KENYA PORTS AUTHORITY

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT STUDY REPORT FOR REHABILITATION OF BERTHS 1-14

FINAL REPORT

PREPARED BY
HEZTECH ENGINEERING SERVICES
P.O. BOX 42269 – 80100
MOMBASA

October, 2017

CERTIFICATION PAGE

Certification by Firm of Experts:

We hereby certify that this Environmental and Social Impact Assessment Study report has been prepared in accordance with the Environmental (Impact Assessment and Audit) Regulations, 2003 and the methodology and content reporting conform to the requirements of the Environmental Management and Coordination Act, 1999.

Signature_____ Date _____

Name_____**HEZEKIAH O. ADALA**_____

Address____**P.O. BOX 42269 – 80100 MOMBASA**_____

For and on behalf of: **HEZTECH ENGINEERING SERVICES**

Certificate of Registration No_____**5194**_____

Certification by the Proponent

We, KENYA PORTS AUTHORITY hereby confirm that the contents of this report are a true reflection at the site of the proposed works. We shall endeavour to implement mitigation measures proposed in the report to ensure the project complies with applicable environmental regulations.

Name_____

Signature and Stamp _____ Date _____

For and on behalf of KENYA PORTS AUTHORITY

ACCRONYMS

BOD	Biological Oxygen Demand
BMU	Beach Management Unit
CIDP	County Integrated Development Plan
CITES	Convention on International Trade in Endangered Species
COD	Chemical Oxygen Demand
DfID	Department for International Development
DO	Dissolved Oxygen
EA	Environmental Audit
ECDE	Early Childhood Development Education
EHS	Environmental, Health and Safety Guidelines
EIB	European Investment Bank
EMCA	Environmental Management and Coordination Act
EMMP	Environmental Management and Monitoring Plan
EMP	Environmental Management Plan
ERL	Effects Range Low
EPZ	Export Processing Zone
ESIA	Environmental and Social Impact Assessment
HABS	Harmful Algae Blooms
FAO	Food and Agriculture Organization
GoK	Government of Kenya
IFC	International Finance Corporation
IMO	International Maritime Organization
IOC	Indian Ocean Commission
IUCN	International Union for Conservation of Nature
KES	Kenya Shillings
KFS	Kenya Forestry Service
KMA	Kenya Maritime Authority
KMFRI	Kenya Marine and Fisheries Research Institute
KPA	Kenya Ports Authority
KWS	Kenya Wildlife Service
LEL	Lowest Effects Level
MPA	Marine Protected Areas
NEM	North East Monsoon
NEMA	National Environment Management Authority
OM	Organic Matter
OEL	Occupational Exposure Level
PAP	Project Affected Persons
PAH	Polyaromatic Hydrocarbons
RCM	Recording Current Meter
TEU	Twenty foot Equivalent Units (of containers)

TMEA	Trademark East Africa
ToR	Terms of Reference
TSS	Total Suspended Sediments
SDF	State Department of Fisheries
SEA	Strategic Environmental Assessment
SEM	South East Monsoon
SEL	Severe Effect Level
SGR	Standard Gauge Railway
SHM	Stakeholder Meetings
UNESCO	United Nations Educational, Scientific and Cultural Organization
VCT	Voluntary Counselling and Testing

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Ms. Lenice Ojwang	BSc. Environmental Science	Associate Expert / Rapporteur

EXECUTIVE SUMMARY

Mombasa Port is the principal Kenyan seaport which plays an important role in the country's economic development and is expected to be one of the key players in the attainment of Kenya's Vision 2030. The port however requires upgrading in order to accommodate the rapidly increasing cargo volume and to provide efficient logistics services for the country and neighbouring landlocked countries such as Uganda, Rwanda, Burundi, Democratic Republic of Congo and Southern Sudan. In response to these needs Kenya Ports Authority (KPA) which is the state corporation mandated to manage the port of Mombasa, with the support of Trademark East Africa (TMEA) intends to undertake the proposed projects, which are aimed at upgrading selected berths at the Port of Mombasa. Following condition assessment study, three main project components were proposed as follows:

- Rehabilitation, strengthening and deepening of Berths No. 1-5;
- Rehabilitation, strengthening and deepening of Berths No. 7-10; and
- Rehabilitation, strengthening and deepening of Berths No. 11-14.

Berths 1 to 5 and Berths 7 to 10 are located at the western part of the Port of Mombasa (Kilindini Harbour), while the northern part of the port comprising of Berths 11 to 14 are located at Port Reitz. The berths of Port Reitz and those of Kilindini Harbour are separated by a small creek. The areas between Berth 5 and Berth 7, as well as between Berth 14 and Berth 16, comprise two small bays where berthing facilities have never been built. To the south of Berth 1 there are the Lighter Quays which are abandoned and no longer in use. The Dockyards, located south of the Lighter Quays, are operated by KPA and comprise workshops, slipways and other facilities for maintenance. At Mbaraki Creek there is a dry dock operated by African Marine and General Engineering Co Ltd. The most southern part of the Port of Mombasa consists of the Mbaraki Wharf which is used for handling of dry bulk cargo.

Within the port boundaries there are two oil jetties Shimanzi Oil Terminal (SOT) located to the north of Berth 10, and Kipevu Oil Terminal (KOT) located directly to the west of Berth 19.

The location of Berths 1-14 is as in the outline map below.

Aerial map of the Port of Mombasa showing the proposed project area (Berths 1-14)

Details of the proposed works include:

a) Works at Berths 1-5

- Rehabilitation of areas with spalling and exposed reinforcement at the quay beam
- Sealing of cracks
- Installation of new bollards, fenders and life ladders
- Installation of new manhole covers.

b) Works at Berths 7-10

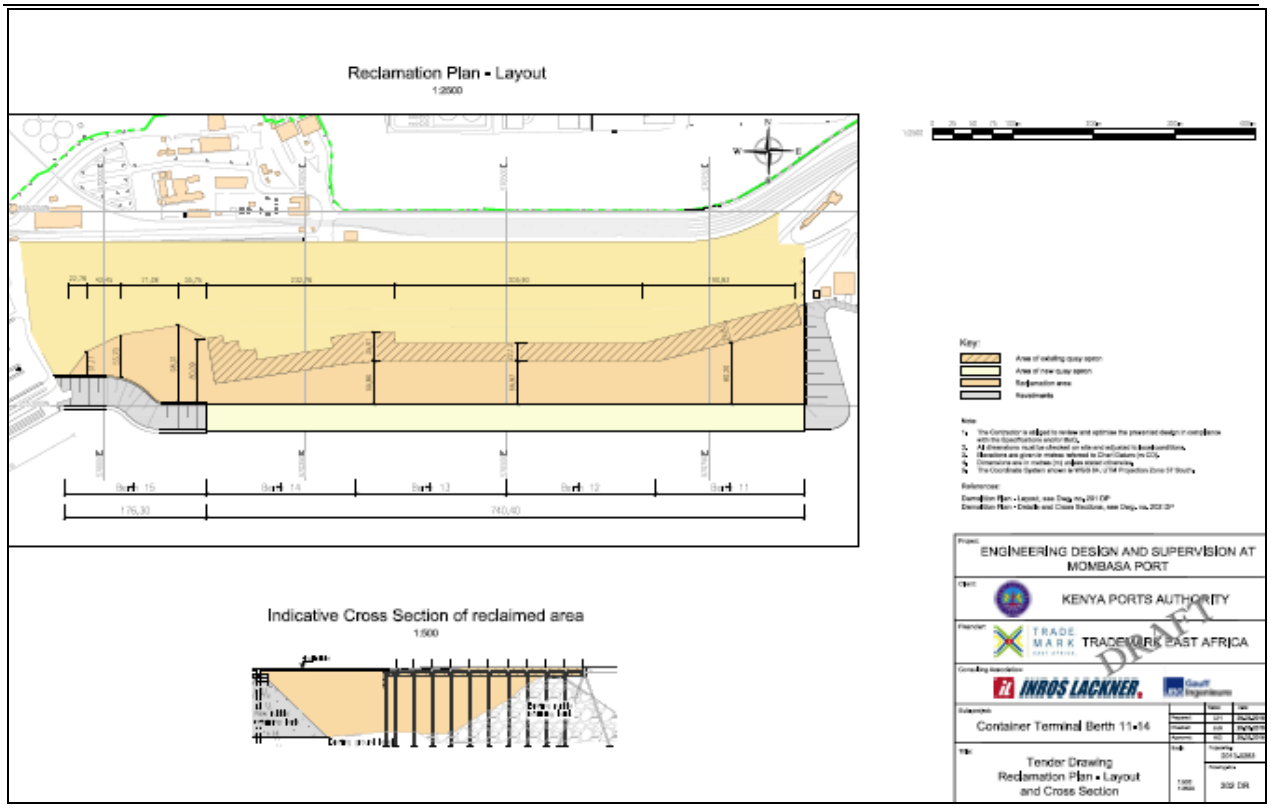
- Rehabilitation of areas with spalling and exposed reinforcement at the quay beam
- Repair of the deck slab by shot-creting or cathodic protection
- Repair of the pile caps
- Sealing of cracks
- Installation of new bollards, fenders, manhole covers and life ladders.

c) Works at Berths 11-14

- Construction of a container terminal including all auxiliary works to gain an additional area of 60,000 m^2;
- Straightening of the quay line and increasing the water depth to 15 metres below chart datum (– 15 mCD)
- Demolition and removal of existing infrastructure on the back-up area behind Berth 11 – 14 and existing quay wall (suspended deck structure)
- construction of embankments on both sides of the terminal and suspended deck structure (length approx. 740 m)
- construction of reverted slope under suspended deck and scour protection

- provision of infrastructure at terminal area including utilities (electricity, fresh water, etc.)
- erection of reefer stacks
- construction of drainage system with oil separators and sediment tanks.

The reclamation plan and section drawings are as illustrated below:



Reclamation plan and section drawings of berths 11-14 (Source: Inros Lackner)

KPA anticipates that the above projects would lead to modernization of infrastructure facilities at the Port of Mombasa hence improvement of efficiency in delivery of services.

Implementation of the proposed projects would create a wide range of environmental and social impacts and thus requires Environmental and Social Impact Assessment (ESIA). Consequently the KPA has undertaken this ESIA Study in order to ensure compliance with environmental regulations prescribed by Kenya's National Environment Management Authority (NEMA) as well as requirements of international financing institutions such as the World Bank (WB), United Kingdom Department for International Development (DfID), European Investment Bank (EIB) and German KfW. In addition the proposed assessment is intended to ensure compliance with International Finance Corporation's (IFC) Environmental, Health and Safety (EHS) Guidelines.

The approach adopted for the Environmental and Social Impact Assessment was as follows:

- *Screening:* A rapid assessment of the project area to identify the environmental and socioeconomic resources in the project area and determine the level of environmental assessment that needs to be done.
- *Scoping:* This was undertaken as part of baseline studies to provide an implementation plan for subsequent steps by making a preliminary assessment of methods needed to obtain reliable baseline information. Upon completion of the scoping exercise the consultant developed Terms of Reference for ESIA study and sent the same to NEMA for approval.
- *Project Description:* Involved giving a highlight of key components of the proposed project such as description of the project site, nature and volume of construction works, project timelines, implementing agents, a brief history of the project and a justification as to why the project is necessary.
- *Baseline studies:* Establishing environmental, social and associated baselines for analysis of potential impacts and for future monitoring purposes;
- *Impact analysis:* Examining in detail likely adverse environmental and social impacts directly and indirectly attributable to the proposed project and prescription of mitigation measures for the identified and associated impacts;
- Preparation of an Environmental Management and Monitoring Plan (EMMP) to ensure that the proposed mitigation measures are implemented and the desired remediation effects achieved;
- Stakeholder consultation and public engagement to share information about the proposed project with stakeholders and collect their views for consideration during project implementation.

Detailed ESIA Study involved conducting literature review of available documents relevant to the study such as recent research papers and environmental assessment reports, review of local environmental laws and regulations, international conventions and protocols to which Kenya subscribes as well as reference to standards and guidelines issued by regulators such as NEMA and other Lead Agencies. Field studies were also conducted within port areas and its environs to document the baseline ecological and chemical conditions.

As part of the consultancy service the Consultant in liaison with the client undertook stakeholder consultation and public participation processes in line with the provisions of the Environmental Management and Coordination Act, 1999 and the Constitution of Kenya 2010. Two (2 no) Stakeholder Meetings (SHM) were held during the course of the study. The 1st SHM was a key informant SHM held at the scoping stage to brief the stakeholders on the project details and have their concerns on board to be addressed during the study while the 2nd SHM was held at the end of the study to present the key findings. The views gathered from the stakeholders were taken into account in developing the ESIA report and feedback given to them on the findings of the study.

Key positive impacts identified during the study include:

- Implementation of the project would create employment opportunities for construction works and market for construction inputs;
- Upon completion the port would have stable berthing structures that would ensure safety of marine craft and seafarers, and reduce chances of marine casualties such as oil spills;
- Boost in trade due to improved efficiency of port operations as a result of the ultra-modern facility.

Negative socio-economic impacts anticipated include:

Sector/activity affected	**Project Phase**	**Impacts/Issues identified**	**Proposed mitigation measures**
Fishing	Construction	Restriction of access to some fishing grounds which may be declared security zones; thereby displacing the artisanal fishermen from their traditional fishing grounds and landing sites.	• Compensate fishers who would not be able to use their traditional fishing grounds so that they can access alternative fishing grounds • Empower the local fishermen to move to deep waters by offering training on deep-sea fishing methods and providing fishing gears and vessels that can enable them venture into distant deep water fishing grounds • Support provision of basic infrastructure in the alternative fish landing sites such as cold storage facilities and improvement of access roads
	Construction	Probability of accidents at sea	Demarcate passageways for small fishing vessels separate from those used by ships
Tourism	Construction	Depreciation in value of mangroves and coral reefs due to effects of dredging would impact on tourism activities such as diving and snorkeling	Use clean technologies such as silt curtains and /or coffer dams and ensure correct choice of dredging period as proposed in the EMP to minimize damage to adjacent mangroves and corals due to effects of turbidity and sedimentation
Transport / Communication	Construction /Operation	Expected increase in road traffic due to transportation of construction material at the construction phase and increased logistics traffic during the operations phase as a result of increased container volumes	Liaise with the County Government of Mombasa and the Kenya Police Service to post additional traffic marshals along affected roads during the construction phase; Make use of the standard gauge railway to decongest roads.
Socio-cultural and Political	Construction	Degradation of cultural and heritage sites	Protection / conservation of cultural and heritage sites such as kayas that are located in close proximity to the project site
	Construction	The rehabilitation works may attract attention from activists and pressure groups who may make petitions.	Adequate disclosure of information and engagement of concerned NGOs and other interested groups
Public Health	Construction	Potential for rise in new cases of communicable	• Support HIV / Aids sensitization programs • Avail and equip a Voluntary Counselling and

Sector/activity affected	Project Phase	Impacts/Issues identified	Proposed mitigation measures
		diseases such as HIV/Aids due to interaction with migrant workers	Testing (VCT) Centre during the construction period.

Negative environmental impacts include:

Sector/activity affected	Project Phase	Impacts/Issues identified	Mitigation measures suggested
Marine Environment	Construction	Generation of suspended sediment during dredging may reduce the productivity of phytoplankton and other aquatic plants smother benthos on habitats adjacent to the dredging / construction sites	• Careful choice of dredging period (North East Monsoon) when sediments would be propagated away from sensitive habitats; • Reductions in the amount of suspended sediment through use of appropriate civil technology (dredger type, timing) will further reduce risks. • Continuous monitoring for developments and accumulations of harmful algae blooms
	Construction	Physical removal from the seabed of submarine sediments and their associated attached sessile organisms will result into destruction of the infaunal and epifaunal biota;	Reduction in the amount of suspended sediment through use of appropriate civil engineering technology (dredger type, timing) will reduce risks
Critical habitats	Operation	Accidental oil spills and discharge of ship waste from vessels during operation phase may affect critical habitats and seabirds due to oiling;	Put in place best practice procedures through IMO, KMA's and KPA's port and shipping regulations to reduce probabilities of accidental and/or operational spills. Activate oil spill management systems such as National Oil Spill Response Contingency Plan in the event of spill.
Air	Construction	Air pollution from dusty construction material at the project as well as dust and particulate emission into the atmosphere during transportation of construction material, demolition, excavation and ground levelling works	• Construction materials carried in vehicles should be properly covered, unloading of bulk construction materials should be in areas protected from the wind; • Enforce speed restrictions within the construction site. • High moisture content on exposed surface and roads should be maintained by spraying with water. • Ensure efficient maintenance for construction vehicles for optimum performance and reduced emissions.

Sector/activity affected	Project Phase	Impacts/Issues identified	Mitigation measures suggested
Air	Operation	Air pollution as a result of emissions from ships, as well as emissions from container handling equipment and haulage trucks.	• Promote use of ultra-low sulphur diesel fuel could reduce pollutants emissions. • Provide shore-based power connection for use by ships when docked at the berths
Noise	Construction	Noise from on-site construction activities such piling, haulage of material and mixing of concrete.	• Minimize the generation of noise through the use of equipment with complying to the recommended standards • Adherence to a good and regular maintenance: • Personnel exposed to noise levels beyond threshold limits should be provided with protective gear like earplugs, muffs, etc.
Water	Operation	A rise in discharge of ballast water in the harbour due to increased shipping activities as a response to the berths availability may increase the risk of introduction of marine exotic species	Enforce KPA policy that prohibits discharge of ballast water within port areas.
Fishing activities		Overall decline in fish catches as a result of temporary displacement of fish from the dredge and disposal sites due to elevated levels of turbidity.	• Empowerment of fishers to access alternative fishing grounds during the dredging period; • Equip affected fishers with modern fishing gear and train them on how to use the gear; • Compensation of fishers for loss of livelihood during the dredging period

Details of the significance of these impacts and their duration are outlined in the thematic sections. Mitigation measures have been proposed for each impact and an Environmental Management and Monitoring Plan (EMMP) prepared to ensure that the proposed mitigation measures are implemented and desired level of compliance attained.

Conclusion

The ESIA Study has established that the proposed rehabilitation works would create stable berthing structures and additional container storage areas hence boosting port efficiency and the overall economy of the country thereby creating employment. However the project area is located in the neighborhood of sensitive ecosystems such as mangroves and coral reefs which act as habitat for key fisheries resources on which the livelihoods of local communities depends. The proposed project is likely to impact on these resources due to turbidity and sedimentation at the construction phase. A detailed fisheries assessment has been undertaken as part of this ESIA study to determine the likely impacts of the proposed works on fisheries resources and proposes mitigation measures to ensure restoration of livelihoods of the project affected persons.

The proponent has committed to undertake the proposed works in an environmentally responsible manner as demonstrated by commissioning the ESIA study to establish the inherent environmental and social risks associated with the works, and inviting stakeholders to share with them the findings of the study. An Environmental Management and Monitoring Plan (EMMP) prepared during this study has estimated the cost of mitigation actions at about Ksh 129 million. It is proposed that this provision be included in the capital budget of construction works to ensure implementation of the EMMP.

1.0 PROJECT DESCRIPTION

1.1 Project Location

The Port of Mombasa is located within a creek, on the west of Mombasa Island and on the mainland at Kipevu. The geographic position of the port is approximately **4' 00' S, 39" 40' E**. A map of the region is shown in Figure 1.1.

Berths 1 to 5 and Berths 7 to 10 are located at the western part of the Port of Mombasa in Mombasa island (Kilindini Harbour), while the northern part of the port comprising of Berths 11 to 14 are located at Port Reitz. The berths of Port Reitz and those of Kilindini Harbour are separated by a small creek. The areas between Berth 5 and Berth 7, as well as between Berth 14 and Berth 16, comprise two small bays where berthing facilities have never been built. To the south of Berth 1 there are the Lighter Quays which are abandoned and no longer in use. The Dockyards, located south of the Lighter Quays, are operated by KPA and comprise workshops, slipways and other facilities for maintenance. At Mbaraki Creek there is a dry dock operated by African Marine and General Engineering Co Ltd. The most southern part of the Port of Mombasa consists of the Mbaraki Wharf which is used for handling of dry bulk cargo.

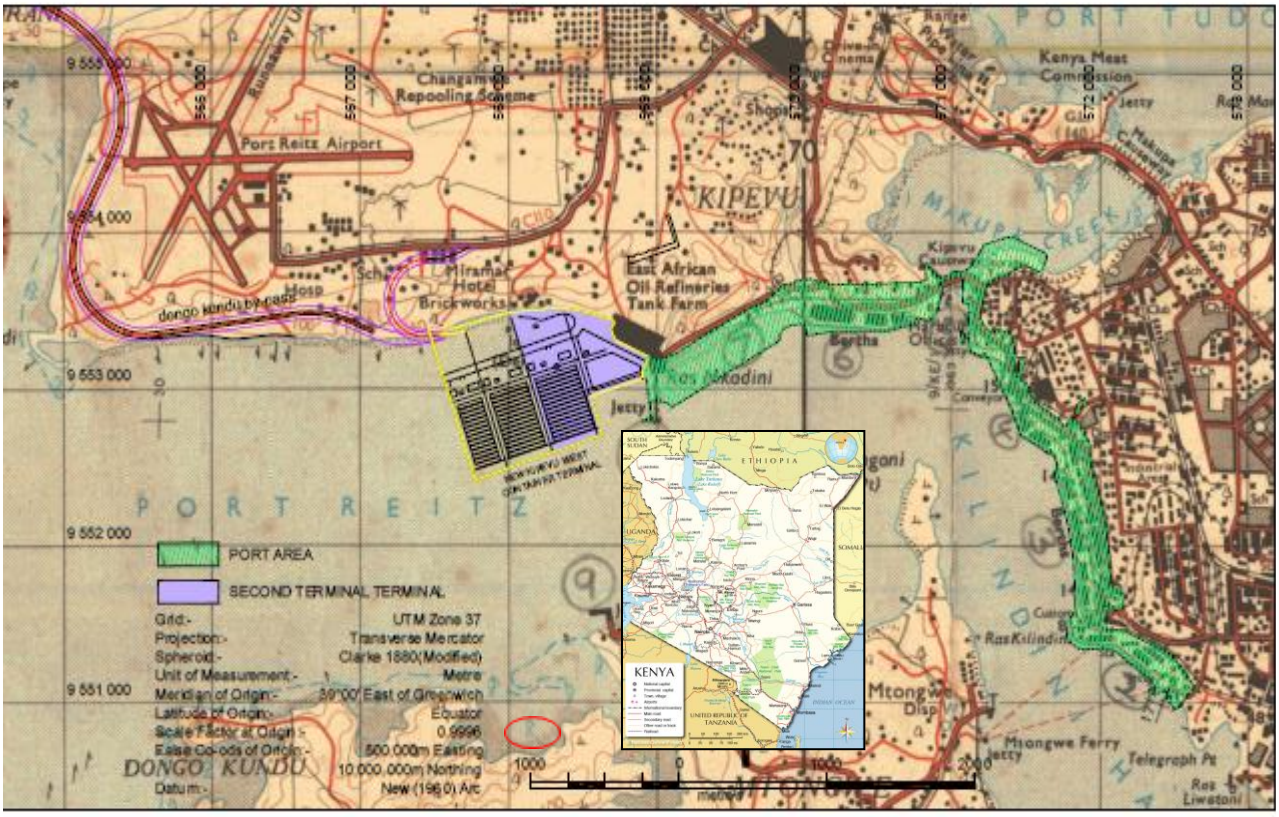


Figure 1.1: Map showing the Port of Mombasa and approaches

Within the port boundaries there are two oil jetties Shimanzi Oil Terminal located to the north of Berth 10 (SOT) and Kipevu Oil Terminal (KOT) located directly to the west of Berth 19. Characteristics of the main berthing facilities are listed in Table 1-1.

Table 1-1: Main characteristics of deep water berths

Harbour	Berth	Length (m)	Apron width (m)	Top level quay apron (mCD)	Advertised water depth (mCD)	Year of construction	Type of construction	Usage
Kilindini Harbour	1	181	15.2	5.49	-10.06	1926	Gravity wall	Cruise liners, ConRo, general cargo
	2	181	15.2	5.49	-10.06	1926	Gravity wall	Cruise liners, ConRo, general cargo
	3	181	15.2	5.49	-10.06	1929	Gravity wall	Dry bulk cargo
	4	181	15.2	5.49	-10.06	1929	Gravity wall	Conventional cargo
	5	181	15.2	5.49	-10.06	1931	Gravity wall	Conventional cargo, RoRo, ConRo
	6	No berth structure						
	7	198	20.3	5.49	-10.06	1942 - 1944	Suspended deck slab supported by reinforced concrete piles	Conventional cargo
	8	197	20.3	5.49	-10.06	1942 - 1944	Suspended deck slab supported by reinforced concrete piles	Conventional cargo
	9	205	21.0	5.49	-10.06	1956 – 1959	Suspended deck slab supported by reinforced concrete piles	Conventional cargo / soda ash
	10	203	21.0	5.49	-10.06	1956 - 1959	Suspended deck slab supported by reinforced concrete piles	Conventional cargo, edible oil
Port Reitz	11	185	20.5	5.49	-9.75	1958/59	Suspended deck slab supported by reinforced concrete piles	Container
	12	183	20.3	5.49	-9.75	1958/59	Suspended deck slab supported by reinforced concrete piles	Container
	13	183	20.3	5.49	-10.36	1958/59	Suspended deck slab supported by reinforced concrete piles	Container
	14	185	20.3	5.49	-10.36	1958/59	Suspended deck slab supported by reinforced concrete piles	Container

1.2 Present Conditions

In 2014 KPA commissioned a firm of consulting engineers, M/s Inros Lackner to undertake a condition survey on the target berths. Part of the target area shown in Fig 1.2 below (Berths 1-14) has now been identified as the priority area for rehabilitation and is the subject of the current ESIA study. The proposed project area is located within Kilindini Harbour between Berth No. 1 coordinates **(39.64807, -4.05925)** and Berth No 14 **(39.63212, -4.04384).** This location is designated as a port operations area.

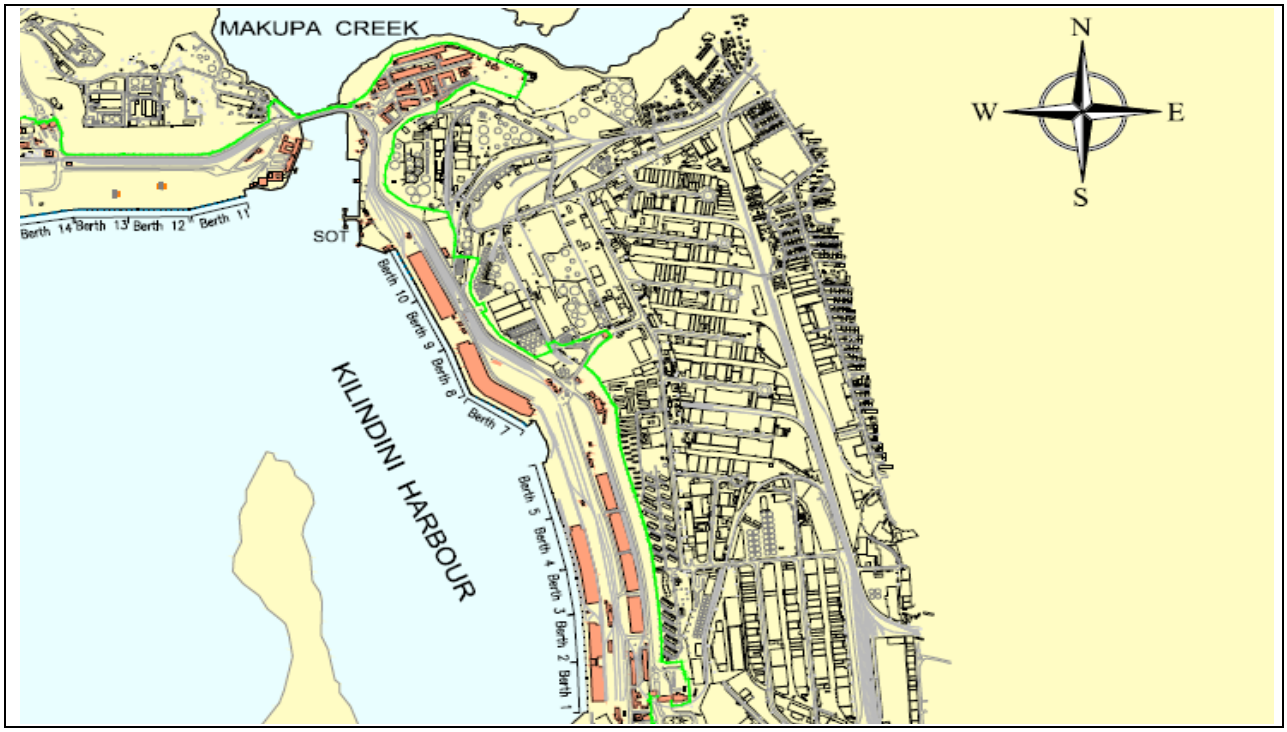


Fig 1.2: Aerial Map of Mombasa Port showing Berths 1-14 and associated yards (Source: Inros Lackner)

During condition survey of Berths 1 – 5, Berths 7 – 10 and Berths 11 – 14 it was found that the quay walls are in poor to critical conditions as there are signs of advanced deterioration. In time if left unrepaired this could lead to partial failure of the structures, which could then accelerate the overall speed of deterioration. Specific concerns for each section are as follows:

2.2.1 Berths 1-5

Typical damages of the quay beam above water level are edge breakout, spalling and cracks. Those damages were observed almost over the entire length of the quay beam. In some areas the reinforcement is exposed. There are a series of vertical cracks through the masonry blocks along its length, which extend from the bottom up to the fourth layer of the berths *(Inros Lackner)*. On the sea floor in front of the berths the large steel parts and chains from the fender fixings (Berth 1) were noted. Some of these parts protrude from the sea bottom up to 1 m and pose a risk to mooring vessels. The gravity wall at Berths 1 to 5 is in a poor condition. The main damages are:

- broken quay beam,

- cracks in the concrete block wall,
- missing or deformed and corroded life ladders,
- corroded bollards
- inappropriate fender system
- Blocked manholes.

2.2.2 Berth 7 - 10

Based on the results of the condition survey Berths 7 – 10 are in a poor condition. A major concern of safety is the missing fenders or fender plates. The quay beams are in a fair to poor condition. Typical observed damages are edge breakouts, spalling with exposed reinforcement and horizontal and vertical cracks. At the bottom of the concrete slab there is general surface corrosion so that the bottom reinforcement is partly exposed.

The piles are generally in a poor to serious condition showing signs of advanced deterioration such as cracks and spalling.

Besides the above mentioned defects further damages were observed as follows:

- Missing fenders or fender plates,
- Corrosion of the concrete slab and piles,
- Missing or deformed and corroded life ladders,
- Corroded bollards
- Blocked manholes

Fig 1.3: Damage to quay wall at Berth No. 9 (Source: Inros Lackner)

2.2.3 Berth 11 - 14

Berths 11 - 14 are in a critical condition. Large areas of the concrete slab are highly corroded and large areas of exposed and corroded reinforcement were noted. Heavy spalling and cracking of the concrete in combination with severe loss of main reinforcement bars characterise the state of the majority of structural parts of Berths 11 to 14. Such damages and losses of steel and concrete, resulting in drastic deterioration, may lead to total closure of the berths in the near future.

Fig 1.4: Corrosion attack on fenders Berth 11 (Source: Inros Lackner)

Fig 1.5: Exposed Reinforcement at bottom Berth 11

The quay walls at Berths 11 to 14 are generally in a critical condition. As stated above, a total closure of Berths 11 to 14 for regular port operations will be unavoidable very soon unless immediate action is initiated for their reinstatement.

Fig 1.6: Damage to quay beam berth 12

Fig 1.7: Corrosion attack on piles Berth at 14

2.3 Analysis of Alternatives

The repair options that were considered include:

2.3.1. Do Nothing

This option will lead to severe loss of steel section, loss of bond between steel and concrete leading to significant reduction in structural capacity and ultimately structural failure of the berthing structure. It is not feasible.

2.3.2 Patch Repair

Patch repair including replacement of steel with more than 10% section loss – This is necessary to restore and preserve the capacity of the structure but will not stop ongoing corrosion. Corrosion may actually accelerate in adjacent areas which have not been repaired. Patch repairs alone require cutting out concrete behind the rebars, and to at least 50mm beyond and rust and corrosion damage

on the bars. If patch repairs are coupled with cathodic protection, only damaged concrete is removed. This reduces the amount of propping required.

2.3.3 Cathodic protection

Cathodic protection is recommended for heavily chloride-contaminated structures. Cathodic protection works by ensuring that cathodic reaction occurs on all the reinforcing steel. Cathodic Protection would need to be applied to the whole of the underside areas of the berthing structures. Therefore, galvanic cathodic protection is the most likely method of successfully protecting the quay wall substructure elements.

Under this method a range of zinc based anodes are installed in or on the concrete to provide a high level of corrosion protection. The system has very low maintenance requirements although it may be necessary to replace the anodes at 10 to 15 year intervals. Installation does not necessarily require high levels of skill and technology.

2.4 Proposed Repair Works

2.4.1 Berths 1-5

- Rehabilitation of areas with spalling and exposed reinforcement at the quay beam
- Sealing of cracks
- Installation of new bollards, fenders and life ladders
- Installation of new manhole covers.

2.4.2 Berths 7-10

- Rehabilitation of areas with spalling and exposed reinforcement at the quay beam
- Repair of the deck slab by shot-creting or cathodic protection
- Repair of the pile caps
- Sealing of cracks
- Installation of new bollards, fenders and life ladders
- Installation of new manhole covers.

2.4.3 Berths 11-14

The Works at Berths 11-14 comprise the construction of a container terminal at Berths 11 – 14 including all auxiliary works. It is intended, to expand the terminal area approx. 90 m towards the sea to gain an additional area of 60,000 m² (see Figure 2.8 and 2.9 below)The quay line will be straightened and the water depth will be increased to a depth of 15 metres below chart datum (– 15 mCD). The Works include, but are not limited to:

- demolition and removal of existing infrastructure on the back-up area behind Berth 11 – 14 and existing quay wall (suspended deck structure)
- dredging and dumping of dredged material and reclamation of land with suitable material
- construction of embankments on both sides of the terminal and suspended deck structure (length approx. 740 m)

- construction of reverted slope under suspended deck and scour protection
- provision of infrastructure on terminal area including utilities (electricity, fresh water, etc.)
- delivery and installation of fenders, life ladders, bollards and other marine equipment
- erection of reefer stacks
- construction of drainage system with oil separators and sediment tanks

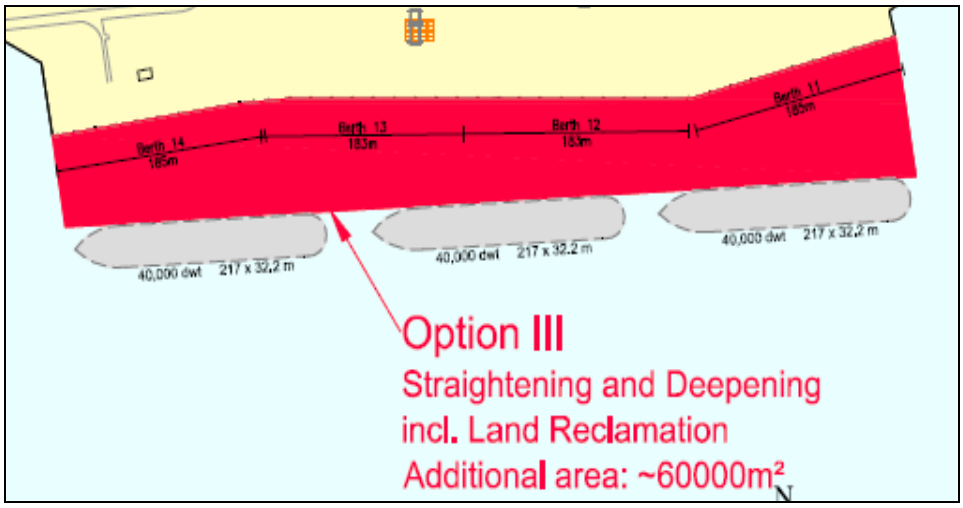


Fig 1.8: Proposed works at berths 11-14 indicating dredging and land reclamation areas

The main dimensions of the new container terminal are as follows:

- Length of quay wall: 740 m
- Additional yard area: 68,000 m² (incl. land reclamation at Berth 15)
- Complete future terminal area: 200,000 m²
- Maximum extensions of project site: 1,000 x 300 m

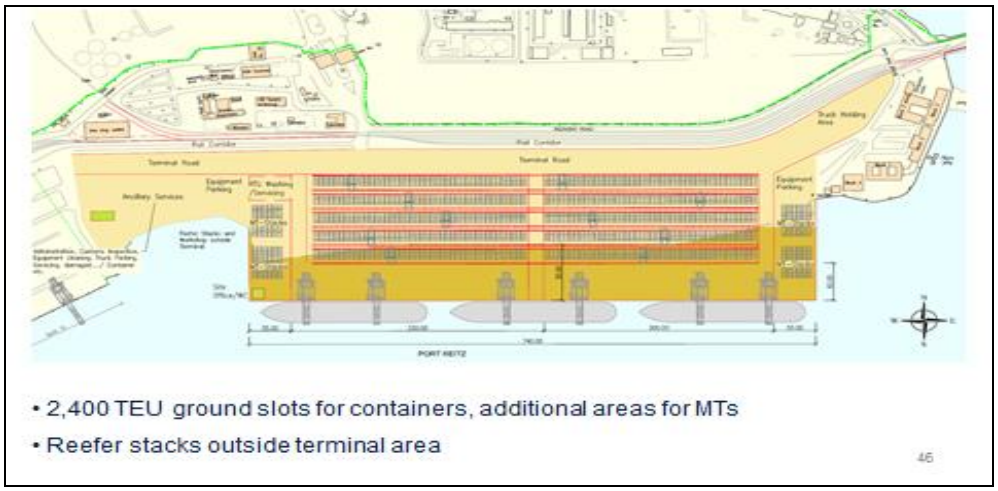


Fig 1.9: Possible layout of berths 11-14

2.5 Dredging and Reclamation

For the expansion of the container terminal, land adjacent to the existing quay structures will be reclaimed. Both sides of the reclaimed area will be protected by dams with revetments. This is to prevent dredged material from being eroded during the construction period and to protect the created terminal area against wave attacks. The expected volumes of dredging and reclamation works are as outlined in the Table 1-2 below:

Table 2-2: Volumes of dredging and reclamation works

Dredging and land reclamation	No. (pcs):	Height (m):	Width (m)/ Cross section area area (m²)		Length (m):	Unit	Volume & Quantity:
Dredging							
Mobilisation and demobilisation of plan and equipement for dredging work				***Cost is included in Contractor's facilities in General Items***	740,00	LS	1,00
Dredging Berth Pocket up to -17.40 m CD, existing water depth: -11 m CD in front of the new structure (Grab Dredger) soft material	1,00	6,40	50,00		838,00	m³	268.160,00
Dredging Berth Pocket up to -17.4 m CD, existing water depth: -11 m CD in front of the new structure (Grab Dredger) Very Dense Material	1,00	6,40	50,00	10 % of total Volume to dredge	838,00	m³	26.816,00
Soil remplacement dredging : Exisiting soil in place to be dredged in line with plan and the cross-section according to the Geotechnical survey			576,21		740,00	m³	426.395,40
Dredging Obstacles underwater	1,00		1,00		740,00	u	4,00
Dredging Waiting Time							
WT barge	45,00				740,00	h	45,00
WT Cutter	45,00				740,00	h	45,00
WT backhoe	45,00				740,00	h	45,00
WT Hopper	45,00				740,00	h	45,00
Land Reclamation							
Backfill Material A (-11m up to +5,045m) sea or beach sand							
Berth 11	1,00	16,05		262.016,00	181,00	m³	262.016,00
Berth 12	1,00	16,05		161.733,50	183,00	m³	161.733,50
Berth13	1,00	16,05		204.985,00	182,00	m³	204.985,00
Berths 14	1,00	16,05		159.478,50	184,00	m³	159.478,50
Additional backfill material due to soil remplacement	1,00				740,00	m³	426.395,40

Section drawings for berths 1-14 are as illustrated below:

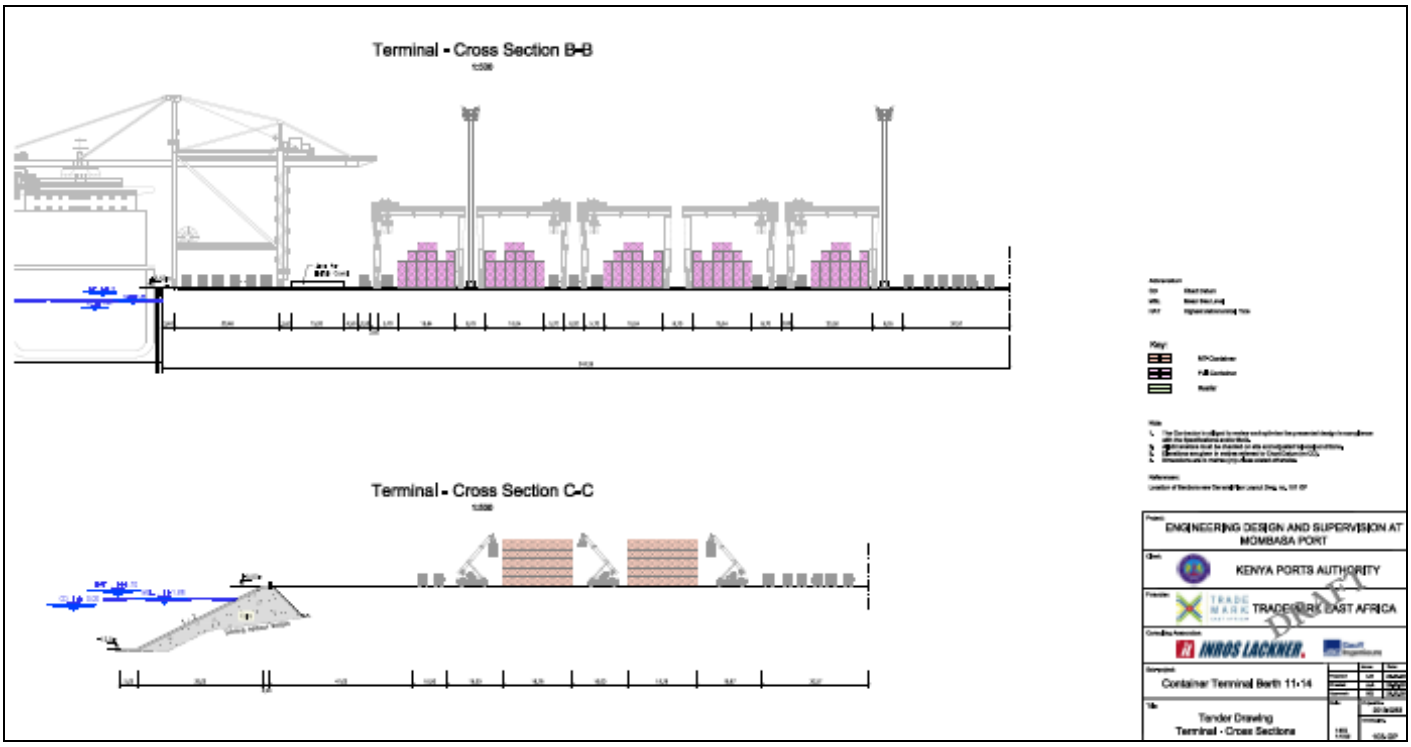


Fig 1.10: Section drawing of a typical container berth

Sand shall be sourced from a location within the Indian Ocean from where the sand for the just completed second container terminal was harvested. The geographical location for the site is as shown in figure 1.11 below.

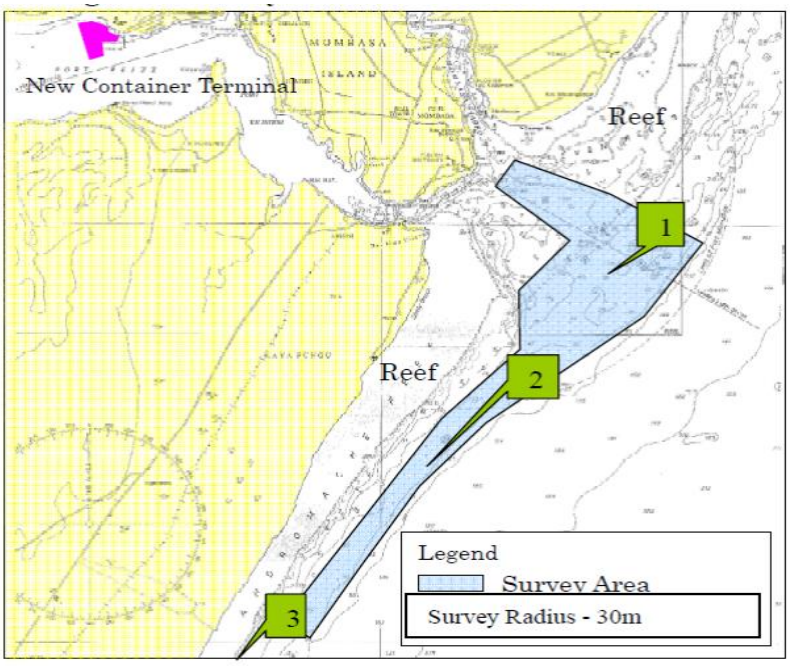


Fig 1.11: Location of sand mining sites relative to the Port of Mombasa

The geographical locations of these points are as shown in Table 2.3 below:

Table 1-3: Geographical positions of sand mining sites

	UTM System (WGS84, Zone 37S)		Geographic Coordinates (WGS84)	
Point	**Easting**	**Northing**	**Longitude**	**Latitude**
1	578147	9546930	39 39'58"E	4 9'28"S
2	572308	9540990	39 39'41	4 09'49"S
3	569731	9533900	39 38'52	4 11'46"S

These are illustrated further in the georeferenced map in Figure 1.12 below:

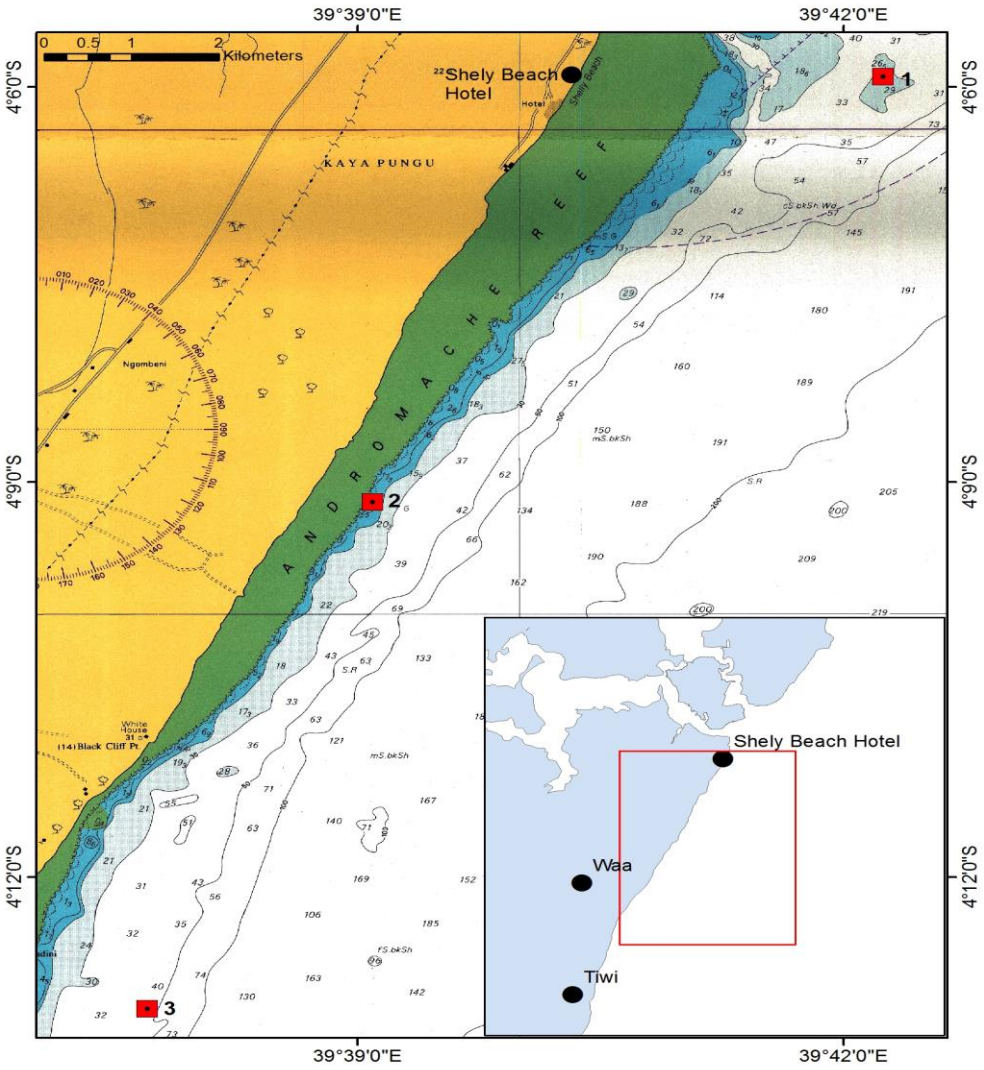


Fig. 1.12: Georeferenced location of sand mining sites

2.6 Demolition Works

The existing quay structures, pavement and buildings will have to be partially demolished so that they do not interfere with the new structures for the proposed container terminal. In a first step the

pavement including road surfaces and railway tracks has to be broken up and removed. Then the deck, beams and pile caps have to be removed and the piles have to be cut at the level indicated in the Tender Drawings and dismantled.

2.7 Infrastructure Works

New infrastructure will be constructed on the terminal area including roads, parking spaces, container stacks, reefer stacks and other paved areas. Drainage and sewing systems will be installed and lighting poles will be erected. The electric power supply to the various consumption points is also included.

2.8 Equipment

The equipment proposed for use in the project are listed in Table 2.4 below:

Table 1-4: List of Construction equipment

SN	Type of equipment	Model
1	Piling barge	High pile frame BSP-CG240 hammer
2	Dredger	8 m³
3	Self-propelled hopper	1000 m³
4	Sand suction dredger	2000 m³
5	Anchor boat	400 HP
6	Stone dumper	25 m³
7	Mobile crane	QY50K- I
8	Crawler excavator	SY215C-8S
9	Loader	ZL50CN
10	Trailer	
11	Lorry with trailer	
12	150T Crawler crane	QUY150
13	Concrete mixer	SY5252GJB 8m3
14	PC300 Crawler excavator	PC300LC-7
15	Air compressor	XAS97DD PE SQ F AC LEG 6m3
16	Concrete pump	HBT60C-1413DIII
17	Roller	YZ18C
18	Generator	VOLVO PENTA 400KW

2.9 Project Timelines

Implementation of the project is at preliminary stages with detailed design and ground investigations ongoing. Upon conclusion of tendering and procurement processes the construction of Berths 11-14 is expected to commence by April 2018. A detailed programme of the project is as outlined in Table 2.5 below:

Table 1-5: Summary of Project Timeline

1	ESIA report submitted to NEMA	September 2017
2	Financial appraisal and endorsement by donors/lenders	Oct 2016-June 2017
3	Lenders, GOK & KPA negotiations	Jan-Dec 2017
4	Procurement of contractors	Oct 2017-Jun 2018
5	Construction Berth 11-14	Jul 2018-Jun 2021 (3yrs)
6	Construction Berth 1-5	Jul 2020-Jun 2022 (2yrs)
7	Construction Berth 6-10	Jul 2022-Dec 2024(2.5yrs)

2.10 Project costs and potential financing arrangements

The overall project cost estimate is USD 192,500,000 as summarised in Table 2.6 below. The project cost estimates are based on feasibility and detailed design studies of the project. The detailed Design studies were carried out by Inros Lackner and would be further informed by the pending Geotechnical Investigations.

Table 1-6: Outline of Project Costs

Descriptions	**Amount USD)**
o Insurance, technical documents etc.	5,200,000
o Demolition of container yard	3,200,000
o Soil replacement (depending on GI)	14,100,000
o Reclamation of Berth 15	1,700,000
o Re-assessment of dredging prices	5,950,000
o Introduction of STS cranes	6,550,000
o Heavy duty project cargo berth	1,100,000
o Longer piles (depending on GI)	6,200,000
o Berth facilities (OPS, water)	150,000
o Fender piles	1,800,000
o Enhanced corrosion protection	4,100,000
o Pavement and drainage container yard	22,650,000
o Utilities (electricity, reefers, lighting…)	15,850,000
Sub-Total USD	88,550,000
o Civil works	90,950,000
Total 1	**179,500,000**
Environmental related costs	
o Environmental monitoring and mitigation	1,100,000
Total 2	**1,100,000**
Cost of Equipment	
Ship to Shore (STS) cranes	10,000,000
Rubber Tyred Gantries (RTG) cranes	1,800,000
Terminal tractors	100,000

Descriptions	Amount USD)
Total 3	**11,900,000**
Office building	
Total 4	
Grand Total (Total 1+2+3+4)	**192,500,000**

It is expected that the project will be co financed by GOK through KPA. Euroopean Investment Bank (EIB) and AFD are expected to provide debt financing on concessionary terms. This facility will be blended with grant financing from the European Union. A Detailed Economic and Financial appraisal of the proposed project is being carried out by Ernst and Young (EY).

2.0 ESIA METHODOLOGY AND SCOPE

Introduction

In order to fulfill mandate the consultant undertook literature review on available documents relevant to the study such as recent research papers and environmental assessment reports, local environmental laws and regulations, international conventions and protocols to which Kenya subscribes as well as standards and guidelines issued by regulators such as NEMA and other Lead Agencies.

Field studies were conducted within the port areas to document the baseline environmental conditions and review the impact of the proposed project on the baseline environment. Upon completion of impact analysis mitigation measures were proposed and an Environmental Management and Monitoring Plan (EMMP) prepared that would ensure the proposed mitigation measures are implemented and desired effects achieved.

2.1 Preliminary Tasks

Preliminary tasks that were undertaken during the study were:

2.1.1 Screening

This is a rapid assessment of the project area by use of a questionnaire to identify the environmental and socioeconomic resources in the project area and the level of environmental assessment that needs to be done to determine project impacts. Screening was done upon commencement of the ESIA study so as to inform the issues that needed to be addressed at the scoping stage.

2.1.2 Scoping

The scoping exercise was undertaken as part of baseline studies and provided an implementation plan for subsequent steps by making a preliminary assessment of methods and levels of study needed to obtain reliable baseline information to evaluate baseline conditions.

The Scoping process involved:

- Review of project tasks and target location;
- Demarcation of Project Area using maps and sketches;
- Identification of key environmental and social issues within the project area;
- Development of sensitivity maps;
- Identification of issues to be addressed in the ESIA.

2.1.3 Development of Terms of Reference (TOR) for Investigation of Environmental and Social Impact Assessment

Terms of Reference (ToR) were developed based on the findings of the Scoping Study and included, among others:

- Description of the project site and surroundings;
- Description of project activities;
- Determination of baseline environmental conditions (air quality, water quality, sediment / soil quality, noise & vibration, odour) of the selected site through sampling and analysis.
- Socioeconomic survey (livelihood, literacy levels, employment); prevalence of infectious diseases such as HIV/Aids, Occupational Health and Safety aspects of the project, accidents and emergency management as well as the impacts of climate change.
- Identification of aspects of the project that are likely to have adverse environmental and social impacts, or whose impacts cannot be established by the scoping process;
- Detailed methodology for investigation of each item and to determine its environmental and social impacts;
- Development of mitigation measures and an Environmental Management and Monitoring Plan (EMMP).

Upon completion of scoping the consultant prepared a project report containing the Scoping Report and Terms of Reference for ESIA study and sent to NEMA for approval. Detailed studies then commenced in line with the detailed methodology outlined below.

2.2 Project Description

Key components of the proposed project were highlighted, including the implementing agents, a brief history of the project and a justification for the project, as follows:

- A full description of the project using maps and sketches, objectives of the project as well as potential benefits to the country and to the local communities;
- Geographical location and extent of study area as well as adjacent or remote areas considered to be affected by the project such as areas targeted for dumping of dredged material, sources of construction material, reclaimed land etc.
- Project tasks likely to be undertaken such as rehabilitation of berthing structures, construction of administration buildings, dredging and land reclamation, materials to be used and waste likely to be generated;
- extent and magnitude of site reclamation and/or clearance, excavation and concrete works;
- sediment containment, settling and turbidity control measures;
- project schedule `and life span;
- project sustainability and decommissioning of obsolete or abandoned works.

2.3 Baseline Studies

Baseline data was obtained through field studies at the proposed project site and its environs. Data on biological resources and baseline environmental characteristics was obtained through sampling and analysis at a NEMA approved laboratory. Socio-economic data was obtained through literature

review and field studies to determine what may have changed since the documents under review were published.

The baseline information obtained during the study as well as the methodology are summarized in Table 2.1 below

Table 2-1: Summary of Methodology and Approach for ESIA Study

Activity	Methodology/ Approach
Physical environment: geomorphology, meteorology, sea currents and bathymetry, surface hydrology, estuarine/marine receiving water quality, and ambient noise. Hazard vulnerability and storm surge	Literature review and field studies
Geographical and topographical information (lake, river, channel, basin area, groundwater, vegetation), etc.	Literature Review
Biological environment: terrestrial and marine vegetation and fauna, rare or endangered species, wetlands, coral reefs, and other sensitive habitats, Marine Protected Areas (MPAs), species of commercial importance, and species with the potential to become nuisances or vectors.	Literature Review, field studies and consultation with key informant stakeholders
Chemical environment - water quality, soil quality and air quality; solid waste generation and disposal systems; noise and vibration	Literature review, sampling and analysis at a NEMA approved laboratory
Socio-cultural environment: socio-economic activities, population and land use, planned development activities, employment, recreation and public health, cultural heritage sites and social facilities (schools, hospitals and religious facilities); vulnerable groups, indigenous peoples, education level, and poverty levels; infrastructure facilities such as roads, railways and electricity; availability and use of domestic water; fishing activities and use of the port, population, vulnerable and marginalized groups in project area	Literature review, field studies and Stakeholder Consultation
Occupational Health and Safety aspects – Construction impacts such as noise, dust and vibrations, fires, Potential for marine casualties during construction due to proximity to the seafront, fire safety preparedness, oil spill response coordination (oil spills may result from oil tanker mishaps and from land based industrial activities). Procedures for accident reporting and investigation, Provision and use of Personal Protective Equipment	Literature Review, field studies and consultation of key informant stakeholders

During Literature Review environmental and social impact assessment reports and related project documents recently prepared for major infrastructure development projects around Mombasa port were studied, including the following:

- The Master Plan for the Port of Mombasa, 2009;
- ESIA for the ongoing Mombasa Port Development Project;
- Feasibility Study for Construction of the Offshore Jetty and pipeline in Pungu / Dongo Kundu area by National Oil Corporation of Kenya;
- ESIA Report for Dredging of the Access Channel at the Port of Mombasa
- Environment Sensitivity Atlas for the Coastal Area of Kenya;
- State of the Environment Report, Coast Edition; NEMA 2013.
- Republic of Kenya. 2010. 2009 Kenya Population and Housing Census
- Republic of Kenya 2016. Marine Fisheries Framework Survey.

Detailed methodologies for baseline studies for each thematic area are as outlined in the following sub-sections:

2.3.1 Characterization of the Biological Environment

This was necessary so as to document the baseline ecological conditions of the project area such as flora and fauna, and was be done through sampling and analysis. For each sampling sites and sampling points, this included a description of **vegetation** (including dominant species, alien invasive species and environmental weeds, species and assemblages of conservation significance, and vegetation cover); **fauna** (including dominant assemblages, dominant species, species of conservation significance, alien / invasive species and vermin/pest species), and **habitats** (including major types and biological significance of each).

In particular, the following sensitive/critical habitats potentially impactable were assessed:

a) Marine Habitats

- Mangrove and other wetlands community sites;
- Coral reef and sponge community sites;
- Seagrass community sites;
- Rocky platforms with attached/sessile life-forms;
- Soft bottom communities with macro-benthos;
- Species of special/commercial such as rare and endangered species as per IUCN red-listings;
- Species with potential to become nuisances or vectors

b) Terrestrial Habitats / Species:

- Wild plants – floristic composition, physiognomy and growth form, ethnobotany, economic species, endangered and rare species,
- Crop and plantation plants

- Invertebrates, small fauna and burrowers
- Visiting populations: birds, reptiles
- Wildlife populations – conventional big animals, bats,
- Livestock populations – domesticated animals

The inventory of fauna and flora in the area concerned was made by field survey, interviews with conservation agencies and the benthic studies.

2.3.2 Characterization of the Physical Environment

An assessment was made of the physical environmental conditions such as:

- Geomorphology and sedimentology,
- Meteorology (rainfall, wind, surface hydrology),
- Oceanographic characteristics (bathymetry, circulation systems, sea currents {tidal, stream-flow, wind-driven}, winds, pressure, waves and tides),
- The port near shore environment (lagoons, creeks, bays, sub-tidal, intertidal and supra-tidal environments, estuarine/marine receiving water quality).
- Hazard vulnerability; vulnerability of port near shore environments to flooding and storm surge,
- Vulnerability of project area to effects of climate change.

2.3.3 Characterization of the Chemical Environment:

This was done to determine baseline chemical conditions such as soil quality, marine sediment quality and marine water quality.

For each habitat type or sampling site, a determination was made of the physico-chemical properties of the surface water (including, temperature, salinity, pH, transparency, and nutrients). Attention was paid to physico-chemical characterization of sediments beneath the water sampling points as well). The samples were taken to a NEMA approved laboratory (Polucon Services Kenya Limited) for analysis. In particular, the following subcomponents were assessed:

A. Water Quality – Physico- Chemical Analysis:

- Suspended and dissolved solids
- Temperature
- Salinity/conductivity;
- Dissolved oxygen
- pH, BOD, COD
- Dissolved N and Dissolved P
- Chloride

B. Water Quality – Microbiological Analysis:

- Total coliforms
- Fecal coliforms

- E. coli
- Enterococci

C. Sediments Quality Survey/Sampling:

Sediment Quality Survey: Seabed sediment material sampling was done at the same sampling points as with water quality sampling; and the following parameters recorded:

- Grain size Analysis
- Total Organic Matter (Ignition loss)
- Moisture content
- Heavy metal content – Mercury, Arsenic, Lead, Chromium, Cadmium, Nickel, Iron, Lead, Zinc, Copper
- PAH
- Total N and Total P

D. Air Quality and Noise Level Survey

Sampling for air quality was done at selected sampling points within the project area using a direct reading air quality analyzer for monitoring gaseous pollutants whereas a particle counter was used to measure airborne particulates.

Noise level was determined using a Sound Level Meter and equivalent noise level (L_{eq}), maximum sound pressure level (L_{max}) and minimum sound pressure level (L_{min}) parameters recorded to quantify ambient noise levels.

The results of noise and air quality baseline levels were compared with area-specific noise guidelines by World Bank and NEMA (Air Quality and Noise pollution guidelines).

2.3.4 Socio-economic Survey

This section of the study presents socio-economic conditions in the area including livelihoods, security, health and education. Aspects covered include:

- Population distribution around the project area
- Social infrastructure (schools, health facilities, water, electricity, roads, sanitation etc.)
- Socio-economic profile – livelihood, security, health, education, land use activities, and economic activities,
- Cultural profile – Identification of cultural resources (graveyards, shrines, historical sites) that may be affected;
- Identification of project related activities that may cause temporary restriction of access to sources of livelihood;
- Determination of existence of Vulnerable and marginalized groups.

The information was obtained through literature review of published reports and official government records, and confirmed during field studies.

2.3.5 Fishery Survey

Fishery survey was undertaken through the identification of the fishing grounds, fishing villages, fish landing sites, as well as review of fisheries records to determine the amount of fish landed, marketing arrangements, income generated from fishing and the impact the sector may suffer from the proposed development such as loss of the fishing villages, fishing grounds, landing sites, loss of incomes, loss of employment and the available alternatives.

Identification was made of fishing resources such as fishing grounds or landing sites that may be affected and fishermen and Beach Management Units (BMU) likely to suffer losses as a result of the project. Quantification was made of the level of use of the channel and impact likely to result from limitation of access to fishing grounds.

2.4 Stakeholder Consultation and Public Participation

Stakeholder Consultation and Public Participation was necessary to ensure compliance with The Constitution of Kenya, 2010 and the Environmental Management and Coordination Act 1999. The consultants provided information on project activities and findings of ESIA study to stakeholders, Lead Agencies, relevant government agencies and port users, and obtained the views of stakeholders and affected groups. Details of the stakeholder consultation process are outlined in chapter 10 of this report.

The following stakeholders were consulted and their concerns addressed:

- Stakeholders with environmental interests – Kenya Marine and Fisheries Research Institute (KMFRI), Kenya Wildlife Service (KWS), Kenya Forest Service (KFS), NEMA, Kenya Maritime Authority (KMA)
- Lead Agencies – County Government of Mombasa, Kengen, Kenya Pipeline Company, Kenya Power, Kenya Bureau of Statistics, State Department of Fisheries, Kenya Revenue Authority, Kenya Plant Health Inspection Services
- Port users - Logistics companies (Container Freight Stations, Shipping Companies), Concessionaires (Grain Bulk Handlers Limited, Mbaraki Bulk Terminals Limited, Bamburi Cement Limited, Tata Chemicals (Magadi), and
- The local communities particularly the fishers and people who use the area for recreational purposes such as those that frequent Kwa Skembo beach.

Two (2 no) Stakeholder Meetings (SHM) were held during the course of the study. The 1st SHM was a key informant SHM held at the scoping stage to brief the stakeholders on the project details and have their concerns on board to be addressed during the study. The second SHM was held at the end of the study to present the key findings and have stakeholder input on the same so that their comments are incorporated in the final report.

2.5 Policy, Institutional and Regulatory Considerations

This involved identification, review and description of the regulations, policies and administrative framework relevant to the proposed project. World Bank safeguard policies were also reviewed to identify which of the policies are likely to be triggered by the proposed development.

2.6 Identification of Potential Impacts

Identification was made of impacts related to project elements such as berth rehabilitation, dredging, land reclamation and construction of associated facilities. A distinction was also made between significant impacts that are positive and negative, direct and indirect, and short and long term. Special attention has been paid to:

- Impacts of the project on water quality and existing coastal ecosystems and resources,
- Impacts on the existing water activities such as fishing and on the rights/operations of any other stakeholders,
- Impacts of the project on maritime traffic and road traffic,
- Impacts of the project on ambient air quality and noise levels,
- Impacts of the project on historical and cultural resources, and
- Potential impacts of the project on climate change.

2.7 Proposal of Mitigation Measures

Proposals have been made of possible measures to prevent or reduce significant negative impacts to acceptable levels with particular attention paid to:

- Management of potential impacts on sensitive ecosystems;
- Control of impacts of dredging and disposal of dredged material;
- Measures to minimize disruption to existing socio economic activities;
- Contingency measures for prevention and containment of potential oil spills especially at the operations phase;
- Disaster preparedness and management plans;
- Fire safety and security measures;
- Management of potential impacts on archeological and cultural resources
- Compensation for project affected persons (PAPs), where required.

2.8 Development of an Environmental Management and Monitoring Plan

Critical issues requiring monitoring to ensure compliance with the proposed mitigation measures were identified and an impact management and monitoring plan for such issues prepared. The monitoring plan proposed includes the parameters to be monitored, frequency and responsibility for the monitoring tasks.

Monitoring of seawater quality would involve application of international standards and equipment for taking samples, and analysing them at a NEMA approved laboratory. Parameters to be

monitored include temperature, pH, salinity, BOD, dissolved oxygen, COD, organics, nutrients, heavy metals, coliforms, turbidity. Surveying sites may include areas adjacent to dredging and reclamation areas, environmentally sensitive areas and at offshore sand extraction and dumping areas.

Sediment quality monitoring would involve determination of levels of organic matter, oil and heavy metal content and grain size determination. Biological monitoring would concentrate around the number of micro-organism, the density of individuals, and animals at the sea bottom. Selective parameters for air quality monitoring include dust, O_2, CO_2, H_2S, SO_2, NO_2, CO while parameters for noise level measurement would be L_{max}, L_{min}, L_{eq} levels.

The EMMP prescribes the monitoring frequency for the different sites and the depth at which samples would be extracted.

2.9 Analysis of Alternatives

This section gives a description of the alternatives to the proposed project that would achieve the same objective including the "no action" alternative. Included here are alternative approaches for rehabilitation of the dilapidated berths.

2.10 Socioeconomic Survey

Socioeconomic survey was undertaken as part of the ESIA process and involved an assessment of population distribution, sources of livelihood, literacy levels, and employment levels, prevalence of infectious diseases such as HIV/Aids, occupational health and safety aspects of the project, accidents and emergency management.

The socioeconomic survey was carried out using questionnaires and involved focus group discussions and key informant interviews. Focus group discussions were arranged in advance with groups of 5-12 people to discuss peoples' views. Key informant interviews were carried out with opinion leaders. Data collected using questionnaires were coded and analysis carried out using descriptive statistics and content analysis performed on the data generated through focus group discussions and key informant interviews.

2.11 Report Preparation

This report, to be presented to NEMA, KPA and TMEA in electronic and hard copies, contains the key findings of the study, focusing on significant environmental and social issues. Conclusions and recommendations have been made supported by summaries of the data collected during the study and citations for any references used in interpreting those data.

3.0 LEGAL, POLICY, AND INSTITUTIONAL FRAMEWORK

3.1 Legal Framework

Legislative provisions applicable to the proposed project are:

3.1.1 Constitution of Kenya, 2010

The current constitution was promulgated in 2010 establishing a system of devolved government based on counties. The key constitutional provisions relevant to the proposed rehabilitation works are:

- Article 10 on national values and principles of governance including 10(2a) on democracy and participation of people;
- Fourth Schedule Article 10 on implementation of specific national government policies on natural resources and environmental conservation;
- Fourth Schedule Article 22 under national government on the protection of the environment and natural resources with a view to establishing a durable and sustainable system of development;
- Bill of rights Article 42 which states that every person has the right to a clean and healthy environment;
- Article 196 on public participation.

3.1.2 Environmental Management and Coordination Act, 1999

This is an Act of Parliament to provide for the establishment of an appropriate legal and institutional framework for the management of the environment. The Act established the National Environment Management Authority (NEMA) as the regulatory authority in charge of environmental matters.

Relevant Provisions include mandates given to NEMA such as:

1. Section 2(a): Co-ordination of environmental management activities and promotion and integration of environmental considerations into development projects.
2. Section 2(d): Examine land use patterns to determine their impact on the quality and quantity of natural resources;
3. 2(e): Carry out surveys which will assist in the proper management and conservation of the environment;
4. 2(l): Monitor and assess activities carried out by relevant lead agencies in order to ensure that the environment is not degraded by such activities, that environmental management objectives are adhered to, and adequate early warning on impending environmental emergencies is given.

3.13 Fisheries Management and Coordination Act No 35, 2016

This is an Act of Parliament is to provide for the conservation, management and development of fisheries and other aquatic resources to enhance the livelihood of communities dependent on fishing, and to establish the Kenya Fisheries Services; and for connected purposes.

Relevant provisions:

- Section 5(1): protect, manage, use and develop aquatic resources in a manner that is consistent with ecologically sustainable development and to uplift the living standards of fishing communities
- Section 7 which provides for the establishment of Kenya Fisheries Service as the state agency responsible for conservation, management and development of Kenya's fisheries resources.

3.1.4 Forest Act, 2005

This Act established the Kenya Forest Service (KFS) and supportive institutions for management and conservation of all types of forests. The Act mandates the KFS to conserve and manage all forests and sets out the roles and responsibilities of communities in managing forests.

Relevant Provisions:

Section (23) Upon the recommendation of the forest conservation committee for the area within which a forest is situated, the local authority and the Board, the Minister shall declare any land under the jurisdiction of a local authority to be a local authority forest where:

- land is an important catchment area, a source of water springs, or is a fragile environment;
- land is rich in biodiversity or contains rare, threatened or endangered species;
- forest is of cultural or scientific significance; or
- forest supports an important industry and is a major source of livelihood for the local community.

3.1.5 Water Act, 2002

The Water Act (2002) makes provision for the conservation, control and use of water resources in Kenya and for incidental and connected purposes. This Act aims at providing for harmonized and streamlined management of water resources, water supply and sewerage services.

Section 6 of this Act provides that 'An application for a license shall be the subject of public consultation and, where applicable, be subjected to environmental impact assessment in accordance with the requirements of the Environmental Management and Coordination Act of 1999'.

3.1.6 Physical Planning Act, Cap 286, 1996

The Act provides for preparation of regional and local physical development plans and grants local authorities (now County Governments) powers to control development within the area under their jurisdiction. Relevant sections are:

- Section 36**:** If in connection with a development application a local authority is of the opinion that proposals for industrial location, dumping sites, sewerage treatment, quarries or any other development activity will have injurious impact on the environment, the applicant shall be required to submit together with the application an environmental impact assessment report.

3.1.7 Maritime Zones Act, Cap 371

This Act of Parliament is to consolidate the law relating to the territorial waters and the continental shelf of Kenya; to provide for the establishment and delimitation of the exclusive economic zone of

Kenya; to provide for the exploration and exploitation and conservation and management of the resources of the maritime zones; and for connected purposes.

3.1.8 Energy Act, No. 2006

The Energy Act, No. 12 was enacted in 2006 and has consolidated the law relating to energy whilst simultaneously focusing on improved management and delivery of energy services. The Act brought forth the Energy Regulatory Commission

Relevant provisions include:
Section 14: The Commission shall, in granting or rejecting an application for a license or permit, take into consideration:-
(a) the impact of the undertaking on the social, cultural or recreational life of the community;
(b) the need to protect the environment and to conserve the natural resources in accordance with the Environmental Management and Coordination Act of 1999;

3.1.9 Wildlife Conservation and Management Act, Cap 376

This Act provides for the protection, conservation and management of wildlife in Kenya and also restricts entry into a protected area without proper permission, prohibits wilful or negligent cause of bush fire, felling of trees, hunting, digging, laying, or constructing any pitfall, net, trap, snare or other device whatsoever, capable of killing, capturing or wounding any animal.

3.1.10 Kenya Maritime Authority Act (Cap. 370).

An Act of Parliament to provide for the establishment of the Kenya Maritime Authority as a body with responsibility to monitor, regulate and coordinate activities in the maritime industry and for all other matters connected therewith. Relevant sections include the following functions of the Authority:

- to ensure, in collaboration with such other public agencies and institutions, the prevention of marine source pollution, protection of the marine environment and response to marine environment incidents;
- to regulate activities with regard to shipping in the inland waterways including the safety of navigation; and
- to implement and undertake co-ordination in maritime security;

3.1.11 Tourism Act, 2011

This Act provides for the development and management of stainable tourism and tourism-related activities and services, and for connected purposes. Mombasa County is a popular tourist destination and plans developed in the area have to comply with the Act. Under Section (5) of the Act the Authority responsible for regulation of tourism activities shall, in considering license applications, have regard to:

a) the protection of fragile environmental resources, ecosystems and habitats as provided for by the ministry for the time being responsible for matters relating to the environment;
b) an environmental impact assessment license issued under Part VI of the Environmental Management and Co-ordination Act, 1999 (No. 8 of 1999);
c) any representations received from members of the public.

The Act prohibits discharge of any dangerous materials, substances or oil into a designated tourism development area and pollution of wildlife habitats and ecosystems, or discharge of any pollutant detrimental to the environment contrary to the provisions of this Act or any other law.

3.2 Policies and Regulations

The table below highlights some of the relevant policies and their overall provisions as related to the proposed rehabilitation works:

Table 3-1: Policy Framework and Regulations applicable to Rehabilitation of Berths 1-14

Policy	Provision Applicable to Proposed Project
Environmental Management and Coordination (Impact Assessment and Audit) Regulations, 2003	These Regulations guide on the procedure for conducting ESIA studies by detailing the issues to be addressed during the study as well as the parameters to be evaluated and guidelines for development of environmental management and monitoring plans. In addition the regulations provide guidelines for conducting annual environmental audits.
Beach Management Units (BMU) Regulations, 2007	These regulations created Beach Management Units (BMUs) comprising of stakeholders within fishing communities with mandates of conservation, protection, monitoring and control of fishery resources and the environment, and fisheries planning and development in collaboration with government. The participation of fisher-folks is in line with the general principles of Code of Conduct for Responsible Fisheries (FAO, 1995). BMUs act as co-management institutions and provide for fisheries management at the grassroots level.
Environment Impact Assessment Guidelines And Administrative Procedures, 2002	These guidelines were developed to support the Environmental Impact Assessment (EIA) and Environmental Audit (EA) processes and assist in the integration of environmental and social concerns in economic development to foster sustainable development in Kenya.
Kenya Vision 2030	Kenya Vision 2030 is a long-term development blueprint for the country to create a globally competitive and prosperous country with a high quality of life by 2030. It aims at transforming Kenya into "a newly-industrializing, middle income country providing a high quality of life to all its citizens in a clean and secure environment".
National Environment Policy and Guideline 2013	Upon the promulgation of Constitution of Kenya 2010, it was found necessary to review the draft policy of 2008 to accommodate new developments due to time lapse and to align it to the new Constitution.

National Energy Policy 2004	The Sessional Paper No. 4 of 2004 governed the policy direction of the energy sector for past eight years, which has been aligned to the new Constitution 2010 and made tandem with the Vision 2030. The overall objective of the energy policy is to ensure affordable, sustainable and reliable supply to meet national and county development needs, while protecting and consenting the environment.
National Tourism Strategy 2013-2018	The national tourism strategy is a culmination of extensive stakeholders' involvement and participation besides fulfilment of the Tourism Act 2011, Section 3. The main aim of this strategy is to address national issues confronting the Kenya tourism sector and focus the players in the sector on sustainable tourism.
Environmental Management and Coordination (Water Quality) Regulations, 2006	These are described in Legal Notice No. 120 of 2006 and provide for protection of ground and surface water from pollution, quality standards for sources of domestic water and the limits and parameters of pollutants in treated waste water which can be discharged into the aquatic environment.
Noise and Excessive Vibration (Pollution Control) Regulations, 2008 (Legal Notice No 61)	These regulations apply to operation of equipment or machinery and engagement in commercial or industrial activity that is likely to emit noise or excessive vibrations. The regulations specify the limits or levels within which these shall be undertaken. The Regulations also stipulate in the second schedule that construction activities undertaken during the night should not emit excessive noise beyond the permissible levels.
Environmental Management and Coordination (Waste Management) Regulations, 2006 (Legal Notice No 121)	These regulations outline the responsibility of the waste generator and prescribe proper mechanisms for handling all waste through segregation, recycling and reuse.
Environmental Management and Coordination (Air Quality) Regulations, 2009	These regulations provide for prevention, control and abatement of air pollution from premises, processes, operations or works, and prescribes exposure limits of air pollutants and emission levels of hazardous substances.

3.3 Applicable World Bank Safeguards and International Conventions

The following international treaties, Conventions, and WB Policies have provisions applicable to the proposed project:

Table 3-2: WB Safeguard Policies and International Conventions Applicable to Proposed Works

Sector	Convention / Policy
EIA	World Bank Operational Policy 4.01(Environmental Assessment)
Resettlement	World Bank Operational Policy 4.12 (Involuntary Resettlement)

Water Quality	Ballast water management regulations (IMO Convention)
Disposal of Dredged Material and other waste	• London convention on the Prevention of Marine Pollution by Dumping of Waste and Other Matter(1972) • International Convention for the Prevention of Pollution From Ships, 1978.(Marpol 73/78) • World Bank Technical Paper Number 126 - Environmental Considerations for Port and Harbor Development
Cultural and Historical sites	Convention Concerning the protection of the World Cultural and Natural Heritage, Paris 1972
Wetlands	Convention on Wetland of International Importance (Ramsar, 1971)
Biodiversity	Convention on Biological Diversity (1992) WB OP 4.04: Natural Habitats
Wildlife	• Bonn Convention on the Conservation of Migratory Species of Wild Animals • Washington Convention on International Trade In Endangered Species (CITES,1973)
Hazardous Waste	Basel Convention on the Control of Trans-boundary Movement of Hazardous Wastes (1989)
Oil Spill	International Convention on Oil Pollution Preparedness, Response and Cooperation(1990)

3.4 Inconsistencies between Kenyan Legislation and WB Safeguards Policies

A review of World Bank safeguards policies and EMCA regulatory provisions indicates that they are generally aligned in principle and objectives but have few inconsistencies as follows:

- While World Bank OP 4.01 stipulates different scales of EIA for different categories of projects, Kenya's EMCA requires EIA for all projects listed under Schedule 2 of the Act irrespective of their scale.
- Whereas EMCA requires Strategic Environmental Assessments as framework instruments for large scale projects with impacts beyond the project location, WB Safeguards require that an Environmental and Social Management Framework (ESMF) be prepared as a safeguard document for projects whose exact boundaries and scale of impacts are not yet clear.
- EMCA recognizes other sectoral laws while WB has safeguards for specific interests.
- The national provisions for the management of resettlement related issues are not yet fully developed and therefore not at par with the World Bank safeguard WB OP 4.12. Where resettlement and compensation issues are encountered WB OP will be applied.

4.0 SOCIOECONOMIC ASSESSMENT

4.1 Introduction

Mombasa Port is the largest port in the East African region serving Kenya and the landlocked countries such as Uganda and Rwanda. The cargo handling volume in Mombasa Port has increased drastically in the recent years, exceeding the previous future demand forecast. While this growth has been occurring, berths 1-14 have deteriorated over time and require immediate rehabilitation. These berths are located at the Kilindini Harbour which is surrounded by an area that is endowed with diverse natural, human, financial and technological resources that support different economic activities and provide livelihoods, employment and income to the inhabitants of Mombasa. The berths are located in the port in the area that extends from Mombasa island to the West mainland areas of Changamwe and Kipevu. The project site is also bordered by Likoni, Mtongwe and Dongo Kundu on the south coast. Dongo Kundu is less developed and is set aside for development of the Special Economic Zone. Some historical and cultural heritage sites exist in the Island and Mtongwe-Dongo Kundu area within the proximity of the project site. These sites include the historic Mombasa Old Town with its narrow streets, Fort Jesus, and Kayas. Most of these sites are protected by the National Museums of Kenya.

4.2 Methodology for Socioeconomic Assessment

The socioeconomic assessment involved a review of the existing literature (published articles, official Government documents, previous ESIA reports, and unpublished reports held by different stakeholders), gap analysis, and key informant interviews to fill existing information gaps. The key informant interviews involved use of interview guides in a personal face-to-face interview approach. The interview guide was constructed taking into account the objectives of the ESIA study.

During the literature review, the main reports that were reviewed included:

- The Master Plan for the Port of Mombasa, 2009;
- Strategic Environmental Assessment for Special Economic Zone;
- ESIA for the ongoing Mombasa Port Development Project;
- EIA Report for Dredging of the Access Channel at the Port of Mombasa; and
- Environment Sensitivity Atlas for the Coastal Area of Kenya.

The government publications that were reviewed include:

- 2009 Kenya Population and Housing Census;
- The State of the Coast Report for Kenya;
- Mombasa County Integrated Development Plan.

4.3 Findings of socioeconomic study

Key findings of the socioeconomic study are as follows:

4.3.1 Demographic characteristics of Mombasa

Mombasa County which houses the project site had a total population of 939,370 people in 2009 out of which 486,924 were male and 452,446 were female *(Republic of Kenya, 2010)*. Based on the 2009 population census statistics, it was projected that the total population of Mombasa County would increase to 1,158,880 people by the year 2015 and 1,242,908 people by year 2017. In addition, Mombasa County had a population density of 4,293 persons per square kilometre in 2009 and was projected to increase to 6,640.5 in the year 2012. The population density is not even throughout the county. It is much higher in Mvita, Changamwe and Nyali sub-counties and much lower in Kisauni, Likoni and Jomvu sub-counties (population density in these last three sub-counties range between 2,188 to 4,040 persons per sq. km) (County Integrated Development Plan, CIDP). The population density for Mombasa County in 2009 was much higher than the national population density of 66 persons per sq. kilometre as well as the coast region's population density of 40 persons per sq. kilometre.

The historical long distance trade and the recent developments in tourism development, shipping and harbour activities and commerce provide opportunities for livelihoods, employment and leisure and have attracted a large population to Mombasa County. Table 5.1 shows the distribution of population in Mombasa County.

Table 4-1. Demographic characteristics of Mombasa County

Sub-County	Male	Female	Total	Density
Mvita	71,135	71,993	143,128	9,751
Changamwe	70,309	62,383	132,692	8,306
Nyali	57,158	49,022	106,180	7,213
Kisauni,	139,745	134,130	273,875	2,826
Likoni	87,654	78,354	166,008	4,039
Jomvu	60,923	56,564	117,487	3,300
TOTAL	**486,924**	**452,446**	**939,370**	**4,293**

Source: Republic of Kenya, 2010.

Trends in the population and settlement patterns show that population increases towards unplanned areas where land and housing is relatively cheap, and population increases in areas that have inadequate or non-existent sanitation infrastructure since this is where land is available for development.

4.3.2 Respondent Characteristics

4.3.2.1 Gender and age

70% of the 61 respondents who were interviewed during the study were men while 30% were women. Respondents were aged 25 to 72 years with the mean age of 38 years and a mode of 50 years. Most of the respondents fell within the economically active age of 18-60 years.

4.3.2.2 Marital status

About 75% of the respondents were married while 18% were single, 2% were widowed and 5% were divorced. The marital status shows that the respondents had different levels of responsibility within their households.

4.3.2.3 Levels of education and available educational facilities

The respondents were characterized by low levels of education with most of them (70% of all the respondents) having attained different levels of primary education or no education at all (see figure 4.1). Only 11% had attained O-level qualification while 3% had attained A-level and university qualifications.

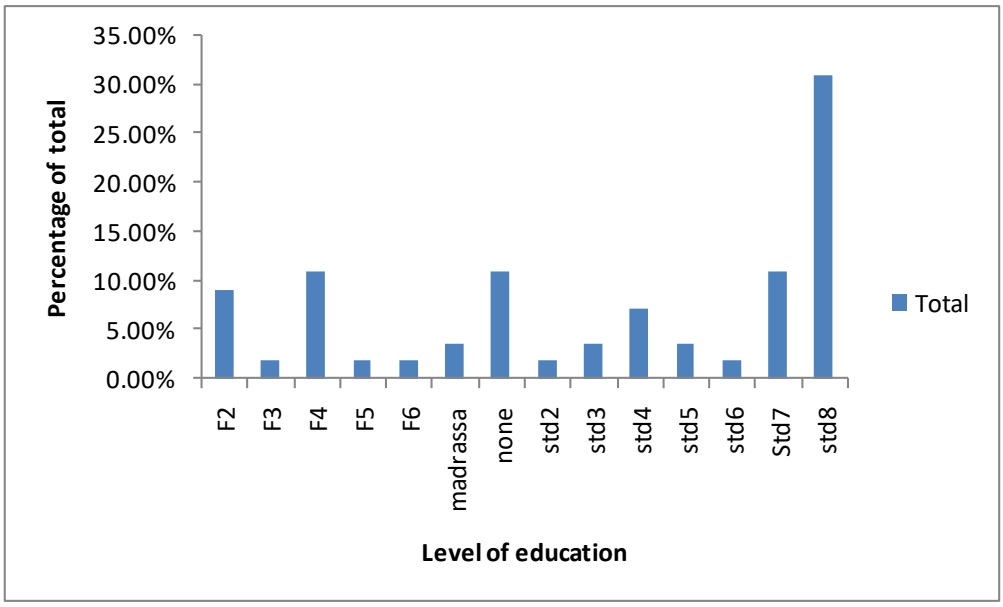


Figure 4.1: Distribution of levels of education among the respondents

In terms of educational facilities, there are 645 primary schools in Mombasa County. Out of this number, 95 are public schools while 550 are private schools. On average, there are 70,345 students in public schools and 76,301 students in private schools. Teacher-pupil ratio in public schools is estimated to be 1:41. This compares well with the recommended ratio of 1:40. In addition, there are 35 public secondary schools with a student population of 15,538 and 423 teachers. There are four youth polytechnics, one teacher training college, and a technical training institute. Furthermore, there is one chartered Public University (Technical University of Mombasa) and four satellite public university campuses namely University of Nairobi, Kenyatta University, Jomo Kenyatta University of Agriculture and Technology, and Moi University. Besides, there are three private university campuses namely Daystar University, Kenya Methodist University and Mt. Kenya University. Mombasa County also has 770 Early Childhood Development (ECD) Centres out of which 85 are public centres and 685 private centres with 47,867 students and 1,714 teachers.

Mombasa County has a relatively low literacy level of 86.3% despite the existence of free primary education and subsidized secondary education. The main challenge facing education in the county is inadequate school infrastructure, learning tools such as desks and chairs, and human resources.

4.3.2.4 Household Roles

Most of the respondents (75%) were heads of households who were responsible for the provision of livelihoods to their households (Figure 4.2). Majority of them were men with women accounting for about 30%. Their responses to the questionnaires were therefore influenced by their perceived expectations from the project.

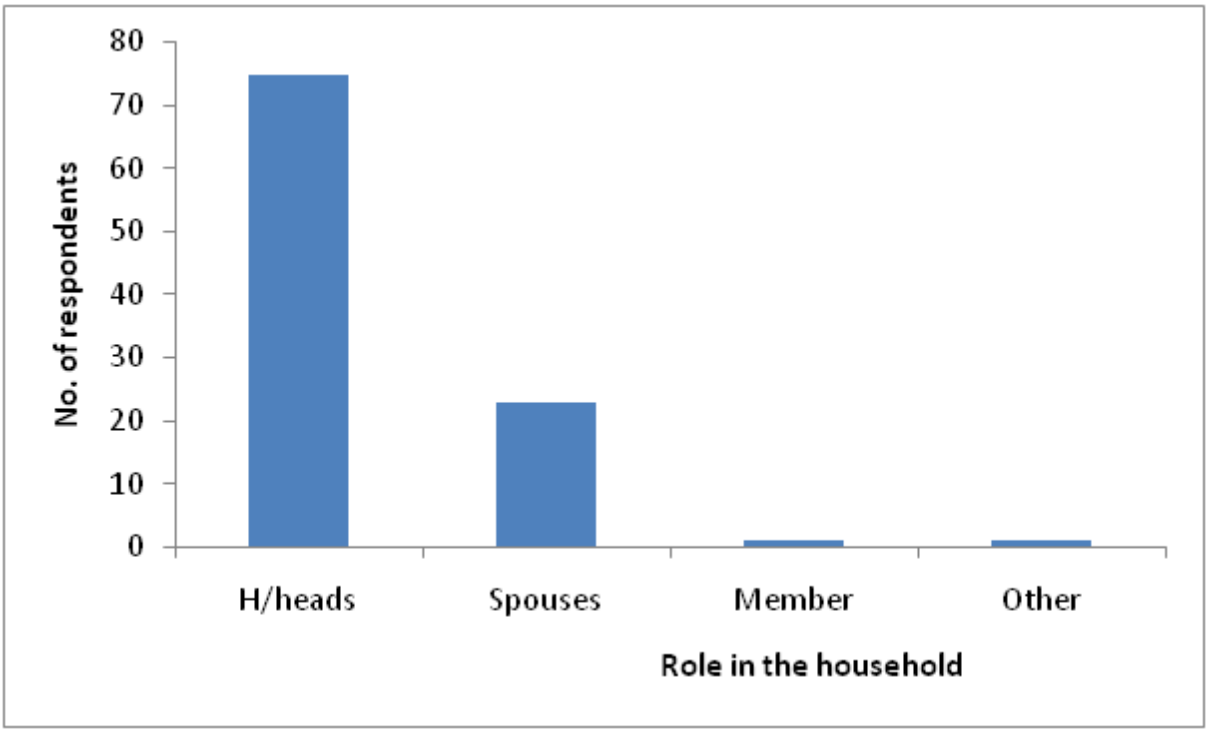


Figure 4.2: Roles of respondents in households

4.3.2.5 Occupational Structure

Figure 4.3 below presents the occupational structure of the respondents. It is evident from this figure that 52% of the respondents are involved in small scale businesses as a means of earning livelihood. The business activities in the area are varied and range from the small-scale food-selling kiosks to the medium scale shops that sell household items, workshops and garages. The small-scale businesses are operated by both men and women. Some of them 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. Many people are employed in the companies that operate around the project site. Some people are employed as security guards by different firms while others are teachers, nurses, among others. The occupation that ranks third in terms of the number of people employed is artisanal fishing and the informal "jua-kali" sector.

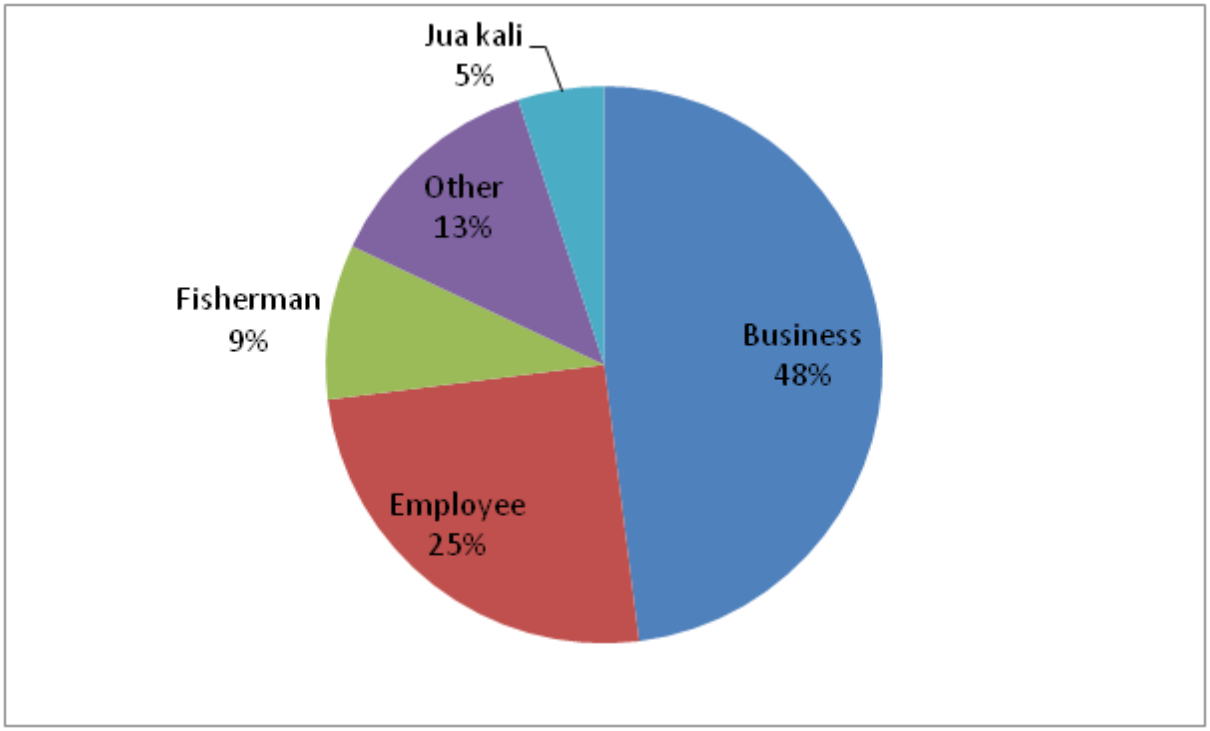


Figure 4.3: Occupation Structure in the study site

4.3.3 Economy

The economy of Mombasa County is supported by maritime industry, tourism and hospitality, manufacturing, mining, banking and micro-finance, agriculture, livestock, fisheries. The planned rehabilitation works will take place in a built up commercial and industrial area with major oil companies in Shimanzi and Kipevu located close to or within the Port of Mombasa.

4.3.3.1 Ports and Shipping

Mombasa has two natural harbours, the Kilindini Harbour (Mombasa Port) which is the main port located along Kilindini Channel and the Old Port which is located along Tudor creek. Mombasa Port is the largest port in the East African region serving not only Kenya, but also the landlocked countries such as Uganda, Rwanda and the Democratic Republic of Congo. In the recent past, the cargo handling volume in Mombasa Port increased drastically, exceeding the previous future demand forecast. Besides Mombasa Port, the Old Port has also remained active and is important for handling smaller vessels.

4.3.3.2 Tourism and hospitality

Mombasa County which houses the project site has many tourist attractions. These attractions include World Heritage sites such as Fort Jesus Museum, the Likoni Ferry Services, the moulded gigantic elephant tasks, the Mombasa Old town, the old port, sandy beaches, the Mombasa Marine Park, Haller Park, and butterfly pavilion. The development of tourism in Mombasa County resulted in clusters of beach hotels adjacent to the shoreline. Many hotels and restaurants have also been built in the Island as well as other strategic locations in the County. There are about 430 beach and

tour operator firms that provide tourism related services. Over 201 registered hotels and lodges are available in the County with a total bed capacity of 8,000 beds and average annual bed occupancy of 64%. Tourism and related activities have spurred other economic activities. Safari tour operators, curio vendors, boat operators, entertainment spots, salons and boutiques, sport-fishing, snorkelling and diving depend on the tourism. Tourism and related activities provide employment opportunities for the inhabitants of Mombasa County. The activities also generate revenue to both County and National Governments. In addition, tourism provides a market for produce and products from agriculture and livestock sectors (*Government of Kenya, 2009).* The existing tourist hotels will benefit from increased number of tourists once the project is completed due to projected increase in trade at the Mombasa Port.

4.3.3.3 Manufacturing and other industrial production enterprises

There are several manufacturing enterprises in Mombasa. These range from export processing, flour mills, glass ware, oil refineries and cement manufacturing. Many textile industries have also been established in the export processing zones (EPZs). Many industries are also engaged in agro-processing for both local consumption and export. These enterprises provide employment to the residents of Mombasa City. The other industrial activities in Mombasa City include steel rolling mills, iron smelting and bottling of drinking water. It is envisaged that measures will be put in place to ensure that exports from these manufacturing enterprises and industrial production are not negatively affected during the rehabilitation works. The same applies to the handling of some of the production inputs that are imported for the manufacturing enterprises. The enterprises will however benefit from increased efficiency at the port once the rehabilitation works are completed.

4.3.3.4 Mining and minerals

Some basic mining takes place in Mombasa and is limited to three minerals namely coral limestone, weathered shale and sand. Coral limestone is mined by Bamburi Cement Limited for use as the basic raw material for cement production. Weathered shale is mined in open pits near Nguu Tatu, West of Bamburi for use as secondary raw material in the production of cement *(Government of Kenya, 2009).* Coral limestone blocks are also extracted in some parts of the Mombasa for use in the building industry. Pit sand which is an important building material is mined at Junda in Kisauni Sub-County. It is worth noting that sand and limestone are currently being mined without supportive legislation.

4.3.3.5 Small-scale agriculture

The main crops that are grown in Mombasa include food crops such as maize and cassava and cash crops such as mango, banana and coconut. The livestock that are kept in the area include cattle, goats and poultry. Cattle and goat population is however limited since Mombasa is mainly an urban County with very little space left for farming activities.

4.3.3.6 Artisanal fisheries

Artisanal fishing in the project area takes place in the adjacent Port Reitz and Makupa creeks as well as the inshore waters around Shelly Beach in the south coast**.** Artisanal fishing is an important economic activity employing many people in the fishery value chain. The number of artisanal fishers in Mombasa County has increased from 957 in the year 2004 to 1,635 in the year 2012 (see figure 4.1). The number of fish landing sites in Mombasa County has increased progressively from 23 landing sites in 2004 to 31 landing sites in 2012 (see figure 5.5). Some of the fish landing sites are

under threat from private developers due to lack of title deeds. The number of fish sheds (bandas) has remained constant at 2 between 2004 and 2012 while the number of working cold rooms increased from 1 in 2004 to 2 in 2012 *(Republic of Kenya, 2012)*.

Fish landing sites along the Kilindini Channel as well as in the adjacent Port Reitz and Makupa creeks and Shelly Beach will be adversely affected by the dredging works. Artisanal fishers are increasingly being marginalized with displacement and delays in compensation by different development projects (Plate 4A and 4B below).

Plate 4A: Fish landing site at Kwa Skembo / Port Reitz taken away by SGR development

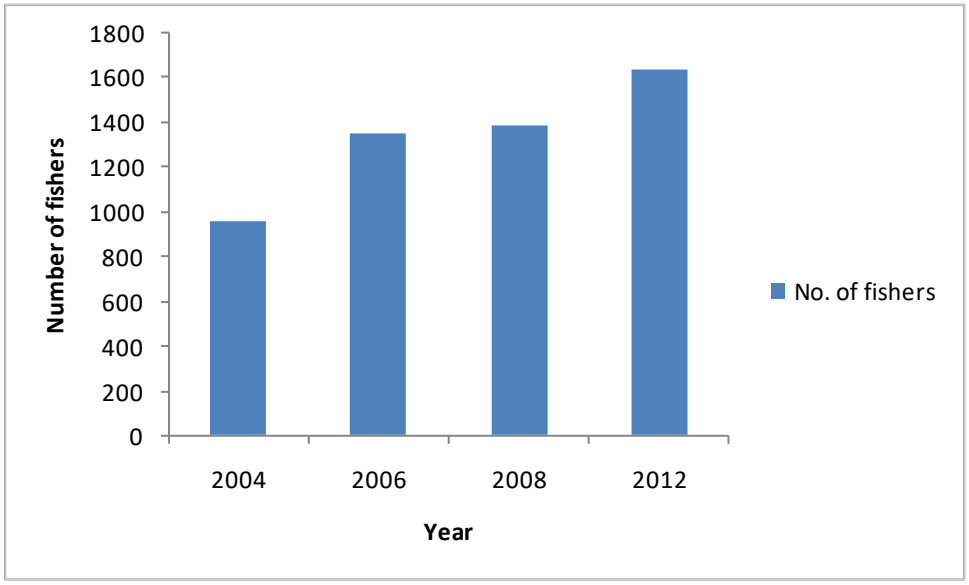


Figure 4.4: Number of fishers in Mombasa County 2004-2012

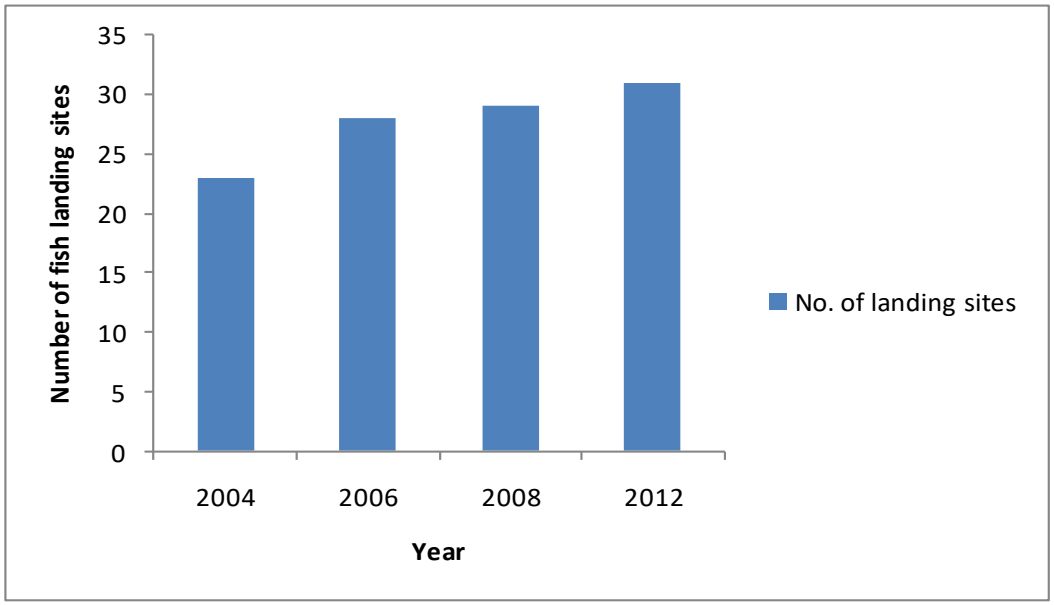


Figure 4.5: Number of fish landing sites in Mombasa County between 2004 and 2012

4.3.3.7 Infrastructure development

Major infrastructure development works are currently being undertaken around the project area particularly on the Port Reitz side (Plate 5B below).

Plate 4B: Infrastructure development at Kwa Skembo – Port Reitz

Road construction works are also going on in the Changamwe area. These projects are related to operations of the port of Mombasa since they aim to improve off-take of cargo from the port and ease congestion along the port access roads. The cumulative effect of the construction works by other agencies and the proposed rehabilitation of berths 1-14 will be significant and needs effective mitigation measures to be put in place.

4.3.3.8 Transport

The existing road network in Mombasa was originally designed for low traffic but the number of vehicles has increased beyond the capacity of the roads. The situation has been further complicated by a dramatic increase in the number of heavy commercial vehicles without upgrading of the roads. This has resulted in increased traffic congestion along the different roads as well as rapid damage of roads. The neighbourhood of the project area in particular experiences perennial traffic congestion at the Makupa causeway due to increased number of trucks on the road particularly in the late afternoon and evening hours. The congestion extends to Miritini along the Changamwe-Mikindani-Miritini road. Construction material for berths 1-14 will be transported through the existing routes and this is likely to worsen the situation during the period of rehabilitation. This situation is however expected to improve once the rehabilitation works are completed and when the road construction works in the mainland west are completed. Most residents of Mombasa City rely on public transport (*matatu*) and therefore most of the people who will be involved in the rehabilitation works are likely to use this mode of transport.

Besides road transport, air transport plays a critical role in meeting the transportation needs of the residents of Mombasa as well as the transportation needs of the tourism sector in Mombasa City. Moi International Airport is the main airport in the coast region is located in Mombasa County (*Government of Kenya, 2009).* It handles both international and domestic air traffic. The project site is also served by a railway line that transports cargo from Mombasa Port and passengers from Mombasa City. The railway is currently being replaced by a Standard Gauge Railway whose construction has just been completed.

Maritime transport especially the ferries that link the south coast with the Mombasa island is very important to the residents. Traditional boats are also used to provide localized transport in some areas around the project site.

4.3.3.9 Community Services

Community services are available in Mombasa County include health amenities, electricity, primary and secondary schools, religious places (mosques and churches), piped water, telephone, banks and security (police stations and county administration).

4.3.3.9.1 Health Amenities

Public hospitals available in Mombasa City include:

- A Level 5 referral hospital, the Coast General Hospital, which provides both in-patient and out-patient services;
- Two level four hospitals namely Tudor and Port Reitz Hospitals that provide out-patient and in-patent medical services;

- Thirty five (35) public dispensaries and health centres, and 18 clinics.

In addition, there are private clinics and pharmacies that provide health care services. As population grows, there has been a tendency to open new private clinics to cater for increasing demand for health care. Two medical training colleges also exist in the area. KPA also has a health facility that provides first level treatment for its staff and refers them to the bigger hospitals when there is need. The project will benefit from these diverse health facilities. It is however worth noting that these health care facilities are not enough to cater for the health care needs of the whole population.

4.3.3.9.2 Electricity and other sources of energy

Most of the project area is served with electricity from the national grid. Electricity lines run parallel to the main roads serving both the commercial and residential areas. The Kengen Power Station in Kipevu generates electricity in close proximity to the project site. Households in the area depend on electricity, cooking gas, kerosene, and charcoal to meet their energy needs.

4.3.3.9.3 Recreation

There has been a sandy beach at Kwa Skembo close to the project site. This sandy beach served as an important recreational site for the residents of Mombasa mainland west (Port Reitz, Magongo, Chaani and Migadini estates). However this recreational site has been displaced by infrastructure development and those who depended on it are forced to consider the alternative sites which are located far away from Kwa Skembo such as the Jomo Kenyatta Public Beach at Bamburi (Photo 2).

Plate 4C: Bamburi Public Beach where residents of Mombasa west have to go for recreation

4.3.3.9.4 Telephone

The project site is served by telephone lines as well as mobile phone networks particularly Safaricom, Airtel and Telkom.

4.3.3.9.5 Potable water

Generally, a large part of Mombasa County is served with 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 (Japan Port Consultants *et al.,* 2010). This translates to 45% of the demand being met. The 72,000m^3/day of water is supplied to consumers through rationing. Water for domestic use is also supplied by mobile vendors who sell water as a business.

Exploitation of groundwater in Mombasa has been haphazard with no strict government control on borehole drilling or well development. The current water supply shortages and increased urban population has resulted in increased dependence by many residents of Mombasa on groundwater for potable water needs (Adala *et al*, 2007).

4.3.3.9.6 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 treated, with most discharged to the Ocean causing localized pollution. Over 65% of the coastal population is served by pit latrines and a mere 2% have a flush toilets. 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, 2000).

4.3.3.9.7 Security

There are a number of Police Stations in the project area strategically located to provide security to the area. In addition, the County Commissioner, Deputy County Commissioners, the location Chiefs and Assistant Chiefs work together to ensure there is security in the project area. Community policing has also been encouraged to promote networking between the National Police Service and the public on matters of security.

4.3.3.9.8 Religion and Religious places

Islam and Christianity are the dominant religions in the neighbourhood of the project site. Consequently, both mosques and churches are available in areas around the project site. Since Islam and Christianity are the dominant religions the interventions that will affect the livelihoods and other ways of life of the local communities must take cognizance of the values that are enshrined in both Islamic and Christian faith.

4.3.3.9.9 Historical and cultural sites

Historical and archaeological sites such as old mosques, tombs, mounds and walls of ancient city houses that were linked to Swahili Culture in East Africa were not reported by the respondents at this stage. However, the respondents identified the presence of three *Kaya* forests namely *Kaya* Mtongwe, *Kaya* Mihongani and *Kaya* Shonda/Pungu. The *Kaya* refers to unique indigenous forest that is found along the coast. The *Kaya* forests are highly biodiverse and have high cultural

significance to the Mijikenda communities, who consider them as sacred and have used them for traditional religious and spiritual ceremonies for centuries (Blackett, 1994; Government of Kenya, 2009). The *Kaya* have recently spurred the growth of forest tourism in the coastal region (Government of Kenya, 2009). The Kayas are sacred sites that serve as the repositories of spiritual beliefs of the Mijikenda communities. These cultural sites are used for performing cultural rites which are important especially to the original inhabitants of the area. The other benefits of these cultural sites include tourism attraction, bee keeping and attraction of rain.

4.3.3.9.10 Leadership

In terms of leadership arrangements, the main form of leadership is the formal Government structures. The Chief and his assistants represent the Government authority at the location and sub-location levels respectively. They are assisted by village headmen/women whom they have appointed from amongst respected people in the villages or estates to administer these smaller units and handle petty matters on their behalf. The chiefs report to the Assistant County Commissioners who further report to the Deputy County Commissioners. County Government is in place with the Governor as the head with administrative responsibilities over the County while the County Commissioner is also present to coordinate National Government activities within the County. Some form of traditional leadership arrangements also exist particularly in the peri-urban areas.

4.4 Respondent's Perceptions about the Rehabilitation Works

An analysis of respondents' perceptions about the rehabilitation works was carried out and the results that were obtained have been presented in figure. 5.6 below. It is evident here that 10% of the respondents felt that the project will have negative impacts and therefore did not approve of it. 7% of the respondents felt that the project would negatively affect them but if certain concerns are addressed adequately then their perception about the project will change to be positive. 51% of the respondents felt that the project is out-rightly good since in their view, it will create employment opportunities to many people who reside in the area and will open up the area for increased business. About 30% of the respondents 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. About 2% of the respondents did not have any comment.

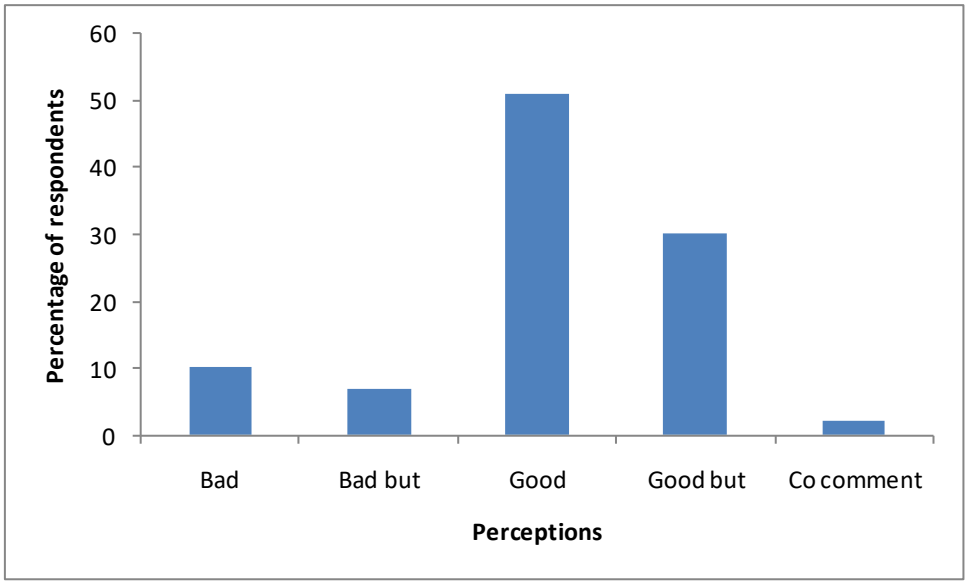


Figure. 4.6 Respondent's perceptions about the planned rehabilitation works

4.5 Analysis of Socioeconomic Impacts

An analysis was performed on the likely positive and negative impacts of the project and the results are as follows:

4.5.1 Employment Creation

Impact: Employment opportunities would be created for construction works and market for construction inputs;
Nature of Impact: Positive
Duration: Short Term, as this would be only be expected during the construction phase
Likelihood: High
Significance: Medium

4.5.2 Boost in Trade

Impact: Increased efficiency will result into faster turn-around time of ships hence increased volume of cargo handled at the port once the rehabilitation is completed.
Nature of Impact: Positive
Duration: Long Term;
Likelihood: High
Significance: High

4.5.3 Improved safety

Impact: The proposed rehabilitation works would result into construction of modern stable berthing structures ensuring safety of marine craft and seafarers. This would also significantly reduce chances of marine casualties such as oil spills;
Nature of Impact: Positive

Duration: Long Term
Likelihood: High
Significance: High

4.5.4 Traffic Congestion

Impact: Expected increase in road traffic due to transportation of construction material may cause traffic congestion on the roads
Nature of Impact: Negative
Duration: Short Term, as this would be encountered at the construction phase only
Likelihood: High
Significance: High
Significance upon mitigation: Low
Mitigation:

- Liaise with the County Government of Mombasa to initiate effective traffic control by posting of additional traffic marshals along the affected roads.
- Initiate road safety awareness programs

5. ECOLOGICAL ENVIRONMENT AROUND BERTHS 1-14

5.1 Methodology and Approach

The methodology for ecological assessment was as follows:

- Reconnaissance visits and joint planning between study teams and KPA engineers, environmental officers and operations office to familiarize with project area, proposed development sites and safety requirements.

- Identification of the appropriate survey areas: The 14 berths for rehabilitation, strengthening, deepening and modernization were clustered into 3 groups as follows:
    a. Group 1: Berths 1 – 5;
    b. Group 2: Berths 7 – 10;
    c. Group 3: Berths 11 – 14.
- In addition to the 3 groups, two (2) more categories were identified to cater for:

    a) Group 4: Control site locations on water quality and existing biodiversity;
    b) Group 5: Control site locations on fisheries critical habitats (mangroves and seagrass).

- Priority habitats and micro-habitats were sampled in the 5 groups selected (using appropriate sampling protocol, tools and equipment), and involved the following methods:

    a) Location mappers: GPS location (Fig. 5.1);
    b) Water sampling for phytoplankton and zooplanktons;
    c) Quadrat scrapes on pilings and wharfs for attached benthos and fouling communities;
    d) Large sediment cores (16 cm diameter) for sediment benthic infauna;
    e) A collation of appropriate environmental data, including temperature, salinity, depth, turbidity, nutrient concentration);
    f) For the Control site locations on fisheries' critical habitats (mangroves and seagrass), an audit-based assessment on existing biotopes was undertaken;

- Collected samples from the 5 selected group sites were treated as per standard scientific protocols (fixation, preservatives, storage and transport environments, etc,) and taken to KMFRI laboratory for species characterization and functional group determinations using Internationally Recognized Standard Operating Procedures and Laboratory Standards and References with known traceability, and to a NEMA accredited laboratory (Polucon Laboratory Services in Mombasa) for chemical and nutrient analysis.

- The marine ecology ESIA approaches are presented in the following plates:

    - Plate 5.1: showing field activities related to water sampling for phytoplankton and zooplanktons;
    - Plate 5.2: showing field activities related to quadrat scrapings on pilings and wharfs for benthos and fouling communities;

- Plate 5.3: showing field activities related to large sediment core sampling (18 cm diameter) for sediment benthic infauna;
- Plate 5.4: showing field activities related to sampling for associated water quality and environmental data;
- Plate 5.5: showing field activities related to sampling for fisheries control site indicator results (mangroves, seagrass, seaweeds and coral lagoons).
- Plate 5.6: showing laboratory activities related to sample sorting and analysis for characterization of taxa and functional groups.

Details of field and laboratory methods:

a) Port of Mombasa Spatial Field Strategy Plan

The Port of Mombasa is located on an extensive seasonal estuarine system that also supports a number of industries adjoining it. The Mombasa Port environment can be subdivided into a number of smaller port-zones and areas: Port Reitz, Port Kilidini, Port Tudor, Mombasa Harbour, including the Old Port area (Figure 5.1), and the many adjacent marine habitats used by port operations.

Field sampling was conducted for a week (from 20th – 26th July, 2016). The sampling points were georeferenced and were located at areas indicated in Figure 5.1 (point 1 to 15). The target for sampling was for the documentation (presence / nil occurrence) of major groups of biota, an index of their biomass or population, the documentation of any species of special concern (subsistence, commercial or conservation concerns), and the documentation of species with potential to become nuisance / vectors. It was not a scientific investigation to profile species structure and dynamics which occur with diurnal, tidal or seasonal fluctuations of oceanographic or metrological parameters. This means the data has to be interpreted with these limitations in mind.

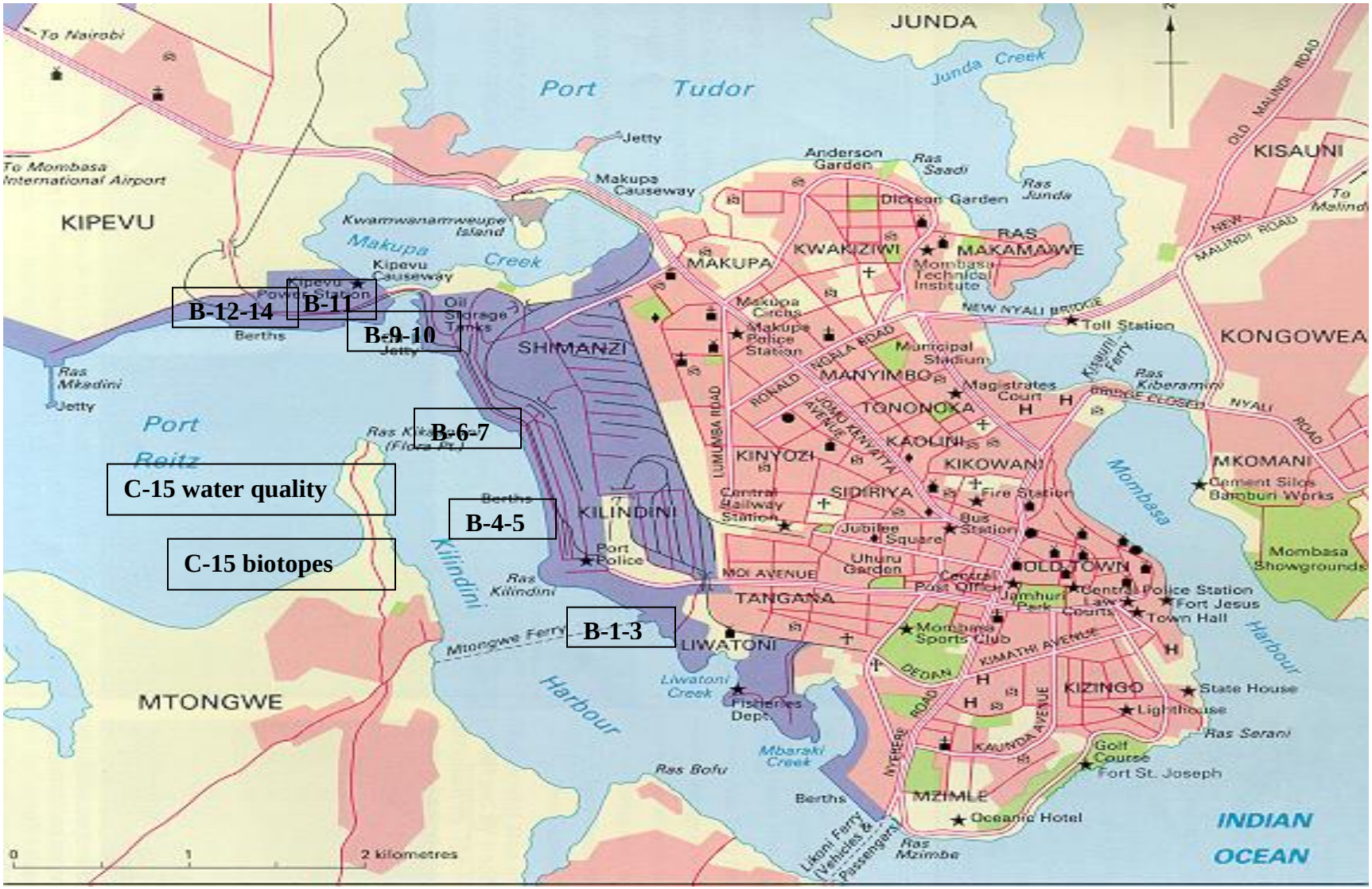


Fig 5.1: A grab of the Mombasa Port environment showing smaller port-zones (Port Reitz, Port Kilindini, Port Tudor, Mombasa Harbour) and Sampling areas

b) hyto-plankton sampling

i. Field Sampling

The phytoplankton survey followed the methodologies outlined in the CRIMP port survey protocols (Hewitt & Martin 2001), adapted to suit local ecological conditions at KPA Mombasa Port waters. A total of 14 sampling sites were selected within the areas of berths 1-14, and associated habitats (C15). The selection of these sites was motivated by an increased likelihood of its proximity or relationship to areas proposed by KPA for berth improvements, reconstructed, and other potential sink areas where species may be deposited due to currents and circulation patterns. At all the berth sampling sites (Berths 1-14) and control sites (C15), a fibre glass boat platform was used for phytoplankton sampling. At every sampling point, water samples were collected using a bucket of known volume and passing the measured volume of water (i.e., 20 litres) through 20µm mesh-size plankton net for plankton concentration.

These concentrated plankton samples were collected into a receptor bottle attached at the bottom of the plankton net (Plate 5.1 A – C). The concentrated plankton samples were then transferred to sample bottles, each bottle pre-labelled with date, sampling station, and immediately fixed with Lugols' iodine solution for quantitative analysis later in the laboratory.

ii. Laboratory Methods

At the laboratory, an inverted light microscope fitted with 10x (20x) and 40x objectives / lenses was used for examination of the samples. For each sample preserved in Lugols' iodine solution, 1µl aliquot sub-samples were pipetted into a Sedgwick-Rafter counting cells and observed under a light microscope at the two objective lens magnifications. The specimen obtained therein were identified, counted, and grouped according to orders, classes and genus. The appropriate phytoplankton taxa were identified, and where possible to the species level, using Hasle and Syvertsen (1977) "Identification Manual of Harmful Marine Microalgae", IOC-UNESCO Manual and Guides NO 41 on "Potentially Harmful Microalgae of the Western Indian Ocean", and Botes (2003) "Phytoplankton Identification Catalogue".

c) Zooplankton

i. Field Sampling

The same sampling duration and platform used in phytoplankton applied for zooplankton. At each sampling location, water samples were collected in triplicates (Plate 5.1D). Zooplankton water samples were collected at each location by obliquely towing a zooplankton net with a mesh size of 100 µm and a mouth radius of 30 cm in subsurface water for 10 minutes within about 100 m distance. The mouth of the net was fitted with a flow meter to estimate the volume of filtered water. Samples were immediately preserved in 5% buffered formalin. Only one towing was conducted to cover for two sites (i.e., Berth 1 was combined with Berth 5; 7 with 10; and 11 with 14) where the distance between the sites was shorter to allow for respective individual site towing.

ii. Laboratory Methods

At the laboratory, whole zooplankton samples were first inspected under a Wild Heerbugg microscope (with a maximum magnification of 400X). Each sample was further sub-sampled (1/10), and all present individuals identified and grouped in their taxonomic categories. "A guide to the Marine Life of Southern Africa" by Branch G.M. and Griffiths C.L., (1994) and "Zooplankton of the South-Western Indian Ocean" by Conway, (2003) identification guides were used as guides for identification of the zooplankton to the appropriate taxa, and where possible to species level.

Plate images showing field and laboratory operations

Plate 5.1: Water sampling for phytoplankton and zooplanktons

Plate 5.1A: approach to typical port murky waters near the berths and wharfs

Plate 5.1B: phytoplankton sampling near the berths

Plate 5.1C: phytoplankton sampling around the channel areas

Plate 5.1D: zooplankton sampling around the channel areas

Plate 5.2: Quadrat scrapes on pilings and wharfs for benthos and fouling communities

Plate 5.2A: SCUBA gear – part of the survey crew on board a research vessel for marine-based field assessments

Plate 5.2B: SAFETY AT SEA – part of the survey crew getting ready to dive for submarine sampling

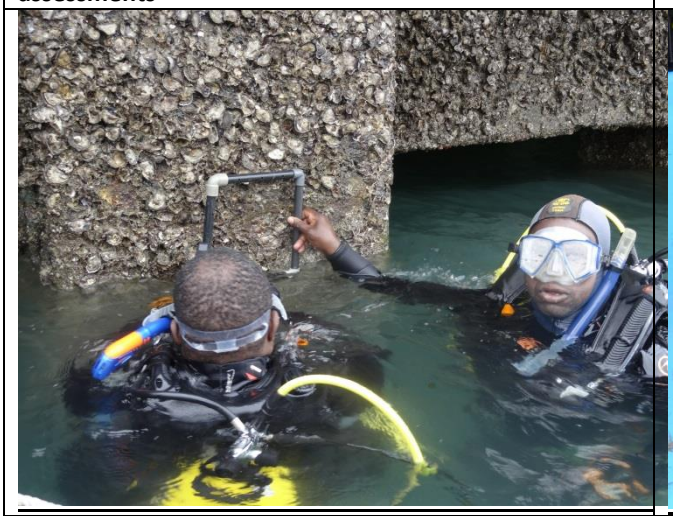


Plate 5.2C: part of the attached benthic community flagged for assessment using standard methods (CRIMP protocols adapted to local conditions)

Plate 5.2D: part of retrieved samples from sea floor: mixed fouling organisms put into retaining bags and well labelled

Plate 5.3: Large sediment core sampling (18 cm diameter) for sediment benthic infauna extraction from submarine sediments

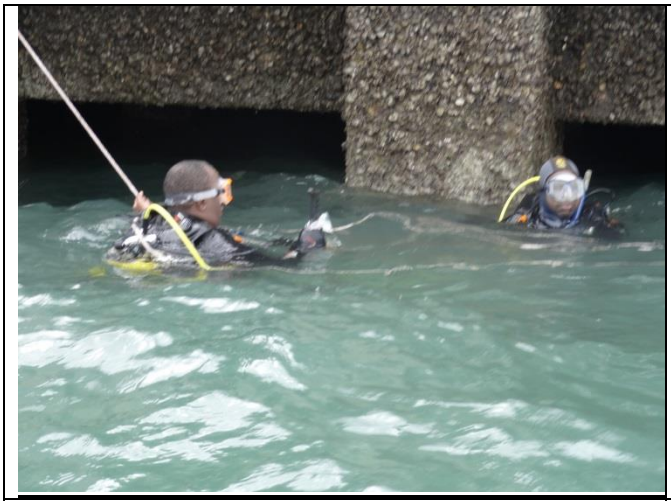


Plate 5.3A: use of ropes to access sea-floor beneath wharfs due to poor visibility – purpose: for sub-marine-sampling

Plate 5.3B: team-work within the survey crew to ensure samples in heavy gear are brought on board vessel

Plate 5.3C: sample extraction from corer to receiving pre-labelled bags

Plate 5.3D: part of retrieved samples from sea floor: soft sediment put into retaining bags and well labelled

Plate 6.4: Environmental Data Sampling,

Plate 5.4A: Niskin bottle water sampler for determination of water limnological conditions (for coupling to biological conditions)

Plate 5.4B: Combination of other oceanographic environmental probes for determination of various environmental variables

Plate 5.4C: Deep sediment core sampler extracted by divers (for determination of geo-chemical conditions for coupling to biological conditions)

Plate 5.4D: Shallow sediment core sampler for sediment extraction from boat (for determination of geo-chemical conditions)

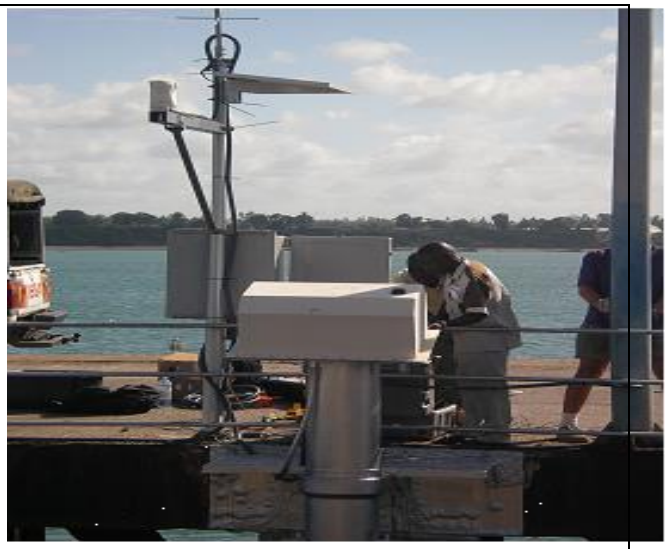
	
Plate 5.4G: equipment for measuring current direction and speed to augment environmental quality indicators	**Plate 5.4H: Upgraded Mombasa KMFRI GLOSS Tide Station also used to augment environmental quality indicators**

Plate 5.5: Fisheries control site indicator results (mangroves, seagrass, seaweeds and coral lagoons).

	
Plate 5.5A: mangrove formation around the control sites	**Plate 5.5B: mangrove structural assessments around the control sites**

Plate 5.5C: commonly occurring beach cast material on sandy beaches and lagoons off shelly beach

Plate 5.5D: commonly used fishing gear (*Malema*) normally set on mangrove creeks at Port Reitz, or on seagrass beds and lagoons off shelly beach

Plate 5.5E: fish caught (5 kgs) by an effort of 2 fishermen in 2 hours in a pre-set *Malema* trap from mangrove creeks displayed in one canoe (small boat)

Plate 5.5F: fish caught (20 kgs) by an effort of 7 fishermen in 2 hours from pre-set 6 *Malema* traps are sorted by groups and types for identification and characterization

Plate 5.5G: juvenile prawns caught (4 kgs) by an effort of 3 fishermen in 3 hours in a pre-set trap at a mangrove creek near the Control site of the port sampling areas

Plate 5.5H: sample of shelled molluscs and crustaceans caught by women fishermen (effort of 1 woman in 5 hours day-time during low tide)

Plate 5.5I: sampling for marine biota during high tide off shelly beach

Plate 5.5J: sampling for marine biota during low tide off shelly beach

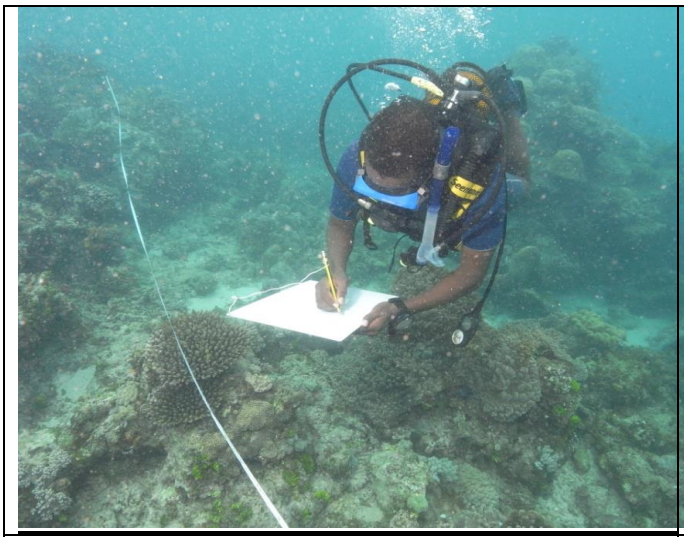


Plate 5.5K: part of the diving team undertaking underwater census of biodiversity off shelly beach

Plate 5.5L: catch of aquarium fish caught by licenced aquarium divers packed in oxygen bags for sale/ trade

The assessment on critical habitats and fisheries control site indicator results also looked at existing and gazetted fishing areas and fish landing sites. These were geo-referenced and mapped. 3 fish landing sites (near the control sites) were surveyed for primary catch data (gill-net, trap-fisheries, and prawn-fisheries).

Plate 5.6: Laboratory pre-treatment and analysis for characterization of taxa and functional groups

Plate 5.6A: fixing samples and sorting them further for appropriate storage prior to analysis

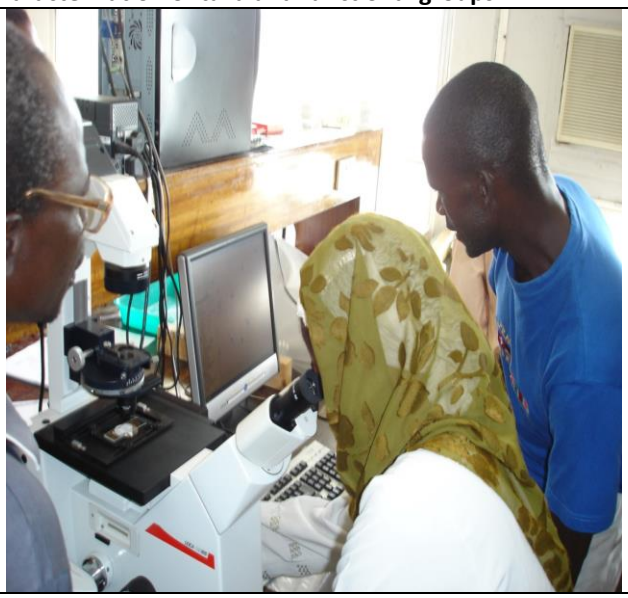


Plate 5.6B:computor-aided identification of plankton groups

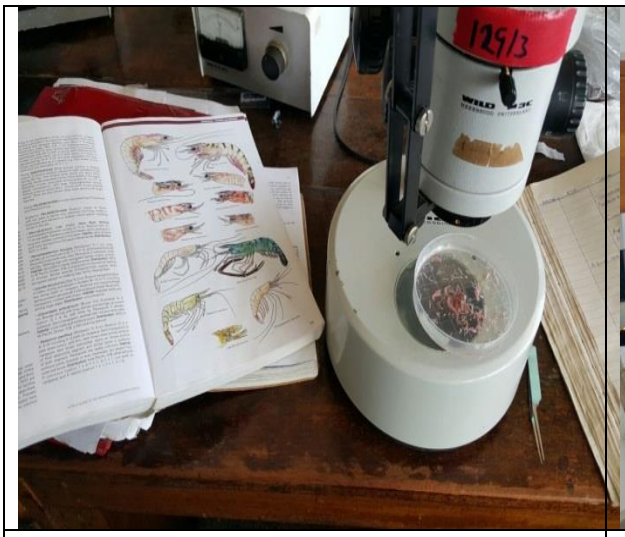
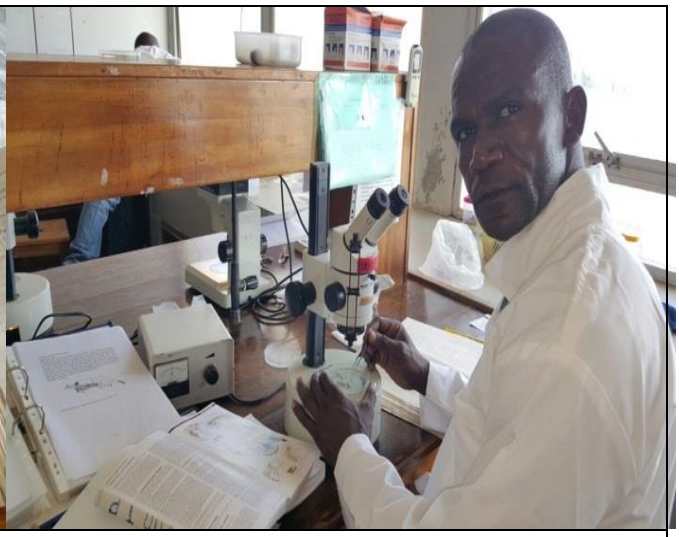
	

Plate 5.6C: sorted and grouped benthic organisms are set under magnification for identification using manuals and guides	**Plate 5.6D: specialists taxonomists confirms the taxa and assigns ID tags**

5.2 Results of Ecological Baseline Survey

Results are presented by the 5 groups:

a) Water sampling results for phytoplankton and zooplanktons;
b) Quadrat scrapes results for attached benthos and fouling communities;
c) Large sediment cores (16 cm diameter) results for benthic infauna;
d) Critical habitat and biodiversity at the control sites;
e) Fisheries sites indicator structure (mangroves and seagrass).

5.2.1 Phytoplankton Community Structure

The phytoplankton taxa group composition and abundance varied between sampling Berth sites (Figure 5.2).

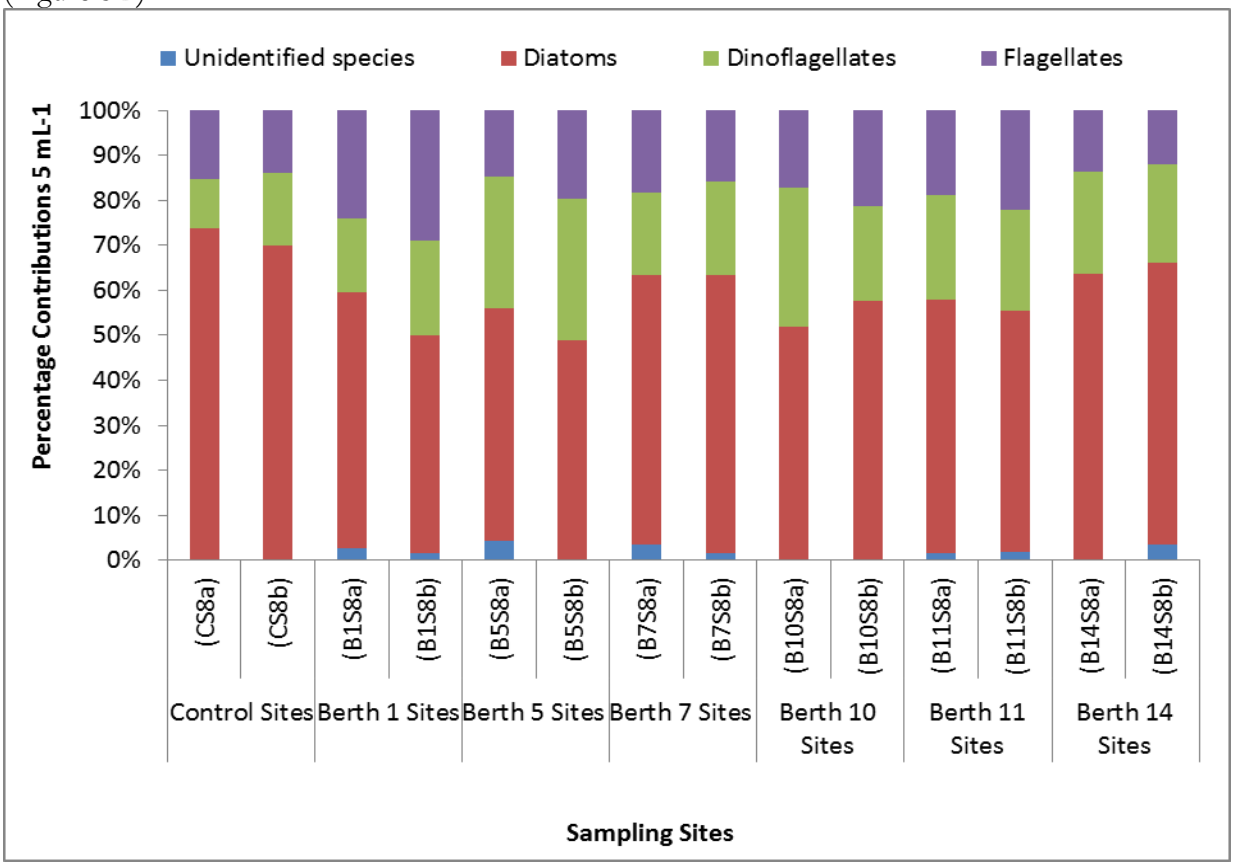


Figure 5.2: The phytoplankton community group abundances at sampling Berth 1-14.

The phytoplankton taxa group composition and abundance when grouped together indicated varied composition (Figure 5.3).

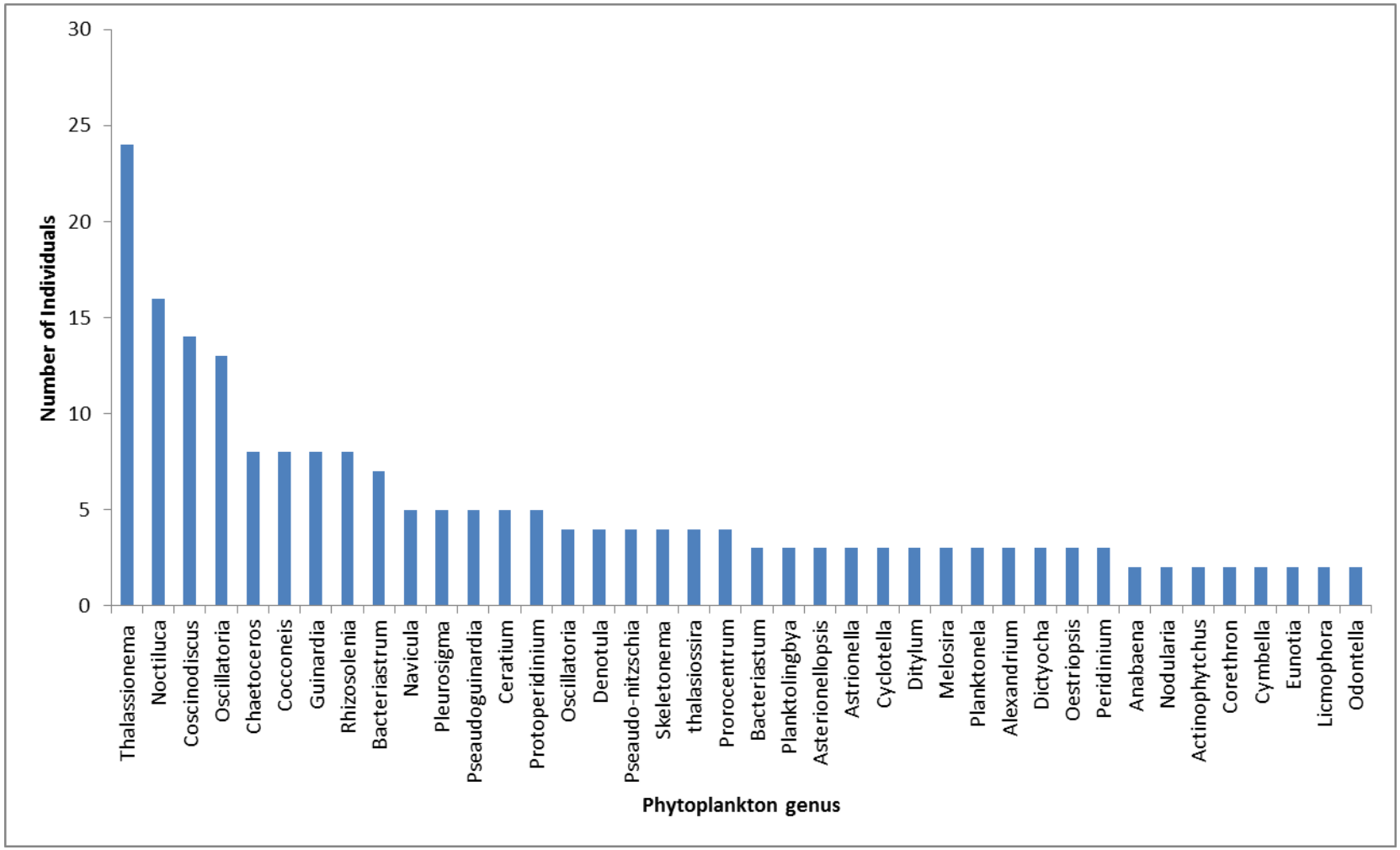


Fig. 5.3: Phytoplankton genus representation with more than single genus (all sampling Berth 1-14 grouped)

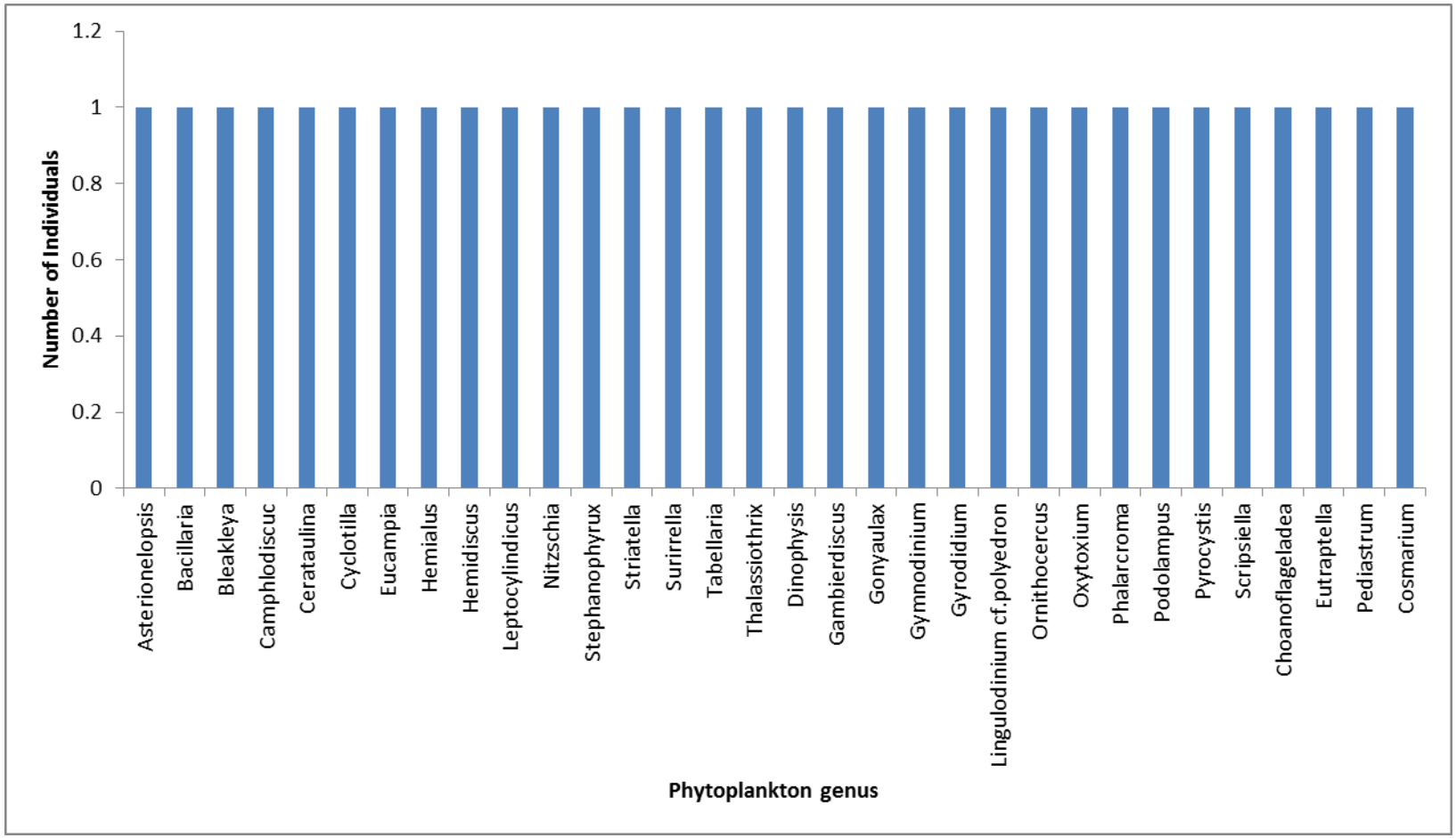


Fig. 5.4: Phytoplankton genus representation with single genus (all sampling Berth 1-14 grouped)

Flagellates:

- ✓ An important bloom-forming flagellate recorded from this port assessment was the bioluminescent dinoflagellate *Noctiluca scintillans*;
- ✓ Extensive blooms of this species were observed in Berths 1 to 7 sampling sites ;
- ✓ These species forms spectacular red-tides having the potential of removing oxygen from the water column after the death of the bloom;
- ✓ However, majority of these toxin producing phytoplankton do not need to be in a bloom-state to be of risk to the marine environment and fisheries;
- ✓ This is because some of the species such as *Dinophysis acuta, D. acuminata, D. norvegicus* and *Alexandrium catenela* (also recorded during this assessment) can be toxic even at concentrations of just a few hundred cells litre^{-1}.

5.2.2 Zooplankton Community Structure

The zooplankton taxa group composition and abundance are presented in Fig 3.

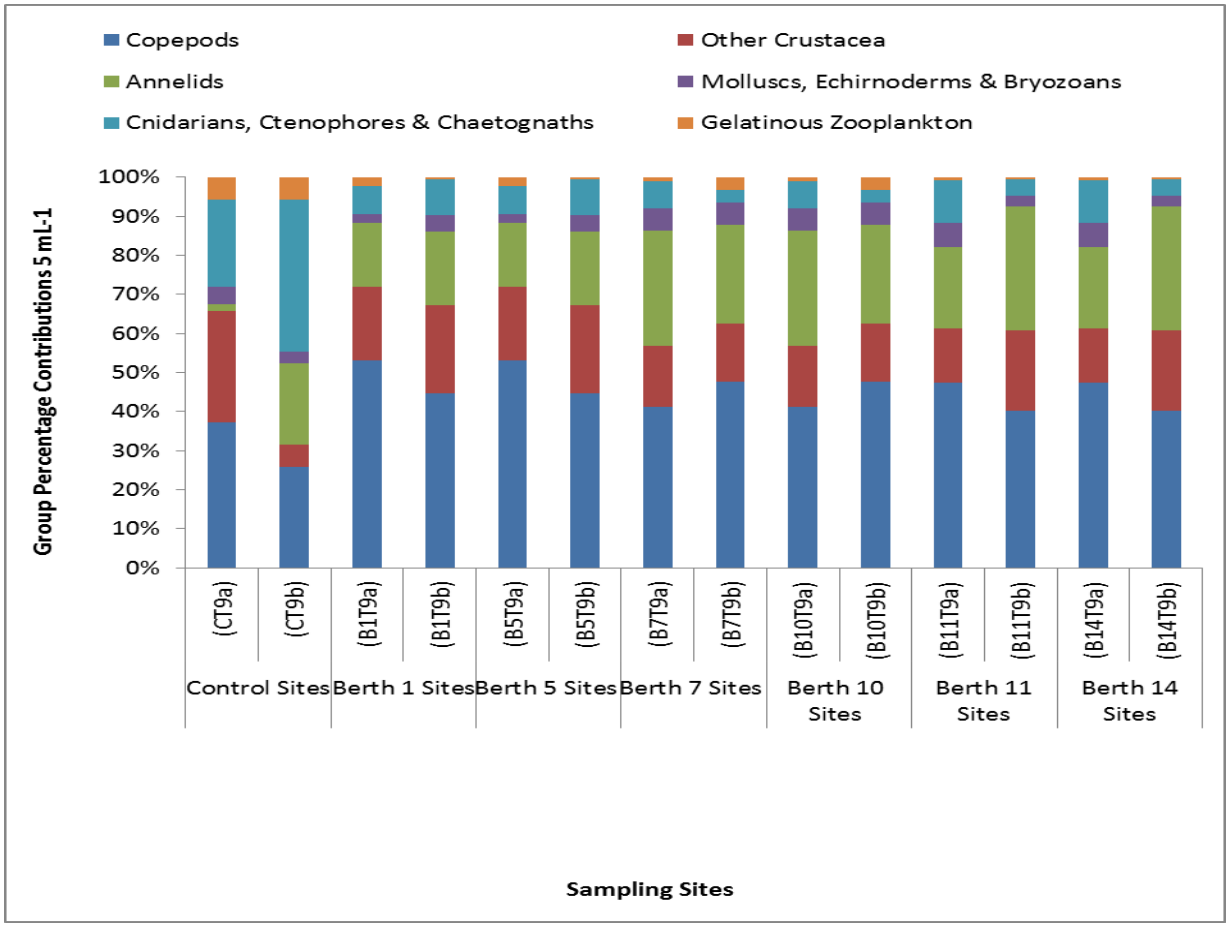


Figure 5.5: Zooplankton group Abundances at sampling Berth 1-14 sites.

The zooplankton taxa group composition and abundance when grouped together also indicated varied composition (Figure 5.5).

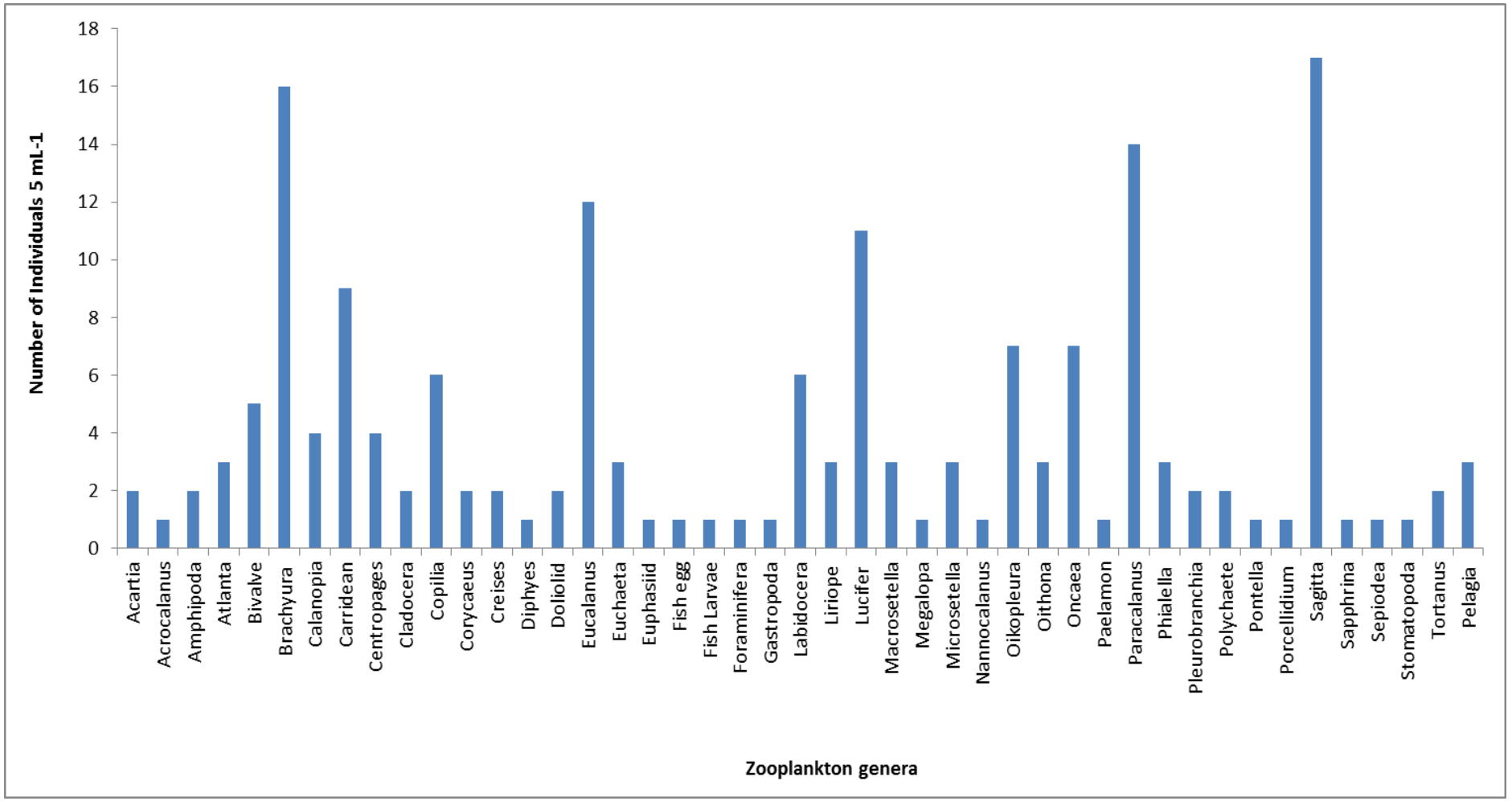


Figure 5.6: The overall abundance (Numbers) of Zooplankton genera (grouped together).

Significant statements:

- ✓ The zooplankton comprised a total of forty-five (45) genera including;
- ✓ The most abundant genera were; *Sagitta* (17); *Brachyura* (16); *Paracalanus* (14); *Eucalanus* (12); *Lucifer* (11) amongst others (Figure 5.5).
- ✓ The copepods formed the greatest proportion of them in most sites with an exception only in the control site CT9b;

Copepods:

- ✓ The copepod population was almost entirely of the sub-order calanoida. However, *Oithona* sp. of the sub-order cyclopoida was also present in low biomass;
- ✓ Copepods constitute major prey items for the larvae of many commercial fish species which at first feed on copepod nauplii, but as they grow, feed on larger copepod prey items;
- ✓ However, the abundance of copepods may vary throughout the year depending on the abundance of their food – the phytoplankton.

Crustacean zooplankton:

- ✓ The pelagic shrimp-like crustacean zooplankton (often referred to as "krill", the euphausids) were also observed during this assessment study;

Other zooplankton

- ✓ Others were the filter feeder small pelagic tunicate group of larvaceans or appendicularians of *Oikopleura* spp.; numerous relatively large (up to 4cm) annelid species in the class *polychaeta*; chaetognaths, often referred to as the active planktonic arrow-worm predators within the genus *Sagitta*; and gelatinous zooplankton covering coelenterates and ctenophores grouped as macro / mega plankton due to their relatively large sizes (Tait, 1992). Majority of these coelenterates are carnivorous, and therefore if found in high enough abundances may lead to a significant predatory effect on copepods and fish larvae (Bunn *et al*., 2000).

Resting stages

- ✓ Both phytoplankton and zooplankton organisms can produce resting stages (encysting organisms or as diapause eggs) that are capable of sinking into the sediment and remaining buried therein for considerable periods of time before hatching;
- ✓ Some species in the port waters such as *Acartia, Centropages* and *Temora* spp. observed during the assessment study are all known to produce resting stages at water depths of between 20m and 80m with low seabed stress and near to tidal fronts (Lindley, 1990; Mauchline, 1998).
- ✓ In phytoplankton, the most common and abundant group of encysting organisms are the dinoflagellates (Marret & Scourse, 2002);

5.2.3 Benthic Community Structure

The benthic taxa composition and abundance are presented in Table 5-1 and 5-2, as well as in Fig 5.6.

Table 5-1: Benthic macroinvertebrate fauna composition and abundance at sampled Berth 1-14 areas.

Sample	Phylum	Class	Taxa No
Berth3.	Annelida	Polychaeta	359
Berth3.	Arthropoda	Malacostraca	68
Berth3.	Nematoda	Enoplea	1
Berth3.	Echinodermata	Ophiurida	19
Berth3.	Mollusca	Bivalvia	3
Berth3.	Sipuncula	Sipunculidea	2
Berth3.	Arthropoda	Maxillopoda	10
Berth3.	Porifera	Demopspongiae	5
Berth9.	Annelida	Polychaeta	379
Berth9.	Arthropoda	Malacostraca	38
Berth9.	Echinodermata	Ophiurida	5
Berth9.	Mollusca	Bivalvia	10
Berth9.	Sipuncula	Sipunculidea	19
Berth9.	Annellida	Oligochaeta	1
Berth9.	Arthropoda	Maxillopoda	49
Berth9.	Porifera	Demopspongiae	1
Berth9.	Cnidaria	Anthozoa	1
Berth6.	Annellida	Polychaeta	256
Berth6.	Arthropoda	Malacostraca	71
Berth6.	Nematoda	Enoplea	2
Berth6.	Echinodermata	Ophiurida	6
Berth6.	Mollusca	Bivalvia	1
Berth6.	Sipuncula	Sipunculidea	8
Berth6.	Annellida	Oligochaeta	1
Berth6.	Arthropoda	Pycnogonida	1
Berth6.	Arthropoda	Maxillopoda	9
Berth6.	Porifera	Demopspongiae	8
Berth10.	Annellida	Polychaeta	427
Berth10.	Arthropoda	Malacostraca	111
Berth10.	Nematoda	Enoplea	1
Berth10.	Echinodermata	Ophiurida	37
Berth10.	Mollusca	Bivalvia	4
Berth10.	Sipuncula	Sipunculidea	5
Berth10.	Annellida	Oligochaeta	1

Berth10.	Arthropoda	Ostracoda	7
Berth10.	Arthropoda	Pycnogonida	2
Berth10.	Arthropoda	Maxillopoda	33
Berth10.	Porifera	Demopspongiae	2
Berth14.	Annellida	Polychaeta	472
Berth14.	Arthropoda	Malacostraca	70
Berth14.	Echinodermata	Ophiurida	11
Berth14.	Nematoda	Enoplea	57
Berth14.	Mollusca	Bivalvia	4
Berth14.	Sipuncula	Sipunculidea	27
Berth14.	Annellida	Oligochaeta	1
Berth14.	Arthropoda	Maxillopoda	20
Berth14.	Porifera	Demopspongiae	2
Berth11.	Annellida	Polychaeta	285
Berth11.	Arthropoda	Malacostraca	137
Berth11.	Nematoda	Enoplea	1
Berth11.	Echinodermata	Ophiurida	13
Berth11.	Mollusca	Bivalvia	10
Berth11.	Sipuncula	Sipunculidea	20
Berth11.	Arthropoda	Ostracoda	2
Berth11.	Mollusca	Gastropoda	1
Berth11.	Arthropoda	Maxillopoda	11
Berth11.	Porifera	Demopspongiae	4
Control	Annellida	Polychaeta	2
Control	Arthropoda	Malacostraca	8

Table 5-2: Total taxa of benthic macroinvertebrate fauna (all Berths 1-14 grouped together).

Class	Taxa No
Polychaeta	3981
Anthozoa	503
Bivalvia	132
Demospongia	91
Sipunculidea	81
Enoplea	52
Gastropoda	32
Malacostraca	22
Maxillopoda	10
Oligochaeta	4
Pycnogonida	3
Ophiurida	1
Ostracoda	1

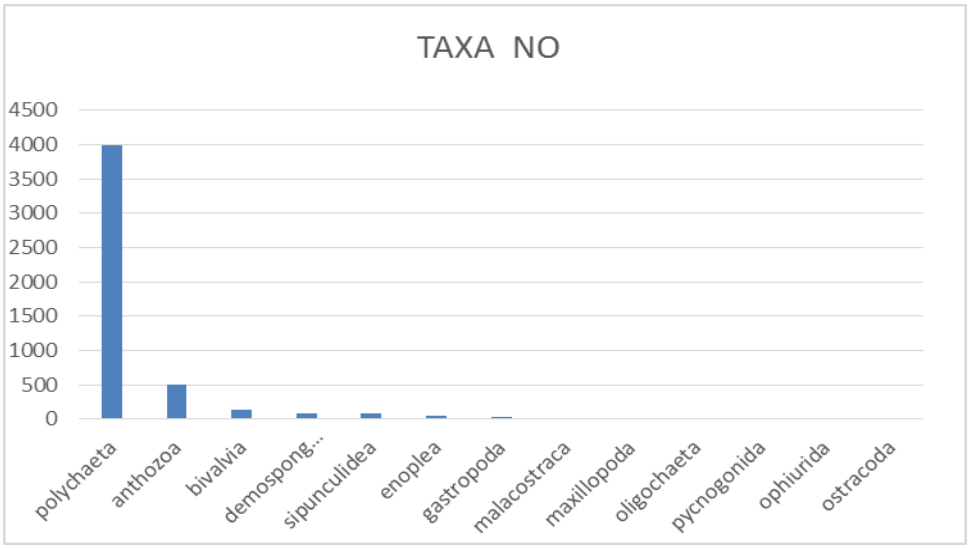


Fig 5.7: Total taxa of benthic macroinvertebrate fauna at sampled areas (all Berths 1-14 grouped together).

Significant statements:

- The most diverse group were the Polychaete worms (3981 individuals), followed by marine anthozoa (503),
- Other benthos existed at intermediate levels: bivalvia (132), demospongia (91) sipunculidea (81) enoplea (52), gastropoda (32), malacostraca (22), maxillopoda (10),
- The rare ones were oligochaete (4) pycnogonida (3), ophiurida (1), and ostracoda (1)

A. Biodiversity at control sites, and including fisheries indicator sites

Critical habitats structure and biodiversity at the control sites were represented as follows:

Biota:

a) Seagrass

At Port Reitz control sites, there was no occurrence of seagrasses.

b) Seaweeds

The seaweeds structure of Port Reitz control sites comprised mostly blue-greens loosely attached on silty sediments. The main groups were represented by patches of *Enteromorpha crassa*, followed by *Padina, Ulva* and floating *Sargassum*. Some species were found epiphytic on mangrove roots (e.g., *Enteromorpha, Bostrychia and Murrayella* spp. on *Avicennia*).

Epiphytic seaweed community

Epiphytic seaweed communities encountered included some *Ulva, Caulerpa, Colpomenia, Hydroclathrus, Pocockiella, Jania, Amphiroa,* and *Gracilaria.*

c) Mangroves

Table 3 summarizes the general characteristics of the main mangrove formation near the control sites surveyed (existing forest area > 0.5 acres), and in the traditional mangrove areas of Port Reitz creek.

Table 5-3: Mangrove community structure at the study plots in Port Reitz basin

Parameter	Site												
	Kilindini Channel	**Control sites at Port Reitz Channel**											
	Site-1 Mweza Creek	Site-1 Mangrove Is-1	Site-2 Mangrove Is-2	Site-3 Mangrove Is-3	Site-4 Mwagonde	Site-5 Dongo Kundu,	Site-6 R. Chasimba Creek	Site-7 Tsunza	Site-8 Mwache	Site-9 Mkupe-Maweni	Site-10 Kwa Skembo	Site-11 Kitanga Juu	
Avg area studied (Ha)	1.5	0.5	1.2	0.5	1.5	2	2	1.5	3	1.5	1.5	0.5	≥
Spp comp	Rm, Ct, Bg, Am, Lr, Sa	Sa	Sa	Sa	Rm, Ct, Am, Sa	Sa, Rm, Ct, Bg, Am	Sa, Rm, Ct, Bg, Am, Lr	Sa, Xg, Rm, Ct, Bg, Am, Lr	Sa, Xg, Rm, Ct, Bg, Am, Lr	Sa, Xg, Rm, Ct, Am	Xg, Rm, Ct, Bg, Am, Lr	Rm, Am, Lr	≥
Dominant adult species	Rm - Ct	Sa	Sa	Sa	Am	Sa - Rm	Sa - Rm	Sa	Sa - Am	Am	Am	Am	≠
Dominant young species	Ct - Rm	Sa	Sa	Sa	Am	Rm - Sa	Rm - Am	Rm - Ct	Rm - Sa - Am	Rm	-	-	≥
Avg ht (m) - adults	2.4	1.7	1,3	0.9	3.8	3.1	3.4	2.2	3.5	2.1	3.1	2.7	≥
Avg density (no/10m2 pots) - adults	11 ± 3.6	4 ± 2.2	3 ± 1.2	3 ± 1.6	7 ± 4.2	18 ± 8.1	19 ± 17.6	13 ± 6.9	15 ± 5.6	8 ± 5.1	3 ± 2.8	0.2 ± 1.6	≥
Dominant regeneration status (class I, II, III)	III	III	III	III	I	II	III	III	II	-	-	-	≠
Understory cover													
Halophytes (% substratum cover)	10	0	0	0	6	3	5	0	2	5	5	2	≤
Associated substratum (feel)	sandy to silty	sandy			sandy	sandy to silty	silty	sandy to silty	silty	sandy to silty	sandy	sandy	rocky

Control sites data are shown in bold. Adults[1] description based on UNESCO 1984; regeneration[2] status based on UNESCO 1984 and Kairo 1995.≤ is less than, ≥ is greater than, ≠ is not comparable

Key:

Am *Avicennia marina* Ct *Ceriops tagal* Xg *Xylocarpus granatum*

Rm	*Rhizophora mucronata*	Lr	*Lumnitzera racemosa*	Hl	*Heritiera littoralis*
Bg	*Bruguierra gymnorhiza*	Sa	*Sonneratia alba*		

5.3 Impact determination, prediction and mitigation

Based on the project design and proposed activities, a determination was made on the impacts likely to arise from implementation of the project and categorised according to the following consequences citeria:

Table 5-4 A: Magnitude criteria for categorisation of impacts

Criteria-1: Magnitude of impact (establishes whether the impact is destructive or innocuous and whether or not it exceeds set standards)		
Category	**Definition**	**Rating**
Negligible	where natural environmental functions and processes are negligibly affected	1
Minor	where the environment continues to function but in a noticeably modified manner in a minor scale	2
Marginal	where the environment continues to function but in a noticeably modified manner in a medium scale	3
Significant	where environmental functions and processes are altered such that they temporarily or permanently cease, exceed legal standards/requirements and/or have international implications)	4
Catastrophic	where environmental functions and processes are altered severely that they temporarily or permanently cease, exceed legal standards/requirements and/or have international implications)	5
Criteria-2: Geographic extent of impact		
Category	**Definition**	**Rating**
<500m^2	site-localized, in-situ (exclusively bounded within) project area, therefore impacts felt in restricted area	1
500m^2 - 999m^2	local off-site impacts, within impact radius of project area (within 50m radius)	2
1000m^2 - 9.99km^2	felt further outside project area, but within 3-km radius	3
10km^2 - 99.99km^2	regionally felt outside project area, but within 10-km radius, therefore impacts felt in larger areas including areas outside project areas	4
>100km^2	felt outside project area, more than 10-km radius, therefore impacts exported to areas without and may have trans-boundary effects	5
Criteria-3: Impact duration (classifies the lifetime of the impact)		
Category	**Definition**	**Rating**
short term	<1 month, therefore impacts felt in short duration	1
medium term	1 - 12 months	2
long term	14 - 36 months	3
very long term	38 - 72 months, therefore impacts felt in longer duration	4
permanent	>72 months, therefore impacts felt for more or less permanent duration	5
Criteria-4: ecology and socio-economic context		
Category	**Definition**	**Rating**
Negligible	where biodiversity / ecological functions and processes are negligibly affected	1
Minor	where biodiversity / ecological functions and processes continue to function but in a noticeably modified manner in a minor scale	2
Marginal	where biodiversity / ecological functions and processes continue to function but in a noticeably modified manner in a medium scale	3
Significant	where biodiversity / ecological functions and processes are altered such that they temporarily or permanently cease, exceed legal standards/requirements and/or have international implications)	4
Catastrophic	where biodiversity / ecological functions and processes are altered severely that they temporarily or permanently cease, exceed legal standards/requirements and/or have international implications)	5

Table 5-4B: Frequency criteria for categorisation of impacts

criteria-1: Frequency of hazard / impact problems		
category	**definition**	**rating**
Annually or less	where hazard occurs at least once in every 12-month cycle or less, therefore low frequency	1
6 monthly/temporary	where hazard occurs at least once in every 6-month cycle or less	2
Monthly/infrequent	where hazard occurs at least once in every 1-month cycle or less	3
Weekly/life of the operation	where hazard occurs at least once in every 7-days cycle or less	4
Daily/permanent	where hazard occurs at least once every 24-hour cycle or less, therefore high frequency	5

criteria-2: Frequency of hazard impact		
category	**definition**	**rating**
<11 events/year	where hazard impact occurs at most 11 times in every 12-month cycle or less, therefore frequency of impacts are low	1
11 - 50 events/year	where hazard impact occurs at least 11 times and at most 50 times in every 12-month cycle or less	2
51 - 100 events/year	where hazard impact occurs at least 51 times and at most 100 times in every 12-month cycle or less	3
101 - 200 events/year	where hazard impact occurs at least 101 times and at most 200 times in every 12-month cycle or less, therefore frequency of impacts are high	4
>200 events/year	where hazard impact occurs at most 11 times in every 12-month cycle or less, therefore frequency of impacts are definite	5

criteria-3: probability of occurrence (considers the likelihood of the disturbance occurring)		
category	**definition**	**rating**
Improbable	very low likelihood of occurrence	1
Lowly probable	Low possibility will occur	2
Medium Probable	Medium possibility will occur	3
Highly probable	most likely will occur	4
Definite	disturbance will definitely occur	5

The two tables were compounded to come up with the rating scheme outlined in Figure 5.8 that was then used to determine the significance of impacts

Figure 5.8: Impact significance rating scheme (based on a 5-grade score)

SIGNIFICANCE																				
	CONSEQUENCE (Magnitude+Geographic Extent+Impact duration+ecol-socio-ec aspects)																			
LIKELIHOOD (hazard frequency + impact frequency + probability of occurrence)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60
	4	8	12	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80
	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	108	114	120
	7	14	21	28	35	42	49	56	63	70	77	84	91	98	105	112	119	126	133	140
	8	16	24	32	40	48	56	64	72	80	88	96	104	112	120	128	136	144	152	160
	9	18	27	36	45	54	63	72	81	90	99	108	117	126	135	144	153	162	171	180
	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200
	11	22	33	44	55	66	77	88	99	110	121	132	143	154	165	176	187	198	209	220
	12	24	36	48	60	72	84	96	108	120	132	144	156	168	180	192	204	216	228	240
	13	26	39	52	65	78	91	104	117	130	143	156	169	182	195	208	221	234	247	260
	14	28	42	56	70	84	98	112	126	140	154	168	182	196	210	224	238	252	266	280
	15	30	45	60	75	90	105	120	135	150	165	180	195	210	225	240	255	270	285	300

Mitigation Ratings			
Very High	251-300		Propose mitigation measures
High	201-250		Propose mitigation measures
Medium - High	151-200		Propose mitigation measures
Low - Medium	101-150		Maintain current management
Low	51-100		Maintain current management
Very Low	1-50		Maintain current management

The ecological and social resources in the project area that are likely to be impacted by the proposed project are as illustrated in Figure 5.9 below:

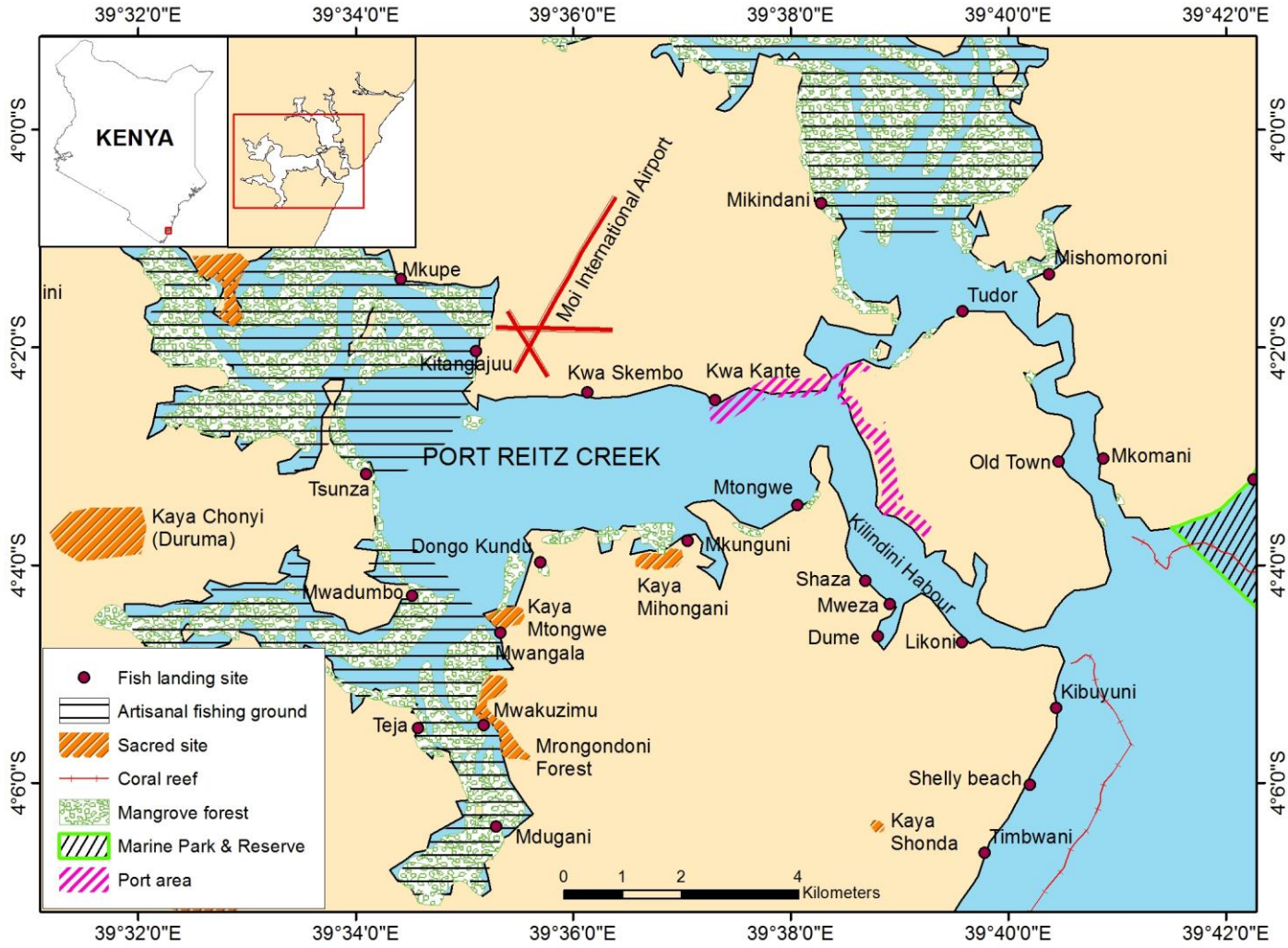


Figure 5.9: Ecological and social resources around the Port of Mombasa

The key marine impacts, their likelihoods and significance are therefore presented in Table 6.5 and the narrative in the text that follows:

Table 5-5: Environmental risk assessment matrix using the consequence and likelihood scores and weighted significance.

B 1 -14 Reonstruction potential environmental hazards	consequence criteria					likelihood criteria				significance
	magnitude	geographic extent	duration	Ecol/ Soc-ec context	consequence score	hazard frequency	impact frequency	probability	likelihood score	significance score
Dredging activities: Removal of sub-marine sediment and associated attached sessile organisms	3	2	2	2	9	3	3	4	10	90
Dredging activities: Suspended sediment effects on sessile and slow-moving invertebrates	2	2	3	3	10	2	2	3	7	70
Dredging activities: Effects of Suspended sediment on fish	2	2	3	3	10	1	2	4	7	70
Dredging activities: Effects of Suspended sediment on phytoplankton productivity and other aquatic plants	2	2	4	2	10	3	3	5	11	110
Construction / dredging activities: Sedimentation on subtidal muddy and sandy habitats	3	2	3	2	10	3	2	3	8	80
Operational activities: Accidental oil spill effects on critical habitats (coral reefs, seagrass beds, mangroves) and seabirds	4	3	4	5	16	4	4	3	11	176
Operational activities: Accidental oil spill effects on marine life and habitats	3	2	2	4	11	3	2	3	8	88

Introductions of alien species	2	3	2	5	12	3	2	3	8	96
Chemical waste hazards	4	3	3	4	14	3	4	4	11	154
Solid waste hazards	2	2	3	2	9	3	4	3	10	90
Operational activities: Potential negative impacts specific to coral gardens and Mombasa Marine Reserve	3	2	3	2	10	2	2	3	7	70
Wellness: occupational health and safety concerns	3	4	3	3	13	4	4	5	13	169
Decommissioning setbacks	4	3	3	4	14	3	4	3	10	140

The impacts identified are summarized as follows:

5.3.1 Dredging activities: Removal of sub-marine sediment and associated attached sessile organisms

Nature of impact – Submarine sediments and their associated attached sessile organisms will be physically removed from the seabed with consequential destruction of the infaunal and epifaunal biota;
Duration – Short: recolonization is predicted to take about one year on silty clays (see Table 5.4);
Intensity – Medium: majority of the attached benthic organisms are likely to die, but quite a number will relocate by migration (Hall 1994, Kenny and Rees 1994, 1996, Newell *et al.* 1998, Herrmann *et al.* 1999, Ellis 1996, 2000); Long-lived species, like molluscs and some crustaceans will need longer to re-establish the natural age and size structure of the population (Kenny and Rees 1994, 1996);
Probability – Definite;
Status of impact – Negative;
Degree of confidence – High;
Significance – Medium: due to the short duration and medium intensity of the impact;
Mitigation – Deep sites that will not be dredged will act as undisturbed patches (reservoirs between the dredging areas), to speed up recolonization and recovery. This is already implied in the works structure as dredge areas are discrete and clearly marked and some areas will remain undisturbed.
Significance upon Mitigation: Low, regeneration may take about 3 years

5.3.2 Dredging activities: Suspended sediment effects on sessile and slow-moving invertebrates

Nature of impact – Generation of suspended sediment plumes during dredging may have sublethal or lethal impacts on sessile and slow-moving invertebrates;
Duration – Medium: potential effects extend over the duration of the dredging activity (expected to last few months);
Intensity – Low: area already under high turbidity regimes and existing organisms are adapted to those local high turbidity levels (cf past studies: Globallast 2004, Adala et al 2007, Adala et al., 2009, Gwada 2011, this ESIA study);

Probability – Definite: elevated suspended sediment concentrations are a very typical by-product of soft bottom marine sediment dredging;
Status of impact – Negative;
Degree of confidence – High;
Significance – Low, due to the medium duration and low intensity of the impact;
Mitigation – Reductions in the amount of suspended sediment through use of appropriate civil technology (dredger type, timing) will further reduce risks.
Significance upon Mitigation: Low, maximum recovery period is 5years (Table 5.6)

Table 5-6: Timing for recovery of seabed habitats after dredging (after Ellis 1996)

Sediment type	Recovery time
Fine-grained deposits: muds, silts, clays, which can contain some rocks and boulders	1 year
Medium-grained deposits: sand, which can contain some silts, clay and gravel	1-3 years
Coarse-grained deposits: gravels, which can contain some finer fraction and some rock and boulders	5 years
Coarse-grained deposits: gravels with many rocks and boulders	>5 years

5.3.3 Dredging activities: Effects of Suspended sediment on fish

Nature of impact – Generation of suspended sediment plumes during dredging may have sub-lethal or lethal impacts on fish and/or may result in avoidance behaviour;
Duration – Medium: potential effects extend over the duration of the dredging;
Intensity – Low: fish are mobile and will move out of the affected area. Effects on fish vary greatly and critical exposure levels can range from ~500 mg/l for 24 hours to no effects at concentrations of >10 000 mg/l over 7 days (Clarke and Wilber 2000);
Probability – Definite: elevated suspended sediment concentrations are a typical by-product of soft bottom marine sediment dredging;
Status of impact – Negative;
Degree of confidence – High;
Significance – Low, due to short duration and low intensity of the impact;
Mitigation – Reductions in the amount of suspended sediment through use of appropriate civil engineering technology (dredger type, timing) will further reduce risks. Support community developments in locally managed areas as compensation for lost fishery habitats and abundances.
Significance upon Mitigation: Nil, fish will readily return to their habitats once situation is contained.

5.3.4 Dredging activities: Effects of Suspended sediment on phytoplankton productivity and other aquatic plants

Nature of impact – Generation of suspended sediment plumes in the dredging may reduce the productivity of phytoplankton and other aquatic plants;
Duration – Low: potential effects extend over the duration of the dredging;

Intensity – High: the proportion of very fine sediment is very high (over 80%) and the settling of the material out of the photic zone will be slow. Results from a geophysical survey by Japan Port Consultants (Adala et al, 2009) and confirmed in this ESIA study showed that organic matter in the vicinity of the Berths 11 – 14 is high;
Probability – Definite: elevated suspended sediment concentrations are a very typical by-product of soft bottom marine sediment dredging;
Status of impact – Negative;
Degree of confidence – High;
Significance – low, due to the low duration and high intensity of the impact;
Mitigation – Reductions in the amount of suspended sediment through use of appropriate civil technology (dredger type, timing) will further reduce risks. Continuous monitoring for developments and accumulations of harmful algae blooms (HABS).
Significance upon Mitigation: Nil

5.3.5 Construction / dredging activities: Sedimentation on subtidal muddy and sandy habitats

Nature of impact – Settling of material from construction works may smother benthos on subtidal muddy and sandy habitats adjacent to the dredging / construction sites;
Duration – Medium to long: recovery can take from <1 year (muddy habitats) up to 3 years (sandy habitats) (see Table 4);
Intensity – Medium: depending on the sediment layer thickness many organisms may burrow to the surface through the deposited sediment and many filter-feeders are highly adaptable to increased sediment loads
Probability – Definite;
Status of impact – Negative;
Degree of confidence – High;
Significance – Low: due to the small extent of the impact;
Mitigation – Reductions in the amount of suspended sediment through use of appropriate civil technology (dredger type, civil works deign, etc) will further reduce risks.
Significance upon Mitigation: Insignificant

5.3.6 Operational activities: Accidental oil spill effects on critical habitats (coral reefs, seagrass beds, mangroves) and seabirds

Nature of impact – Accidental and/or operational oil spills from vessels during dredging and post dredging operational phase may affect critical habitats and seabirds due to oiling;
Duration – Very long term: due to (1) potential damage to mangroves which takes several decade-years to clean, and (2), potentially reduced breeding success of some seabirds;
Intensity – High: (1) on severe spills, oil-smoothed mangroves will die and so do their ecosystem services; and (2) seabirds die or their breeding success is reduced and this may have international implications;
Probability – Unknown: no predictions are made for the likelihood of increases in oil spill with increased ship traffic or for possible accidents during dredging or during the operational phase; the assumption is the use of international best practice will prevail;
Status of impact – Negative;

Degree of confidence – High;
Significance – High: mangroves and birdlife thereon are protected in Kenya (mangroves – Kenya Forest Service; Birds – Birdlife International, Nature-Kenya, Kenya Wildlife Service and National Museums of Kenya), and impacts on them have international implications through the Biodiversity Convention, Important Birdlife Areas, and IUCN conservation;
Mitigation – Through IMO, KMA's and KPA's port and shipping regulations, and best practice procedures to be put in place, such as activation of the National Oil Spill Response Contingency Plan. Seek to reduce probabilities of accidental and/or operational spills through enforcement of vessel traffic and oil spill management systems. However, due to devastating effects of even one large spill significance would remain high but mitigation can help reduce probabilities of accidents. Compensation by restoration of degraded habitats that are identified and associated with civil works is proposed.
Significance upon Mitigation: Medium (even with contingency measures threat of oil spill remains, hence the need for sustained vigilance)

5.3.7 Operational activities: Accidental oil spill effects on marine life and habitats

Nature of impact – Accidental and/or operational oil spills from vessels during dredging and post dredging operational phase may affect marine life due to direct toxic effects and/or habitat alteration;
Duration – Medium (but chronic);
Intensity – Low;
Probability – Probable;
Status of impact – Negative;
Degree of confidence – Medium;
Significance – Low, most of the potentially affected organisms are widely distributed in the port area, and in the Western Indian Ocean region;
Mitigation – Through IMO, KMA's and KPA's port and shipping regulations, and best practice procedures to be put in place, seek to reduce probabilities of accidental and/or operational spills through enforcement of vessel traffic and oil spill management systems. However, due to devastating effects of even one large spill significance would remain high but mitigation can help reduce probabilities of accidents. Application of EMCA's Polluter pays principle.
Significance upon Mitigation: Insignificant

5.3.8 Operational activities: Ship wastes effect on marine life

Nature of impact – Potential waste from ships docked at the refurbished berths may affect marine organisms;
Duration – Unknown: depends on the waste;
Intensity – Unknown, depends on the waste;
Probability – Improbable, when regulations of no discharge are followed (under IMO, KMA's and KPA's port and shipping regulations);
Status of impact – Negative;

Degree of confidence – Low, due to unknown duration and intensity;
Significance – Low, when IMO, KMA's and KPA's port and shipping regulations of no discharge into water are followed;
Mitigation – enforcement of compliance and conformance to IMO, KMA's and KPA's port and shipping waste management regulations. Application of EMCA's Polluter pays principle.
Significance upon Mitigation: Insignificant

5.3.9 Operational activities: Discharge of ballast water and potential introductions of alien invasive species

Nature of impact – A rise in discharge of ballast water in the harbour due to increased shipping as a response to the berthing of ships may increase the risk of introduction of marine exotic species;
Duration – Unknown, depends on the introduced organisms but likely to be very long term or permanent when an introduced alien becomes invasive;
Intensity – Unknown, depends on the introduced organisms;
Probability – probable, but KPA prohibits discharge of ballast water within port areas (plans are under way to establish ballast water regulations through KMA and IMO's initiatives);
Status of impact – Negative;
Degree of confidence – Low, due to unknown duration and intensity;
Significance – Medium: currently, no policy of management of ballast water in Kenya;
Mitigation – Abide by the interim provisions of the Management of Ballast Waters in Port states currently under development by IMO; ratify and implement the Ballast water convention. Application of EMCA's Polluter pays principle. Compliance with KPA policy which prohibits discharge of ballast water.
Significance upon Mitigation: Low

5.3.10 Operational activities: Potential negative impacts specific to coral gardens and Mombasa Marine Reserve

Nature of impact – A hydrodynamic sediment plume modelling done by the Japan Port Consultants (Adala et al, 2009) and confirmed in this ESIA study indicates that during the South East Monsoon (SEM) months, a discharge of plume at designated points off the KPA port entrance will result in plume direction moving northwards and into parts of the Marine Protected Area (MPA). However, the deleterious plume of over 50mg/l is not expected to move into the coral reef areas. The model predicts the plume with total suspended solids of 50mg/l will be limited to depths beyond 50m contour for most of the time. However, if done in the North East Monsoon the plume direction is away from the MPA and coral gardens;
Duration – Unknown, depends on the activity timing with the Monsoon phase, but likely to be deleterious when done in SEM and un-deleterious when done in NEM;
Intensity – Unknown, depends on the activity phasing;
Probability – probable, given that there is no guarantee that the work plan will strictly coincide with proper monsoon timing (past experiences during the dredging phase had a similar lapse);
Status of impact – Negative;
Degree of confidence – Unknown, due to unknown activity duration and intensity;

Significance – Medium: currently, no strict enforcement in activity operations to international standards;

Mitigation – Abide by the national and international best practice in dredge spoil management, i.e. dredging be done during NEM but silt curtains deployed in the event that dredging is done during SEM; develop and implement an operational plan that strictly meets the International conventions. Application of EMCA's Polluter pays principle.

Significance upon Mitigation: Low

6.0 FISHERIES ASSESSMENT

6.1 Introduction

Capture fisheries is the main type of fisheries and is predominantly undertaken by artisanal fishermen in the shallow waters and within the reef using small non mechanized boats. Semi industrial fishing vessels do land their catches in Mombasa for export and local consumption. Therefore the marine fisheries resources are very beneficial to the economy and wellbeing of the local community. Determining the status of fishery resources helps in maintaining the long term prosperity and sustainability of the resources for the future generations. Port Reitz and Makupa creeks together form the key fishing grounds neighbouring the project area.

Small scale fisheries in Port Reitz creek is carried out in the scattered fishing grounds along the creek area. The area is characterized by unique marine habitats, with migratory marine fauna, diverse flora and extensive mangrove habitats in the peninsular.

6.2 Approach and Methodology

In order to understand the fishery and the fishers likely to be impacted, a questionnaire-based survey was conducted at selected landing sites within each Beach Management Unit in the two creeks looking into the type of fish landed, sizes, fishing patterns, fishing gears and overall fishing effort in the area. Information on the market and trade was also collected. Desktop analysis was also conducted and analysis done from the fisheries data and information available at the Department of Fisheries. Reports of previous studies done in the area were reviewed with specific reference on the type and nature of project including the impacts highlighted and mitigation measures proposed. The field survey targeted at least 30% of the total number of fishers or traders. The interviewed fishers were as follows; Mtongwe (Shaza, Mweza Mtongwe , Migigo and Hawaii landing sites)-29; Mwangala BMU (Dongo Kundu. Mkunguni, Mwangala, Mwakuzimu and Teja) -47; Tudor -6; Kitanga Juu – 10; and Mkupe-10; Mwandumbo (Tsunza)- 12.

6.3 Objectives of the fisheries assessment

The overall aim of the assessment was to analyse the fisheries resources within the Port Reitz and Makupa creeks in order to understand the status of the fishery in terms of the amount and value of fish caught. The two creeks are in close proximity to the project area and the local fishers depended on creek fishery hence it would be important to understand the likely impacts of the proposed rehabilitation works.

6.4 General locations of fishing activities

The Port Reitz creek lies in the south-west of Mombasa Island and is a major fishing ground shared by fishers from both Mombasa and Kwale Counties. The spatial location of some of the landing sites is as shown in the map below (figure 6.1).

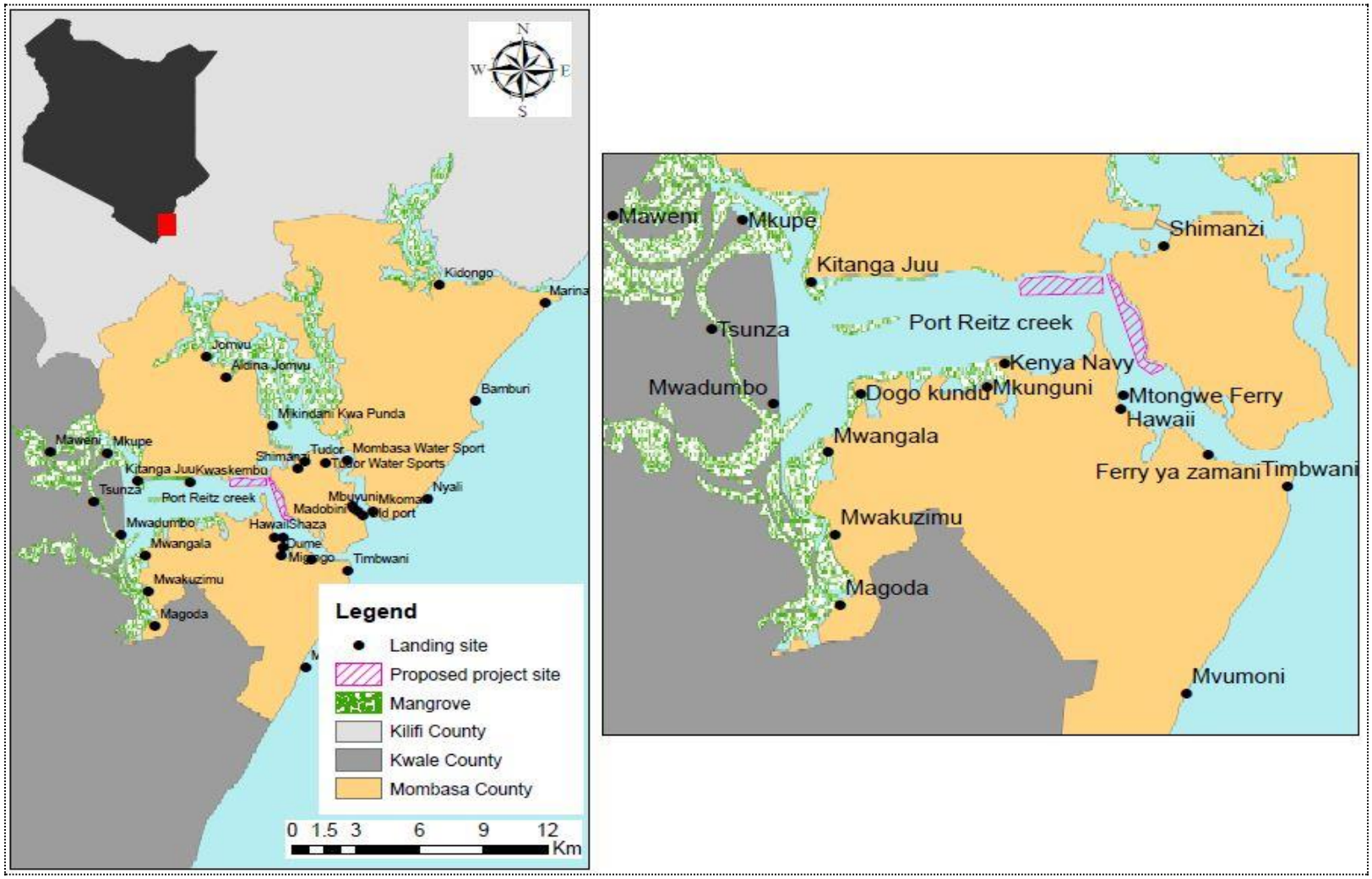


Figure 6.1: Map showing the location of the landing sites and proposed project area

6.4.1 Fish Landing sites in the creek area

The creek fisheries resources are harvested by fishers from Changamwe and Likoni sub counties of Mombasa. Major landing sites as recorded in the Marine Frame survey of 2016 include; Mwagonda, Tsunza Teja, Mwakuzimu, Mwangala, Dongo kundu, Mkunguni, Mtongwe and Old ferry on the Likoni- Mtongwe area of the creek. Other fishers utilizing the creek are from Kitanga Juu and Mkupe- Maweni in Changamwe Sub County.

The proposed project is also likely to impact on the fishery in the Makupa creek with the fishers forming part of the Tudor BMU and mostly landing at the Shimanzi landing site. Details of the specific landing sites that have been considered in the assessment and with reference to overall areas for data are captured are geo-referenced in Figure 6.2 and Figure 6.3 below.

It is important to note that data is reported at sub-county level for Mtongwe and Mangala BMUs. Mkupe-Maweni and Port Reitz the reported data reflects the landings at specific sites.

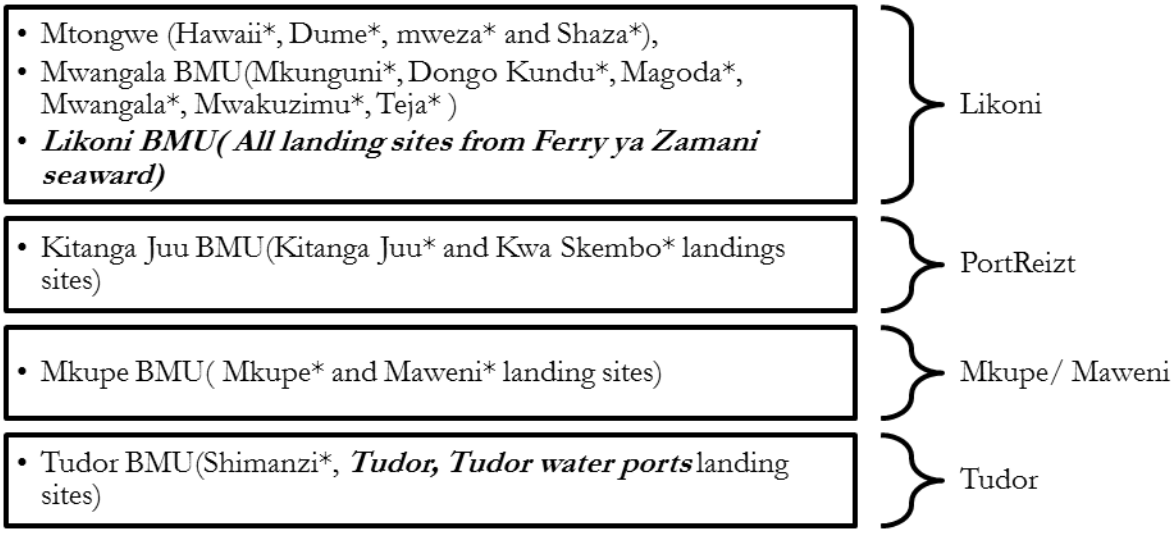


Figure 6.2: Landing sites within the two creeks and their respective overall areas (for data reporting) within the five BMUs considered in the assessment (* *indicates Landing sites considered under the assessment area)*

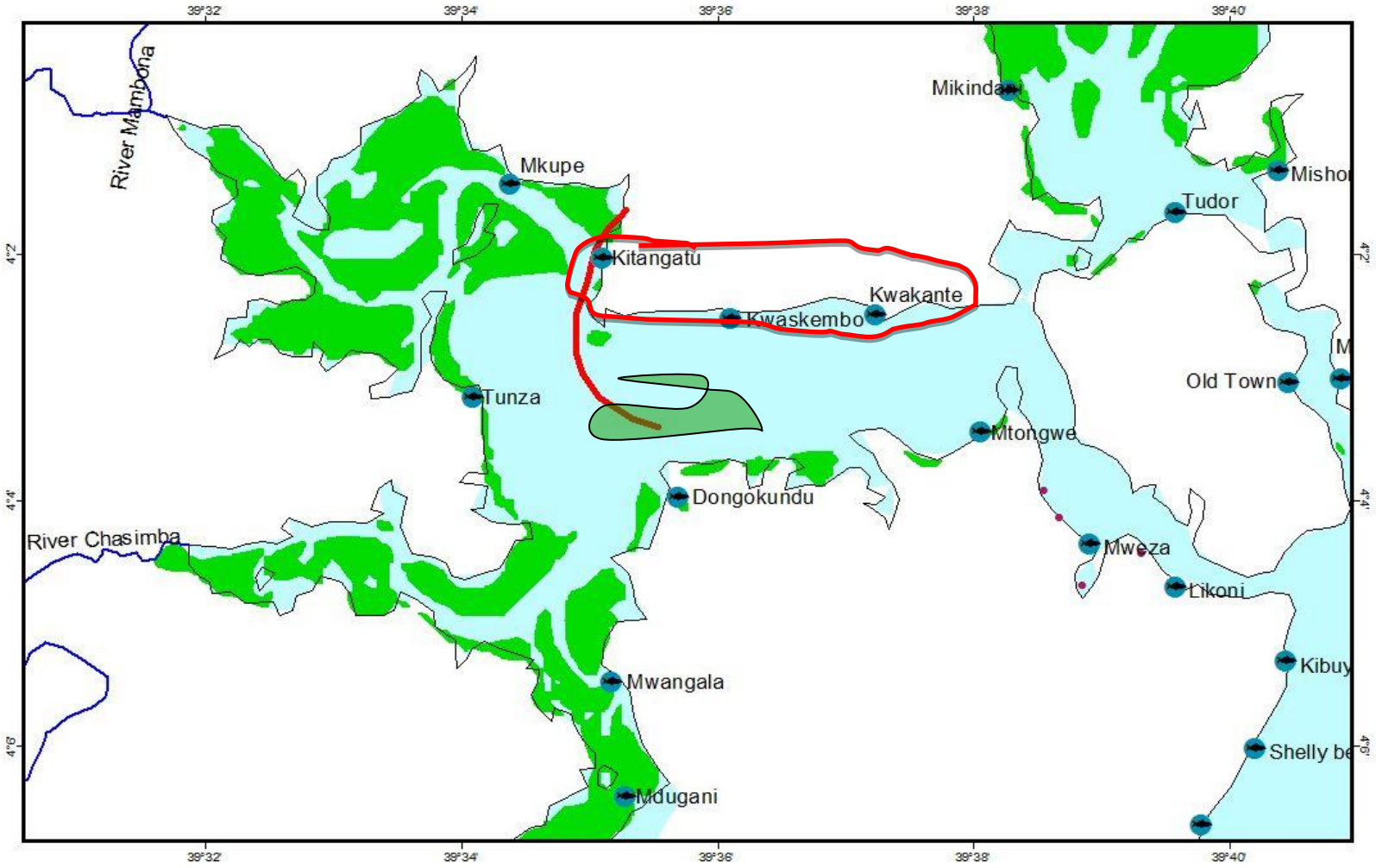


Figure 6.3: Geo-referenced site locations for gazetted fish landing sites. The three landing sites enclosed in red (Kwatane, Kwaskembo, Kitangutu) shape have since been ceded to KPA Port development and SGR

6.4.2 The fishing grounds

Fishing grounds utilized in the creek are numerous with over 27 areas recorded for Kitanga Juu fishers based on Catch Assessment survey data 2013-2014 (*Government of Kenya State Department of Fisheries- Catch assessment surveys 2013-2014)*. The most important fishing areas include; Dongo Kundu, Mto wa Mvuo, Manguzoni, Tonesa, Chamba cha Amani, Mtongwe, Mwangala, Mwishimo, Mto wa Ngare, Mshahame, Maboyani, Mkupe and Tsunza as indicated in Figure 6.4. Fishers from Likoni areas are also known to fish within the creek especially Mweza creek and Port area.

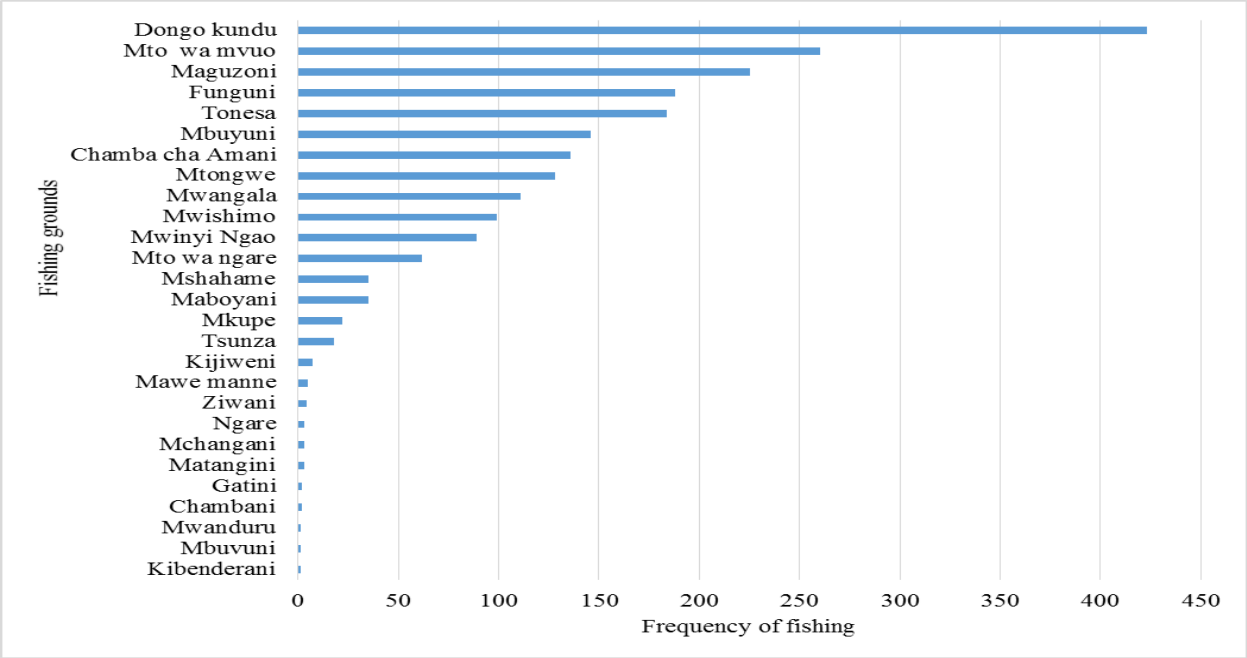


Figure 6.4. Key fishing grounds in the Port Reitz creek (Catch Assessment Survey 2013)

6.5 Fishing effort in the creek

6.5.1 Fishing methods

The methods and fishing gears used are a determining factor of the amount of catch and also the sustainability of the fish resource. The fishermen use non-motorized traditional vessels with the most common vessels being the dugout canoe and the *dau* whose method of propulsion is the paddle. The low catch during the South East Monsoon season (SEM) within the area can be attributed to the ineffective fishing gears and vessels used by the fishers.

In total the number of fishers fishing within the creek area is estimated at 605 and fish traders that depend on fish landed in the various landing beaches are 195. The distribution of the all fishers either registered or not registered with the BMU in the beaches as in Table 6.1

Table 6-1: Distribution of effort in Port Reitz, Likoni and Mtongwe including Mwangala and Tudor BMU landing sites in the project area (FID Mombasa County)

Landing site/BMU	*No of Fishers (All)*	*No of vessels (non-mechanized*	*Average no of fishing days*	*No of traders*
Shimanzi (Tudor)	10	5	30	5
Kitanga Juu	140	42	25	25
Mkupe/Maweni	230	72	30	80
Mtongwe	130	36	30	35
Mwangala	80	41	30	50
Likoni **	15	-	30	-
Mwandumbo	>80			

*Likoni is an area and not a treated as a landing site in the assessment.

Most of the fishers are reported to use seine nets in shallow areas, cast nets, monofilament gillnets, multifilament gillnets and hand lines. The average number of vessels used for a particular technology and the number of fishers involved in use of the gear is detailed in Table 6.2

Table 6-2 Fishing gears and number of vessels and fishers using gear category in the creek fishery (Fisheries Department – Marine Frame survey 2016)

Fishing method	Average No. of vessels	No. fishers
Beach Seine	8	72
Cast net	31	64
Fence Trap	4	13
Gillnets (multifilament)	21	42
Hand gathering	0	5
Handline	8	40
Hooked stick	-	12
Longline	5	30
Monofilament gillnet	14	51
Prawn seine	7	14
Pointed stick	-	1
Reef seine	3	9
Small basket trap	7	9
Scoop net	2	46

6.5.2 *Fishing vessels*

Fisheries information from the County indicates that fishing in the creeks mainly done by artisanal fishers. Most common fishing vessel is the dug-out canoes (67%) propelled by paddles and *dau* comprises only 7% of the vessels in the area (Figure 6.5). Frame survey results 2016 indicate 23% the fishery is comprised of fishers without vessels. Outboard engine is rarely used.

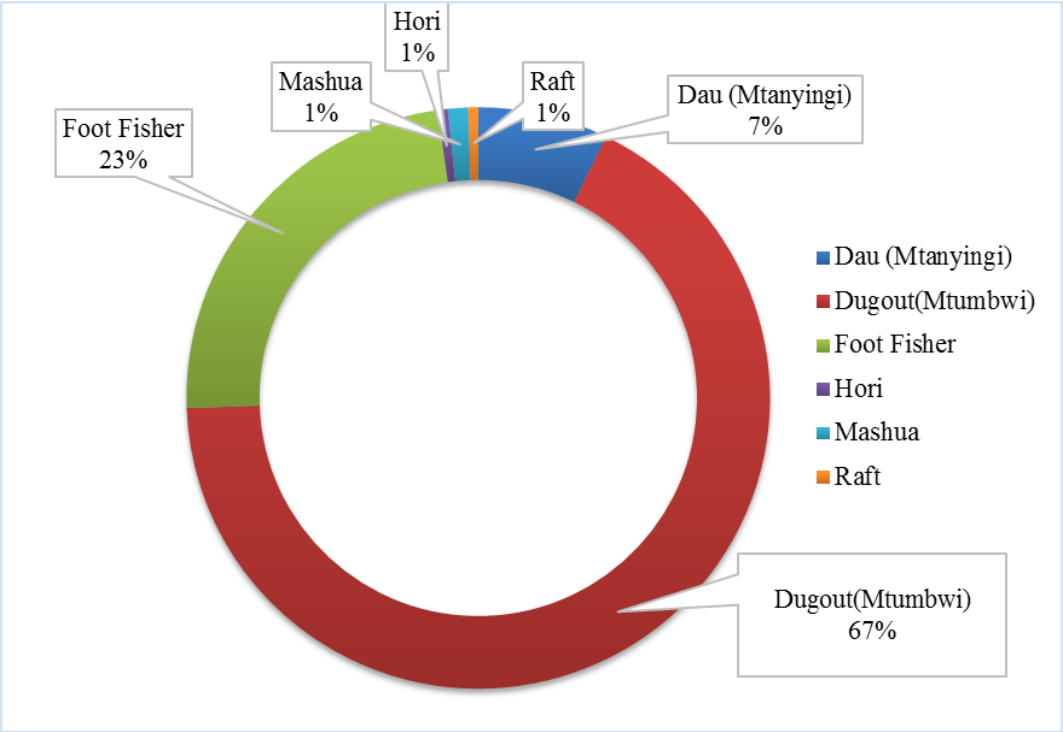


Figure 6.5: Composition of fishing vessels in the creek area

6.5.3 *Fishing gear technology*

The most commonly used fishing techniques within the creek traps referred to as traditional gear are cast net, hand lines and small meshed gill net termed as modern fishing technology. Castnets contribute to majority of the gears (21%), gill nets (14%), and small basket traps (12%) as shown in Figure 6.6. It important to note that while some gears basically catch fish species depending on the mode of deployment, castnets, prawn seines and traps specifically target to catch sardines, prawns. Hooked stick is used by fishers targeting crabs.

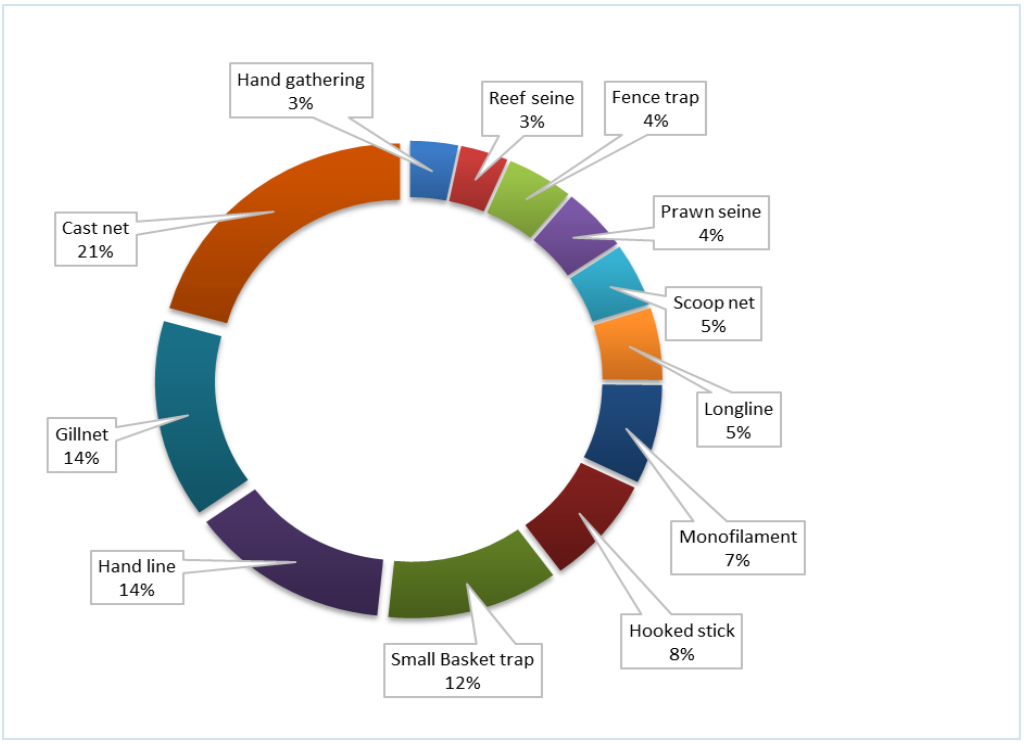


Figure 6.6: Fishing gear composition in the creek fishery (Marine frame survey 2016)

6.6 Fish production

6.6.1 Fish families and species

The fish caught within the creek includes pelagic species comprising mainly Baracuda (*Sphyraena* spp.), Kingfish (*Scomberomorus* spp.) and Mullets (*Mugil* spp.) Demersal species including rabbitfishes (*Siganus* spp.), Scavengers (*Lethrinus* spp.), Snappers (*Lutjanus* spp.), Grunters (*Terapon* Spp.) and Pouters (*Gerres* Spp.). Crustacean fisheries are dominated by prawns comprising the Indian prawn (*Fenneropenaeus indicus)* harvested in the shallow waters and mangroves areas. Mangrove crabs are also harvested in the area. Other Spiny lobsters of the family Palinuridae caught in the shallow water fishing grounds though in small quantities. The Cephalopod fisheries mainly target squids (Loliginidae) and octopus *(Octopodidae)* categorized as mollusks.

Figure 6.7 below summarizes the species/ families that contribute to the creek fisheries.

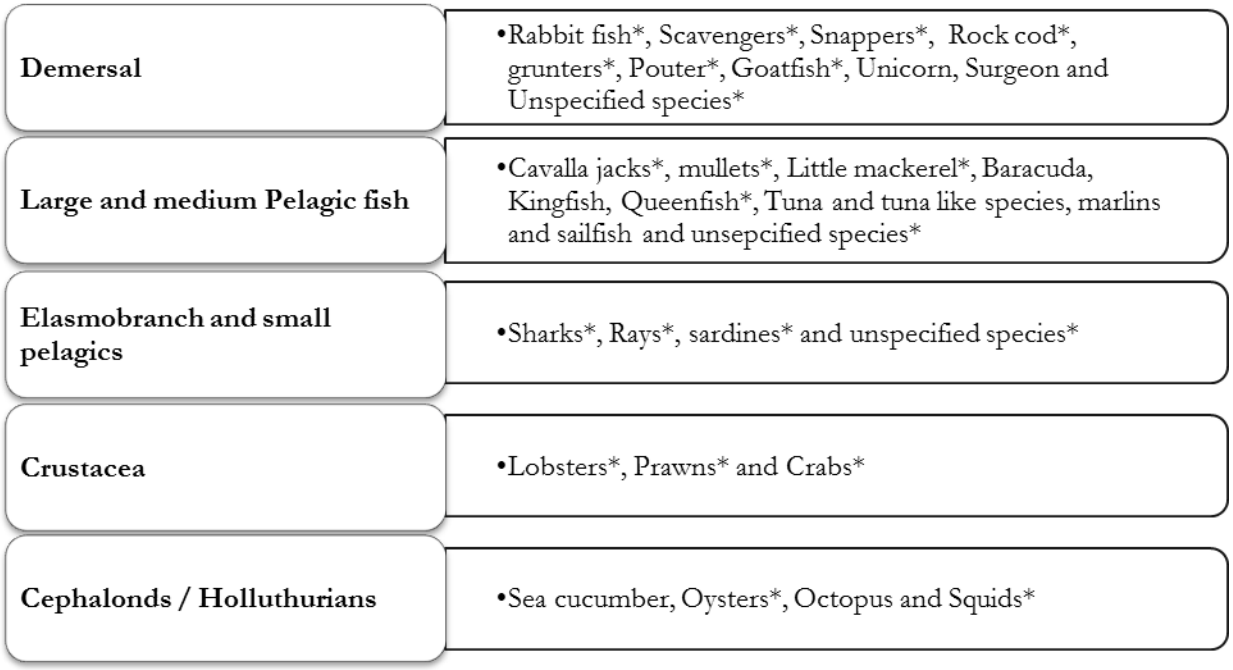


Figure 6.7: Fish families/species categorized into groups. * indicate most common fish species/families in the creek fisheries

6.6.2 Fish production trends

The annual production of artisanal fish catches is estimated between 380 -1381 metric tons (MT) with an average of 697.68 MT annually Table 6-3.

Table 6-3. Fish catch landings (Likoni, Mkupe, PortReitz and Tudor) 2011-2015

Year	Landings (Mt)	Area/Location	Average Catch (Mt)
2011	551.55	Tudor	36.99*
2013	1381.02	Likoni	377.27*
2014	477.27	Port Reitz	146.53
2015	380.87	Mkupe/maweni	85.97

**Fish catch landings includes fish not caught within the creeks

Most of the fin fish, crustacea and oysters, squids are landed at Kitanga Juu (146.5 MT) and Mkupe (86 MT) landing sites. Likoni area fish landings include fish caught in Mtongwe and Mwangala BMU landing sites but also include catch from the open sea not necessary from the creek area. The landings from Tudor include fish catch from Makupa creek. These estimates are from pooled data from the four areas namely Likoni, Mkupe / Maweni, Port Reitz and Tudor as well as fish records from other landing sites not part of the current assessment (See Figure 6.6).

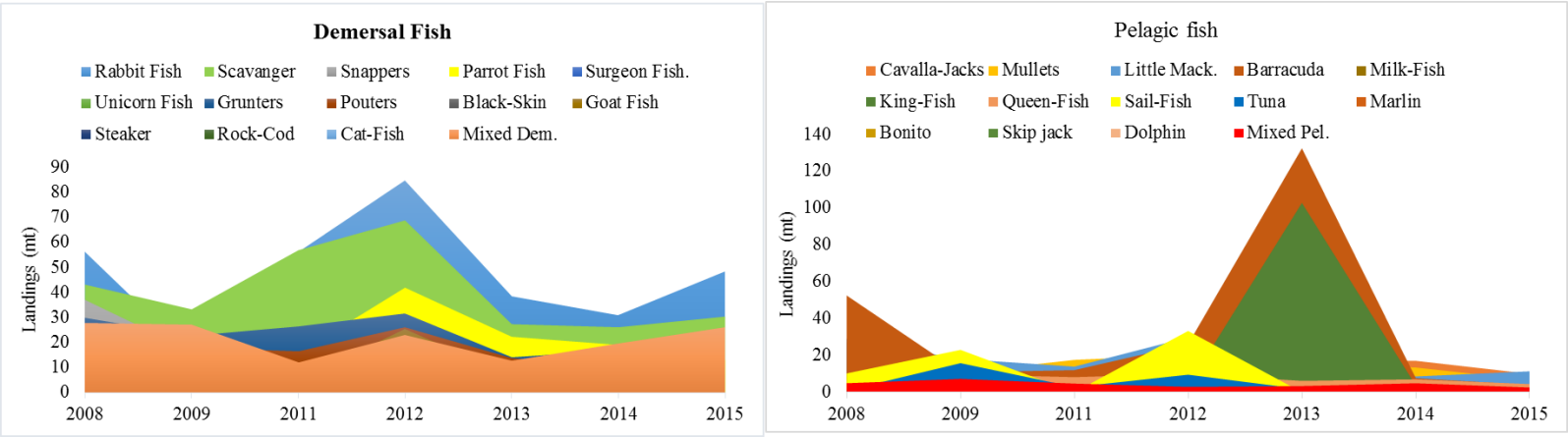


Figure 6.8(a): Annual trends for demersal and pelagic fish species 2008 -2015

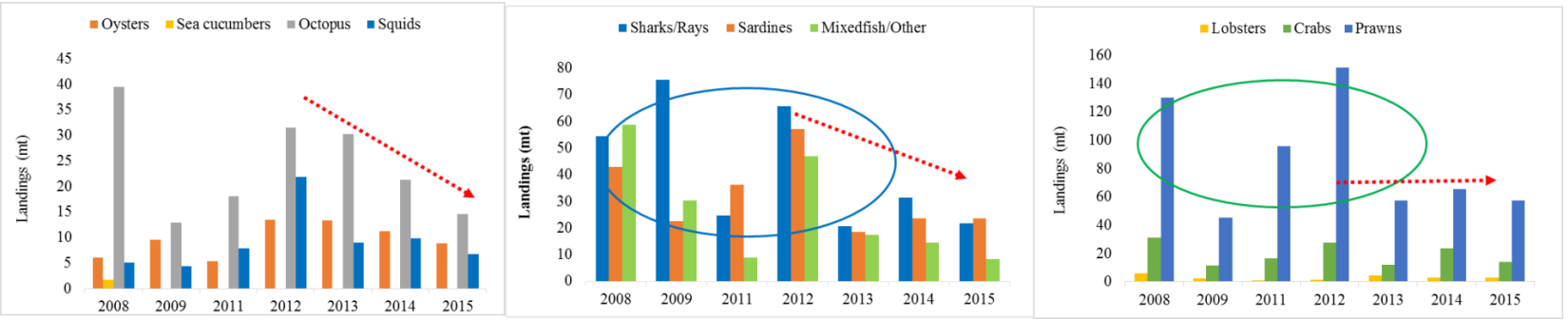


Figure 6.8(b): Annual trends for Cephalops, and oysters, sharks and Rays, and crastacea 2008-2015

The overall annual fish landings indicate a decline from 970 MT in 2010 to the 700 MT in 2015. The highest demersal fish catches was recorded in 2012 mainly for rabbit fishes (*siganus spp.*) 84 MT and scavengers (*Lethrinids*) at 68 MT. The pelagic fish species catch was highest in 2012 for barracudas and little mackerel of 26MT and 30MT respectively. However, catches of most species has fluctuated over time with the lowest catch recorded in 2015. In 2012 prawn catches were as high as 151 MT and 28 MT for crabs. The declining trend is similar for sharks and rays and sardines from 66 MT for sharks and rays in 2012 to 21MT in 2015. Sardines declined from 57MT in 2012 to 24 MT in 2015. The overall trend for all fish groups is shown in Figures 6.8(a) and 6.8(b).

6.6.3 Seasonality of the Fishery

Fishing in the two creeks is conducted throughout the year based on the responses from the fishers conducted during the survey. Fishing is done mainly in the shallow waters of the creeks with only less than 10% of the fishers reported to fish in the open sea. Fish production is influenced by the two seasons, northeast monsoons (NEM) between November-March and southeast monsoons (SEM) between April-September. These oceanographic processes also cause noticeable seasonality in small-scale fisheries within the creek, with high fishing catches recorded during the NEM season. The seasonal variations also influence the way fishing effort is distributed with resultant adaptations including modification of gears, change of gears and even migrations of effort (fishers) between the creek and open waters.

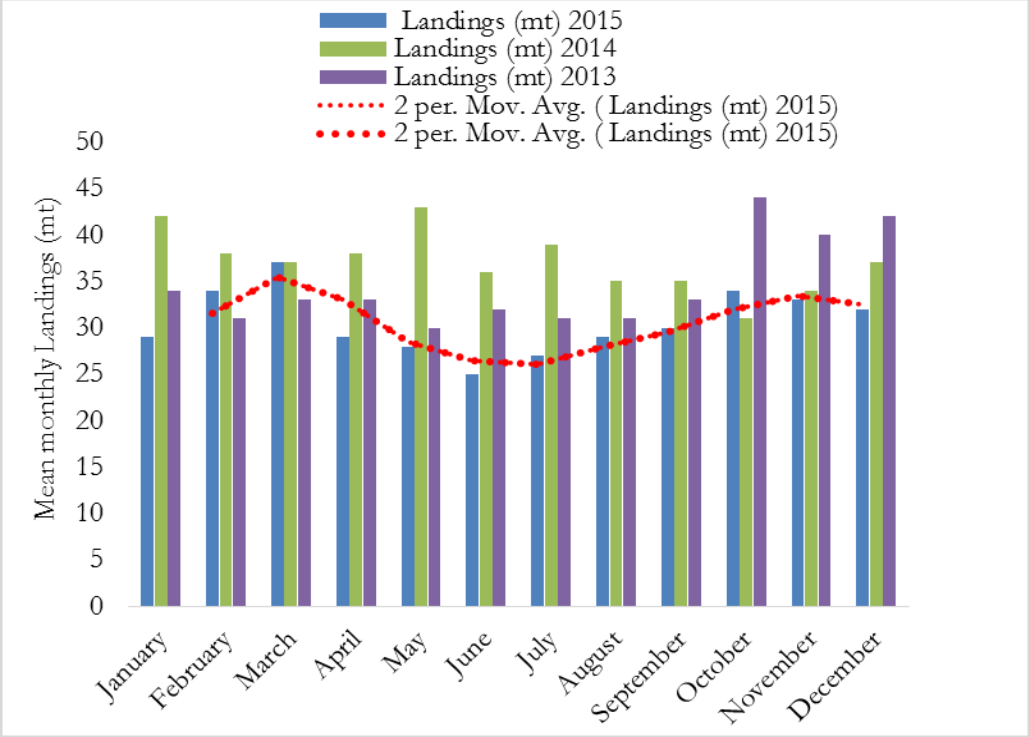


Figure 6.9: Seasonality in fish catches (2013-2015)

Comparative monthly landings between 2013, 2014 and 2015 for pooled data for all fish catches (figure 6.9) indicate seasonal changes in amount caught within the creek. High catch records are indicated in 2013 and 2015 from October to March but the trend is different for 2014 when fishing is active in the month of May normally a time when the winds are strongest. This change could be attributed to changes in weather pattern hence delayed changes in the monsoons but can also be due to other factors not considered during the analysis.

Fish spawning behavior is dictated by photoperiod and the water temperature. Most of the fish including the crustaceans, the fin fish and the mollusks spawn between the months of May and August.

6.6.4 Economic Value of the Creek Fishery

The average annual value for the creek fishery is Kenya shillings 119 million with the value declining the lowest value estimated at 84 million KES in 2011 and 95 Million in 2015. The highest ex-vessel value is reported for the catch landed in Likoni area. However most of the catches within the creek is landed in Mkupe and Port Reitz areas with an estimated value of 17-19 million Kenya shillings annually. Summary of estimated ex-vessel value by years and by area is shown in Table 6-4. The price per kilo for prawn ranges from KES 600 to KES 800 depending on the season, while that of fish ranges from KES 250 -350 a kilo depending on the species.

Table 6-4. The Value (Million KES) of fish landed by year (2011-2015) and average Ex-vessel value (million KES) by landing area

Year	Value (Million KES)	Area/Location	Average Ex-Vessel Value (Million KES)
2011	84.86	Tudor	5.29
2013	186.16	Likoni	310.57
2014	107.74	Port Reitz	18.83
2015	95.92	Mkupe/maweni	16.91

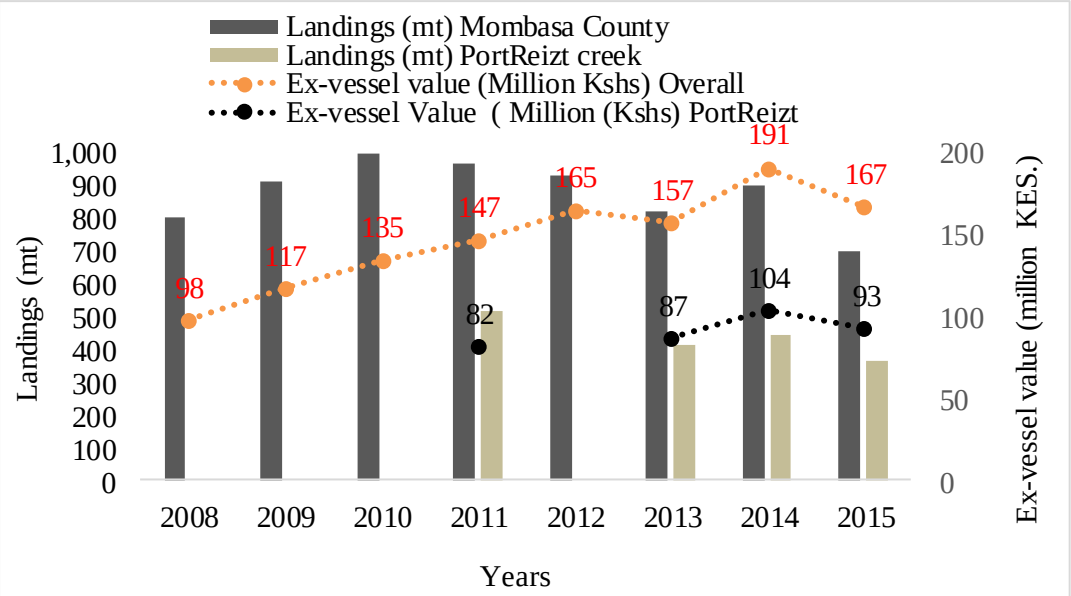


Figure 6.10: Comparison of overall annual landings and value for the creek and Mombasa County

The creek contributes largely to fish catches caught in Mombasa County. 429 MT out of the average of 879 MT caught between 2008 and 2015 is from the creek as shown in figure 6.10. The value of the fishery has increased with the highest 104 Million KES estimated in 2014.

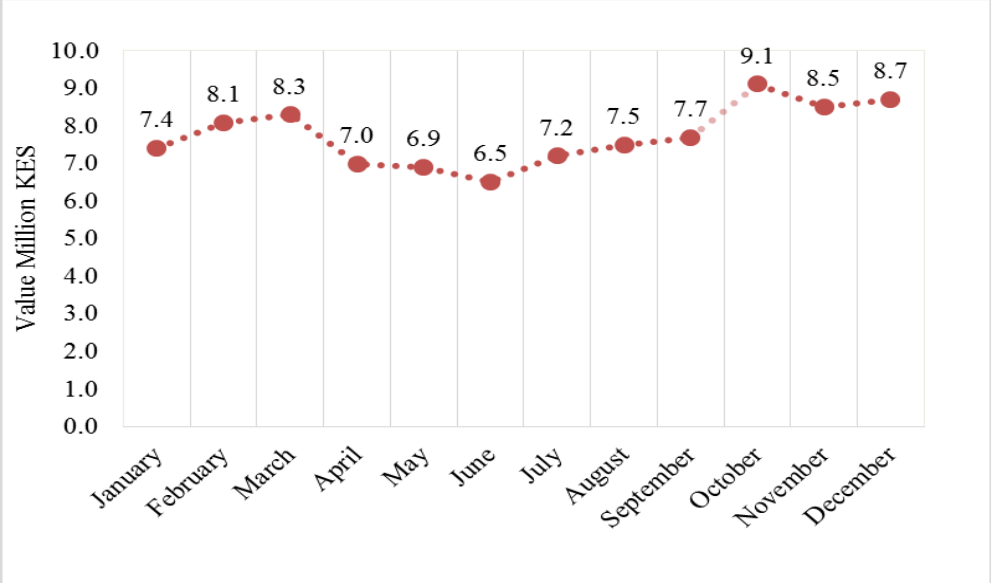


Figure 6.11 Monthly ex-vessel value of fish landed in creek area

The value of the fishery is highest between October and March ranging 8.3 to 9.1 million Kenya shillings. In January the NEM winds are stronger hence fishing is disrupted during this time of the year. Figure 6.11 shows the monthly changes in value of fish in the two creeks.

6.7 Fisheries Resource Management and Marketing

6.7.1 Fisheries Co-management structures

Fisheries co-management involves interaction between the government, fishers, fisheries stakeholders, coastal stakeholders and external agents. This is a flexible management structure which enhances power sharing, decision making, conflict management and dialogue among resource users, stakeholders and the government. The Beach Management Units (BMUs) liaise with the county fisheries officers with an aim of managing the fishing activities to ensure sustainability. Illegal fishing gears such as the beach seine have been banned by the national and county government to prevent overfishing and destruction of the aquatic habitat. Fishermen are required to obtain fishing licenses and to register their boats.

Beach Management Units (BMUs) act as co-management institutions and provide for fisheries management at the grassroots (resource) level. BMUs are composed of stakeholders in fishing communities with mandates of conservation, protection, monitoring and control of fishery resources and the environment, and fisheries planning and development in collaboration with government. BMUs are guided by BMU Regulations of 2007 (GoK, 2007). The participation of fisher-folks is in line with the general principles of Code of Conduct for Responsible Fisheries (FAO, 1995).

The BMU with the largest number of members is Mwadumbo which has 262 members. There are seven (7) Beach Management Units (BMUs); Mwangala, Kitanga Juu, Mkupe and Mwandumbo (within Tsunza peninsular) all in the upper part of the Port Reitz creek while Mtongwe and Likoni beach management units are in the lower area of the creek area. Tudor is within the Makupa creek represented by one landing site namely Shimanzi. Fishers from these BMU are likely to be impacted during and after implementation of the proposed project. The number of BMU members and registered fishers based on the 2015 register with the State Department of Fisheries Mombasa County and confirmed from the field data collection survey is approximately 1000. The number of fishers registered with the respective BMU range from 10 to 186 based on the various landing sites with details given in Table 6-5. This is an indication of community involvement in sustainable management of the fishery. The rest of the members are either fish traders/dealers or youth groups involved in mangrove conservation activities or fish farming in the intertidal zones.

Table 6-5 Membership in the BMUs in the area

Beach Management Unit	*BMU members (based on survey)*	*No of registered fishers (2015 BMU register*
Tudor	85*	10**
Mwangala	226	77
Mkupe/Maweni	256	151
Mtongwe	220	119
Kitanga Juu/Ngare	203*	116*
Likoni area	234*	186 (15**)
Mwandumbo	262	-

**Data covers all members in several landing sites **Number of fishers considered under proposed area*

6.7.2 Fish community characteristics

A total of 117 questionnaires were administered among respondents (92.3% males and 7.7% females) at landing sites of the BMUs within the proposed project area. Most of the people engaging in the fishing activities are males with the majority being in the age bracket of 30- 50 years based on the socio-economic survey. Their level of education is quite low with over 90% having acquired knowledge up to the primary level, less than 10% have attained secondary school certificate. This means most of the school leavers engage in fishing as the only source of livelihood while others take up the trade from their parents. Fishing is done communally or in groups although some fishers reported to be undertaking fishing activities on their own. Between 70- 80% of the fishermen use hired boats while 5-10 % own their fishing vessels. The rest of the fishers wade to shallow grounds or in the mangrove areas during low tide.

6.7.3 Market and trade

The fish destination market is around the landing site and restaurants in Mombasa town. No preservation is applied in this case because once the fish is obtained it is sold immediately hence the fish quality is high although the quality may deteriorate at markets far away from landing sites as no ice is used in the process.

6.7.4 Mangrove conservation and mariculture activities

The mangrove forest has been greatly degraded over the last decade due to human activities and oil spills hence the communities have stepped up initiatives to rehabilitate this important ecosystem. The neighbourhood of the project area has a mangrove cover important for the sustainability of fishery which should be protected and enhanced.

There are youth groups involved in mangrove rehabilitation and conservation within the project area; one in Mkunguni / Dongo Kundu area known as Dongo Kundu Youth group and another group that occupies the area from Dongo Kundu to Mwangala known as Mbuta Mazingira youth. The youth groups are also involved in economic activities such as bee keeping especially the area from Dongo Kundu to Makombeni (Oyster area) as well as also mangrove crab farming. In Tsunza area the BMU is involved in Prawn and milk fish farming as well as crab farming as alternative source of livelihood.

In general the area is suitable for crab, finfish and prawn farming as alternative livelihoods. The BMUs have plans to develop fish farming in the area which fits in the larger strategic plans of the county government to enhance aquaculture development. Aquaculture development is important in this area of the county as it is one of the places where farming of the prawns, crabs and marine fish can be done within the mangrove area.

6.7.5 Habitats and Species of special concern

Large sharks and rays visit the area during high tide and are caught in set gillnets during these times. Some shark species are threatened and listed in Appendix I and II of the IUCN Red List hence their protection is vital. Research findings have indicated the important role of shallow areas and estuarine areas which form habitats for early life of marine and brackish water organisms.

6.8 Key Challenges

From the analysis of existing data and from the survey it was established that fishery is faced with a lot of challenges. Although fishery may seem to support local communities the quantities are quite low and some of the reasons attributed to current status of the fishery include:

1. Declining of fish catches in the Port Reitz creek. This may be attributed the numerous projects recently undertaken in the area including the Dredging of the Access Channel, Construction of the second container terminal, Standard Gauge railway projects, among others. Dumping of waste at Kibarani areas and construction activities around the Makupa creek may also have attributed to the declining fish catches.
2. Due to decline of fish catches some fishers have resorted to use of illegal fishing gears such as beach seines.
3. Lack effective fishing gears and vessels has put fishing pressure in the shallow area 10-15 m, and in case of harsh conditions such as storms they cannot fish due to small vessels that are unable to venture into the deep sea.
4. Low prices of fish attributed to deterioration of quality due to lack of preservation facilities and far off markets, and size of fish.
5. Lack of proper fish handling facilities at the landing sites leading to post-harvest losses.
6. Harassments of fishers by the authorities at the port area which is considered as a restricted area.

6.9 Conclusions

1. The fishing area within the two creeks has reduced overtime due to projects that are being undertaken to support port development and associated infrastructure development hence fishing challenges have increased overtime.
2. The fishing area is shared by all the fishers in the creek hence there is need for a joint co-management area to support sustainable fishing activities and community development in the area. There are numerous landing sites in the area creating challenges in data capture within the creek.
3. The area is a key ground for the prawn fishery and other commercially important finfish species.
4. The creeks are ecologically important with mangroves and patchy reefs that play an important role as feeding and nursery habitats. The sheltered creeks also provide temporary feeding area for pelagic fish and large predators like the sharks.
5. The Port Reitz creek has potential mariculture sites and especially in the upper creek sites including the peninsular.

6. Fishery activity in the Makupa creek is limited to a few fishers. The creek area has shrunk due to construction of Container Freight Stations (CFS) around the creek and infiltration of solid waste from Kibarani dumpsite spreading to the sea hence the water quality a concern.
7. Fish marketing systems and trade is not centralized hence traditional trade system between the fishers and traders across Port Reitz creek exists.

6.10 Fisheries Impacts and Mitigation Measures

Direct impacts on fisheries resources and fishing operations including habitat loss due to dredging works may be regarded as low. This is because the dredge area is small (Figure 6.1) and the project area is classified as a protected port area and not a fishing area. However there other anticipated adverse indirect impacts such as:

6.10.1 Loss of access to traditional fishing grounds

There will be temporary restriction of access to traditional fishing grounds while the dredger is in operation. Whereas the loss due to restriction of access may be temporary, the actual loss of the fishing grounds is likely to be significant if the entire area is declared a port security zone.

Extent of Impact: Localised
Probability: Certain
Duration: Short term, only during the dredging period
Magnitude/ Intensity: Low
Significance: Moderate
Significance upon mitigation: Low

6.10.2 Overall decline in fish catches and /or reduced availability of target species

Fish catches may be affected by dredging, dumping and reclamation due to localized, short-term peaks in suspended sediment concentration and elevated levels of turbidity, forcing fish to move to clear waters if level of suspended sediments is too high. This effect is expected during and after dredging. Fish population may take 3-4 years to recover (taking into account the construction period of 2-3 years and another 1year for biodiversity recovery) depending on the extent of degradation of the habitats. Previous fish catch trends also provide useful information on the likely period of the recovery for key species such as the demersal fish, crustacea and molluscs.

Extent of Impact: May impact in fishing areas beyond the site
Probability: Likely
Duration: Short term, only during the dredging and recovery period
Magnitude/ Intensity: Moderate
Significance: Moderate
Significance upon mitigation: Low

6.10.3 Interference with fishing activity

There is the potential for interference with fishing vessels since the vessels are not highly mobile as most of them are propelled by paddles or sails. Indirect effects are likely to include an increased risk

to navigational safety, increased risk of gear damage as the dredger may interfere with set fishing gear during operations and even disposal of the dredge material. However the effect is expected for a short-term duration and highly localized but the level of impact may be significant.
Extent of Impact: Local
Probability: Moderate
Duration: Short term, only during the dredging period
Magnitude/ Intensity: Low
Significance: Moderate
Significance upon mitigation: Low

6.10.4 Interference with habitat rehabilitation and temporary loss of habitats

The creek is important ecologically and there will be negative ecological impacts on the important fishery ecosystems in the area (Mangroves, coral reefs, river system). These are covered in detail in the ecological assessment.
Extent of Impact: May impact beyond the site depending on extent of propagation of sediments
Probability: Likely
Duration: Medium, as ecosystem recovery may take up to 4 years (Bolam S. & Rees. H. 2003)
Magnitude/ Intensity: Moderate
Significance: Moderate
Significance upon mitigation: Low

6.10.5 Impacts on aquaculture /mariculture activities in the creek.

Reduction in aquaculture and mariculture activities during the dredging period as a result of escalated turbidity levels due to increased suspended solids. The aquaculture depends on the seed or larvae from the wild and the effect on the eggs and larvae may adversely affect the aquaculture activities in the creek hence indirect effect on alternative livelihoods.
Loss of source of income from fishing and fish trading due to reduced fishing ground and impacts of the fisheries leading to reduced fish catches

6.11 Proposed Mitigation Measures

According to the assessment the proposed mitigation measures include avoidance, minimization or compensation. In view of the short-term construction and dredging work for the project, it is predicted that there will be fisheries impacts associated with the project and especially with reduced fish catches during the dredging and the recovery period of the habitats and fishery that may take over 3-4 years. It is important to implement mitigation measures against water quality that will minimize the levels of suspended solids including the use of silt screens. Proposed compensation mechanisms could include:

1. Compensation during project implementation and recovery phase for a period of 4 years. To implement the compensation an understanding between the Beach Management Units (BMUs),

State Department of Fisheries (SDF) and other relevant stakeholders should be developed and an exhaustive census of all affected persons(Fishers, traders, BMUs) need to be carried out with socio-economic status of each one in order to avoid conflicts among the fishing communities

2. Improvement of the cold chain system through provision of cold storage facilities eg freezers and cool boxes to minimize postharvest losses.
3. Enhancement of the fishing capacity through provision of better fishing vessels and gears with capacity to access the open sea fishery.
4. Development of a centralized market for their fish. This can be through construction of fish *bandas* at the landing sites to act as a platform for selling the fish.
5. Construction of fish stores with cold storage facilities at the landing site.
6. Develop mechanism for ensuring safety and security with regard to the fishers who fish in the Port Reitz creek and access to offshore fishing grounds.

7.0 OCEANOGRAPHIC ASSESSMENT

7.1 Background

Many of the world's seaports, harbors and navigational channels are located on estuaries and ready access requires maintenance of navigation channels. Estuaries are also effective sediment traps, and this is a problem for ports. A significant feature of most estuaries is a zone of high-suspended sediment concentration near the head of the estuary, also known as turbidity maximum zone. This zone often contains high concentrations of contaminants to which are added pollutants from effluent discharges (Martin, 1999). The accumulation of sediments in harbors and navigational channels makes it necessary to carry out dredging works to ensure safety of navigation.

Due to geometrical complexity of most estuaries, both field observations and numerical models are needed to understand the hydrodynamics. Knowledge of the hydrodynamics of estuaries is necessary for a better understanding of how sediments are transported and dispersed within the system and how the channel is flushed through exchange with offshore waters. The fate and transport of materials in the system are strongly related to the hydrodynamic conditions. Among a wide range of factors influencing sediment transport in estuaries, tidal range and current speed are the most important (Althausen and Kjerfve, 1992; Lindsay *et al.*, 1996).

7.2 Methodology for Oceanographic Assessment

The methodology for oceanographic assessment was as follows:

Key Issues to be investigated

- Sediment transport (Turbidity plumes);
- Currents speed and direction (water movement);
- Water level variations (sea level rise);
- Wind and waves;
- Assessment of impacts of the proposed activities on the physical environment.

Main Activities

- Desktop synthesis and numerical modelling of hydrodynamic and sediments information on the proposed site.
- Estimation sediment loadings and collection of water and sediment samples, for the determination of total suspended sediments (TSS) and grain-size distribution.
- In situ measurement of physico-chemical parameters using CTD and obtaining the ocean current velocities & directions using Aquadopp Recording Current Meter (RCM).
- Water level measurements from KMFRI Mombasa tide gauge station.
- Analysis of time series data and development of hydrodynamic models (Harmonic & spectral analysis).

Expected Outcomes

- Baseline data and information on hydrodynamic characteristics of the Port of Mombasa.
- Ocean current velocities and directions
- Sediment movement models
- Mitigation measures and EMP for proposed activities

7.3 Numerical Modeling of Hydrodynamics of Kilindini Harbor

Due to the large spatial and temporal variability in water levels, current velocities and salinity that exist, a large number of field observations must be carried out in order to determine the hydrodynamic characteristics of estuaries. The costs associated with data collection are usually quite high. A way out of this situation is the use of numerical models as sophisticated techniques for interpolation of field data in both special and temporal domains.

This report presents the hydrodynamic characteristics of Kilindini Channel (inclusive of the specific Berths 1-14), Mombasa. This analysis has been done holistically on the whole channel because the processes that occur (e.g. sediment transport, wave behaviour) are a function of the cumulative influences of the whole system (in this case the Kilindini channel). In this study, numerical simulations were applied by means of a model that couples hydrodynamics and diffusion of Total Suspended Sediment (TSS) and sedimentation of dumped soils.

The approach was as follows:

- Obtaining the water levels measurements for one-year period from the tide gauge station located at the Kilindini (**latitude -4.067 and longitude 39.65**) operated by Kenya Marine and Fisheries Research Institute, KMFRI.
- Time series of current velocity and water temperature data were observed for a period of 30 days. Investigations were done to determine the factor(s) responsible for water movements, circulation patterns and establish if there is tidal asymmetry in the harbour.

The aim of the numerical modelling studies was to provide detailed information on the hydrodynamic and sedimentation effects due to the proposed channel straightening, strengthening and deepening and to also support studies relating to the Environmental and Social Impact Assessment (ESIA). The key result area was to develop a model which accurately represented natural tidal conditions and hence sediment movement within the study area. The model provided a means to assess the following:

- Prediction of the currents and hence how a sediment plume may behave;
- Prediction of sediment deposition during dredging and disposal.

In order to generate a better spatial resolution data for model calibration and validation, stations were established at selected locations within Kilindini Harbor and in close proximity to Berths 1-14 to monitor tides, currents and suspended solids as well as salinity.

Four scenarios were examined during the numerical simulations:

Scenario 1: Offshore dumping in NE Monsoon season at designated Point
Scenario 2: Offshore Dumping in SE Monsoon Season at Designated Point
Scenario 3: Basin Dredging Operation at Berths 1-14 and potential turbidity dispersion during NEM Season
Scenario 4: Basin Dredging Operation at Berths 1-14 and potential turbidity dispersion during SEM Season
After extensive validation against available observations, the model was used to predict the effects of the proposed scheme on tidal flows, waves and sediment transport.
During the simulation field setting, the following cases were considered:

- Latest bathymetry measured in this study (see Figure)
- Current measured in this study.

Bathymetry

Below are figures showing the raw water depths (Figure 7.1) data and the subsequently generated bathymetry (Figure 7.2) map for the Kilindini Harbor. The bathymetry in itself can be used to infer on the sediment movements within the port channel. Figure 8.3 however shows the bathymetry extending to the outer reef.

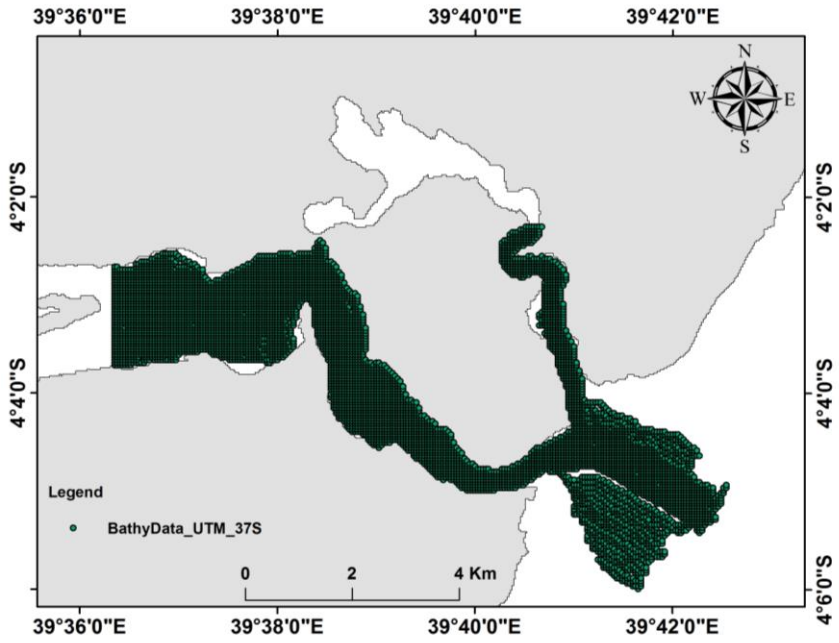


Figure 7.1: Raw data points of water depths around Mombasa Island (Kilindini and Tudor Channels).

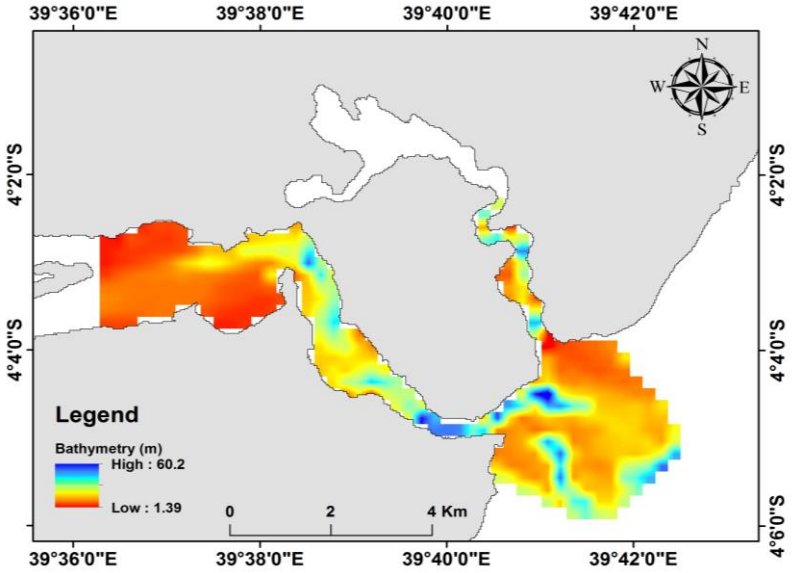


Figure 7.2: Derived bathymetry of the Kilindini and Tudor Channels with the highest interpolated water depth at ~60 m and the shallowest at ~1 m.

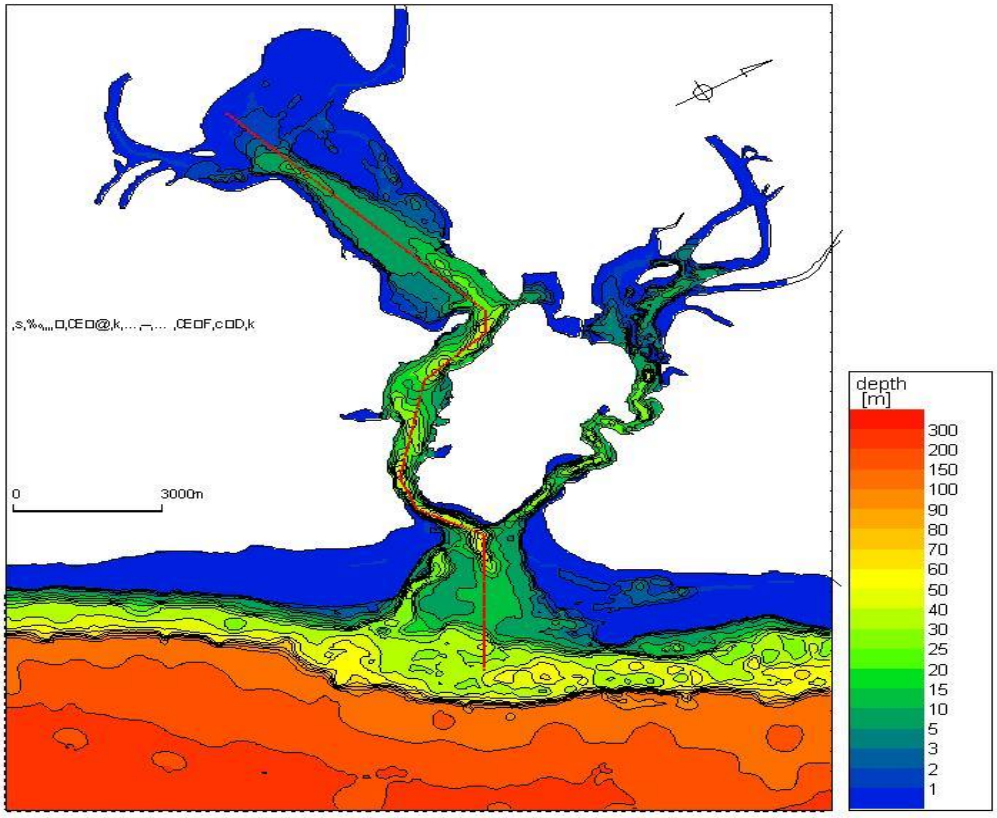


Figure 7.3 Result of two-dimensional bathymetric survey of Kilindini harbor and its approaches

The simulation period of the model continued for 10 days during spring tide duration, in which turbidity levels had increased and reached constant values.

7.4 Interpretation of Simulation Results

Results of the simulation exercise can therefore be interpreted as follows:

7.4.1 Scenario 1

Turbid water will disperse toward SW direction from dumping point; however, 10 mg/l contour will not reach to -50m depth contour, which is understood as deepest outer fringe limit of Coral Reefs (Figure).

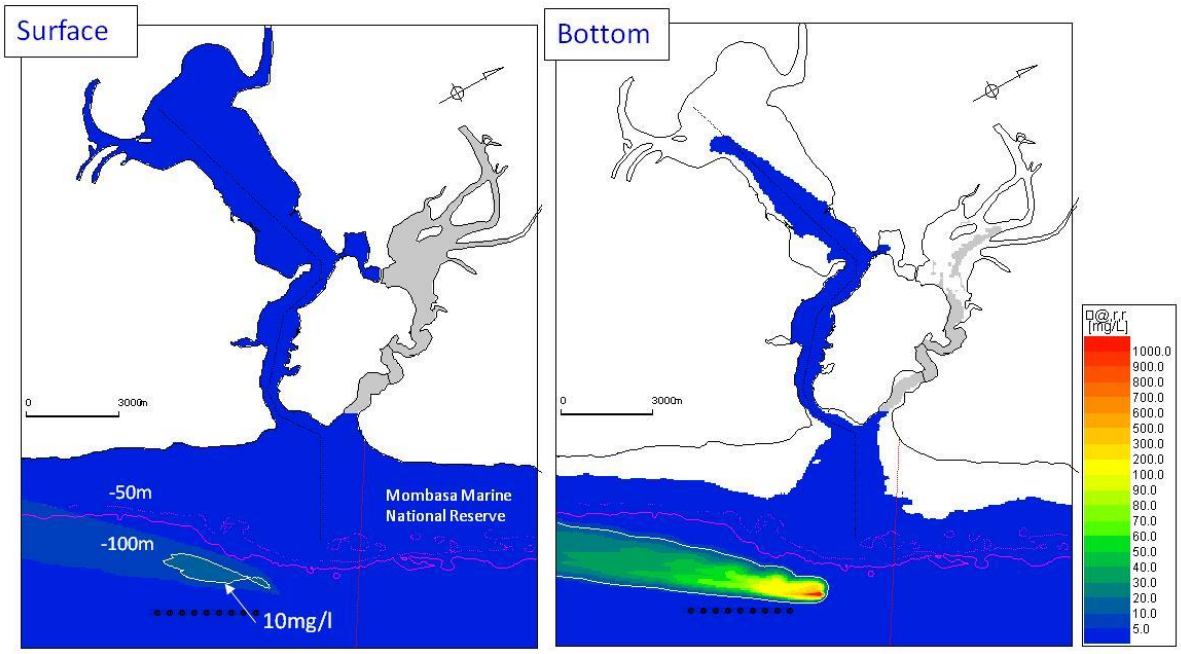


Figure 7.4: Turbid water dispersion simulation (surface and bottom layers) at offshore dumping during NEM season (Jan – Apr).

7.4.2 Scenario 2

Turbid water will disperse toward NE direction from dumping point. On the water surface in southwest-end of the Mombasa Marine National Reserve, temporally turbidity increase by 20 mg/L will be observed (Figure). However, no increase higher than 10 mg/L will reach the -50m depth counter in bottom layer, which is understood as deepest outer fringe of Coral Reef. (See Figure 8.5).

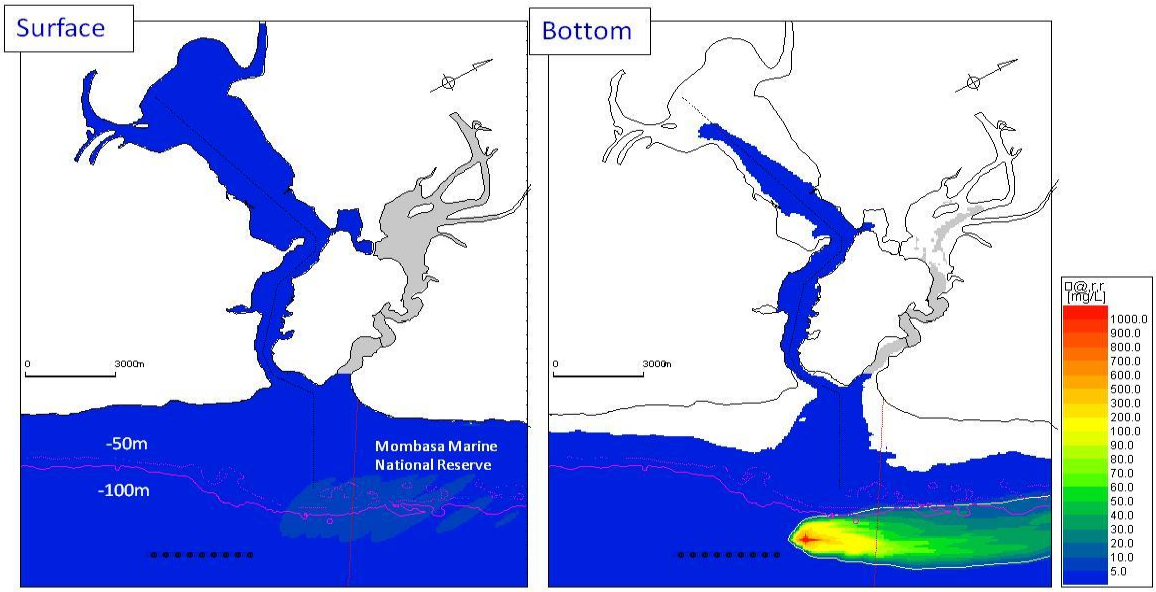


Figure 7.5: Turbid water dispersion simulation (surface and bottom layers) at offshore dumping during SEM season (Jul – Oct).

7.4.3 Scenario 3 and 4

No significant difference is shown between scenario 3 and 4. No turbid water will be moved out beyond the port entrance. High turbidities indicated by red color are shown in the deepest area of Port Reitz. However, these are caused by re-suspension of existing fine materials due to extreme shallowness of the area, but it is difficult to eliminate the indications from the output of the simulation results (Figures 8.6 and 8.7).

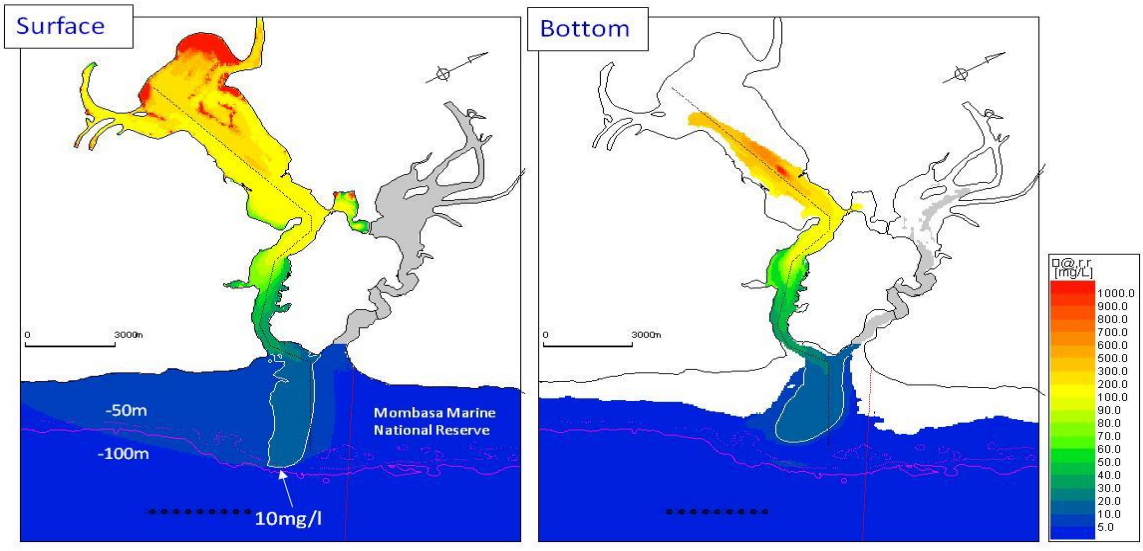


Figure 7.6: Turbidity water dispersion due to potential dredging works at Berths 1-14 during NE Monsoon.

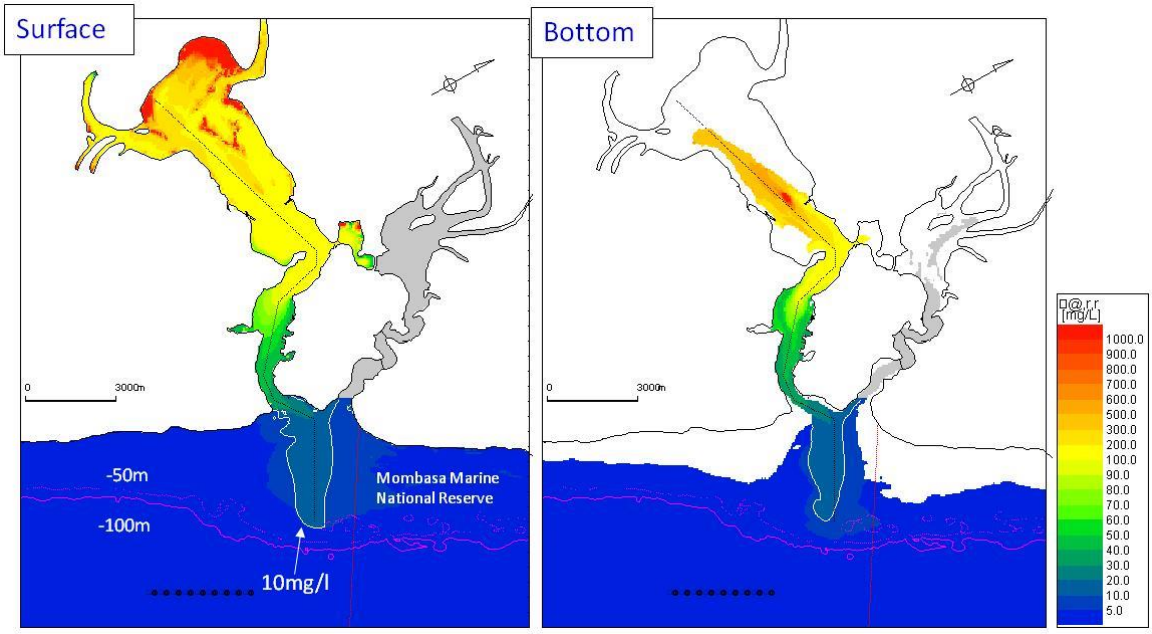


Figure 7.7: Turbidity water dispersion due to potential dredging works at Berths 1-14 during SE Monsoon.

7.5 Potential for Sediment Resuspension.

The results of the hydrodynamic model were then used to assess, amongst other things the sedimentation and turbidity as a result of dredging activities and consequently potential impacts on marine flora, fauna and biological processes within the study area. Figure 7.8 and Figure 7.9 shows the predicted extent and level of concentrations of suspended sediment expected at Berth 1-14 and offshore site.

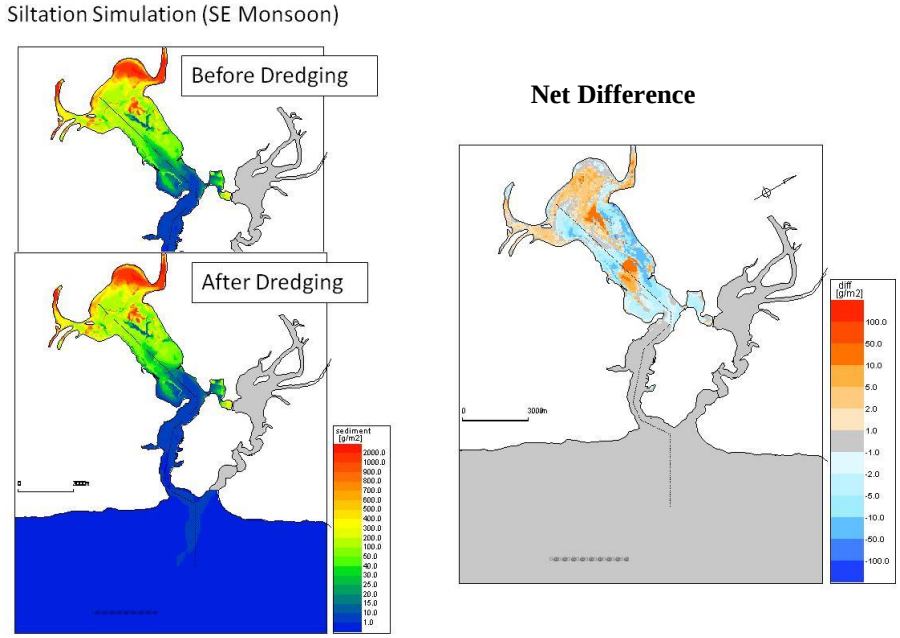


Figure 7.8: Results of numerical simulations of siltation before and after dredging at Berths 1-14 during the South East Monsoon season and the siltation difference before and after dredging.

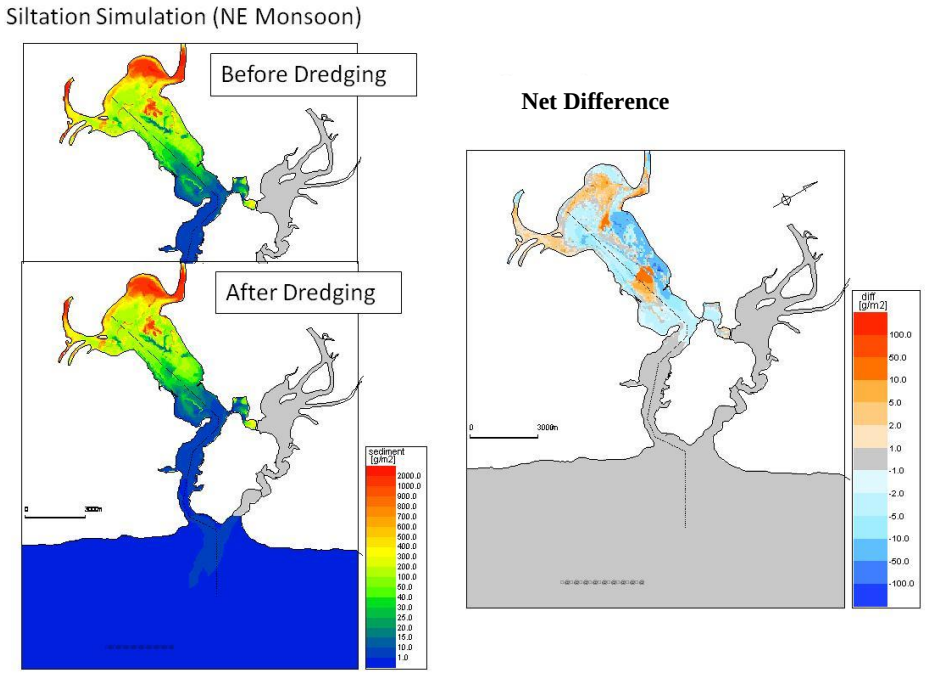


Figure 7.9: Results of numerical simulations of siltation before and after dredging at Berths 1-14 during the North East Monsoon season and the siltation difference before and after dredging.

7.6 Hydrodynamic Modelling of Water Quality Impacts

Dredging increases water turbidity and relocation of dredged material to an offshore site can spread the plume over a greater area. The aim of developing the hydrodynamic model for the project was to predict the spatial extent of impact from turbid plumes as well as the concentrations of suspended sediments that would be experienced by biota through the reduction in available photosynthetic light and through physical smothering of deposited dredge sediments.

This approach enabled the project team to predict turbidity related impacts and develop management and mitigation strategies prior to the commencement of the dredging project and occurrence of impacts. The focus was on the dredging process to enable a responsive approach to management. As part of the predictive monitoring approach, mitigation measures based on tolerance values were developed for sensitive habitats and then used to develop management responses.

7.7 Concluding Remarks

7.7.1 Hydrodynamic Characteristics

There is an asymmetry of ebb-dominance with ebb currents being stronger than flood currents. Maximum ebb and flood velocities are 0.8 ms^{-1} and 0.5 ms^{-1} respectively. This situation tends to favor a net export of materials (including sediments) out of the system. Typically, flood tide last for 6.58 hours while ebb tide extends for 6.04 hours within the harbor.

Temperature variations are diurnal with maximum values occurring at about midday and during the afternoon within the harbor. These variations are slightly sensitive to the semi diurnal variations caused by the tides.
Meteorological forcing due to wind stress or fluctuations in air pressure play a minor role in the harbor-ocean exchange processes. This indicates that water movements in Kilindini harbor are exclusively caused by the tides.
Harmonic and spectral analysis methods are useful tools for characterization of estuarine flows. Both methods describe fairly well the hydrodynamic characteristics of Kilindini harbor.

7.7.2 Numerical Modeling

Three-Dimensional hydrodynamic models coupled with advection-diffusion term can be used to simulate the hydrodynamics of Kilindini harbor including the transport of suspended sediments. The model applied in this study was used to predict the effects of the proposed dredging scheme on tidal flows, waves and sediment transport using four scenarios examined during both the NE and SE monsoon seasons. The results of the hydrodynamic model were then used to assess, amongst other things, the sedimentation and turbidity as a result of dredging activities and consequently potential impact on sensitive habitats in the harbor and nearby areas.

Modelling results indicates that sea levels will not be impacted by the dredging and that the tidal water levels will be reduced very slightly by about 20 mm in the harbor. The results also indicate that there will be no change in the current speeds in the harbor or the dredged channel after the dredging. However, there will be a small decrease in current speeds through the entrance of the Harbor associated with the increase in the cross sectional area. There shall be a slight decrease of current in the Turning Basin because of the deepening.

Results of the model further indicated that changes to wave heights (increase or decrease) were negligible (less than 10% change) implying that the proposed dredging works is not likely to alter alongshore erosion and sediment transport processes.

7.7.3 Offshore Dumping

The width of the Kenya's continental shelf is relatively narrow extending about 5 – 10km wide with depths dropping to below 200 m in under 4km of the shoreline. The seabed at Mombasa, including the ocean floor near the entrance of Kilindini harbor, is characterized by a slope that gradually becomes steeper. From the proposed offshore dumping site, the seafloor slope reaches 200 m of depth over a distance of 500 m. A depth of over 2000 m is already reached at 10 km from Mombasa. Disposal of the dredged material will be carried out in this area (Figure 8.10), where the sediments will move into deep waters, and prevent a significant increase in the sediment load in the plume. Considering the available alternatives and their possible environmental impacts, offshore disposal of the dredged material is considered to be the most favorable option.

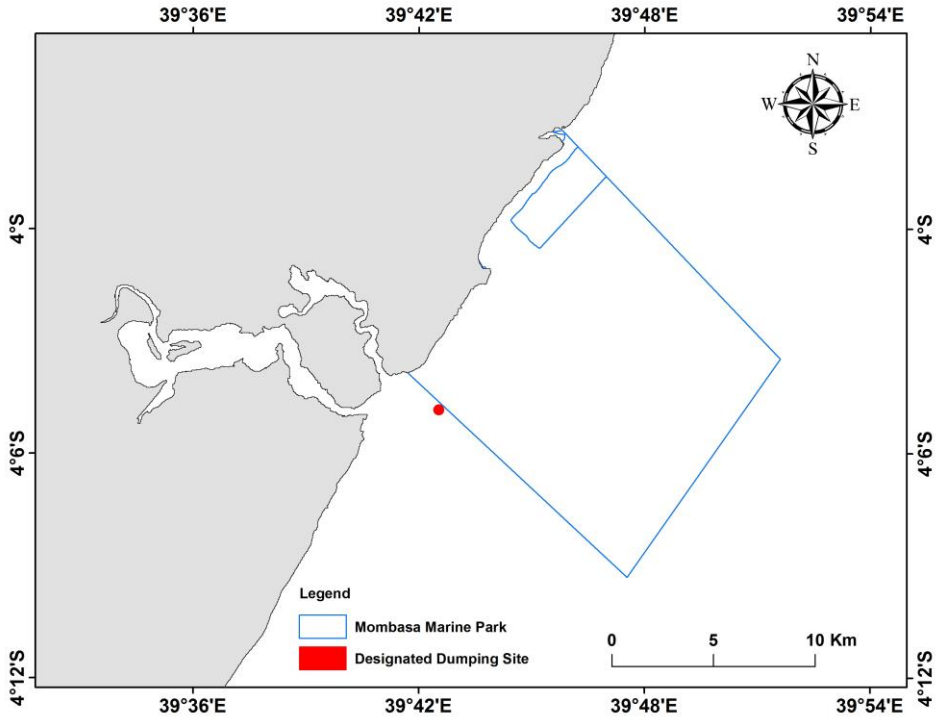


Fig. 7.10: Location of dredge dumping site and boundary of Mombasa Marine Park

7.7.4 Tides

Regarding the impact of the capital dredging works on tidal currents within Kilindini Harbor, the following conclusions were drawn:

- The spring tide current directions are little altered, although there are corresponding small changes to the current speed;
- Although more water is drawn into the channel during flood tide and flushed out during ebb tide as a result of the deepening and widening, this does not necessarily imply faster currents in the channel, given the additional cross section of the channel.

7.8 Anticipated Oceanographic Impacts and Mitigation Measures

7.8.1 Impacts of Dredging

All dredged material has significant physical impact at the point of disposal. This includes local covering of the seabed and local increase in suspended solids. Physical impacts may result from subsequent transport, particularly of the finer fractions, by wave and tidal action and residual current movements. Biological consequences of these physical impacts include smothering of benthic organisms in the dumping area. The significance of the physical and biological impacts largely depends on the physical conditions and natural values locally met.

Numerical modeling results from the applied dispersal models suggest that any sediment plumes resulting from dredging operations will either be dispersed northwards during the South East Monsoon (SEM) season and southwards during the North East Monsoon (NEM) season. The

model further predicts the magnitude and extent of turbidity. The sediment plume dispersion is higher during the SEM as compared to the NEM period (Figure and Figure). The maximum values of TSS concentrations were 50 mg/l during SEM as compared to 20 mg/L during the NEM.

It is important to note that continuous monitoring stations shall be set to monitor turbidity levels at selected locations (especially at the Mombasa Marine Park and nearby sensitive habitats such as coral reefs) during the dredging period in order to adopt the necessary mitigation measures and further validate the model results.

7.8.2 Impacts of Changes in Bathymetry

Currents: Impacts of changes to bathymetry and the increase of the cross-sectional area of the entrance to Kilindini harbor associated with dredging and widening were modelled. Modelling results indicates that sea levels will not be impacted by the dredging and that the tidal water levels will remain almost exactly the same in the harbor. The results also indicate that there will be no change in the current speeds in the harbor or the dredged channel after the dredging. However, there will be a small decrease in current speeds through the entrance of the Harbor associated with the increase in the cross sectional area.

Tides: Potential impacts to tides and shoreline wave action from changes in the bathymetry of Kilindini harbor through dredging and widening of the shipping channel were also modeled. Results showed that changes to wave heights (increase or decrease) were negligible (less than 10% change) as shown in Figure 7.11.

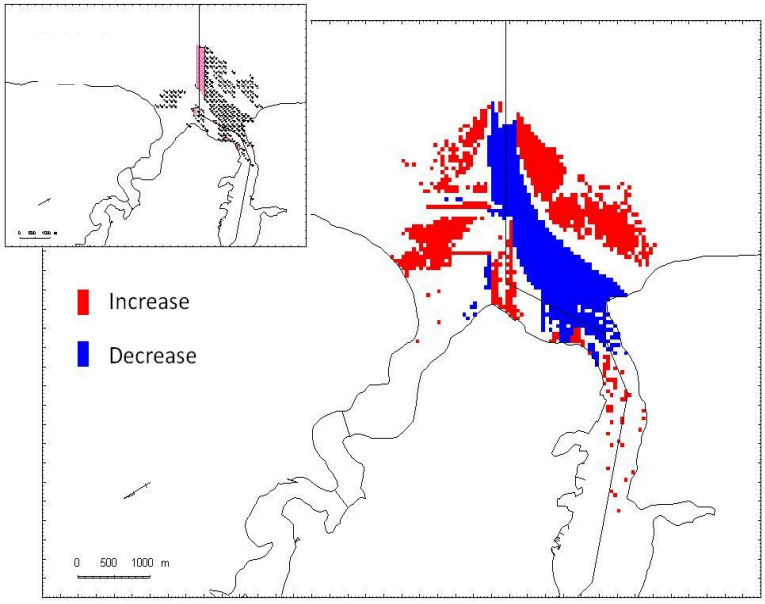


Figure 7.11: Results of wave penetration simulation showing that change of wave heights (increase/decrease) due to dredging is negligible (less than 10%).

It is predicted that spring tide low water levels in Kilindini harbor would be lowered by up to 20 mm as a result of the effect of the channel deepening and widening on tidal propagation, resulting in the increased exposure of intertidal areas at low water on spring tides. Figure 7.12 shows an instantaneous snap short of depth-averaged current velocity vectors generated by numerical simulations during spring tide conditions.

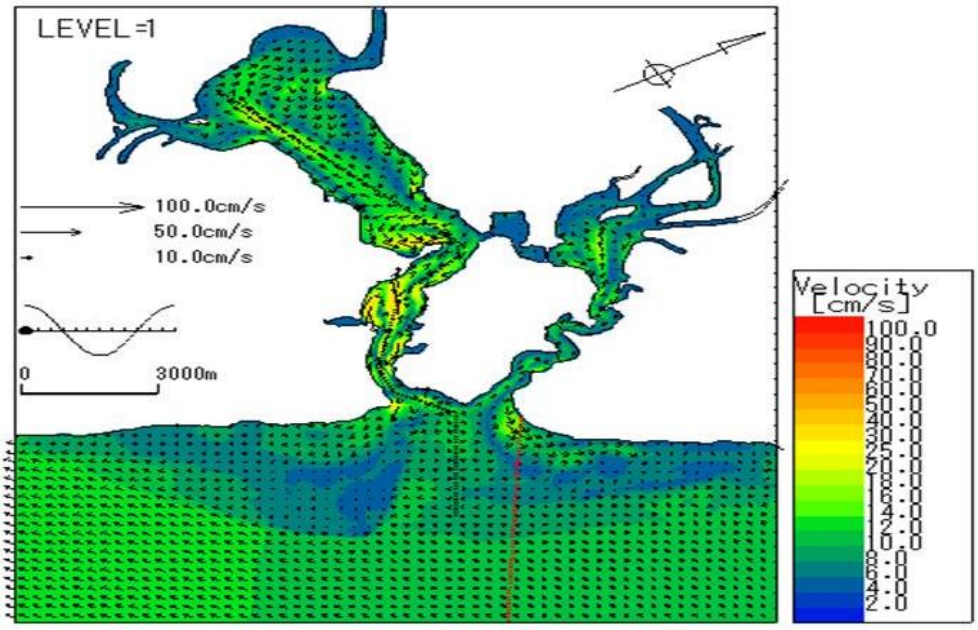


Figure 7.12: Numerical simulation results of created current velocities vector field in Kilindini harbor including the offshore dumping site and the adjacent Tudor creek.

8.0 CHEMICAL ENVIRONMENT

Introduction

Major sources of adverse effects on water and sediments quality during the proposed rehabilitation of berths 1-14 include impacts resulting from rehabilitation of the berths and impacts from construction of new support infrastructure. This part of the ESIA report gives indications of water, sediment and quality as well as baseline noise levels and aims at identifying the potential impact of the proposed rehabilitation on the chemical environment. Proposals are made of how these impacts can be mitigated and EMP matrix provided for monitoring purposes. The purpose of the assessment is to characterise the existing environmental conditions of the project area in order to provide data that will act as reference for the EMP and baseline against which future measurements will be compared to predict the impact of future port expansion operations.

8.1 Methodology for Environmental Characterization

Environmental characterization was undertaken through literature survey of different studies conducted in the project area, and any identified filled through field survey conducted in June 2016.

Water quality survey included three elements:

(a) measurement of general features such as temperature, salinity, pH;
(b) turbidity, as measured by determination of suspended solids; and
(c) eutrophication-related factors measured by dissolved oxygen, biological oxygen demand, nitrogen, phosphorus and chlorine.

Sediments quality survey encompassed:-

a) general feature such as grain size, organic matter,
b) quality related issues i.e. contamination of bottom sediments by toxic or harmful substances such as Pb, Cr, Cd, Co, As, PAH and oils & grease.

The existing condition was analysed in comparison with permissible levels of pollutants where available.

8.2 Samples collection and analysis

The study area was divided into 3 different clusters as follows, based on the arrangement of the existing berths in order to obtain representative samples:

- Cluster 1: Berths 1, 2, 3, 4 and 5;
- Cluster 2: berths 7, 8, 9 and 10 and
- Cluster 3 had berths 11, 12, 13 and 14.

8.2.1 Water Quality Assessment

Water sampling was carried out in the first and the last bertth of each cluster (i.e. cluster 1 was represented by berth 1 and berth 5; cluster 2 had berth 7 and 10 while cluster 3 had berth 11 and 14) [Figure 8.1].

Figure 8.1: Map showing water (B1, B5, B7, B10, B11, B14) and sediments (SED B5, SED B10, SED B13) sampling points

Water samples were collected from the surface, mid water column and bottom water column using a Niskin bottle (Plate 8A).

Sediment samples were collected from the middle berth of each cluster (i.e. berths 5, 10 and 13) while a control site was chosen at the opposite side of the port development. Sediment samples were obtained by using 50 cm sediment corer and the sample divided into top and bottom portions.

Water temperature, pH, conductivity and salinity were taken *in situ* with a handheld multi-parameter meter (YSI Professional Plus) while samples for the analysis of the other parameters were stored appropriately for analysis at the NEMA accredited laboratory (Polucon Laboratories). In the laboratory, water samples were analysed for microbial contamination, Dissolved oxygen (DO), Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Suspended Solids (TSS), suspended organic matter, chlorophyll-a, ammonia, nitrate/nitrite and phosphate and grease and oil in water by using standard methods for water and waste water analysis (Table 9.1).

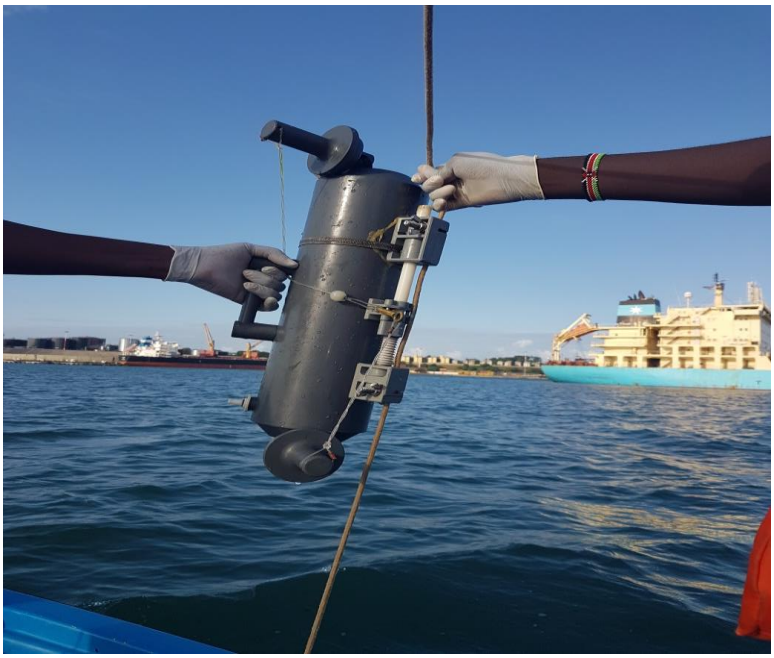


Plate 8A Samples collection using Niskin bottle

Sediment samples were collected from a mid-location in each cluster (SEDB5, SEDB10, SEDB13) by coring using UWITEC gravity corer (equipped with 60 cm length and 6 cm diameter Polyvinyl chloride [PVC] tubes). Sediment samples were split into half (top 30cm and bottom 30 cm), homogenized and subsamples of 500g each of top and bottom sediments collected.

Table 9-1 Water quality analysis methods

Parameter	**Analysis Method**
Water quality	
Temperature, salinity and pH	Hand held YSI Professional Plus meter
Nitrates	APHA Method 4500-NO_3 B
Phosphates	APHA 4500-P F (Automater Ascorbic Acid Reduction Method)
Ammonia	APHA Method 4500-NH_3G B
TSS	USGS- 3765-85 (Solids, residue suspended evaporation 105° C)
Total coliforms	ISO 4832 (Horizontal method for the enumeration of coliforms- Colony count technique)
E.coli	ISO 16649-2
Faecal coliforms	APHA 9222D (Faecal Coliform Membrane Filter Procedure)
BOD	AOAC 973.44 (Incubation Method)
DO	AOAC 973.45 (Titrimetric method)

8.2.2 Sediment Quality Analysis

Sediment samples were analysed for grain size, sediment organic matter, Total PAH, heavy metals (Cd, Pb, Cr, Co and As). Sediment grain distribution was carried out using dry sieving and referenced to Wentworth (1922) grain size classification.

Table 8-2 Sediment quality analysis methods

Sediment quality	
Oil and grease	APHA 5520E (Extraction Method for Sludge Samples)
PAH	APHA 6440B (Liquid-Liquid Extraction Chromatographic Method)
Metals (Pb, Cr, Cd, Co, As)	AOAC 990.08 (Metals in Solid Wastes by ICP)

Currently, no sediment guidelines exist for heavy metals and PAH in Kenya. However, several sediment quality criteria have been developed around the world and were applied in this study. A comparison of the results of this study was made against two levels of risk that have been established for metals and PAH contamination in sediments, Effects Range Low (ERL)/ Lowest Effect Level (LEL) and the Effects Range Low (ERL)/ Severe Effect Level (SEL)(MacDonald et al, 2000) [Table 8-7]. These guidelines have been applied as useful tools for predicting chemical toxicity in screening or assessments of sediment quality. These approaches generally set two threshold levels, one below which effects rarely occur e.g. ERL/LEL], and one above which effects are likely to occur [e.g. ERL/SEL]. Sediment is considered contaminated if either criterion is exceeded. If both criteria are exceeded, the sediment is considered to be severely impacted. If only the Lowest Effect Level criterion is exceeded, the impact is considered moderate.

8.2.3 Air Quality Survey

Air quality assessment was carried at for Cluster 1, 2 and 3 at berths 5, 10 and 12 respectively. Two main elements were assessed:

(a) soot and dust, measured by particulate matter (PM), and

(b) concentration of sulfur oxides (SO_x) nitrogen oxides (NO_x), carbon monoxide (CO) and carbon dioxide (CO_2).

A direct reading air quality analyzer was used for monitoring gaseous pollutants whereas a particle counter was used to measure airborne particulates.

8.2.4 Noise Level Survey

Noise level was determined for clusters 1,2 and 3 at berths No 5, 10 and 12 using a Sound Level Meter model number TES-1358C. Equivalent noise level (L_{eq}), maximum sound pressure level (L_{max}) and minimum sound pressure level (L_{min}) parameters were recorded to quantify ambient noise levels during at the time of measurement.

The obtained noise and air quality baseline levels were compared with area-specific noise guidelines by World Bank and NEMA (air quality and noise pollution guidelines).

8.3 Results and Discussion

8.3.1 Water Quality

Temperature, salinity, conductivity and pH was generally similar in all the sampling sites and along the water column with ranges of 26.9-27.5 °C, 28-34 PSU, 50.9-51.8 ms/s and 7.93-8.07 respectively (Table 8-3). Physicochemical parameters were within the normal levels expect for berth 5 which had relatively lower salinity which could have resulted from surface runoff during sampling period.

Table 8-3. Temperature pH, Conductivity and Salinity at the project site and the control.

CLUSTERS	BERTHS	Sample	Temperature (°C)	pH	Conductivity (ms/cm)	Salinity (PSU)
Cluster 1	Berth 1	Surface	27.4	7.99	50.9	34
	Berth 1	Mid	27.2	7.99	51.6	33
	Berth 1	Bottom	27.0	7.98	51.8	34
	Berth 5	Surface	27.5	8.07	51.6	28
	Berth 5	Mid	27.1	8.00	51.6	29
	Berth 5	Bottom	27.0	7.96	51.3	28
Cluster 2	Berth 7	Surface	27.3	7.95	51.6	32
	Berth 7	Mid	27.0	7.93	51.6	31
	Berth 7	Bottom	27.1	7.96	51.4	31
	Berth 10	Surface	27.4	7.99	51.7	34
	Berth 10	Mid	27.2	7.99	51.4	33
	Berth 10	Bottom	27.4	8.05	51.5	32
Cluster 3	Berth 11	Surface	27.5	7.98	51.5	32
	Berth 11	Mid	27.4	7.99	51.1	33
	Berth 11	Bottom	27.3	7.96	51.6	33
	Berth 14	Surface	27.3	8.01	51.5	34
	Berth 14	Mid	27.2	7.98	51.5	33
	Berth 14	Bottom	27.2	7.99	51.6	32
Control	Control	Surface	27.3	8.02	51.3	33
	Control	Mid	26.9	8.00	51.7	33
	Control	Bottom	27.1	8.02	51.6	32

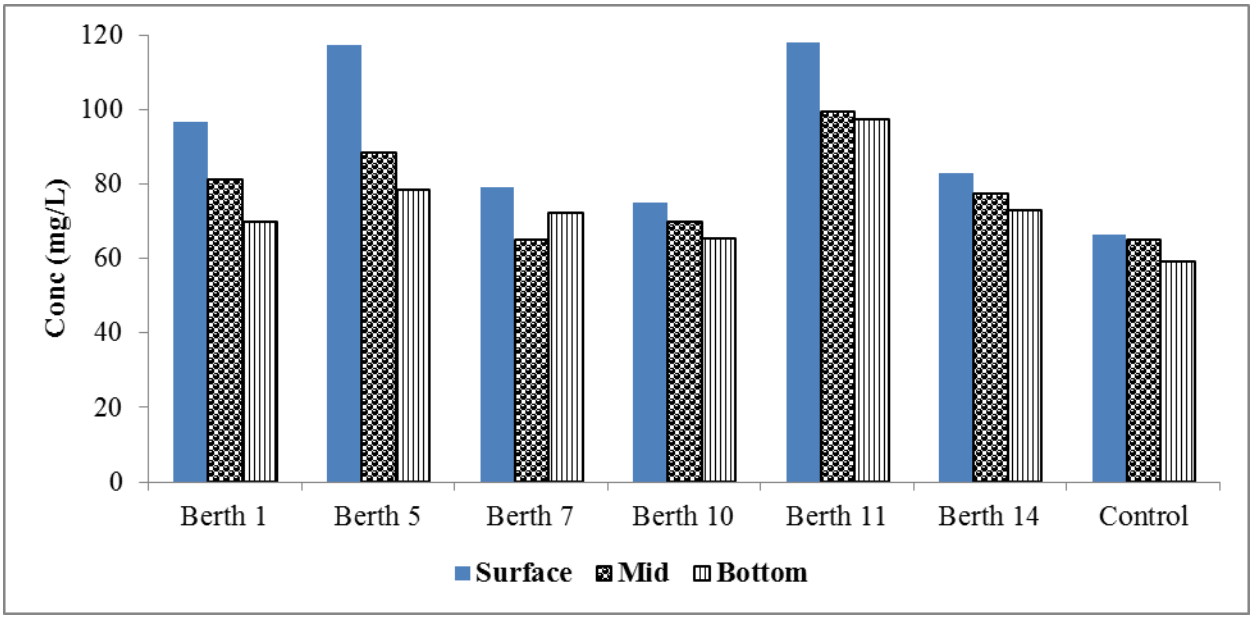


Figure 8.2. TSS concentrations (mg/L) in water column (surface, mid and bottom) in the proposed project area and the control.

TSS concentrations were higher at the surface (range: 66.2-117.9 mg/L) and reduced towards the bottom (range: 97.3-59.1 mg/L) [Figure 8.2]. This could have been caused by high plankton biomass in the surface.

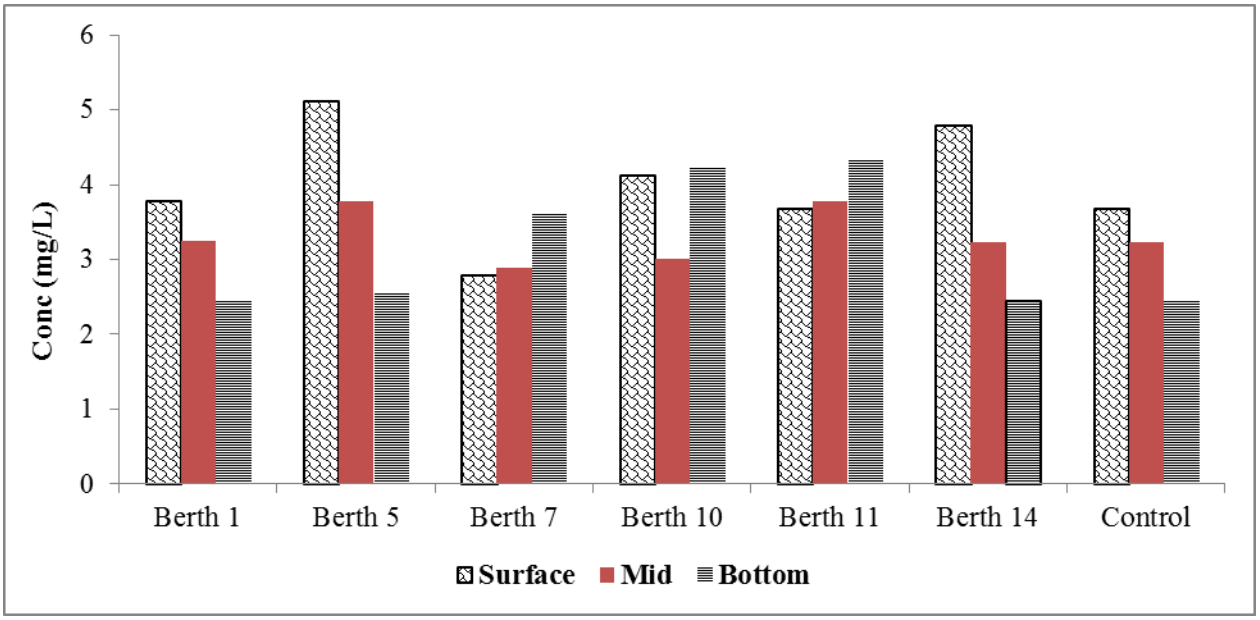


Figure 8.3. Organic matter concentrations (mg/L) in water column (surface, mid and bottom) in the proposed project area and the control

The organic matter concentrations in the water columns ranged from 2.44 to5.11 mg/L and showed a decrease with depth in cluster 1 and control (Figure 8.3). This shows that plankton was a major component of TSS. Cluster 2 had higher Organic Matter (OM) concentration in the bottom compared to surface suggesting that this area experiences occasional resuspension of bottom sediment.

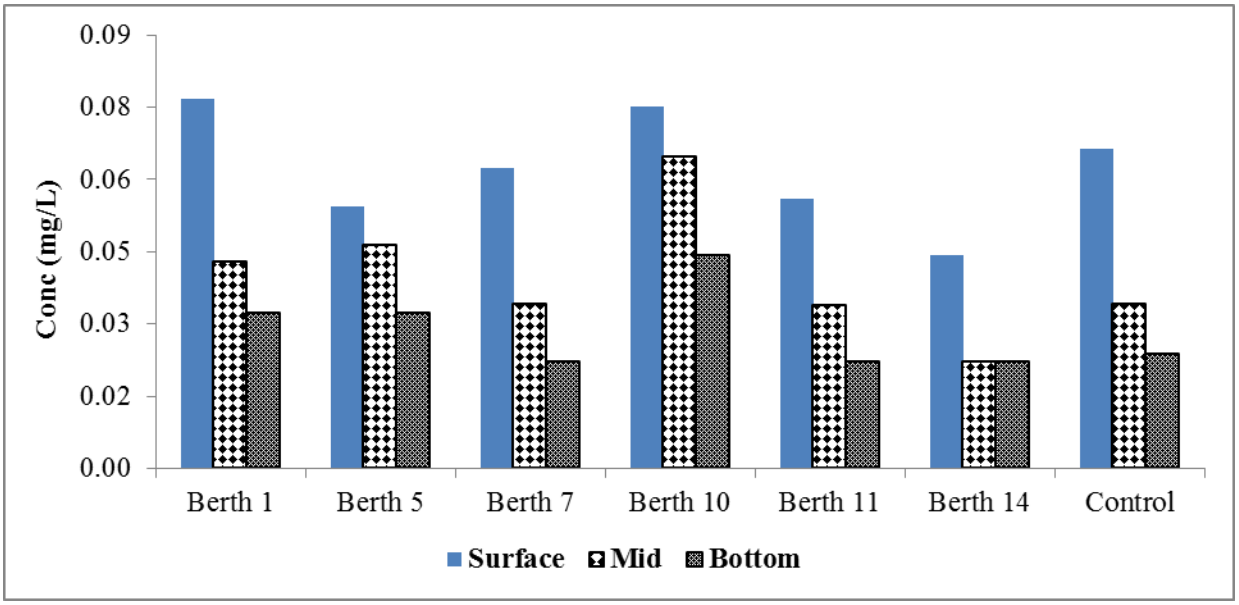


Figure 8.4 Chl-*a* Concentrations (mg/L) in water column (surface, mid and bottom) in the proposed project area and the control

Chl-a concentration ranged between 0.02-0.08 mg/L and had a well-defined trend (reduction with depth) [Figure 8.4]. This reduction could be attributed to reduction of plankton biomass with depth resulting from their preference for photic zone.

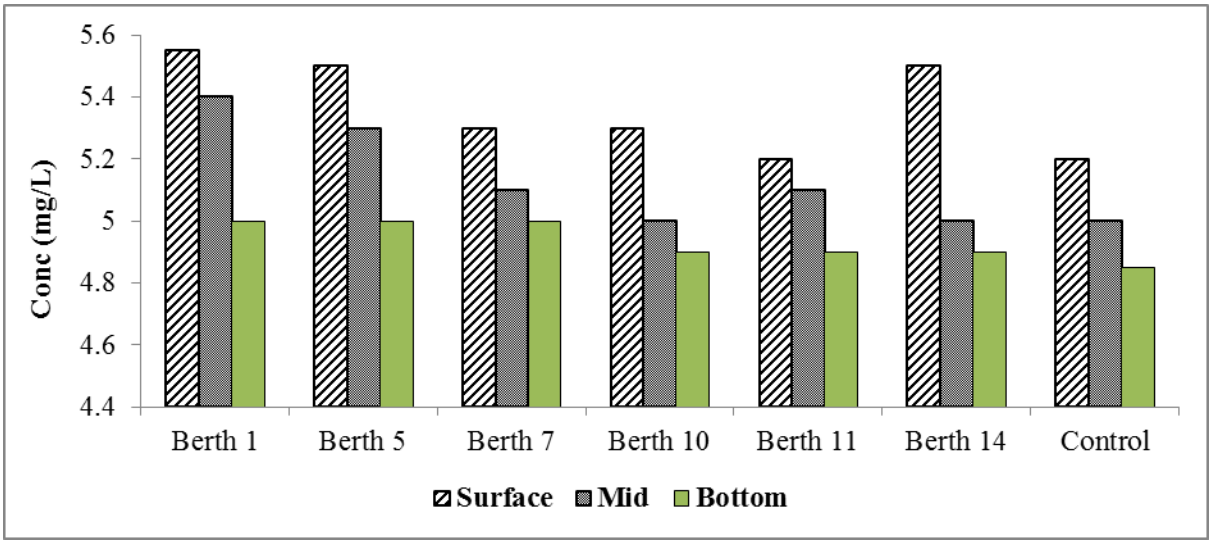


Figure 8.5 DO Concentrations (mg/L) in water column (surface, mid and bottom) in the proposed project area and the control

DO concentration ranged between 5.0-5.6 mg/L and similarly showed a well-defined trend (reduction with depth) [Figure 8.5]. This reduction could be attributed to reduction of plankton

biomass with depth and the associated reduction in photosynthetic inputs of DO. Additionally, DO utilization by heterotrophic biota and OM remineralization may have also resulted to lower concentration of DO in the bottom waters. DO utilization increase with depth is further confirmed BOD (range 2.96-7.2 mg/L) that showed a clear increase with depth.

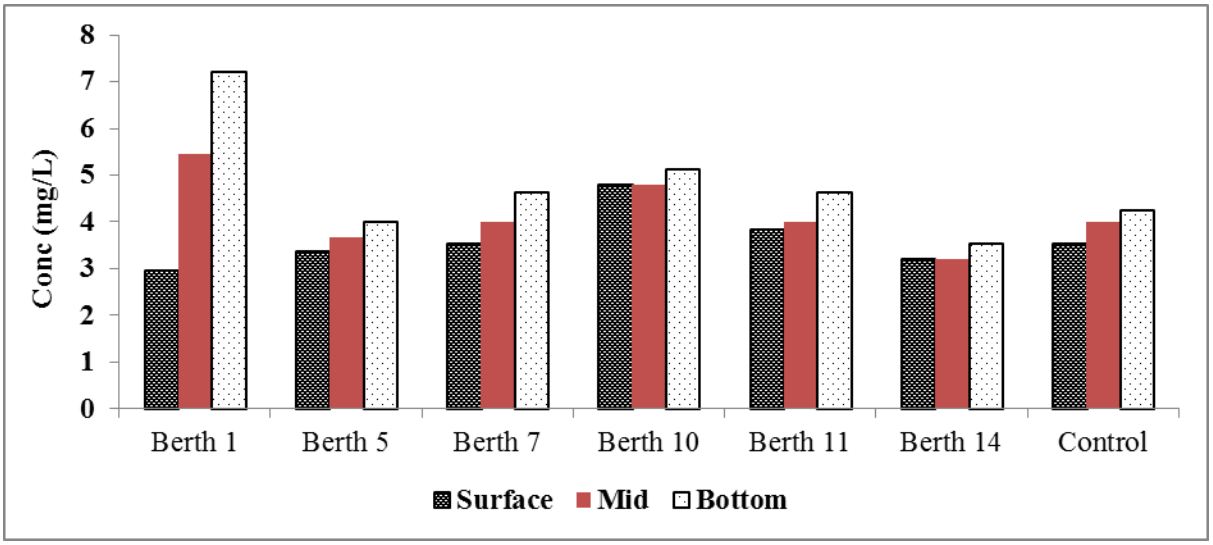


Figure 8.6 BOD Concentrations (mg/L) in water column (surface, mid and bottom) in the proposed project area and the control

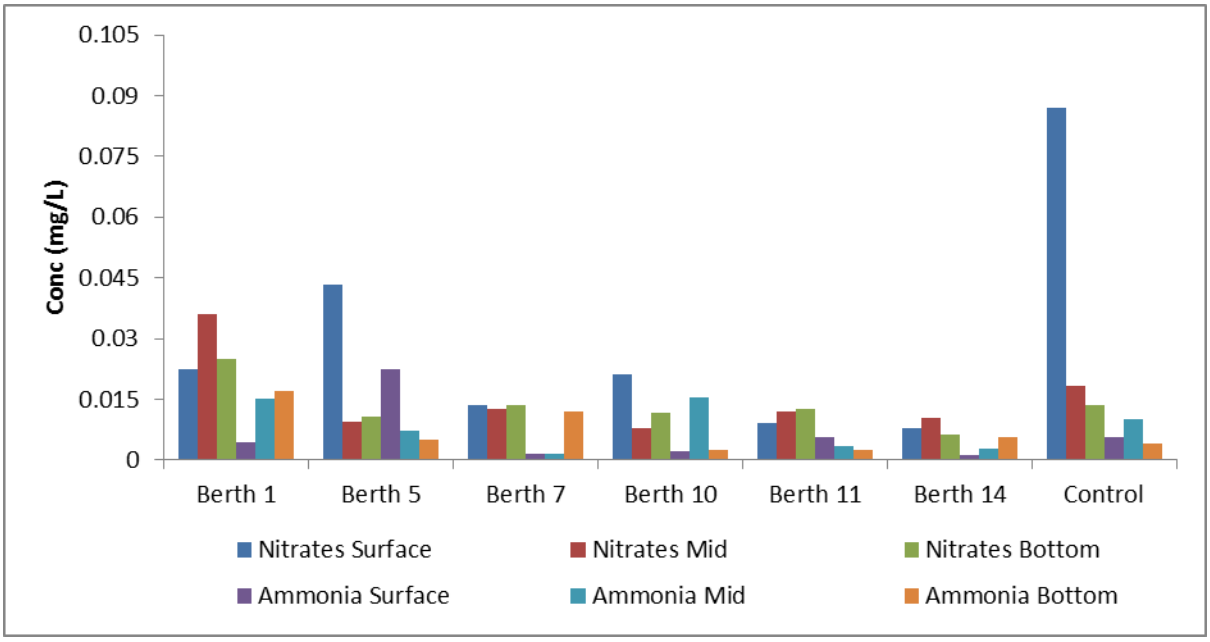


Figure 8.7. Nitrates and Ammonia concentrations (mg/L) in water column (surface, mid and bottom) in the proposed project area and the control

The concentrations of nitrates ranged from 0.001-0.029 mg/L while the concentrations of Ammonia ranged from 0.001-0.023 mg/L (Figure 9.7).Nitrates and ammonium levels were within the normal range except for berth 5 which had relatively higher levels resulting from surface runoff and the

control site that had extremely higher levels of nitrates which maybe of the river source or from extensive nitrification process in the neighbouring mangroves.

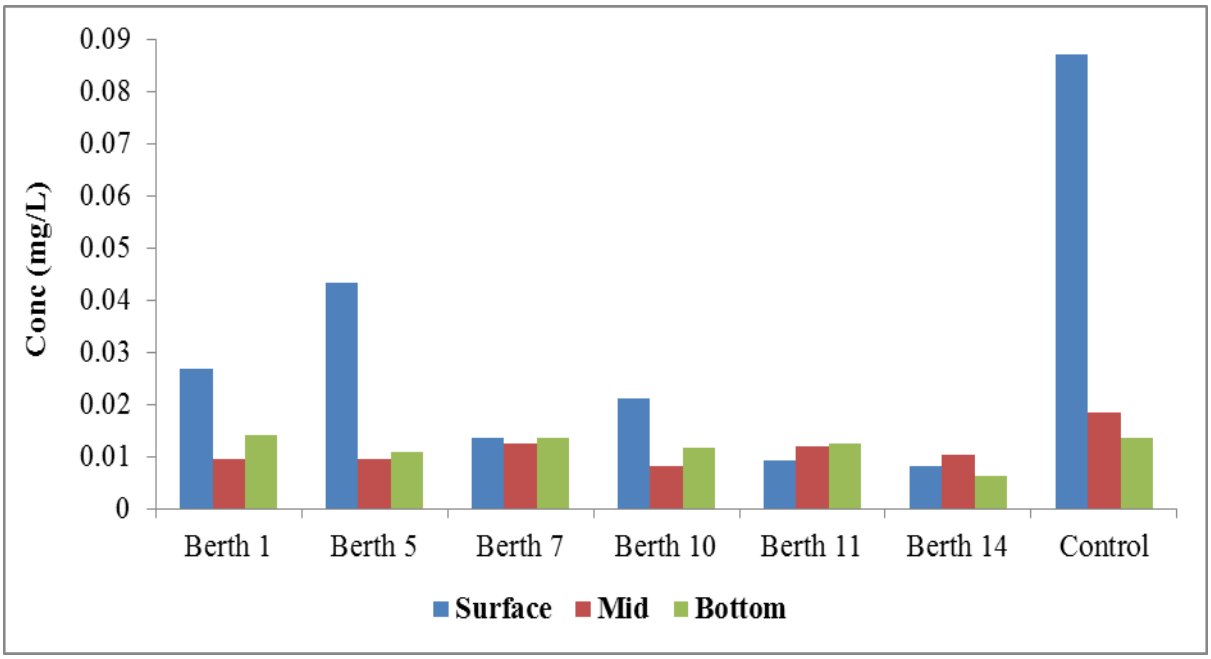


Figure 8.8. Phosphates concentrations (mg/L) in water column (surface, mid and bottom) in the proposed project area and the control.

The ranges in the proposed project area were similar with those in the control showing that the project site and the control were both receiving nutrients from the same source. The surface water had generally higher phosphates concentrations with a range of 0.006-0.087 mg/L (Figure 8.8).

Table 8-4: Microbial contamination in the surface water samples in the proposed project area and the control.

Parameter	Sampling Stations						
	Berth 1	Berth 5	Berth 7	Berth 10	Berth 11	Berth 14	Control
Total coliform count (cfu/ml)	**118**	2330	228	167	167	46	34
Escheria coli (cfu/ ml)	**Not detected**	81	8	2	2	2	Not detected
Faecal coliform (cfu/10 ml)	**Not detected**	600	46	6	8	10	Not detected

Microbial counts were detected in all the three clusters including the control. Only total coliform were reported in berth 1 while total coliforms, faecal coliform bacteria and *Escheria coli* were reported in all the other berths including the control (Table 8-4). The presence of these indicator species shows that the study sites were receiving contaminated wastewater.

8.3.2 Sediment Quality

Top sediments had a generally higher organic matter (407.5-179.3mg/Kg) compared to the bottom sediment (392.6-127.5mg/Kg) [Figure 8.9]. Cluster 1 and control had higher organic matter compared to the other project areas.

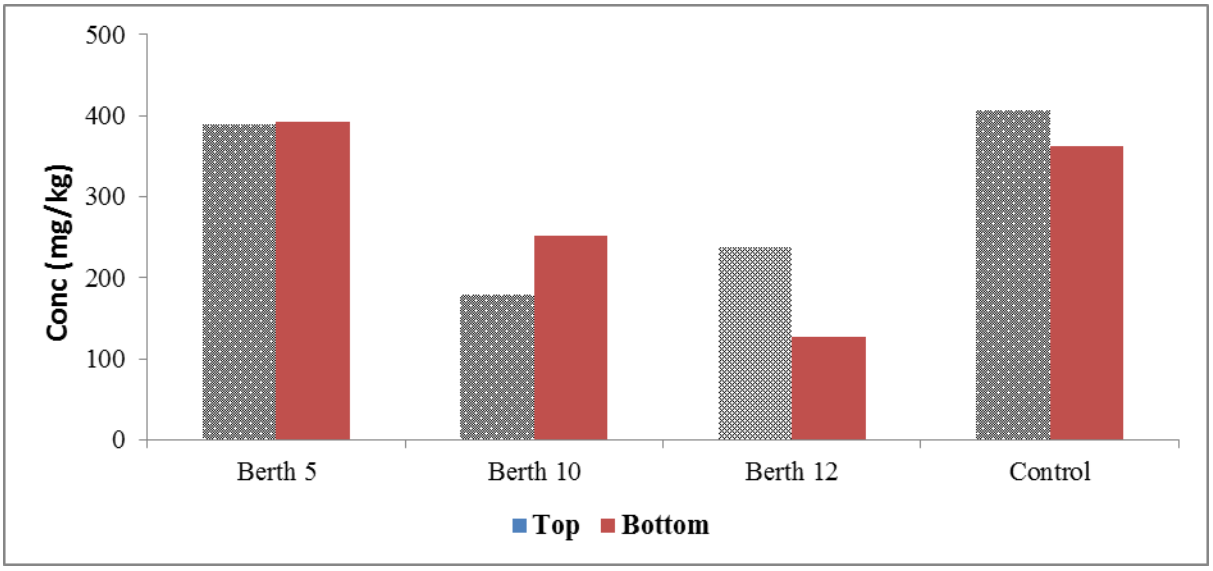


Figure 8.9 Sediment organic matter (mg/ Kg dw) surface and bottom sediment in the proposed project area and the control

There was a variation in the amounts of total suspended sediments (TSS) in and around the proposed project site. The TSS varied from 70 mg/l (lowest) to 104.9 mg/l (highest) as shown in Figure 8.10 below; -

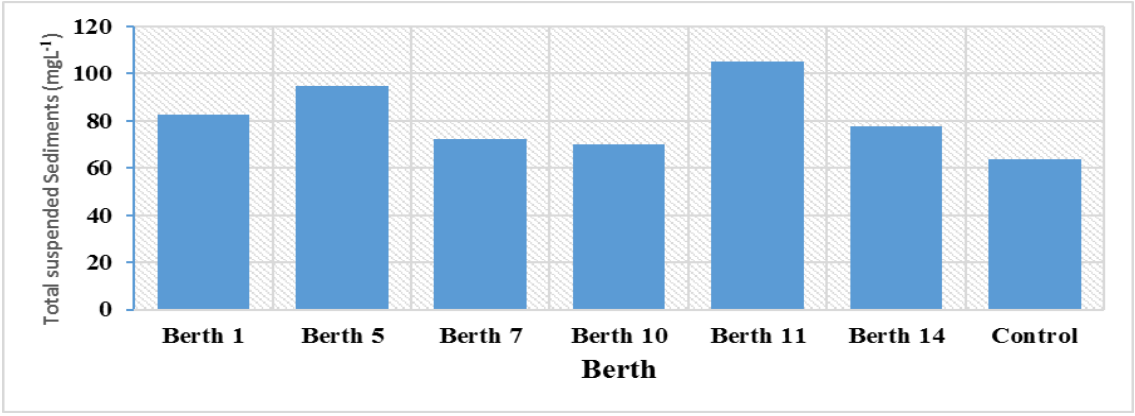


Figure 8.10: Showing the variation in total suspended sediment (TSS) in selected berths in the project site.

From the grain size analysis (see Figure below) of grab sediment samples, the sediments in and around Berth 1-14 can be classified as fine to coarse grained sand.

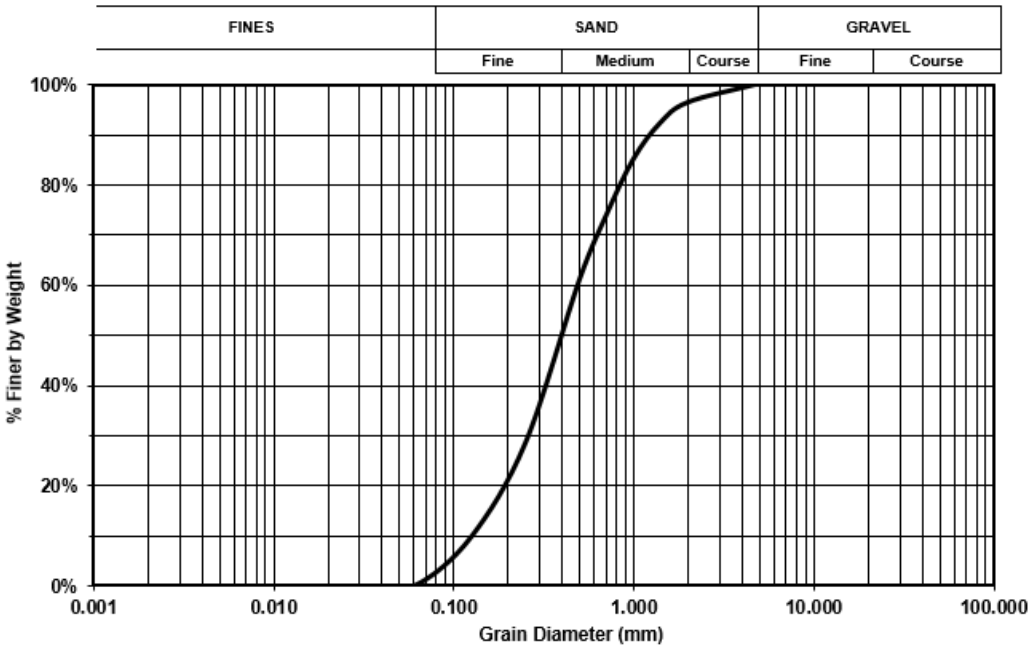


Figure 8.11: Grain size analysis for sediments collected at the Kilindini Channel (Berth 1-14)

Table 8-5. Sediments grain size classification for Clusters 1, 2, 3 and control site.

Clusters	Section	% Sand	% Silt	Classification
1	**Top**	75.70	24.30	loamy sand
	Bottom	97.22	2.78	sand
2	**Top**	81.73	18.27	loamy sand
	Bottom	81.00	19.00	loamy sand
3	**Top**	79.18	20.82	loamy sand
	Bottom	71.66	28.34	loamy sand
Control	**Top**	77.96	22.04	loamy sand
	Bottom	95.99	4.01	sand

All the surface sediments had fine grain size (loamy sand) while the bottom sediment s were either loamy sand or sand (Table 8-5). The fine surface sediment is capable of adsorbing any contaminants released during the rehabilitation and they also have the ability to be easily re-suspended to cause a turbidity plume.

Table 8-6. Heavy metals (mg/Kg dw), PAH (mg/kg dw) and oil and grease content (% wt ww) in surface and bottom sediments from the proposed project area and the control.

	Control		Cluster 1		Cluster 2		Cluster 3	
Parameter	**Surface**	**Bottom**	**Surface**	**Bottom**	**Surface**	**Bottom**	**Surface**	**Bottom**
Pb	<0.04	51.00	<0.04	<0.04	<0.04	<0.04	28.00	30.50
Cr	<0.02	<0.02	<0.02	<0.02	<0.02	65.00	42338.00	<0.02
Cd	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Co	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	342.5	<0.02
As	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Total PAH	<0.05	2.14	0.78	0.37	1.04	2.29	37.80	4.22
Oil and grease	NIL	NIL	6.42	NIL	17.00	20.10	4.81	11.66

Table 8-7: Comparison of heavy metals (mg/Kg dw) to the result of related studies

SAMPLE	Cd	Pb	Cr	Co	Hg	As	Reference
This study	<0.01	<0.04-51.00	<0.02-42338.00	<0.02-342.50	<0.001	<0.01	
Laptev, Russia	0.03-1.06	16-22	-	-	-	-	Nolting in press
Pattani Bay, Thailand	0.01-0.04	79-97	-	-	-	-	Evaarts et al., 1994
Coastal Zone, Kenya	1.1-8.5	0.13-0.56	-	-	-	-	Evaarts and Nieuwenhuize, (1995)
Gazi Bay/	0.027		1.576	-	-	-	Okuku et al., 2010
Chale	BDL		9.576	-	-	-	Okuku et al., 2010
LEL	0.6	31.0	26.0		0.15	6.0	Persuad *et al.* (1992)
SEL	9.0	110.0	110.0		1.3	33.0	Persuad *et al.* (1992)

Heavy metals were reported in trace levels except for Cr in berth 10 bottom (65 mg/kg) and berths 12 top (42338 mg/L), Co in cluster 3 surface sediment (342.5 mg/kg) and Pb in control bottom (51 mg/L) [Table 8-6] and Cluster 3 surface and bottom sediments. The results obtained from the study shows that heavy metals concentrations are relatively higher compared to areas with limited anthropogenic activities (Gazi and Chale) but relatively lower compared to other harbours in the world (Table 8-7).

All the proposed project sites had Cd, Pb Hg and As in concentrations lower than LEL and are therefore considered non-contaminated by these metals (i.e. are present at levels that may not cause harm to aquatic environment) [Table 8.6]. All the project sites had Cr in concentrations lower than LEL and are therefore considered non-contaminated by Cr apart from Cluster 3 that had concentrations higher than SEL and can be considered as extremely contamination (i.e. can cause significantly affect marine biota) [Table 8.6].

Oil and grease were reported in all the clusters in low levels which are indicative of slight oil contamination. The total PAH ranged between <0.05- 37.8 mg/L (Table 8.5) which were below the sediment quality guidelines (ERL 4000 and ERM 35000 mg/Kg) [Table 8.6]. Generally, sediments in the proposed port area had PAH below the threshold levels where effects rarely occur (LEL) thus no PAH contamination is anticipated in the proposed project area.

Plate 8B: Dust generation during offloading of bulk cargo is one of the sources of air pollution

Plate 8C: equipment for measuring baseline aerosol quality indicators

8.3.3 Results of Air Quality and Noise Level Assessment

Concentration of Priority Air Pollutants in the project area compared to Ambient Air Quality Tolerance Limits as contained in 1st Schedule of EMCA (Air Quality Regulations) and WHO guidelines are as presented in Table 8-8 below:

Table 8-8: Concentration of Priority Air Pollutants

Station	PM 2.5 (µg/m³)	PM_{10} (µg/m³)	CO (mg/m³)	CO_2 (mg/m³)	NO_x (µg/m³)	SO_2 (µg/m³)	CxHy (µg/m³)
Cluster 1	1	2	0.0	432	0.0	0.0	0.0
Cluster 2	198	396	0.0	443	0.0	0.0	0.0
Cluster 3	14	7	0.0	401	0.0	0.0	0.0

EMCA standards (legal notice 34 1st Schedule)- 24hours	75	150			150	125	
WHO guidelines (1 hr average)		50			500	200	

Priority air pollutant levels were within the permissible levels except for PM_{10} for berth 10 that was above the recommended limit allowed by national law and the World Health Organization standards.

Table 8-9 Noise levels in the project area comapred to permissible levels of Kenya Noise regulations

Area monitored	L_{eq}	L_{max}	L_{min}	L_5	L_{50}	L_{95}
Berth 5	77.5	92.7	71.8	80.8	76.8	74.8
Berth 10	64.3	82.8	48.8	67.6	58.6	52.4
Berth 12	65.6	84.7	54.7	69.6	63.2	58.4
EMCA Noise standards	60					
World Bank	70					

The results of noise levels compared with exposure limits as contained in 1st Schedule of EMCA (Noise Regulations) and WHO guidelines are as presented in Table 8-9 above. The noise average L_{eq} value for berths 5, 10 and 12 were above the stipulated EMCA level of 60dBA for commercial area but only berth 5 exceeded the World Bank guideline of 70 dBA. It is important to note that the Kenyan Government has set a noise standard limit at 90 dBA for 8 hours as the Occupational Exposure Level (OEL), which workers can continually be exposed to without developing occupational hearing loss in industries (occupational deafness). The recorded baseline noise value is likely to increase during construction phase of the project and should only be used for monitoring (EMP) while mitigation measures should be put in place to check the noise levels.

8.4 Potential Chemical Impacts and Mitigation Measures

The assessment of the impacts of the proposed port rehabilitation on chemical environment proceeded through a process that considered four key elements: prediction of the magnitude of impacts on the environment; evaluation of significance of the impacts taking into account the sensitivity of the environment; development of mitigation measures to prevent reduce, or manage the impacts, and development of Environmental Management Plan (EMP) defining roles and responsibilities for the implementation agencies to assess the residual significant impacts after the application of mitigation measures. The identified impacts and mitigation measure include:

8.4.1 Water pollution resulting from dredging activities in front of the existing berths

Dredging works would be undertaken in front of the existing berths to increase the depth in order to accommodate larger ships. The main environmental effects associated with dredging are the deterioration of water quality due to increase in suspended sediments and the associated turbidity and mobilization of toxic or harmful substances.

Suspended matter concentration is expected to increase during the dredging process from sediments excavation at the bed, loss of material during transport to the surface, overflow from the dredger whilst loading and loss of material from the dredger and/or pipelines during transport. Turbidity has an impact of reducing sunlight penetration thus affecting photosynthesis.
Dredging may also re-suspend sediments which may result in the release of toxic substances into the water column. However, this is only expected for Cluster 3 which was found to be contaminated with Chromium (Cr). The other project sites had low levels of toxic substances that may not have an impact on the ecosystem.
Extent: Local
Duration: Medium-term (through re-suspension of sediments)
Magnitude: Moderate
Significance: Moderate
Significance with mitigation measures: Low

Proposed mitigation measures

The adverse impacts of dredging on water quality could be minimized through

1. Selection of appropriate dredging equipment
2. Careful transportation to, and disposal of dredged material to the deposition area ((preferably on landfills). Effective barriers must be provided if the land fill is close to the sea.
3. Disposal of sediments from cluster 3 should strictly be done in landfills due to the observed contamination with Cr. The contaminated dredge spoil must be placed in an impermeable confined disposal facility- impermeable liners) to prevent the return of the sediments to the ocean especially during rainy periods.
4. Use of silt curtains (silt screens) in the dredging area to ensure that suspended sediments at burrow sites are contained. The silt curtains should properly be deployment at burrow pit, ensuring that lower end of 'skirt' is resting upon the seafloor, and that top of the 'skirt' is always above the surface of the water.
5. Sediment barriers or sediment curtains must have characteristics that provide maximum efficiency in any possible local conditions (waves, currents, wind speed, depth, etc.)
6. Reduction of the time over which the dredging operation is to be carried out in order to minimum the duration for re-suspension of sediments.
7. Confining dredging and sediment transport operations to calmer sea states to reduce resuspension of sediments.
8. Carryout continuous monitoring of environmental parameters to: i) measure the changes in turbidity; ii) compare such changes to those predicted; and; iii) identify whether, when or where remedial actions are required.

8.4.2 Water and sediment pollution resulting from the storage and handling of chemical products during construction activities

The storage and handling of chemical products such as fuel, lubricants, anticorrosion products, cement and paint could result in localized pollution which may enter the ocean during rainy seasons with subsequent impacts on water, sediment and biota quality. The possible impacts may arise from:

1) spills during the storage of chemical products; 2) spills during the transport of chemical products; 3) spills during the maintenance/repair of vehicles and machinery and 4) spills during the application of paint and anti-corrosion products.

Extent: Local
Duration: Mid-term (the contamination maybe sporadically or of short-duration, but the construction works will continue for entire project period)
Magnitude: Moderate
Significance: Moderate
Significance with mitigation: Low

Proposed mitigation measures

1. Have in place an effective preventive maintenance programme for equipment and vehicles in order to avoid breakdowns and the subsequent spillage of oil and fuel.
2. Use of qualified and experienced staff for maintenance and operation exercise is a pre-cautionary approach of dealing with accidents and spills.
3. Maintenance of equipment and vehicles to be carried out in designated areas and on impermeable surface with adequate drainage and reception facilities for any oil spills.
4. In cases of hydrocarbon spills, the spill must be controlled and absorbed by absorbent material. The absorbent material should then be placed in the open air to allow the hydrocarbons to evaporate.
5. Storage areas for fuel and other chemicals must be located at least 50 m from the sea. Such storage areas must be provided with impermeable containment basins that retain and permit the collection of possible spills. The areas should have appropriate signs in English and Kiswahili showing the contents.
6. Employees working with chemical products must receive appropriate instructions and personal protection equipment (such as gloves, masks, uniforms).
7. Used oil must be stored in sealed drums, and must not be mixed with other substances such as petrol and solvents. Such used oil should promptly be delivered to the recycling firms.
8. Oil spill control measures should be adopted as per the National Oil Spill Response Contingency plan. Prompt reporting systems would be key to prevention of oil dispersal.
9. Marine environmental monitoring as per environmental monitoring programme should be carried out at the recommended points and periods and compared with baseline levels during entire rehabilitation period.

8.4.3 Water pollution resulting from domestic and non-hazardous construction waste produced during construction activities

During the construction stage significant amount of construction and domestic wastes will be produced including packaging waste, empty drums, scrap metal, old tyres, building rubble etc. If not managed correctly, this kind of waste may contaminate the adjacent water through surface runoff.

Additionally, there will be a significant increase in the number or workers during the construction phase that may produce additional waste if adequate sanitation facilities are not provided.

Extent: Local
Duration: Mid-term (the contamination maybe sporadic or of short-duration, but the construction works will continue for the entire project period)
Magnitude: Low
Significance: Moderate
Significance with mitigation: Low

Proposed mitigation measures

1. All employees involved in the work must be subject on-site training with regards to waste management procedures
2. The working areas must be kept clean and waste disposed appropriately in designated bins.
3. Concrete and cement waste should be re-used whenever possible to reduce the amount of waste.
4. Periodical clean-up of floating wastes (marine debris) should be carried out to ensure port water quality.
5. Rubble must be reduced to small pieces, placed in appropriate waste disposal areas and covered with topsoil.
6. Scrap metal must be removed from the area and promptly delivered to the recycling firms for reuse.
7. Waste containers with lids must be placed in strategic locations in working areas. They must be in sufficient number and have sufficient capacity for the estimated amount of waste to be produced. Biodegradable and non-biodegradable wastes must be placed in separate waste bins which are labelled accordingly.
8. Discharge of waste into sea shall remain prohibited and adequate wastewater management facilities including biodigesters should be provided.
9. NEMA regulations on effluents standards discharged from waterfront industries and provision of sanitary treatment facilities are indispensable for reducing pollutants from hinterlands and in ensuring port environment protection.
10. Careful port design should be carried out, focusing on the possibility of reducing water stagnation within the yards and other open areas, thus reducing water quality issues related to localized eutrophication.
11. Marine environmental monitoring as per environmental monitoring programme should be carried out at the recommended periods and compared with baseline levels during entire rehabilitation period.

8.4.4. Water pollution resulting from deposition of dust during the civil works

Increase in water turbidity due to deposition of dust may impact negatively on water quality and primary productivity. However, the occurrence of such impacts has low probability and does not present any major environmental hazard.

Extent: Local

Duration: Medium term (although the emission of dust and their permanence in the bay may occur in short-term, the construction activities will occur for the entire period)
Magnitude: Low
Significance: Low
Significance with mitigation measures: low

Proposed mitigation measures

The proposed mitigation measures aimed at reducing dust and preventing its spread through space are as follows:

- Wetting the dusty areas by sprinkling water using water bowsers twice a day to prevent generation of fugitive dust.
- Covering the disposal sites for the construction materials (like sand, cement and stone) with zinc sheets or other opaque material.
- Cover the places where the concrete will be prepared with zinc sheets or other opaque material.
- Marine environmental monitoring as per environmental monitoring programme should be carried out at the recommended periods and compared with baseline levels during entire rehabilitation period.

8.4.5 Potential Impact on air quality resulting from port operations

Sources of air pollution at the project site include emissions from ships as they enter the port area and while docked at the berths, as well as emissions from container handling equipment and haulage trucks. Motor vehicles and trucks also generate pollutants in the project area, both from exhaust emissions and dust from unpaved roads. These sources may result in SO_2, NOx, CO, VOC and particulate emissions and may have a negative impact on ambient air quality with possibilities of exceeding ambient standards. Significant air quality degradation also occurs during offloading of bulk cargo due to poor containment.
Extent of Impact: Local
Duration: Long-term
Magnitude: Low
Significance: Moderate
Significance with mitigation: Low

Proposed Mitigation measures

- Use of specialized ship loaders/ off-loaders, wagon tippler, covered conveyors and rapid loading system through silos could greatly reduce air pollution.
- Prohibit use of heavy diesel oil as fuel and promotion of the use of ultra-low sulphur diesel fuel could reduce pollutants emissions.
- Dust suppression measures (such as use of covers, screens, enclosures, sprinkling water and other similar methods) should be put in place at loading/unloading points, wagon tippler complex, transfer points, stockyard, rapid loading system and in internal roads.
- Truck speed regulation and prohibition of trucks movement outside the designated routes.
- Periodic cleaning of cargo spills, equipment and transport vehicles to remove accumulated dirt

- Environmental awareness and training should be carried out to all personnel involved in port operations
- Regulation and proper detection of emissions from ships are effective means to reduce emission of pollutants.
- Monitoring of air quality is recommended to ensure adherence to acceptable levels of emissions.

8.4.6 Impact on air quality resulting from Construction works

Most civil construction activities generate dust and emit particulates into the atmosphere during vehicle dust entrainment, demolition, excavation, ground levelling, etc. Presence of potentially dusty construction materials in the project site is also a potential source of air pollutants especially dust.

In most cases the dust is relatively coarse, but may also include fine respirable particles (PM_{10}). The coarse particulates generally settle relatively close to the emission source while finer particulates may be transported further from the point of release by wind. The resulting impact is however expected to be low, limited to the project site and will occur during the construction and at time of strong winds.

In addition, exhaust emissions from construction vehicles and equipment typically include particulates (including PM_{10}), carbon monoxide (CO), nitrogen oxides (NOx), and sulphur dioxide (SO_2).

Extent: on-Site

Duration short-term:

Magnitude: low

Significance without mitigation: Medium

Significance with mitigation: Low

Proposed Mitigation Measures:

- Dusty construction materials carried in vehicles should be properly covered.
- Loading and unloading of bulk construction materials should be in areas protected from the wind and carried out in calmer conditions.
- Access to construction site should be limited to construction vehicles only.
- Vehicle speed restrictions should be adhered to in the construction site.
- High moisture content on exposed surface and roads should be maintained by spraying with water.
- Maintenance programme for construction vehicles should be adhered to ensure optimum performance and reduced emissions.

8.4.7 Impact on air quality resulting from dredging in front of existing berths

During dredging, exhaust emissions from dredger exhaust which includes: particulates (including PM_{10}), carbon monoxide (CO), nitrogen oxides (NO_x), sulphur dioxide (SO_2) are expected to be the main air pollutants. However, ambient concentrations of SO_2, NO_x, CO and particulates resulting from dredger exhaust emissions are expected to be low and to comply with ambient standards on

and off the site. The resulting impact is expected to be very low, limited to the project area and will occur only during the dredging activities.
Extent: on-Site
Duration mid-term:
Magnitude: low
Significance without mitigation: Insignificant
Significance with mitigation: not significant

Proposed Mitigation measures

- Prohibition of the use of heavy diesel oil as fuel and promotion of the use of ultra-low sulphur diesel fuel could reduce pollutants emissions.
- Regulation and proper detection of emissions from dredgers is effective means to reduce emission of pollutants.
- Monitoring of air quality is recommended to ensure acceptable levels of emissions.

8.4.8 Noise resulting from Construction works

Potential sources of noise and vibration during the construction and operation of the proposed renovation include: construction noise from activities on site from additional traffic generated during the construction phase; noise and vibration from construction equipment such as concrete mixers and poker vibrators as well as noise and vibration related to piling activities.
Extent: local to on-site
*Duration: S*hort to mid-term:
Magnitude: depends on the exceedance level
Significance: Medium
Significance with mitigation: Low
Proposed Mitigation measures:
The project is to be undertaken in a low populated area (in industrial area). Overall, it is expected that the rehabilitation works are likely to result in minor and temporary noise effects. However, the following mitigation measures should be put in place:-

- Minimize the generation of noise through the use of machinery, equipment, motors, etc., with characteristics of sound generation that complies to the recommended standards
- Adherence to a good and regular maintenance:
- Procurement of machinery/ construction equipment should consider specifications that conform to low source noise levels.
- Personnel exposed to noise levels beyond threshold limits should be provided with protective gear like earplugs, muffs, etc.

8.4.9 Impact on noise levels resulting from dredging

Minor dredging would be undertaken in front of the existing berths to increase the depth in order to accommodate larger ships. The dredger is expected to produce some noise during the dredging operations.

Extent: local to on-site
Duration: mid-term:
Magnitude: depends on the exceedance level
Significance without mitigation: Low
Significance with mitigation: not significant

Proposed mitigation measures:

- Proper maintenance of equipment and adherence to operational procedures:
- Training of personnel to adhere to operational procedures that reduce the occurrence and magnitude of individual noisy events.
- Environmental noise monitoring: This should be carried out regularly at specific positions to detect deviations from predicted noise levels and enable corrective measures to be taken where warranted.
- Noise attenuation should be practiced for noisy equipment by employing suitable techniques such as acoustic controls, insulation and vibration dampers

8.4.10 Noise resulting from improved port operations

The potential sources of noise and vibration during after commissioning include:

- operational noise from the refurbished port generated by container handling equipment, mobile plant and from vessels berthed at the marine facility;
- operational noise impacts due to changes in traffic flows on surrounding roads resulting from trucks accessing or leaving the refurbished port area.

Extent: local to site
Duration: long-term
Magnitude: *Medium*
Significance without mitigation: Low
Significance with mitigation: not significant
Proposed mitigation measures

- Minimize the generation of noise through the use of machinery, equipment, motors, etc., with characteristics of sound generation obeying the standards recommended nationally and internationally, and with a good and regular maintenance:
- Procurement of machinery/ construction equipment should consider specifications that conform to low source noise levels.
- Personnel exposed to noise levels beyond threshold limits should be provided with protective gear like earplugs, muffs, etc.
- Ambient noise levels should be maintained below threshold levels and monitored at regular intervals for conformity to NEMA noise regulations.

9 STAKEHOLDER CONSULTATION AND PUBLIC PARTICIPATION

Introduction

The Constitution of Kenya 2010 recognizes the sovereignty of the people and that people possess the power to guide development within their areas either directly or indirectly through their leaders. The public should therefore be involved in the evaluation process because the constitution demands it to be so.

The main objectives of the stakeholder engagement process are to:

- Inform the stakeholders about the proposed project and provide opportunities for influencing/amending the plans;
- Collect stakeholders' views on the proposed project including potential positive/negative impacts the stakeholders may associate with the project
- Get an idea of Stakeholders' preferred approaches to implementation of the project;
- Get local knowledge on any sensitive areas within the project area of influence (physical, environmental, cultural or proposed facilities); and
- Get expert advice on land use/ area zoning, water availability and supply, power and road infrastructure

9.1 Stakeholder Identification

Stakeholder identification was undertaken through consultative meetings with the proponent, KPA. Field visits were conducted in selected areas within the boundaries of the proposed plan to flag out persons or institutions that may have interest in the plan.

The following groups of stakeholders were identified and consulted:

- Stakeholders with environmental interests – Kenya Marine and Fisheries Research Institute (KMFRI), Kenya Wildlife Service (KWS), Kenya Forest Service (KFS), NEMA, Kenya Maritime Authority (KMA)
- Lead Agencies – County Government of Mombasa, Kengen, Kenya Pipeline Company, Kenya Power, Kenya Bureau of Statistics, State Department of Fisheries, Kenya Revenue Authority, Kenya Plant Health Inspection Services
- Port users such as logistics companies (Container Freight Stations, Shipping Companies), concessionaires such as Grain Bulk Handlers Limited, Mbaraki Bulk Terminals Limited, Bamburi Cement Limited, Tata Chemicals (Magadi), and
- The local communities particularly the fishers who use the fishing grounds and landing sites close to the project area as well as people who use the area for recreational purposes such as those that frequent Kwa Skembo beach.

9.2 Stakeholder Meetings

Two (2 no) Stakeholder Meetings (SHM) were held during the course of the study. The 1st SHM was held on 31st May 2016. This was a key informant SHM held at the scoping stage to brief the stakeholders on the project details and have their concerns on board to be addressed during the study. The 2nd SHM was held at the end of the study on 7th September 2106 to present the key findings. The views gathered from the stakeholders were taken into account in preparing the ESIA report and feedback given to them on the findings of the study.

Plate 9A: Delegates at Stakeholder Meeting No I

Plate 9B: Mr Martin Mutuku of KPA addressing delegates at SHMI

Plate 9C: Delegates at SHM II

Plate 9D:Mr Denis Muganga of KPA addresses delegates at SHMII

9.3 Issues Raised at Stakeholder Meetings

Key highlights of issues raised and responses given at the Stakeholder meetings are as summarized in Table 9-1 below:

Table 9-1: Issues raised by stakeholders

Issue of Concern	Response/Action
Are there any intentions to dredge surrounding areas?The high turbidity/sedimentation/siltation affecting machinery in the adjacent area is being attributed to the several ongoing works ***(Grain Bulk Handlers Ltd)***	1. Minor dredging works will be done to deepen the berths where required. Mitigation measures will be undertaken to take careof dredging impacts
Timeline for the assessment is short. This may not comprehensively cover phytoplankton studies Will modelling be done to determine propagation of sediments? ***(Kengen)***	2. The study will use indicator signals to spatially reconfirm data available from previous studies hence this can be accomplished within the specified timeframes. There are existing phytoplankton studies and biological baseline surveys for port areas
With several ongoing projects around the same area, are there measures in place to get the overall /cumulative impacts of all these projects? ***(KeNHA)***	Cumulative study would be necessary though it is not in the Terms of Reference for the current ESIA.
A formerly dry area near the Kenya Navy effluent discharge point currently has a lot of mangroves. Could this be a compounded result of the several projects in the port area? ***(Kenya Navy)***	Mangroves thrive when conditions suitable for them prevail. Such conditions may arise from factors within the project area or beyond. Studies need to be taken around Kenya Navy area to ascertain the cause of emergence of mangroves.
Has the project factored the safety of cargo ships and artisanal fishing boats during the construction phase? Has maritime security been considered during the project implementation phase considering issues of terrorism ***(State Department of Fisheries)***	Navigation may have challenges during the transit period. Modifications in routes will be communicated and standard operating procedures developed. Hydrographic surveys will be done to update existing charts. In terms of movement of people, KPA has put structures in place to control access to the premises. These require positive identification of persons before access is granted -Scheduling is done way in advance before the arrival of ships hence ensuring smooth flow of traffic.
In previous a dredging project material was done away from Marine Protected Areas (MPAs) but due to the effects of currents the marine parks were affected The rapid ecological assessment should look into the composition of the dredged material and factor in possible effects of dumping dredged materials containing benthic biodiversity as this may have significant impact if introduced in ecologically sensitive areas ***(Kenya Wildlife Service)***	Specific areas for dumping of dredged materials and sourcing of filling material will be recommended in the report. It is the upon the contractor to comply and KPA to enforce Samples will be subjected to independent laboratories for water and sediment analysis to identify invasive species and appropriate recommendations on sources and dumping sites will be made
More Stakeholders should have been invited to the meeting.. For instance Surveys of Kenya South Coast residents association, NEMA county and regional offices Assessment should clearly state the dumping site and sources of sand KPA should come up with an oil spill specific plan for sites they intend to do the project***(KMA)***	NEMA was invited though they did not send a representative to the meeting. KPA will consider inviting South Coast Residents Association for the next meeting Specific areas for dumping dredged materials and sourcing the filling material will be recommended in the report. A study justifying the proposed source was done during the just completed MODP KPA already has an Oil Spill Response Plan which will be applied during project implementation
How is asbestos from the port being handled and	There is a separate project specifically dealing with replacement

disposed. The current project should not use asbestos***.(CDA)***	and disposal of the asbestos. The proposed berth repairs project would not use asbestos
The ESIA process should include a learning component/civic education by inviting students to such meetings ***(KeNHA)***	Invitations would be sent to learning institutions to send representatives at the next meeting
It is not clear on how the additional stress on the roads due to the current expansion of the port will be mitigated. ***(Kengen)***	The Kenya National Highway Authority (KNHA) has been working with KPA and has factored expansion of the port in its plans to address projected impacts of the project. KPA is also working closely with other stakeholders such as the County Government of Mombasa who are working on a Master Plan to address congestion within Mombasa city.
Some impacts stated are likely to create conflicts as they touch on fisheries. There will be need for a vetting desk to address conflicts between real fishers and impostors. ***(State Department of Fisheries)***	A vetting desk will be established and hosted by the Authority. Prior to commencement of the project a detailed environmental management and monitoring plan will be prepared on how the contractor will implement the recommendations of the ESIA, including conflict resolution. (KPA) State Department of Fisheries should avail a legitimate list of fishermen during the compensation process to avoid conflicts and imposters.
Considering the possibility of oil spill, is there a contingency plan in place**.** ***(CORDIO)***	Kenya is well prepared to deal with oil spills considering the equipment available at KPA Pollution Control Centre and oil spill drills undertaken by the Oil Spill Mutual Aid Group (OSMAG). The country has prepared and implemented a National Oil Spill Response Contingency Plan.
Has the Assessment considered the long term effects of climate change in terms of sea level rise on the port ***(CORDIO)***	According to projections the rise is in the range of 1meter by 2100 hence the flooding potentials have no impact on the dredging activities
Fishing within the port area is done mainly by the small scale fishermen. Is KPA doing anything to address the associated security concerns as some fishermen have been found within the naval base? ***(Kenya Navy)***	Kilindini is a port channel hence port activities take precedence. The Authority is cognizant of the fishermen's need of livelihood. The challenge is in the nature of fishermen as they tend to pursue fish even in restricted or unsafe zones. Sensitizations are however on going on these concerns.
10. Was an assessment of species on the sea grass conducted considering marine life forage in these areas? ***(Bamburi Cement)***	Yes. the ESIA study was very detailed and a mapping was conducted indicating locations of sea grass areas close to the project area of influence
What will be the frequency of future dredging as this is critical in determining the financial implications and for long term planning. ***(Trade Mark East Africa)***	Frequency of dredging was not in the TORs of the consultant. However considering the Bathymetry and characteristics of the upper part of the creek, currents are stronger going outside of the creek hence flush materials outside the system contributing to self-maintenance of the channel.
Are there intentions to widen the channel? Currently there are some relatively narrow sections that have made it difficult for two ships to maneuver at the same time ***(Grain Bulk Handlers Ltd)***	Traffic within the channel is being modeled by marine pilots. In terms of operations, the ships come in one at a time and the current width of the channel is appropriate for the largest vessel.
15. Baseline outlined the potential pollution by heavy metals and other substances. Marine debris	Marine debris is a complex issue. There is no baseline survey for marine debris for the Kenya waters though there are 14 general

pollution form land based activities and ships should be included. ***(CDA)***	mitigation measures to deal with marine debris proposed in the ESIA

These issues are clarified in greater detail in Annexes 3 and 4 of this ESIA Study Report.

10 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

Introduction

This ESMP has been designed as part of the environmental review process to ensure that during project implementation, mitigation measures proposed in this ESIA Study report are implemented to protect the environment from adverse impacts that may occur. EMCA 1999 defines Environmental and Social Management Plan (ESMP) as "*all details of project activities, impacts, mitigation measures, time schedule, costs, responsibilities and commitments proposed to minimize environmental and social impacts of activities, including monitoring and environmental audits during implementation, operation and decommissioning phases of a project*".

A summary of key impacts and mitigation measures identified during this ESIA study are as follows:

Table 10-1: Summary of key impacts and mitigation measures

Project Phase	Potential Impact	Significance	Mitigation
Construction	Dredging and Dumping of dredged material may cause turbidity and sedimentation of receiving waters	High	• Careful choice of dredging period (North East Monsoon); • Use of silt curtains to contain propagation of sediments
	Dust from construction activities such as particulate emission into the atmosphere during transportation of construction material, demolition, excavation and dusty construction material at the project	Medium	• Construction materials carried in vehicles should be properly covered, • Enforce speed restrictions within the construction site. • Sprinkle water on exposed surface and roads to maintain high moisture content • Erect temporary barriers where practicable to trap dust
	• Temporary Displacement of fishermen from traditional fishing grounds during dredging • Temporary decline in fish catches as a result of temporary displacement of fish from the dredge and disposal sites	High	• Compensate fishers who would not be able to use their traditional fishing grounds • Empower the local fishermen to move to deep waters by offering training on deep-sea fishing methods equipment • Support provision of basic infrastructure in the alternative fish landing sites
	Destruction of habitats due to removal from the seabed or exposure of submarine sediments	Medium	Reduce the amount of suspended sediment through use appropriate dredger type, timing of dredging period and use of silt curtains
	Noise from on-site	Medium	• Use only equipment complying with

	construction activities such as piling, and from vehicles hauling construction material		recommended standards • Adherence to a good and regular maintenance • Provide exposed personnel with protective gear like earplugs, muffs, etc.
	Occupational safety and health – Potential for accidental injuries to workers in the course of undertaking construction works	Medium	• Undertake job safety analysis prior to commencement of construction works • Deploy a Safety Officer to the site on full-time basis to enforce KPA safety rules • Avail a fully equipped first aid box manned by trained first aid personnel at all times during construction works • Employee training and safety awareness • Accident reporting and investigation
	Interaction with migrant workers may result into spread of communicable diseases such as HIV/Aids	High	• Support HIV / Aids sensitization programs • Avail and equip a Voluntary Counselling and Testing (VCT) Centre during the construction period.
Operation	Accidental oil spills and discharge of ship waste from vessels	High	• Apply IMO, KMA's and KPA's port and shipping regulations. • Activate National Oil Spill Response Contingency Plan in the event of spill.
	Potential rise in discharge of ballast water in the harbour	Medium	• Enforce KPA policy that prohibits discharge of ballast water • Compliance with IMO regulations on management of ship waste
	Increased possibility of ship collisions or small vessels colliding with ships, due to increased volumes of maritime traffic.	Medium	Demarcate passageways for small fishing vessels separate from those used by ships
	Air pollution as a result of emissions from ships, as well as emissions from container handling equipment and haulage trucks.	Medium	• Promote use of ultra-low sulphur diesel fuel could reduce pollutants emissions. • Provide shore-based power connection for use by ships when

			docked at the berths
	Marine debris such plastic water bottles and packaging waste from docking ships and seafront activities	Low	• Compliance with IMO regulations on management of ship waste • Periodical shoreline clean up
	Water pollution from sewage and other domestic effluent		Installation of biodigesters for treatment of effluent
	Water pollution from land based oil spill and effluent from maintenance		Installation of interceptors / Oil-water separators

10.1 Purpose of ESMP

The purpose of the ESMP is to ensure that measures are taken to protect the environment by mitigating adverse impacts that occur during execution of the works. The ESMP outlines monitoring and mitigation measures that would be undertaken to restore and maintain environmental and social parameters at acceptable levels. The ESMP would focus on the following:

10.2 Water Quality Management

10.2.1 Sources of Impacts

Key potential sources of water pollution were identified as:

- Dredging during the construction phase may cause turbidity and sedimentation;
- Sand filling / reclamation works in front of the berths;
- Offshore dumping of dredged material;
- Land based oil spill and effluent from maintenance - leakage of oils, lubricants and chemicals from storage yards and maintenance areas during operations;
- Surface water run-off from paved yards and port may increase siltation load;Sewage and other domestic effluent from the proposed terminal and waterfront activities

Mitigation Measures have been proposed for anticipated impacts during construction, operation and decommissioning of the proposed project. These are the measures that are to be implemented to minimize negative impacts of project activities on the environment as predicted in the ESIA study.

10.2.2 Indication of Impacts

- Increased sediment load in the receiving water
- Increased turbidity in the receiving water;
- Decline in fish populations;
- Concerns from fishermen and conservation agencies
- Traces of oil and increased biological load in water samples.

10.2.3 Monitoring Objectives

- To assess the variation in water turbidity and chemical properties due to project activities which could alter the physical or chemical characteristics of the Mombasa port area, offshore dumping area and offshore sand borrow pit;

- To assess the effectiveness of environmental management programs designed to minimize surface water contamination.

10.2.4 Monitoring Methods

Water quality monitoring shall be done at the prescribed monitoring points at port areas and at the dumping site using a water quality meter. Turbidity of the sea water shall be monitored with an approved meter every day at 50 cm, 3m and 6m below the surface at the 10 monitoring points. Chemical characteristics of the water shall be monitored every 10 days. Monitoring shall commence at least 2 weeks before commencement of the reclamation works, so that the prevailing baseline conditions prior to commencement of the project can be documented.

Visual observation will also be undertaken in construction areas as a means of gauging the perspective degree of turbidity but this has to be authenticated by a turbidity meter. To complement ongoing water quality monitoring initiatives samples shall periodically be extracted and taken to a NEMA approved laboratory for analysis. Parameters to be monitored include:

- Total Suspended Solids, TSS;
- pH;
- Chemical Oxygen Demand, COD;
- Dissolved Oxygen, DO;
- Turbidity

10.2.5 Monitoring Locations

It is proposed that water quality monitoring be carried at not less than 5 monitoring points near the dredging / reclamation area, at least 3 points near the sand borrow pits and at 3 points near dumping site. The exact locations of the monitoring points would be specified by the Engineer.

10.2.6 Monitoring Frequency

Both turbidity and chemical properties (TSS, PH, COD, DO) shall be monitored daily for 30 days for prior to commencement of works for purposes of establishment of the baseline conditions. During dredging and reclamation works turbidity would be monitored daily while chemical properties would be monitored every 2 weeks. Post dredging period these parameters would be monitored every 3months for a period of 2 years. If at any time measurements indicate the turbidity levels or chemical parameters are exceeded the contractor shall take reasonable measures to counteract the conditions. Such measures might include provision of silt curtains and / or coffer dams. Under such circumstances the works shall be suspended until acceptable levels are restored.

10.3 Air Quality Monitoring

10.3.1 Sources of Impact

Sources of impact on air quality would be:

- mobilization of equipment,
- particulate and dust escape during material haulage,

- site clearance and earthworks during the construction phase.
- dust generation as a result of trucks ferrying containers along port roads
- emission from exhaust of haulage trucks and other construction equipment.

10.3.2 Indicators of Impact

- Visual intrusion as a result of dust and particulate emission
- Reported cases of respiratory irritation complaints raised by local residents.

10.3.3 Monitoring Objectives

- ❖ To measure concentrations of dust and gaseous emissions at selected locations surrounding the project area so that the results can be assessed in relation to Environmental Management and Coordination (Air Quality Regulations), 2008 and related standards.
- ❖ To ensure that adopted air pollution controls and management are effective.

10.3.4 Monitoring Methods

Air quality sampling and analysis will be done by the contractor in liaison with a laboratory approved by NEMA. Air monitoring parameters will include 24-hour readings of the following parameters:

- ❖ Hydrogen Sulphide, H_2S;
- ❖ NO_2;
- ❖ CO;
- ❖ SO_2;
- ❖ SPM (Suspended Particulate Matter)

Other parameters may be monitored subject to specific complaints received from residents.

10.3.5 Monitoring Frequency

Air quality monitoring will be conducted once before commencement of the works and every 3 months thereafter.

10.3.6 Monitoring Locations

Air quality monitoring shall be conducted at active construction areas and near sensitive receptors as would be determined in consultation with the Engineer

10.4 Noise Level Monitoring

Construction / rehabilitation works shall be carried out in port areas, designated as an industrial zone. The *Environmental Management and Coordination (Noise And Excessive Vibration Pollution) (Control) Regulations, 2009* (Legal Notice No.61) provides that for areas other than residential, institution and educational areas and health facilities maximum noise levels permitted should not exceed 75 dBA during the day and 65 dbA during the night. These regulations also provide that any person carrying out construction, demolition, mining or quarrying work shall ensure that the vibration levels do not exceed 0.5 centimetres per second beyond any source property boundary or 30 metres from any moving source. The contractor in liaison with KPA shall conduct noise level monitoring during construction to ensure the said limits are adhered to.

10.4.1 Sources of Impacts

- On-site construction activities such as demolition, casting of concrete, grinding, piling,
- Vehicles hauling construction material;
- Port traffic at the operations phase

10.4.2 Methodology for Noise Level Measurement

The noise measurements would be carried as follows:

- Inspection of the measurement area and the implicated activities.
- Identification of perimeter points.
- Verification/Calibration of the sound level meter before measurements.
- Recording of the meteorological conditions during the measurement such as temperature, wind speed and relative humidity;

All the measurements would be taken in diurnal schedule.

10.4.3 Instruments to be used

The following instruments would be used during the measurement:

- Sound Level Meter;
- Vibration Meter.

10.4.4 Parameters to be monitored

The measurements results would be 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 has the same mean square sound pressure as a sound under consideration whose level varies with time;
- **Noise levels** at the following distances from source – L5, L50, L95;
- **Vibration velocity –** maximum value during 10 minutes hourly;
- Record of noise and vibration source.

10.4.5 Locations for Noise Level Measurement

Noise level measurement shall be conducted at the same locations as for air quality monitoring as determined by the Engineer

10.4.6 Monitoring Frequency

Noise level monitoring will be conducted every 3 months during the construction period.

10.5 Monitoring of Marine Ecosystem

10.5.1 Sources of Impacts

- Land reclamation;
- Dredging and dumping of dredged material;
- Sand harvesting
- Construction of berths and other waterside structures;

- Operational of the terminal - operational impacts such as oil spills from terminal operations, ship waste, potential spill from oil tankers as a result of marine accidents.

10.5.2 Significant Impacts on Environment

- Destruction of habitats due to removal from the seabed of submarine sediments due to dredging.
- Sedimentation and turbidity changes will contribute to changes in the physico-chemical characteristics of watercourses with secondary impact on aquatic flora and fauna. Such an impact would also be expected on corals.
- Large oil spills if experienced at the operations phase wouldresult into death of marine flora and fauna, with impacts extending beyond project area.

10.5.3 Indicators of Impact

- Biodiversity index and abundance index – Relative change in quantity and / or coverage of key biodiversity parameters such as sea grass and corals as the project progresses in comparison to abundance at commencement of project (baseline conditions)
- Fish deaths
- Visible changes in turbidity.
- Reported complaints from fishers, community and conservation groups.

10.5.4 Monitoring Objectives

- To determine the effectiveness of water quality management put in place by proponent;
- To determine the progress of recovery of aquatic biota following the surface water quality management.

10.5.5 Monitoring Methods

Marine ecosystem surveys will be carried out by extraction of samples at the designated monitoring points followed by laboratory quantification and identification of the organisms recovered from water samples. These shall be compared with results obtained during baseline studies.

10.5.6 Monitoring Locations

Marine ecosystem monitoring shall be undertaken at locations close to sensitive habitats as would be determined in consultation with the Engineer.

10.5.7 Monitoring Frequency

Monitoring during the construction stage shall be monthly initially for 3 months, quarterly thereafter for one year and biannually afterwards in case monitoring indicates continued compliance.

10.6 Monitoring of Livelihood Restoration

10.6.1 Sources of Impacts on Livelihood

- Improvement in livelihood as a result of employment opportunities generated by the project;
- Turbidity and sedimentation as a result of dredging activities may force fish to move to clearer waters hence resulting into reduced fish catches in traditional fishing grounds

- Restriction of access to fishing grounds during the construction period;
- Negative ecological impacts on the important fishery ecosystems in the area such as mangroves, coral reefs and seagrass likely to affect fish availability and reproduction

10.6.2 Indicators of Impacts

- Evidence of turbidity and / or sedimentation as observed from environmental monitoring;
- Complaints received from fisher communities with regard to loss of catches;
- Evidence of restriction of fishing vessels from accessing traditional fishing grounds on account of security or safety

10.6.3 Monitoring Objectives

To ensure that the mitigation programme proposed in the ESMP and implemented through the Livelihood Restoration Plan restores livelihood of Project Affected Persons (PAPs) to equal or better levels than the pre-project livelihood standards.

10.6.4 Monitoring Methods

Monitoring shall be carried out through periodic administration of questionnaires to PAPs, Focus Group Discussions and conducting individual interviews, as well as localized public meetings/consultations (*barazas)* attended by PAPs and other stakeholders. The following parameters would be monitored:

- Number of members of local communities employed in the project;
- Modern fishing equipment supplied;
- Daily catches as a result of provision and use of modern equipment at offshore fishing grounds;
- Credit disbursed (if proposed) towards assisting local communities restore livelihood
- Training and technical support provided – for use of equipment or for management of credit disbursed

10.6.5 Monitoring Frequency

Livelihood restoration monitoring would be done every month during the first one year and every 3 months thereafter. In the event that the monitoring process indicates decline in livelihood conditions of the community then a morefrequent timetable would be prepared in consultation with the Engineer

10.7 Monitoring of HIV / Aids Prevalence

10.7.1 Sources of Impacts

Interaction between local people and migrant workers with disposable incomes staying away from their families.

10.7.2 Indicators of Impacts

Increase in reported cases of new HIV /Aids infections

10.7.3 Monitoring Objectives

- To mitigate the impacts anticipated from influx of construction workers into the site and surrounding residential areas;

- To increase HIV / Aids awareness among construction workersand neighbouring communities thereby promoting behavior change in order to minimise cases of new HIV / Aids infections

10.7.4 Monitoring Methods

A reputable NGO with experience in administration of HIV/Aids programmes would be engaged to drive the HIV monitoring programme. Among the parameters to be monitored are:

- Level of awareness campaign – campaign materials distributed, meetings / training session sheld and topics discussed;
- Evidence of acceptance of HIV status for those who are HIV positive, and reduction of stigmatization;
- Reduction in numbers of new infections
- Provision and equipping of Voluntary Counselling and Testing centre
- Condom Access

10.7.5 Monitoring Frequency

Monitoring of HIV prevalence would be done and reported on monthly basis.

10.8 Responsibility and Timeframe of ESMP

A summary of responsibilities, timeframe and main items that need to be monitored to ensure successful implementation of the ESMP is as outlined in Table 11.2 below:

Table 10-2 Responsibility and Timeframe of ESMP

No.	Component / Issue	Phase	Responsibility	Monitoring Items
1.	Water Quality	Construction	Contractor	Turbidity, Chemical Composition
		Operation	KPA	Oil Pollution, Ballast water
2.	Air Quality	Construction	Contractor	Dust, Particulates
		Operation	KPA	Ship emissions, Fugitive dust
3.	Fauna	Construction	Contractor	Abundance, Habitat accessibility.
		Operation	KPA	Recolonisation/Habitation, Resilience
4.	Critical Ecosystems (Coral, Mangroves, Nesting Grounds)	Construction	Contractor	Abundance, Presence/Absence,
		Operation	KPA	Regeneration, Size.
5.	Noise & Vibration	Construction	Contractor	Construction noise - Levels, Frequency, Times of exposure
		Operation	KPA	Noise from ships, haulage trucks, container handling equipment
6.	Effluent	Operation	KPA	Effluent Quality, Biodigester efficiency
7.	Fisheries Constraints	Construction	KPA / State Department of Fisheries (SDF)	Restriction of access, Compensation, Provision of equipment

		Operation	KPA / SDF	Livelihood Restoration.
8.	HIV/AIDS & STI Prevalence	Construction	KPA / Contractor	Awareness, Prevalence, Cases, Condom Access
9.	Oil Spill	Construction	Contractor	Spill from construction equipment, maintenance activities
		Operation	KPA	• Spill from marine accidents - ship collisions, ships running aground, ships colliding with berthing structures • Review sufficiency of oil pollution control equipment • Preparedness of oil spill response staff
10	Occupational safety and health	Construction	Contractor / KPA	• Accident reports / statistics and investigation records • Provision and use of PPE • Availability of first aid facilities / trained first aid personnel • Safety training and awareness
11	Fires	Operation	KPA	• Availability of firefighting equipment • Training of fire brigade • Fire drills / emergency response simulations
12.	Water Traffic	Construction	Contractor	Accidents, separation of fishing vessels from dredgers / operations traffic
		Operation	KPA	Congestion, Accidents.

10.9 Estimated Costs for Environmental Monitoring

During the of the proposed berth rehabilitation works the contractor shall conduct environmental and social monitoring of ambient environmental qualities such as water quality, air quality, noise/vibration levels and biodiversity, which are likely to be degraded by the construction activities, as well as progress of implementation of efforts put in place to enhance restoration of livelihoods of Project Affected People.

The costs of environmental monitoring as well as costs for compensation and implementation of mitigation measures shall be properly factored into the capital budget for the construction works. The contractor shall submit a detailed Environmental Management and Monitoring Plan (EMMP) to satisfy the requirements for approval by KPA before submission to NEMA.

Table 10-3: Estimated Costs for Environmental Monitoring

Item	Timing	Unit	Total No of Units	@	Amount
Water quality					
Turbidity	Every day for 2 weeks prior to commencement of the Works at 50cm, 3m, 6m below surface at 5 stations	Sample	3 x 5stations x14days =210 samples	4,000/-	840,000/-
SS, pH, COD, DO, SPM	Every week during the construction period of 24 months at 5 sampling points	Sample	2 years x52weeks x 5 stations = 520 samples	20,000/-	10,400,000/-
Air quality					
SO_x, NO_x, VO_x and Particulate Matter (PM_{10}), CO, H_2S	Once before construction (1); monthly during construction (24) and during major earthworks (allow 10additional activities)	Activity	35x5=175	Ksh. 55,000/-	9,625,000/-
Noise and Vibration	To be done at 5 stations monthly during construction and during the periods of the high noise/vibration level (allow 10 activities)	Activity	34x5=170	30000/-	5,100,000/-
Biological Impact Monitoring					
Terrestrial flora and fauna	Twice a year across project area of influence	Activity	2x2 years = 4	225,000/-	900,000/-
Marine vegetation and fauna	Monthly for the initial 3 months (3 Activities) and quarterly thereafter (7) taken at 5 stations	Sample	10x5=50	250,000/-	12,500,000/-
Installation of Biodigester for treatment of effluent	During operation – Biodigester to accommodate a population of approximately 200 people	No.	2	4,500,000/-	9,000,000/-
Provision for compliance with IMO regulations					
Compliance with regulations on management of ballast water and ship waste	PROVISIONAL SUM				10,000.000/-
Compliance with regulations on disposal of ship waste	PROVISIONAL SUM				5,000,000/-

Provide an amount for compensation of fisher communities for disturbance during the construction period and recovery period of 1 year	PROVISIONAL SUM				30,000,000/-
Provision of Personal Protective equipment (PPE)	During construction: - PPE such as safety shoes, dust masks, hearing protection, head protection to be supplied by contractor for use by construction staff	**LOT**			5,000,000/-
Dust suppression measures	During Construction: - Water bowser to be provided by contractor for use in construction areas for suppression of airborne dust	Trips	2 trips per day for 2 years = 730 trips	10,000.00	730,000/-
HIV/Aids awareness and management program	During construction: - **provisional sum** for combating spread of HIV/Aids among fishermen and local communities interacting with migrant workers	PROVISIONAL			30,000,000**/-**
TOTAL					**129,095,000/-**

10.10 Feedback Action

During construction the consultant will submit the results of the monitoring to NEMA two times in a year. To ensure the successful implementation of mitigation measures, a feedback system would need to be adopted which allows for discussion of the monitoring results with key stakeholders (conservation, maritime) and if necessary, improvement of the mitigation measures.

By involving the stakeholders 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 corrective action will be taken and outcome made public again.

ANNEX 1: TERMS OF REFERENCE FOR ESIA STUDY

These Terms of Reference have been prepared based on the Scoping studies and concerns raised by stakeholders during the first Stakeholder Meeting (SHM I) held at the Royal Court Hotel on 31st May 2016.

A1: Executive Summary

The experts will be required to give an executive summary of the methodology and main findings of the study. This will be a brief non-technical description of the main findings and recommendations. This section should contain:

- Project description and environmental setting of the site
- major impacts and their significance;
- proposed mitigation measures;
- the environmental management plan; and
- any other critical matters that bear on the decision.
- the results of public consultation;
- key recommendations and conclusions.

A2: Background of the Project

A clear statement of the need for and objectives of the project will be given. Reference will need to be made to the demands and issues that the proposed project is intended to address, the result that will be achieved, and the benefits that are anticipated. This section will include a description of the location of the project together with supportive maps.

A2: Legal and policy framework

There will be a brief description of the legal, regulatory and policy framework that applies to the proposal. Applicable World Bank safeguard policies as well as relevant international instruments would need to be cited and reviewed to ensure that the study results are compliant with environmental and social standards prescribed by international lending institutions.

A3: Description of the proposed project and its alternatives

A description of the project and the alternatives indicating the elements and main activities that will take place during project construction, operation and decommissioning will be presented. This section of the report will draw attention to the major differences between the alternatives, including the no-action alternative. Among the items to be included here are:

- Project Layout;

- Technology, procedures and processes to be used in the implementation of the project;
- Materials to be used in the construction and implementation of the project,
- The products, by products and waste expected to be generated by the project.

A4: Description of the affected environment

A concise description of the biophysical and socio-economic conditions of the affected environment will be presented. Baseline information will include current and any changes anticipated before the project begins. Current land use and other proposed development activities within the project area will also be taken into account. Baseline conditions will provide the necessary background and baseline against which to understand impact predictions. Key aspects of the affected environment that need to be included for this purpose include:

- spatial and temporal boundaries;
- biophysical, land use and socio-economic conditions;
- major trends and anticipated future conditions;
- environmentally sensitive areas and valued resources that may need special protection.

A5: Methodology

A description will be made of how environmental and social data were gathered, the predictive methods used and the criteria used to judge significance. This should include detailed sampling methodology as well as approaches used in stakeholder identification and consultation

A6: Environmental impacts and their evaluation

This should include an evaluation of the potential positive and adverse impacts for both the proposal and its alternatives and for each component of the environment identified as important in the scoping process. Impact characteristics are described as predictions of magnitude, severity, occurrence, duration, etc. The significance of residual impacts that cannot be mitigated should be highlighted so that decisions made to take cognizance of this fact.

Information contained in this section should include:

- potential impacts of project activities on air and water quality during construction and operation phases;
- prediction of each major impact, its characteristics and likely consequences;
- consideration of their compliance with environmental standards and policy objectives;
- evaluation of significance of the residual impacts (stating the standards or criteria used); and
- limitations associated with impact prediction and evaluation, as indicated by the assumptions made, gaps in knowledge and uncertainties encountered.

Both direct and indirect impacts, including potential cumulative effects, will be highlighted.

A7: Proposed mitigation measures

For each potential negative impact identified, mitigation measures for environmental protection will need to be proposed. These will include recommended measures for avoiding, minimising and remedying the identified impacts.

A8: Environmental Management and Monitoring Plan

The environmental management and monitoring plan would need to be developed for pre-construction, construction and the operational phases of the project. The key parameters of the monitoring plan will be obtained from the identified impacts of the project and the suggested mitigation measures. The EMP will then include provision of an action plan for the prevention and management of foreseeable threats to sensitive ecosystems, prevention of accidents and environmental hazards, and measures to contain the hazards and ensure safety in the working environment during both construction and operation phases of the project.

A9: Public participation and consultation

A concise and complete statement of the nature, scope and results of public consultation will be presented including the following:

- identification of the interested and affected public;
- the method(s) used to inform and involve stakeholders;
- analysis of the views and concerns expressed;
- how these have been taken into account; and
- outstanding issues and matters that need to be resolved.

A10: Conclusion and recommendations

Overall recommendations and conclusions will need to be presented based on information gathered from detailed studies and impact evaluation.

ANNEX 2: SCREENING REPORT

KENYA PORTS AUTHORITY

Environmental and Social Impact Assessment for Rehabilitation of Berths No. 1-14

SCREENING REPORT

PART A: Description of the environmental setting

The project site is located within the Port of Mombasa in an area already designated and operating as a port area. The existing berths were constructed between 60 and 80 years ago and are in critical condition as a result of operational wear and corrosion attack from sea water.

PART B: Identification of key Environmental and Social Impacts

State whether the proposed project would impact on the following:

	Description	Yes	No	Comments
1	**Environmentally Sensitive Areas or Threatened Species** Are there any environmentally sensitive areas or threatened species that could be adversely affected by the project such as:			
	• Natural or riverine forests		√	*There are no ecologically sensitive areas in the immediate vicinity of project area but project activities such as dredging and land reclamation may impact on ecological resources in the neighbourhood of project area*
	• Surface water courses or natural springs		√	
	• Wetlands (lakes, swamps, seasonally flooded areas)		√	
	• Coral reefs	√		
	• Seagrass beds	√		
	• Area of high biodiversity	√		
	• Habitats of endangered/threatened species	√		
2	**Contamination and Pollution Hazards** Is there any possibility that the project will be at risks of contamination and pollution hazards from latrines, dump sites, Industrial discharge, water discharge, etc.?	√		*Waterfront industrial activities may negatively impact on project if not well managed*
3	**Geology and Soils** Are there areas of possible soil instability (soil erosion, degradation, salinity, landslide prone or subsidence-prone)?		√	*Cases of porosity have been reported near G-section. Need to confirm proximity of target yards to such areas*
4	**Land** Will the project increase pressure on land resources or result in decreased holdings by small land owners? Will the project result in involuntary land acquisition?		√	
5	**Water** Would implementation of the project affect quantity or			

	quality of any of the following:			*Dredging and reclamation activities may result into turbidity and sedimentation*
	• Fresh water		√	
	• Surface water		√	
	• Ground water		√	
	• Marine water?	√		
6	**Energy Source** Will the project :			*Additional cargo handling equipment would require more electrical energy from the local grid*
	Increase the local demand for conventional energy sources?	√		
	Create demand for other energy sources?		√	
	Decrease the local supply of conventional energy sources?		√	
7	**Migratory Species** Do migratory fish, birds or mammals use the project area? If so will project affect the habitat and numbers of such species?		√	*Some migratory fish, rays and sharks have previously been captured in port areas. The design should allow movements in and out. Mangrove islands have pockets of migratory birds which will need to be identified and mangrove habitats conserved for continued survival*
8	**Degradation of Resources** Would the project involve considerable use of natural resources, land or energy, significant excavations, demolition, movement of earth or clearance of significant vegetation?	√		*Construction activities would consume large quantities of sand and ballast*
9	**Loss of Shelter and /or Livelihood** Will the sub-project activity displace any existing dwellings, adversely affect the livelihoods of local communities or limit their access to natural resources?	√		*Project likely to interfere with fishing activities due to turbidity and access restriction at the construction phase*
10	**Migrant Population** Are there currently any mobile groups in the target population? Will the project result in inward migration of people from outside the area for employment or other purposes?	√		*There is likely to be migration of construction workers into the project area looking for employment*
11	**Conflict / Dispute** Would sub-project result in conflict or disputes among communities?		√	
12	**Health and Safety** Would project result in human health or safety risks during construction or later?	√		*Accidental injuries likely from use of hand tools during the construction phase*
13	**Noise and Vibration** Will the operating noise level exceed the allowable decibel	√		*Construction activities such as demolitions, grinding,*

	level for that zone?			*welding would produce noise above allowable levels*
14	**Beneficial Plants, Animals and Insects** Do non-domesticated plants, animals or insects exist in the project area which are used or sold by local people? Will the project affect these species by reducing their habitat or number in any way?	√		*Mangroves that are used by local communities exist close to the project area. Impact on mangroves would need to be investigated. Some fish and rays are captured by fishermen from waters in port areas. The works may temporarily disrupt fishing activities but these will recover after a while*
15	**Disease Vectors** Are there known disease problems in the project area transmitted through vector species? Will the project increase habitat for vector species?	√		*There is potential of exciting buried and /or spore forming species back to life. Some forms may be invasive*
16	**Cultural / Historical Significance** Would the project adversely affect historically-important or culturally-important sites nearby? Will the project affect religious and/or cultural attitudes of area residents? Are there special beliefs, superstitions or taboos that will affect acceptance of the project?		√	*There may be prayer sites for fisher communities. This would be verified during the study*
17	**Distribution Systems** Will the project enhance inequities in the distribution of agricultural and/or manufactured products? Will the project increase or decrease demand for certain commodities within or outside the project area? Will the project enhance inequities in the distribution of benefits?		√	
18	**Waste** Will the sub-project generate solid or liquid wastes that could adversely affect local soils, vegetation, rivers and streams or groundwater?	√		*Dredging and piling activities would expose submerged sediments that may be contaminated*
19	**Tourism and Recreation** Is there at present a significant degree of tourism in the area? Will the project adversely affect existing or potential tourist or recreation attractions?		√	*Some tourists arrive via the Port of Mombasa. There are recreational sites are adjacent to the project area. No adverse impact expected on existing or potential tourist or recreation attractions adversely*

PART B: CONCLUSION

Summary	**Safeguard Requirements**	
All the above answers are "No"	If all the above answers are "No", there is no need for further action. This means either no significant environmental and social impacts were identified, or sufficient environmental and social review has already been conducted and safeguards incorporated into the project.	
There is at least one "Yes"	If there is at least one "Yes", then one of the following actions would be recommended:	
CATEGORY		**RECOMMENDATION**
A. Environmental Project Report if impacts are clearly foreseeable, are site specific; few if any of them are irreversible; and in most cases mitigation measures are readily designed.		
B. Environmental and Social Impact Assessment (ESIA) Study if the project implementation may result into significant direct or indirect adverse environmental impacts that are sensitive, diverse or unprecedented. These impacts may affect an area broader than the sites or facilities subject to physical works.		*Most impacts predicted above fall into this category hence an ESIA study is mandatory.*
C. Other Recommendation		

ANNEX 3: MINUTES OF STAKEHOLDER MEETING NO. 1

MINUTES OF THE 1ST STAKEHOLDERS MEETING ON THE ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) FOR REHABILITATION OF BERTHS 1-14

DATE: TUESDAY, MAY 31, 2016 **VENUE: ROYAL COURT HOTEL, MOMBASA**

1.0 Purpose of Meeting

This first stakeholder's consultation meeting was held in compliance with the requirements of the Environment Management and Coordination Act, 1999 that requires stakeholder consultation in the ESIA process. In addition it provided an opportunity for public participation in the management, protection and conservation of the environment as stipulated in the Constitution of Kenya 2010.

2.0 Agenda

i. To share details of the proposed project with the stakeholders;
ii. Highlight issues to be investigated in the ESIA study;
iii. Obtain inputs from stakeholders for consideration during the detailed ESIA study;
iv. AOB.

3.0 Introduction of Participants

The meeting began at 10:30 am with a word of prayer from one of the participants. Mr. Martin Mutuku (Head of Corporate Development, KPA) then led participants through a round of self-introductions. Participants included representatives from the county government, research institutions, national government agencies and the private sector among others which clearly displayed the diversity expected in such a forum **(see appendix 2.0).**

4.0 Welcome Note by Mr Martin Mutuku

Mr Mutuku highlighted the significant role of the Port of Mombasa not only to the nation but also to the East and Central Africa region. He listed the neighboring countries depending on the port and recalled that the 2007 post-election violence in Kenya had negative impacts beyond Kenyan borders as the transport system remained paralyzed resulting into massive pile-up of cargo at the port.

He pointed out that the port has been doing fairly well over the years and was ranked number 116 in the world in 2014 in terms of cargo handling. The cargo dwell time *(time between off-loading the ship and dispatch from the port*) has been the biggest challenge in the port management. He explained that the port's capacity is driven by the yard capacity and the dwell time with later being the main contributor to additional costs incurred in importing goods through the port.

He further explained that a study on the status of the berths 1 to 14 commissioned over 2 years ago shows that the status of some berths are deplorable and in need of urgent repairs. To this effect he highlighted the significance of the proposed project which focuses on straightening, strengthening and deepening the berths, with berth 11 to 14 to be prioritized for repairs and serve as container terminals too instead of being limited to conventional cargo.

He acknowledged the potential impacts of such a project and the need to undertake an Environmental and Social Impact Assessment (ESIA) as required by the Environment Management and Coordination Act, 1999.

5.0 Project Presentation by Eng. Kennedy Nyagah (KPA)

This focused on the details of the proposed project in terms of current status of Berths 1-14 and the scope of repairs required. Mr Nyagah explained that the project's proposed activities would help in meeting objectives of sustainable development through its three objectives namely:-

- Increase productivity and reduce cost;
- Rehabilitation for structural integrity and strengthening, deepening and straightening of berths.

Spatially, the whole project will cover berth 1 to 14 though these have been categorized into three main sections as follows berth 1 to 5 (straightening and rehabilitation); berth 7 to 10 (deepening and straightening) and berth 11 to 14 (rehabilitation and reinforcement). Participants were also informed that inputs of the meeting were crucial as they would help in shaping the assessment and that the output will inform the other phases of the project.

5.0 ESIA Presentation by Mr Hezekiah Adala and Mr Patrick Gwada (Heztech)

Mr Adala began by explaining the diversity of the consultancy team comprising of experts in major areas such as ecology, socioeconomics, oceanography, occupational health and safety, fisheries as well as environmental chemistry.

This was followed by an explanation of the Environmental and Social Impact Assessment (ESIA) process and the methodology / approach proposed for the current task.

Assessments will be conducted in six (6) thematic areas namely: socioeconomic assessment; ecological assessment; oceanographic assessment; fisheries assessment, chemical assessment (water and sediment quality) as well as occupational safety and health. Samples will be analyzed at a NEMA approved laboratory.

It was also pointed out that the project would impact on the 14th and 13th Sustainable Development Goals (SDGs) on life below water and climate change respectively. Further, the project will impact on the 8th, 9th and 16th Aichi targets on pollution reduction, invasive species prevention and the Nagoya protocol respectively.

6.0 Key issues raised by participants

Issue of Concern/Institution	Section of presentations	Response/Action
1 Are there any intentions to dredge surrounding areas as the high turbidity/sedimentation/siltation affecting machinery in the adjacent area is being attributed to the several ongoing works at the port ***(Grain Bulk Handlers Ltd)***	**Scope of the project**	1. Minor dredging works will be done to deepen the berths where required. Mitigation measures will be undertaken during the works such as correct choice of dredge equipment and scheduling of dredging period to limit turbidity and sedimentation
2 Ecological survey seems very ambitious and considering the timelines for the assessment this may not be comprehensively done ; phytoplankton studies take 2 to 3 years 3. Methodology is good but in Kenya no modelling has been done before, will this be considered? 4. Project will lead to reclamation of the sea. Has the project considered what is happening behind the creek and developments around Kibarani - during high tides water is pushed further inland affecting fresh water areas with potential introduction of invasive species and destroying fish landing sites 5. Due to absence of model there is no information to illustrate the various measures to be taken for example in the event of an oil spill. ESIA studies should not be designed for compliance only but should expand the knowledge base in various research areas and consultants should request for more time if need be to achieve this considering the resources that go into such projects. ***(Kengen, 2,3,4,5)***	**Ecological survey**	2. Survey program is not ambitious. The team has undertaken similar studies around the same area with similar strategies and timelines, and all reports were completed in time. The study will use indicator signals to spatially reconfirm data available from previous studies hence this can be accomplished within the specified timeframes. There are existing phytoplankton studies and biological baseline surveys for port areas 3. Modelling was done during ESIA study for Access Channel Dredging. Simulation will be done for reconfirmation. KMFRI as a local lead agency has undertaken a lot of research in the marine environment. The consultants have access to these documents and will refer to them 4. KMFRI has positioned a tide gauge in Liwatoni that monitors sea level at the port on daily basis. If construction works were having significant impacts on sea level the readings / trends would have shown 5. The National Oil Spill Response Contingency Plan was developed based on the understanding of ecologically sensitive areas and high risk areas within the port and its environs. Due to time and budget constraints there is no provision for elaborate modelling in the current project.
6. With several ongoing projects around the same area, are there measures in place to get the overall /cumulative impacts of all these projects as individual projects may have minimal impacts but collectively the impact could be significant ***(KeNHA)***	**ESIA process**	6. Such a study would be necessary though it is not in the Terms of Reference for the current ESIA.
7. A formerly dry area near the Kenya Navy effluent discharge point currently has a lot of mangroves. Could this be a	**Ecology**	7. Mangroves thrive when conditions suitable for them prevail. Such conditions may arise from factors within the project area or

compounded result of the several projects in the port area? (***Kenya Navy)***		beyond. Studies need to be taken around the project area to ascertain the cause of emergence of mangroves.
8. Has the project factored the safety of cargo ships and artisanal fishing boats during the construction phase? 9. Has maritime security been considered during the project implementation phase considering issues of terrorism (***SDF 8,9)***	**Security and Access**	(***8-9)*** Navigation may have challenges during the transit period. Modifications in routes will be communicated and standard operating procedures developed. Hydrographic surveys will be done to update existing charts. (Navy) -In terms of movement of people, KPA has put structures in place to control access to the premises. These require positive identification of persons before access is granted (KPA) -Scheduling is done way in advance before the arrival of ships hence ensuring smooth flow of traffic (KPA) -The project will adopt construction sequence management to minimise interference with normal operations. -Kenyan pilots are familiar with the channel and responsible for steering the ships to dock within Kenyan waters hence they will have no problem adjusting to any route changes communicated in time. -Kenya navy will intensify patrols when the task kicks off to ensure maritime security (Kenya Navy) -KPA has control tower hence can monitor vessels coming in and going out of the port (KPA) -Before the channel, there is a buffer zone manned by KPA and the Navy. KPA has to be notified 14 days before the arrival of any vessel (KPA) -KPA is in the process of acquiring a new vessel –boat, to assist in monitoring/enhancing maritime security (KPA)
10. ESIA should model path of sediments in different scenarios before recommending a dumping site. In previous project the dumping of dredging material was done away from MPA's but due to the effects of currents the marine parks were affected 11.The rapid ecological assessment should look into the composition of the dredged material and factor in possible effects of dumping dredged materials containing benthic biodiversity as this may have significant impact if introduced in ecologically sensitive areas	**Pollution/dumping/ dredging**	**(10/13).** Specific areas for dumping of dredged materials and sourcing of filling material will be recommended in the report. It is the upon the contractor to comply and KPA to enforce (Consultant) ***(11/12/13).*** Samples will be subjected to independent laboratories for water and sediment analysis to identify invasive species and appropriate recommendations on sources and dumping sites will be made

12. Chemical assessment should also consider the composition of the substrate as this may affect ecologically sensitive areas 13. The source of the filling material should be carefully selected as scooping sand can destabilize sea floor and affect areas far off the scooping point. The composition of the material also needs to be assessed to ensure it can be safely introduced in the new sites ***(KWS 10,11,12,13)***		(Consultant) ***(10/11/12/13)*** A good study vis a vis implementation are different issues. Contractors tend to do contrary to the reports to cut on cost especially if they are not under strict supervision. The findings of the study need to be translated into an operational plan. (Consultant)
14. More Stakeholders should have been invited to the meeting. For instance Surveys of Kenya has a fully-fledged department of hydrography; South Coast residents association considering some berths cuts across their area, NEMA county and regional offices 15. KPA should submit the following to KMA: a)design plans for the berths with the dimensions , b)vessel traffic including an inward and outward procedure considering the project will be undertaken in a busy channel c)particulars of vessels doing dredging and the personnel d)Data for water quality assessment 16.A good valuation of impacts of the project should be done and appropriate compensation determined 17. Assessment should clearly state the dumping site and sources of sand 18. KPA should come up with an oil spill specific plan for sites they intend to do the project (***KMA 14/15/16/17/18)***	Stakeholder involvement; compensation, Pollution/dumping/dredging	14. NEMA was invited though not represented at meeting. KPA will consider inviting South Coast Residents Association for the next meeting ***(15.c/d 17/18).*** There are currently no actual specifications about the project; it's too early to know the dredging vessel and personnel and as details are availed by the project implementers these will be communicated and site specific assessments will be done *(KPA/consultant)* 17. Specific areas for dumping dredged materials and sourcing the filling material will be recommended in the report. The study will justify the proposed source as a survey will be done and will entail among others the distance from the shore, developments inwards, population of marine ecosystems around the place 18. KPA already has an Oil Spill Response Plan which will be applied during project implementation A monthly report on environmental management plan by KPA has shown increase in fish due to increased aeration following dredging
19. How is asbestos from the port are being handled and disposed. The current project should not use asbestos. ***(CDA)***		19. There is a separate project specifically dealing with replacement and disposal of the asbestos. The proposed berth repairs project would not use asbestos
20. Several problems have risen when dumping is not done at designated locations. Stakeholders including institutions with mandates in different areas should be involved correctly on	Stakeholders involvement/monitoring	20. Involving stakeholders in monitoring process is a challenge with regards to who will meet their cost if the project hasn't budgeted for the costs incurred by these stakeholders. Stakeholders directly

issues of site selection and monitoring.		involved in environmental issues can be considered for monitoring subject to availability of funds -Vessels to be used for dredging will have specifications with a capability of vessel log in to enable tracking of the movements made by the vessel.
22. The ESIA process should include a learning component/civic education by inviting students to such meetings ***(KeNHA)***		Invitations would be sent to learning institutions to send representatives at the next meeting

AOB

There being no other business, the participants were thanked for their attendance. It was pointed out that all the objectives of the meeting had been met as participants were now aware of the project, what the study will involve, and participants have raised their concerns for consideration during the ESIA study. The meeting ended at 1.30 pm.

SHM I ATTENDANCE REGISTER

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT FOR REHABILITATION OF BERTHS NO. 1 – 14

SHM I ATTENDANCE REGISTER

Date: 31st May 2016 VENUE: Royal Court Hotel

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30.			

ANNEX 4: MINUTES OF STAKEHOLDER MEETING NO. II

MINUTES OF THE FINAL STAKEHOLDERS MEETING ON ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT FOR THE REHABILITATION OF BERTHS 1-14 AT THE PORT OF MOMBASA

DATE: WEDNESDAY, SEPTEMBER 7TH, 2016 VENUE: ROYAL COURT HOTEL

1.1 Purpose of Meeting

Integrating environmental and social considerations in development initiatives is one of the prerequisites for achieving sustainable development. This involves several actors with diverse interests underpinning the need for a formal stakeholders' engagement process to ensure key concerns are addressed.

The Environment Management and Coordination Act, 1999 provides for stakeholder consultation during environmental and Social impact assessment (ESIA). This final stakeholder's consultation meeting was held in compliance with the requirements of the Acts but also provided an opportunity for public participation in the management, protection and conservation of the environment as stipulated in the Constitution of Kenya 2010.

1.2 Agenda

i. To share details of the proposed project with the stakeholders;
ii. To provide a comprehensive feedback on key findings based on issues investigated in the ESIA study;
iii. Obtain inputs from stakeholders for consideration during preparation of the final report of the ESIA study;
iv. AOB.

1.3 Introduction of Participants and climate setting

The meeting began at 10:15 am with a word of prayer from one of the participants. This was followed by introductions which brought out the diversity in expertise of the participants as well as their multi-sectoral backgrounds.

1.4 Project Brief by Eng. Kennedy Nyagah (KPA)

Eng Kennedy Nyagah of Kenya Ports Authority gave a brief history of the port pointing out that it had expanded over the years from the time it was established in 1978. Making reference of the detailed presentation made in the previous stakeholders' meeting held in May 2016, he reiterated the scope of the current project which will cover berths 1 to 14. He then informed the participants of the two main objectives of the project which are:

i) to increase the port's productivity and reduce cost and
ii) to rehabilitate existing structures where feasible.

He pointed out that the original design of the berths was appropriate for the 1st to 3rd generation of ships ranging between 100 and 200m wide and that it did not consider long term expansion potentials as it cannot handle the current vessels which are much wider. Further, the condition survey images revealed the

dilapidated status of the berthing structures and the need for yard improvement in other areas. These challenges have necessitated the re-design of the port to take care of the current and future shipping needs.

The proposed activities will be in the form of straightening, deepening and strengthening of the berths to enable them accommodate bigger vessels and to withstand the high salinity of the marine environment. He justified the proposed moves as having a projected potential to double the handling capacity of the port.

He then gave an outlook of the phases of the project and progress made so far as shown below:-

1. Financial and economic appraisal;-to be finalized based on the ongoing ESIA study report
2. ESIA study-The first meeting was held in May and the current meeting serves as the second and final stakeholders consultation meeting before the report is sent to NEMA;
3. Ground investigation: -set to start in a month's time and upon finalization of the ESIA study
4. Detailed design-90 % complete
5. Procurement-To be done upon finalization of the pending phases.

1.4.1 Remarks by Mr. Denis Muganga - (KPA)

The basic intervention in the project is to expand the ports capacity. He pointed out that the ports handling capacity has grown steadily over the years at 9.4 % per annum to 1.76 million TEUs currently, and targeting 1.8 million TEUs per annum by 2018. Some of the projects that have been undertaken to realize these achievements include construction of the first terminal and the more recent completion of the second terminal west of Kipevu with a capacity of 550 000 TEUs. He acknowledged the support the authority has received from Trademark East Africa to undertake the project and informed participants of the authority's green port policy which is its commitment to preserve and take care of the environment. He emphasized that the concern for the integrity of the environment amidst development was the driving force behind ensuring that as part of the port operations, each project has EIA conducted to ensure the project is in line with the preservation of the environment and life.

1.4.2 Remarks by Port Environment Officer (KPA)

The officer began his remarks by thanking the consultant's team for undertaking the ESIA study and the stakeholders for availing themselves for the feedback meeting. He then urged the participants to work consistently in ensuring the environment in its totality is properly protected. He remarked that failure to take care of the marine environment would negatively impact on the ocean. He pointed out that the authority considers every project to be as important as the environment hence they ensure Environmental Impact Assessments are conducted for all proposed projects and that the developed management plans are implemented fully.

1.5 ESIA Presentation

1.5.1 Overview of findings - Mr. Hezekiah Adala

The aim of the study was to evaluate the environmental and social issues related to the rehabilitation, straightening, strengthening and deepening of berths 1 to 14. The impacts considered were both on the marine environment and terrestrial environment and these reverberate beyond the project area. He proceeded to give a summary of the ESIA process which includes screening; scoping; conducting baseline studies; policy, institutional and regulatory considerations and identification of potential impacts and mitigation

measures. The methodology used to conduct the assessment include literature review, field studies (both for ecological and social baseline), stakeholders' consultations, chemical survey, fisheries survey and oceanographic assessment as the main components. He emphasized on the essence of stakeholders consultation stating it is a requirement of the constitution of Kenya and the EMCA Act which ensures disclosure of the proposed project's details to stakeholders and that their views are captured. Having given the overall flow of activities, he moved on to present the overall key findings of the socioeconomic, oceanographic, fisheries and chemical assessments.

1.5.2 Key ecological issues - Mr. Patrick Gwada

Mr Gwada began by an explanation of the approach used in sampling stating that the Berths were treated in clusters (1 to 5; 7 to 10 and 11 to 14) and that the ecological sampling focused on key issues identified. He listed other important infrastructural areas in close proximity to the project area such as the Mtongwe Ferry, Likoni Ferry, oil jetty, Kibarani dumping site and the Makupa Causeway. He brought the attention of the stakeholders to the initial gazettement of the mangroves which was in 1895 pointing out the significant degradation of the ecosystem that has been experienced over the years with the major event being an oil spill in 1988. Massive death of mangroves could have been a major factor in the conversion of Kibarani area into a dumping site.

Mombasa marine protected area covers 210 Km2 and it is nearly the size of Mombasa County with its boundaries very close to the project area hence a very significant area that was considered in the study. Mapping had been done of priority coral zones which act as coral gardens and key in conservation and tourism. Other mapped areas include the marine turtle conservation areas, beaches, Fort Jesus, forests, key mariculture areas and creeks. Stone fish, a rare species in Kenya, had been found around the old port hence such areas need conservation.

There are on ongoing co-management efforts in fisheries to support communities through implementation of guidelines on establishment and operation of co-management areas developed by CORDIO East Africa. International best practices like the Environmental, health and safety guidelines for ports and harbours developed by the International Finance Corporation can be adopted in the project. Regarding dredging activities, the turbidity is minimal and may not go beyond the access channel and impact on coral gardens and MPA. Dredging and dumping dredged materials should be conducted during the North East Monsoon season when the plume direction is away from the MPA and coral gardens hence very minimal potential impacts if any. The proponent should develop and implement an operational plan that strictly meets the international standards.

1.5.3 Questions and Answers

A plenary session was then ushered in to allow stakeholders to raise questions and provide any additional input.

1.6 Issues raised on the presentations

Issue of Concern/Institution	Section of presentations	Response/Action
1. The ESIA study has been done comprehensively. The current traffic jams being experienced in Mombasa can be traced back to the port however, from the presentation, it is not clear on how the additional stress on the roads due to the current expansion of the port will be mitigated. **(KENGEN)**	**Project presentation**	The Kenya National Highway Authority (KNHA) has been working with KPA and has factored expansion of the port in its plans to address projected impacts of the project. Some areas being worked on include the roundabout to Mariakani; dual carriage from Digo Road to Jomvu; replacement of the Changamwe roundabout with a two-level interchange road to cater for tracks from Kipevu to Nairobi and from Nairobi to Kipevu; access road to the Moi international airport; construction of the Dongo Kundu by-pass; Mwache dual interchange **(KeNHA)** KPA is working closely with other stakeholders such as the county government which is looking at issues of congestion within Mombasa city. The authority is considering having a track marshaling yard to hold the tracks and allow them to move to the port based on appointment. In addition the standard gauge railway is expected to be completed by mid 2017 and will ease the movement of tracks in and out of the port. Further, the revised master plan (2015-2035) for Mombasa has factored construction of SGR and movement of trucks**. (KPA)**
2. The ESIA study is quite good. However some impacts stated are likely to create conflicts as they touch on fisheries and will involve dealing with humans especially where compensations will be done. There is need for a vetting desk to address conflicts between real fishers and impostors. **(SDF)**	ESIA Study	The study report has made reference of conflicts and the need to actively engage stakeholders including the local communities in the entire process. The action plan will have a redress mechanism and will require further engagement with stakeholders on how to go about this. Though the impacts could be small in terms of fisheries, the overall impact from a livelihoods perspective is quite significant hence early engagement is key for all those likely to be affected to feel they are part of the process. **(Consultant)** A vetting desk will be established and hosted by the Authority. Prior to commencement of the project a detailed environmental management and monitoring plan will be prepared on how the contractor will implement the recommendations of the ESIA, including conflict resolution. (KPA) State Department of Fisheries should avail a legitimate list of fishermen during the compensation process to avoid conflicts and imposters. A group compensation is more

		likely as opposed to individual settlements (KPA)
3. With regards to dredging, it is not coming out clearly where the dumping will be done. In the past dumping was done in areas where the materials finally drifted to the marine park**. (SDF)**	ESIA Study	Dumping will be done at the same location as during dredging of the Access channel. Dredging activities be conducted during the NE monsoon period to reduce any risks of the materials drifting to sensitive areas along the coastline. The location will be the approved zone for ocean dumping. The materials dredged from the 3rd cluster are expected to have significant impacts due to the chromium levels hence land based disposal will be proposed. Proper containment will be factored to ensure surrounding soils are not contaminated**.(KPA)** Businessmen sometimes do not to comply with stipulated dumping locations hence monitoring should be done to ensure all vessels involved in the exercise comply with the dumping specifications. **(Kenya Navy)** The kind of equipment and vessels used for the dredging activity is equipped with GPS technology that has a log mechanism , a trip is logged from excavation to dumping site hence the authority can track the entire movement of the vessel . These specifications will be articulated during procurement of vessels. In a previous capital dredging project, the vessels were tracked and one could clearly see the route used by the vessel. The information is shared with NEMA daily hence action can be taken on errant persons**. (KPA)**
4. Considering the possibility of oil spill, is there a contingency plan in place**.(CORDIO EA)**		Kenya is well prepared to deal with oil spills considering the equipment available at KPA Pollution Control Centre and oil spill drills undertaken by the Oil Spill Mutual Aid Group (OSMAG). The country has prepared and implemented a National Oil Spill Response Contingency Plan. The pollution control centre in KPA is among the best equipped centres in the continent coming second after South Africa. The contingency measures by KPA and other stakeholders are among the best in the region. In addition the Kenya Maritime Authority has a regional maritime rescue coordination centre (RMRCC) monitoring the ports**.(KPA)**
5. Has the Assessment considered the long term effects of climate change in terms of sea level rise on the		According to projections the rise is in the range of 1meter by 2100 hence the flooding potentials have no impact on the dredging activities.(Consultant)

port**.(CORDIO EA)**		
6. Fishing within the port area is done mainly by the small scale fishermen. Is KPA doing anything to address the associated security concerns as some fishermen have been found within the naval base? **(Kenya Navy).**	**Project presentation**	Kilindini is a port channel hence port activities take precedence. The Authority is cognizant of the fishermen's need of livelihood. The challenge is in the nature of fishermen as they tend to pursue fish even in restricted or unsafe zones. Sensitizations are however on going on these concerns. **(KPA)** The maritime security committee has developed standard operating procedures for fishermen operating along the creek and can know when they come in or leave and where ships are. The fishermen are being sensitized that they can only be allowed to have innocent passage in restricted areas. They are also not allowed to come near a ferry**.(SDF)**
7.Aare there measures in place by KPA to address delays and congestions in the marine environment considering the projected increase in capacity to handle larger vessels **(KMA)**	**Project presentation**	Different approaches are being used to address congestion issues for instance it is anticipated that the ability to handle larger vessels will lead to reduction in the number of vessels as more cargo can fit in one vessel. On the other hand the port has a commitment to reduce the ship turn-around time to 48 hours or 2 days. This currently stands at 2.4-2.5 days hence moving towards the target and the faster clearance is expected to ease congestion**.** A productivity improvement plan has also been done on how to manage all vessels from how they come in, to waiting and allocation to different berths. This will further help in clearing the channel as the activities will be managed within the port facility. **(KPA)** The control tower at the port, established in 2010, enables the controller to see the entire 360 degrees over a 20 km radius distance from KPA hence help in managing traffic entering and leaving the port. **(KPA)**
8. Vessels will require seaworthiness certificates hence KPA should contact KMA to ensure vessels are inspected and that they comply with the set standards. **(KMA)**	**Project presentation**	Pilots are aware of the certification requirements for their vessels and will take care of the process at the right time**.(KPA)**
10. Was an assessment of species on the sea grass conducted considering marine	ESIA study	Yes.. the ESIA study was very detailed and a mapping was conducted indicating locations of sea grass areas close to the project area of influence

life forage in these areas? Mitigation measures should consider these species **(Bamburi cement).**		
11. What will be the frequency of future dredging as this is critical in determining the financial implications and for long term planning. Are there allowable limits of dredging or is it just adequate to have control points? **(Trade Mark East Africa)**	ESIA study	Frequency of dredging was not in the TORs of the consultant. However considering the Bathymetry and characteristics of the upper part of the creek, currents are stronger going outside of the creek hence flush materials outside the system contributing to self-maintenance of the channel. Consequently the frequency of dredging is likely to be lower. However the maintenance dredging will depend on land use of the upper part of the channel. KPA should engage other stakeholders to ensure good planning and land use practices in the upper Mwache creek. Degradation, erosion and siltation should be minimized. **(Consultant)**
12. The lowest and highest projected sea levels for the Port area need to be known as these are key in long term planning **(Trade Mark East Africa)**	ESIA study	Noted. **(Consultant)**
13. Are there intentions to widen the channel? Currently there are some relatively narrow sections such as near Likoni ferry that have made it difficult for two ships to maneuver at the same time hence this can only be a bigger challenge with introduction of larger ships. (**Kenya Navy)**	Project presentation	Traffic within the channel is being modeled by marine pilots. The simulation is still work in progress to check on the effect of bigger vessels. In 2012 the channel was widened to 300meters. The next phase of dredging will involve checking the challenges and conflicts in navigating through the channel. If the existing right of way is considered insufficient further expansion can be undertaken. In terms of operations, the ships come in one at a time and the current width of the channel is appropriate for the largest vessel. (**KPA).**
14. Is it possible that the dredging activities will lead to transportation and settlement of sediments to the naval base side of the creek? If so, can dredging be done concurrently on both sides of the creek to ensure that depths in both areas are not affected?(**Kenya**	Project presentation	Dredging is preceded by checking current levels of sediment through the entire channel using echo-sounding. The data is then used to ascertain if other areas are affected of not. It is only upon certification that the sediment levels meet requirements for dredging that the actual exercise will be completed**.(KPA)** Recommended dredging uses trailing suction dredger where the dredged materials are sucked and deposited in the vessel to ensure no sediment traverse the channel.

Navy)		**(Consultant)**
15. Baseline outlined the potential pollution by heavy metals and other substances. Marine debris pollution form land based activities and ships should be included. **(CDA)**	ESIA Study	Marine debris is a complex issue. There is no baseline survey for the Kenya waters though there are 14 mitigation measures to deal with marine debris proposed in the ESIA

1.7 AOB

There was no AOB.

1.8 Closing remarks and vote of thanks

1.8.1 General remarks by head of consultants team, Eng. Adala

The team leader thanked the stakeholders for the interactive session that had made the exercise a success. In comparing the meeting to other forums, he pointed out that this had been a more focused meeting with a lot of good will as stakeholders were not out to criticize the work that had been done but had raised pertinent issues and proposed relevant solutions. He assured the stakeholders that all areas of concern and weaknesses had been noted and will be addressed before submission of the final report to NEMA. He further invited stakeholders to look out for and comment further on the report during the 60 days period upon its publication on two widely read dailies by NEMA.

1.8.2 Closing remarks by Eng. Nyaga, (KPA)

Mr Nyaga thanked the stakeholders for purposing to attend the meeting. He acknowledged the sacrifice that stakeholders had made to be in such a forum considering it had been convened at a time presumed to be one of the commonly busiest days of the week .He commended the role played by KeNHA representative in elaborating interventions being taken to address the congestion issues in Mombasa County which is home to the port. He further applauded the partnerships with other institutions such as the Kenya Railways Corporation, Kenya Maritime Authority and State Department of Fisheries and Blue Economy who are actively involved in the port's plan. He cited the good will form KMA and the projected increase in use of rail transport from the current 5% to 60% as examples of the benefits of such collaboration. Finally, he urged all the stakeholders to work hand in hand with the Authority for the success of the project.

1.8.3 Closing remarks Hannah Ngugi (Trade Mark East Africa)

Madam Ngugi, a representative of the financier, emphasized on her institution's keenness on matters of the environment. She pointed out that the environment is a key thematic area that cuts across all projects hence its increased prioritization in proposed initiatives. She acknowledged the significance of stakeholder engagement and assured participants that the recommendations and concerns raised will be considered to minimize challenges during implementation of the project. She explained that Trade Mark 's focus on the Port of Mombasa as a gate way to East Africa together with other ports such as Port of Dar Es Salaam stem from the company's goal of promoting trade in East Africa. To this end, she informed stakeholders that the company has implemented several projects within the port to help it meet its objectives. On the next step, she informed participants that an external evaluation by specific key international institutions, including banks will be conducted to ensure the project complies with the set standards. She expressed optimism that the project will transform the Port of Mombasa. She further informed participants that Trade Mark was also involved in financing projects along the Northern corridor which will help address congestion and contribute towards ease of doing business. She urged KPA to consider mitigation measures proposed in the ESIA, emphasizing on the need for effective enforcement to ensure disposal is done at the designated place.

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT FOR REHABILITATION OF BERTHS NO. 1 – 14

SHM II ATTENDANCE REGISTER

Date: 7th September 2016 **VENUE: Royal Court Hotel**

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ANNEX 5: KEY INFORMANT INTERVIEW GUIDE

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT
STUDY FOR REHABILITATION OF BERTHS 1-14

KEY INFORMANT INTERVIEW GUIDE

Location _____ Date:____/____/ 2016

Part I. Personal Information

1. Residence
2. Gender: Male/female
3. Age
4. Marital status
5. Education/ literacy level
6. Occupation
7. Religion

Community services

8. Health facilities used by the community
9. Educational facilities used by the community
10. Electricity and other sources of energy
11. Potable water supply and sanitation services
12. Security arrangements in the area
13. Religious places available in the area
14. Leadership arrangements in the area

Recreational activities

15. Recreational sites available to the residents in the project area
16. Level of dependence on the recreational site including frequency of visit to the site(s)
17. Alternative recreational sites (their location and distance from the project site) ease of accessibility

Fisheries activities

18. Fishing grounds
19. Level of dependence on the fishing grounds including frequency of visit to the landing site (number of days fishing is done in a week)
20. Number of fishers using the landing site
21. Membership to Beach Management Units
22. Number of fishing boats
23. Fish landings
24. Fishers' residence
25. Distance of fishers residences to the landing sites
26. Type of gear(s) used
27. Type of vessel used
28. Vessel ownership

Opinion about the rehabilitation works by KPA

29. Aware of the planned rehabilitation works by KPA on berths 1-14
30. Any anticipated positive social and economic impacts from the proposed rehabilitation works
31. Any anticipated adverse social impacts from the proposed rehabilitation works
32. Suggestions on mitigation measures

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