Report, MPDP

2. Equipment.

The following equipment was used during the execution of the sand source survey.

Table 6.1 Equipment List

i. Positioning System	
Description	**Model**
RTK DGPS System.	Hemisphere.
Navigation software	Hypack.
Gyro Compass	TSS Meridian Surveyor.
ii. Analogue Systems.	
a) Ecosounder system.	

Ecosounder	ODOM MK3 3200 Dual Frequency
Heavy compensator	AML SV plus
Transducer	Odom
b) Side Scan Sonar system	
Side Scan Sonar	Edgetech 701-DL System
Side Scan Fish	Edgetech Discover 4200FSL
c) Sub Bottom Profiler system	
Transmitter	Geopulse 5430A
Receiver	Geopulse 5210A
Transducer	Geopulse 132B
Acquisition Unit	CODA DA2000
d) Sound velocity System	
SVP	Seatex MRU-5 Heave Compensator

Source: Detailed Design Report, MPDP

6.4. Survey Methodology

1. General

The extent of the survey area was identified with the full details of the boundary locations. The scope of the survey exercise focused on bathymetric survey, Side Scan Sonar survey, Seismic Profiling, seabed material sampling and Laboratory testing. Since every line run within the blocks there was information picked at every 100 metres along the track line which were preset on the survey equipment mounted on the survey ship.

2. Side Scan Sonar

An *Edgetech 701 DL* (the “fish”) system with a swath was used for the side scan sonar. A 100m range of track lines were used with 100% overlap with adjacent run lines.

The fish system was used to capture the surface features of the seabed and was generally run at a range of 15m to maximize on the depiction on any seabed sand ripples. In coral areas, it was run higher at 20m off seabed.

Figure 6.2:Edgetech 701 DL 'Fish' for Side Scan Sonar

Source: Detailed Design Report, MPDP

3. Seismic Profiling

A Sub-Bottom Profiler (SBP) was used to determine the relative penetration on the sedimentary layers and provide detailed high resolution images thereof. The amount of sub bottom penetration is controlled by the sediment type within a range of 0 to 50m.

The SBP's application involves mapping of the soil boundaries and geological relationship in the uppermost layers of the seabed and assessment of soil type and the localization of buried objects and pipeline.

The following are the data recording parameters of the SBP;

Record Sweep length	: 50m to 70m
Recording Delay	: 0ms
Sampling Frequency	: 24 KHz.
Heave	: Internal
Filter	: 2.4 KHz – 4.8 KHz (Set at 2.7 for this Project)
AGC	: TVG 31ms – 170ms Adjustable
Seabed set	: Manual at 5
Trigger	: External
Back up Format	: Double Sided DVD

4. Bathymetry

An ODOM 3200 dual frequency single beam echo sounder was used to obtain single beam bathymetry data on the vessel. This equipment is a dual-frequency with 33 KHz and 210 KHz. The recording parameters used were as follow;

Output Frequency	: 33 KHz and 210 KHz.
Recording scale	: 20 or 40meters
Transducer Drought	: 1.20m
Mean Speed of Sound	: 1544m/s

5. Laboratory Results

a. Particle Size Analysis

To establish the particle size distribution of the sand material sample from the seabed, a laboratory particle size sieve analysis test was carried out. This test was performed by Geoff Griffith Laboratory in Nairobi.

The particle size analysis test was conducted in accordance to the descriptions of the BS 1377 - Part 2: 1990. The samples were soaked in a defflocculant and thereafter washed over a 0.0075mm sieve to reduce adherent particles. They were then dried to $105^0C \pm 5^0C$ for a period of 24 hours before dry sieving over a set of specified sieves.

The equipment/chemicals used for this report included BS test sieves of various sizes, sample dividers, drying oven, sieve brushes, sodium hexametaphosphate etc.

b. Specific Gravity

To establish the suitability of the sand material sample from the seabed a laboratory-specific gravity test was performed. This test was also carried out by Geoff Griffith Laboratory in Nairobi.

The specific gravity test was conducted in accordance to BS 1377 – 2: 1990 editions to determine the apparent specific gravities.

The preparation sequence involved oven drying of the specimen to 105^0C and subsequent drying to a constant weight. The sample was placed in a standard one litre capacity pycnometer then filled with water. Trapped air in the soil was then removed by stirring the mixture. This was allowed to stand for 24 hours. The apparent specific gravity was computed based on the measured weights of oven dried sample, pycnometer filled with water and that of pycnometer containing sample and filled with water.

6.5. Survey Area

The area was divided up into three blocks. The channel block included the outer channel together with the area to the North and South. This block was run in an East-West direction parallel to leading light with cross lines running from South to North direction in a perpendicular orientation.

The Southern block was a North - South elongated block that paralleled the south coast shoreline for 8Km. The main lines were run in a North – South direction parallel to the shoreline with cross lines at both ends of the block and middle.

The third block was to the South of the Southern Block towards Mwachema river outfall delta.

6.6. Seabed Sampling

1) Sampling Methodology

Seabed material sampling points were picked based on the result of side-scan sonar survey and seismic profiling. The locations chosen were those that had the deepest penetrations and water depths ranging between 27m to 55m.

Gravity drop corer with a half (0.5) tonne bob attached to the end of a steel barrel was used to take samples from the seabed under a free fall from a winch system mounted on the ship deck. See **Figure 6.3**

The steel barrel was lined with a 100mm diameter transparent 3 meter plastic pipe to hold the sample. The mouth of the sampler was fixed with a core cutter (Cutting shoe) to prevent the samples from spilling out in the process of retrieving the pipe.

Penetration was achieved by allowing the unit to fall free in the last 5m – 10m to the seabed.

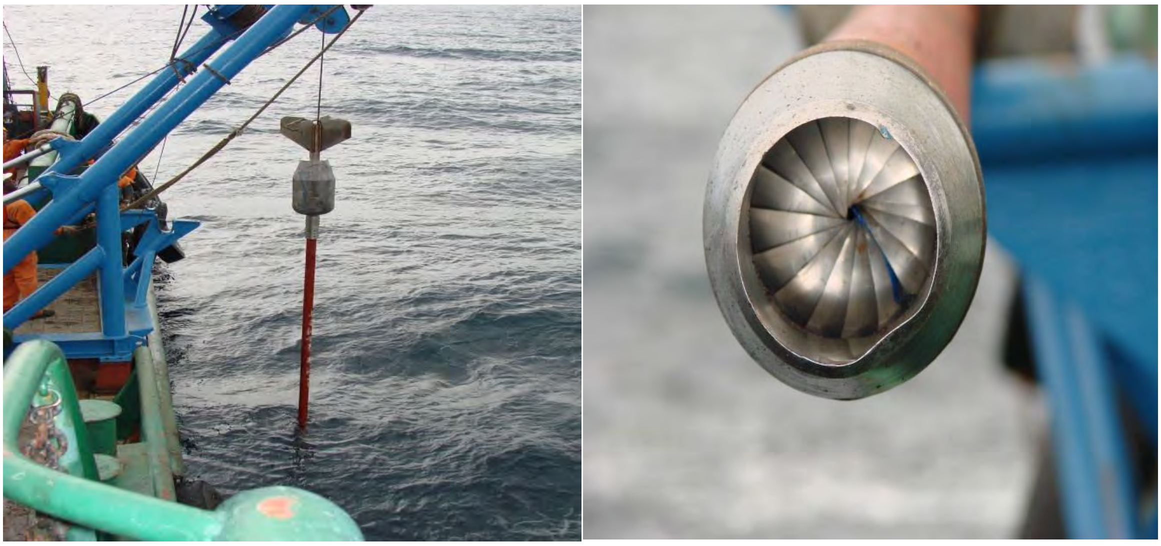


Figure 6.3: Sampler and core cutter during the sampling exercise.

Source: Detailed Design Report, MPDP

2) Confirmation Exercise

This exercise employed majorly the use of the divers. A metallic rod was used to strike the sea bed and scrapper for digging out the samples from the sea bed. Samples were then picked by hand and placed into the sample bags carried by the divers.

The team commenced the work from survey point number one and proceeded to locations two and three respectively. In areas where the water depths exceeded 50m, several attempts were made in alternate locations to ensure that the water depths are limited to a maximum of 50m.

A depth gauge attached to the oxygen bottles was used to measure the water depth for each and every location within the survey area. Seabed photographs and videos were taken at different points within the locations of the survey.

In addition to this, a hummer was used to strike the seabed surface to establish whether the location was composed of hard or soft material.

6.7. Survey Results

1) Side Scan Sonar Soundings

These results obtained from the survey indicate patches of deposits at different locations within the survey area. The patches in most locations are sandwiched between coral rocks.

2) Seismic Survey

The results of the sub bottom profiler are logical assumptions based on the data and the general view of the survey area. These results were verified by seabed sampling and coring to arrive at a meaningful conclusion with respect to the geophysical interpretation.

The sub bottom profiler achieved relative penetrations of up to 10metres reflector depths within the survey area (*Ref. Sand Source Survey Report by Alpha Logistics, March 2009*) with minimum penetrations of 1.0m. On some occasions there were insignificant penetrations indicating an out crop of a hard surfaced material.

3) Bathymetry

It is noted that from the drawings the water depths within which the survey was carried out ranges from 6.0m to 44.6m (*Source: Sand Source Survey Report by Alpha Logistics, March 2009*). The deepest water depths were the areas towards the Mombasa port entrance channel.

4) Confirmation of Results

The following results for the seabed visual observations were reported according to the locations of the survey as follows:

a. Block No 1

This area is characterized by numerous coral rocks up stand with coral sand patches around these rocks. The bed is generally sloping with the deepest end towards the channel entrance. The water depths in this location range between 28m to 35m.

The sample picked from this location contained coral sand with relatively large grain sizes mixed with shells.

b. Block No 2

This area is characterized by a wider extent of sand deposit which is evident from the small sand ripples on the seabed. There are also patches of coral rocks within this area. The bed is slightly rugged with the coral rock. The seabed slopes gently to the East off the shore and towards the outer port entrance channel. The water depths in this location range between 30m to 35m.

The seabed materials from this location contain coral sand mixed with coral rocks and shells. The material has relatively large grain sizes.

c. Block No 3

This area is characterized by a wider spread of sand deposit which is evident from the conspicuous sand ripples on the seabed. The bed is generally sloping rapidly off the shore.

The water depths in this location range between 26m to 40m with the Eastern off-shore falling to over 50m. Due to these rapidly changing depths within very short distances, there is a possible deposit of sand materials further to the deepest end.

The ripples predominate the surface of the seabed without any coral rock up-stand within this area which is an indication of sand deposit.

The sample collected from this location was characterized by fine grains with slight clay lumps. In addition, from the physical analysis of the sample grains it contained silt materials which could be further confirmed from the laboratory tests.

6.8. Results of Sand Resource Survey Results

These results were reached at by an approximate estimation and averaging of the relative reflector penetrations at the sea bed. The results show that the sand borrow pit has sufficient sand for the required.

7. SAND HARVESTING

7.1. General

This method describes sand extraction from the designated offshore sand borrow pit for the construction of container berths and yard, supplement area, building areas etc. which covers soil investigation to harvesting of material.

7.2. Scope of Work

This discusses the process and sequence of works for the production of sand among work items that will follow the flow chart described in Item No. 3 of this method statement. Work includes survey works prior to harvesting, testing of gathered samples, pumping up of suitable materials from the specified offshore sand borrow pit, transportation and dumping of materials to the designated area.

7.3. Workflow

Sequence of work activities will be as follows:

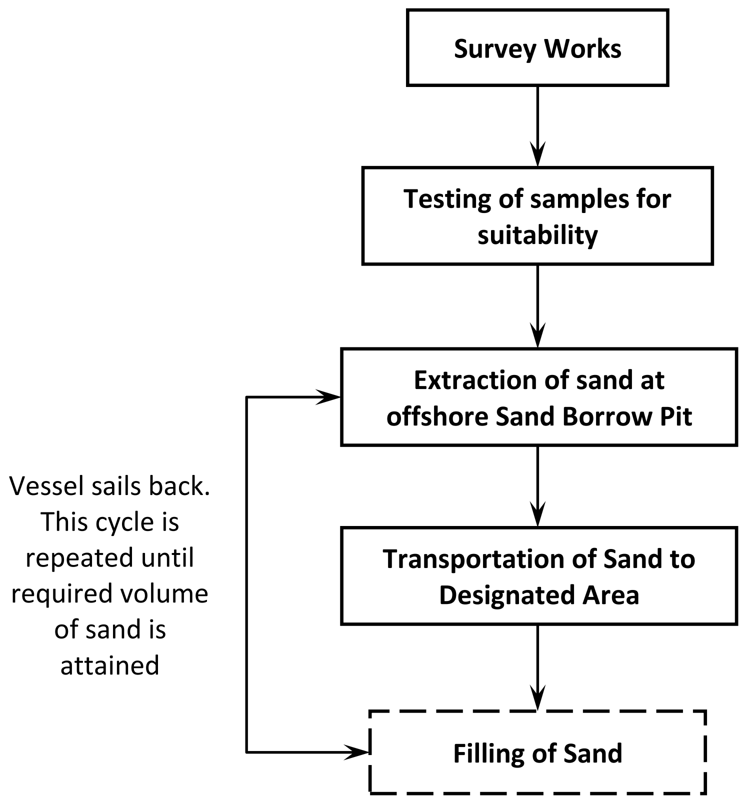


Figure 7.1: Workflow Programme
Source: MPDP

7.4. Resources

1. Materials

Main materials for this item of work will be as follows:

Table 7.1: Materials

Description	Specification/ Type	Expected Quantity	Unit	Source	Remarks
Reclamation	Silt content is less than 5% in weight of particles passing 74 µ	1,700,000	cu.m.	Designated Offshore Sand Borrow Pit	Sand Under ±0.00m
		3,800,000	cu.m.		Sand Over ±0.00m
Filling Sand	Silt content is less than 5% in weight of particles passing 74 µ	1,300,000	cu.m.	Designated Off-shore Sand Borrow Pit	Sea Sand
Surcharging	Silt content is less than 5% in weight of particles passing 74 µ	1,500,000	cu.m.	Designated Off-shore Sand Borrow Pit	Sea Sand

Source: MPDP

2. Manpower

Expected manpower of this item of works is as follows:

Table 7.2: Manpower

Work Item	Man-days	
	Skilled	Unskilled
Extraction of sand & filling (off-shore)	24	10
Filling (On-shore)	26	18

Note: This quantity of "man-days" is the maximum expected quantity in a day for this item of work.

Source: MPDP

3. Equipment

Expected equipment of this item of works is as follows:

Table7.3: Equipment

Equipment	Spec's/ Capacity	Particular	Qty
Trailer Suction Hopper Dredger (TSHD)	13,000m3	Hydraulic excavator & Hydraulic Filling	1
Spraying Pontoon	1,500ton	Hydraulic Filling	1
Anchor Boat	200hp	Assist Spraying Pontoon	1
Tug Boat	500hp	Assist Spraying Pontoon	1
Service Boat	100hp	For manpower service	1

7.5. Work Procedure

1. Survey Works

A sand resource survey will be conducted to determine the potential source of materials for reclamation and sand filling for structures for the project. This is to ensure sufficient supply of suitable filling sand materials and to classify the properties of the existing seabed materials from the borrow pit.

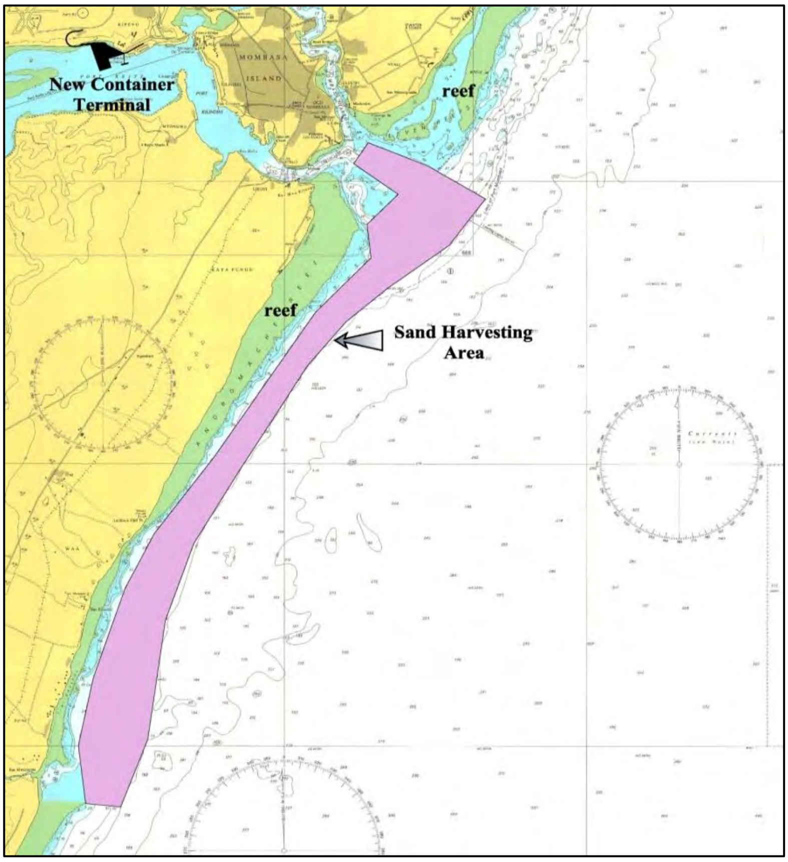


Figure 7.2: Designated Off-shore Sand Borrow Pit
Source: MPDP

2. Extraction of Sand from Off-Shore Sand Borrow Pit

After establishing and determining the specific location for harvesting, extraction will commence. The Trailer Suction Hopper Dredger will be utilized and positioned at the designated off-shore sand borrow pit.

Suction pipes are lowered on the sea floor and pumps the sand and deposits it into a hopper. The extraction commences when the vessel slows down to under 3 knots and suction pipe(s) are lowered onto the sea bed. The lower end of the suction pipe will be dragged along the sea bed. At the end of the suction pipe, a drag head will be attached which will scrape the sea bed.

The extracted material will be pumped up to the hopper through a centrifugal pump. Excess water in the dredged materials is spilled off as sand settles to the bottom of the hopper. This excess water is returned to the sea to reduce weight and increase the amount of materials that can be carried in one load.

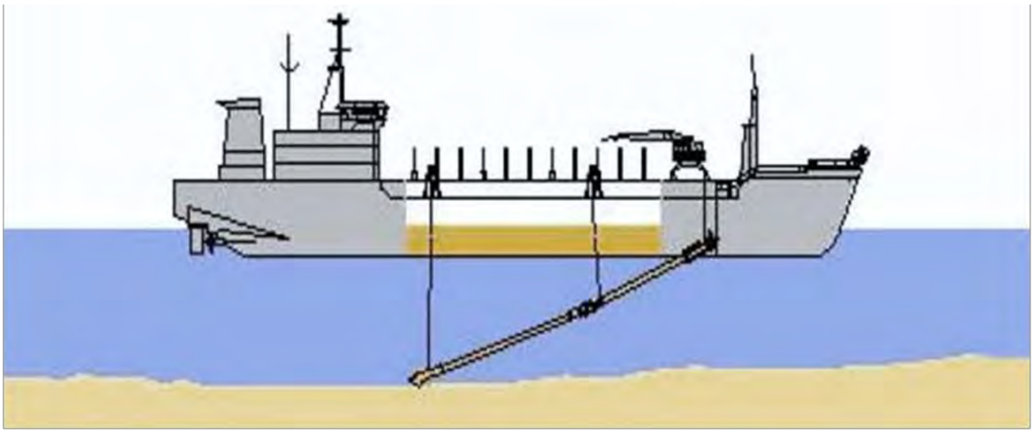


Figure 7.3: Suction Hopper Dredger (TSHD) whilst trailing
Source: MPDP

Figure 7.4: Pictorial Illustration of Trailer Suction Hopper Dredger (TSHD)
Source: MPDP

The progress of extraction will be monitored through the excavation control computer for all the excavation processes such as the excavation level of the drag head, pump settings, power control and control of the bottom doors.

3. Transportation

When the hold or hopper of the dredging vessel is full, the suction pipes will be hoisted back aboard. The vessel will then sail to the reclamation area to discharge the quarried sand from the off shore sand borrow pit. After discharge of harvested materials, the vessel then goes back to the sand resource area until the required volume is attained at the construction area.

All activities will be coordinated with the Harbour Master in order to have a smooth and safe sailing prior to transportation schedule within the Mombasa Port. Information regarding weekly schedule will be disseminated well in advance amongst the concerned persons involved in the activity.

8. POTENTIAL IMPACTS AND MITIGATION MEASURES

It is important to note that potential impacts of sand harvesting and transportation were highlighted in the ESIA report for Container Terminal that was approved in 2007. However for clarity these have again been outlined below:

8.1. Loss of Bottom Habitat, Shellfisheries, Fisher Food Sources

Harvesting of sea sand has the potential to remove important bottom-living aquatic life. However the bottom habitats at the harvesting depths are not as rich as in the shallow areas <-30m and will readily be recolonized by replacement benthic organisms within a few seasons. As the original habitat will probably have changed due to the operations the new population might differ from the original one. Simulations undertaken during the EIA study indicate there would be no significant change in current patterns hence this impact is expected to be minimal.

Nature of Impact: Low - since harvesting will occur in specific areas only thus leaving undisturbed areas that will enhance decolonization.

Duration: Short - re-colonization is predicted to take about one year.

Probability: Definite

Mitigation: The sand harvesting will be carried out within the borrow pit boundaries which do not contain rich bottom habitat of seaweeds, etc. Harvesting would be done at sea depths greater than -30m.

8.2. Water - Column Turbidity

The activity of extracting the sea sand involves the use of a Trailing Suction Hopper Dredger which is a sea-going self-propelled vessel equipped with a suction pipe, designed to trail over the sides of the vessel. This method results in minimal turbidity as a high concentration of loose material is lifted by the suction head.

Nature of Impact: Low – Suction technique will not create turbidity. Any re-suspended sea sand will settle without propagating to the surface.

Duration: Short - Any turbidity will be on the sea bottom and will settle within minutes of the vessel completing works in a specific area.

Probability: Possible

Mitigation: Reduction of hauling volumes. Revision of harvesting locations within the borrow pit further from shore. Restrict overflow during sand loading in hopper.

8.3. Impact on Fisheries

The sand harvest activity will involve the movement of one vessel within the proposed sand borrow pit area for a period of 9 months. Movement of this vessel will not restrict the movement of fishermen in the area. The agitation of bottom habitat has been observed to actually increase the number of fish in the area due to suspension of plankton. The area is classified as medium scale for small scale fishing.

Nature of Impact: Low – Movement of vessels will not restrict the movement of small scale fishermen.

Duration: Short

***Probability*:** Possible

Mitigation: Sand harvesting will be carried out within the borrow pit boundaries of depths between 30m to 60m. *Uzio* fishing is not carried out in this area.

8.4. Migration of Sea Turtles

Since the sand will be harvested from seabed, disturbance of sea turtle nesting grounds on sandy beaches will not occur. However there is potential for encounters with migrating turtles on their way to nesting grounds in the region. The likelihood of interference with these migration routes is insignificant due to the rarity of sightings in the area and the location of the nesting ground in relation to the sand borrow pit area where the vessel will be operating. According to KESCOM, the Shelly Beach shallow areas provide forage for sea turtles.

Nature of Impact: Low – Rare

Duration: Short

***Probability*:** Possible

Mitigation: The contractor will educate and raise awareness amongst vessel staff to look out for migrating turtles.

8.5. Effluent Discharge from Vessels

Effluent on board will be handled efficiently by on-board effluent facilities. Excess effluent requiring disposal will be handled in line with approved KPA and KMA ship waste handling procedures.

8.6. Accidental Oil Spill

There is potential for marine accidents wherever marine vessels are in operation, with potential for marine oil spill.

In order to respond effectively to accidental oil spill, the Emergency Response Program for the Port of Mombasa will be activated. Reporting and altering mechanism will be established to ensure that any spillage is promptly reported to Kenya Ports Authority. KPA being a principle member of Oil Spill Mutual Aids Group (OSMAG) will mobilise members to ensure rapid response to marine oil spill. OSMAG is established in conformity with the International Maritime Organization (IMO) Conventions and comprises of stakeholders from the oil industry and the Kenya Navy. OSMAG has in response to this requirement formed the

Oil Spill Response Action Team (OSRAT), whose members undergo training and thorough drills on oil pollution prevention and on safety aspects at the port every three months.

9. MONITORING

The monitoring programme will involve measuring and recording of physical, social and economic variables associated with the development impacts. This practice will provide information on the characteristics of environmental variables, in particular on the occurrence and magnitude of impacts predicted in the ESIA report.

The monitoring programme will be undertaken at all stages of the project to ensure all environmental, social and economic impacts as a result of the development are dealt with as stipulated in sub section 69 of the EMCA 1999 and is part of a larger Environmental Management and Monitoring Plan for the entire project.

9.1. Water Quality Monitoring

A water quality monitoring survey shall be constantly conducted to measure the extent and impact in the water turbidity due to excavation, sand filling, reclamation, and any other activities which could alter the physical or chemical properties of the area in the Mombasa Port Basins, Offshore Dumping Area and Offshore Sand Borrow pit. The Environmental Monitoring Plan (EMP) emphasised that in the event that monitoring indicates increase in water turbidity/pollution above approved limits mitigation measures will be taken to ensure limits are not exceeded.

The Contractor shall submit details of the proposed turbidity meter to be used to monitor sea water during the works for approval.

9.2 SS, pH, COD, DO and Perspective Degree

Prior to commencement of the work, the Contractor shall take water samples at 50cm, 3m, 6m below the surface and measure turbidity by approved equipment at various stations for at least 30 days continuously. The samples shall be sent to a laboratory approved by NEMA and the Engineer for analysis of Suspended Sediment (SS). From the data collected, the Contractor shall calculate the overall relation between turbidity and SS, and the background average value of SS at each monitoring station shall be established.

The amount of suspended solids in the sea water surrounding the operation of harvesting shall be similarly controlled so that the amount of sediment in the sea water at 50cm, 3m, 6m below the surface from the working points generating turbidity shall not exceed **a total absolute max +10mg/ltr from the back ground conditions**.

9.3 Monitoring Marine Vegetation and Fauna (Coral reef and Sea Grass)

The survey on Marine Vegetation and Fauna shall be conducted twice a year to monitor the extent of the impact due to the construction and any other activities which could alter the current conditions.

The EMP shall suit the planned works and be aimed at meeting the environmental restrictions or limits imposed on the allowable impact on the environment by the construction. The EMP proposes marine vegetation and fauna is monitored biannually and any adverse impacts be mitigated by:

- Reducing disposal volume per day;
- Relocate dumping site further offshore(agreement with the Engineer & NEMA required)

The detailed contingency plan shall be prepared by the Contractor who shall submit the list of researcher(s) proposed to be engaged in the marine Vegetation and Fauna survey for approval by the Engineer.

The survey shall be conducted at 5 sites. In each site, 9 -10m transects shall be laid where major substrate categories will be recorded. The method of the survey shall be visual observations in the field; viability of coral reefs shall be checked monthly for the initial 3 months of operations and quarterly thereafter.

The result of the monitoring shall be submitted monthly after each field survey. The report will include the list of species found in each site during the survey and their location if they are classified rare/endangered/threatened by IUCN Red List or other references. The survey shall be conducted in the presence of an inspector appointed by the Engineer.

Figure 7-1:Turbid Water Monitoring Points

Source: MPDP

Figure 7-2: Coral Reef and Sea Grass Survey

Source: EIA Report for Dredging, 2009, *Adala et al*

9.2. Feedback System

During construction, the proponent shall submit the results of the monitoring to NEMA once a year. To ensure the successful and effective implementation of mitigation measures, a feedback system needs to be adopted, as shown in **Figure 7-3**, which allows for public consultation and if necessary, improvement of the mitigation measures.

By involving the public, the project establishes transparency and also builds good public relations between the proponent and stakeholders. The system also allows for improvement/adjustment of mitigation measures that are deemed inadequate, after which it will be made public again.

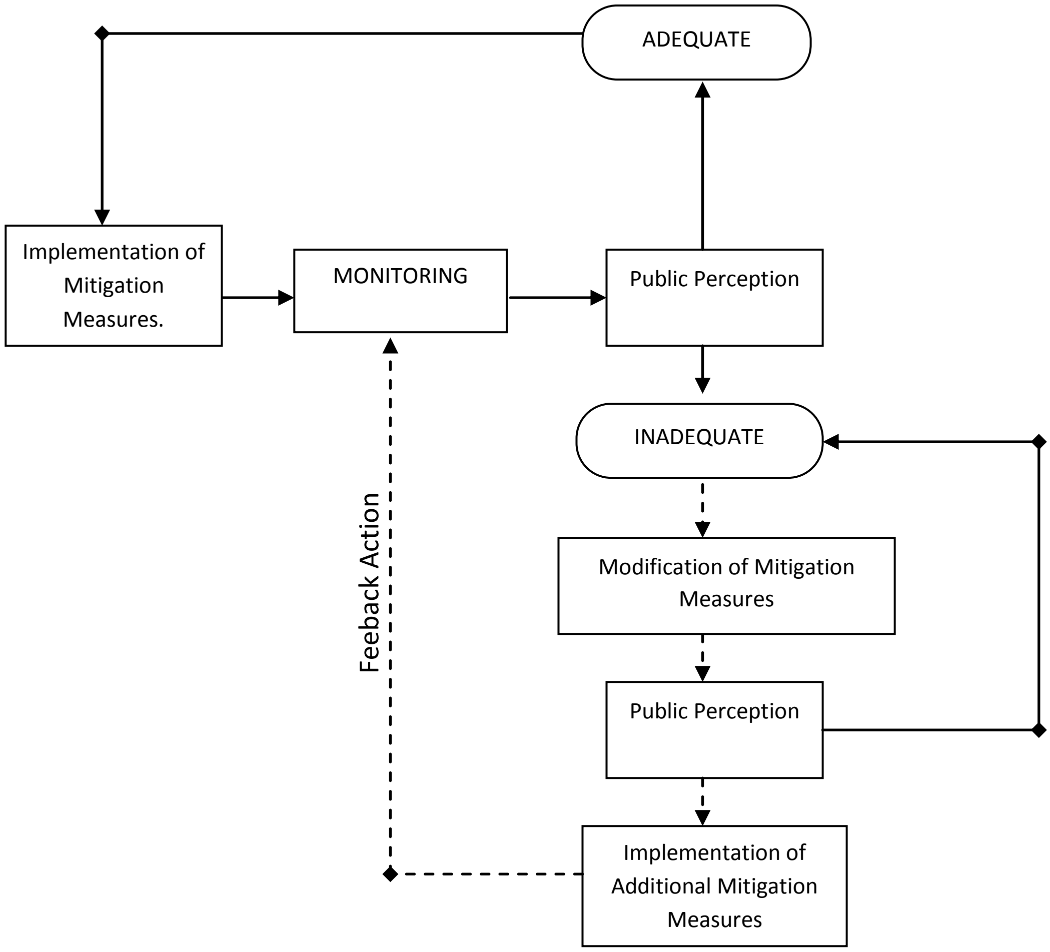


Figure 7-3: Feedback Actions in Environmental Monitoring Program
Source: MPDP

10. RECOMMENDATIONS AND CONCLUSION

Competition from other ports has created the necessity for expansion of the Port of Mombasa in order to meet global demands and to steer the country towards Vision 2030. This project will therefore be greatly beneficial to the country as a regional trading block and transhipment zone. The Environmental and Social Impact Assessment study report which was approved in 2007 together with this addendum will ensure minimal environmental impacts to the rich coastal ecological belt where the project is being undertaken.

Monitoring will allow for continuous assessment of the environmental and social variables of the potential impacts through the systematic collection of the specific data and evaluating the data to confirm whether the proposed mitigation measures effectively address the potential negative impacts.

The activity of sand harvesting was proposed and studied in the same area. This addendum, although proposing the activity to be carried out over a larger area, the volumes remain the same thus not increasing the resource demand. It is also felt that by spreading the sand harvesting activity over a larger area any negative impact such as turbidity will be infinitely diluted, if not all-together nullified.

The sand harvesting technique (suction), the depths of the borrow pit and the nature of sea sand reduces the impact of turbidity on critical habitats as explained in this addendum. The unavoidable impact that will occur is loss of sea bottom habitat at depths greater than minus 30m (-30m). However, these habitats are not critical and will re-colonise and regenerate in approximately one (1) year.

Local fishermen have raised a number of concerns such as dwindling fish catches as a result of turbidity, damage of fishing gear by the sand harvesting vessel, death of fish as a result of waves and noise from the dredger and risk of small fishing vessels colliding with the sand harvesting vessel. Results of monitoring and investigations outlined in this Addendum negate these allegations. These results have been shared with representatives of fishermen, community leaders, government officials and Lead Agencies at stakeholder meetings convened by KPA. However KPA undertakes to continue holding dialogue with community leaders and representatives of fishermen (BMU heads) with a view to identifying a project that would be of benefit to the fishing community and financing the agreed project as part of the Authority’s Corporate Social Responsibility (CSR).

11. REFERENCES

Environmental Impact Assessment Report, *Consultancy for Proposed Dredging Works at the Port of Mombasa*, May 2009, Kenya Ports Authority by *Adala et al*

Environmental Impact Assessment Report of *The Proposed Container Terminal Modernisation Project*, May 2007. Kenya Port Authority by *Adala et al*

Mombasa Port Development Project, Detailed Design Report, Consultancy Services for Detailed Design and Construction Supervision, August 2009, Japan Port Consultants & BAC/GKA JV Co Ltd

KenSea, *Environmental Sensitivity Atlas for Coastal Area of Kenya*, UNDP-KMFRI-GEUS Partnership, March 2006

Effects of Sand mining on Physical Process and Biological Communities Offshore New Jersey USA, *Byrnes, Hammer, Thibaut and Snyder, 2004*

Dredging; A Handbook for Engineers, R.N Bray.

World Bank Technical Paper Number 126,*Environmental Considerations for Port and Harbor Developments*, Transport and the Environment Series 1990, *Davis et al*

APPENDICES

APPENDIX 1: NEMA LICENCES

NATIONAL ENVIRONMENT MANAGEMENT AUTHORITY

Office of the Provincial Director of Environment

NEMA Headquarters
P.O Box 67839 00200
Nairobi, Kenya
Fax: 254-020-608997
Mobile: 0724 253 398, 0733 600 035
E-mail: dgnema@nema.go.ke
Website: www.nema.go.ke

Provincial Director of Environment Office Coast
P.O Box 84700 - 80100
Mombasa
Mvita House next to GTI
Mobile: 0729379414

REF: NEMA/CP/CMP/002/II/VOL.1(64) ***8th MARCH 2012***

The Managing Director
Kenya Ports Authority
P.O. Box 95009-80100
MOMBASA

RE: ADDITIONAL SITES FOR SAND HARVESTING ALONG THE IDENTIFED BORROW PIT AREA FOR THE ON-GOING PORT EXPANSION PROJECT (EIA/254)

The National Environment Management Authority has reviewed the addendum report for additional sand harvesting sites for the proposed Port expansion project which was approved in 2007 (NEMA License No. 0001206)

The Authority has noted that the additional sites will lie along the **same borrow pit area** identified in the approved EIA report. It was also noted that the amount of sand harvested would be the same (7.5 million m^3). There will therefore be no additional impacts from the proposed additional sites.

You are therefore advised to observe **mitigation measures in the approved EIA report** for all additional sites. Also provide GPS coordinates for each new site for monitoring and any future assessment of impacts. This exercise will be closely monitored by NEMA, KWS, Ministry of Fisheries and KMA to ensure compliance with the Environmental Management Plan.

MARTIN SHIMBA
FOR: PROVINCIAL DIRECTOR OF ENVIRONMENT

cc -Director, Compliance and Enforcemnt
-Assistant Director – Coast Conservatıon Area, KWS
-Director General – Kenya Maritime Authority
-Provincial Director – Ministry of Fisheries, Mombasa

Application Reference No: EIA/254
Certificate No: 0000173

For official use

THE ENVIRONMENTAL MANAGEMENT AND COORDINATION ACT

CERTIFICATE OF VARIATION OF ENVIRONMENTAL IMPACT ASSESSMENT LICENCE

This is to certify that the Environmental Impact Assessment Licence No: 0001206

Issued on 7TH AUGUST 2007 (date) to KENYA PORTS AUTHORITY (name of individual/firm)

of P.O. BOX 95009, MOMBASA (address) regarding

PROPOSED CONTAINER TERMINAL MODERNISATION (title of project)

whose objective is to PROVIDE CONTAINER HANDLING SERVICES

(briefly describe purpose)

located at WEST KIPEVU, MOMBASA (locality and district) has been varied to EXTENSION OF EIA LICENCE VALIDITY PERIOD FOR ANOTHER 24 MONTHS

(nature of variation) With effect from 17TH JANUARY 2011 (date of variation) in accordance with the provisions of the Act.

Dated this 26TH day of JAN 20 11.

Signature

(SEAL)

Director General
The National Environment Management Authority

GPK (L)

Application Reference No EIA/254
Registration No: 0001206
For official use

NATIONAL ENVIRONMENT MANAGEMENT AUTHORITY (NEMA)

THE ENVIRONMENTAL MANAGEMENT AND CO-ORDINATION ACT

ENVIRONMENTAL IMPACT ASSESSMENT LICENCE

This is to certify that the Project Report/Environmental Impact Assessment Study Report received from KENYA PORTS AUTHORITY (name of individual/firm) P. O. BOX 95009, MOMBASA (address) submitted to the National Environment Management Authority in accordance with the Environmental Impact Assessment & Audit Regulations regarding CONTAINER TERMINAL MODERNISATION (title of project) whose objective is to carry on PROVIDE CONTAINER HANDLING SERVICES. XXX (briefly describe purpose) located at WEST KIPEVU, MOMBASA (locality and district) has been reviewed and a licence is hereby issued for implementation of the project, subject to attached conditions.

Dated this 7TH day AUG. of 20 07

Signature

(SEAL)

Director General
The National Environment Management Authority

CONDITIONS OF LICENCE

1. This licence is valid for a period of 24 MONTHS (time within which the project should commence) from the date hereof.
2. The Director-General shall be notified of any transfer/variation/surrender of this licence.

3. The proponent shall submit to the Authority a Social Impact Assessment Report and a Resettlement Action Plan with clear commitments by the proponent and the project affected people.

4. The proponent shall adhere to the provisions of the Water Quality and Waste Management Regulations of 2006.

5. The proponent shall ensure strict adherence to the Environmental Management Plan developed throughout the project cycle.

6. The proponent shall collaborate with the EIA Expert(s) and the contractor(s) to ensure that proposed mitigation measures are adhered to during the construction phase and where necessary appropriate mending-up activities undertaken and a report of the same submitted to NEMA.

7. The proponent shall comply with the relevant principal laws, by-laws and guidelines issued for development of such a project within the jurisdiction of Mombasa Municipal Council, Ministry of Transport, Ministry of Roads and Public Works and other relevant Authorities.

8. The proponent shall ensure that the development adheres to zoning specifications issued for development of such a project within the jurisdiction of Mombasa Municipal Council.

9. The proponent shall ensure that during the construction phase, the operations adhere to Legal Notice No. 40, The Factories (Building, Operations and Work of Engineering Construction) Rules, 1984.

10. The proponent shall ensure that environmental protection facilities or measures to prevent pollution and ecological deterioration such as Waste Management systems are designed, constructed and employed simultaneously with the proposed project.

11. The proponent shall ensure that records on conditions of licences/approval and project monitoring and evaluation shall be kept on the project site for inspection by NEMA's Environmental Inspectors.

12. The proponent shall submit an Environmental Audit Report in the first year of occupation/operation/commissioning to confirm the efficacy and adequacy of the Environmental Management Plan.

13. The proponent shall comply with NEMA's improvement orders throughout the project cycle.

APPENDIX 2: MINUTES OF MEETING ON FISHERMEN’S CONCERNS

MOMBASA PORT DEVELOPMENT PROJECT

MINUTES OF DISCUSSION OF MPDP ENVIRONMENTAL MONITORING REPORT FINDINGS WITH FISHERMEN HELD ON 4th October, 2013 IN KWALE

Attendance List:

S/NO	NAME	DESIGNATION	LOCATION/ORG.
1	Hon. Joanne Nyamasyo (Chairlady)	C.E.C, Kwale County – Agriculture, Livestock and Fisheries	Kwale County Council
2	Martin Kiogora	Officer	Fisheries Department
3	Cecilia Nyambu	Officer	NEMA
4	Alice Wachira	Asst. County Commissioner	Office of the President
5	Ken Nyagah	Senior Engineer	Kenya Ports Authority
6	Hussein Mamo	Senior Surveyor	Kenya Ports Authority
7	Michael Okumu	Environmentalist	BAC (Kenya)
8	OnesmusMacharia	Stakeholder	South Coast Residents Association (SCRA)
9	Hamadi M. Ali	Fisherman	Nyari-Kikandini BMU
10	Nassoro O. Gulamu	Fisherman	Nyari-Kikandini BMU
11	Juma K. Tengeza	Fisherman	Nyari-Kikandini BMU
12	Mwafitina J. Bakari	Fisherman	Nyari-Kikandini BMU
13	Abdala M. Mwakumeha	Fisherman	Nyari-Kikandini BMU

Minutes of Meeting:

1. Meeting was opened at 11:15am by the Chairlady.
2. Prayers were conducted.
3. The chair welcomed all present and set the agenda for the meeting which was to discuss the findings to the report prepared by an environmental expert into the concerns and complaints raised by the fishermen in Kwale County as a result of sand harvesting activities under Kenya Ports Authority Mombasa Port Development Project (MPDP).
4. The chair invited M. Okumu (Environmental Expert) to present the report findings to all members present.
5. M. Okumu made a detailed explanation of the entire report and its findings.
6. The fishermen expressed discontent that their independent environmental consultant could not partipate in joint surveys and site visits. Mr H. Mamo of KPA explained that the report was prepared independently and that evidence and confirmation were the key determinants. The Assistant County Commissioner A. Wachira also pointed out that the report is based in facts.

7. The Chair pointed out that KPA had sent a letter promising boats to the affected fishermen. Mr. Mamo proposed that discussion on the boat should be taken up by Office of the Governor and discussed with the Managing Director of KPA. He explained that the boats mentioned in the letter from KPA were for fishermen in Port Reitz who have experienced permanent loss of fishing grounds as covered in the EIA and that any compensation would only be applied if there is a loss or negative impact to which has been confirmed by the independent report.

8. The chair reacted to the report as follows:
    i. KPA should give a clear commitment on adaptation of the recommendations;
    ii. The recommendations given by other stakeholder/ leaders should be captured.
    iii. Under KPA's CSR projects to be implemented in consultation with stakeholders.

9. Mr. Kiogora reacted as follows:
    i. The findings and data presented are ok.
    ii. More copies of the report and more time should be facilitated to stakeholders.
    iii. A non-technical summary should be prepared and circulated to the stakeholders.
    iv. Was of the opinion that there is an effect of disruption of fishing activities for fishermen in terms of time.

10. C. Nyambu (NEMA) gave the following comments:
    i. NEMA suggested that baseline data needs to come out clearer.
    ii. General report findings are acceptable.
    iii. Social impacts were never captured even though they go hand in hand with the EIA.

11. The representatives of the BMU gave their feedback as follows:
    i. KPA should consider School fees as they have evidence of children not being able to meet their financial obligations ever since the sand harvesting exercise came and went. There is a letter detailing the expectations of the fishermen which should be included in the report.
    ii. The investigations should be repeated. The chair said it would be impractical.
    iii. KPA should cooperate with the community on humanitarian grounds even if the findings indicate no adverse impacts.
    iv. Purchase of fishing gear should be expedited
    v. The letter promising boats should be honoured by KPA.

vi. Any compensation should improve the livelihoods of fishermen
vii. Mr. Macharia (SCRA) proposed that KPA top management should give commitment prior to Phase II and that all recommendations would be discussed jointly with the leaders of Kwale.

12. Wachira (OOP) gave comments as follows:
    i. She urged fishermen to register with the Fisheries Department as this would have given a better indication of effect of sand harvesting on fishing through catch data.
    ii. The report has not touched on socio-economic impacts.
    iii. Sensitizations should be carried out prior to Phase II.
    iv. Purchase of fishing gear should be expedited as soon as possible.

The chair made a concluding remark that there is an expectation to get an official response from KPA's top management on what KPA is to commit itself and the meeting ended at 1330Hrs.

Attached: Annex 1 - Recommendations of Report, Annex 2 – Feedback of Key Stakeholder and Local Leaders

Signed: ____________________ Hon. Joanne Nyamasyo Chairlady	Signed: ____________________ Mwafitina J. Bakari Nyari-Kikandini BMU
Signed: ____________________ Eng. K. Nyagah KPA Representative	Signed: ____________________ Michael Okumu Secretary

ANNEX 1:

RECOMMENDATIONS OF MONITORING REPORT

1. **Purchase of Fishing Gears** to replace and supplement the fishing capacity of the affected BMU's / Landing sites in the immediate term. This will ensure no monetary gain is made and will be of benefit directly to the industry. This should be done in cooperation with the Fisheries Department of Kwale.
2. The Proponent should engage in **Sensitization meetings** of the project and the EMP prior to commencement of future phases of construction. This should be done with necessary liaison with the relevant county governments in the medium term.
3. Prior to commencement of Phase II of the license, the proponent should seek for a way of cooperation with the fishermen and local leaders of the area through **Corporate Social Responsibility (CSR) Initiative** in the area such as class rooms, fish sheds and fish markets. This recommendation should be implemented closely with the Fisheries Department.
4. A certain number of **Job Opportunities** for both skilled and non-skilled labour should be sourced from Kwale District.

ANNEX 2:

FEEDBACK OF KEY STAKEHOLDER AND LOCAL LEADERS

1. The project is indeed important but that the proponent should consider CSR as a way of addressing he grievances raised by the fishing community.
2. Despite the scientific findings presented, there should be a need for cooperation between the fishing community and KPA
3. Fishermen should also be educated on the benefits of record keeping.
4. The project is indeed important but that the proponent should consider CSR as a way of addressing he grievances raised by the fishing community.
5. The plight of the wider community and Kaya's should be considered.
6. That KPA wrote a letter in which they pledged to buy fishing boats for the affected fishermen. He stated that this pledge is expected to be fulfilled.
7. KPA should consider construction of markets, landing sites and sheds for the fishermen
8. KPA should consider drilling of a borehole as a source of water for the wider community
9. KPA should consider donating or setting up a school fees fund for the community