THE GOVERNMENT OF THE REPUBLIC OF KENYA
KENYA PORTS AUTHORITY

ENVIRONMENTAL & SOCIAL IMPACT ASSESSMENT STUDY REPORT

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) STUDY FOR THE PROPOSED MOMBASA PORT DEVELOPMENT PROJECT – PHASE III

LOCATED: GPS COORDINATES: 4°02'54.4"S 39°36'39.6"E, PORT REITZ, MOMBASA COUNTY.

Consultant:	Sub Consultants/ Firm of Experts
Japan Port Consultants in association with BAC GKA JV Co. Ltd	**MAZINGIRA & ENGINEERING CONSULTANTS LTD** 1st Floor, Maisha Heights P.O Box 6857-01000, Thika Tel: 0722977377/0721203898 E-mail: info@mazingiraconsultants.com Website: www.mazingiraconsultants.com

CERTIFICATION

FIRM OF EXPERTS

We, the undersigned, submit this Environmental & Social Impact Assessment Study Report for the Proposed **Mombasa Port Development Project-Phase III (MPDP)" (Berth No. 23)**. The Terms of Reference has been carried out in accordance with the Environmental Management and Coordination Act (Amendment) 2015 and Environmental (Impact Assessment and Audit) Regulations, 2003.

Name of Firm of Experts:

MAZINGIRA & ENGINEERING CONSULTANTS LTD.

NEMA Reg. No. 1734

Signature/ Official Stamp:________________ Date:________________

MAZINGIRA & ENGINEERING CONSULTANTS LTD ★ P.O. BOX 1457, THIKA ★

Designation: **LEAD EXPERT/DIRECTOR**

SIMON MATHENGE WANYITU

Lead Expert (NEMA) Reg. No. 0646

PROPONENT

We, the undersigned, submit this Environmental & Social Impact Assessment Study Report for the Proposed **Mombasa Port Development Project-Phase III (MPDP)" (Berth No. 23)**. The Terms of Reference has been carried out in accordance with the Environmental Management and Coordination Act (Amendment) 2015 and Environmental (Impact Assessment and Audit) Regulations, 2003.

Name: DANIEL .M. GITHINJI

Signature/ Official Stamp:________________ Date: 03/09/2024.

MANAGER SAFETY HEALTH & ENVIRONMENT
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MOMBASA

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MOMBASA

ACKNOWLEDGEMENT

We would like to express our sincere gratitude to Japan Port Consultants, Ltd in association with BAC/ GKA JV Co. Ltd (the Consultants) for trusting and engaging our firm expertise in delivering successful ESIA report delivered a world class analysis of impacts, mitigation and consultation. To Kenya Ports Authority (the Proponent) for all the support and guidance accorded to the study team throughout the process. To all those who participated, supported and contributed to the successful completion of this report, thank you.

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Special thanks to Kenya Marine and Fisheries Research Institute (KEMFRI) for providing essential resources, data, and expertise that enriched our understanding and analysis of the marine environmental issues addressed in this report.

We would also like to acknowledge the support of various stakeholders including members of the public within and without the project area, beach management units, stakeholders in the marine products and services value chain, tour operators, traders, community based organizations, professional bodies, private companies, government agencies, academic organizations and experts who participated in the stakeholder engagement exercises throughout the ESIA process. We appreciated your interest and resolve to protect the environment, and your comments were considered in the report preparation.

Finally, we appreciate the participation William Kagia my friend and partner who was very instrumental and supportive in delivering a credible report through a truly consultative process. Other members included Joseph Amuti, MaryDiana Wanjiku, Susan Muthoni and Beatrice Nyambura whose critical roles, reviews and constructive comments were instrumental in refining and finalizing the report.

Thank you all for your contributions and support.
Sincerely,

Simon Mathenge Wanyitu
Director and Lead Expert

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ACRONYMS AND ABBREVIATIONS

ADSA	Alcohol, Drugs and Substances of Abuse
AIDS	Acquired Immune Deficiency Syndrome
BOD	Biological Oxygen Demand
BMU	Beach Management Unit
COD	Chemical Oxygen Demand
DRC	Democratic Republic of Congo
EACC	East African Coastal Currents
EAM	East African Environmental Management Company Ltd
ECD	Empty Container Depot
EMCA	Environmental Management and Coordination Act
ESIA	Environmental and Social Impact Assessment
FAN	Forest Action Network
FGDs	Focus Group Discussions
GOK	Government of Kenya
GPS	Global Positioning System
GRC	The Grievance Redress Committee
ICB	Interlocking Concrete Block
IMLR	Inter Monsoon Long Rains
IMSR	Inter Monsoon Short Rains
ICZM	Integrated Coastal Zone Management
IECs	Important Environmental and Social Components
IMO	International Maritime Organization
ISPFS	International Ship and Port Facility Security
ISS	Integrated Security System
ITCZ	Inter Tropical Convergence Zone
JBIC	Japan Bank for International Cooperation
JICA	Japan International Cooperation Agency
JPC	Japan Port Consultants
KARI	Kenya Agricultural Research institute
KEFRI	Kenya Forestry Research Institute
KFS	Kenya Forest service
KMA	Kenya Maritime Authority
KMFRI	Kenya Marine & Fisheries Research Institute

KENHA	Kenya National Highways Authority
KMD	Kenya Meteorological department
KPA	Kenya Ports Authority
KWS	Kenya Wildlife Service
MPDP	Mombasa Port Development Project
MARPOL	International Convention for Prevention of Marine Pollution
MASW	Multichannel analysis of surface waves method
NEC	National Environmental Council
NEHRP	National Earthquake Hazards Reduction Program
NEMA	National Environment Management Authority
NEM	North Eastern Monsoon
NGOs	Non-Governmental Organizations
NTU	Nephelometric Turbidity Unit
ODA	Overseas Development Assistance
OSRAT	Oil Spill Response Action Team
PAPS	Project Affected Persons
PCI	Pacific Consultants International
RH	Royal Haskoning
RMG	Rail Mounted Gantry
RTG	Rubber Tyred Gantry
RTK	Real-Time Kinematic
SEC	South Equatorial Current
SH	Stakeholders
SLP	Sea Level Pressure
SSG	Ship to Shore Gantry
TDS	Total Dissolved Solids
TEU	Twenty-foot Equivalent Unit
TOR	Terms of Reference
TGS	Total Ground Slot
TSHD	Trailing Suction Hopper Dredger
TSS	Total Suspended Solids
UNEP	United Nations Environment Program
VECs	Valued Environmental and Social Components
WWF	World Wildlife Fund

EXECUTIVE SUMMARY

BACKGROUND

The Government of Kenya (GOK) works to eradicate poverty by fostering infrastructure-driven economic growth and enacting structural reform in a number of industries. This is the reason Mombasa Port's Development Project (MPDP) has been accorded top attention. The most important port in East and Central Africa, Mombasa Port is the main international commercial port in Kenya. The port serves as both Kenya's gateway and the hub port for the region, handling transit cargo to landlocked nations in central Africa like Uganda, Burundi, Rwanda, and the Eastern Democratic Republic of Congo. It offers direct connectivity to more than 80 ports globally. Additionally, a train line connects the port to Uganda.

Mombasa has been referred to as "the city of merchants" for many years, dating back to the era of Vasco Da Gama, when trade between the East Coast of Africa and the Far East was conducted out of Mombasa Old Port. After the Kenya-Uganda railways were built between 1895 and 1802, a new port was established to the west of Mombasa Island. Consequently, the port developed into one of the area's busiest trading hubs. Owing to its advantageous location halfway between South Africa and the Gulf of Aden, the port has seen a huge increase in traffic over time.

Kenya Ports Authority (KPA), also referred to as "the proponent" in this context, is a state corporation that operates under the Ministry of Roads and Transport and was founded in January 1978 through a parliamentary act. Along Kenya's coastline, the KPA is tasked with "maintaining, operating, improving, and regulating all scheduled seaports," which primarily include the Port of Mombasa and a number of smaller ports like Lamu, Malindi, Kilifi, Mtwapa, Kiunga, Shimoni, Funzi, and Vanga. The Authority also oversees the management of Embakasi, Eldoret, and Kisumu's inland container depots, in addition to inland waterways.

The GPS coordinates of the Kenya Ports Authority's Mombasa headquarters are 04°04'13.0"S, 39°39'52.0"E.

BRIEF OUTLINE AND JUSTIFICATION OF THE PROPOSED PROJECT

Kenya Ports Authority (KPA) intends to undertake development of “**Mombasa Port Development Project-Phase III (MPDP)” (Berth No. 23).** The proposed project is located at GPS Coordinates: 4°02'54.4"S 39°36'39.6"E. The proposed site is adjacent to an existing built-up area which is the operational berth 22 and support infrastructure which include the Standard Railway, a network of roads and a busy seaside which has an oil terminal among other port infrastructure. In the same neighbourhood we have a residential estate Port Reitz which overlooks the entire port. The proposed project was previously funded by the Japan International Cooperation Agency (JICA) under Overseas Development Assistance (ODA) loan and therefore JICA Environment and Social Considerations have been taken into account in the ESIA process.

The project consists of the following key activities.

- Construction of Berth No. 23 and Container Terminal

- Construction of Buildings and support facilities such as Administration, Maintenance Shop, Customs Warehouse with verification, Fire-substation, Power substation and etc.,
- Construction of Inner Roads and Parking Areas at the back of the Container Terminal
- Construction of Access Road connecting the new Container Terminal to the Nairobi and inland bound highway
- Construction of utilities for supply of water and electricity communication, sewage, security, etc.
- Procurement of Equipment
- Installation of a Integrated Security System
- Other Miscellaneous Works

The main aim of the proposed project is to develop and expand the container terminal in Mombasa Port at the western side of the existing Kipevu Oil Terminal (“KOT”) next to MPDP Phase 1 and 2 (berths No. 20 & 21). The port of Mombasa is one of the main ports in east Africa and serves landlocked countries such as Uganda, Rwanda and Burundi. Over the years, cargo volumes have increased at the port therefore raising the necessity for the port to increase its container handling and storage capacity as well as have the ability to accommodate larger vessels. Failure to this, the port may become less competitive in the region and eventually become a feeder port. The current annual cargo throughput is 35.96 million metric tonnes and 1.62 million TEUs according to the KPA website. "TEU'' stands for "Twenty-foot Equivalent Unit." It's a standard unit of measurement in the shipping industry used to describe the cargo capacity or volume of a container ship or container terminal.

The port expansion pertains to the act of augmenting a port's capacity, infrastructure, and amenities to suit the escalating maritime operations and the needs of the country and regional economy. The construction of new berth 23, associated facilities, , and construction of access road are some examples of this expansion. In order to make more room for port-related operations, including container storage yards, port development may also entail land reclamation as is the case with the current development. The goal of the expansion is to improve the port's functionality, efficiency, and competitiveness in order to promote economic growth and ease the flow of people and products. However, port development project may have substantial effects on the environment, society, and economy. These effects have been carefully considered and lessened by suitable planning, legislation, and stakeholder involvement.

In order to deepen harbour basin and develop access road, dredging will be carried out and will entail the excavation and removal of silt, debris, and sediments. Silt and debris will be deposited in an approved dumping site in the high seas. The desilted sections will be backfilled with specially selected coarse sea sand which will be compacted. The process of filling in coastal or marine areas with dredged sea sand results in the formation of new land areas. This process is known as land reclamation. This reclaimed area will be developed further for building the new berth 23 with all amenities as detailed in design drawings attached to this report. The reclamation of land may result in significant ecological impacts, such as the destruction of marine ecosystems, the modification of coastal dynamics, and the loss of habitat.

Channelization will involve the modification of the Kilindini harbour to create a navigable channel for maritime traffic which will provide a turning and docking zone with a depth of over 15 metres. This will include straightening, deepening, or widening the existing channel to improve access to the new berth, reduce navigation hazards, and facilitate the movement of ships.

OBJECTIVES OF THE PROJECT

The port modernization and capacity improvements are being conceived with an objective to promote regional integration, enhancing the country's potential to continue to serve as a major centre for trade, logistics and distribution within the East African markets.

The improvement of the Port of Mombasa is one of the nation's key aims to facilitate economic growth. The potential to develop the ports assets is currently high, given recent increase in growth figures. The various alternatives for each of the proposed project components and the recommended options have been considered based on the **Mombasa Port Master Plan and Business Plan Report, 2023.**

ESIA STUDY FOR MOMBASA PORT DEVELOPMENT PROJECT – PHASE I, II AND III

The proposed project is classified as a high-risk project under Legal Notice 31 (Amendment of Second Schedule of EMCA 1999). Further Legal Notice 32 (Environmental (Impact Assessment and Audit) (Amendment) Regulations, 2019) requires projects classified under high-risk projects to conduct and submit to NEMA an Environmental & Social Impact Assessment Study Report.

The Environmental and Social Impact Assessment study for the proposed Mombasa Port Development Project – Phase III (the Project) is being carried out by **Mazingira & Engineering Consultants Ltd** (Under sub contract from **Japan Port Consultants Ltd in association with BAC/GKA JV Co. Limited**) on behalf of **Kenya Ports Authority**. Mazingira & Engineering Consultants Limited is a Licensed NEMA Firm of Experts (ESIA/EA Expert Reg. No. 1743) and works with a team of experts with a proven track record in environment impact assessment, environment audit/monitoring and related services in the country. The team has undertaken numerous development projects since its inception in 2007 for corporate, Institutions, GOK, individual, local and international clients, providing top-quality environmental impact assessments and environmental management plans.

The study examines the potential impacts of construction and operation of a 1 Berth, 3.1 km Access Road, Reclamation, and Dredging works at the Port of Mombasa, west of Kipevu Oil Terminal. The Environmental and Social Impact Assessment (ESIA) Study Report, prepared in 2007, covers MPDP Phases I, II, and III. The report includes detailed studies on engineering designs, oceanography, hydrology, and coastal dynamics to ensure proper engineering works during construction. The project began in September 2018 and completed in May 2022.

NEMA notified KPA in October 2022 to carry out a fresh ESIA Study for implementation of Phase III based on the following reasons:

a. Considerable time lapse since when the Environmental Impact Assessment license was issued in the year 2007.

b. Significant change in the baseline environmental and social conditions of the terminal from the time the Environmental Impact Assessment was done.

c. The scope of the container terminal modernization activity includes dredging and sand harvesting which has significant environmental and social risks.

This ESIA study has therefore been conducted in line with: this directive, Environmental Management and Coordination Act (EMCA), Environmental (Impact Assessment & Audits) 2003, relevant guidelines as well as the JICA Environmental and Social Considerations reviewed in 2022.

OBJECTIVE AND METHODOLOGIES OF THE STUDY

The objective of the ESIA is to examine the environmental and socio-economic aspects in the areas which may be affected by the project, and to propose mitigation measures in an ESMP. The main sections of the ESIA include definition of the legal and institutional frameworks, description of the project and the environment, impacts assessment, identification of mitigation measures, and presentation of an environmental and social management plan (ESMP).

The study was based on a laid down scientific qualitative procedures with most recent methodologies and analysis required in ESIA and strictly adhered to relevant legislative framework governing the maritime development projects. Our investigation examined the potential impact of the project on the project sites, immediate environment and surroundings with due regard to all project phases from construction, operation and decommissioning.

The expert also undertook numerous consultations where issues of concern and interest to the stakeholders/public were raised, discussed and documented. The proponent's commitment to continuous consultation is important and the experts wish to acknowledge the work of the proponent and the stakeholders in identifying relevant issues and responding in a constructive manner.

THE RELEVANT INSTITUTIONAL AND LEGAL FRAMEWORK FOR IMPLEMENTATION OF THE PROJECT

The Table below summarizes the relevant institutional and legal framework for implementation of the project.

TABLE 1 - APPLICABLE LAWS AND LEGISLATIONS

Sector	Laws and Regulations	Licensing & reporting requirement
General Laws/Regulation	Kenya Maritime Authority Act (Cap. 370).	▪ Kenya Maritime Port Development and management
	Kenya Ports Authority Act	▪ Establishment and functions of KPA
Principal Environmental Laws/Regulation	Environmental Management and Coordination Act No.8/1999 (Amended) 2015	▪ Environmental & Social Impact Assessment Report ▪ Environmental & Social Impact Assessment license

Environmental Impact Assessment	The Environmental (Impact, Audit and Strategic Assessment) Regulations, 2009 Legal Notice No.101 Environmental Impact Assessment Guidelines and Administrative Procedures, 2002	▪ Environmental & Social Impact Assessment Report ▪ Environmental & Social Impact Assessment license
Air quality	Environmental Management & Coordination (Air Quality) Regulations, 2014 (Legal Notice No.34)	▪ Baseline air quality report ▪ Quarterly air quality monitoring report (operation phase) ▪ Air quality emission license
Water quality	Environmental Management & Coordination (Water Quality) Regulations, 2006 (Legal Notice No.120)	▪ Baseline water quality report (fresh and marine water) ▪ Biannual water quality monitoring reports ▪ Effluent discharge license (operation phase)
Noise and Vibration	The Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulation, 2009 Legal Notice No.61	▪ Baseline noise and vibration benchmarking report ▪ Annual noise and vibration monitoring report (operation phase) ▪ Permit to emit noise in excess
Controlled Substances	The Environmental Management and Coordination (Controlled Substance) Regulation, 2009 Legal Notice No.61	▪ License to produce, handle, import/export-controlled substances. ▪ Duty to submit reports under section 26. (1)
Coastal Zone	The Environmental (Preservation of Pollution in Coastal Zone and Other Segments of The Environment) Regulation, 2003	▪ Port Waste Disposal Certificate: Under section 6(1) all ships are required to obtain a Port Waste Disposal Certificate issued by a Certified Port Waste Reception Facility at the Port.
Fisheries	Fisheries (Beach Management Unit) Regulations, 2007 Fisheries Management and Development Act No 35, 2016 The Fisheries Act Cap 378 The Merchant Shipping Act No. 4 of 2009	▪ Conservation of fisheries resources ▪ Establishment of beach management units
Biodiversity	The Environmental Management and Coordination (Conservation of Biological Diversity and Resources, Access to Genetic Resources and Benefit Sharing) Regulations, 2006 Legal Notice No.160	▪ ESIA License: Under section 5 ▪ Permit to access genetic resources under section 11
Water Resources	Water Act, 2016	▪ Conservation and utilization of water resources
Land use	Physical Planning Act, Cap 286, 1996 Land Act 2012	▪ Land use and planning
Occupational Safety and health	Occupational Safety and Health Act, 2007 Building Operations and Works of Engineering Construction Rules, 1984 Employment Act, 2007 HIV and AIDS Prevention and Control Act 2006	▪ Safety and Health of workers
Cultural	The National Museums and Heritage Act-Cap 216 (2006)	▪ Conservation of cultural sites and heritage

County Government of Mombasa Development Plans, Laws and Legislations	▪ County Government Act 2010 ▪ Mombasa County Annual Development Plan 2022/23 ▪ Mombasa County, Second County Integrated Development Plan (2018-2022) ▪ The Mombasa County Water and Sewerage Services Act, 2016 ▪ Mombasa County Solid Waste Management Act 2021	
Relevant National Policies	▪ Vision 2030 ▪ National Environment Policy 2013 ▪ Integrated Coastal Zone Management (ICZM) Policy ▪ National Climate Change Framework Policy ▪ Blue Economy ▪ Go Blue Initiative	
International Treaties and Conventions	▪ Marine Pollution (MARPOL) 1973 & 1978 ▪ London Convention and protocol ▪ Sustainable Development Goal 14-Life Below Water	

ORGANIZATIONAL RESPONSIBILITIES IN THE IMPLEMENTATION OF THE PROJECT INSTITUTIONS

The following institutions will have important roles to play in the implementation of this Project:

a. Ministry of Roads and Transport (MRT)

The parent Ministry for the Project will provide policy oversight and provide support to the KPA.

b. The Project Implementation Team (PIT)

Specifically, with regards to this Project, its implementation will be the overall responsibility of the KPA, and more specifically, the Project's PIT.

c. The National Environment Management Authority (NEMA)

NEMA"s mandate is to license projects, monitor the national environment, and so in collaboration with the Lead Agencies, can also monitor compliance with the National policies as they relate to this Project's ESIA. NEMA, with support from its county and regional offices will be responsible for overall external monitoring of the ESMP implementation.

d. Ministry of Environment, Climate Change and Forestry.

It oversees the NEMA and implementation of environmental laws and policies in Kenya.

e. The Grievance Redress Committee (GRC)

A Grievance Redress Committee (GRC) will be put in place by the Project and will play a crucial role in the Plan's implementation process by addressing complaints and concerns raised resulting from the Project activities.

f. Other national institutions

These include the Ministry of Regional Governments, Ministry of Lands and planning, Ministry of Agriculture, Livestock and Fisheries, Kenya Marine & Fishery Research Institute (KEMFRI), Wildlife Service (KWS), Kenya Wildlife Service (KWS), Kenya Forest Service (KWS), which may be required to offer mainly technical advice and/or regulatory information on land and resettlement related issues. The MOF will provide guidance on issues regarding the fisheries operators viz-a-viz the operations of the port and their harmonious co-existence. The KWS will address issues surrounding project activities within the vicinity of the Marine Parks. County Governments of Mombasa and Kwale are necessary in the institutional arrangements as the local authority where the KPA is located.

POTENTIAL ENVIRONMENTAL AND SOCIAL RISKS AND IMPACTS

The ESIA study has identified and addressed all significant impacts of the project. Both positive and negative significant impacts were addressed. The following were identified as major and moderate positive impacts:

- Increase in efficiency of cargo handling
- Increased efficiency of the Port Operations
- Employment opportunities
- Increased indirect income generation opportunities
- Creation of temporary employment during construction phase.
- Improvement in port revenue
- Improvement in local and national economy
- Improved trade with neighbouring countries
- Increased efficiency in removing containers outside the Port
- Increased efficiency of the Office and Port area.

Some of the major and moderate negative impacts identified include the following:

- Congestion and inconvenience due to restricted access of other port users
- Increased suspended sediment from piling, dredging activities impacting marine life
- Distraction in Marine biological environment
- Disturbance and loss of biodiversity from blockage of Movement of Water
- Risks to health and the biophysical environment from improper management of demolition waste
- Risk of Health and Safety related to port operations
- Occupational health and safety risks
- Risks of Communicable Diseases
- Risks of Gender Based Violence (GBV) and Violence against Children (VAC).
- For the construction of the access road some residents will be affected, acquired; all will be demolished and replaced with the required port access road.

This ESIA has defined cumulative impacts as impacts that are similar in all the sub-projects/components so that when their effect is combined, they have a larger impact on a valued receptor than if each of the sub-projects were implemented separately. Based on the climate risk assessment, the climate risks and hazards to the proposed project components and Project area are as follows:

- Extreme Temperatures
- Extreme Precipitation
- Drought
- Sea Level
- Extreme Wind
- Extreme Waves
- River Discharge

The key climate risks to the port are flooding due to extreme sea level, and port operations i.e., downtime due to high temperatures and extreme precipitation. The majority of impact due to climate risks is on downtime while the physical damage to assets is assessed to be limited. The total economic risk of climate change is very significant and adaptation measures can reduce these risks. The climate adaptation measures for each of the project components have been suggested

PUBLIC CONSULTATIONS AND STAKEHOLDER ENGAGEMENT

The project stakeholders extend through the entire region that is East Africa, whose economy is dependent on port operations directly or indirectly. The Kenyan economy is fully dependent on the port for imports and exports which makes every citizen a stakeholder. Coastal communities are more directly affected by port operations and are major stakeholders. The fishermen and tourism operators and their dependents derive their livelihoods from the sea and port operations have a direct impact on these livelihoods. The marine life, both fauna and flora, vegetation, natural movements, sea currents which may be affected by port operations and are recipients of the impacts. Survival, health and sustainability of the ecosystem that is marine life is also important for international bodies.

Any person, institution whether state or non-state, private or public, known or unknown who represents the interests of any stakeholder listed or non-listed is a stakeholder and their views were sought. Mapping, representative sampling, invitations, actual meetings and stakeholder views and suggestions have been captured in detail in the report.

The consultations generated valuable contributions to the proposed development. Majority of stakeholders support the idea of the project to be developed in the proposed area taking into consideration the potential for the growing of economic activities in the region and the country at large.

The views and major concerns raised by participants included:

- Loss of livelihood as a result of dredging and sand harvesting activities - fish smokers, fishermen, will be potentially displaced at least temporarily
- Project activities around the access road area will potentially impact the residents of Ngare area.

Other opinions and suggestions included are as follows:

- Need to address the potential impact of climate change on the facilities and project components during both the construction and operational phases - the Project design must integrate climate change adaptation and mitigation measures

A summary of the issues raised during the public consultations exercise is presented in section 6.5 of the report.

ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)

The following were identified as the key ESMP as implementation indicator as part of the project:

- Physical barriers for the reduction of the suspended particles
- Waste control, use of minimum disturbance techniques during construction for ensuring minimal changes to the aquatic environment.
- Create a clear system for identifying, responding to, and sanctioning GBV and VAC incidents.

Construction of Berth No. 23, Container Terminal, Buildings, support facilities

TABLE 2 – SUMMARISED ESMP FOR MITIGATION MEASURES

Activity	Potential negative impacts	Proposed mitigation measure
Berth 23 and Access Road Construction	Water Quality	• Loop Discharge of Overflow • Reduced Operations • Seasonal Considerations • Silt Curtains • Appropriate Stormwater and Sewage
	Sediment Quality	• Containment • Treatment • Sediment discharge monitoring • Dredged material quantity monitoring
	Destruction of Mangroves	• Habitat restoration by replanting 3000 mangrove seedlings along the coastline conservation location • Community Conservation Capacity Building
	Underwater piling noise	• Deployment and use of Bubble Curtains, Big Bubble Curtain, Little Bubble Curtain, Isolation Casings, Cofferdams and Hydro Sound Dampers (HSD) • Acoustic Improvement of the Piling Process • Vibratory Pile Driving • Drilled Foundations
	Air Quality	• Water Suppression • Dust Screens • Cover/ Contain
	Noise	• Noise Barriers • Construction Planning
	Vibration	Construction Planning
	Waste	• Put in place an elaborate waste management plan • Provide waste receptacles for dropping waste • Designate a temporally area for holding waste

		• Waste segregated on site before disposal. • Provide PPEs. • Waste to be disposed at Mwakirunge disposal site only
Sand Harvesting & Offshore Dumping	Seabed Biodiversity Loss from sedimentation and extraction	• Baseline Monitoring • Sensitivity Mapping • Establish guidelines for sustainable sand extraction techniques (e.g., seasonal harvesting, depth limits, site rotation, technology used) • Partnerships with research institutions and academic organizations
	Destruction and Stress of Corals from TSS	Coral Reef Monitoring plan - **Table 90**
	Sea Turtles Migration and Nesting Sites disruption	• Nesting Sites Status
Social	Physical Displacement	Relocation Land acquisition
	Loss of Livelihood	Compensation Livelihood Restoration Job Opportunities
	HIV-AIDS and ADSA Risk	Peer Education Testing Counselling
	Injuries and Accidents	• WIBA & Insurance for workers • Training • Maintenance of Equipment • Provision of PPE • Dedicated H&S Department (Min. 3 pax)
	Traffic	• Traffic Management
	Disturbance of Cultural Sites	• Stakeholder Engagement • Relocation of Sites
Cargo Operations	Water	• Capacity Building/ training of KPA staff • Installation and Maintenance of Biodigester • Clearing and cleaning of Storm Drains • Waste management
	Injuries and Accidents	• WIBA & Insurance for workers • Training • Maintenance of Equipment • Provision of PPE
	Air Quality	• Promotion of Cleaner Fuels • Reducing congestion • Regular Cleaning / Sweeping • Maintenance of Equipment
	Noise	• Maintenance of Equipment
	GHG Emissions/ Climate Change	• Shore Power Facility • Energy-saving Enhancements • Clean Energy Initiatives
Social	HIV-AIDS and ADSA Risk	• Peer Education • Testing

		• Counselling • Outreach

1. BACKGROUND

1.1. INTRODUCTION

The proposed project is referred to as **<u>"Mombasa Port Development Project-Phase III (MPDP)"</u> <u>(Berth No. 23).</u>** The proposed project is located at GPS Coordinates: 4°02'54.4"S 39°36'39.6"E.

The main aim of the proposed project is to develop and expand the container terminal in Mombasa Port at the western side of the existing Kipevu Oil Terminal ("KOT") next to MPDP Phase 1 and 2 (berths No. 20 & 21). The port of Mombasa is one of the main ports in east Africa and serves landlocked countries such as Uganda, Rwanda and Burundi. Over the years, cargo volumes have increased at the port therefore raising the necessity for the port to increase its container handling and storage capacity as well as have the ability to accommodate larger vessels. Failure to this, the port may become less competitive in the region and eventually become a feeder port.

1.2. PROJECT PROPONENT

Kenya Ports Authority (KPA) herein referred as 'the proponent' is a state corporation under the Ministry of Roads and Transport and which was established in January 1978 under an Act of Parliament. KPA is mandated to "maintain, operate, improve and regulate all scheduled seaports" along the Kenyan coastline including principally Port of Mombasa and other smaller ports including Lamu, Malindi, Kilifi, Mtwapa, Kiunga, Shimoni, Funzi and Vanga. In addition, the Authority manages Inland Waterways as well as Inland Container Depots at Embakasi, Eldoret and Kisumu.

The headquarters of the Kenya Ports Authority are located in Mombasa at GPS Coordinates: 04°04'13.0"S, 39°39'52.0"E.

1.3. OVERVIEW OF THE PROJECT

KPA intends to construct the Phase 3 (Berth 23) of Mombasa Port Development Project (MPDP) by reclamation of the West Kipevu to create an additional 1 berth (No 23). The proposed project also includes construction of a new port access road.

The project consists of the following activities. The major components are shown in Section 1.4.

a. Excavation of the ·seabed and offshore dumping
b. Sand Harvesting and Reclamation
c. Construction of Berth and Container Terminal with buildings and facilities
d. Construction of Access Road connecting the new Container Terminal to the Nairobi and inland bound highway

FIGURE 1 - PROJECT LOCATION

1.4. SCOPE OF WORKS/MAJOR ACTIVITIES OF THE PROPOSED PROJECT

The project consists of the following key activities.

- Construction of Berth No. 23 and Container Terminal
- Construction of Buildings and support facilities such as Administration, Maintenance Shop, Customs Warehouse with verification, Fire-substation, Power substation and etc.,
- Construction of Inner Roads and Parking Areas at the back of the Container Terminal
- Construction of Access Road connecting the new Container Terminal to the Nairobi and inland bound highway
- Construction of utilities for supply of water and electricity communication, sewage, security, etc.
- Procurement of Cargo Handling Equipment -Shop to Shore Gantry Cranes and
- Other Miscellaneous Works

Major construction activities will include:

- Excavation of the seabed and offshore dumping
- Sand Harvesting and Reclamation
- Dredging of the seabed and offshore dumping

1.5. PROJECT OBJECTIVE

The overall objective of the project is to meet the demand of capacity increase by expanding the container terminal at Mombasa port. "This will make the port of Mombasa a classic facility, achieve high productivity and guarantee efficient cargo freight services to importers and exporters.

The specific objectives are:

- To consolidate the new era of the port as a critical transport and logistics hub in the region.
- To transform the Mombasa port, the gateway to East and Central Africa, into the most efficient, competitive, modern and safe port in Africa.
- To transform Mombasa port into the region's transport and trade hub besides improving its efficiency and giving it a competitive edge.
- To catapult Kenya into the league of key global transshipment and commercial maritime hubs.
- To improve cargo handling, operational efficiency and decongest the port.

1.6. PURPOSE OF THE STUDY

The overall objective of the ESIA study is to ensure that potential environmental and social impacts associated with development of the Project are identified, assessed and managed appropriately to meet the compliance requirement of the Government of Kenya (GoK). Mitigation measures are then developed and incorporated into the project to eliminate, minimize or reduce adverse impacts and, where practicable, to enhance benefits.

The specific objectives are:

- To prepare a detailed environmental and social baseline situation.
- To predict and evaluate possible environmental and socio-economic impacts.
- To delineate Environmental Management Plan and Monitoring Plan.
- To develop Resettlement Action Plan.
- To develop Emergency Response Plan.
- To prepare Grievance Redressal Mechanism.

1.7. RATIONALE OF THE STUDY

The proposed project is classified as a 'high project category' by the Legal Notice 31 (Amendment of Second Schedule of EMCA 1999). Further Legal Notice 32 (Environmental (Impact Assessment and Audit) (Amendment) Regulations, 2019) requires projects classified under high-risk projects to submit to NEMA an Environmental and Social Impact Assessment (Full Study) Report for review and licensing.

This study has identified and evaluate potential impacts of the proposed project on environmental and socio-economic conditions in pre-construction, construction, operation phases and decommissioning phases. A detail Environmental and Social Management Plan (ESMP) has been proposed to mitigate the Project induced negative impacts. It is expected that the study will facilitate the planning and design of the proposed Project in more environment friendly manner so that implementation of the Project exerts lesser negative impacts and generate greater benefits. The study, would therefore, contribute in better understanding of whole range of environmental and socio-economic dimensions of the proposed interventions and help the KPA to be judicious in implementing the activities that are outlined in the Project and realize the Project objectives.

The Mombasa port's Environmental and Social Impact Assessment (ESIA) fulfils a number of vital functions.

1.7.1. Environmental Protection

There may be major alterations to the surrounding environment as a result of the port development or extension initiatives. By carrying out an ESIA, you may be confident that possible negative effects on the environment, such as pollution, habitat destruction, and resource depletion, are recognized and reduced to the least amount possible.

1.7.2. Mitigation of Social Impact

Port developments may have significant social effects, such as community uprooting, changes in means of subsistence, and cultural ramifications. These possible social effects are assessed through an ESIA, and recommendations are made for actions to improve the positive results and lessen the negative effects on the impacted populations.

1.7.3. Respect for Regulations

A lot of nations have laws requiring ESIA for major development projects, including port construction. Adherence to these guidelines guarantees that the project fulfils legal obligations and advances the objectives of sustainable development.

1.7.4. Engagement of Stakeholders

Consultation with local communities, NGOs, government agencies, and companies is a common part of ESIA processes. By ensuring that all views are taken into account during the decision-making process, this involvement serves to increase the project's social acceptance and decrease disagreements.

1.7.5. Risk Management

Project developers can integrate risk management strategies into project planning and design by using the ESIA to identify possible environmental and social hazards early in the project lifecycle. This lessens the possibility of expensive delays, legal conflicts, and reputational harm brought on by unforeseen consequences.

1.7.6. Sustainable Development

In the end, by striking a balance between social justice, environmental preservation, and economic growth, the Mombasa Port ESIA helps to advance sustainable development. The Environmental and Social Impact Assessment (ESIA) contributes to ensuring that development activities support the welfare of present and future generations by carefully weighing project alternatives and taking long-term implications into account.

To summarize, carrying out an Environmental and Social Impact Assessment (ESIA) for the Mombasa port is necessary in order to evaluate and handle the social and environmental consequences of port expansion initiatives, guarantee adherence to rules, involve stakeholders, mitigate risks, and foster sustainable growth.

1.8. PROJECT SCREENING AND CATEGORIZATION

The ESIA study aims to explain the legal context through identification of statutory requirements of law of the land, following the guidelines of the NEMA and the JICA Environmental and Social Framework including health and safety guidelines, against which the Project interventions are to be judged. Detailed assessment and evaluation of potential environmental and socio-economic impacts of the Project will then form the basis for designing the EMP.

Task 1: Description of the proposed Project.

Task 2: Description of the Environment (baseline situation)

a. Physical environment (Land resources, topography, climate and meteorology, hydrology, environmental quality, etc.).
b. Biological environment (corals, fisheries and ecological resources) and other aquatic life.
c. Socio-cultural environment (Social, cultural and archaeological issues).

Task 3: Policy, rules and regulatory framework.

Task 4: Analysis of alternatives.

Task 5: Identification, selection and rationalization of Important Environmental and Social

Components (IECs) or Valued Environmental Components (VECs) likely to be impacted by the interventions.

Task 6: Determination of potential environmental and social impacts of the proposed Project;

a. Pre-construction.
b. Construction phase.
c. Operation phase.
d. Decommissioning phase.

Task 8: Conduction of consultation meetings with the Personal Affected Parties (PAP), Project Interested Parties (PIP) and relevant stakeholders.

Task 9: Development of an Environmental and Social Management Plan (EMP) including Monitoring Plan.

Task 10: Development of Emergency Response and Disaster Management Plan.

Task 11: Integration of Climate Change Vulnerability Assessment.

Task 12: Risk and Hazard Assessment.

Task 13: Conduction of Consultation and Disclosure Meeting and Grievance Redress.

1.9. STRUCTURE OF THE ESIA REPORT

The main sections of the ESIA include; executive summary, introduction, nature of the project, location of the project, activities during all project phases, international, national and county environmental legislative and regulatory frameworks, potential environmental impacts and mitigation measures, analysis of alternatives, health/safety plan and accidents prevention action plan, strategic communication plan/public consultation, environmental management plan and Integration of climate change vulnerability assessment and conclusion and recommendation.

1.10. ESIA TEAM

The Environmental and Social Impact Assessment study for the proposed Mombasa Port Development Project – Phase III (the Project) was carried out by **Mazingira & Engineering Consultants Ltd** on behalf of **Kenya Ports Authority**. The study covered the possible impacts of the construction of berth 23 and dredging works at the port of Mombasa to the west of Kipevu Oil Terminal, Port Reitz.

Mazingira & Engineering Consultants Ltd is a Licensed NEMA Firm of Experts (ESIA/EA Expert Reg. No. 1743) and works with a team of experts with a proven track record of excellence focusing mainly on environmental management and monitoring. The team has undertaken numerous development projects since its inception in 2007 for corporate, Institutions, GOK, individual, local and international clients, providing top-quality environmental impact assessments and environmental management plans.

1.11. LIMITATIONS

Assessing the possible environmental and social effects of development projects, particularly port expansion through Environmental and Social Impact Assessment is important for anticipating and minimizing possible adverse effects. However, this undertaking as indeed in similar projects has several setbacks.

ESIA frequently concentrates on known direct consequences, possibly failing to sufficiently consider cumulative or indirect effects. It's possible that when port expansion occurs, indirect effects like heightened air and noise pollution, altered land use patterns, or traffic congestion won't get enough attention or will not be fully anticipated. The scope and depth of assessment is therefore never sufficient to predict and address impacts.

Prediction of effects is usually based on data which is collected and used in modeling and simulation. Such data as air quality, water quality, air and water movements, and turbidity among others is evaluated and results or models used to predict impacts. Inaccurate data or modeling affects predictive accuracy for future environment impacts.

To evaluate impacts, ESIA depends on precise and trustworthy data. However, data availability and accuracy may be limited, particularly as it involves measurement by third parties, for limited periods and limited budget. The assessment's robustness may also be impacted by variations in the quality of the data that is currently available.

The port is a part of larger regional or national development initiatives with many other components. When several projects work together or intensify already-existing environmental and social stresses, ESIA may find it difficult to appropriately account for cumulative effects. It is even difficult to assign cumulative impacts from the particular project.

Stakeholder engagement is a major component of the ESIA process. Determining possible effects and creating workable mitigation strategies require meaningful stakeholder engagement. Stakeholder involvement procedures, however, might not always be inclusive, transparent, or provide real chances for community participation, which could result in biased or incomplete evaluations. The time taken and the extent of stakeholder engagement is also limited.

ESIA identifies possible impacts and suggests ways to mitigate them, it can be difficult to ensure that these steps are carried out and monitored effectively over the course of a project. Lack of resources, knowledge, or regulatory oversight may make the application of mitigation measures less effective.

Weak enforcement of environmental laws or insufficient regulatory frameworks may compromise the effectiveness of ESIA in ensuring environmentally sustainable port development. In the absence of strong governmental supervision, developers can put profit before social and environmental concerns.

Port developments may have a lasting impact on communities and ecosystems. Adaptive management techniques to meet changing environmental and social conditions throughout time may not be given as much thought in ESIA since it frequently concentrates on short-term effects.

To overcome these constraints, the ESIA process has to be strengthened with better data gathering, stakeholder involvement, legal frameworks, and monitoring systems. Furthermore, incorporating resilience and sustainability concepts into port development design can lessen negative effects and encourage more sustainable results. This ESIA has built on previous experiences in development of the port and incorporated these in better data gathering and management, robust stakeholder engagement, improved designs and monitoring methods among others to achieve sustainable development. It has also incorporated climate change mainstreaming in the studies.

2. PROJECT DESCRIPTION AND DESIGN

2.1 INTRODUCTION

The Government of Kenya (GOK) undertakes structural reform in various sectors and focus on poverty reduction through economic growth driven by infrastructure improvement. It is for this reason that the development project of Mombasa Port is given high priority. Mombasa Port is the only international commercial port in Kenya and the most essential port of East Africa and Central Africa. The Port provides direct connectivity to over 80 Ports worldwide and plays roles of not only the gateway port of Kenya, but also the hub port in the area, dealing with the transit cargos to the landlocked countries in central Africa such as Uganda, Burundi, Rwanda and Eastern Democratic Republic of Congo. A railway line also runs from the Port to Uganda and Tanzania.

For years, Mombasa has been known as "the city of merchants". Dating back to the times of Vasco Da Gama when Mombasa old port was being used for trade between the East Coast of Africa and the Far East. After the construction of the Kenya Uganda railways (1895-1902) a new port was born west of Mombasa Island. Subsequently the Port became an increasingly busy trading post for the region. Due to its strategic location, midway between South Africa and the Gulf of Aden the Port has experienced tremendous traffic through the years.

The Port handles various types of cargo, including containers, petroleum products, bulk cargo, and vehicles, as the only port of international repute in the country accounting for approximately 70% of Kenya's total trade in 2021.

The Port is administrated and managed by Kenya Ports Authority (KPA), a wholly government-owned corporation. It is the premier port for east and central Africa. It serves not only the national economy, but also the great lakes region as shown in through the rail and major international road links from the Indian Ocean coastline into the interior of the greater hinterland. Somalia and Southern Sudan are also transit destinations from the Port.

In 2006, a feasibility Study for Mombasa Port Container Terminal Expansion Project (CT2) was conducted aiming at an increase of cargo handling capacity and to improve efficiency of management and operation in the Port, which contributes to social-economic development in the region including Kenya and neighboring countries. This was to be achieved by new container terminal expansion, channel and basin development, access road extension, and additional equipment provision to the Port.

As a result, in 2012 KPA commenced construction of Phase 1 – Berth 20 & 21 which went in operation in 2017. Phase 2 – Berth 22 commenced construction in 2018 and commenced operation in 2022.

FIGURE 2 - PHASE 1 - BERTH 20 & 21

FIGURE 3 - PHASE 2 – BERTH 22

In 2021, KPA commissioned Japan Port Consultants Ltd in association with BAC-GKA JV Co, Ltd as “the Consultant” to review the 2006 feasibility study and the necessity and implementation plan (construction) of Phase 3 – Berth 23 taking into account recent economic conditions, maritime market trend, legal and institutional framework, natural and environmental conditions, KPA’s management and financial status, and relevant undergoing projects (such as Lamu Port development and Dongo Kundu SEZ development projects).

The consultant was tasked with carrying out tasks in relation to Phase 3:

i. Review of Present Conditions of Mombasa Port Validation.
ii. Review of Management, Operation and Maintenance Systems of Mombasa Port.
iii. Review of Assessment for Financial Capacity of Kenya Ports Authority (KPA).
iv. Review of Environmental Considerations.
v. Review of Consulting Services/ Indices for Evaluation of Effects of the Project/ Evaluation in terms of IRR (Internal Rate of Return).
vi. Review of Legal and Institutional Framework.
vii. Environmental and Social Impact Assessment.
viii. Resettlement Action Plan.

2.2 PROJECT JUSTIFICATION

The Consultant carried out a detailed study on the necessity for development of Phase 3 by carrying out a demand forecast study as well as economic and financial analysis. The following major factors were taken into account:

- Demand Forecast
- Economic Feasibility of the Project
- Financial Analysis of the Client
- Port Related Projects
- KPA Master Plan
- Road and Rail development around the port
- Development of competitive ports in the region.
- Legal and Institutional Framework
- Environmental and Social Considerations

Results showed that in order for KPA to keep up with the demand forecast, development of Phase 3 is necessary. If the port does not develop Phase 3 and have it operational by the year 2032, the demand for containerized cargo will exceed the port's capacity to handle and turnaround ships efficiently. The study therefore recommends that due to a long project period of approximately, KPA should commence the proposed project in 2025/6.

Failure to meet the demand, the port of Mombasa will lose its competitive edge in the region and lose critical business for Kenya. The development of ports to handle larger vessels will also mitigate the risk of the Port becoming a feeder port in the future which will affect the country in terms of cost of goods and commodities as Kenya is Net Importer.

2.3 DESIGN CONDITIONS

Phase 3 is planned to construct a new Berth (No. 23) and Container Terminal to the west of the existing container terminal and shipping berths parallel to the turning basin of the Mombasa harbour. This location is characterised by the presence of naturally large water depths off approx. -15m so that vessels with large draughts can navigate.

FIGURE 4 - LOCATION OF PHASE III BERTH AND TERMINAL

The terminal will be constructed on reclaimed sand and a new access road will also be constructed to supplement the existing connecting and access road to Port Reitz area.

FIGURE 5 - ARTISTIC IMPRESSION OF CT2 INCLUDING PHASE 3
Source: The Consultant

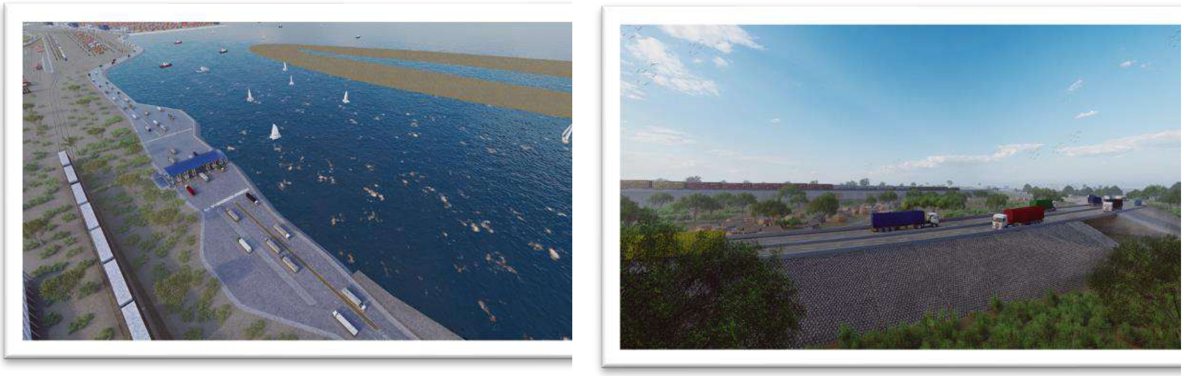


FIGURE 6 - ARTISTIC IMPRESSION OF THE ACCESS ROAD
Source: The Consultant

In order to gain an in-depth understanding of the conditions in the project site and to study the possible material sources, the proponent through the Consultant carried out natural conditions studies as follows:

- Topographical and Bathymetric Survey
- Geotechnical Survey
- Sand Source Survey

2.1.1 Topographical and Bathymetric Survey

The Consultant carried out topographical and bathymetric surveys as shown in the **Figure 7** below. Topographic survey was done in the area adjacent of Phase 2 Container Terminal as well as along the Kipevu link road (areas shaded green). Bathymetric survey was done on offshore areas shaded blue.

FIGURE 7 - TOPOGRAPHICAL AND BATHYMETRIC SURVEY AREA

(1) Bathymetric Survey

A single beam, CEE ECHO dual frequency echo sounder was used for obtaining accurate depths along the survey lines in the survey corridors. This versatile equipment has two transducers operating at 33 kHz and 210 kHz.

The echo sounder was calibrated using a bar check.

1) Transducer Location

The transducer is best installed as close as possible to the centre of the survey vessel to minimize the adverse impact to the survey data through the vessel movement. The transducer face was positioned to ensure minimal water turbulence or aeration from either the propeller or other sources such as cooling outlet pipes. The transducer was located so that the draft (i.e., depth below water surface) of the face is a minimum of 50cm (1.5 feet) below the surface.

2) GNSS Antenna Location

The GNSS antenna was positioned with a clear view of the sky and a minimum distance of 1m away from any transmitting antennas, electrical and communication equipment. 3) Survey line plan Survey line plans were applied for the entire survey as required by Guidelines for Special Order survey as per IHO SP 44, i.e. compulsory 100% bottom search with accuracy (95% confidence level), and depth accuracy for reduced depth (95% confidence level).

3) Track lines

Survey track lines parallel to the coastline were done with a maximum spacing of 10m. Crosslines perpendicular to the shore were also surveyed to check the survey data.

4) Accuracy of measurements

Accuracy of each surveyed point is within 0.10 m in the vertical (Z coordinate) and within 0.05m in the horizontal (X and Y coordinates) - in conformity with IHO Special Publication 44 for accuracy requirements as well as calculations for the Total Horizontal Uncertainty and Total Vertical Uncertainty requirements for a Special-Order Survey.

(2) Topographical Survey

To carry out detailed topo survey at the proposed project area using the most up-to-date surveying equipment such as total station, RTK, to examine the project site and all notable physical features both man-made and natural which shall be, but not limited to, buildings, monuments, places of worship, posts, pipelines, existing roads, cross-drainage structures, septic tanks, manholes etc. which are found on the ground that and are considered necessary to complete the detailed design and the estimation of quantities shall be surveyed. The summary of the methodology was as follows:

a. Establish the Main GPS control network to cover the whole of the survey area. The network shall comprise of 3 GPS control points established by GPS technology and shall be tied to the National Survey Grid, and levels related to the National Benchmarks.

b. Establish the Secondary Traverse Network to cover the whole of the survey area. The network to comprise of about 7 control points established by total station and a static rover.

c. Establish new Vertical Control Network to cover the whole the survey area. The length is about 1km.

d. Carry out topographical survey on land to provide access and to generate the centerline, cross section survey and observe all the surface structures.

e. Ensure center lines of the 20m wide conveyor belt corridors are set out, leveled, cross sectioned at every 10m interval.

During the survey, there were challenges with obtaining access and cooperation from the inhabitants and property owners. However, a series of consultations with both the local authorities and local leaders were held to resolve concerns raised.

(3) Findings

Findings showed that Water depths at the construction site for phase 3 yard range from 0 m to -3.5m CDL. The seabed is generally flat. It is noted that part of the area was partially reclaimed under Phase II of the project. The elevation in the reclaimed portion ranges from 1m to 5.4m.

At the turning basin, the depths range from -14.5m to -16m. In the area of interest for the development of the access road the terrain is generally flat with elevations ranging from 3m to 9m.

There is an existing LPG pipeline that runs southeast on the west end of Kipevu.

It is proposed that a more detailed investigation be carried out at detailed design stage to identify any other underwater objects of significance to construction work.

2.1.2 Geotechnical Survey

(1) General

The Consultant commissioned *Terraconsult Limited*, a Kenyan consulting firm that specializes in Geotechnical Investigations. All the fieldwork was carried out according to BS 5930: 2015 (code of practice for site investigations). Laboratory tests were done as stipulated in the British Standards (BS 1377); the American Society for Testing Materials (ASTM) designated D 2938-79 and D 2845-00. Design recommendations are in adherence to the Manual for the Geotechnical Design of Structures to Euro code 7(2013) and BS 8004.

(2) Field And Laboratory Procedure

The fieldwork for this investigation was conducted from 18th November 2022 to 08th December 2022. It consisted of drilling and sampling six (6 no.) exploratory boreholes to a maximum depth of 30.0m and two (2no.) trial pits below existing grade. The drilling equipment consisted of a rotary drilling rig (GY-150) equipped with conventional soil sampling and testing tools. The supervising technician logged the borings and examined the samples as they were obtained. The samples were properly identified by visual inspection, catalogued in wooden core boxes/sealed sample containers and transferred to the laboratory for testing. A geotechnical engineer later reviewed the samples for consistency of description.

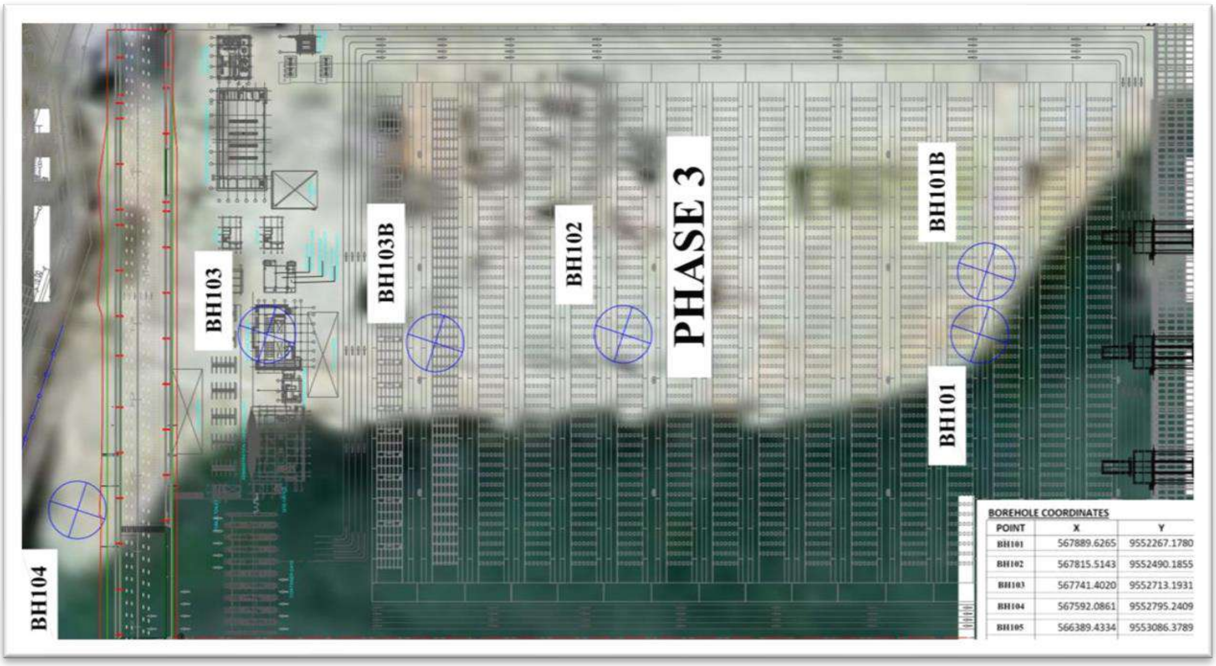


FIGURE 8 - GEOTECHNICAL INVESTIGATION LOCATIONS

Water level measurements were conducted in the open borehole upon completion of drilling. The water was allowed to equilibrate for about 30 minutes before taking the final measurement. The final water rest level is recorded in the borehole logs.

(3) Findings

The boreholes portray whitish to whitish brown to blackish brown, coarse-grained sand and silty sands to fine grained blackish brown silts at different depths in the ground. These soils are underlain by highly decomposed and moderately weathered, highly stratified, fissile, and flaky, fine grained, very soft shale characterized by open, rough and undulating subvertical fracture surfaces.

2.1.3 Seismic Survey

(1) Purpose

The purpose of this seismic survey was to evaluate the subsurface strata and material that may be encountered during the process of construction as well as the thickness of the unconsolidated sediments.

The scope of this investigation included mobilization to the site and the conduction of many seismic survey lines (profiles), demobilization from the site and analysing the seismic data to evaluate the possible presence of highly weathered zones, fractures and faults, and preparation of a report indicating the results of the seismic survey.

The multichannel analysis of surface waves method (MASW) is a non-destructive seismic method to evaluate thickness of geological formations as well as to determine their linear elastic modulus. It analyses dispersion properties of certain types of seismic surface waves (fundamental-mode Rayleigh waves) propagating horizontally along the surface of measurement directly from impact point to receivers. It gives this shear-wave velocity (Vs) (or stiffness) information in either 1-D (depth) or 2-D (depth and surface location) format in a cost-effective and time-efficient manner.

(2) Findings

The interpreted 1D mean model of the profiles depicts a probe to depth of about 30 meters. The S- wave velocity ranges from about 90 m/s at a depth of about 1 meter to a maximum of 900 m/s at the maximum depth of investigations at 30 meters below ground level in all the profiles.

The P-wave velocity indicates a similar trend to that of S-wave with a minimum velocity of 187 m/s at a depth of 1 meter and maximum velocity of 1873 m/s at a depth of 30 meters in all the profiles.

This model exhibits a subsurface geology of varying strengths within narrow thicknesses. The density values range from 1.65 g/cc to 2.11 g/cc.

The Poisson ratio is an average value of 0.35 as shown on the velocity spectrum. The shear modulus ranges from 13 to 1797. The shear velocity V330 for all the profiles ranges from 234m/s to 323m/s.

The interpreted seismic velocity model along the profiles indicates a model, which is divided into layers with changes in primary and secondary velocity of the seismic waves as well as density of the subsurface material. These layers are comprised of weak unconsolidated soil material at the top layers. These soil material rocks are underlain by weathered rock at about 27-30 meters as shown on the subsurface models. The variations in velocity values are caused by changes in the material physical properties.

The average Shear Velocity determined for the area is 273 m/s. This, under the IBC (table 1) and NEHRP codes classifies the site as class D as a consequence of the sites Vs30 determined by in-situ measurement.

The results of this MASW survey are consistent with those of geotechnical investigation.

2.4 ENGINEERING DESIGN

A summary of the project components is shown in **Table 3** below:

TABLE 3 - PROJECT COMPONENTS

Description		Scale/Dimension
Target Vessel	Container Ship	Max 80,000 DWT (Loa 305 m, B 42.0 m, D 14.5 m) Min 5,000 DWT (Loa 109 m, B 18.3 m, D 6.1 m)
Marine Facility	Turning Basin	Dia. 600 m x Depth -15 m (-16 m), Dredging 0.98 M cu-m
	Jetty	L 350 m x W 35 m x Depth -15 m (-16 m)
	Retaining Wall	L 350 m, Sand Replacement Volume 0.21 M cu-m
	Revetment	L 650 m, Sand Volume 1.01 M cu-m
Terminal	Yard	L 650 m x W 400 m, Reclamation Volume 1.28 M cu-m Surcharge Volume: 1.86 M cu-m
	Building	Administration Complex, Welfare Building, Mechanical Equipment Workshop, Electrical Sub-station, etc.
	Trunk Road	8 Lanes, L 350 m x W 35.5 m
Supplementary Area	Area	3.3 ha
	Building	Custom Warehouse, Site Security Office
Access Road	Road	4 Lanes, L 3,100 m x W 22 - 27 m Reclamation Volume 0.93 M cu-m from Surcharge
	Building	Port Gate, Port Gate Office, Public Toilet
Cargo Handling Equipment	Container Crane	3 units
	Transfer Crane	16 units
Security System	Surveillance	Cameras, Scanners, Servers, Radar, Control Room etc.
	Access Control	Barriers, Fence, Gates, IR sensors, etc.
	Back Up Power Supply	UPS and Generator
	Warning System	Public Address, Warning Signages etc.

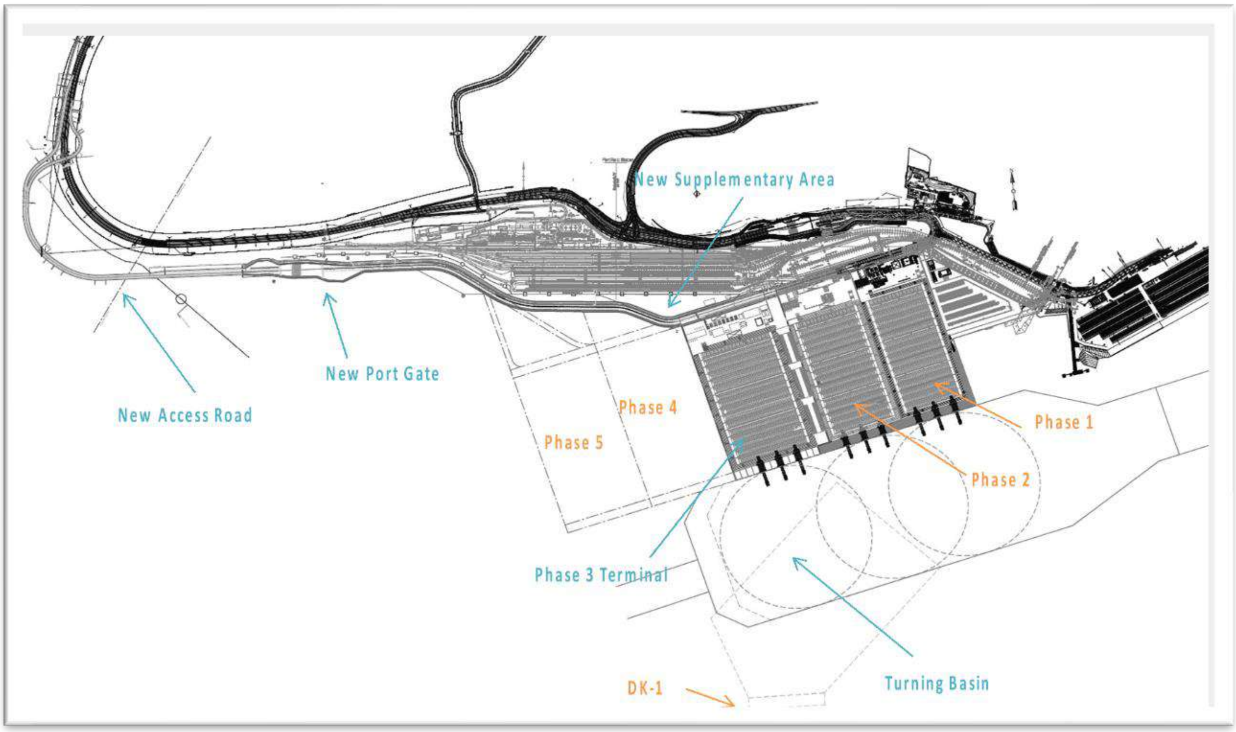


FIGURE 9 - PROJECT LAYOUT

2.4.1 Navigation Channel

During the Detailed Design stage of Phase 1, a ship simulation was conducted targeting 60,000-DWT and 20,000-DWT class container ships for Berth Nos. 20 – 21, and it was confirmed that the ship can safely sail inside Mombasa Port and come alongside or leave the Jetty.

When container ships of about 300m of Loa enter or leave Mombasa Port, the channel is operated as a one-way channel instead of the normal two-way navigation. A general rule for one-way channel is to have a channel width of at least 0.5 of LOA, so a channel width of 300 m is enough for even container ships of 80,000-DWT class.

It can be concluded that no further development is required of the navigation channel to accommodate the design vessel for Phase 3.

2.4.2 Turning Basin

Considering that the required turning basin width is equivalent to approximately 2-time LOA of the target vessel, a 600m wide turning basin shall be required in front of the berth. The figure below shows the scope of dredging for the turning basin.

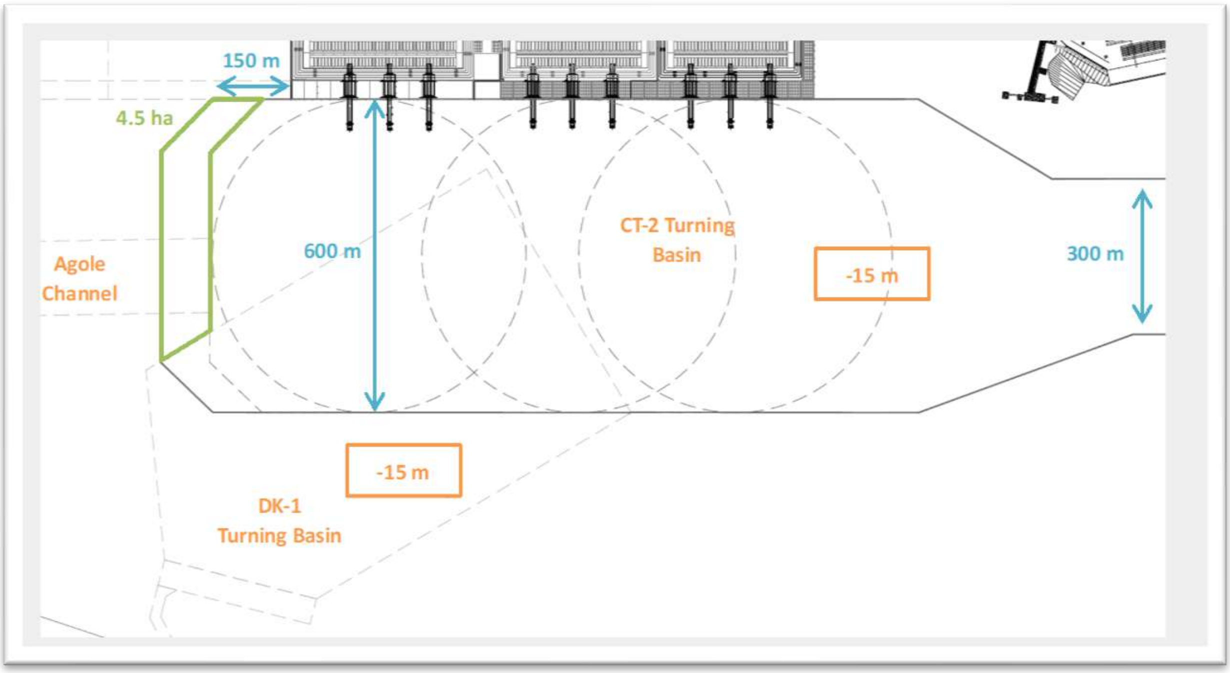


FIGURE 10 - TURNING BASIN EXPANSION SCOPE

2.4.3 Berth Structure

Considering the LOA of the target vessel, the required length of the Jetty shall be 350 m. Taking into consideration the unevenness and shallow depth of the bed rock layer, etc., the substructure of the Jetty shall be designed as a vertically piled system same as for Berth No. 21 and No. 22.

A Prestressed Concrete Type method will be adopted, this method allows enlargement of pile pitch (reducing one row of piles perpendicular to the face line), thereby significantly reducing the number of procurement and placement of piles, as well as leading to the shortening of Jetty construction work and cost. **Figure 11** below shows a typical section of this type of Jetty.

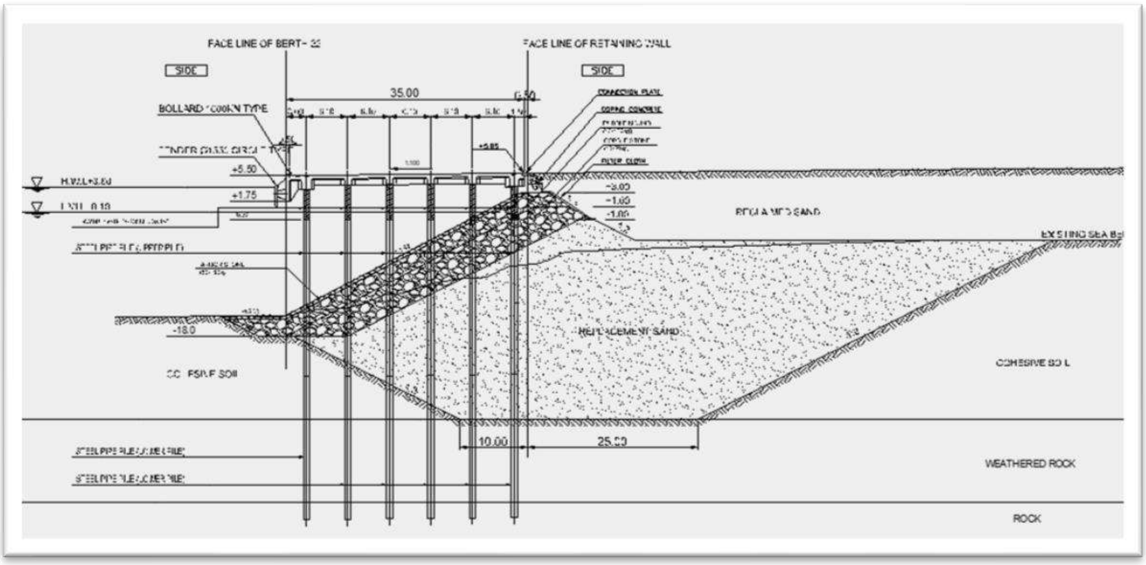


FIGURE 11 - TYPICAL SECTION OF A JETTY

2.4.4 Retaining Wall

The retaining wall is composed of foundation rock mound, concrete wall, and backfilling stones, and shall be 350 m long same as the Jetty. The concrete block method, also used in Phases 1 and 2, will be used for the concrete wall, since it is comparatively easy in manufacture and construction.

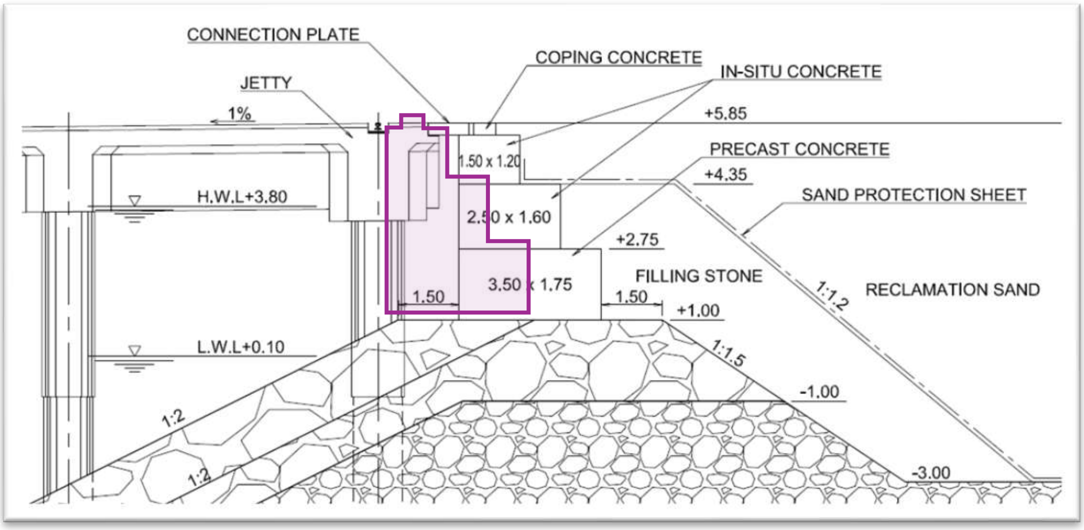


FIGURE 12 - TYPICAL SECTION OF A RETAINING WALL

2.4.5 Revetment

In consideration of future construction of future and to avoid the need for removal of stone during soil improvement for Phase 4 as discussed with KPA, the revetment on the western side of the terminal in Phase 3 shall be constructed with sand material only.

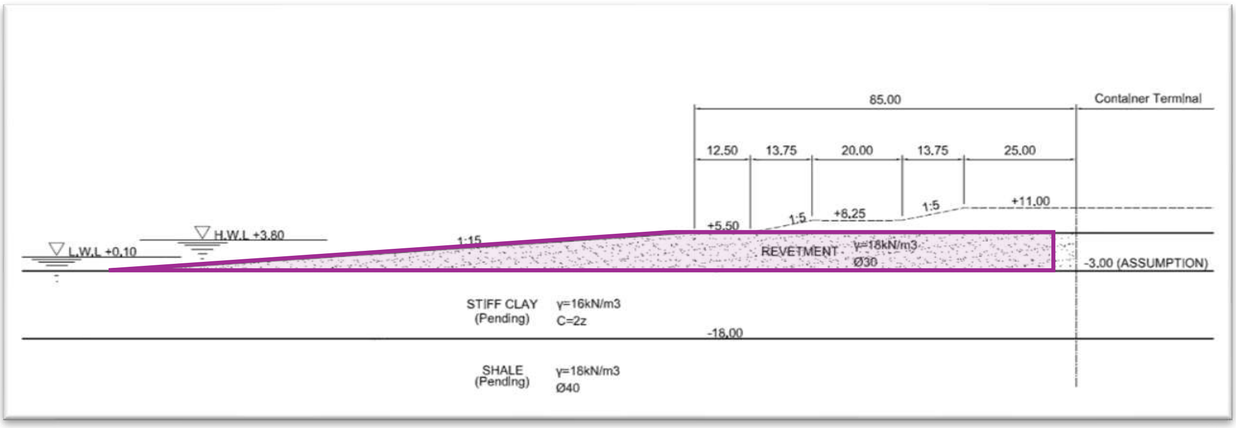


FIGURE 13 - TYPICAL REVETMENT CROSS SECTION

2.4.6 Reclamation

The reclamation will be by up to CDL + 5.5 m followed by soil improvement works and then construction of container stacking yard, buildings and utility works. For reclamation, sand material is more suitable than soil, even if sand contains clay and silt because terminal operations shall immediately start after completion of the construction.

There are three types of sand; mountain sand, river sand and sea sand was considered. It is expected that for this project, large scale transport of the sand material will be required. Large scale transportation of mountain sand and river sand is considered to be inadequate and uneconomical. On the other hand, large scale transport of sea sand by sand carrier barge or trailer suction hopper.

The existing sand volume is estimated at approx. 6.0-10.0 million cubic meters, so far. The sand will also be needed for sand replacement of the soft soils under revetment, settled volume after soil improvement and preloading volume for foundation improvement.

Suitable material should not contain so much silt and clay when considering settlement and flowing out of contaminated effluent. Therefore, the sand material, in which silt and clay contents shall be less than 5 % in weight, is suitable and specified.

Quality control of the material shall be thoroughly conducted during offshore sand harvesting.

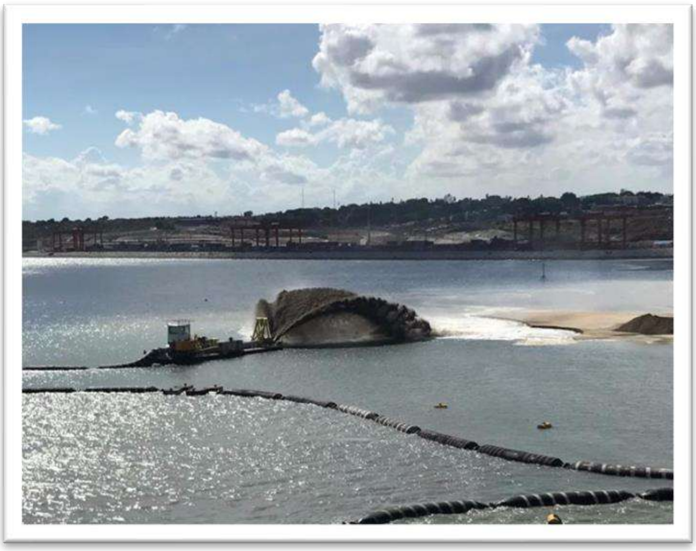


FIGURE 14 - RECLAMATION WORKS OF PHASE 2
Source: The Consultant

2.4.7 Soil Improvement

There are various soil stabilization methods which can be used to increase the bearing capacity and to reduce the settlements of very soft clay. Soil stabilization methods can be classified into geometrical, mechanical, structural, physical and chemical methods, depending on how the methods affect the stability of soft soils or reduce the settlements. The following soil stabilization and improvement methods are usually used for foundations on fine-grained soils:

- Light weight fills,
- Pressure berms,
- Preloading with vertical drains,
- Vacuum preloading,
- Geo-fabric and geo-membranes,
- Soil displacement,
- Dynamic compaction and dynamic replacement,
- Cement columns (dry and wet mixing method),
- Jet grouting,
- Sand compaction piles, stone, gravel and sand columns, and
- Embankment and settlement-reducing piles.

The most common soil improvement methods are preloading combined with vertical drainage, dynamic replacement due to sand compaction piles and cement columns (dry and wet cement mixing method). Different types of soil improvement and ground stabilization methods were studied for this project and Preloading method with vertical drainage was selected as the most appropriate method.

The selection of the optimal ground improvement and stabilization method depends on:

- structural requirements (bearing capacity, settlement),
- geotechnical and geo-hydrological conditions,
- available materials,
- logistic considerations (available transportation and infrastructure),
- time schedule, and
- costs.

The project intends to use Preloading method with vertical drainage. This method is the most cost-effective solution for this project. Since sand material for the method is limited at the project site, PVD method is the most appropriate to the project.

FIGURE 15 - INSTALLATION OF PVD AT PORT
Source: The Consultant

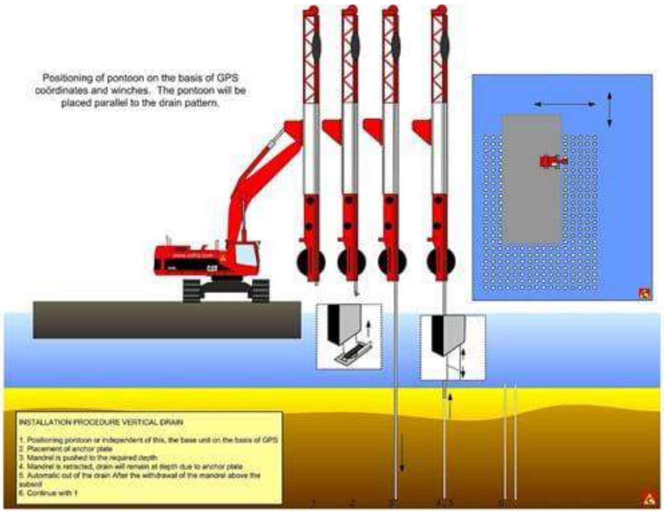


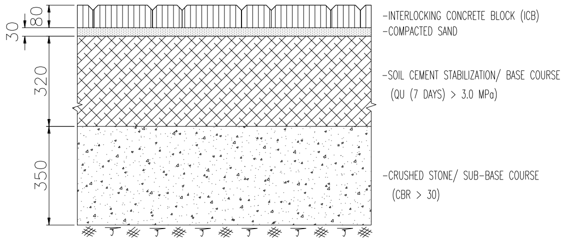
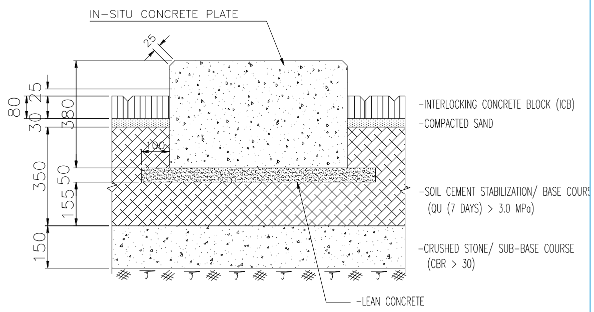
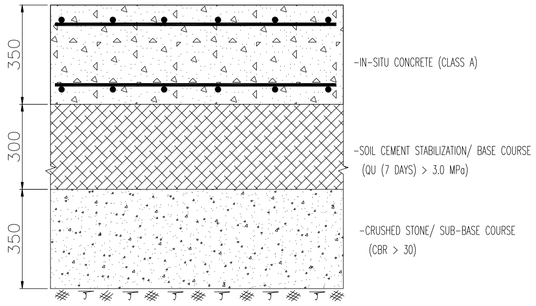
FIGURE 16 - IMAGE OF PVD TECHNOLOGY
Source: www.cofra.org

2.4.8 Pavement & Drainage

The yard pavement shall be determined in consideration of the traffic volume, design wheel load, durability, maintenance, etc. The type of yard pavement preferred is mainly the flexible type such as Interlocking Concrete Block (ICB) pavement and asphalt pavement for the terminal area in consideration of long-term continuation of the settlement of existing ground even after soil improvement. Interlocking Concrete Block has become popular recently for pavement of port terminals on reclaimed area because of ease of repairing without any special equipment. Some specific areas such as travel lane for RTG (Rubber Tired Gantry Crane) and container washing area requires specific pavement according to the purpose of each area.

Soil cement stabilized base course with a minimum 7-day unconfined compressive strength of 3.0MPa is provided to prevent uneven settlement as much as possible after starting operation. Crushed stone with minimum CBR of 30 % is adopted in the design of sub-base course. It is required that “Density testing” and “In-place CBR testing” shall be carried out during construction to ensure compaction requirements of sub-grade are met.

Table 4 - Different Pavement Types for the Project

Area	Type	Load	Section of Pavement
Type 1 **Truck Passage, Office Area**	Interlocking Concrete Block	Container Trailer Truck	
Type 3 **Walk Way**	Interlocking Concrete Block	Persons	
Type 4 **Container** **Stacking Area**	RC Concrete Block	Loaded Container 5 tiers height	
Type 5 **RTG Transfer** **Lane**	RC Concrete Slab	Rubber Tired Gantry Crane (RTG)	
Type 6 **Container** **Washing**	**RC Concrete**	**Forklift**	

The storm water main drainage structure is planned to be box culvert type with consideration of HWL, maintenance, importance and minimum length of drainage, combination between culverts and trench.

Top level of box culvert is equal to ground level. Manholes for maintenance will be provided.

2.4.9 Access Road

Since commencement of Phase 1, significant development of the road network around the Port and Mombasa in general has taken place. Of significance to cargo evacuation from the Port to hinterland is construction of the Kipevu Link Road and Southern Bypass by KENHA under the Mombasa Port Area Road Development Project.

However, the project proposes to construct a new 3.1 km access road due to the following reasons:

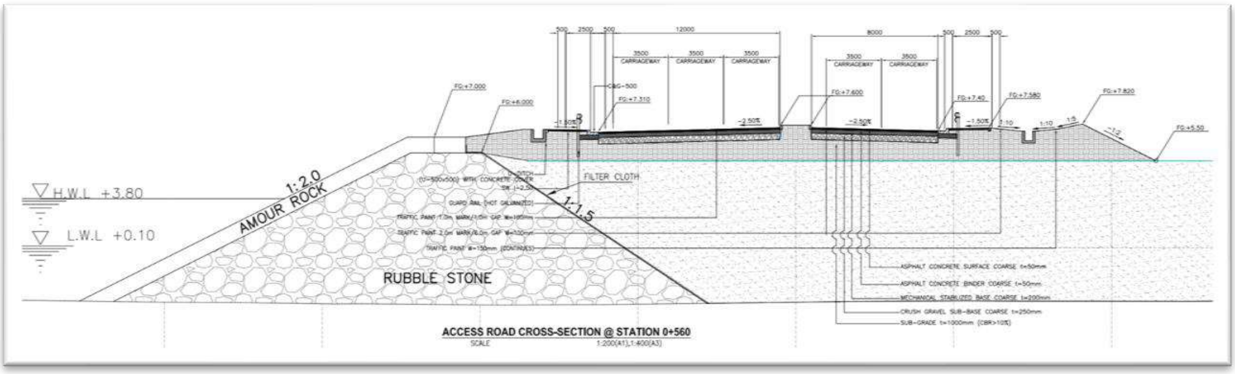
1. Increased traffic at the Port due to the CT2 access road serving a higher number of traffic than originally planned.
2. Diverting port traffic away from Mombasa city roads.
3. Traffic caused by SGR level crossings within the port.

The alignment route runs from the end of the trunk road along the shoreline south of the railway line and crosses under the elevated railway line before connecting with the existing Kipevu Link Road immediately after the aircraft shelter. Reclamation will be required for construction of the 2 Km section of the road that is offshore.

A 30m viaduct has been provided at the fishing community settlement to allow free movement and unimpeded access to the fish landing site.

The horizontal alignment was optimized to minimize reclamation volumes as well as the number of Project Affected Persons (PAPs).

In general, a 4-lane dual carriage has been provided. However, for approaches to the gate from both directions, additional storage lanes have been provided.



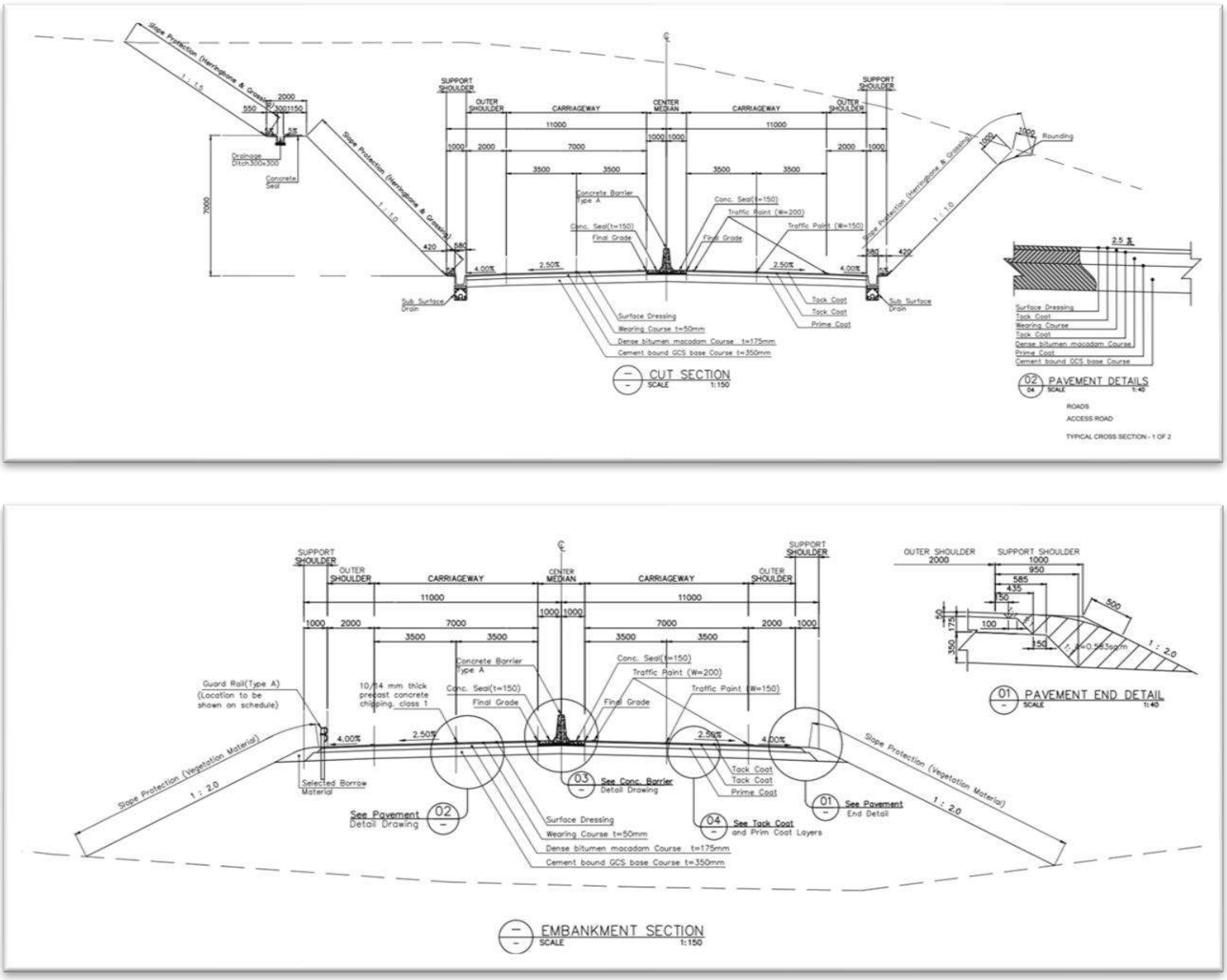


FIGURE 17 - TYPICAL CROSS SECTIONS
Source: The Consultant

2.4.10 Buildings

Since Phase 3 is similar to the previous phase in use and operation, the same size and types of building have been provided. Some buildings have however been increased in size taking into account the overall increase in size of the terminal.

TABLE 5 - PHASE 3 BUILDINGS

BUILDING		STRUCTURE	STORY
INSIDE OF TERMINAL			
1	Administration Complex	RC+S	4
2	Container Gate	RC+S	1
3	Container Gate Office	RC	1
4	Welfare Building	RC+S	2
5	Yard Site Office	RC	1
6	Mechanical Equipment Workshop	RC+S	1+M
7	Electrical Sub-station	RC	1

8	Generator Room	RC	1
9	Generator Shed	RC+S	1
10	Fuel Station (Canopy)	RC+S	1
11	Store 1	RC	1
12	Store 2	RC	1
13	Yard Site Toilet 1	RC	1
14	Yard Site Toilet 2	RC	1
15	Public Toilet	RC	1
16	Parking (Canopy)	S	1
17	Port Gate	RC+S	1
18	Port Gate Office	RC	1
19	Security Site Office	RC	3
20	Customs Warehouse	RC+S	1+M
21	Generator Shed	RC+S	1
22	AP-9 Toilet	RC	1
23	Public Toilet	RC	1

2.4.11 Utilities

Utilities to be provided include:

(1) Electrical supply

The Project will have a comprehensive electrical design to cover the following areas:

- Understanding the maximum power demand for the facility i.e. buildings and equipment.
- Substation
- Emergency Generator
- Compact Substations
- Exterior Lighting

(2) External Works (Water Supply, Wastewater Treatment and Fire Fighting System)

The scope of external works will include:

- Understanding the water supply/ demand at the facility i.e. buildings and vessels
- Identify adequate sustainable water sources such as main supply, recycled water and rainwater harvesting.
- Provision of fire pump, piping and hydrant system for the yard and berth area.
- Adequate storage for firefighting.
- Installation of bio-mechanical wastewater treatment plants.
- Installation of oil separators and grease traps

- Installation of Fuel Supply Station – Pumps and Storage tank

(3) ICT

The scope of ICT Provisions of the project include:

- LAN extensions
- LAN provisions to buildings and equipment
- IP Telephone System

2.4.12 Security System

The Government of Kenya, as a member of IMO, ratified the SOLAS Convention which was amended in 2004 and its annexed ISPS Code of Part A (Mandatory Requirements) and Part B (Guidance). On the basis of the Convention and the Code, the Kenya Ports Authority (KPA) has continually endeavored to enhance the port facility security system named ISS (Integrated Security System) at Mombasa Port. KPA/ISS has satisfied the following ISPS Code provisions and possible systems as measures to make the port a safer, creditable and sustainable place to do business with anti-crime and anti-terrorism.

The scope of the security system for the proposed project include:

(1) ISS Compatible System

(2) Physical Barriers

(3) Access Control System

(4) Public Address

(5) Alarm System

(6) Smart security fences

(7) Observation system – Cameras and supporting poles.

2.4.13 Cargo Handling Equipment

The procurement plan of the Cargo Handling Equipment includes Ship to Shore Gantry (SSG) and Rubber Tired Gantry (RTG). SSG is used for quayside container handling operation and RTG is for marshalling/stacking operation in the container yard.

SSG has to move heavy containers at high speed and handle more than 30 boxes per hour. It is a heavy-duty crane and therefore must be designed and manufactured according to the authorized standards and under the strictly controlled quality assurance system. It will be procured from the eligible manufacturers as a fully finished product.

The project proposes to procure the following:

(1) 3 No.s Post Panamax Type SSG

(2) 16 No.s RTG

FIGURE 18 - PHASE 1 & 2 SSG AND RTG IN OPERATION

2.5 EXISTING PORT AND ITS FACILITIES

Kenya Ports Authority has over the years invested massive resources to build capacities of the port facilities to meet market demands and remain competitive in the ever-dynamic shipping and maritime industry.

The port is divided into two sections designated for conventional cargo operations comprising nine berths and container handling terminals comprising eleven berths, bringing the total berths at Mombasa to twenty. Container section is served by two terminals which make up the total container capacity of the Port to 2.2 million TEUs annually. The terminals are adequately equipped with shore and yard equipment to ensure faster and efficient movement of cargo.

The Port of Mombasa operates specialized berths for express handling of specified cargo within the port. The Port has dedicated Berth 3, 9, Mbaraki Wharf, Base Titanium, Shimanzi Oil Terminal and Africa Gas and Oil Limited as specialized terminals for handling of Bulk Grains, Bulk Soda Ash, Bulk Clinker & Coal, Titanium, Bulk Liquid & Gas Cargo respectively.

The new Kipevu Oil Terminal is an off-shore oil facility with an island terminal. The terminal facility has four berths with a total length of 770m and one work boat wharf at Westmont area for landing facilities. KOT facility handles six different hydrocarbon import and export products. It is also fitted with a Liquified Petroleum Gas (LPG) facility, crude oil and heavy fuel oil. KOT has provisions for handling three types of white oil products (DPK – aviation fuel, AGO – diesel and PMS – petrol). There are risers each dedicated to the separate oil products as well as six onshore pipelines that connect the terminal to the Kenya Petroleum Refineries Limited and Kenya Pipeline Company storage tanks. Other support facilities of the KOT project include electrical power distribution system which is drawn from a substation on-shore. It also has an elaborate water supply and drainage system, firefighting and detection facilities, telecommunications SCADA and control monitoring systems, and navigation aids. The Terminal can accommodate three ships concurrently with a capacity of 170,000 DWT tons. A fourth berth has already been constructed provisionally, which will be fitted with facilities in future commensurate with demand, to be able to handle four ships at a go.

We operate a modern state of the art passenger cruise terminal at the Port of Mombasa. Kenya is the 'Home of the Safari' and this facility caters to the cruise passengers from across the world that visit our magnificent country for the white sandy beaches and the safari adventures. The eco- friendly facility which is fully solar powered has modern amenities including passenger lobby, duty free shops, restaurants and conference facilities,

At the Conventional cargo, the port operates multipurpose berths that handle varied cargo. Berths 1 and 2 serve steel, container and RORO ships while berths 5,11 and 12 serve Conventional and Container ships with own gear.

2.6 KEY FEATURES OF THE SITE AND SURROUNDINGS

The proposed site is adjacent to Berth 22 which is in turn adjacent to the Standard Gauge Railway operated by Kenya Railways adjacent to the main road linking the port and the mainland. The proposed site is on the extreme western end of the port towards the mainland and administratively lies at the boundary of Kwale and Mombasa Counties. The proposed site in on the seaside which will require reclamation and adjacent to this there is a coastal strip of land which will be occupied by the proposed link road which will also pass by some settled area known as Ngare whose affected community have been mapped and will be resettled to accommodate the road corridor.

2.7 PROJECT SCHEDULE

The Project will commence upon commencement of Consultancy Services and will conclude at the end of the Defect Liability Period (DLP) as shown below:

- Consulting Services: 12 months
- Contractor Selection Period: 12 Months
- Construction Period: 48 months

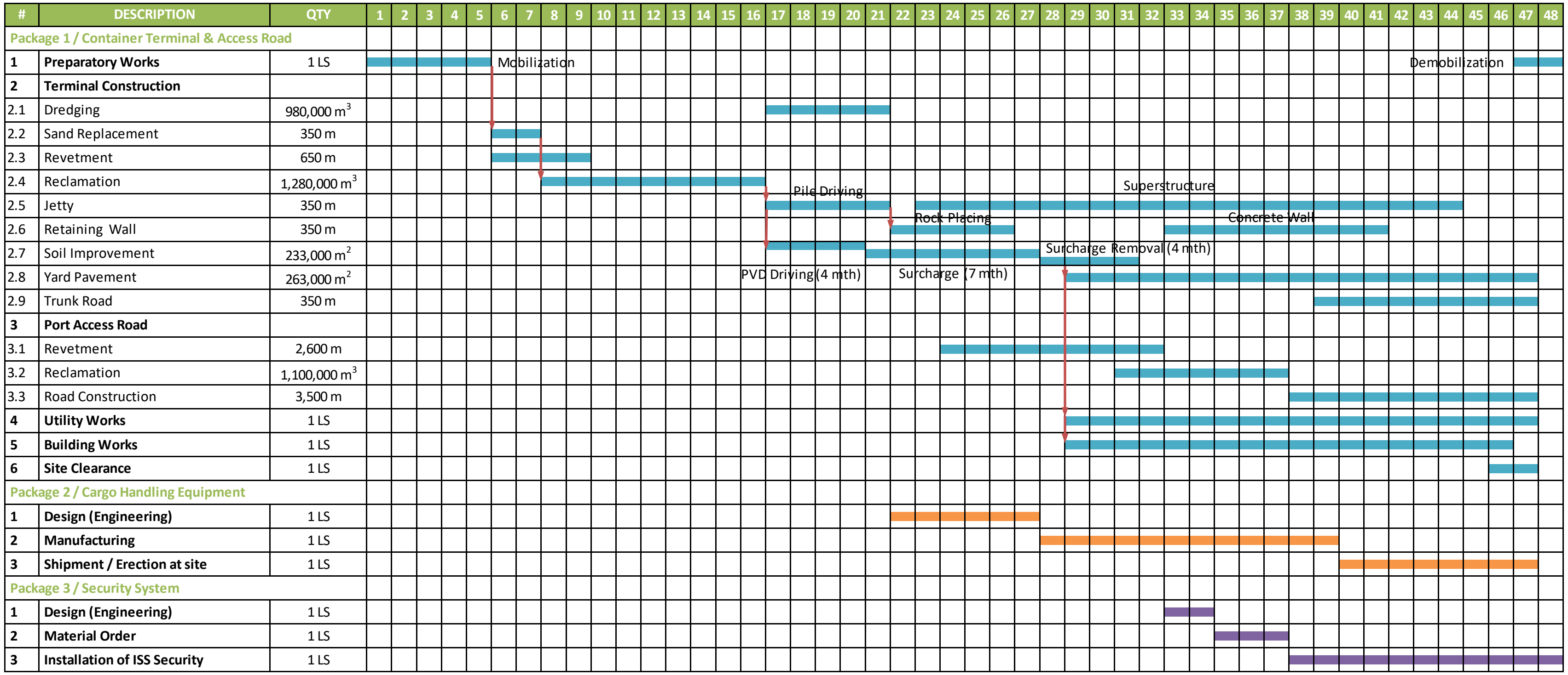


FIGURE 19 – PROJECT SCHEDULE

2.8 PROJECT (CONSTRUCTION) COST

The estimated cost of Construction of Phase 3 is shown in the table below:

TABLE 6 - PROJECT COST

No	ITEM	COST (USD) million
1	Terminal & Berth	110.1
2	Port Access Road	48.9
3	Utility Work	22.6
4	Building Work	13.6
	Total	**195.2**

1 USD = 156 JPY

The estimated cost is **USD 195,200,000.00.**

2.9 PROJECT ALTERNATIVES

Alternatives are defined as ‘‘options, choices, or courses of action; they are means to accomplish ends, these ends include not just a particular agency's goals, but also broader societal goals such as the protection and promotion of environmental quality’’ (Steinemann, 2001). Consideration of alternatives is important in ESIA process (Glasson *et al*., 1999), because alternatives consideration is a core element of ESIA (Jiricka-Pürrer *et al*., 2018; Council on Environmental Quality, 1996; Kamijo and Huang, 2016). Timely identification and evaluation of alternatives in policies, plans and programmes can evade potential hitches at the project level (Therivel and Partidario, 1996). Determination and analysis of alternatives is important as it ensures ESIA process remain relevant, creative and problem solving (Kamijo and Huang, 2016).

A Project Alternative is thus another combination of the project’s costs, schedules, resources, and risks that allow achieving the same results as compared to the project baseline. It is one or more ways to produce the project and address its need while using the same resource base yet operating in a new way and facing new working conditions.

Project Alternative considered for the proposed construction and operation of all the components of the bulk grain terminal are as follows:

- Yes Project Alternative.
- No Project Alternative
- Alternative Project Site

Alternative analysis was also carried out on the following project components:

- Access Road Alignment Alternative
- Sand Resource for Reclamation Alternative

2.9.1 Project Alternatives

Under the project alternatives, two options were analyzed that is the yes projects alternative and the no project alternative. The yes project alternatives analysis why implement the proposed project and hence justifies the proposed project. The no project alternative give reasons why the proposed project should not be implemented

(1) Yes Project Alternative (Port Expansion)

The proposed project seeks to develop infrastructure that will help the Port of Mombasa meet its ever-growing demand for cargo serving Kenya and the land locked countries. Being a net importer, Kenya depends on the competitiveness of the port to ensure efficient unloading and movement of cargo The justification to expand and modernize the port is supported by the facts:

1. The Port of Mombasa is the gateway and exit point for cargo belonging to a vast hinterland that include Kenya, Uganda, Rwanda, Burundi, Democratic Republic of Congo, Tanzania, South Sudan, Somalia and Ethiopia.
2. It is the busiest and premier port in east and central Africa, in competition with Dar es Salaam Port
3. Operations at the Port of Mombasa contributes to the Kenyan GDP and is considered a "National Asset" and accounts for about 70% of Kenya's trade.
4. The Port currently handles 1.5million TEU's annually.
5. Along with the Port of Lamu, the Port of Mombasa are the two international ports in the country.
6. Demand for containerized cargo has continued to grow by approximately 10% at the port and demand forecast shows that it will exceed present capacity by 2032.
7. Construction new container terminals (phase 1 & 2) have an average construction time 4 years therefore showing the need to plan ahead.
8. Ship building trends show that need for larger waterways and berths will need to be considered.
9. The Construction will create employment directly. Expanded port operations will also create job opportunities at the port and industries that support port operations.

Therefore, the yes project alternative will go a long way in establishing a competitive and efficient port that will enable increased movement of cargo into and out of the country not only to domestic needs, but also increase Kenya's regional economic prowess.

(2) The No Project Alternative

The no project alternative means that the proposed project whose develop infrastructure that will help the Port of Mombasa meet its ever-growing demand for cargo serving Kenya and the land locked countries should not be implemented. Justification of the no project alternative will include:

- Increased demand for cargo will exceed the handling capacity which will increase the competitiveness with nearby ports.
- Reduced efficiency will cause delays in unloading of cargo and delivery to businesses.
- Only smaller feeder ships will call at the port resulting in higher costs and longer

turnaround times from larger ports.

Considering the two project alternatives, the yes project alternative is preferred because it not only address trade demand but also increase the use of the port of Mombasa by local businesses and the hinterland.

(3) Proposed Project Site

The proposed project will involve construction a new berth (23), container terminal, access road and associated infrastructure within Kilindini Harbor adjacent to the recently completed Berth 22 at Container Terminal 2 in the Port Reitz area. The proposed location is preferred because of the following reasons:

- It is adjacent to the existing Container Terminal.
- The area provides sufficient depths (-15 meters) for docking and turning of large vessels (Post Panamax ships) thus requiring minimal dredging works.
- The access road will be on reclaimed material therefore requiring less land acquisition.
- The surrounding area is primarily commercial thus keeping with dominant land use in the area.
- A reclaimed terminal in water will cause less disruption to existing infrastructure such as roads and pollution to nearby residents.
- The proposed access road will not put pressure on existing road networks in Mombasa town and will aid in de-congesting the roads leading out to the port in Shimanzi and Changamwe as trucks can connect directly to the Kipevu link road.

(4) Alternative Project Sites

There are no alternative sites for the project as this is expansion an existing container terminal adjacent to the channel. KPA is also carrying out the following projects to boost container handling capacity at the Port of Mombasa:

- Construction of Berth 19b
- Rehabilitation of G. Section
- Strengthening, straightening and Deepening of Berth 11-14

The above show that KPA are expanding all available sites and despite the above, the necessity of the proposed project is justified.

2.9.2 Access Road Alignment Alternatives

For the development of a new access road from the terminal, two cases were considered:

Case-1: Development of Access Road taking into consideration future expansion of CT2 beyond Berth 23 as per the KPA Master Plan

Case-2: Development of the Access Road without taking into consideration of future expansion of the container terminal (CT2)

Three (3) different alignments were considered and analyzed against the following criteria:

- Length
- Route
- Type of Land use to be traversed
- Development policy (future expansion of port)
- Cost
- Environmental Impacts
  - Scale of RAP
  - Loss of Natural Environment
  - Proximity to sensitive facilities

TABLE 7 - SUMMARY OF ALTERNATIVE ANALYSIS OF ACCESS ROAD ALIGNMENT OPTIONS

Outline	Alignment 1 (Option 1)	Alignment 1 (Option 2)	Alignment 2
			
Starting Point	Trunk Road - Berth 23	Trunk Road - Berth 23	Trunk Road - Berth 23
Ending Point	Near the Mombasa Station	Near the mouth of River Mwache	East side of the shade of Kipevu Link Road
Length	5.4 km	3.5 km	1.7 km
Route	Along the shore	Along the shore	Shortest connection with Kipevu Link Road
Structure	Embankment + Flyover	Embankment + Flyover	Embankment + Flyover
Land Use			
Land Use	Railway, Road, Airport, Mangrove, Tidal Flat, Residential/Business /Landing site	Railway, Road, Airport, Mangrove (Mainly degraded), Tidal Flat, Residential/Business /Landing site	Railway, Road, Gas Company
Development Policy	Taking into consideration Berth 24 and 25	Taking into consideration Berth 24 and 25	Not taking into consideration Berth 24 and 25
Technical Aspect			

Technical Feature	Designed for future exp	Bridge/ Underpass for PAP's	None
Cost	High	Moderate	High
E&S Aspect			
Social Environment	Need to acquire 13 parcels of land	Need to acquire 2-3 parcels of land	Need to acquire land used by a Railway and private owner
Natural Environment	Loss of mangrove and Northern tidal flat	Moderate off of Mangrove	Minimum Loss of Mangrove
Pollution Control	No sensitive facilities	No sensitive facilities	No sensitive facilities
Optimal Rout - Reason	△	◎	×

◎ = Optimal, △ = Sub-optimal, x = Unsuitable

2.9.3 Sand Resource for Reclamation Alternatives

Sand is the second most exploited natural resource after water according to the U.N. Environmental Program (UNEP). Sands are habitats for microorganisms and cyanobacteria as the basis of marine food webs (Peduzzi 2014), as well as benthic species. Sand dredging in marine environments leads to major impacts on fauna and flora (Desprez et al. 2010), with significant impacts on biodiversity and fisheries. Marine plants act as an important carbon sink, many of which require a sandy subsoil for their reproduction[1].

The project requires a total of 2 million cubic metres of material to reclaim the area required for the project. Phase 1 and 2 both utilized sea sand for reclamation due to the soft clay sub-surface layer. Suitable reclamation material will be needed to be able to support a soil improvement technique such as PVD Technology (see 6.4.7) A further 500,000 cu.m is then required to pre-load the reclamation area.

The project looked at three (3) alternatives of sand/ material resource:

TABLE 8 - ALTERNATIVE SAND/ MATERIAL SOURCES FOR PHASE 3

No	Description
Alternative 1	Kwale Sand Borrow Pit
Alternative 2	Mjanaheri Inland Sand Borrow Pits
Alternative 3	Mazeras Inland Crushed Rock Quarry

Aspects considered to analyse the alternatives for reclamation material are:

- Distance from Project Site
- Method of Extraction
- Construction Period
- Land Use

[1] Sand Sustainability: 10 Strategic Recommendations to avert a Crisis, UNEP 2022

- Quality
- Volume
- Cost
- Environmental and Social Impact
    - Impacts to Social Environment
    - Impact on Natural Environment
- Mitigation Measures

(1) Alternative 1: Kwale Sand Borrow Pit

i. Location/ Distance from the Port:

Borrow Pit off the coast of Kwale used in both phases 1 and 2 is 15km from the port as per figure below:

FIGURE 20 - SAND BORROW PIT

Source: The Consultant

ii. Method

- The material is sea sand with variant properties. The project requires sand of <5% fines to carry out reclamation successfully.
- The material will be extracted using a Trailer Suction Hopper Dredger.
- Trailing suction hopper dredgers are classified as hydraulic dredgers, that is, a dredger which makes use of centrifugal pumps. They are unique in that they use their

self-propulsion during excavation of sediment from a borrow area and then can transport the material to the placement area. Being self-propelled also means they can easily be mobilised to travel from project to project wherever in the world.

- TSHD's have articulated dredging pipes, known as "drag arms", that extend to the seabed. At the end of the drag arm, a drag head is attached. Trailers move at low speeds suctioning up the seabed material through the drag heads and pipes to the hopper.
- Trailing suction hopper dredgers come in all sizes and can be used for a variety of projects. They can work in both protected and unprotected waters, where stationary equipment is more limited.
- They have also the advantage of being self-propelled. This means they can work in congested areas and because they can move themselves, they will cause minimum disruption to ship traffic. It also means they can travel long distances on their own to borrow areas to win sand for projects.

iii. Construction Period

The construction Period is projected to take approx. 8 months. The TSHD shall operate 24-Hrs a day with days off for maintenance and repairs.

iv. Land Use

The sand borrow pit in Alternative 1 is in the sea where the following activities take place:

- Fishing
- Snorkelling
- Jet Skiing
- Deep Sea Diving

There are a few hotels along adjacent coastline that enjoy the scenic view of the ocean in which the proposed sand harvesting shall take place such as

v. Quality

Sand sampling was carried out in 10 locations in the Kwale Borrow Pit. Grading results show a variation in sand properties from north to south. Generally, sand from the northern deposits is course while that from the south is medium to fine.

vi. Volume

The borrow pit has 10million cubic metres of extractable sand for reclamation. The total amount of sand in the borrow pit is approx. 20 million cubic metres.

vii. Cost

The approx. cost of Alternative 1 is KES 1,000 per m^3

viii. Environmental and Social Impact

- Impacts to Social Environment

  The following are the major potential impacts on the Social Environment

TABLE 9 - MAJOR SOCIAL IMPACTS OF SEA SAND HARVESTING

No	Impact
1.	Reduced fish catch due to seabed disturbance and increased turbidity
2.	Reduced scenic disturbance due to TSHD activities
3.	Conflict with Hoteliers and Tour Companies

- Impact on Natural Environment

  The following are the major potential impacts on the Natural Environment

TABLE 10 - MAJOR ENVIRONMENTAL IMPACTS OF SEA SAND HARVESTING

No	Impact
1.	Coral stress and mortality
2.	Reduced fish population due to turbidity and mortality
3.	Change in nearby beach morphology

- Mitigation Measures

  To mitigate the impacts of the following mitigation measures can be implemented:

  a. Livelihood Restoration Plans for affected communities

  b. Marine Mammal Observation Plan

  c. Reducing overflow discharge at sensitive/ shallow water (see below:

It is generally understood that marine rich areas occur at depths of <-30m CDL. Depths beyond will have reduced coral, sea grass and therefore are less sensitive. To mitigate against the turbid water plums generated during sea sand extraction, the project can discharge the turbid overflow water at a distance of 5km from the -30-contour line as a standard method. This “loop” methodology showed to be highly successful in Phase 2 when there was concern raised on the rate of siltation on corals close to the sand harvesting locations.

The overflow pipe is an outlet pipe on the dredger that discharges fine silt in water back out to ensure only suitable material remains in the vessel. In this case the vessel will move away from the borrow pit area to discharge the silt water and return to fill.

The cycle shall be repeated up until the vessel attains the desired volume of reclamation sea sand.

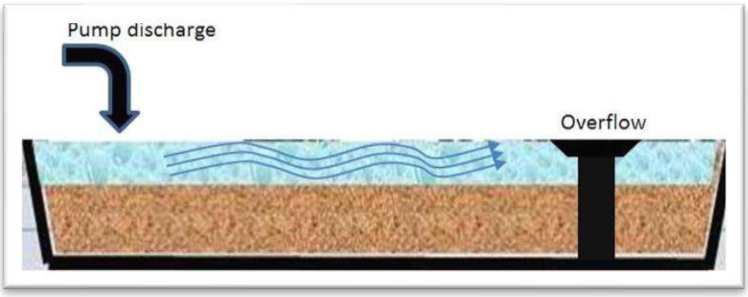


FIGURE 21 - ILLUSTRATION OF OVERFLOW SYSTEM
Source: www.theartofdredging.com

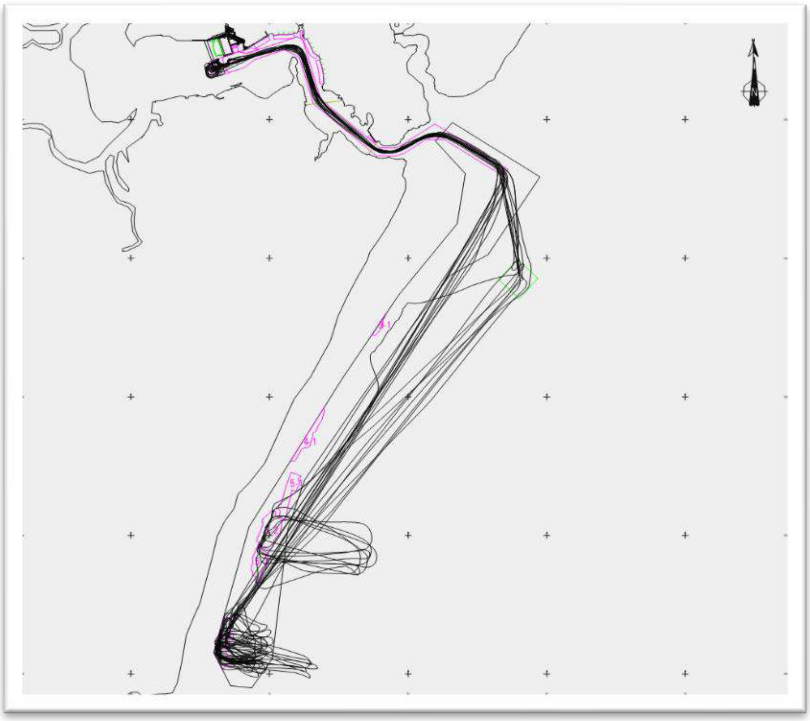


FIGURE 22 - PHASE 2 VESSEL TRACK SHOWING MITIGATION MEASURE

(2) Alternative 2: Mjanaheri, Malindi Inland River Sand Mining Pits

i. Location/ Distance from the Port:

The sand resource of river sand is available from **Alternative 2** in the Mjanaheri-Ngomeni areas of Magarini areas in Malindi which is 150km from the project site where a few inland sand mining quarries are operational.

FIGURE 23 - PROPOSED SAND MINING SITE, MJAMAHERI

Sand mining is the major economic activity in the Mjanaheri Ngomeni areas of Magarini division the operations are indiscriminately carried out without post mining treatment and management of the mined areas, leaving behind abandoned mines and causing massive damaged to land scape and biological communities. The sand mines are located near natural water ways and the permeability of the material in the floors and walls increases their water retention capacities[2].

materials in the floors and walls increases their water retention capabilities.

ii. Method

- The sand will need to be mined by licensed mining company using the opencast method guided by legislature.
- The designated area is first cleared of all vegetation and topsoil removed.
- Sand is then extracted at variant depths and loaded on to trucks.
- The trucks will then transport to a nearby jetty where barges shall transport the material to the project site as shown in the figure below

[2] Impacts of Sand Mining on the Environment in Mjanaheri - Ngomeni Areas of Magarini Division, Kenya, Nguru, 2008

FIGURE 24 - TYPICAL BARGE TRANSPORTATION OF SAND

Source: deamstime.com

iii. **Construction Period**

The construction Period is projected to take approx. 24 months.

iv. **Land Use**

The sand mining areas currently used for sand mining and proposed jetty in Alternative 2 have the following land uses:

1. Sand Mining
2. Sailing
3. Tourism
4. Fishing

v. **Quality**

Grading results show River Sand sample analytical results: 0.25mm – 0.5mm lies within the required quality content with an average of 98%

vi. **Volume**

25 Acres will be required to produce 1.5 million m^3 of river sand and there is 40 acres available.

vii. **Cost**

The approx. cost of Alternative 2 is KES 2,500 per m^3

viii. **Environmental and Social Impact**

- Impacts to Social Environment

  The following are the major potential impacts on the Social Environment

TABLE 11 - MAJOR ENVIRONMENTAL IMPACTS OF SEA SAND HARVESTING

No	Impact
1.	Source of Income
2.	Increased risk of Alcohol and Drug Abuse
3.	Increased risk of HIV-AIDS
4.	High Risk of mining and vehicular accidents

- Impact on Natural Environment

  The following are the major potential impacts on the Natural Environment

TABLE 12 - MAJOR SOCIAL IMPACTS OF SEA SAND HARVESTING

No	Impact
1.	Reduced air quality (dust)
2.	Soil Erosion
3.	Loss of vegetation incl. mangrove trees
4.	High risk of marine accidents by barge
5.	Loss of Sand Dunes

ix. Mitigation Measures

In order to mitigate some of the negative impacts of this proposed alternative, the following measures can be implemented:

a. Community Education and Sensitization Programs
b. Job Opportunities
c. Sustainable Mining Plan
d. Marine Safety Plan

(3) Alternative 3: Mazeras Inland Crush Rock Quarry

i. Distance from Project Site

The nearest crushed rock quarry is in Mazeras located 21 km from the project site.

FIGURE 25 - TYPICAL ROCK QUARRY
Source: Researchgate

ii. **Method of Extraction**

- The method of extraction is primarily drilling or blasting (explosives).
- Once the rocks are extracted, they shall be crushed using a Jaw Crusher and Cone Crusher.
- Material will then be transported by truck to the project site.

iii. **Construction Period**

It is estimated that the period of delivery shall be 48 months as it will take 250,000 trips to meet the required volume of material.

iv. **Land Use**

The area is a designated rock quarry.

v. **Quality**

The quarry will produce crushed rock with high grade of fine material. This will in turn generate very high turbidity plumes of foreign material into the marine environment

vi. **Volume**

Due to the mechanised method of crushing the rock. A large amount of quarrying and crushing will be required to meet the desired reclamation volume. And due to the

vii. **Cost**

The approx. cost of Alternative 3 is KES 2,000 per m^3

viii. **Environmental and Social Impact**

- Impacts to Social Environment

TABLE 13 - MAJOR SOCIAL IMPACTS OF SEA SAND HARVESTING

No	Impact
1.	Job Opportunities
2.	Increased use of explosives and operations
3.	High energy cost
4.	Destruction of roads (250,000 trips)
5.	Increased Traffic and Vehicular accidents.
6.	Longer Construction period

- Impact on Natural Environment

TABLE 14 - MAJOR SOCIAL IMPACTS OF SEA SAND HARVESTING

No	Impact
1.	Increased Dust (Mining and traffic)
2.	Introduction of pollutants into the marine ecosystem
3.	Increased turbidity

ix. Mitigation Measures

In order to mitigate some of the negative impacts of this proposed alternative, the following measures can be implemented:

a. Community Education and Sensitization Programs
b. Use of water sprinklers
c. Silt Curtains
d. Construction Nets
e. Adequate PPE
f. Use of weighbridges

(4) Summary

TABLE 15 - SUMMARY OF ALTERNATIVE ANALYSIS

	Alternative 1 （**Kwale**）	**Alternative 2** （**Malindi**）	**Alternative 3** （**Mazeras**）
			
Material	Sea Sand	River Dunes	Crushed Quarry Waste
Distance from Port	15 km	150 km	21 km
Extraction Method	Sea (TSHD)	Sea and Road	Road (250,000 trips)
Delivery Time	8 months	24 months	48 months
	Land Use		
Use of Area	Fishery, Tourism	Fishery, Tourism and Farming	Quarry & Road
Development Policy	No policy on Sand harvesting at sea	No policy on Sand harvesting at sea	NEMA, Mining Act
Technical Aspect			
Quality	Confirmed	Confirmed	Low
Volume	Confirmed	Confirmed	Confirmed
Cost	Moderate	Very High	High
	E&S Aspect		
Social Environment	Fishing, Tourism, Hotels	Fishing, Tourism, Hotels	Road Traffic
Natural Environment	Coral along the shore and Water Quality	Sand Dunes, Coral along the shore and Water Quality	Existing Quarry and Road infrastructure
Pollution Control	Distance Discharge of overflow and LRP	Dust Control Measures & Turbidity Control	Dust, Noise, Traffic and Vibration mitigation measures
Optimal Site (Reason)	◎	△	×

◎ = Optimal, △ = Sub-optimal, x = Unsuitable

3. APPROACH AND METHODOLOGY TO BASELINE STUDIES

3.1 BACKGROUND TO BASELINE CONDITIONS

The scopes of work in the proposed Project includes carrying out of Environmental and Social Impact Assessment (ESIA) that will satisfy the applicable environmental requirements, including the laws, bylaws and rules of Kenya and the JICA's Environmental and Social Framework, guidelines including health and safety guidelines.

The Project Description was prepared by collecting Project related information from the Feasibility Study and design layouts. Rationale for selection of technology to be used will also be considered keeping in view the social acceptability and environmental sustainability concerns.

The contemporary and standard tools were used in investigating the physical, biological and social environment. Physical observation, Key Informant Interview (KII), stakeholder consultation, water and ambient air quality sampling and analysis, noise level measurement, transect walk, macro level fish catch assessment, analysis of satellite image and geographic information system are the major tools and techniques which were employed for detailed baseline study. A number of physical, biological and socio-cultural parameters are selected after brainstorming of the experts and reconnaissance field investigation.

The environmental parameters were collected, measured and presented in ways which are consistent with applicable environmental standards, norms and requirements of both national and international guidelines. Secondary data was used to comprehend precisely of the study area.

The baseline data includes the following:

(i) **Physical environment resources**

- Land Resources
- Geology, Topography & Soils
- Climate and Meteorological
- Surface water Hydrology and Water Availability
- Coastal Hydrology/Geomorphology
- Modelling/ Simulation of Turbidity
- Bed Sediment Contamination
- Air Environment
- Noise and Vibrations Pollution

(ii) **Biological environment resources**

- Corals
- Seagrass Survey

- Mangrove,
- Marine Turtles Survey
- Fisheries Resource Assessment
- Marine Protected Areas (MPA)
- Marine Ecology

(iii) **Socio-Economic and Cultural resources**

- Traffic
- Fisheries
- Tourism
- HIV/AIDS
- Religious Facilities
- Public Facilities

3.2 PHYSICAL ENVIRONMENT

3.2.1 Land Resources

The characteristics of land resources of the study area was identified by clipping the Agro-Climatic/Ecological Zone prepared by FAO/UNDP in the study area. The land use, and land type data will also be collected from County Government of Mombasa and Ministry of Lands and Planning. The secondary data of these parameters was verified at field level through physical observations as well as in consultation with the local people.

3.2.2 Geology, Topography and Soils

Baseline data was provided on rock types, regional tectonic setting (reported fractures/faulting, folding, warping), and history of any volcanic activity, seismicity and associated hazards, mainly in the coastal area. Information on quarry yields, strengths of rock, distance of quarries from habitat, restrictions for quarrying, environmental controls, statutory permissions etc., shall be provided.

Baseline data was given on description of existing situation of the land at the proposed project area including description of terrain hill slopes coastal and inland topography, coastal features (lowland, beaches, littoral areas, shoal areas), terrain features, slope and elevation. Study of land use pattern, habitation, cropping pattern, forest cover, environmentally sensitive places etc., by employing remote sensing techniques (where necessary) and also through secondary data sources.

Soil data including type, classification, characteristics, soil properties etc., are important from engineering considerations for design of structures, loading capacities of cargo stockpiles, green belt development etc. Changes in parameters of soil also may affect plantation and vegetative growth, which in turn may endanger the health of local habitat. Baseline data of the soil resources was carried for the project area.

3.2.3 Climate and Meteorological

Meteorological data including precipitation, humidity, sunshine hour, cloud coverage, wind flow and direction, evaporation rate was collected from the nearest Kenya Meteorological stations. To assess the baseline climatic condition of the study area a reference period of say 20-25 years was considered except for the history of cyclones and tidal surges for which 100 year data was required. However, the reference will dependent on data availability and its quality.

Time series precipitation data at least for last 25 years was collected from the Kenya Meteorological Department (KMD) for the nearest weather stations.

The main parameters will include the following:

- Rainfall
- Relative humidity
- Temperature
- Barometric pressures
- History of cyclones
- Wind Pattern.

3.2.4 Surface Water Hydrology and Water Availability

State of the current water resources was assessed on the basis of historic and existing situation in and around the study area. Baseline data on location of surface water like lagoons, tidal inlets, streams, rivers, their details, present quality and their utility, if any, was provided. Details of water bodies in the project area was described specifically. Water quality was monitored.

Baseline water quality measurement is important for continuous monitoring to keep track on the changes if any. Water quality parameter was selected dependent on the use of the ambient water use and potential polluting agents from the Project.

The consultant carried out water quality baseline survey at least at 3 locations within the port, and 3 Locations outside the port. The sampling was done at least 2 times a day for 10 days. Water quality parameters included Total Suspended Solid (TSS), Turbidity (NTU), COD, pH and Temperature.

Mombasa does not have any permanent rivers. Nonetheless, groundwater from boreholes and shallow wells is accessible to supplement the people' demands because of the advantageous geology. Other than that, the region gets its water from the Mzima springs in Taita Taveta County, Kwale through Marere Springs and the Tiwi Boreholes, and Malindi through the River Baricho.
Notably, however, are a number of semi-perennial and seasonal rivers that drain into coastal regions from dry and semi-arid catchments, such the Mwache, Kombeni, Tsalu, Hodi-hodi, and Nzovuni.

There is some potential for groundwater resources in Mombasa. This is as a result of its geological structure, which encourages quick surface runoff infiltration and percolation to replenish groundwater aquifers. Both regions covered in Kilindini sands and those with Triassic sandstone geology, which have demonstrated large groundwater yields, offer a strong potential for groundwater.

Based on their anionic content, groundwater near Kenya's coast can be divided into four primary categories: sulphate, bicarbonate, chloride, and carbonate. The coast of Kenya is home to a variety of groundwater types made up of the aforementioned substances.

The primary determinants of groundwater quality are the type and permeability of the rock, as well as the amount of recharge from rainfall and surface runoff. Jurassic shale is linked to the lowest quality water (high TDS); Triassic sandstones and Pleistocene coral limestone are linked to the middle-class water quality; and unconsolidated sands, which have high infiltration capacities and effectively receive recharge, are linked to the highest quality water.

In addition, the depth of the well or borehole, the distance from the ocean, and the closeness to populated areas all affect the quality of groundwater. Overextraction of these boreholes exacerbates the problem of saltwater intrusion that occurs in these coastal areas. The risk of pollution from septic tank-soakage pit systems and pit latrines, which frequently contaminate otherwise high-quality water and make it unfit for human use, exists for boreholes and wells situated in metropolitan areas.

In Mombasa, groundwater exploitation has been haphazard due to a lack of government regulation over well development or borehole drilling. Due to the existing shortage of water supplies and the growing number of urban-rural residents, people in urban areas—particularly Mombasa—are becoming more and more reliant on groundwater for their drinking needs.

3.2.5 Coastal Hydrology/Geomorphology

Coastal hydrology required collection of oceanographic data during the study period, covering the following parameters:

- Tides
- Waves (wind waves and swells)
- Storm surges
- Currents
- Salinity
- Sea water temperature
- Suspended load, and
- Seabed bathymetry

Baseline oceanographic data extended at least to depths more than 10m of proposed deepening of the harbor approach and basin as per design plans. A study on likely changes in the sediment transport and littoral drift due to the construction of port particularly the breakwater was taken up.

Details of mangroves, coral reefs, see grass, marshes and other coastal vegetation, sand dunes, coastal stability, seismic characteristics, history of any endangered species, coastal erosion, and shoreline changes was furnished.

3.2.6 Modelling/ Simulation of Turbidity

The Consultant carried out a detailed mathematical modelling of turbid water dispersal caused by construction activities in the project site and the surrounding environment. The simulation showed models in the different monsoon seasons in Mombasa.

3.2.7 Bed Sediment Contamination

The Consultant carried out sediment sampling at least at 2 locations within the port and conducted laboratory analysis for parameters taken into consideration for the potential pollutants such as heavy metals.

3.2.8 Air Environment

The Consultant carried out air quality baseline survey at least 3 points, one within the port, one at the nearest residential area to the proposed terminal area, one in Ras Hodi. This baseline survey was carried out for 24 hours per one location. Air Quality parameters included NO2, NO_x, SO^2, CO, H_2S and PM^{10}.

3.2.9 Noise and Vibration Pollution

The Consultant carried out, noise and vibration baseline survey at least 3 points, one within the port, one at the nearest residential area to the proposed terminal area, one in Ras Hodi. This baseline survey was 24 hours, and 24 data per one location was obtained.

3.3 BIOLOGICAL ENVIRONMENT

Ecological components of the ESIA study focuses on terrestrial and aquatic ecology including both floral and faunal resources which include amphibians, reptiles, birds and mammals. Information on bio-ecological zones and their characteristics was adopted from the publication of the International Union for Conservation of Nature (IUCN). The information relevant to ecological resources was included as ecosystem and habitat information and was assessed to determine ecological changes over the periods and potential ecological impacts due to the Project. In addition, relevant secondary documents was reviewed to get an idea about the previous status of the ecological condition. Homestead vegetation survey was conducted for understanding the vegetation patterns of the area along with its dependent wildlife and their interactions. Consultations with local people was conducted following different tools and techniques such as Rapid Rural Appraisal (RRA) and Key Informant Interview (KII), etc. Field visits was carried out for delineating the ecological baseline condition. Using IUCN database, a preliminary inventory of common flora and fauna was constructed for designing the field survey. Vegetation and wildlife information will also be collected through physical observation.

The specific Ecological Resources survey will include:

3.3.1 Coral

The Consultant conducted a coral field survey at least at 6 locations and identify the name of species with IUCN red list categories. The consultant evaluated the coral health and risks to coral with regard to sea water temperature rise and other factors.

3.3.2 Sea Grass

The consultant conducted a Sea grass field survey at least at 6 locations and identify the name of species with IUCN red list categories. The survey can be conducted by using transect method.

3.3.3 Mangrove

The consultant conducted a mangrove field survey and establish the mangrove structure, composition, canopy cover, number of trees, the area of the project affected areas. The consultant established the correlation between mangrove associations and natural conditions.

3.3.4 Sea Turtle

The consultant conducted a desktop survey and interviews with specialists to understand the sea turtle species and spawning sites. Consultants identified the name of species and their IUCN categories.

3.3.5 Fishery

The consultant conducted a field survey to identify fish and other marine species inhabit in the AOI and its IUCN categories. Fisheries resources was assessed based on primary and secondary data. The primary data was collected from the field by selecting representative sites considering capture and culture fishery. The major sets of primary data included physical condition of different fish habitats, catch status, fish species diversity, composition, fishermen and fishers status etc. Secondary data was collected from concerned BMUs and KEFRI.

The spatial extent and area of fish habitats was obtained from the land use data that was generated by analyzing image and water resources database. The habitat quality was assessed based on the measured water quality data. Fish yield and production for individual habitats of capture and culture fisheries was estimated using both primary and secondary data.

3.3.6 Marine Protected Area (MPA)

The Consultant identified the MPAs in the AOI and provide the descriptions about each MPA in terms of biodiversity and conservation status such as management and monitoring plan and its implementation.

3.3.7 Marine Ecology

The Consultant mapped out the above-mentioned information by using GIS or equivalent and analyzed the information from ecological point of view.

3.4 SOCIO-CULTURAL ENVIRONMENT

Clear understanding of the socio-economic context of any project intervention is a mandatory task and a legal requirement under the Government of Kenya rules.

Socio-Economic environment has included social and economic baseline condition of the study area. From the reconnaissance field visit, major socio-economic indicators were opted for perceiving potential impacts on them by the proposed Project. The indicators are demography; occupation and employment; education; health, utility services (present water supply and water uses, sanitation and energy facilities), economic information in terms of income expenditure, land ownership pattern, self-assessed poverty status; migration, social overhead capitals and quality of life; disasters, conflicts of the study area; cultural and heritage features, ethnic community and transportation system was collected.

Data for this Social Impact Assessment was collected from both primary and secondary sources. Secondary data was collected from National Housing and Population Census, 2019 and other available relevant literatures and documents from different agencies. On the other hand, primary data was collected from the field visit in the study area. Before immersing into the field, the relevant secondary data on the selected indicators was reviewed so as to triangulate with primary data during the field level investigation. A semi-structured questionnaire, and a checklist was followed for primary data collection.

The methods for data collection included semi-structured interview, informal interview, group discussion, key informant interview and observation. For a semi-structured interview, a semi-structured questionnaire (open ended and guided questions) was followed. For informal interview, the field investigator has discussed with the project related stakeholders without formal informed consent. For group discussion and key informant interview, a checklist was followed.

The Consultant collected information about population, religion, race and other basic information in Mombasa, Kwale and Kilifi County. The consultant also collected information about the industry and development plan of each county.

The following data/information was collected from different sources:

TABLE 16 - SOCIO-CULTURAL DATA/INFORMATION

Area of Studies	Indicators	Secondary Sources	Primary Data Acquisition Process
Community structure	Population density, demography, education, culture, age and workforce distribution, gender	KNBS	Field survey, FGD
Economic condition	Distribution of income, labor market, employment, dependency ratio	KNBS	Field survey, FGD
Archeological site, Cultural heritage	Declared archeological site, tribal groups, indigenous customs	Kenya National Museum	Field study

The Consultant conducted desktop research on the following items before conducting field surveys and conduct interviews with relevant persons in the area to collect information.

3.4.1 Traffic

The Consultant conducted a 24-hour field traffic survey within and outside the port. The traffic survey locations were at least at 2 points and collect the traffic volume information by type and by direction.

3.4.2 Fishery

The Consultant collected information about the BMUs, landing sites and catch in the AOI and analyzed the data.

3.4.3 Tourism

The Consultant conducted a field survey on tourism by interview with tourists to identify the purpose of visit and expectations in this region and analyze the data. The Consultant collected information about the destinations.

3.4.4 HIV/AIDS

The Consultant collected baseline information related to HIV/AIDS in Mombasa and analyzed the information by age, by sex and by the mode of infection.

3.4.5 Religious Facilities

The Consultant identified any religious or cultural sites, establishment or other that is in the area of impact of the project.

3.4.6 Public Utilities

Base line data of existing public utility infrastructure was ascertained and reported to assess the impacts of the project on these public utilities in order to incorporate desired methods in the ESMP and monitor the same during the construction as well as operational phases of the project.

The Consultant identified the potential waste which was generated during construction and operation of the proposed container terminal and the volume. The Consultant has proposed proper treatment and dumping method of such waste. The Consultant has identified the landfill to be used for the project and confirm the capacity is enough.

3.5 POLICY, RULES AND REGULATORY FRAMEWORK

Policy, Act and Administrative Framework that are considered relevant for the construction and operation of the Project were reviewed to ensure whether the proposed Project in congruent with the national policy, guidelines and legislations as well in conformity to Kenya Government commitment to multilateral environmental agreements were reviewed. The proposed Project falls under “High Risk” category according to Legal Notice 31 and 32 (Amendment of Second Schedule of EMCA 1999). This study has analyzed relevant national and international law acts and rules that are of relevance at different phases of the Project.

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

TABLE 17 - APPLICABLE LAWS AND LEGISLATIONS

Sector	Laws and Regulations	Licensing & reporting requirement
General Laws/Regulation	Kenya Maritime Authority Act (Cap. 370).	▪ Kenya Maritime Port Development and management
	Kenya Ports Authority Act	▪ Establishment and functions of KPA
Principal Environmental Laws/Regulation	Environmental Management and Coordination Act No.8/1999 (Amended) 2015	▪ Environmental & Social Impact Assessment Report ▪ Environmental & Social Impact Assessment license
Environmental Impact Assessment	The Environmental (Impact, Audit and Strategic Assessment) Regulations, 2009 Legal Notice No.101 Environmental Impact Assessment Guidelines and Administrative Procedures, 2002	▪ Environmental & Social Impact Assessment Report ▪ Environmental & Social Impact Assessment license
Air quality	Environmental Management & Coordination (Air Quality) Regulations, 2014 (Legal Notice No.34)	▪ Baseline air quality report ▪ Quarterly air quality monitoring report (operation phase) ▪ Air quality emission license
Water quality	Environmental Management & Coordination (Water Quality) Regulations, 2006 (Legal Notice No.120)	▪ Baseline water quality report (fresh and marine water) ▪ Biannual water quality monitoring reports ▪ Effluent discharge license (operation phase)
Noise and Vibration	The Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulation, 2009 Legal Notice No.61	▪ Baseline noise and vibration benchmarking report ▪ Annual noise and vibration monitoring report (operation phase) ▪ Permit to emit noise in excess
Controlled Substances	The Environmental Management and Coordination (Controlled Substance) Regulation, 2009 Legal Notice No.61	▪ License to produce, handle, import/export-controlled substances. ▪ Duty to submit reports under section 26. (1)
Coastal Zone	The Environmental (Preservation of Pollution in Coastal Zone and Other Segments of The Environment) Regulation, 2003	▪ Port Waste Disposal Certificate: Under section 6(1) all ships are required to obtain a Port Waste Disposal Certificate issued by a

		Certified Port Waste Reception Facility at the Port.
Fisheries	Fisheries (Beach Management Unit) Regulations, 2007 Fisheries Management and Development Act No 35, 2016 The Fisheries Act Cap 378 The Merchant Shipping Act No. 4 of 2009	Conservation of fisheries resources Establishment of beach management units
Biodiversity	The Environmental Management and Coordination (Conservation of Biological Diversity and Resources, Access to Genetic Resources and Benefit Sharing) Regulations, 2006 Legal Notice No.160	▪ ESIA License: Under section 5 ▪ Permit to access genetic resources under section 11
Water Resources	Water Act, 2016	Conservation and utilization of water resources
Land use	Physical Planning Act, Cap 286, 1996 Land Act 2012	Land use and planning
Occupational Safety and health	Occupational Safety and Health Act, 2007 Building Operations and Works of Engineering Construction Rules, 1984 Employment Act, 2007 HIV and AIDS Prevention and Control Act 2006	Safety and Health of workers
Cultural	The National Museums and Heritage Act-Cap 216 (2006)	Conservation of cultural sites and heritage
County Government of Mombasa Development Plans, Laws and Legislations	▪ County Government Act 2010 ▪ Mombasa County Annual Development Plan 2022/23 ▪ Mombasa County, Second County Integrated Development Plan (2018-2022) ▪ The Mombasa County Water and Sewerage Services Act, 2016 ▪ Mombasa County Solid Waste Management Act 2021	
Relevant National Policies	▪ Vision 2030 ▪ National Environment Policy 2013 ▪ Integrated Coastal Zone Management (ICZM) Policy ▪ National Climate Change Framework Policy ▪ Blue Economy ▪ Go Blue Initiative	
International Treaties and Conventions	▪ Marine Pollution (MARPOL) 1973 & 1978 ▪ London Convention and protocol	

	▪ Sustainable Development Goal 14- Life Below Water	

3.6 STAKEHOLDER ENGAGEMENT AND PUBLIC PARTICIPATION

Stakeholder Engagement and Public Participation included the following:

- Undertaking Stakeholder Engagement in line with the laws and regulations
- Prepare a Stakeholder Consultation Plan, providing an opportunity for the relevant stakeholders and PAPs to raise issues and concern pertaining to the proposed project and allow the identification of the additional alternatives and recommendations.
- Assess stakeholder level of interest and project support to enable views of stakeholders be taken into account not only during project design but also for environmental and social performance of the proposed project.
- Promote but also provide means for an inclusive and effective engagement with project affected persons on issues that could affect them throughout the project life cycle.
- Provide appropriate pathways for timely disclosure to all stakeholders, appropriate project information on environmental, social risks and impacts in a manner and format that will be understandable and accessible.
- Provide critical accessibility and inclusive means to project affected parties to raise their grievances for appropriate response and management by the project proponent
- Gather more detailed information through which the study team could anticipate issues not raised by the PAPs that will be addressed by the environmental and social impact assessment report.
- Focus the study on relevant issues and recommend specific investigations, such that the resulting ESIA is useful to decision makers and it addresses the concerns of PAPs
- Summarised the issues identified during the public participation process. Document stakeholders' concerns and issues raised and actions planned/taken and justifications for no action wherever relevant.
- Prepare a grievance Redress Mechanism

Stakeholder engagement process involved the following:

- Stakeholder identification and analysis
- Planning how the engagement with stakeholders take place
- Disclosure of information
- Consultation with stakeholders through public barazas, workshops, focus groups and questionaries
- Addressing and responding to grievances
- Reporting to stakeholders

A list of identified stakeholder groups has been presented in the Chapter 6 - Public Consultations

4. LEGAL AND REGULATORY FRAMEWORK

4.1 INTRODUCTION

The legal framework for maritime development projects in Kenya primarily revolves around various laws, regulations, and policies governing maritime activities, port operations, and coastal development. Here are some key elements of the legal framework in Kenya related to maritime development projects

4.2 RELEVANT NATIONAL POLICIES

Several policies have been developed over the years to guide the development and management of proposed projects to ensure both economic and social sustainability these policies are discussed below. The Kenya Government's environmental policy aims at integrating environmental aspects into national development plans. The broad objectives of the national environmental policy include:

- Optimal use of natural land and water resources in improving the quality of human environment.
- Sustainable use of natural resources to meet the needs of the present generations, while preserving their ability to meet the needs of future generations.
- Integration of environmental conservation and economic activities into the process of sustainable development.
- Meeting national goals and international obligations by conserving bio-diversity, arresting desertification, mitigation effects of disasters, protecting the ozone layer and maintaining an ecological balance on earth.

4.2.1 The National Environmental Action Plan Framework, 2009 - 2013

The National Environmental Action Plan Framework is the second national environmental policy after the 1994 National Environmental Action Plan (NEAP). The development of NEAP is provided for by EMCA, 1999 which requires preparation of Environmental Action Plan at different levels; County, provincial, and national levels. The framework recognizes the intertwined linkages between economic growth and environment in Kenya. It highlights priority themes and activities for the country towards achieving sustainable environment.

The policy framework among others, proposes integration of environmental concerns into regional and local development plans, promotion of appropriate land uses and enforcement of EMCA, 2015 Amendment Act and its subsidiary and other relevant legislations. The policy framework also advocates for efficient water harvesting, storage and usage. On human settlements and infrastructure, this policy framework recognizes the associated environmental issues. These include waste management, sanitation, diseases, land use changes in conservation areas, demand for water, energy, construction materials, pollution, land degradation, biodiversity loss etc. In managing operations of the proposed Project, consideration of the highlighted issues is vital towards contribution to the national sustainable development goals.

Multiple stakeholders' involvement inclusive of the private sector is advocated for within the implementation of this framework towards achievement of sustainable development goals. Finally, the framework also advocates for monitoring and evaluation to ensure effective and efficient environmental policy implementation.

The NEAP for Kenya was prepared in mid 1990s. It was a deliberate policy effort to integrate environmental considerations into the country's economic and social development. The integration process was to be achieved through a multi-sectoral approach to develop a comprehensive framework to ensure that environmental management and the conservation of natural resources are an integral part of the societal decision-making.

4.2.2 Policy Paper on Environment and Development (Sessional Paper No. 6 of 1999)

The key objectives of the policy include:

- To ensure that from the onset, all the development policies, programmes and projects take environmental considerations into account.
- To ensure that an independent ESIA report is prepared for any industrial venture or other development before implementation.
- To come with effluent standards that will conform to acceptable health guidelines.

Under this paper, broad categories of development issues have been covered that require a sustainable development approach. These issues relate to waste management and human settlement. The policy recommends the need for enhanced reuse/recycling of the residues including wastewater, use of raw or non-waste technologies, increased public awareness rising and appreciation of the clean environment. It also encourages participation of the stakeholders in the management of the waste within their localities. Regarding human settlement, the paper encourages better planning in both rural and urban areas and provision of basic needs such as water, drainage and waste disposal facilities among others.

4.2.3 Kenya Vision 2030

Following the expiry of the Economic Recovery Strategy (2003-2007), Kenya's Development Agenda is now anchored on the Kenya Vision 2030, which aims at creating "a globally competitive and prosperous country with a high quality of life by 2030". It aims to transform Kenya into "a newly – industrialized, middle-income country providing a high quality of life to all its citizens in a clean and secure environment". Simultaneously, the Vision aspires to meet the Millennium Development Goals (MDGs) for Kenyans by 2015.

The Vision is anchored on three key pillars: economic, social and political. The economic pillar aims was to achieve an average economic growth rate of 10 per cent per annum by 2012 and sustaining the same till 2030 in order to generate more resources to meet the MDGs and Vision 2030 goals. The social pillar seeks to achieve a just, cohesive and equitable social development in a clean and secure environment, while the political pillar aims for a democratic, issue-based, people-centred, result-oriented and accountable system.

The proposed project falls under the first pillar-fostering economic growth.

4.2.4 The National Biodiversity Strategy and Action Plan, 2007

The overall objective of the National Biodiversity Strategy and Action Plan (NBSAP) is to address the national and international undertakings elaborated in Article 6 of the Convention on Biological Diversity. It is a national framework of action to ensure that the present rate of biodiversity loss is reversed and the present levels of biological resources are maintained at sustainable levels for posterity. The general objectives of the strategy are to conserve Kenya's biodiversity to sustainably use its components; to fairly and equitably share the benefits arising from the utilization of biological resources among the stakeholders; and to enhance technical and scientific cooperation nationally and internationally, including the exchange of information in support of biological conservation.

4.2.5 National Policy on Water Resources Management and Development

While this policy seeks to enhance systematic development of facilities in all sectors for promotion of the country's socio-economic progress, it also recognizes the by-products of this process as wastewater. It, therefore, calls for development of appropriate sanitation systems to protect people's health and water resources from institutional pollution.

Industrial and business development activities therefore should be accompanied by corresponding waste management systems to handle wastewater and other waste emanating there from. Such projects should also undergo ESIA studies that will provide suitable measures to be taken to ensure environmental resources and people's health in the immediate neighborhood and further downstream are not negatively impacted by the emissions. As a follow-up to this, EMCA, 2015 requires environmental audits to be conducted in order to ensure that mitigation measures and other improvements identified during ESIA study are implemented.

In addition, the policy provides for charging levies on waste on the basis of quantity and quality. The "polluter-pays-principle" applies in which case parties contaminating water are required to meet the appropriate cost of remediation. The policy provides for establishment of standards to protect water bodies receiving wastewater, a process that culminated in the enactment of the Environmental Management and Coordination (Waste management) Regulations 2006.

Water is at the heart of all development, because it is the key resource for health, food and cash crops, hydropower and the ecosystems. Safe, adequate, reliable water supplies, good sanitation and sound hygiene are therefore essential to achieving the Millennium Development Goals including those on poverty, hunger and the HIV/Aids epidemic

The Kenya government recognizes that the current arrangement are inappropriate and a bottleneck to achieving the set poverty reduction objectives. The government therefore started a process of comprehensive policy and institutional reform that will facilitate pro-poverty water and sanitation services programs. As a first step, a national water policy on water resources management and development was created in 1999. It has four broad objectives:

- To preserve, conserve and protect available water resources and allocate them in a sustainable, rational and economic way.

- To supply water of good quality and in sufficient quantities to the various water needs, while ensuring safe disposal of wastewater and environmental protection.
- To establish an efficient and effective institutional framework to achieve a systematic development and management of the water sector promoting and supporting participation of users.
- To develop a sound and sustainable financing mechanism for effective water supply and sanitation development.

4.3 RELEVANT NATIONAL LEGISLATION

4.3.1 Environment Management and Coordination (Amendment) Act (No. 5 of 2015)

This law provides a framework for environmental protection and management, including regulations concerning environmental impact assessments (EIAs) for maritime development projects. It ensures sustainable development and conservation of marine resources. The Environmental Management and Coordination (Amendment) Act (No. 5 of 2015) is an act of parliament to provide for the establishment of an appropriate legal and institutional framework for the management of the environment and for related matters.

National Environment Management Authority is a body established under the Act. NEMA has the legal authority to exercise general supervision and coordination over all matters relating to the environment and is the principal instrument of the Government charged with the implementation of all policies relating to the environment.

Part II of the Act states that every person is entitled to a clean and healthy environment and has the duty to safeguard the same. It is worth noting that the entitlement to a clean and healthy environment carries a correlative duty. Hence, there is not only the entitlement to a clean and healthy environment, but also the duty to ensure that the environment is not degraded in order to facilitate one's own as well as other persons' enjoyment of the environment.

According to section 58 of the act, an environmental impact assessment study needs to be carried out on all projects specified in the second schedule of the act that are likely to have a significant impact on the environment. This proposed project is considered to fall under the second schedule of the Act.

4.3.2 Environmental Impact Assessment and Environmental Audit regulations, 2003

The regulations apply to all policies, plans, programmes, projects and activities specified in Part IV, Part V and the Second Schedule of the Act.

The regulation state as follows: 4. (1) No proponent shall implement a project - (*a*) Likely to have a negative environmental impact; or (*b*) For which an environmental impact assessment is required under the Act or these Regulations; unless an environmental impact assessment has been concluded and approved in accordance with these Regulations. (2) No licensing authority under any law in force in Kenya shall issue a license for any project for which an environmental impact assessment is required under the Act unless the applicant produces to the licensing authority a license of environmental impact assessment issued by the Authority under these Regulations. (3) No licensing authority under any law in force in Kenya shall issue a trading, commercial or development permit or license for any micro project activity likely to have cumulative significant negative environmental impact before it ensures that a strategic environmental plan encompassing mitigation measures and approved by the Authority is in place.

The project is classified as a high-risk project under Legal Notice 31 (Amendment of Second Schedule of EMCA 1999). Further Legal Notice 32 (Environmental (Impact Assessment and Audit) (Amendment) Regulations, 2019) requires projects classified under high-risk projects to conduct and submit to NEMA an Environmental Impact Assessment Comprehensive Project Report.

4.3.3 Waste Management Regulations 2006

These are described in Legal Notice No. 121 of the Kenya Gazette Supplement No. 69 of September 2006. These Regulations apply to all categories of waste as provided in the Regulations and include: industrial wastes, hazardous and toxic wastes, pesticides and toxic substances, biomedical wastes and radioactive substances.

These Regulations outline requirements for handling, storing, transporting, and treatment / disposal of all waste categories as provided therein.

4.3.4 The Sustainable Waste Management Act 2022

This is an Act of Parliament to establish the legal and institutional framework for the sustainable management of waste; ensure the realization of the constitutional provision on the right to a clean and healthy environment and for connected purposes.

The main objectives of the act are as follows:

- promote sustainable waste management.
- improve the health of all Kenyans by ensuring a clean and healthy environment.
- reduce air, land, fresh water and marine pollution.
- promote and ensure the effective delivery of waste services.
- create an enabling environment for employment in the green economy in waste management, recycling and recovery.
- establish an environmentally sound infrastructure and system for sustainable waste management.
- promote circular economy practices for green growth.
- mainstream resource efficiency principles in sustainable consumption and production practices.
- inculcate responsible public behavior on waste and environment.

The Act operates on some general principles which are as listed below.

- promoting the right to a clean and healthy environment.
- the precautionary principle where the lack of scientific certainty shall not be used to postpone measures to prevent environmental degradation where there are threats of damage to the environment.

- the polluter pays principle in which the cost of cleaning up any element of the environment that has been damaged by pollution, the cost of the beneficial uses of the environment that have been lost as a result of the pollution, and any other costs associated with or incidental to the pollution shall be paid by the polluter.
- payment for ecosystem services or payment for ecological services in which payments are made to farmers or landowners who have agreed to take certain actions to manage land or watersheds in order to provide ecological services as an incentive to conserve natural resources.
- zero waste principle in which products and processes are designed and managed to reduce the volume and toxicity of waste and materials, and to conserve and recover all resources, and to prevent the burning or burying of resources, in order to treat waste as a resource that can be harnessed for wealth creation, employment and the reduction of pollution.
- achieving sustainable waste management goals.

The Act operationalizes the concept of **"extended producer responsibility"** which is an environmental management approach in which producer's responsibility for a product is extended to the post-consumer stage of a product life cycle. This means that the responsibility extends through the entire product life cycle and any effects the product may have on the environment. Under this approach a **"take-back scheme"** is established as a responsibility of the producer. This is an arrangement for collection, transportation and return of products or packaging from end users and consumers.

The act establishes a Waste Management Council to be established by the Cabinet Secretary within one year of the coming into operation of this Act. The Council, the Authority (NEMA), waste generators, licensed waste handlers and the County Governments have specific roles set out in the Act. The roles are all geared towards sustainable management of wastes that minimizes loss while safeguarding the environment.

The Authority role is to develop standards and guidelines on sustainable waste management as well as generate and disseminate waste information for the public in consultation with county governments. The authority also has responsibility to enforce waste management legislation in consultation with county governments among other functions.

The Authority shall provide analytical reports and support on waste management to ministries, agencies and counties and serve as the national knowledge and information management center for disseminating information on sustainable waste management.

Part 12 (1) of the act requires that all public and private sector entities shall segregate non-hazardous waste into organic and non-organic fractions.

(2) The segregated waste shall be placed in properly labeled and colour coded receptacle, bin containers and bags.

(3) All waste service provider shall collect, handle and transport segregated waste as provided for under this act

(4) Hazardous waste will be handled and managed a prescribed by the Environmental Management and Co-Ordination Act, 1999 and any other relevant written law.

4.3.5 Water Quality Regulations 2006

These are described in Legal Notice No. 120 of the Kenya Gazette Supplement No. 68 of September 2006. These Regulations apply to drinking water, water used for agricultural purposes, water used for recreational purposes, water used for fisheries and wildlife and water used for any other purposes. This includes the following:

- Protection of sources of water for domestic use.
- Water for industrial use and effluent discharge.
- Water for agricultural use.

These Regulations outline:

- Quality standards for sources of domestic water.
- Quality monitoring for sources of domestic water.
- Standards for effluent discharge into the environment.
- Monitoring guide for discharge into the environment.
- Standards for effluent discharge into public sewers.
- Monitoring for discharge of treated effluent into the environment.

4.3.6 Conservation Of Biological Diversity (BD) Regulations 2006

These regulations are described in Legal Notice No. 160 of the Kenya Gazette Supplement No. 84 of December 2006. These Regulations apply to conservation of biodiversity which includes Conservation of threatened species, Inventory and monitoring of BD and protection of environmentally significant areas, access to genetic resources, benefit sharing and offenses and penalties.

4.3.7 Fossil Fuel Emission Control Regulations 2006

These regulations are described in Legal Notice No. 131 of the Kenya Gazette Supplement no. 74, October 2006. The regulations include internal combustion engine emission standards, emission inspections, the power of emission inspectors, fuel catalysts, licensing to treat fuel, cost of clearing pollution and partnerships to control fossil fuel emissions. The fossil fuels considered are petrol, diesel, fuel oils and kerosene.

4.3.8 Air Quality Regulations 2014

The objective of the Regulations is to provide for prevention, control and abatement of air pollution to ensure clean and healthy ambient air. It provides for the establishment of emission standards for various sources such as mobile sources (e.g., motor vehicles) and stationary sources (e.g., industries) as outlined in the Environmental Management and Coordination Act, 1999. It also covers any other air pollution source as may be determined by the Minister in consultation with the Authority. Emission limits for various areas and facilities have been set. The regulations provide the procedure for designating controlled areas, and the objectives of air quality management plans for these areas. The emission standards for mobile sources are however stipulated under KS 1515.

4.3.9 Wetlands, Riverbanks, Lake Shores and Sea Shore Management Regulations, 2009

The aim of these Regulations is to ensure conservation and sustainable use of riverbanks, wetlands, Lake Shores and Sea Shore in Kenya. The regulations provide guidelines on the above natural resources management.

4.3.10 Noise and Excessive Vibration Pollution) (Control) Regulations, 2009

Section 14 (1) says, where defined work of construction, demolition, mining or quarrying is to be carried out in an area, the Authority may impose requirements on how the work is to be carried out including but not limited to requirements regarding - (a) Machinery that may be used, and (b) The permitted levels of noise as stipulated in the Second and Third Schedules to these Regulations. (2) The relevant lead agency shall ensure that mines & quarries where explosives & machinery used are located in designated areas and not less than two kilometers away from human settlements. (3) Any person carrying out construction, demolition, mining or quarrying work shall ensure that the vibration levels do not exceed 0.5cm per second beyond any source property boundary or 30m from any moving source.

On Permissible noise levels, section 5 states that No person shall make, continue or cause to be made or continued any noise in excess of the noise levels set in the First Schedule to these Regulations, unless such noise is reasonably necessary to the preservation of life, health, safety or property.

4.3.11 The Water Act 2016

The Water Act 2016 is an Act of Parliament meant to provide for the management, conservation, use and control of water resources and for the acquisition and regulation or rights to use water. This Act is also meant to provide for the regulation and management of water supply and sewerage services; to repeal the Water Act 2002 and certain provisions of the Local Government Act; and for related purposes.

The purpose of the Water Act is to provide for the management, conservation, use and control of water resources and for the acquisition and regulation of rights to use water, to provide for the regulation and management of water supply and sewerage services. Except for waters that are wholly situated in a private landowner's domain, the Act vests the rights over all surface and ground water in the state. This is only subject to the rights which users may acquire under license from time to time.

Part II, section 18 of the act provides for national monitoring and information systems on water resources. Following on this, sub-section 3 allows the Water Resource Management Authority to demand from any person or institution, specified information, documents, samples or materials on water resources. Under these rules, specified information, documents, samples or materials on water resources may be kept by a water user and the information thereof furnished to the authority.

Section 94 of the act makes it an offense to through or convey or cause or permit to be thrown or conveyed, any rubbish, dirt, refuse, effluent, trade waste or other offensive or unwholesome matter or thing into or near to water resources in such a manner as to cause, or be likely to cause, pollution of the water resource.

4.3.12 The Community Land Act, 2016

This is an Act of Parliament to give effect to Article 63 (5) of 2016. the Constitution; to provide for the recognition, protection and registration of community land rights; management and administration of community land; to provide for the role of county governments in relation to unregistered community land and for connected purposes.

4.3.13 The Agriculture, Fisheries and Food Authority (Amendment) Act No. 37 of 2013

This is an Act of Parliament to amend the Agriculture, Fisheries and Food Authority Act, 2013 and for connected purposes. The act provides legislative control for soil conservation aimed at stimulating development of agricultural land in accordance with the accepted practices of good land management and husbandry. This Act primarily guides and regulates farming practices and is the principal land use statute covering, *inter-alia,* soil conservation and agricultural land use.

Of direct relevance to the proposed project are the basic land usage rules under the Act, which cover issues such as soil erosion; protection of lands exceeding 12% slope and watercourses. The rule states that "Clearing of vegetation from steep slopes or in areas next to water courses without authorization is forbidden". Basic land usage rules should be observed by members of the proposed project.

4.3.14 The Lakes and River Act Chapter 409 Laws of Kenya

This Act provides for protection of River, lakes and associated floral and fauna. The provisions of this Act may be applied in the management of the project.

4.3.15 The Fisheries Management and Development Act, 2016

This is an Act of Parliament 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

4.3.16 Maritime Zones Act

An Act of Parliament 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. This act delineates Kenya's maritime boundaries, including territorial waters, contiguous zones, exclusive economic zone (EEZ), and the continental shelf. It governs rights, jurisdiction, and responsibilities within these maritime zones.

4.3.17 Kenya Ports Authority Act

This legislation establishes the Kenya Ports Authority (KPA) and outlines its functions, powers, and responsibilities in managing and developing Kenya's ports, including the Port of Mombasa, which is a critical hub for maritime trade in East Africa.

4.3.18 Kenya Maritime Act

This is 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 and incidental thereto.

The Act establishes the Kenya Maritime Authority Act which is a corporate body whose principal objects are to regulate, coordinate and oversee maritime affairs in Kenya.

The duty of directing, coordinating, and supervising marine affairs falls to the Kenya Maritime Authority.

KMA's responsibilities in carrying out this mandate include: advising the government on the creation of international maritime conventions, treaties, and agreements as well as their incorporation into Kenyan law; conducting research, investigations, and surveys in relation to maritime affairs; developing and maintaining the country's oil spill response plan in coastal and inland waterways in collaboration with the oil industry; coordinating search and rescue operations in coordination with the Kenya Navy, KPA, and other pertinent bodies; and guaranteeing the sustainable exploitation of marine resources and prompt reaction to maritime disasters.
As a result, KMA offers a venue where the different stakeholders in maritime affairs may create maritime policies and incorporate them into the national development strategy.

Furthermore, Kenya ascribes to the rules of The International Convention for the Prevention of Pollution from Ships, 1973 (MARPOL 73/78), which governs KPA policy on environmental concerns. This is the most significant tool available to stop pollution from coming from maritime transportation. MARPOL 73/78 was created when it was adopted in 1973 and changed by the 1978 Protocol that was related to it. It has the following five Annexes:

Annex I: Oil: Ships are not allowed to release oil or greasy water within 12 miles of land, including oily bilge water and dirty ballast water with more than 15 parts per million. Discharges outside 12-mile boundaries are subject to additional requirements.

Annex II: Bulk Noxious Liquid Substances Chemicals are rated according to the potential environmental harm they could do to the sea (Categories A, B, C, and D). Tank washings and other residues of less hazardous substances (Categories B, C, and D) may only be discharged under certain conditions, such as total quantity, distance from the shore, and depth of water, prescribed depending on the hazards. The most harmful chemicals (Category A) cannot be discharged into the sea. Certain substances are exempt from limits, such as wine, water, acetone, and ethyl alcohol.

Annex III: Hazardous Substances in Packaged Form: This section primarily focuses on controlling packaging, labelling, marking, and stowage in order to prevent pollution.

Annex IV: Sewage - Ship-generated sewage cannot be released until it has been treated in a sewage treatment plant that has received approval or until it is a specific distance away from land.

Annex V: Trash: Trash generated on board a ship, including food scraps and packaging, must be stored on board and released into the sea or ashore subject to certain restrictions, such as the distance from land. Any kind of plastic discharge is forbidden.

Additionally, the London Convention of 1972, which forbids the disposal of waste at sea, governs maritime activity.

4.3.19 Merchant Shipping Act

This is an Act of Parliament to make provision for the registration and licensing of Kenyan ships, to regulate proprietary interests in ships, the training and the terms of engagement of masters and seafarers and matters ancillary thereto; to provide for the prevention of collisions, the safety of navigation, the safety of cargoes, carriage of bulk and dangerous cargoes, the prevention of pollution, maritime security, the liability of ship-owners and others, inquiries and investigations into marine casualties; to make provision for the control, regulation and orderly development of merchant shipping and related services; generally to consolidate the law relating to shipping and for connected purposes.

The Act applies Kenyan ships wherever they may be and all other ships while in a port or place in, or within the territorial and other waters under the jurisdiction of Kenya. However, this does not apply to security vessels under the control or consent of the Kenyan Government

4.3.20 Coastal Development Act

An Act of Parliament to provide for the establishment of an Authority to plan and co-ordinate the implementation of development projects in whole of the Coast Province and the exclusive economic zone and for connected purposes. it establishes the Coastal Development Authority (CDA): The CDA is responsible for overseeing coastal development projects and ensuring sustainable utilization of coastal resources while promoting socio-economic development in coastal areas.

4.3.21 Public Health Act Cap 242 (Revised Edition 2012)

This Act concerns the protection of public health in Kenya and lays down rules relative to, among other things, food hygiene and protection of foodstuffs, the keeping of animals, protection of public water supplies, the prevention and destruction of mosquitos and the abatement of nuisances including nuisances arising from sewerage. The Act establishes the Central Board of Health and a county health management board in each county. It also establishes and defines functions of health authorities.

4.3.22 The Physical and Land Use Planning Act, 2019

The said Act section 29 empowers the local Authorities to reserve and maintain all land planned for open spaces, parks, urban forests and green belts. The same section allows for prohibition or control of the use and development of an area.

Section 30 state that any person who carries out development without development permission will be required to restore the land to its original condition. It also states that no other licensing authority shall grant license for commercial or industrial use or occupation of any building without a development permission granted by the respective local Authority.

4.3.23 The National Construction Authority Act No. 41 of 2011

This is an Act of Parliament to provide for the establishment, powers and functions of the National Construction Authority and for connected purposes.

The National Construction Authority in short NCA Kenya is a body constituted under Act No. 41 of 2011 Laws of Kenya. Contractors operating or willing to undertake construction operations in Kenya are required by law to register through the NCA.

NCA is mandated to clear Kenya builders and contractors as a way of eliminating rogue contractors and malpractices in building and construction. The authority, which has recently started inspecting construction and building projects around the country to ensure high quality of work and close projects posing health risks and collapse hazards, is expected to provide the regulatory framework for registration and renewal of contractors

4.3.24 National Construction Authority Regulations, 2014

The regulations deal with:

- Registration of contractors
- Identification and reporting of construction
- Works, contractors or projects by owner
- Certification and accreditation of skilled
- Construction workers and construction sire supervisors
- Collection and payment of construction levy

4.3.25 Building Code 1968

Section 194 requires that where sewer exists, the occupants of the nearby premises shall apply to the local Authority for permit to connect to the sewer line and all the wastewater must be discharged in to sewers. The code also prohibits construction of structures or building on sewer lines.

The Building Code, a regulatory document which spells out the regulations that should govern any type of buildings constructed in the country. Over the years the government has been trying to prepare a new building code. However, this is yet to be realized.

4.3.26 Kenya Roads Act, 2007

This is an Act of Parliament to provide for the establishment of the Kenya National Highways Authority, the Kenya Urban Roads Authority and the Kenya Rural Roads Authority, to provide for the powers and functions of the authorities and for connected purposes.

4.3.27 Urban Areas and Cities Act of 2011 (Rev. 2019)

The Urban Areas and Cities Act (UACA) operationalizes article 184 of the Constitution of Kenya 2010 on Urban Areas and Cities. Section 13 of the Act makes provision for establishment of Cities while Section 14 makes provision for establishment of Municipalities. Section 20 of the Act spells out functions of the board of city or municipality which include promotion of and undertaking of infrastructural development and services.

4.3.28 The Public Roads and Roads of Access Act (Cap 599)

The act states in part that: "Where an order made under this section dictates a line of public travel, such a line of public travel shall be absolutely dedicated to the public as public road within the meaning of any law now or hereafter in force relating to public roads. In every order made under this section, the line of public travel shall be clearly described

4.3.29 Occupational Safety and Health Act, 2007

This is an Act of Parliament to provide for the safety, health and welfare of all workers and all persons lawfully present at workplaces, to provide for the establishment of the National Council for Occupational Safety and Health and for connected purposes. It applies to all workplaces where any person is at work, whether temporarily or permanently. During the construction phase the works contractor must adhere to the requirements of this Act.

(i) **Safety and Health committee rules of 2004**

These rules state that any employer/proponent/occupier who employs more than twenty persons must establish a committee to address the health, safety and welfare of workers. The employer must also cause to be carried out a health and safety audit of all his operations on an annual basis by a registered health and safety advisor who should forward such a report to the Director of Occupational Health and Safety Services.

(ii) **First Aid Rules**

These have details on first aid requirements in terms of facilities and capacity building among non-medical workers.

(iii) **Hazardous Substances Rules**

These regulate the handling, transportation and use of certain listed chemicals which may have negative effects on the body when one is exposed.

(iv) **Noise Prevention and Control Rules of 2005**

These rules have set minimum maximum exposure limits beyond which workers and members of the public should not be exposed to noise without adequate means of protection. The rules also have limits for exposure out of workplaces. The rules have several recommendations on a comprehensive noise control program for workplaces that includes a requirement for medical examination of workers who are exposed to noise. The rules have also set the minimum noise levels that should emanate from a facility to public/neighbouring areas by day or by night

(v) **Medical Examination Rules**

The rules offer a guide on the need and target of workers who have to undergo regular medical examination to identify the symptoms of hazardous exposures on the body. This is with a sole purpose of monitoring exposure for remedial action.

(vi) **Building Operations and Works of Engineering Rules**

The rules guide health and safety matters in all building/construction and civil engineering works. These rules state clearly that it is the duty of the proponent to ensure health, safety and welfare of workers and authorized visitors to the site before commencement of operations, the proponent should notify the DOHSS of the intention so that from then on the Director advises and follows up on the necessary conditions to safeguard the health, safety and welfare of workers on site.

The rules also state that qualified and experienced persons must be appointed to act as safety supervisors by the proponent. These should supervise the enforcement of standards to achieve the objectives mentioned above. The rules have specific sections on excavations, transport, demolitions, formwork and scaffolds, lifting and lifting equipment and other safety measures.

4.3.30 County Governments Act 2012

This act gives effect to Chapter Eleven of the Constitution, which provides the county governments the powers to function and take responsibilities for the delivery of services within their designated counties including management of environment and natural resources among other responsibilities. The functions provided for in Article 186 of the constitution and as assigned in the Fourth Schedule of the Constitution. These include management of water resources, biodiversity, forests, and National Reserves among others.

4.3.31 The Climate Change (Amendment) Act, 2023

This is an Act of Parliament to provide for a regulatory framework for enhanced response to climate change; to provide for mechanism and measures to achieve low carbon climate development, and for connected purposes.

The Climate Change Act amendment **in 2023** was a timely law that was passed at a period when Kenya is experiencing the adverse effects of climate change. The Act was first passed into law in May 2016 and amended in **2023,** although the regulations operationalizing the Act are yet to be developed. There has been a cyclical series of drought in Kenya which is a clear indication of the effects of climate change and the need for robust legal framework on climate change

The CCA aims to reduce vulnerability to climate change and improve our country's ability to take advantage of the opportunities that climate change offers. The Act is to be applied for the development, management, implementation and regulation of mechanisms to enhance climate change resilience and low carbon development for the sustainable development of Kenya. The legislation further creates a framework for taking domestic action on adaptation to the impacts of climate change and action to transition to a low-carbon development pathway. In addition, the CCA positions Kenya to deliver on international contributions and reporting requirements.

The CCA is premised on the concept of mainstreaming–defined in the law (Part 1, Section 2) as "the integration of climate change actions into decision making and implementation of functions by the sector ministries, state corporations and county governments". This approach demonstrates recognition by the law that climate change is a cross-sectoral issue that has economic, social and environmental impacts. Additionally, climate change is recognized as a cross-jurisdictional issue because the national government is mandated to make policy on climate change, while various functions assigned to county governments are integral to fulfillment of actions to address climate change through mainstreaming processes. The role of private entities, including public benefit organizations, in mainstreaming climate change interventions is equally recognized, the CCA sets the framework the development of climate change duties by these private entities.

The Climate Chance Act presents a net benefit for Kenya, bearing in mind the real costs of inaction to respond to climate change impacts. It frames the appropriate context for climate change to be considered as a cross-cutting policy challenge affecting sustainable development of Kenya, and not as a singular environmental issue. The requirements for mainstreaming of climate change across a range of key sectors is indicative, including education, disaster risk reduction, as well as the provision to create duties for private entities. In the latter case, regulations for private entities duties could support companies to pursue and adopt GHG mitigation programmes that, in addition, result in clear co-benefits for business and the country. Structurally, private sector is likely to deploy GHG mitigation options that bear co-benefits when they enjoy a competitive advantage, have consumer acceptance, and supportive regulatory frameworks.

The Act provides for the creation of the National Climate Change Council which should be headed by the President.

4.3.32 Traffic Act (Cap 403)

The act prohibits obstruction of traffic, either by persons or facilities constructed in such a way as to interfere with the flow of traffic on roads or road reserves. The law also regulates the quality of exhaust emissions from such mobile vehicles.

4.3.33 International Maritime Conventions and Treaties

Kenya is a party to various international maritime conventions and treaties, such as the International Maritime Organization (IMO) conventions, which influence its domestic maritime legislation and standards.

4.3.34 Public Procurement and Disposal Act

Public Procurement and Disposal Act: This legislation governs public procurement processes, including tendering and contracting procedures for maritime infrastructure projects funded by the government.

4.3.35 Occupier's Liability Act Cap. 34

The act regulates the duty that an occupier of premises owes to his visitors in respect of dangers due to the state of the premises or to things done or omitted to be done on them. It requires that the occupier warn the visitors of the likelihood of dangers within his premises to enable the visitor to be reasonably safe.

4.4 NATIONAL AND COUNTY FRAMEWORKS FOR CLIMATE CHANGE

4.4.1 National Climate Change Act, 2016

It's a national legislation that provides a regulatory framework for enhanced response to climate change. The Act is applied for the development, management, implementation and regulation of mechanisms to enhance climate change resilience and low carbon development for the sustainable development of Kenya. The Act places duties on the national and county governments to mainstream climate change responses into development planning, decision making and implementation and to respond in various other ways to climate change. The Act sets out principles of climate change planning and implementation of measures (GOK, 2016).

4.4.2 The Kenya National Climate Change Response Strategy (2010)

It's a strategic document with a multisectoral approach whose vision is for a prosperous and climate change resilient Kenya. Its objective is to respond to climate change by among other aspects ;enhancing understanding of the global climate change negotiation process, international agreement, policies and processes and most importantly the position Kenya needs to take in order to maximize beneficial effects, assessing the evidence and impacts of climate change in Kenya , recommending robust adaptation and mitigation measures needed to minimize risk associated with climate change while maximizing opportunities, enhancing understanding of climate change and its impacts nationally and in local regions, recommending vulnerability assessment, impacts monitoring and capacity building framework needs (KNCCRS, 2010).

4.4.3 Climate Risk Management Framework for Kenya (2016)

Outlines how the government intends to harmonize its climate change and disaster risk policies. According to the framework, there are ten priority areas that overlap between climate change and disaster risk policies, which can be areas for the government intervention. Specifically, the Government intends to:

a. Harmonize programs and projects and create a coordination mechanism among the national government (institutional framework).

b. Create an enabling policy and legal framework for integrated climate risk management (policy framework).
c. Build capacity at national and county level for integrated climate risk management (capacity building).
d. Analyze the level of exposure, vulnerability to disasters and capacity at the local scale (exposure, vulnerability and capacity).
e. Involve communities at risk and consider gender and marginalized groups (gender mainstreaming).
f. Mobilize financial resources for climate risk management (resource mobilization).
g. Mainstream climate risk management into sector programs, plans and activities (mainstreaming climate risk management).
h. Design and implement pilot projects for climate risk management at county and national level (pilot projects).
i. Enhance research and dissemination of information about climate risk management (training, research, and outreach).
j. Create platforms for sharing lessons and good practices on integrated climate
k. risk management (learning).

4.4.4 National Climate Change Action Plan (NCCAP, 2013-2017)

Its objective is to encourage low carbon climate resilient development through implementation of the National Climate Change Response Strategy, 2010.

4.4.5 National Climate Change Action Plan 2018-2022 (NCCAP)

It sets out the path towards low carbon climate resilient development in a manner that prioritizes adaptation. It provides a framework for Kenya to deliver on its National Adaptation Plan [2015-2030] and its Nationally Determined Contributions under the Paris Agreement of the United Nations Convention on Climate Change. It encourages the mainstreaming of adaptation and mitigation actions across sectors and levels of government, engagement and participation of key stakeholders including the private sector, development partners and the general public in climate change processes and interventions.

4.4.6 Kenya National Adaptation Plan (NAP, 2015-2030)

It's anchored in the Constitution of Kenya and Vision 2030. It also aligns itself with the MTP and MTEF planning processes. The NAP is also aligned with the Climate Change Act,2016. The NAP provides a background of Kenya's national circumstances, including socio-economic circumstances, and future scenarios that the country needs to consider in decision making, planning and budgetary process. A vulnerability analysis is also presented against the identified hazards in the NCCAP, namely drought, floods and sea level rise.

It builds on the foundation laid by the National Climate Change Response Strategy and the National Climate Change Action Plan. It's the basis for the adaptation component of Kenya's intended Nationally Determined Contributions that was submitted to the United Nations Framework Convention on Climate Change Secretariat. Its vision is enhanced climate resilience towards the attainment of vision 2030 (NAP, 2015).

4.4.7 Public Finance Management Act, 2012 (Revised 2014)

The Public Finance Management Act, 2012 sets the rules for how government can raise and spend money, includes funding from bilateral and multilateral agencies, through which much climate finance is expected to flow. The Cabinet Secretary for Finance must approve any grant or donation that goes to any national government entity; the grant must be accounted for using national financial accounting systems; and the grants are to be consistent with the national development plan, Vision 2030. Counties can also receive funding from loans or grants from donors and face the same rules as the national level, except that the approval must be given by the County Executive member for finance (No. 18 of 2012).

4.4.8 National Climate Finance Policy, 2018

It establishes the legal, institutional and reporting frameworks to access and manage climate finance, consistent with the institutional structures and framework set out in the Climate Change Act, 2016. It sets out a number of strategic interventions that can encourage the mobilization of climate finance and increase financial flows. Including Climate funds (Platform) which will help mobilize, coordinate and track climate finance for transparency in climate financing. The policy encourages building capacity to develop bankable projects and effectively manage and implement those projects.

4.4.9 County Governments Act, 2012

The County Governments Act, 2012 obligates counties to develop a County Integrated Development Plan [CIDP] that serves as a legal development blueprint in the county for a five-year period. The CIDP must set out a resource mobilization and management structure. As per Section 107(2) "shall be the basis for all the budgeting and planning in a county" The mandatory requirement for development of sectoral plans allows room for detailed analysis of climate change priorities and investment needs at the county level (No. 17 of 2012).

4.4.10 County Integrated Development Plan [CIDP] 2023-2027

It reflects the strategic long- and medium-term priorities of the county government. The CIDP is a product of highly participatory, consultative and inclusive stakeholder's process conducted throughout the county to ensure that no one is left behind. Consequently, this plan is prepared in accordance with Section 104 (1) of the County Government Act that provides for '*a county government shall plan for the county and no public funds shall be appropriated without a planning framework developed by the county executive committee and approved by the county assembly*'.

The CIDP is the planning instrument for the County Government for a five-year period through which County Governments identify their priority developments for implementation. To ensure the prioritization of climate change adaptation and mitigation developments, they are mainstreamed into the CIDP.

4.4.11 Mombasa County Climate Change Policy, 2021

The objective of the policy is to provide a Framework for the county's transition to low carbon-resilient development in line with the Climate Change Act, 2016 as well as the current and successive NCCAPs, to provide for mainstreaming and integration of Climate Change issues into the CIDP, provide legal and institutional Framework for addressing climate change issues in the county and to promote collaboration and partnerships with relevant stakeholders.

4.4.12 Mombasa Climate Change Action Plan (2020-2024)

It was developed to guide the county in mitigation and adaptation to climate change impacts. Its development is in line with the Climate Change Act, 2016 which requires County Governments to Develop Action Plans to guide the incorporation of Climate Change in the sector projects. It covers a period of three years

4.5 INSTITUTIONAL ANALYSIS

4.5.1 Institutions under Environmental Management and Coordination (Amendment) Act (No. 5 of 2015)

The Government established the following institutions to implement the Environmental Management and Coordination (Amendment) Act (No. 5 of 2015). National Environmental Council, National Environmental Management Authority, County Environmental Committees, Public Complaints Committee & standards and enforcement Committee

4.5.2 Institutional Structure of the Water Sector

The National Policy on Water Resources Management and Development and the Water Act 2016, presently guides water resources management. The overall goal of the national water development policy is to facilitate the provision of water in sufficient quantity and quality and within a reasonable distance to meet all competing uses in a sustainable, rational and economical way. This policy separates policy formulation, regulation and services provision and defines clear roles for sector actors within a decentralized institutional framework and includes private sector participation and increased community development.

Under the policy, the Ministry of Water and Irrigation is responsible for policy development, sector co-ordination, monitoring and supervision to ensure effective Water and Sewerage Services in the Country, sustainability of Water Resources and development of Water resources for irrigation, commercial, industrial, power generation and other uses. The Ministry executes its mandate through the following sector institutions.

4.5.3 Water Resources Authority (WRA)

WRA is a state corporation established under Section 11 of the Water Act, 2016. Pursuant to Section 6 of the Act, the Authority is an Agent of the National Government responsible for regulating the management and use of water resources. The Water Act, 2016 makes extensive provisions on the Authority's role in regulating the use and management of water resources.

WRA was operationalized on 21st of April 2017 vide Gazette Notice No. 59. However, the Authority has been in existence for 12 years following its establishment under the Water Act, 2002 as Water Resources Authority (WRA).

The powers and functions of WRA which include:

- Developing principles, guidelines and procedures for the allocation of water resources.
- Monitoring the national water resources management strategy.
- Receiving and determining applications for permits for water use.
- Monitoring and enforcing conditions attached to permits for water use.
- Regulating and protecting water resources quality from adverse impacts.
- Managing and protecting water catchments.

4.5.4 Water Services Regulatory Board (WASREB)

The regulatory Board is responsible for the regulation of the water and sewerage services in partnership with the people of Kenya. The mandate of the regulator covers the following key areas:

- Regulating the provision of water and sewerage services including licensing, quality assurance, and issuance of guidelines for tariffs, prices and disputes resolution.
- Overseeing the implementation of policies and strategies relating to provision of water services licensing of Water Services Boards and approving their appointed Water Services Providers,
- Monitoring the performance of the Water Services Boards and Water Services Providers,
- Establish the procedure of customer complaints,
- Inform the public on the sector performance,
- Gives advice to the Minister in charge of water affairs.

4.5.5 Water Services Trust Fund (WSTF)

This body assists in the financing of the provision of Water Services to areas of Kenya which are without adequate water services. This shall include providing financing support to improved water services towards:

- Capital investment to community water schemes in underserved areas.
- Capacity building activities and initiative among communities.

- Water services activities outlined in the Water Services Strategic Plan as prioritized by the Government.
- Awareness creation and information dissemination regarding community management of water services.
- Active community participation in the management of water services.

4.5.6 Water Services Boards (WSBs)

The WSBs are responsible for the efficient and economical provision of water and sewerage services in their areas of jurisdiction. Tana Water Services Board is among the eight Water Services Boards established under the Water Act, 2002 and is mandated to:

- Develop the facilities, prepare business plans and performance targets.
- Planning for efficient and economical provision of Water and sewerage services within their areas of jurisdiction.
- Appointing and contracting Water Service Provider.
- Asset holding of Central Government facilities.

4.5.7 Water Services Providers (WSPs)

Water Service Providers are the utilities or water companies. They are state owned but have been commercialized to improve performance and run like business within a context of efficiency, operational and financial autonomy, accountability and strategic, but minor investment.

4.6 RELEVANT INTERNATIONAL POLICIES AND TREATIES TRIGGERED BY THE PROJECT

Kenya is a signatory as well as a party to various international conventions, treaties and protocols relating to the environment which aims at achieving sustainable development. According to the Registrar of International Treaties and other Agreements in Environment (UNEP 1999), there are 216 treaties, 29 of which are of interest to Kenya. The country is a signatory to 16 such agreements, which range from use of oil, protection of natural resources and protection of the atmosphere. The agreements are both regional and international and became legally binding on Kenya upon ratification thereof by the rightfully designated Kenyan Authority. The agreements of interest to Kenya can be categorized as those for protecting natural resources, atmosphere and social well-being of man.

There are 12 agreements of significance to Kenya under the protection of natural resources category which the country has signed and ratified. This section reviews a number of policies that are triggered or met by the proposed project:

- United Nations Convention to Combat Desertification (UNFCCC) of 1994.
- The United Nations Framework Convention on Climate Change 1992.
- Convention on Biological Diversity (CBD) 1993.

- The Convention on Trade in Endangered Species (CITES).
- Kyoto Protocol to the United Nations Framework Convention.
- World Commission on Environmental and Development (The Brundtland Commission of 1987).
- Convention on International Trade in Endangered Species (CITES) of Wild Fauna and Flora, 1990.
- The Convention of Control of Desertification in Countries Experiencing Serious Drought and/or Desertification, Particularly In Africa (UCCD)(1992).
- World Health Organization air quality and emission guidelines.
- The Convention concerning the protection of workers against occupational hazards.
- Ramsar Convention on wetlands of international importance such as water flow Habitats.
- Basel Convention on the control of trans-boundary movement of hazardous wastes – 1989.
- World Health Organization environmental guidelines/standards for industrial discharge (1983).

5. DESCRIPTION OF THE BASELINE STATUS OF THE PROJECT SITE

Baseline studies were conducted in areas which were identified during screening and scoping. These studies were conducted under the leadership of competent and experienced in their areas. The have extensive experience in the project area and have linkages with the private and public sector. The studies have been described in the following subsections.

5.1. ZONE OF INFLUENCE

The geographic location, business network, and strategic importance that Mombasa Port possesses in terms of regional and global trade, transportation, and development are collectively referred to as its "Zone of Influence".

Kenya's Mombasa Port is the busiest and largest seaport in East Africa. It is an important trading hub for Kenya as well as its landlocked neighbours, including Rwanda, Uganda, Burundi, South Sudan, and portions of the eastern Democratic Republic of Congo. As a result, Mombasa Port's Zone of Influence encompasses more than just Kenya; it also includes the hinterland areas and the economies of the surrounding nations, who significantly rely on it for their import and export operations. In conclusion, Mombasa Port's Zone of Influence comprises more than just its immediate geographic area; it also influences trade dynamics, economic growth, and strategic alliances both inside and outside of East Africa.

Mombasa Port is a major maritime gateway for trade lines connecting East Africa with the Middle East, Asia, Europe, and beyond due to its advantageous location along the coast of the Indian Ocean. Maintaining steady marine commerce flows and regional stability depends on its security and stability.

By promoting global trade and business, Mombasa Port has a significant positive impact on the economy of Kenya and its surrounding nations. Its capacity, efficiency, and connection have a big impact on industrial development, job creation, and regional economic growth.

Mombasa Port has an impact on major cities and economic hubs in surrounding nations as well as inland destinations along the transportation corridors that link it to these locations. Roads, railroads, and pipelines are some of the transportation networks that make it easier for cargo to get to and from the port.

Port infrastructure investments, including berths, terminals, handling machinery, and logistical facilities, not only increase the port's capacity but also foster the growth of the neighbouring communities and auxiliary industries.

5.2. PHYSICAL ENVIRONMENT

Mombasa Port's physical surroundings are varied, with a combination of urban infrastructure, natural landscapes, and coastline elements.

Mombasa Port provides access to the deep seas of the Indian Ocean and is located along Kenya's coast. There are mangrove woods, rocky outcrops, and sandy beaches along the shore. The region's warm seas and coral reefs sustain a diverse marine life, drawing tourists and providing jobs for coastal residents.

Ship berths, warehouses, cargo handling facilities, and container terminals make up the majority of the port infrastructure in the immediate neighbourhood of Mombasa Port. These amenities are necessary for storage, logistical operations, and the loading and unloading of cargo, all of which support the port's status as a key East African commercial gateway.

Mombasa, the second-largest urban centre in Kenya, is a thriving seaside metropolis. Urban development, comprising business Countys, residential neighbourhoods, and industrial zones, is what defines the area around the port. The city's skyline is characterised by tall skyscrapers, lodging facilities, and historical sites.

A network of transport infrastructure connects Mombasa Port to other countries and inland areas. This comprises the pipelines, railroads, and roadways that make it easier for cargo to enter and exit the port. The Mombasa-Nairobi Standard Gauge Railway (SGR) is an essential route for both passenger and freight transit, offering a direct rail connection to Kenya's capital.

Efforts to promote sustainable development and environmental conservation are made in the physical surroundings of Mombasa Port. The goal of programmes like marine conservation, coastal zone management, and mangrove restoration is to maintain the region's natural ecosystems and biodiversity while promoting economic activity.

The region's socioeconomic landscape is shaped by the physical environment surrounding Mombasa Port, which is a result of the dynamic interaction between coastal geography, urban development, port infrastructure, transportation networks, and environmental conservation initiatives.

5.2.1. Topography and Geology

The geography and geology surrounding Mombasa Port have a major role in the development of its facilities and operations. Mombasa Port is situated on Kenya's southeast coast, which is defined by an inland coastal plain that juts out from the Indian Ocean. The majority of the land surrounding the port region is level, which makes it easier to operate the port and build infrastructure like terminals, warehouses, and transit systems. From the port, the terrain gradually changes into low-lying plains and plateaus that are ideal for urban growth and agriculture.

Mombasa Port's coastline location and closeness to the Indian Ocean have an impact on the area's geology. Marine formations and sedimentary deposits are common in coastal locations. Sedimentary rocks, which are typical in coastal areas, include limestone, sandstone, and shale in the region's geology. The region's limestone formations are especially noteworthy, and they have been used for infrastructure and building materials in the building sector. The development of karst landscapes, which include sinkholes, caves, and subsurface drainage networks, is facilitated by the presence of limestone and may have an effect on land use planning and construction operations. Furthermore, geological processes including erosion, sedimentation, and coastal dynamics affect the coastal zone. These activities can have an impact on shoreline stability and necessitate management strategies for infrastructure resilience and coastal protection.

Comprehending the topography and geology of the Mombasa Port and its surroundings is crucial for organizing and carrying out infrastructural initiatives, handling ecological consequences, and guaranteeing the enduring viability of port activities in this shoreline location.

5.2.2. Land Use

Land use is varied and designed to facilitate port operations, business endeavours, industrial activity, and urban development. An outline of the usual land use practices in the Port area is provided below:

1. Port infrastructure, including as container terminals, cargo handling facilities, ship berths, storage yards, and administrative buildings, makes up the majority of the area directly surrounding Kilindini Port. These spaces are essential for logistical tasks, ship operations, and the loading and unloading of cargo.
2. There are facilities and industrial zones all around the port that cater to port-related businesses like assembly, manufacturing, logistics, and warehousing. These industrial zones support operations like distribution, packaging, processing, and storage of commodities passing via the port.
3. There are business Countys situated next to the port that serve companies in the maritime sector, such as shipping companies, freight forwarders, customs brokers, marine suppliers, and other service providers. Offices, shops, hotels, restaurants, and other facilities serving port users and tourists are frequently located in these neighbourhoods.
4. The area surrounding the Port is home to access routes, railroads, and roadways that link the port to nearby nations and inland areas. These passageways assist the smooth flow of products and people and make it easier to carry cargo to and from the port.
5. Locals, port personnel, and workers from industries associated to the port live in residential neighbourhoods in several of the port's surrounding Countys. Low-income housing areas and informal settlements may also be a part of these communities.
6. The area around the port may be preserved by the use of green spaces, natural habitats, and coastal ecosystems. Mangrove forests, parks, and conservation zones that preserve the environment and biodiversity might all fall under this category.
7. To suit the needs of the port and the surrounding areas, supporting infrastructure such as power plants, water treatment facilities, communication networks, and waste management facilities may also be present.
8. The functionality and development of Kilindini Port and the surrounding area are facilitated by a variety of land uses, including residential areas, commercial and industrial services, industrial operations, port-related activities, transportation infrastructure, and environmental conservation initiatives.

5.2.3. Natural Hazard

Like many coastal areas, Mombasa Port is vulnerable to a range of natural disasters that could endanger port operations, infrastructure, and the local population. The following are some of the main natural dangers that Mombasa Port could face:

Mombasa Port is situated in an area that is vulnerable to tropical cyclones, especially in the rainy seasons. Strong winds, a lot of rain, storm surges, and flooding are all possible effects of these cyclones, which could harm port infrastructure, ships, and cargo.

Human activity, sea level rise, and wave action can all cause coastal erosion, which puts the port region at risk. Port infrastructure, including berths, terminals, and coastal protection structures, may be threatened by erosion, which could cause stability problems and possibly impair port operations.

During very severe weather conditions, Mombasa Port may be affected by high tides, storm surges, and huge waves. These natural occurrences have the potential to inundate, erode, and harm waterfront buildings, port infrastructure, and harbour vessels.

In low-lying regions around Mombasa Port, heavy rainfall combined with inadequate drainage and urbanisation can cause floods. Floods can interfere with port operations, harm infrastructure, equipment, and cargo, and endanger worker safety.

Mombasa Port is situated in an area that is prone to earthquakes, which increases the risk of landslides, tsunamis, liquefaction, and ground shaking. Port operations and supply chains may be impacted by seismic events that destroy buildings, transportation networks, and port infrastructure.

Although less frequent than other dangers, drought can nonetheless have an impact on Mombasa Port and the surrounding areas. Drought circumstances have the potential to disrupt port operations and cargo quantities in addition to having an impact on water availability, agricultural production, and economic activities.

Incidents involving oil spills, chemical releases, or hazardous material accidents might be made worse by natural dangers at the port. These occurrences may have substantial negative effects on the environment and society, necessitating the need for emergency response plans and cleanup initiatives.

Seaport operations may be significantly impacted by climate change, which could have an effect on overall efficiency, safety, logistics, and infrastructure. Increasing coastal floods, erosion, and inundation of port facilities can be caused by rising sea levels brought on by climate change. Damage to quays, berths, terminals, and warehouses can cause disruptions to port operations and necessitate expensive repairs and adaption measures.

Extreme Weather Events such as cyclones, and other storms are predicted to become more frequent due to climate change. These events can cause significant disruptions to port operations due to strong winds, heavy rain, storm surges, and waves. These occurrences may cause harm to ships, cargo, and infrastructure, which could result in delays, cancellations, and safety hazards.

Change in rainfall patterns such as variations in the amount and distribution of rainfall, can have an impact on the levels of water in inland waterways, ports, and rivers. This may have an effect on port access, vessel movements, and the need for dredging and sedimentation rates.

As temperatures rise, heatwaves may occur, which may have an effect on port workers, machinery, and cargo handling operations. Severe heat can increase energy consumption for refrigeration and cooling systems, lower operational efficiency, and endanger the health of personnel.
Efforts to mitigate climate change, such as carbon pricing, rules governing emissions, and subsidies for renewable energy sources, may have an impact on port operations and the maritime sector. In order to comply with regulations and meet market needs, ports may need to make investments in energy efficiency upgrades, alternative fuels, and emission reduction initiatives.

Disruptions caused by climate change in other areas, such crop failures, extreme weather, or rising sea levels that threaten coastal infrastructure, can have an influence on port operations, cargo volumes, trade flows, and global supply chains.

Seaports must employ climate resilience methods, such as risk assessments, emergency response plans, infrastructure upgrades, and stakeholder collaboration, to address these issues. Seaports may increase their resilience, reduce interruptions, and guarantee the continuation of their operations in a changing climate by proactively responding to the effects of climate change. Comprehensive planning, readiness, and resilience measures—such as infrastructure upgrades, emergency response procedures, early warning systems, and community involvement programs—are needed to mitigate the risks brought on by these natural calamities.

Mombasa Port can strengthen its resilience and guarantee the continuation of its operations in the event of natural obstacles by being aware of and taking action against these threats.

5.3. NOISE, AIR, WATER AND SEDIMENT QUALITY BASELINE SURVEYS

5.3.1 Background

Water and Sediment quality surveys were carried out in the Mombasa Port area, Mombasa Marine Park and Reserve, Diani- Chale Marine Park and Reserve and along Shelly- Tiwi area to provide baseline data for monitoring the ecological impacts of the Mombasa port development project phase III.

Mombasa Port's aquatic environment includes many facets of the coastal environment, the marine life, and port operations. A wide range of marine species, coral reefs, seagrass beds, and mangrove forests can be found in the waters around Mombasa Port. Fisheries, coastal protection, and wildlife all depend on these areas.

A number of factors, including port operations, industrial discharges, urban runoff, sewage effluent, and natural processes, can affect the quality of the water in and around Mombasa Port. Pollution can damage marine life and deteriorate water quality from sources like solid waste, chemical pollutants, and oil spills.

For ship navigation, berthing, cargo handling, and other maritime operations, Mombasa Port depends on the marine environment. In order to ensure safe and effective operations, the port's infrastructure—which includes quays, berths, jetties, and navigational channels—needs to be maintained.

Mombasa Port is susceptible to various coastal phenomena, including but not limited to tides, waves, currents, and sediment transfer. Port accessibility, the need for dredging, coastline stability, and coastal erosion are all impacted by these activities. Ensuring navigational safety and preserving port infrastructure depend on managing coastal dynamics.

To preserve navigational channels, deepen berths, to reclaim new areas, and get rid of silt buildup, dredging is done in and around Mombasa Port. Dredging procedures must be followed correctly to protect the environment, maintain water quality, and guarantee vessel safety. Mangrove forests, seagrass meadows, and coral reefs are just a few of the natural ecosystems that may be preserved and restored inside and around Mombasa Port. Important ecological services including protecting against coastal erosion, stabilising the shoreline, and serving as marine species' nidification grounds are all provided by these ecosystems.

Programmes for monitoring the water quality, biodiversity, and ecological well-being of Mombasa Port's maritime environment may be put into place. Through these programmes, environmental issues may be identified, trends can be tracked over time, and management choices for sustainable port growth can be informed.

All things considered, Mombasa Port's aquatic environment is a dynamic, complex system that is essential to maintaining marine ecosystems, assisting with port operations, and enhancing the socioeconomic health of the area. To ensure the long-term viability of Mombasa Port and the surrounding waterways, it is imperative to strike a balance between the demands of port expansion and environmental conservation.

The soil quality at Mombasa Port varies depending on factors such as location, land use, and human activities. Here are some general considerations regarding soil quality at the port. Soil quality at Mombasa Port is influenced by a combination of natural factors, human activities, and management practices. Understanding and addressing soil-related issues are essential for sustainable development, environmental protection, and the long-term viability of the port and its surrounding areas. Soil quality tests were mainly centred around the quality of sand for reclamation and is discussed elsewhere in the report.

According to the Ministry of Agriculture, Government of Kenya (1988), the soil types in the Port of Mombasa area are generally related to the geological formations along the physiographic zones in Mombasa County.

Four types of soil are most common along the coastal lowlands:

- In the quaternary sands zone, also known as Kilindini sands, there are well-drained moderately deep, to deep, sandy clay loam, to sandy clay, underlying 20 to 40 cm loamy medium sand.
- There are also areas with very deep soils of varying drainage conditions and colour, as well as variable consistency, texture, and salinity; Well-drained very deep, dark red to strong brown, firm, sandy clay loam to sandy clay, underlying 30 to 60 cm medium sand to loamy sand soils are also found on the Kilindini sands.

The soils of the coastal plain are formed on coral limestone that merges with the sands of Kilindini inland. The coral soils typically have a sandy clay loam to sandy clay texture and are well-drained. They vary from extremely shallow and highly rocky to quite deep and non-rocky. The soils that have formed on the Kilindini sands range from extremely deep, very sandy, and poorly drained soils to extremely deep, heavy clay soils with inadequate drainage. There are large stretches of clayey, poorly drained soils in the southern portion of the coastal plain.

The majority of the County's agricultural activity takes place in the mainland regions of Changamwe (west mainland), Likoni (south mainland), and Kisauni (north mainland). The agro-ecological zones of cashew nut-cassava and coconut-cassava predominate in the low-lying areas (GOK Ministry of Agriculture 1988).

The coconut-cassava zone includes most of Mombasa Island and portions of Kisauni and Likoni. The farming season in this zone is medium to long, with intermediate precipitation. The cashew nut-cassava zone, which includes the remaining low-lying portions of Kisauni and Likoni, is typified by a medium cropping season and intermediate rains.

Within the cashew nut-cassava zone is the majority of the elevated Changamwe area. The elevated regions of Changamwe and Kisauni, which are primarily the shale areas, belong to the livestock-millet zone in the lowlands. A short to medium cropping season and an intermediate cropping second season define this zone.

Information on bed sediment contamination at Mombasa Port is not readily available, but it's reasonable to assume that, like many ports around the world, Mombasa Port may face challenges related to sediment contamination due to various anthropogenic activities and natural processes. Here are some potential sources and considerations regarding bed sediment contamination at ports in general, which may apply to Mombasa Port.

Activities such as cargo handling, vessel traffic, dredging, and ship maintenance can introduce contaminants into the port's aquatic environment. These contaminants may include heavy metals, hydrocarbons, pesticides, and other industrial chemicals.

Industrial facilities within and around the port area may discharge effluents containing pollutants into the water, contributing to sediment contamination. Industries such as shipping, manufacturing, storage, and processing can generate waste streams that may contain hazardous substances.

Stormwater runoff from urban areas can carry pollutants such as heavy metals, nutrients, sediment, and organic matter into the port's waterways. Urbanization and land development activities may increase the volume and intensity of runoff, exacerbating sediment contamination issues.

Historical industrial activities, waste disposal practices, and contamination incidents may have left legacy pollutants in the sediments of ports. These legacy pollutants can persist over time and pose risks to aquatic ecosystems and human health.

Shipping activities, including ballast water exchange, hull cleaning, and accidental spills, can release contaminants into port waters and sediments. Ballast water may contain invasive species and pathogens, while hull cleaning can release antifouling chemicals and bioaccumulated pollutants.

Natural processes such as erosion, sedimentation, and deposition can transport and redistribute contaminants in port environments. Sediment resuspension during dredging operations or extreme weather events can release previously buried contaminants into the water column.

Regular monitoring of sediment quality in port areas is essential for assessing contamination levels, identifying sources of pollution, and evaluating potential risks to human health and the environment. Monitoring programs may include sampling and analysis of sediment samples for a range of pollutants.

Port authorities, industries, government agencies, and stakeholders to implement pollution prevention measures, remediation strategies, and sustainable management practices. Environmental regulations, enforcement mechanisms, and public awareness campaigns can also play important roles in protecting the water quality and ecological integrity of port environments.

Air quality and noise levels and vibration were within the allowed limits of noise and air quality regulations.

Air, Water and sediment quality surveys and noise measurements were carried out as part of the project baseline characterization. The surveys provided a basis for predicting how water and sediment quality will change with the implementation of the Mombasa Port Development Project Phase III. The surveys further provided the baseline data to be used to monitor the actual changes in conditions brought about the by Mombasa Port Development Project Phase III.

5.3.2 Scope Of Water and Sediment Quality Baseline Data Collection

1) Water Sampling

Water Quality samples were collected in four distinct sampling areas i.e., Mombasa Port (5 stations), Mombasa Marine Park and Reserve (6 stations), Shelly-Tiwi (6 stations), and Diani Chale Marine Reserve (6 stations). Sampling stations were distributed in the in-reef and off-reef locations except the Mombasa Port area where all the samples were collected along the Kilindini channel.

In the Port area water quality parameters determined included Temperature, Salinity, pH, Dissolved Oxygen (DO), TSS, Turbidity, Total Nitrogen, Total Phosphorus, Biological Oxygen Demand (BOD), and Chemical Oxygen Demand (COD), *Escherichia coli* (*E. coli*) and Total Coliforms. In all the other stations only Temperature, Salinity, pH, TSS, and Turbidity were analyzed.

2) Sediment Sampling

Sediment quality sampling was conducted in four stations (WQ MP1, WQ MP2, WQ MP3 and WQ MP4) in the Mombasa Port area. The temporal scope of the sampling was considered the worst-case scenario; thus, the sampling activity was limited to the dry season.

Sediment quality parameters determined included PAH, oil and grease, and trace metals including Lead (Pb), Arsenic (As), Cadmium (Cd), Zinc (Zn), Copper (Cu), Total Chromium (Cr), Mercury (Hg) and Nickel (Ni).

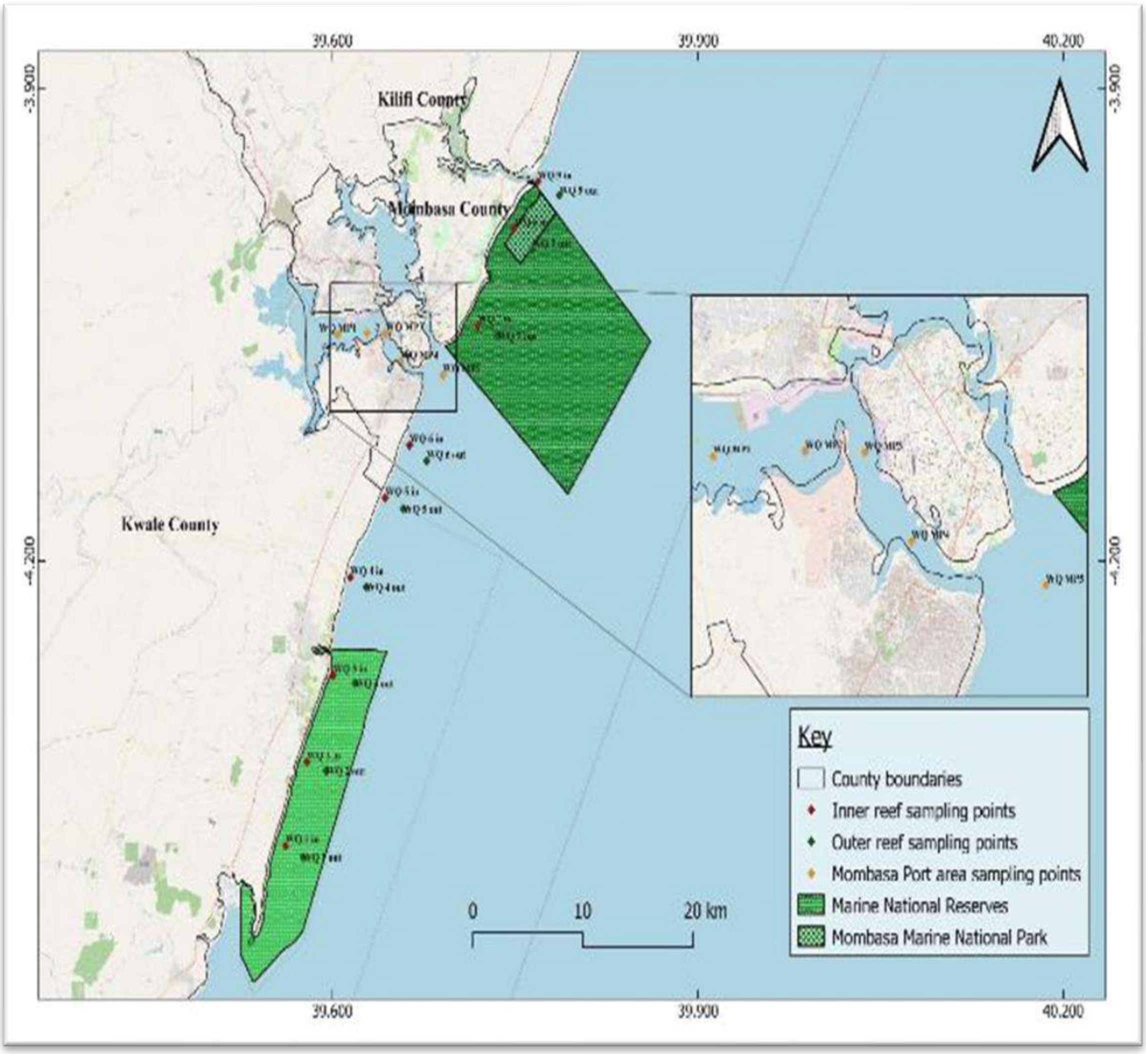


FIGURE 26 - MAP SHOWING THE SAMPLING STATIONS IN MOMBASA PORT, MOMBASA MARINE RESERVE, DIANI-CHALE MARINE RESERVE AND SHELLY – TIWI AREAS.

5.3.3 Methods of Data Collection and Coordination with other Components

1) Water Quality Sampling

Samples were collected from 23 locations as shown in **Table 18**. Water samples were collected using a Niskin Bottle (General Oceanics). Temperature, Salinity, pH, and DO were determined *in situ* using a YSI Meter (Professional Plus).

Samples for TSS, Turbidity, Total Nitrogen, Total Phosphorus, BOD, COD, *E. coli*, and Total Coliforms analysis were transferred from a Niskin bottle to labelled containers and stored in a cooler box before transportation to the laboratory. Chain of custody (CoC) forms were filled and signed by all the personnel handling the samples until delivery to the laboratory as a quality assurance measure.

2) Sediment Quality Sampling

Sediment samples were collected from 4 stations using a van Veen grab. At each station, 3 sediment samples were randomly collected and homogenized to give surface sediment samples. Water depth was determined using a portable handheld echo sounder (Hondex PS-

7). The samples for trace metal analysis were collected in labelled plastic bottles while the samples for the organics analysis were collected in glass sampling containers.

The parameters determined for sediment quality included Oil and Grease, PAH (Naphthalene, Acenaphthylene, Acenaphthene, Fluorene, Carbazole, Phenanthrene, Anthracene, Fluoranthene, Pyrene, Benzo(a)anthracene, Chrysene, Benzo(e)pyrene, Benzo(k)fluoranthene, Benzo(a)pyrene) and trace metals (Pb, As, Cd, Zn, Cu, Cr, Hg and Ni).

TABLE 18 - WATER AND SEDIMENT QUALITY SAMPLING LOCATIONS

Sampling area	GPS(S)	GPS(E)	Area
WQ MP1	-4.056134101	39.60454455	Mombasa Port
WQ MP2	-4.055222995	39.62829985	Mombasa Port
WQ MP3	-4.055386319	39.64372587	Mombasa Port
WQ MP4	-4.073227375	39.65583743	Mombasa Port
WQ MP5	-4.082060248	39.69064708	Mombasa Port
WQ Station 1 Inn	-4.381006385	39.56165421	Diani - Chale marine reserve
WQ Station 1 Out	-4.388221898	39.57576069	Diani - Chale marine reserve
WQ Station 2 Inn	-4.327742213	39.57922948	Diani - Chale marine reserve
WQ Station 2 Out	-4.333455746	39.5949847	Diani - Chale marine reserve
WQ Station 3 Inn	-4.272684017	39.60084512	Diani - Chale marine reserve
WQ Station 3 Out	-4.277703908	39.61860234	Diani - Chale marine reserve
WQ Station 4 Inn	-4.210566533	39.61468266	Shelly-Tiwi
WQ Station 4 Out	-4.216509641	39.62776773	Shelly-Tiwi
WQ Station 5 Inn	-4.159857066	39.64337892	Shelly-Tiwi
WQ Station 5 Out	-4.166821343	39.65813763	Shelly-Tiwi
WQ Station 6 Inn	-4.126448791	39.66338069	Shelly-Tiwi
WQ Station 6 Out	-4.136506836	39.67736691	Shelly-Tiwi
WQ Station 7 Inn	-4.050279734	39.71929756	Mombasa marine reserve
WQ Station 7 Out	-4.057025374	39.73571447	Mombasa marine reserve
WQ Station 8 Inn	-3.988492244	39.74921078	Mombasa marine reserve
WQ Station 8 Out	-4.002497583	39.76386654	Mombasa marine reserve
WQ Station 9 Inn	-3.959046818	39.76845351	Mombasa marine reserve
WQ Station 9 Out	-3.967613689	39.78621308	Mombasa marine reserve

3) Air Quality Sampling

The air quality survey consisted of two main elements: (a) soot and dust, measured by particulate matter (PM_{10}), and (b) concentration of sulfur oxides (SO_x) and nitrogen oxides (NO_x). Baseline air quality monitoring was carried out for three selected monitoring locations (the residential area at Port Reitz, Revetment area and the SGR Terminal) to determine the existing air quality conditions before the project which will be used for to compare monitoring levels to detect any changes due to the proposed projects' activities. Air quality monitoring was carried for 24 hours at each monitoring location.

Measurement of ambient air quality was conducted using AQM 09 Air Quality Monitor system. Measurements for Nitrogen Oxides, Carbon monoxide and Sulfur dioxide was done using the gas-sensitive electrochemical methods of active and continuous sampling. Ozone, Hydrocarbons and Carbon Monoxide were measured using a gas-sensitive semiconductor sensor.

4) Noise Sampling

Baseline noise measurements involved determining and documenting the existing noise levels within and around the proposed project area before the commencement of the intended project to generate baseline data for monitoring levels for understanding the potential impacts of construction-related noise on the surrounding environment, including nearby communities, wildlife habitats and the sensitive ecosystems.

The Noise measurements were carried as per the ISO 1996 Parts 1, 2 and 3 standards. A series of short-term measurements (duration of 5to 10 minutes) of LAeq, LAmax, and LAmin, L90 and L10 were conducted at representative measurement locations using Larson and Davis Noise Meter. These allowed the nature, character and dominant noise sources surrounding and within the study area to be recorded. Measurements were in. Noiselevels are expressed in decibels, A-weighted sound pressure level (dBA). The measurement results are expressed as follows:

5.3.4 Sample Analysis Methods

All the samples were analyzed at Polucon Services Ltd (a NEMA-designated laboratory and an ISO/IEC 17025 accredited laboratory). Water quality (TSS, Turbidity, Total Nitrogen, Total Phosphorus, BOD, COD, *E. coli*, and Total Coliforms) and sediment (trace metals, PAH, and oil and grease) were analyzed following methods provided in

TABLE 19 - ANALYSIS METHODS FOR WATER AND SEDIMENT QUALITY PARAMETERS.

	Parameter	Test Method	Unit
		Sediment Quality	
PAHs	Naphthalene	PQA/LlW004	mg/kg
	Acenaphthylene	PQNLlW004	mg/kg
	Acenaphthene	PQA/LlW004	mg/kg
	Fluorene	PQAJLlW004	mg/kg
	Carbazole	PQA/LlW004	mg/kg
	Phenanthrene	PQA/LlM/004	mg/kg
	Anthracene	PQAJLlW004	mg/kg
	Fluoranthene	PQAJLlW004	mg/kg
	Pyrene	PQA/LlW004	mg/kg
	Benzo(a)anthracene	PQA]LlW004	mg/kg
	Chrysene	PQA/LlW004	mg/kg
	Benzo(e)pyrene	PQA/LlW004	mg/kg
	Benzo(k)fluoranthene	PQA/LlW004	mg/kg
	Benzo(a)pyrene	PQNLlW004	mg/kg
Trace Metals	Lead as Pb	EPA 3050 B	mg/kg

	Cadmium as Cd (mg/kg)	EPA 3050 B	mg/kg
	Zinc as Zn (mg/kg)	EPA 3050 B	mg/kg
	Copper as Cu (mg/kg)	EPA 3050 B	mg/kg
	Nickel as Ni (mg/kg)	EPA 3050 B	mg/kg
	Mercury as Hg (mg/kg)	EPA 365.3	mg/kg
	Total Chromium as Cr (mg/kg)	EPA 3050 B	mg/kg
	Arsenic as As (mg/kg)	EPA 3050 B	mg/kg
Water Quality			
	Total Suspended Solids	APHA 2540D	mg/L
	Turbidity	APHA 2430D	NTU
	Total Nitrogen	APHA4500N	mg/L
	Total Phosphorus	APHA4500PE	mg/L
	Biological Oxygen Demand (BOD)	APHA 5210B	mg/L
	Chemical Oxygen Demand (COD)	APHA 5220B	mg/L
	Escherichia coli (*E. coli*)	ISO 9308-1	cfu/100ml
	Total Coliform	ISO 9308-1	cfu/100ml
	Temperature	YSI Meter (professional plus)	degrees celsius (^{o}c)
	DO	YSI Meter (professional plus)	mg/L
	Salinity	YSI Meter (professional plus)	PSU
	pH	YSI Meter (professional plus)	

5.3.5 Data Analysis and Results Interpretation

Water and sediment quality results were compared against guideline trigger values of Australian and New Zealand guidelines for Fresh and marine water quality (ANZECC, 2000) for moderately disturbed tropical systems given that Kenya has not developed water and sediment quality guidelines. The guidelines have two levels of risk, low trigger value and High trigger values. These guidelines were applied as useful tools for predicting chemical toxicity in screening or sediment quality assessments. ISQG-low are levels at which effects rarely occur while effects are likely to occur if levels are above ISQG-high. Sediment is considered contaminated if either criterion is exceeded. If both criteria are exceeded, the sediment is considered to be severely impacted. The impact is considered moderate if only the Lowest Effect Level criterion is exceeded.

Noise measurement results were compared to The Kenyan Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations, 2009 and World Health Organization Guidelines for Community Noise to determine compliance to the maximum allowable limits. Air quality measurements were compared to The Kenyan Environmental Management and Coordination *(Air Quality) Regulations, 2014*

TABLE 20 - EMCA LEGAL NOTICE 61. FIRST SCHEDULE EXTRACT

ZONE		Sound Level Limits dB (A)L eq, 14 h		Noise Rating Level (NR)L eq, 14 h	
		DAY	NIGHT	DAY	NIGHT
A	Silent Zone	40	35	30	**25**
B	Place of worship	40	35	30	**25**
C	Residential: Indoor	45	35	35	**25**
	Outdoor	50	35	40	**25**

D	Mixed Residential (with some commercial and places of entertainment)	55	35	50	**25**
E	Commercial	60	35	55	**25**

TABLE 21 - WHO GUIDELINE VALUE FOR COMMUNITY NOISE

Specific Environments	**Critical Health effect(s)**	**LAeq (dBA)**	**Timebase**	**LAmax (dB)**
Industrial, commercial shopping and traffic areas, indoors and outdoors	Hearing impairment	70	24	110

TABLE 22 - AMBIENT AIR QUALITY TOLERANCE LIMITS

	Pollutant	**Time weighted Average**			
	-	**-**	**Industrialarea**	**Residential, Rural & Other area**	**Controlled areas*** **
1	Sulphur Oxides (SOx)	24 hours**	125 µg/m^3	80 µg/m^3	30 µg/m^3
2	Oxides of Nitrogen (NOx)	24 hours	150 µg/m^3	80 µg/m^3	30 µg/m^3
3	Nitrogen Dioxide	24 hours	100 µg/m^3	0.1 ppm	-
4	Respirable particulate matter (<10 µg/m^3) (RPM)	24 hours**	150µg/Nm^3	100µg/Nm^3	75µg/Nm^3
5	PM2.5	24 hours	75 µg/m^3	-	-
6	Carbon monoxide / carbon dioxide	8 Hours	5 mg/m^3	2.0 mg/m^3	1.0 mg/m^3
7	Hydrogen Sulphide	24 hours**	150 µg/m^3	-	-
8	Non-methane hydrocarbons	Instant peak	700 ppb	-	-
9	Total VOC	24 hours**	600 µg/m^3	-	-
7	Ozone	8 hours	120 µg/m^3	1.25 ppm	-

5.3.6 Survey Results and Interpretation

(1) Water Quality

a. Temperature

The mean temperature recorded in all the surveyed stations ranged between 25.6 - 26.5 (ºc) with high mean temperatures recorded in stations of Mombasa Port area (**Table 23**). It is noteworthy that sea surface temperature largely depends on the diurnal cycles of time of day. While there are no standards for ambient temperature in the marine environment, the Canadian Water Quality Guidelines for the Protection of Aquatic life (1999) recommends that human activities should not cause changes in ambient temperature of marine and estuarine waters to exceed ±1ºC at any time, location, or depth. The maximum rate of any human-induced temperature change should not exceed 0.5ºC per hour (MWLAP, 2001).

b. pH

pH values ranged between 7.63 - 8.05 in all the surveyed stations, with mean pH ranges of 7.73 - 8.0. Stations around Shelly -Tiwi area recorded a high mean pH of 8.0 with stations around Mombasa Port recording a mean low pH of 7.73. The Australian and New Zealand guidelines gives a pH standard range of 8.0 - 8.4. Stations in the Mombasa Port area and Diani Chale area had pH values lower than the standards provided, with a pH range of 7.72 - 7.92 (**Table 23**).

c. Dissolved Oxygen

The average DO level for the sampled area (Mombasa Port area) was 4.44 mg/L, with DO measurements having a maximum reading of 4.7 mg/L and a minimum of 4.2 mg/L (**Table 23**). ANZECC 2000 guidelines provide the trigger value for DO as 90% saturation i.e., 7.44 mg/L, however, the DO results for the sampled area averaged (4.44 mg/L) which falls below the standard.

d. Salinity

Salinity measured in situ in all the stations ranged between 21.9 PSU (in the Diani-Chale Reserve area) - 32.9 PSU (in the Shelly-Tiwi area). The mean salinity values ranged between 30.9 - 32.9 PSU (**Table 23**).

e. Turbidity and TSS

Turbidity was measured in situ in all the stations and ranged between 0.76 - 2.46 NTU with mean turbidity ranges of 0.2- 1.87 NTU (**Table 23**). The turbidity results show that the water around the Mombasa Port area is more turbid (mean turbidity of 2.46 NTU) than the water in the Mombasa Marine Park (mean turbidity of 0.76 NTU). The Australian and New Zealand guidelines provide a trigger value range of 1-20 NTU in which Low values are indicative of offshore coral-dominated waters and Higher values are representative of estuarine waters. Out of all the stations surveyed, only nine stations fell within the range of the provided standard (1.29 - 2.80 NTU). TSS in all the surveyed stations ranged between 2.8 - 43.6 mg/L with mean TSS concentrations ranging from 8.0 mg/L in the Diani-Chale Marine Reserve area to 27.72 mg/L in Mombasa Port area, suggesting the Mombasa Port area having a higher TSS concentration whereas the Diani- Chale area had a lower concentration.

f. E. coli and Total Coliforms

Escherichia coli (E. coli) and total coliforms were analyzed in the Mombasa Port area only E. coli was present in two of the five surveyed stations, with minimum and maximum concentrations of 4.0 and 48.0 (cfu/100ml) respectively, having a mean concentration of 26.0 (cfu/100ml) (**Table 23**). Total coliforms were present in all the stations sampled along the Mombasa Port area, with a mean of 52.2 (cfu/100ml). The minimum and maximum concentrations of total coliforms concentration being 21.0 and 100.0 (cfu/100ml) respectively.

g. Total Phosphorus and Total Nitrogen

Total Phosphorus and Nitrogen was analyzed in areas along the Mombasa Port area only. The mean concentration of Total Phosphorus was 0.012 mg/L and that of Total Nitrogen was 0.68 mg/L. Total Phosphorus minimum and maximum concentrations were 0.01 and 0.02 while that of Total Nitrogen was 0.65 and 0.70 mg/L respectively. The Australian and New Zealand guidelines provide trigger values for Total Phosphorus as 0.015 mg/ and that of Total Nitrogen as 0.1 mg/L. Total Phosphorus concentrations in all the surveyed stations were below the standards, with a mean concentration of 0.012 mg/L. Total Nitrogen concentrations were higher than the provided standard with a mean of 0.68 mg/L.

h. BOD and COD

BOD concentrations had a mean concentration of 368.98 mg/L and ranged between 320.0 - 390.0 mg/L in all the surveyed stations in the Mombasa Port area.

TABLE 23 - WATER QUALITY PARAMETERS RANGE AND AVERAGES IN THE FOUR SAMPLING AREAS (MOMBASA PORT, DIANI-CHALE MP, SHELLY-TIWI AND MOMBASA MPA)

Area	Range	Temp (°c)	DO (mg/L)	Sal (PSU)	pH	TSS (mg/L)	Turbidity (NTU)	BOD (mg/L)	COD (mg/L)	*Escherichia Coli* (cfu/100ml)	Total Coliform (cfu/100 ml)	Total Phosphorus (mg/L)	Total Nitrogen (mg/L)
Mombasa Port	Min	26.7	4.70	32.6	7.79	34.00	2.46	390.00	1197.00	48.00	100.00	0.02	0.70
	Max	26.0	4.20	32.4	7.63	15.30	0.97	323.00	1052.00	4.00	21.00	0.01	0.65
	Mean	26.5	4.44	32.6	7.73	27.72	1.87	368.98	1109.4	26.0	52.2	0.012	0.68
Diani- Chale Marine Reserve	Min	25.7	-	32.8	7.87	2.80	0.10	-	-	-	-	-	-
	Max	25.8	-	32.9	7.92	20.00	0.42	-	-	-	-	-	-
	Mean	25.7	-	32.9	7.89	8.0	0.2	-	-	-	-	-	-
Shelly- Tiwi	Min	25.4	-	21.9	7.96	8.70	0.26	-	-	-	-	-	-
	Max	25.8	-	32.8	8.05	43.30	2.80	-	-	-	-	-	-
	Mean	25.6	-	30.9	8.0	20.6	1.12	-	-	-	-	-	-
Mombasa Marine Reserve	Min	25.5	-	31.9	7.71	3.60	0.12	-	-	-	-	-	-
	Max	25.9	-	32.8	8.04	36.40	2.43	-	-	-	-	-	-
	Mean	25.7	-	32.5	7.95	11.8	0.76	-	-	-	-	-	-
Trigger Value			7.44 -		8.0-8.4		1-20					0.015	0.1

(2) Sediment Quality

a. Trace metals

Total Cr concentration ranged between 16.08 to 25.16 mg/kg, Zn concentration ranged between 3.69 to 8.47 mg/kg and Cu concentration ranged between 1.76 to 5.11 mg/kg. Cd, As, Ni and Pb recorded low concentration limits of <0.01 to 0.06, <0.01, <0.01 to 0.03 and < 0.01 to 0.16 respectively. Hg recorded the lowest concentration of <0.001.

Sediment Cd, Pb, Zn, Cu, Ni, Hg, Cr and As levels in the sediment were lower than the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2000) recommended trigger levels of 50, 200, 65, 21, 0.15, 80, and 20 mg/kg (dry wt) respectively.

Table 24 - Results of trace metals analysis for Mombasa Port Area

	MPWQ 1	MPWQ 2	MPWQ 3	MPWQ 4	ISQG low
Lead as Pb (mg/kg)	0.04	0.16	<0.01	0.02	50
Cadmium as Cd (mg/kg)	<0.01	0.03	0.06	<0.01	1.5
Zinc as Zn (mg/kg)	6.2	4.36	8.47	3.69	200
Copper as Cu (mg/kg)	2.67	5.11	2.03	1.76	65
Nickel as Ni (mg/kg)	0.03	<0.01	<0.01	<0.01	21
Mercury as Hg (mg/kg)	<0.001	<0.001	<0.001	<0.001	0.15
Total Chromium as Cr (mg/kg)	21.16	16.08	20.93	25.16	80
Arsenic as As (mg/kg)	<0.01	<0.01	<0.01	<0.01	20

b. PAH

PAH concentrations in the Sediment were lower than the ISQG-low level recommended in the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC, 2000) and can cause minimal harm to the resident organisms.

c. Oil & grease

Oil and grease were not detected in all the stations in the Mombasa Port area.

Table 25 - Results of PAH and Oil & Grease analysis for Mombasa Port Area

	MPWQ 1	MPWQ 2	MPWQ 3	MPWQ 4	Low trigger value	Unit
Oil and Grease	Nil	Nil	Nil	Nil		mg/kg
PAH						
Naphthalene	0.02	0.03	0.02	0.05	160	mg/kg
Acenaphthylene	<0.01	<0.01	<0.01	<0.01	44	mg/kg
Acenaphthene	<0.01	<0.01	<0.01	<0.01	16	mg/kg
Fluorene	<0.01	<0.01	<O.01	<0.01	19	mg/kg
Carbazole	0.05	0.05	0.09	0.06		mg/kg
Phenanthrene	<0.01	<0.01	<0.01	<0.01	240	mg/kg

Anthracene	<0.01	<0.01	<0.01	<0.01	85	mg/kg
Fluoranthene	<0.01	<0.01	<0.01	<0.01	600	mg/kg
Pyrene	0.02	0.01	0.08	0.03	665	mg/kg
Benzo(a)anthracene	<0.01	<0.01	<0.01	<0.01	261	mg/kg
Chrysene	<0.01	<0.01	<0.01	<0.01	384	mg/kg
Benzo(e)pyrene	<0.01	<0.01	<0.01	<0.01		mg/kg
Benzo(k)fluoranthene	0.01	<0.01	0.01	<0.01		mg/kg
Benzo(a)pyrene	0.01	0.01	0.01	0.02	430	mg/kg
Total PAH	**0.11**	**0.1**	**0.21**	**0.15**		

(3) Noise Levels

Baseline nocturnal noise levels surpassed the EMC (Noise and Excessive Vibrations), Regulations, 2009 at the of monitoring. Nocturnal noise at the Port Reitz residential area could have been attributed to the noise from the SGR tarmacroad which connects the Port Reitz and the KPA and the main SGR highway. Within the Port, at KPA Revetment Noise levels surpassed the Regulatory Limits due to the Port Operations whereas SGR operation impacted the baseline noise levels within the terminal. The baseline noise data obtained poses no harm to the environment and the residents. However, the nocturnal limits need to be minimized and protective gears to be worn during the construction phase for places where noise will be estimated to be high.

Diurnal noise levels at the three selected monitoring locations were found to be within the EMC (Noise and Excessive Vibrations), Regulations, 2009 at the time of monitoring. Diurnal Noise levels were majorly attributed to vehicle movements and SGR operations.

TABLE 26 - NOISE LEVEL STANDARDS

Measurement Location	LAeq Decibels (dBA)		LA Max Decibels (dBA)	LA Min Decibels (dBA)
	Diurnal	**Nocturnal**	**LA Max Decibels (dBA)**	**LA Max Decibels (dBA)**
Residential area (Port Reitz -Location I)	55.45	47.43	55.50	**46.12**
KPA Revetment Location II	55.81	47.56	53.53	**46.30**
SGR TerminalLocation III	53.83	46.78	54.45	**45.02**
EMC (Noise & Excessive Vibrations), Regulations, 2009 Diurnal	60 (dBA)	35 (dBA)	*	*

FIGURE 27 - NOISE MEASUREMENT AND AIR QUALITY MEASUREMENT AT REVETMENT AREA

(4) Air Quality

All the gaseous parameters complied with the EMC (Air Quality) Regulations, 2014 at the time of monitoring. The primary sources of the gaseous parameters were from the combustion emissions from locomotives sources such as vehicles and motorbikes. At the Revetment area, most gaseous emissions could have been attributed to the port operations, emissions from vehicles, trucks and all vehicles operating within the port. At the SGR Terminal, the primary source of gaseous parameters was from the SGR operations. Fugitive emissions carried by wind could be other source.

Particulate Matter concentrations for all three locations complied with the EMC (Air Quality), Regulations,2014 at the time of monitoring. Particulate Matter concentrations at the residential area could have been attributed to the fugitive dust from locomotive movements. Port operations could have impacted the Particulate Matter while SGR operations were the main source of emissions at thetime of monitoring.

TABLE 27 - AIR QUALITY STANDARDS

Measurement Location	Particulate Matter (PM2.5))	Particulate Matter (PM10)	Sulphur Dioxide SO2	Nitrogen Dioxide NO2	Nitrogen Oxides NO	Carbon Monoxide CO	Hydrogen Sulphide H2S

Residential area (Port Reitz - Location I)	10.417	24.625	16.83	14.750	9.126	0.721	**0.119**
KPA Revetment Location II	12.625	21.583	13.208	22.042	13.585	0.815	**0.113**
SGR Terminal Location III	14.83	16.167	11.125	24.750	14.917	0.613	**0.122**
EMC (Air Quality) Limits 24 Hours) µg/m³	**75**	**100**	**80**	**80**	**80**		

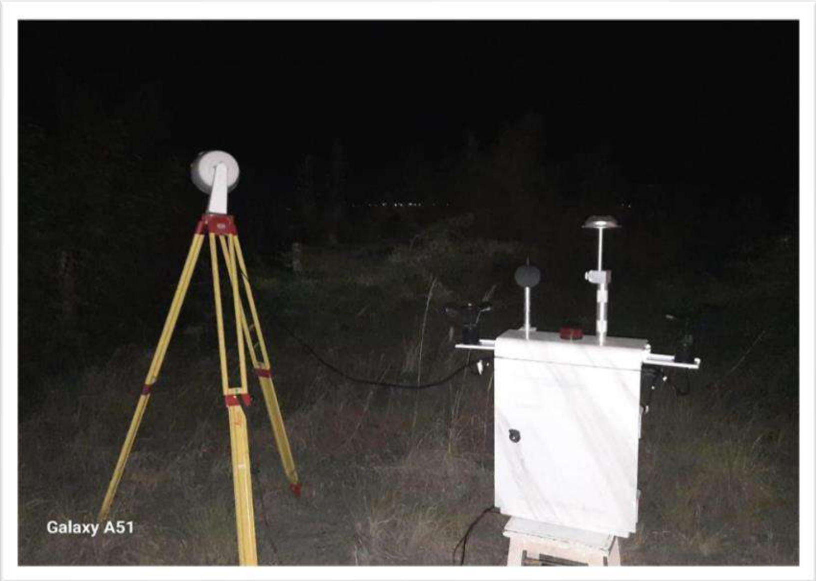


FIGURE 28 - AMBIENT AIR MEASUREMENT AT SGR TERMINAL USING THE AQM 09.

(5) Mean Vibration Measurement

The vibration velocity ranged between 0.20-0.26 mm/s which is below the allowed limit of 50mm per second EMC (Noise and Excessive Vibrations), Regulations, 2009.

TABLE 28 - VIBRATION LEVEL STANDARDS

	Acceleration (mm/s2)	Velocity (mm/s)	Displacement (mm)
KPA Port Reitz	0.017	0.20	0.003
SGR Terminal	0.023	0.26	0.004
KPA Revetment	0.023	0.24	0.004

5.4. HYDRODYNAMICS

The objective of this study was to determine the hydrodynamics characteristics of the Kilindini Channel and its mouth and conducting turbidity simulation exercise is to predict extent and concentration of turbid water dispersion discharged from the TSHD during its overflow operation along the Mombasa coastline.

5.4.1 Hydrodynamic Survey

(1) Instrumentation

The data was collected using an Acoustic Wave and Current profiler (AWAC), which was positioned at the sea bottom and directed upwards. The AWAC device is equipped with four (4) acoustic transducers - one vertical and three inclined at a 25-degree angle. The AWAC assesses the speed and direction of water currents at varying depths. Furthermore, it contains an additional temperature sensor to gauge the water's temperature. Acoustic Doppler profilers operate by emitting sound along beams at a consistent frequency and detecting the reflections from sound-scattering elements in the water, like plankton, suspended sediment, or bubbles. By determining the Doppler shift and travel time of these reflections, the instrument can compute velocities at different depths within the water. The AWAC utilized in this on-site activity was affixed to an aluminum and lead tripod. The mooring tripod stands at a height of two feet and measures four feet on each side. The entire system is powered by batteries and is placed remotely, not requiring a shore-connected cable. **Figure 29** provides a visual representation of the AWAC tripod setup.

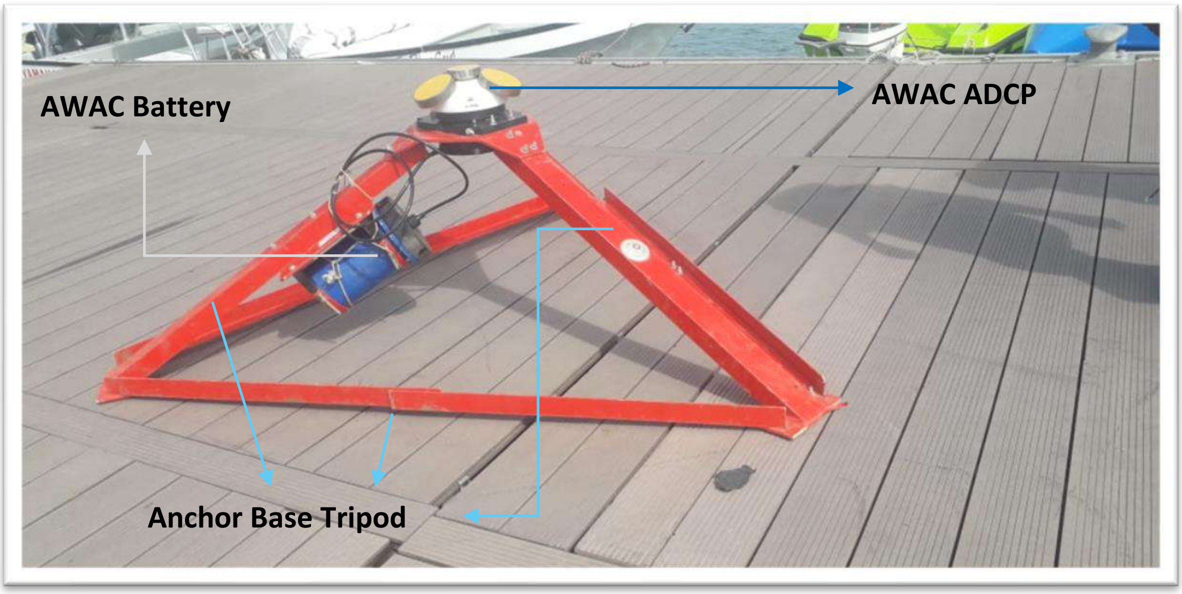


FIGURE 29 - AWAC BOTTOM MOUNT TRIPOD CONFIGURATION

(2) Deployment

The AWAC was deployed in two pre-selected sites namely; a) inshore inside the Kilindini channel at 4°03'17.0"S and 39°37'03.7"E and b) offshore at the mouth of the Kilindini channel at 4°05'40.3"S and 39°41'22.4"E (**Figure 30**). Before each deployment the system was preset using the AWAC AST software (see Table 1 & Appendix 1). To ensure the instrument's correct positioning, two divers confirmed that the AWAC tripod at the sea bottom maintained a proper vertical orientation without tilting, as depicted in **Figure 31**. The AWAC system was set up to measure current velocities in depth cells of two and a half meters, every 15 minutes, utilizing a one-minute averaging window, and to gather ocean water current data.

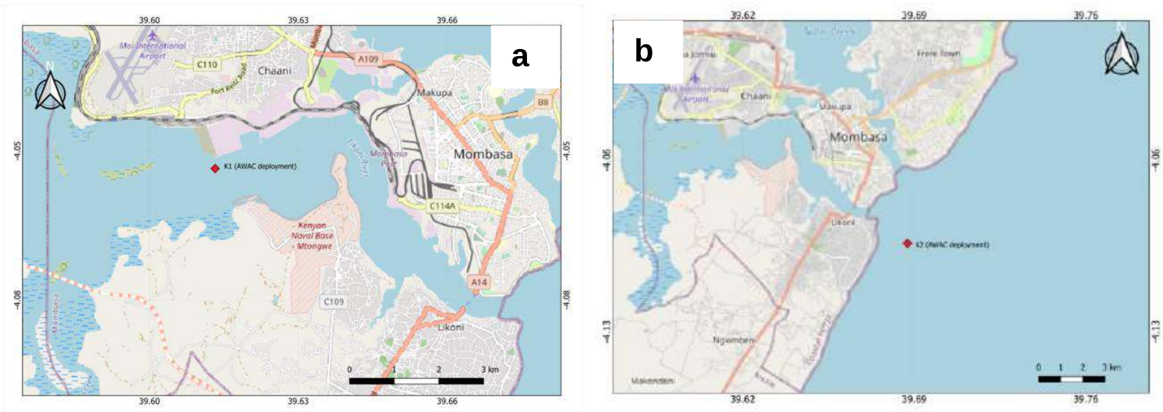


FIGURE 30: SHOWING AWAC DEPLOYMENT LOCATIONS AT (A) KILINDINI CHANNEL INSHORE LOCATION AND (B) OFF SHELLY BEACH OFFSHORE LOCATION.

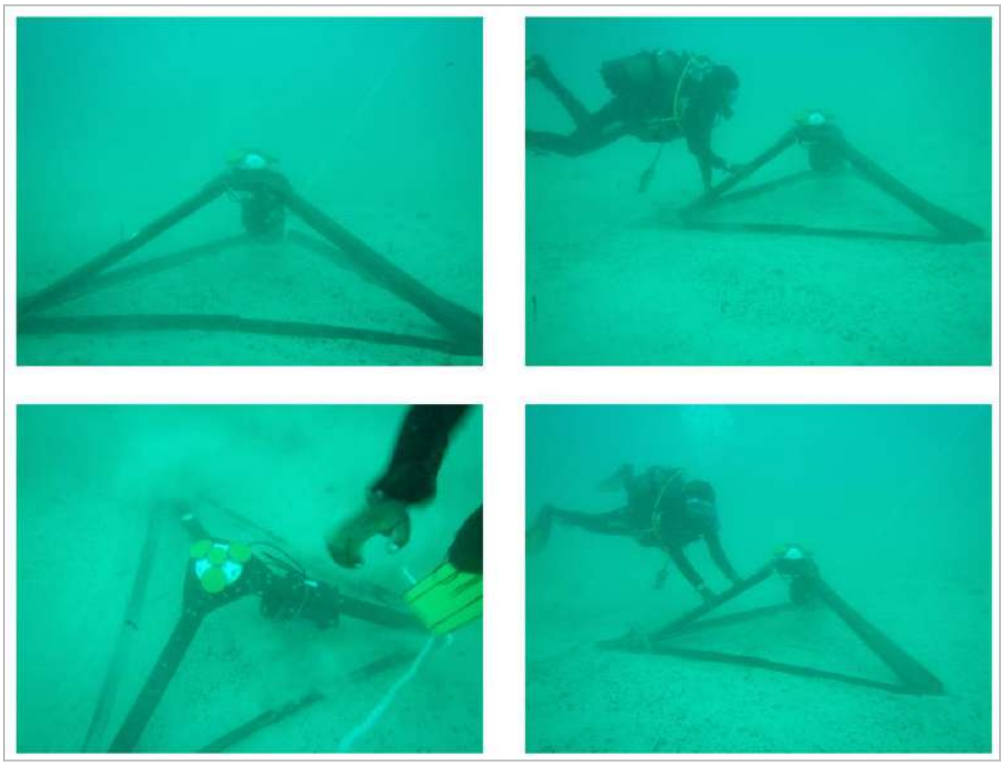


FIGURE 31: SHOWING THE BOTTOM-MOUNTED AWAC WITHOUT ANY TILTING.

TABLE 29 - AWAC DEPLOYMENT SCHEDULE

Depth Information				
	Deployment Depth	Deployment Date	Retrieval Date	Available Data
Inshore Kilindini Channel	18.5m	16/08/2023	21/08/2023	5 days
Offshore Off-Shelly Beach	26m	30/08/2023	04/09/2023	5 days
Deployment pre-configuration				
User defined	Blanking depth	Frequency	No. of cells	Cell Size
	2.5m	600 kHz	Varied	2.5m

(3) Data Analysis

The collected data from the deployment were retrieved. The retrieved data was the initial raw binary data in ***.wpr** format which underwent conversion to usable ***.csv** format using AWAC-AST and STORM applications.

Subsequent analyses were also performed using Nortek's specialized software, which includes AWAC-AST and STORM applications and MATLAB©.

(4) Results

1) Inshore current measurements

The compass plots below (**Figure 32**) show current speed and direction within the water column from surface, mid, to bottom waters, inshore in the Kilindini Channel. The maximum ebb current speed within the surface water recorded was 0.59 m/s, while the maximum flood current speed was 0.68 m/s (**Figure 32**a). The maximum mid-water ebb current speed recorded was 0.39 m/s, while the maximum flood current speed was 0.35 m/s (**Figure 32**b). The maximum bottom water ebb current speed recorded was 0.32 m/s, while the maximum flood current was 0.34 m/s (**Figure 32**c). It was also discernible that the maximum current speed decreases with increasing depth within the entire water column. This is attributed to the increasing density as well as the friction between the bottom water and the sea floor. Ocean circulation, water residency and tidal flushing depends mainly on the current speed. The rapid-flowing currents are effective for moving and spreading sediments to deeper areas. The floods current at the surface exhibited greater speeds compared to the ebb current, possibly influenced, and exacerbated by the effect of surface winds. These elevated current speeds could potentially result in the rapid transport of dredged materials and subsequent deposition in or near critical habitats especially mangroves – situated further upstream of Kilindini Channel towards Mwache, and far away from disposal sites. Likewise, the strongest recorded current at the lower depths was during the ebb phase. Consequently, and coupled with seasonal large-scale currents and currents, there's a possibility that disposed dredged materials from the bottom might be resuspended and accumulate along the shore near the critical habitats. On the other hand, the mid-water ebb current showed promising signs for effectively transporting materials to the open ocean dispersing suspended dredged materials, being notably stronger than the flood current.

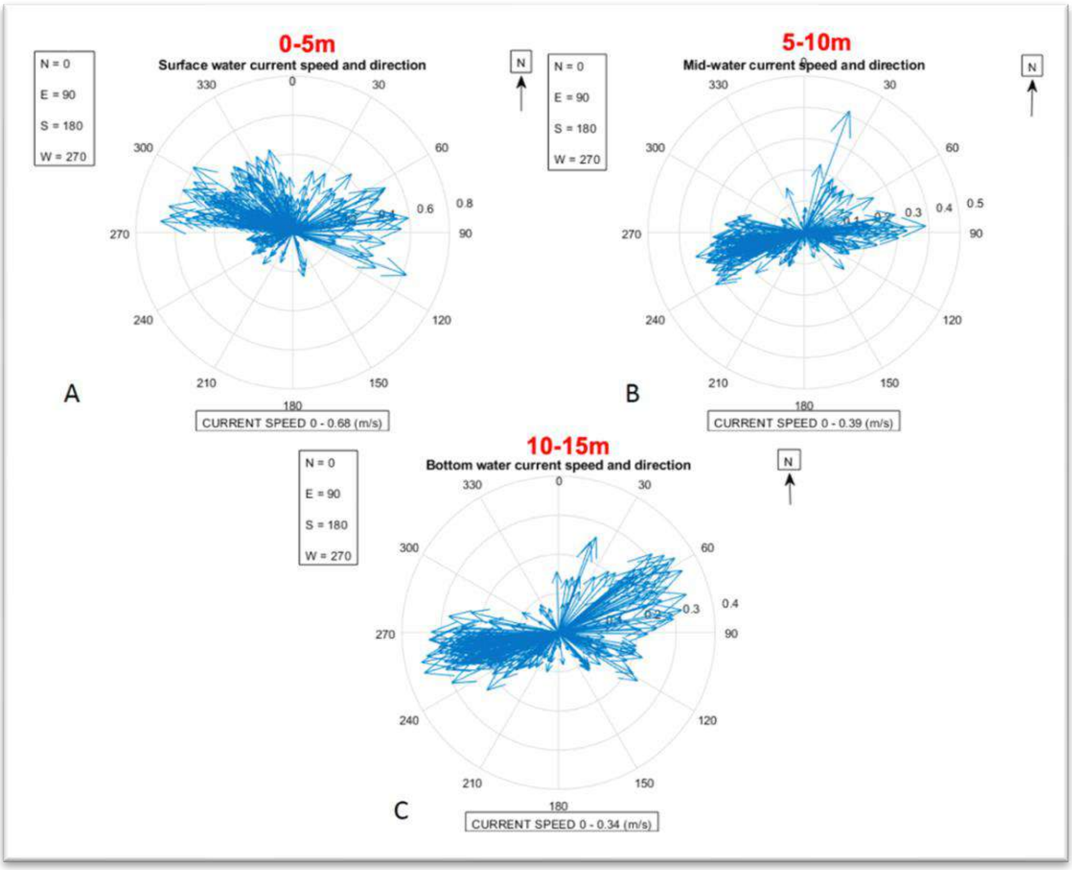


FIGURE 32 - COMPASS PLOT SHOWING THE OCEAN CURRENT SPEED AND DIRECTIONS AT DIFFERENT DEPTHS.

The observed strength in the ebb current could facilitate the flushing of dredged material, dilution and dispersal process minimizing their impacts on proximal critical habitats. From the above compass plots, it is also evident that the surface currents (**Figure 32a**) are multi-directional. This is mainly due to wind direction which influences surface currents. However, for mid (**Figure 32b**) and the bottom (**Figure 32c**) sections, the current directions are bi-directional representing the distinct ebb and flood currents.

2) Offshore Current Measurements

The highest recorded speed of ebb currents at the surface water was 1.58 m/s, and for flood currents, it was 0.46 m/s. In the mid-water region, the maximum ebb current speed observed was 1.55 m/s, while the peak flood current speed reached 0.75 m/s. As for the bottom water, the maximum ebb current speed recorded was 2.27 m/s, with a maximum flood current speed of 0.79 m/s. Notably, the highest current speeds tend to diminish with increasing depth throughout the water column. As discussed in section 3.1, this decline could be attributed to increased water density and increased friction between the bottom water and the ocean floor.

It is also clear from the data (**Figure 33**) that surface water currents exhibit multiple directions however, it also aligns with the predominantly northward-flowing East African Coastal Current. Conversely, the mid- and bottom-water currents (**Figure 33b** and **Figure 33c**) predominantly flow southeast, indicating an ebb-dominant channel.

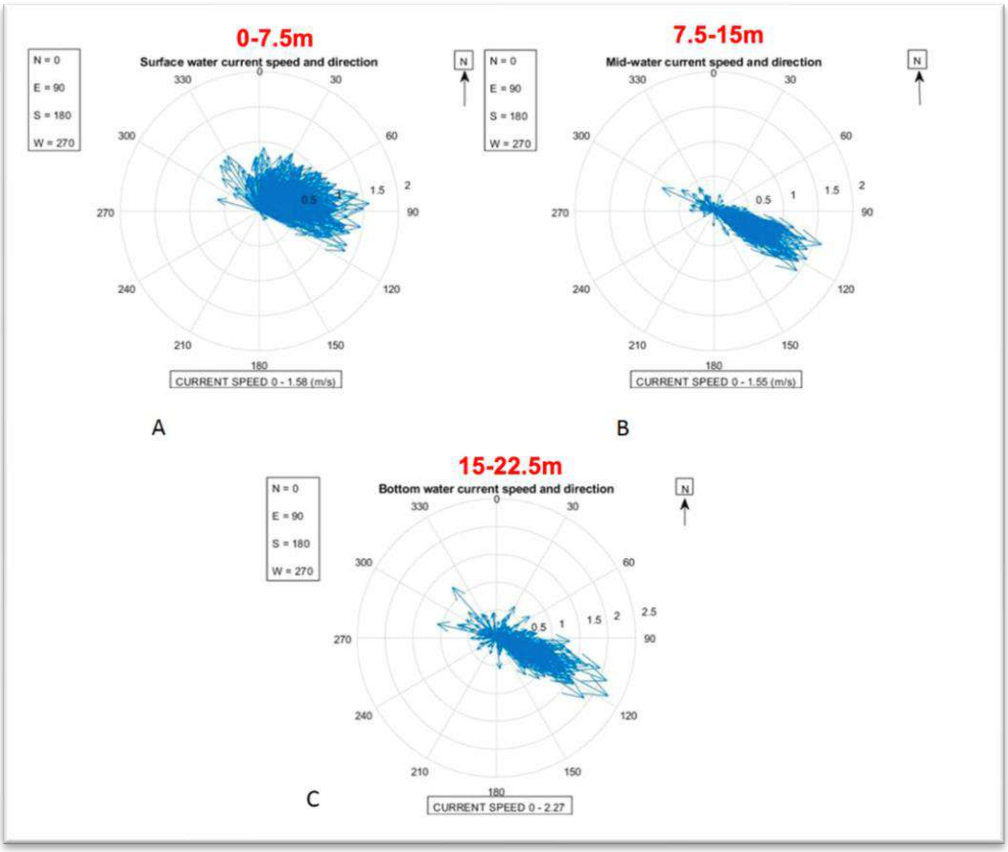


FIGURE 33 - COMPASS PLOT SHOWING THE OCEAN CURRENT SPEED AND DIRECTIONS AT DIFFERENT DEPTHS.

The high-velocity currents facilitate the movement and dispersion of sediment into open offshore waters. However, the observed flood current at the surface exhibited greater strength than the ebb current, potentially influenced by wind speed. This situation could lead to the transport and deposition of dredged materials up-creek and close to the mangroves of Mwache. Similarly, the bottom flood current was recorded as stronger than the ebb current, likely influenced by the constriction of the channel against incoming tide and the seafloor's topography. This could result in the scouring of the bottom, resuspension, transport, and deposition of dredged materials inshore at the Kilindini channel. However, the mid-water ebb current demonstrated a promising ability to disperse suspended dredged materials, with its strength surpassing that of the flood current. This promising ebb current can aid in effectively dispersing the dredged materials and flushing of the channel.

3) Bathymetry

The bathymetry of the current field of reproduction ranges from 1m to 300m (**Figure 34**). The coral reef edge is observable at the 30m water depth mark.

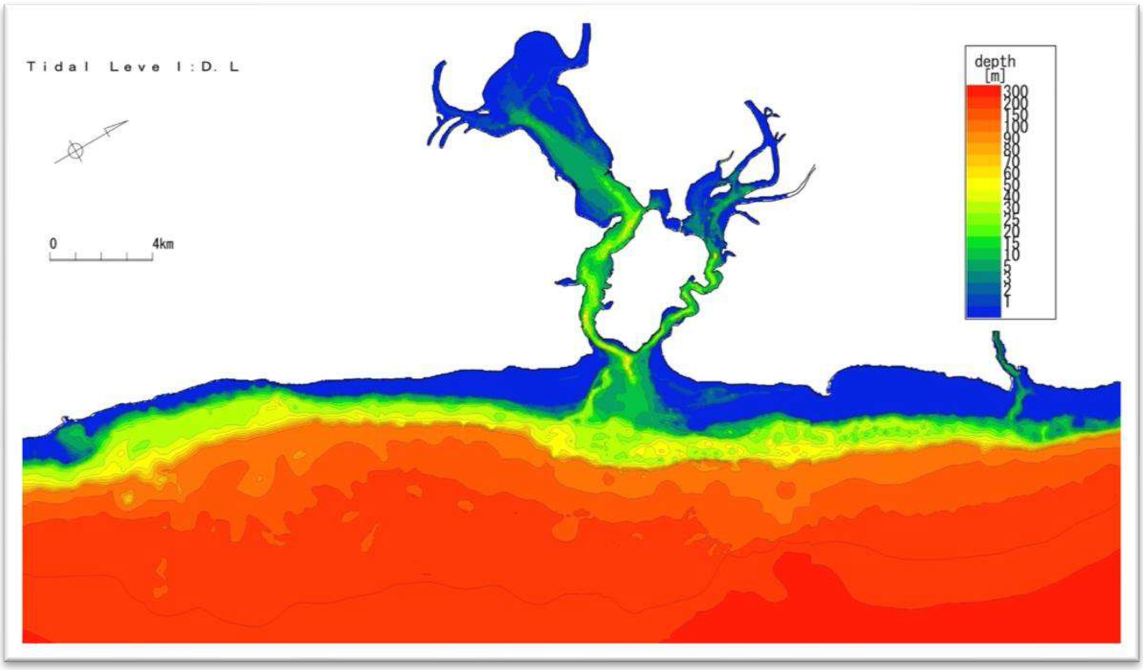


FIGURE 34 - BATHYMETRY OF CURRENT FIELD REPRODUCTION

4) Reproduced current field.

Current field at three (3) vertical layers in NE and SE monsoon seasons during four (4) tidal conditions (high tide, ebb tide, low tide, flood tide) are reproduced as shown in the **Figure 35** - **Figure 58** below.

As shown, SW and N bound currents are dominant in NE and SE monsoon seasons, respectively,at the surface (Level=1) and middle (Level=2) layers.

a. **Northeast Monsoon (NEM) – November to February**

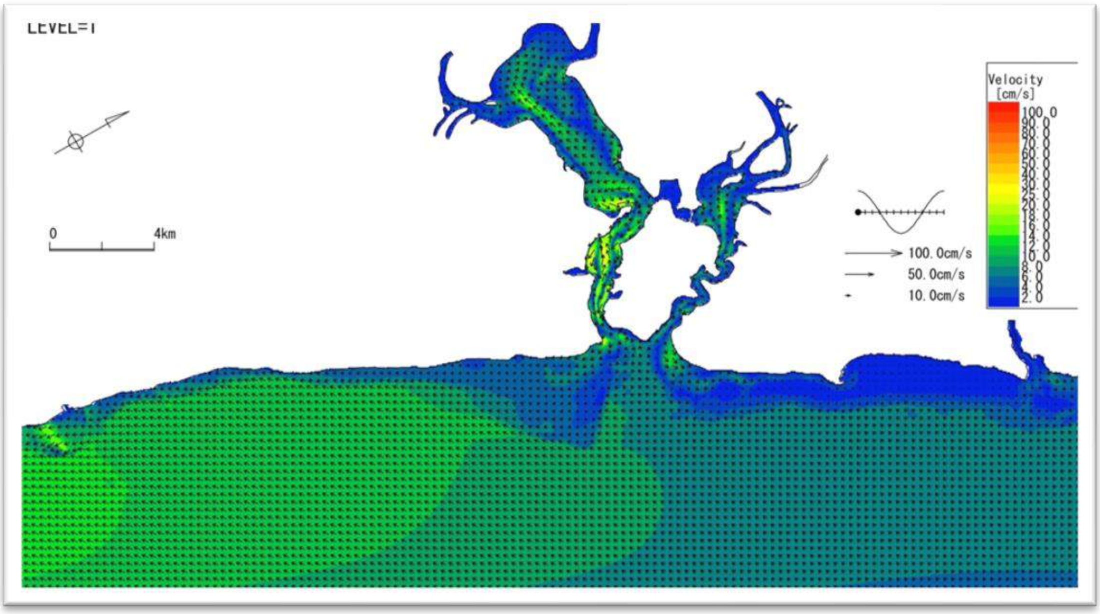


FIGURE 35 - CURRENT FIELD (NE / HIGH TIDE / SURFACE LAYER)

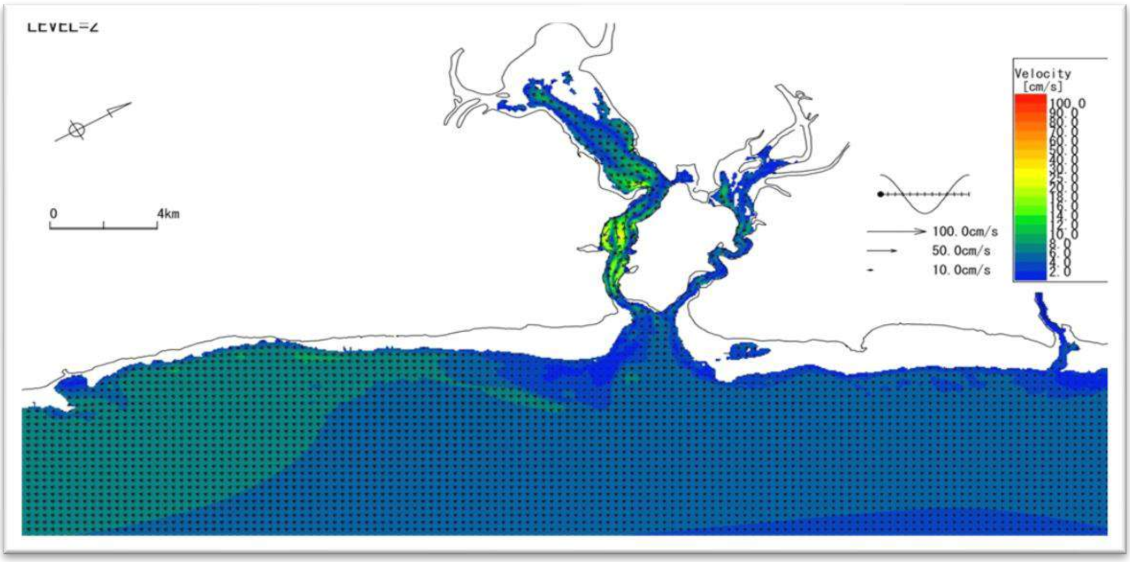


FIGURE 36 - CURRENT FIELD (NE / HIGH TIDE / MIDDLE LAYER)

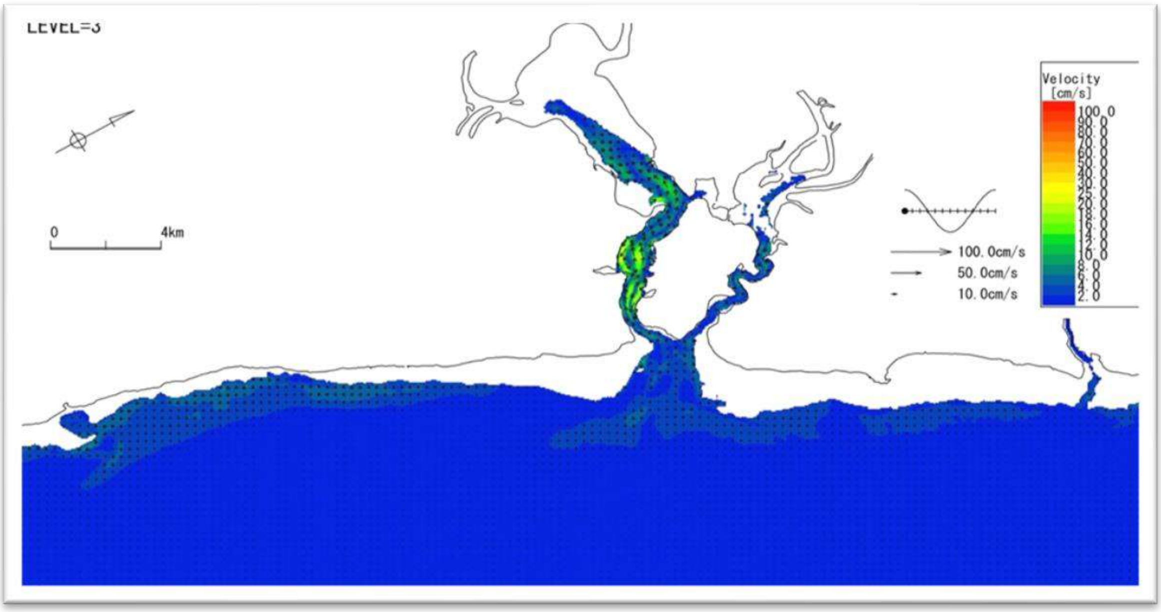


FIGURE 37 - CURRENT FIELD (NE / HIGH TIDE / BOTTOM LAYER)

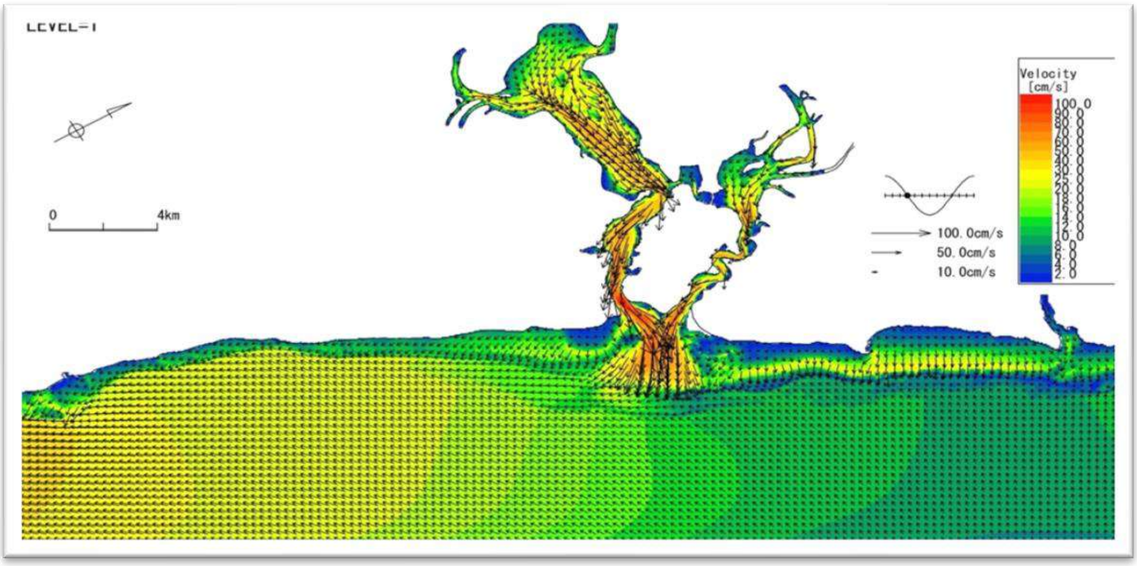


FIGURE 38 - CURRENT FIELD (NE / EBB TIDE / SURFACE LAYER)

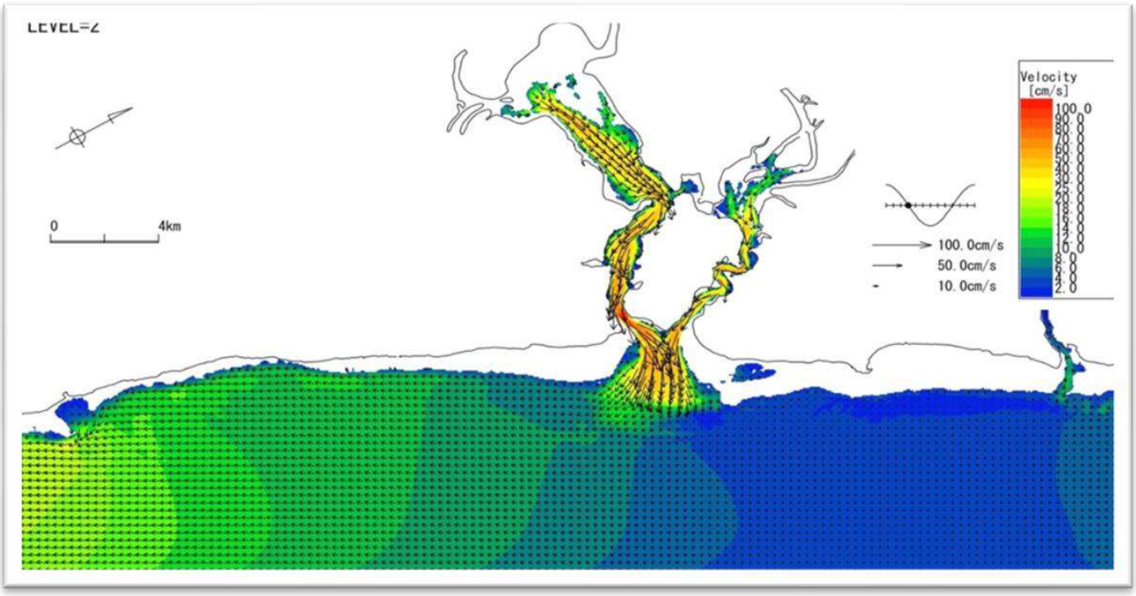


FIGURE 39: CURRENT FIELD (NE / EBB TIDE / MIDDLE LAYER)

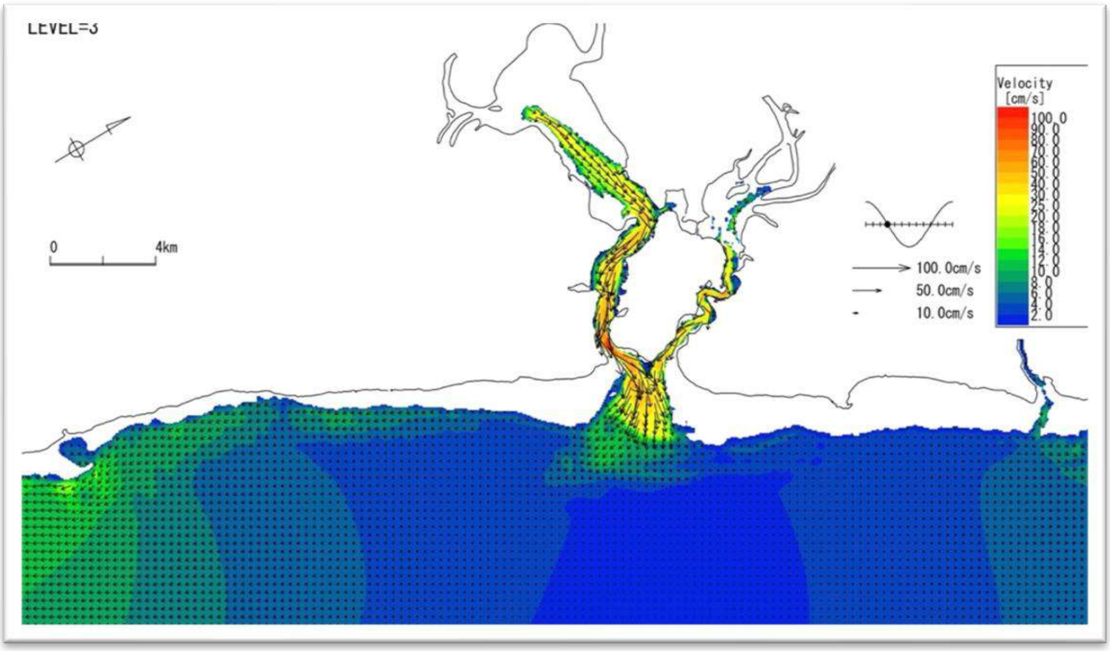


FIGURE 40 - CURRENT FIELD (NE / EBB TIDE / BOTTOM LAYER)

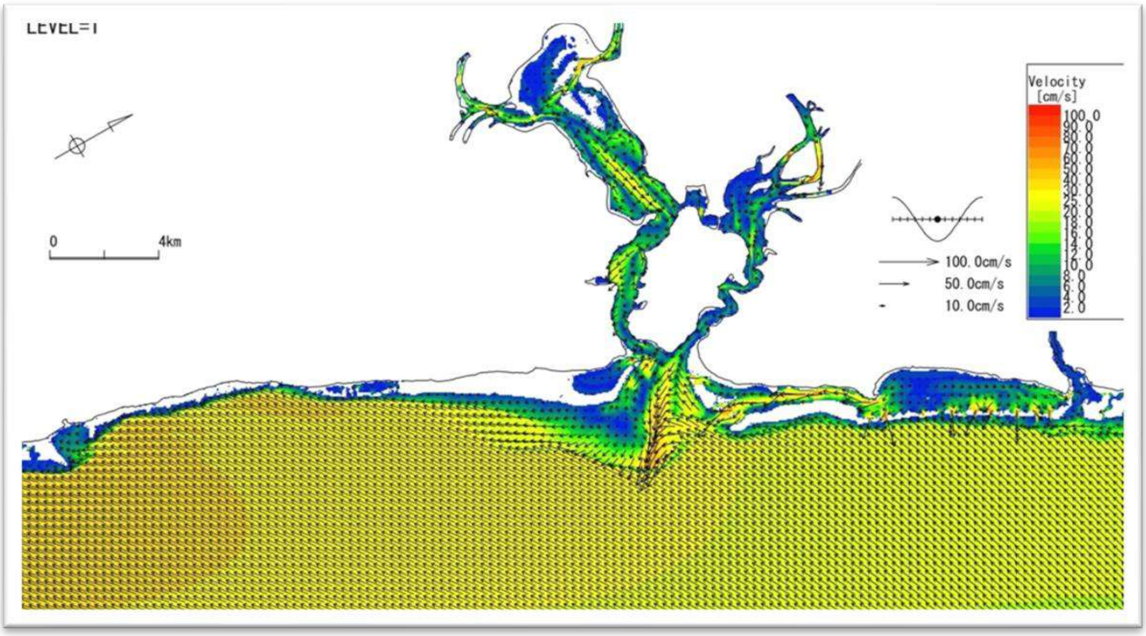


FIGURE 41 - CURRENT FIELD (NE / LOW TIDE / SURFACE LAYER)

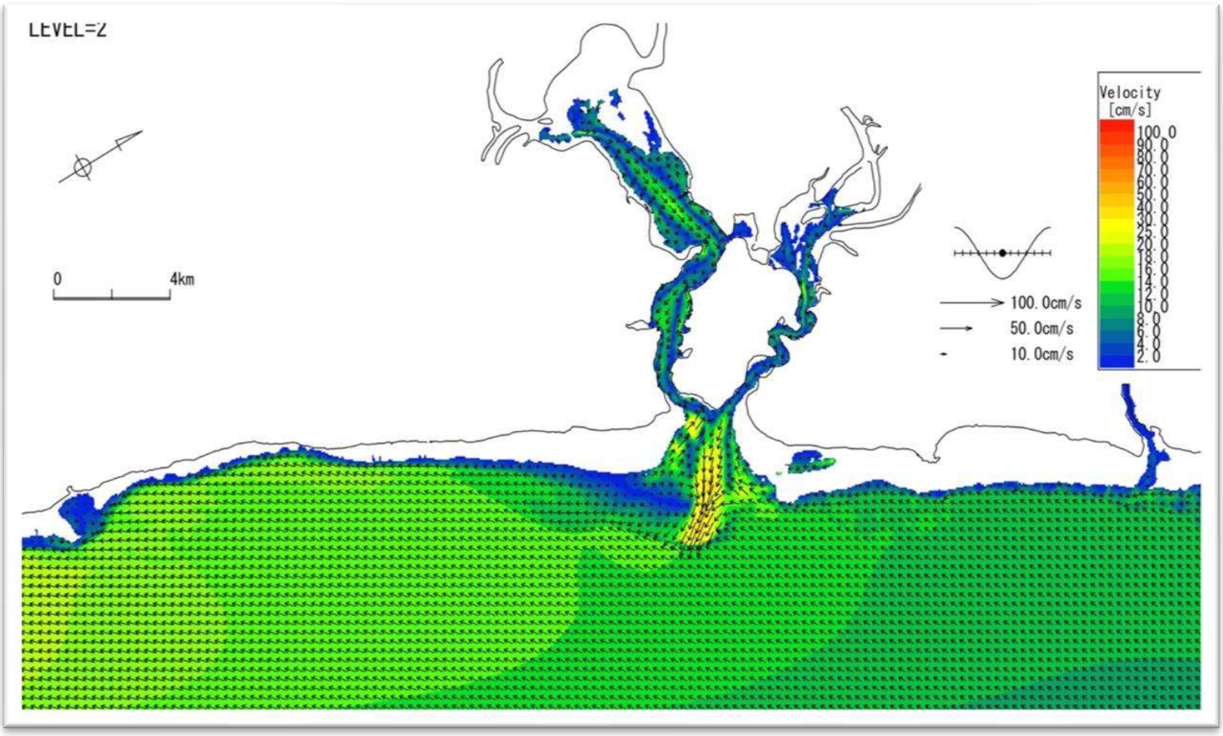


FIGURE 42 - CURRENT FIELD (NE / LOW TIDE / MIDDLE LAYER)

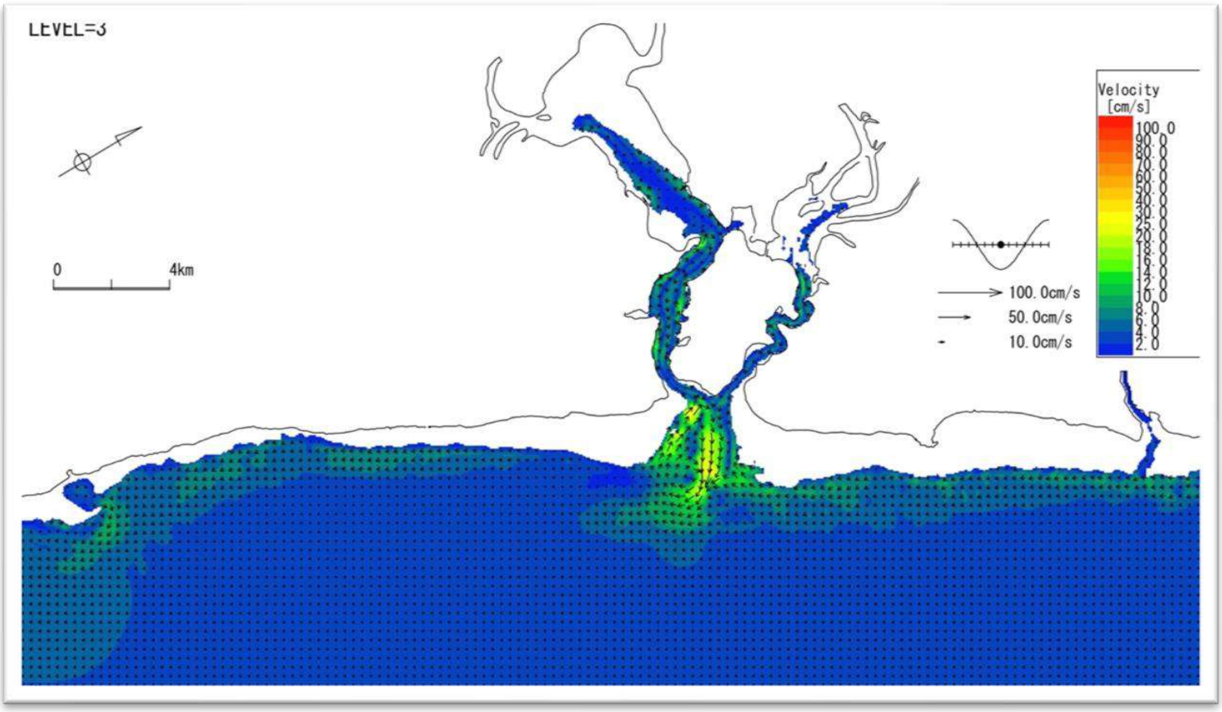


FIGURE 43 - CURRENT FIELD (NE / LOW TIDE / BOTTOM LAYER)

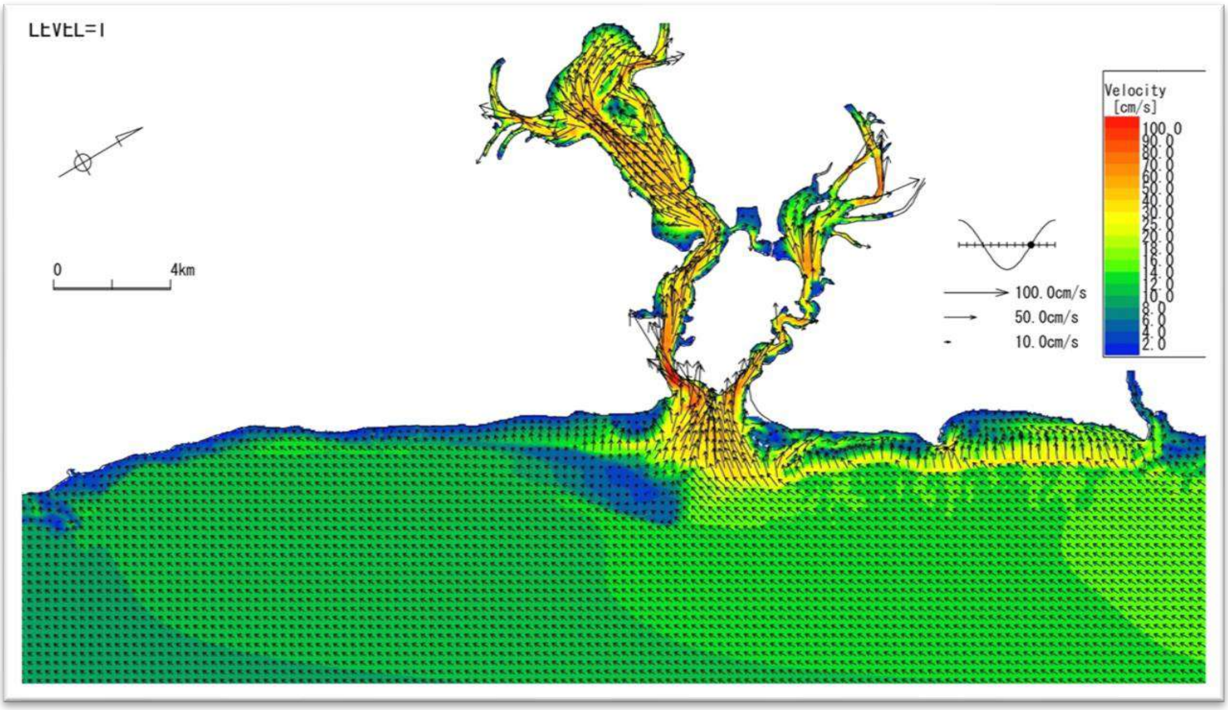


FIGURE 44 - CURRENT FIELD (NE / FLOOD TIDE / SURFACE LAYER)

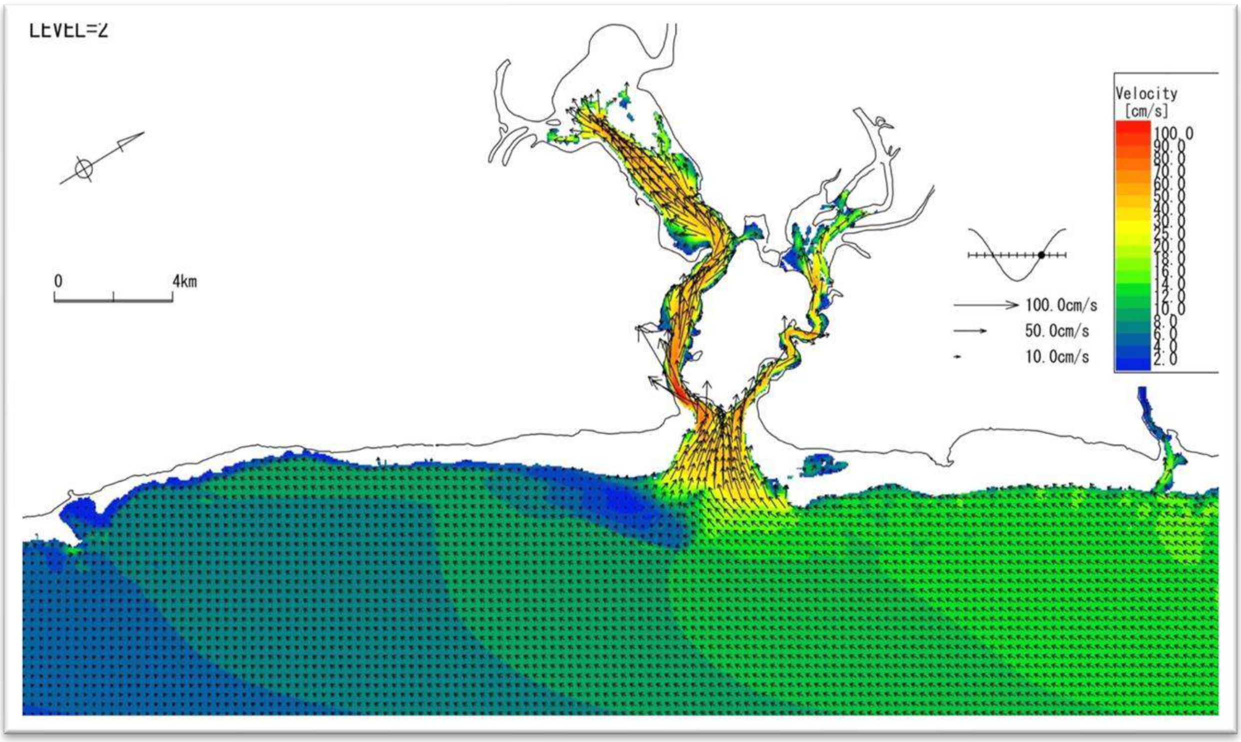


FIGURE 45 - CURRENT FIELD (NE / FLOOD TIDE / MIDDLE LAYER)

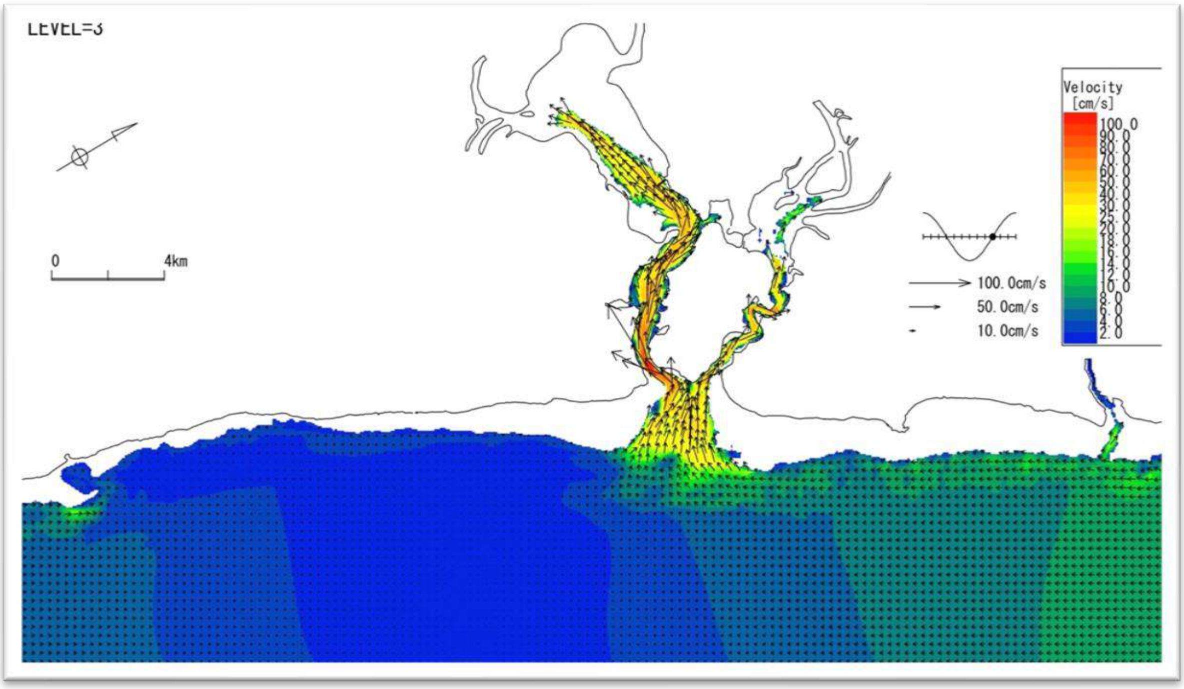


FIGURE 46 - CURRENT FIELD (NE / FLOOD TIDE / BOTTOM LAYER)

b. Southeast Monsoon (SEM) – April to August

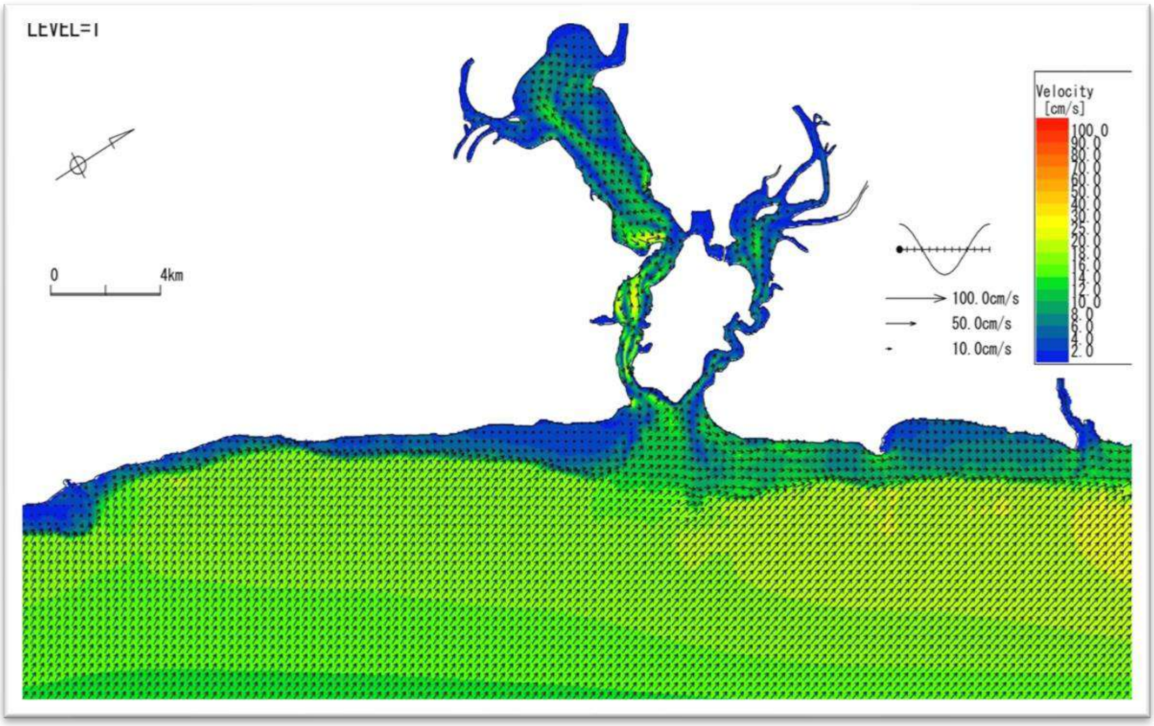


FIGURE 47 - CURRENT FIELD (SE / HIGH TIDE / SURFACE LAYER)

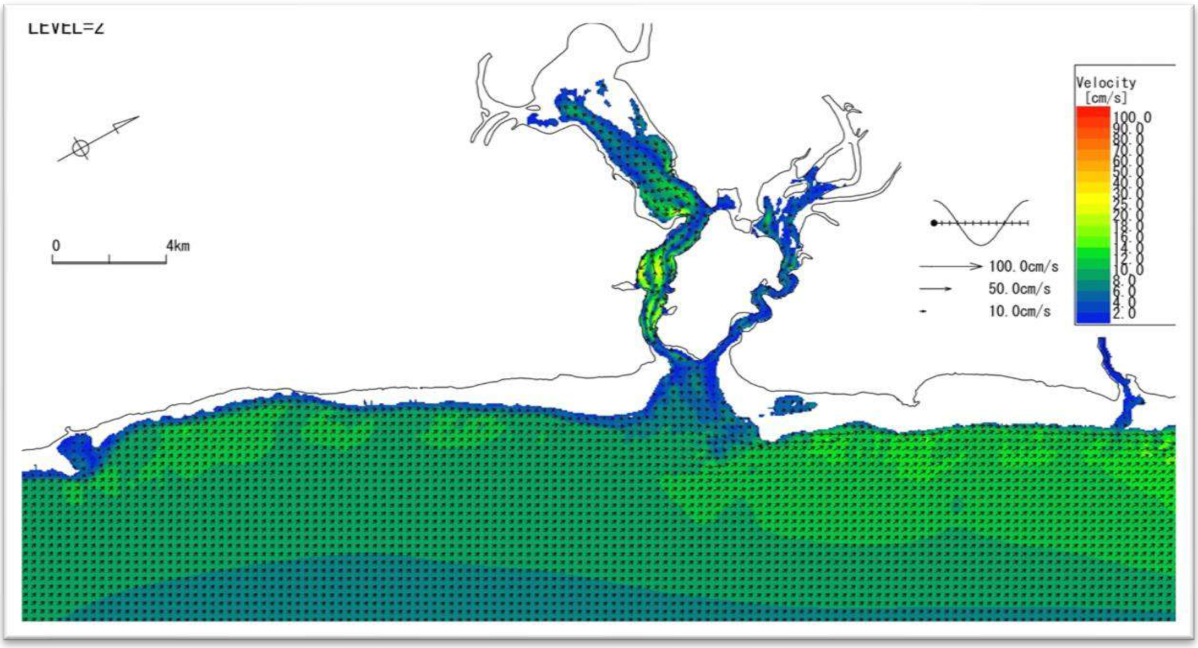


FIGURE 48 - CURRENT FIELD (SE / HIGH TIDE / MIDDLE LAYER)

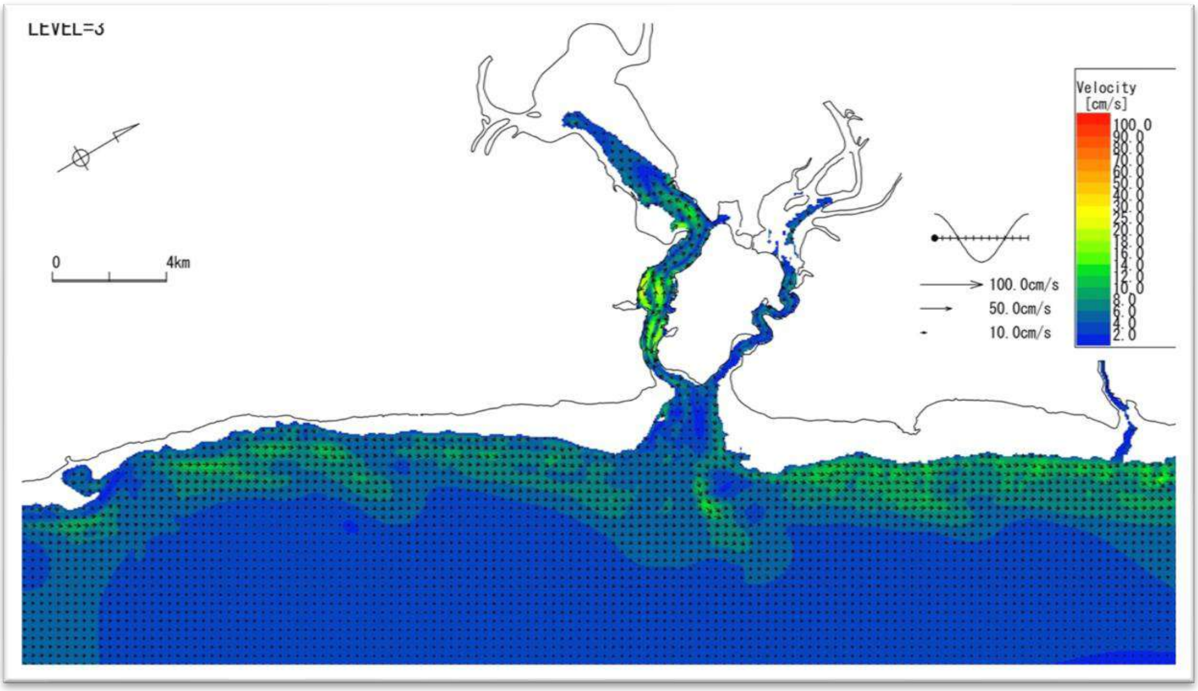


FIGURE 49 - CURRENT FIELD (SE / HIGH TIDE / BOTTOM LAYER)

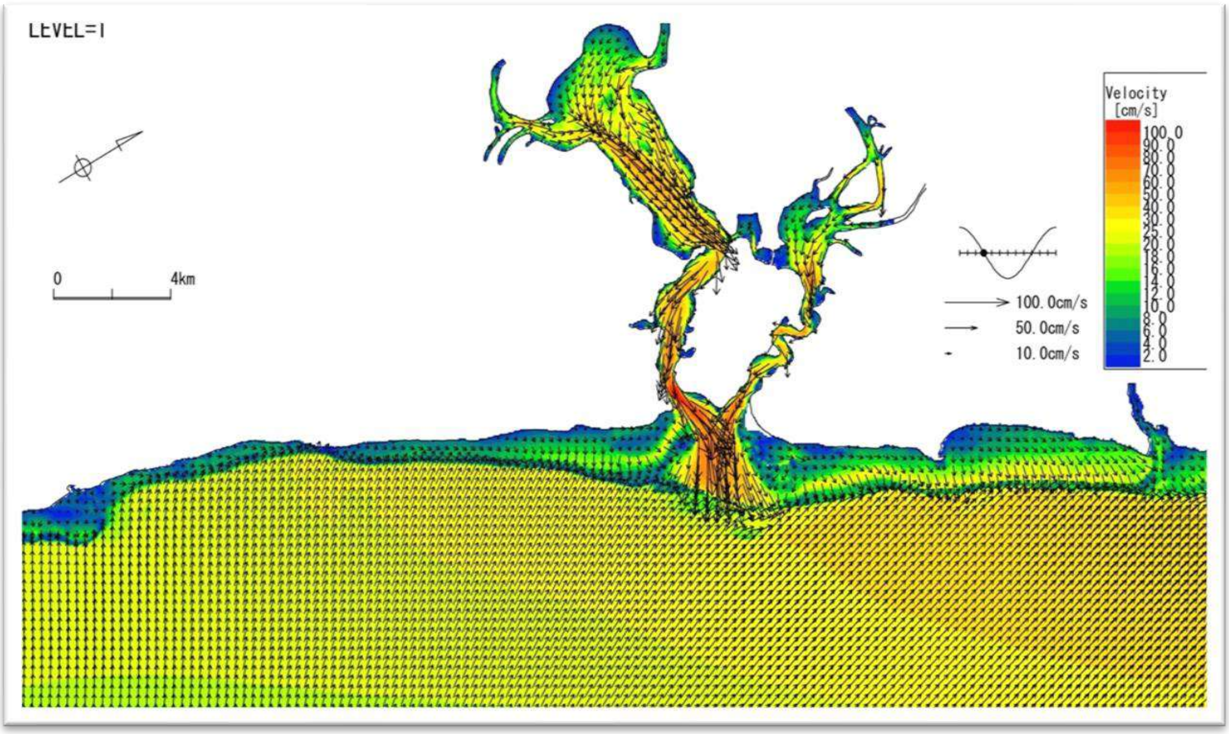


FIGURE 50 - CURRENT FIELD (SE / EBB TIDE / SURFACE LAYER)

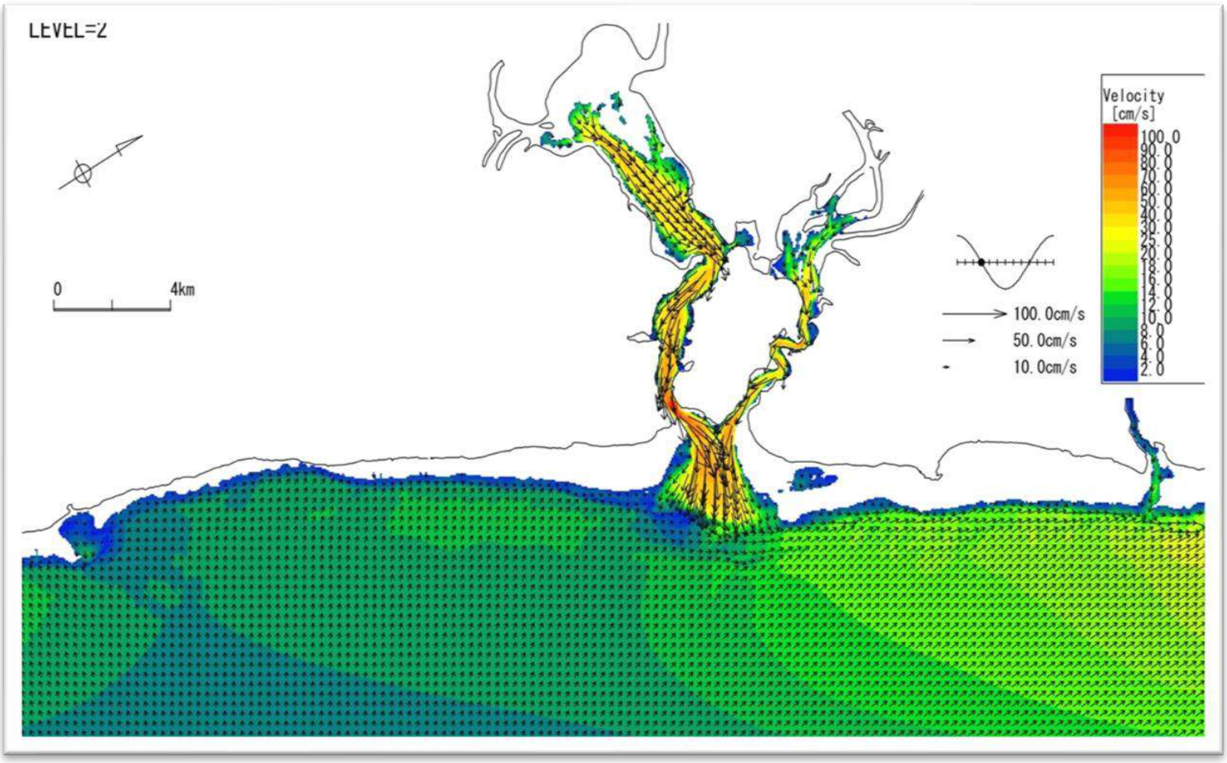


FIGURE 51 - CURRENT FIELD (SE / EBB TIDE / MIDDLE LAYER)

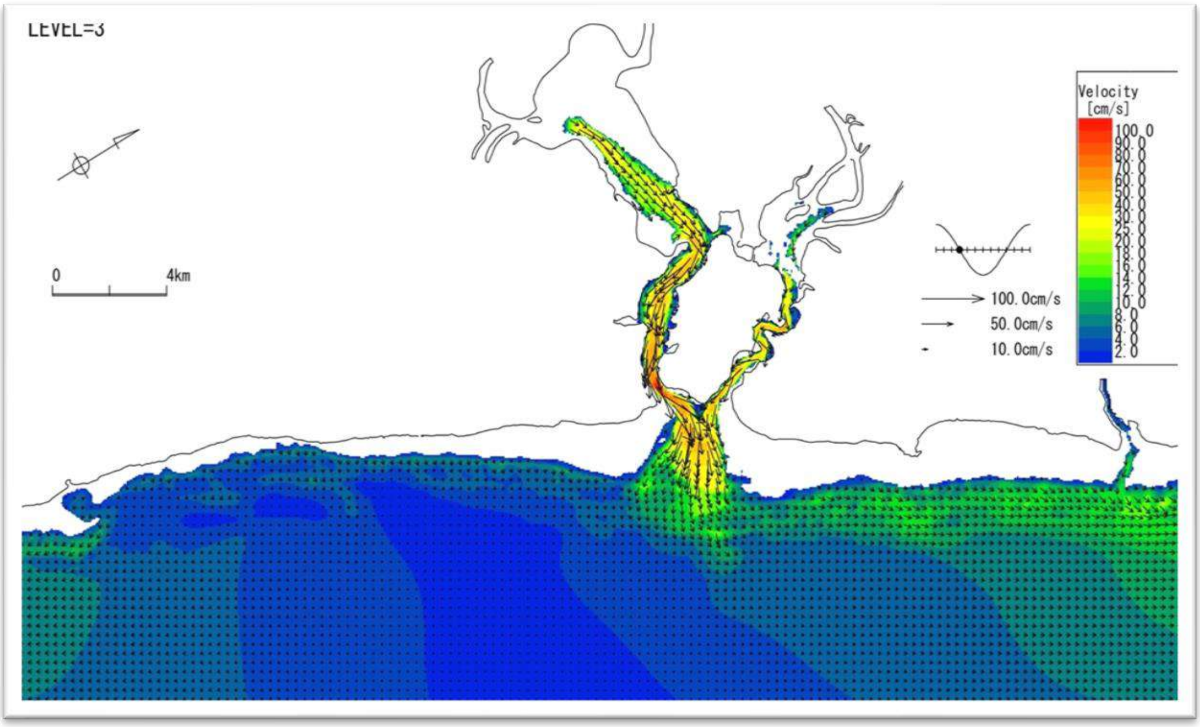


FIGURE 52 - CURRENT FIELD (SE / EBB TIDE / BOTTOM LAYER)

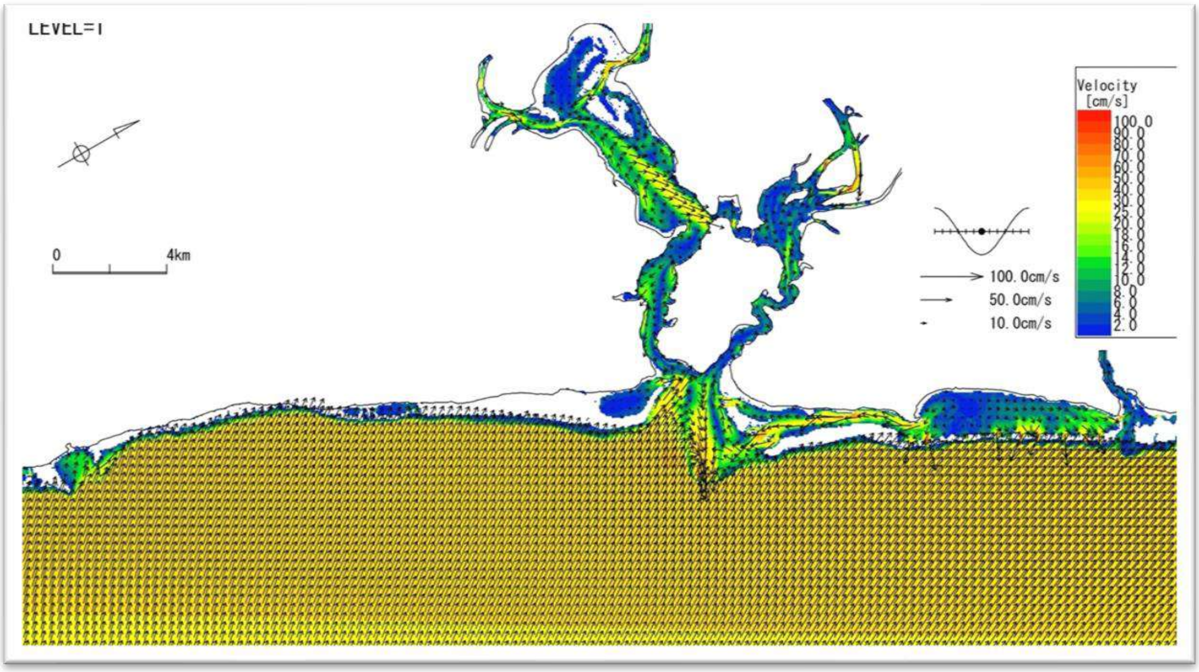


FIGURE 53: CURRENT FIELD (SE / LOW TIDE / SURFACE LAYER)

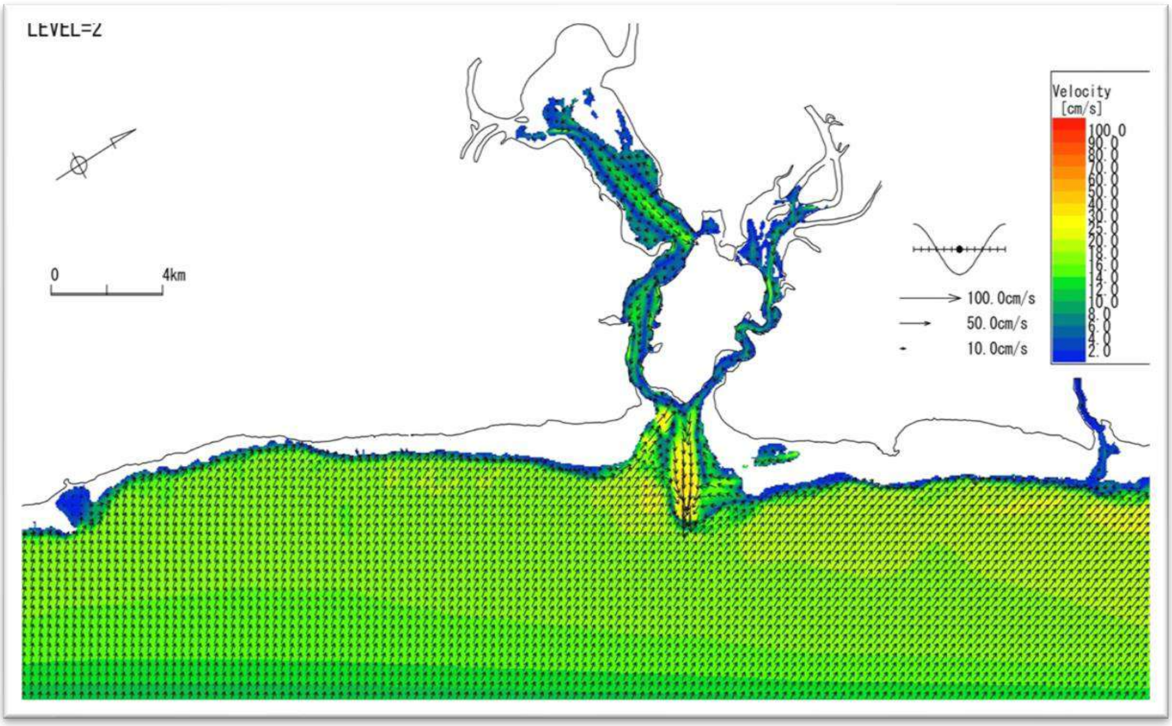


FIGURE 54 - CURRENT FIELD (SE / LOW TIDE / MIDDLE LAYER)

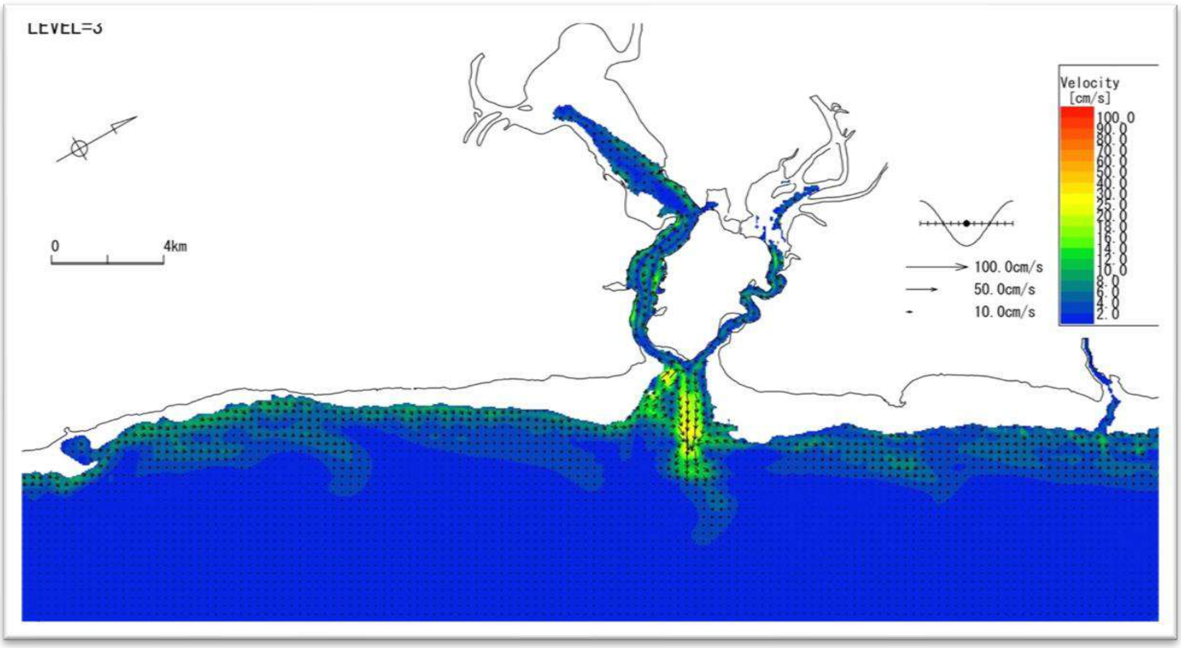


FIGURE 55 - CURRENT FIELD (SE / LOW TIDE / BOTTOM LAYER)

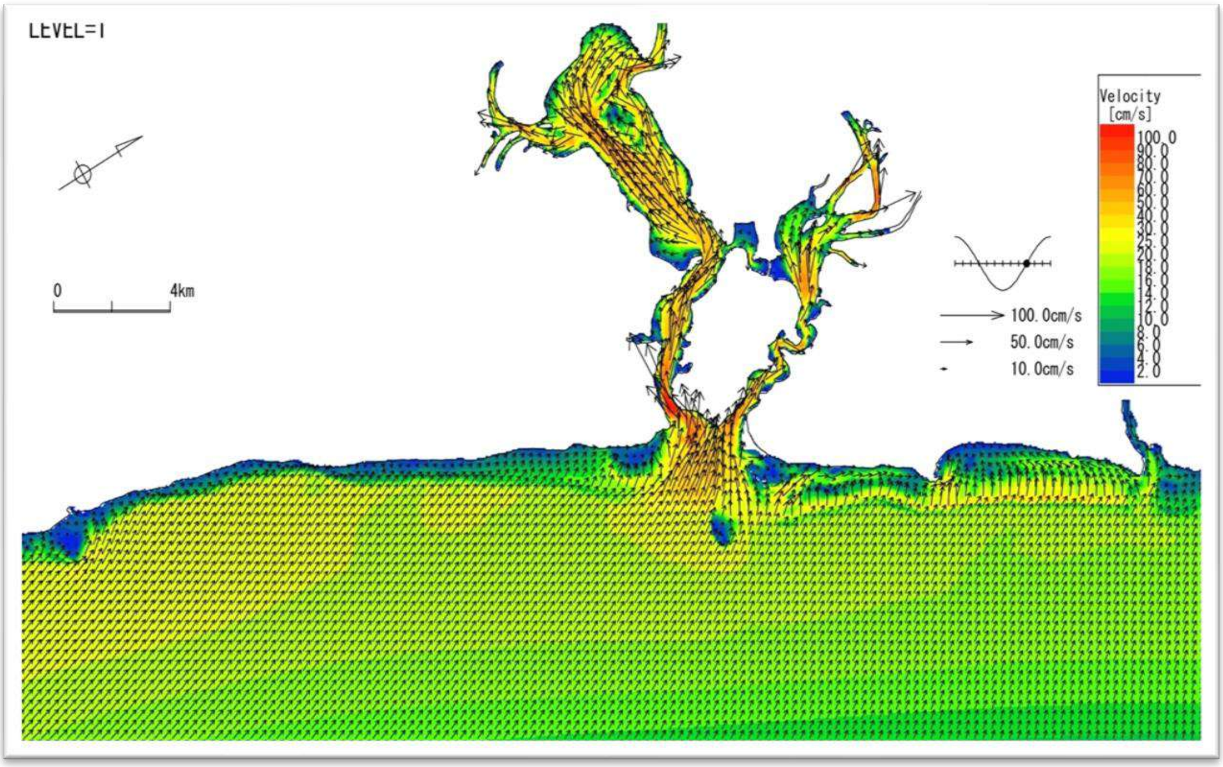


FIGURE 56 - CURRENT FIELD (SE / FLOOD TIDE / SURFACE LAYER)

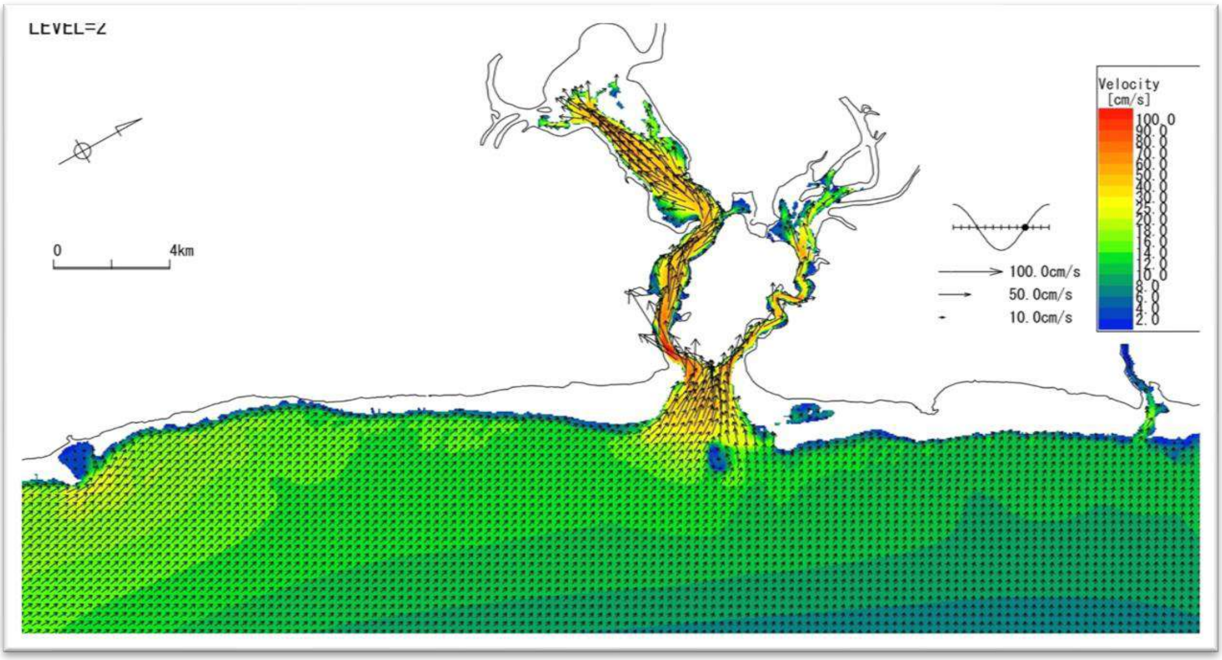


FIGURE 57 - CURRENT FIELD (SE / FLOOD TIDE / MIDDLE LAYER)

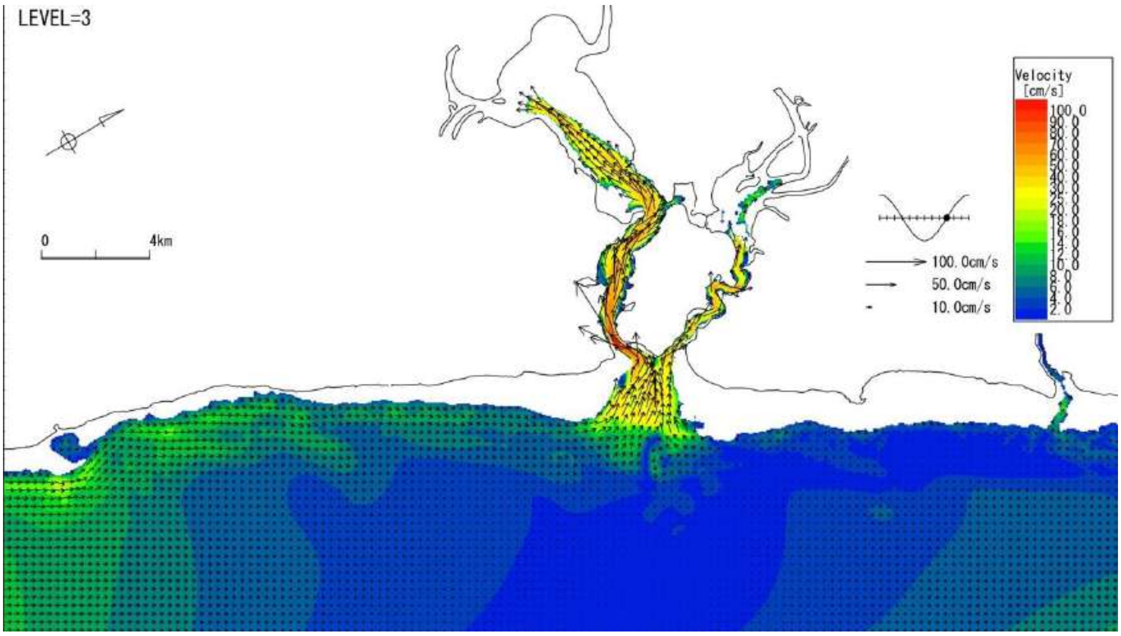


FIGURE 58 - CURRENT FIELD (SE / FLOOD TIDE / BOTTOM LAYER)

5.4.2 Turbidity Simulation

Flow Diagram of the simulation is shown in **Figure 59**. As shown, the simulation consists of two (2) parts, current field reproduction and turbidity dispersion calculation.

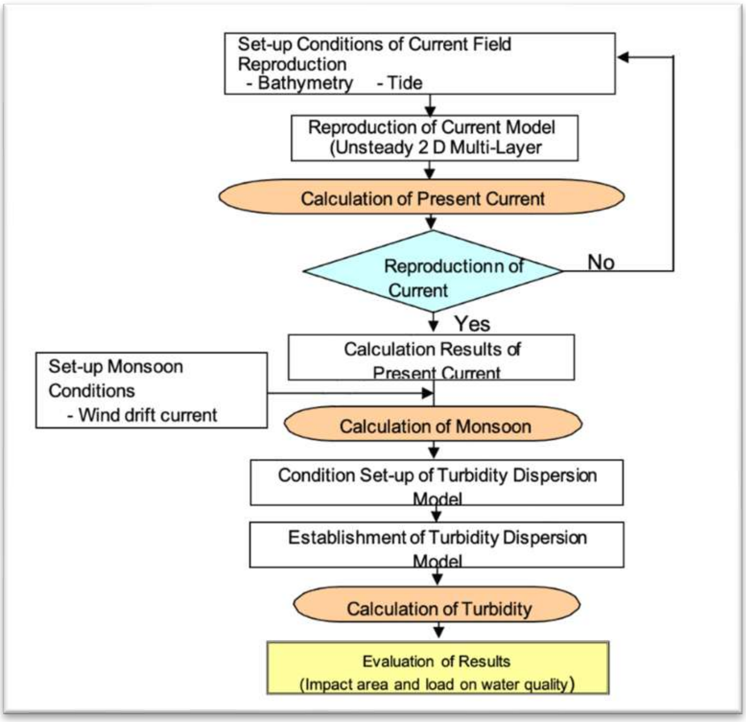


FIGURE 59 - FLOW SIMULATION

Once the present current field had been numerically well re-produced, the calculation of turbidity dispersion, as a suspended solid dispersion is initiated in the reproduced current field, considering the monsoon conditions. Sections below describe the current field re-production and the turbidity dispersion calculation, respectively.

(1) Current Field Re-production

1) Numerical Model

A dynamic equation of Navier Stokes and two (2) dimensional multi-layer model are applied for this simulation. This model, which is based on the Fick's dispersion equation, simulates trans-flow of water temperature and salinity simultaneously. Image of the simulation model and equations are shown in **Figure 60**, and **Figure 61**)

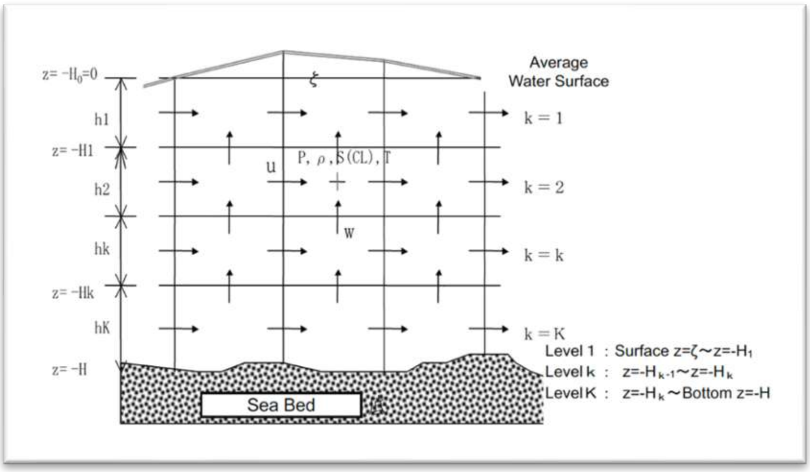


FIGURE 60 - IMAGE OF BASIC SIMULATION MODEL

$$W_K = 0$$

$$W_{k-1} = W_k - \frac{\partial M_k}{\partial x} - \frac{\partial N_k}{\partial y} \quad (k = 2,3,4 \cdots\cdots\cdots K)$$

$$\frac{\partial \zeta}{\partial t} = W_1 - \frac{\partial M_1}{\partial x} - \frac{\partial N_1}{\partial y} \ or \ \frac{\partial \zeta}{\partial t} = -\frac{\partial}{\partial x}\left(\sum_k M_k\right) - \frac{\partial}{\partial y}\left(\sum_k N_k\right)$$

[a]

$$\frac{\partial M_k}{\partial t} = -\frac{\partial M_k U_k}{\partial x} - \frac{\partial M_k V_k}{\partial y} - (UW)\big|_{z=-Hk-1} + (UW)\big|_{z=-Hk}$$

$$+\frac{h_k}{\rho_k}\left\{\left[\tilde{P}_x\right]_k - \frac{1}{2} g h_k \frac{\partial \rho_k}{\partial x}\right\}$$

$$+\frac{\partial}{\partial x}\left(\nu_x \frac{\partial M_k}{\partial x}\right) + \frac{\partial}{\partial y}\left(\nu_y \frac{\partial M_k}{\partial y}\right) + \frac{1}{\rho}\tau_x^{k-1,k} - \frac{1}{\rho}\tau_x^{k,k+1}$$

$$\frac{\partial N_k}{\partial t} = -\frac{\partial N_k U_k}{\partial x} - \frac{\partial N_k V_k}{\partial y} - (VW)\big|_{z=-Hk-1} + (VW)\big|_{z=-Hk}$$

$$+\frac{h_k}{\rho_k}\left\{\left[\tilde{P}_y\right]_k - \frac{1}{2} g h_k \frac{\partial \rho_k}{\partial y}\right\}$$

$$+\frac{\partial}{\partial x}\left(\nu_x \frac{\partial N_k}{\partial x}\right) + \frac{\partial}{\partial y}\left(\nu_y \frac{\partial N_k}{\partial y}\right) + \frac{1}{\rho}\tau_y^{k-1,k} - \frac{1}{\rho}\tau_y^{k,k+1}$$

[b]

FIGURE 61 - A) BASIC EQUATION AND B) DYNAMIC EQUATION

2) Conditions

Several conditions set for the current field re-production are shown in **Table 30**.

TABLE 30 - CONDITIONS OF CURRENT FIELD RE-PRODUCTION

Item	Conditions	Remarks
Area	East-West: Approx. 20km South-North: Approx. 16km	**See Figure 62a**
Bathymetry	Sand source survey result	
Grid	50m	

Vertical Layers	3 layers Surface： Surface～3.0mMiddle： 3.0～6.0m Bottom：6.0 m～Seabed	
Horizontal Viscosity Coefficient	$1.0 \times 10^2 cm^2/s$	**Japanese guidelines**
Internal Friction Coefficient	0.0013	**Ditto**
Roughness Coefficient	0.025	**Ditto**
Tidal Constituent	M2+S2	**Observed mean spring tide**
Tidal Boundary Conditions	Amplitude (cm) Phase (degree） A： 167.0 -0.2 B： 167.0 -0.2 C： 167.0 0.2 D： 167.0 0.2	See **Figure 62**b
Wind-drift Current	NE monsoon：4.0m/s SE monsoon：6.2m/s	(ENVIRONMENTAL IMPACT ASSESSMENT REPORT OF THE PROPOSED CONTAINER TERMINAL MODERNIZATION PROJECT FOR KENYA PORTS AUTHORITY MAY 2007) P.64
River Discharge	NE SE Mukurumuji River：$0.15m^3/s$ $1.38m^3/s$Shimba River ：$0.33m^3/s$ $1.94m^3/s$	(ENVIRONMENTAL IMPACT ASSESSMENT REPORT OF THE PROPOSED CONTAINERTERMINAL MODERNIZATION PROJECT FOR KENYA PORTS AUTHORITY MAY 2007) P.74
Time Step	1.0（s）	CFL: $DT \leq DX / \sqrt{2 \cdot g \cdot H_{max}}$
Period	**48hours（4 tide period）**	**Reach constant state**

The area under simulation is represented by the map below (**Figure 62**). The East-west boundary extends to ~20km while the north-south boundary extends up to ~16km.

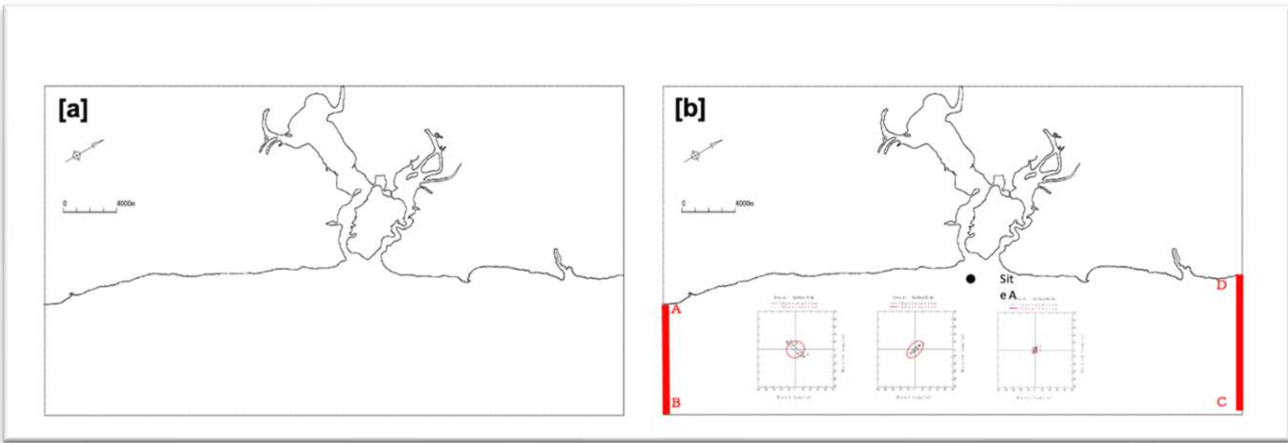


FIGURE 62- A) AREA OF CURRENT FIELD REPRODUCTION AND B) TIDAL BOUNDARY OF CURRENT FIELD REPRODUCTION

(2) Turbidity Dispersion Calculation

1) Conditions

Several conditions set for the turbidity dispersion calculation are shown in **Table 31.**

TABLE 31 - CONDITIONS OF TURBIDITY DISPERSION CALCULATION

Item	Conditions	Remarks
Area	East-West: Approx. 20km South-North: Approx. 16km	**Same as current field re-production**
Bathymetry	Sand source survey result	**Ditto**
Grid	50m	**Ditto**
Vertical Layers	3 layers Surface : Surface～3.0m Middle : 3.0～6.0m Bottom : 6.0 m～Seabed	**Ditto**
Horizontal Dispersion Coefficient	$0.1 \times 10^2 cm^2/s$	**Japanese guidelines**
Vertical Viscosity Coefficient	0.1	**Ditto**
Tidal Constituent	M_2+S_2	**Same as current field re-production**
Overflow Duration	10 minutes overflow x 5 times inevery 680 minutes (1 cycle)	**See Table 32**
Overflow Load	Overflow Point-A: 674 ton/cycle Overflow Point-B: 1,422 ton/cycle Overflow Point-C: 2,259 ton/cycle	**See Table 33**
Period	**10 days（20 tide period）**	**10 days after reaching constant state**

2) Overflow Point

Turbidity dispersion is calculated at three (3) TSH designated points five (5) km offshore frompossible dredging points as shown in **Figure 63**.

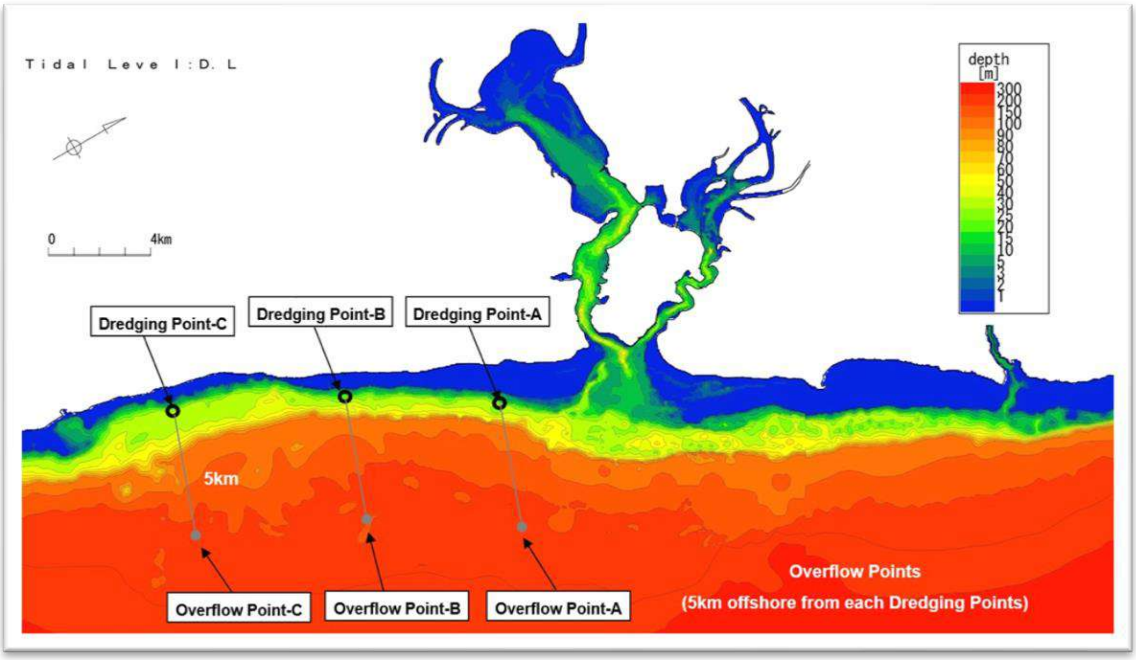


FIGURE 63 - LOCATION OF OVERFLOW POINTS

3) Overflow Duration

Overflow operation of TSHD is scheduled as shown in **Table 32** according to the actual operationrecorded in Phase 2 of the Project. As shown, TSHD perform dredging and overflow operations for 350 minutes in every 680 minutes(1 cycle) including averaged duration for the sailing between reclamation site of the Phase 3 and the dredging points.

TABLE 32 - OPERATION SCHEDULE OF TSHD

Operation	Duration (minutes)
TSHD arrive at Dredging Points from Reclamation Site	
Dredging	25
Sailing to Overflow Point	15
1st Overflow Operation	**10**
Sailing to Dredging Point	15
Dredging	25
Sailing to Overflow Point	15
2nd Overflow Operation	**10**
Sailing to Dredging Point	15
Dredging	25
Sailing to Overflow Point	15
3rd Overflow Operation	**10**

Sailing to Dredging Point	15
Dredging	25
Sailing to Overflow Point	15
4th Overflow Operation	**10**
Sailing to Dredging Point	15
Dredging	25
Sailing to Overflow Point	15
5th Overflow Operation	**10**
Sailing to Dredging Point	15
Dredging	25
TSHD leave Dredging Points for Reclamation Site	
Total	350

4) Overflow Load

Overflow load, weight of the fine particle (<74μ) to be discharged by overflow operation of the TSHD in everyone (1) cycle, is calculated as shown in **Table 33**. The calculated overflow load at each point is different due to the different ratio of the fine particle content in the seabed materials reported in the Sand Source Survey. It should be noted that the calculated overflow load at each point is discharged into the sea (middle layer of simulation model) from the bottom of the TSHD being divided equally into five times, as shown in **Table 32**.

TABLE 33: LOAD OF OVERFLOW

Item	Overflow Point-A	Overflow Point-B	Overflow Point-C
Fine particle content in dredged material (%) [1)]	5	10	15
Unit weigh of dredged material (t/m3) [1)]	1.6	1.6	1.6
Dredging volume of TSHD (m3/cycle) [2)]	8,000/0.95=8,421	8,000/0.9=8,889	8,000/0.85=9,412
Overflow Load (ton/cycle)	8,421x0.05x1.6=674	8,889x0.1x1.6=1,422	9,412x0.15x1.6=2,259

[1)] Results of Sand Source Survey

[2)] THSD dredges volume including 8,000m3 to be transported for reclamation and volume to be discharged as overflow

5) Calculated Turbidity Dispersion

The dispersion of turbid water discharged due to the TSHD overflow operation is calculated and visualized in the Figures below, as a concentration distribution of suspend solid in the three (3) layers. Consulting with the relevant Kenyan EIA Experts, judgement on the existence of the environmental impact due to the TSHD overflow operation is made based on the conditions below. As a result of Simulation, it is concluded that:

- Since the turbid overflow is discharged from bottom of the TSHD, the SS concentration in thesurface and middle layers, as depicted in the Figures, tends to be higher than that in the bottom layer. This might imply that the high SS concentration in the surface and middle layer would not reach the -30m depth contour line (area of coral life on the seabed) in some cases. However, in consideration of the extent of uncertainty in numerical simulations and the controversial potential scenic degradation in and around existing tourism water areas along the coastline, it is judged that the increase of 2 mg/L in SS concentration from baseline across all layers shall not reach the -30m contour line.
- In the NE monsoon conditions, as the most critical case, the area of 2mg/L increase in the middle layer at Point-C (**Figure 71**) reaches 1.5km distance from the -30m contour line.
- In the SE monsoon conditions, the areas of 2mg/L increase in the middle layer at all points reach 0.5km distance from the -30m contour line.
- In conclusion, to avoid potential negative impacts on the coral life and water quality, the overflow operation of the TSHD must be conducted at **more than 5 km from the dredging points throughout the year, cannot be less than 4.5km**.

Note: *The area where the suspended solid (SS) concentration in the water column, surface, middle and bottom layers, increased by 2mg/L due to the TSHD overflow operation reaches a depth of -30m contour line, which is considered as an outer fringe of the coral growth area.*

a. NE monsoon

The following **Figure 64** to **Figure 72** shows the simulated suspended sediment dynamics during the northeast monsoon (NEM) in the three layers (surface, middle and bottom) and during high and low tides.

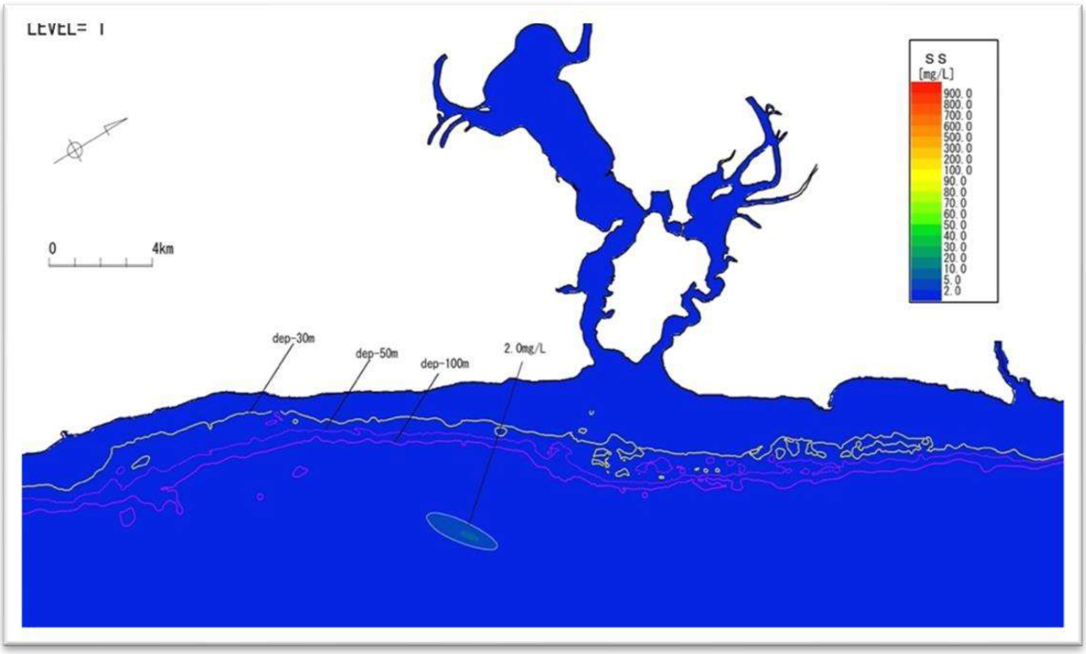


FIGURE 64 - TURBID WATER DISPERSION AT OVERFLOW POINT-A (NE/SURFACE LAYER)

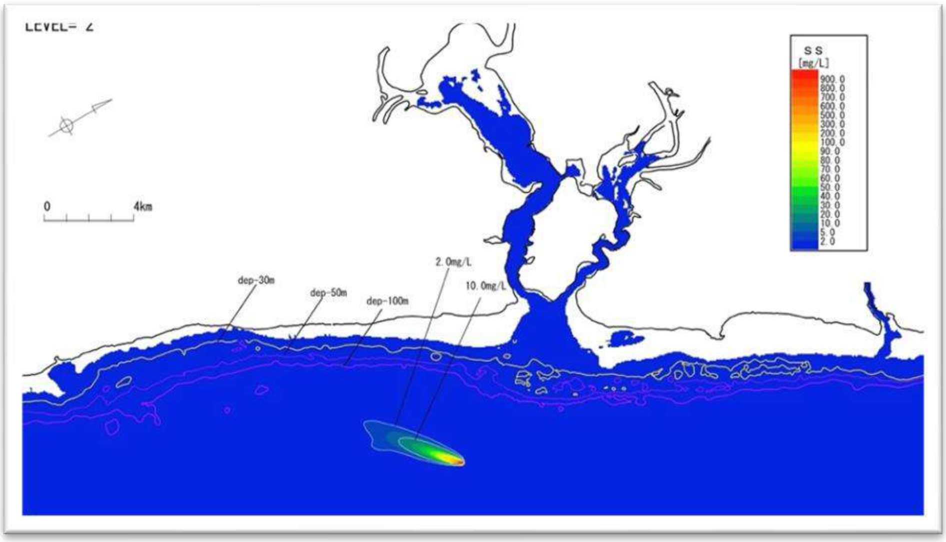


FIGURE 65 - TURBID WATER DISPERSION AT OVERFLOW POINT-A (NE/MIDDLE LAYER)

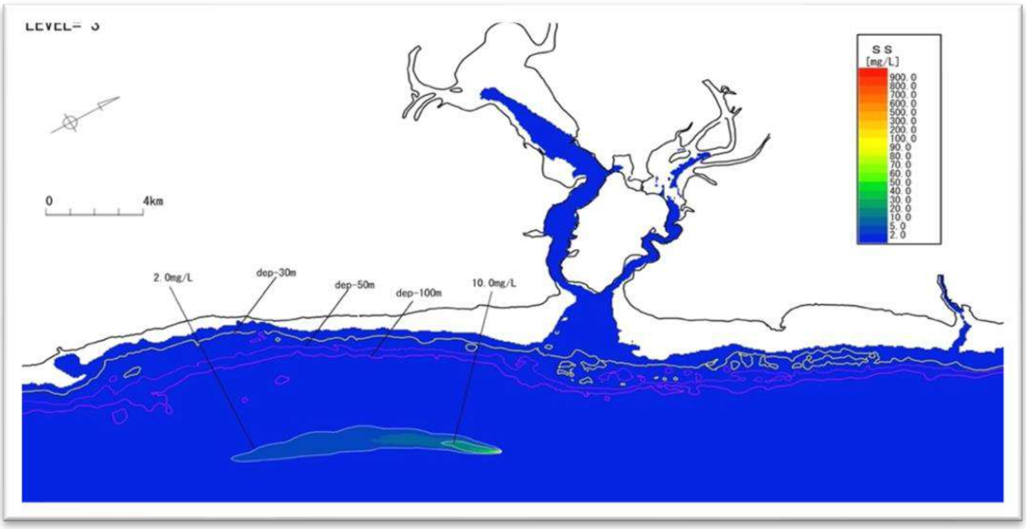


FIGURE 66 - TURBID WATER DISPERSION AT OVERFLOW POINT-A (NE/BOTTOM LAYER)

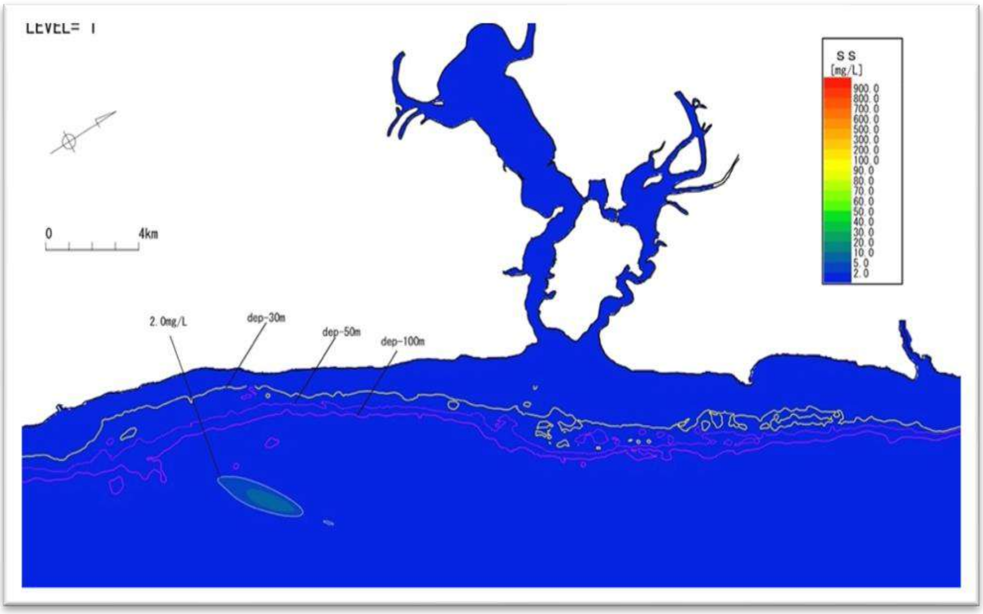


FIGURE 67 - TURBID WATER DISPERSION AT OVERFLOW POINT-B (NE/SURFACE LAYER)

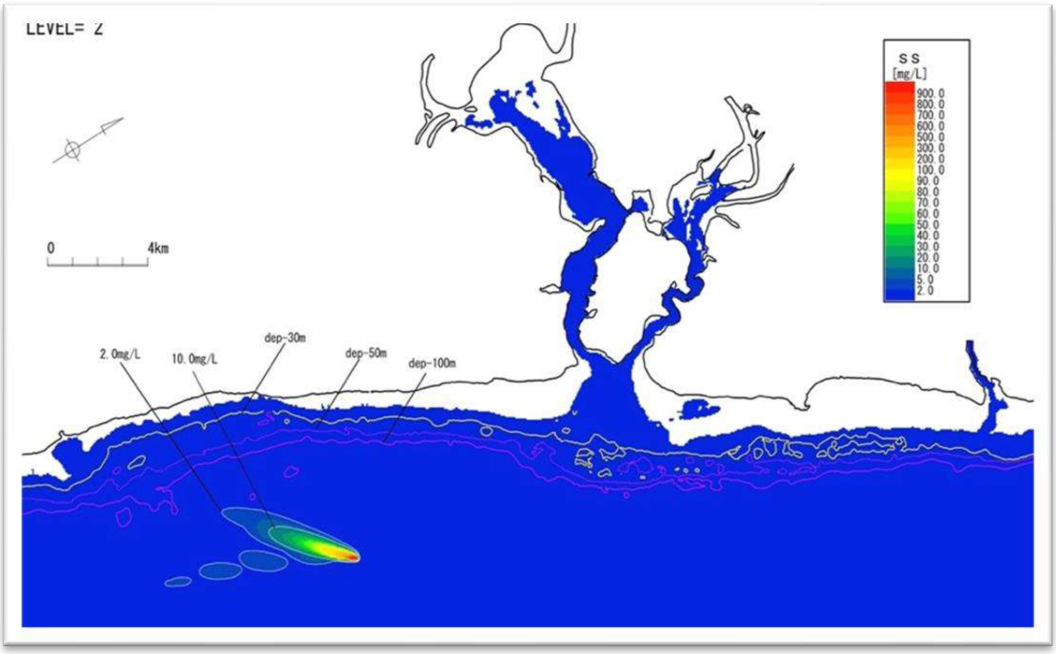


FIGURE 68: TURBID WATER DISPERSION AT OVERFLOW POINT-B (NE/MIDDLE LAYER)

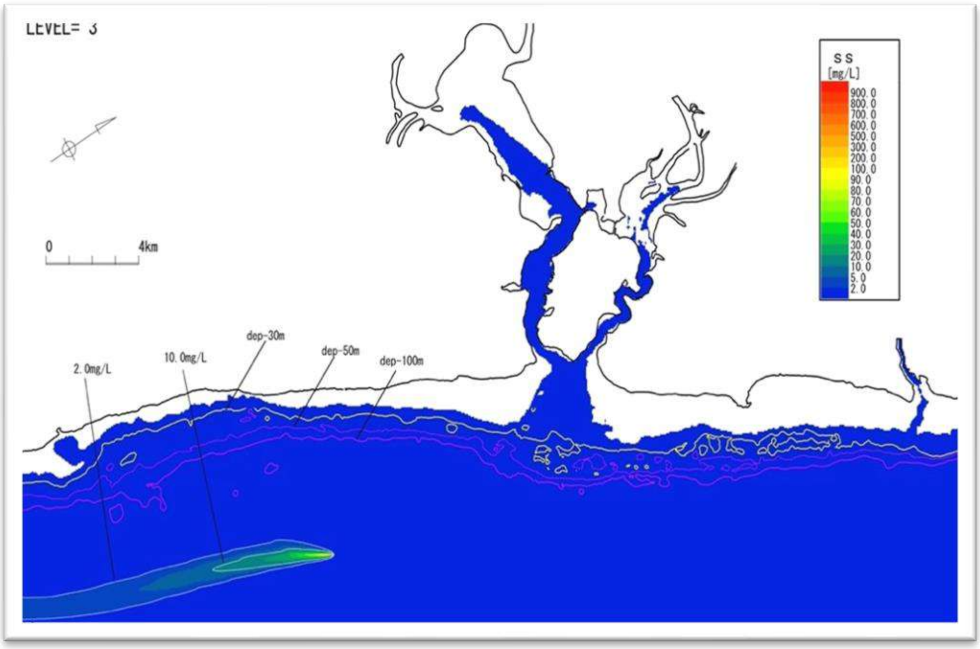


FIGURE 69 - TURBID WATER DISPERSION AT OVERFLOW POINT-B (NE/BOTTOM LAYER)

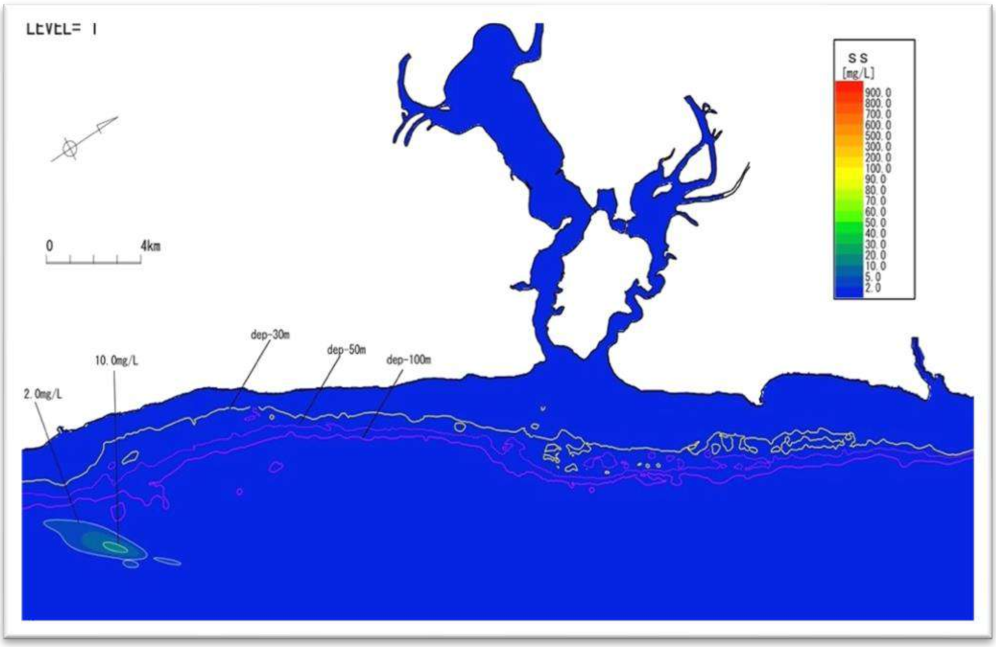


FIGURE 70 - TURBID WATER DISPERSION AT OVERFLOW POINT-C (NE/SURFACE LAYER)

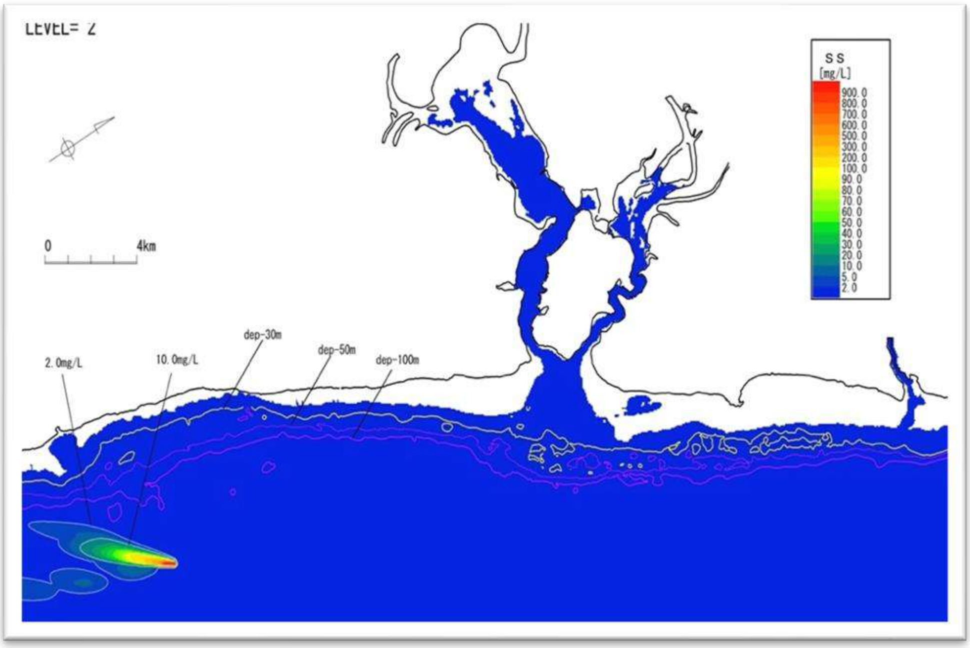


FIGURE 71 - TURBID WATER DISPERSION AT OVERFLOW POINT-C (NE/MIDDLE LAYER)

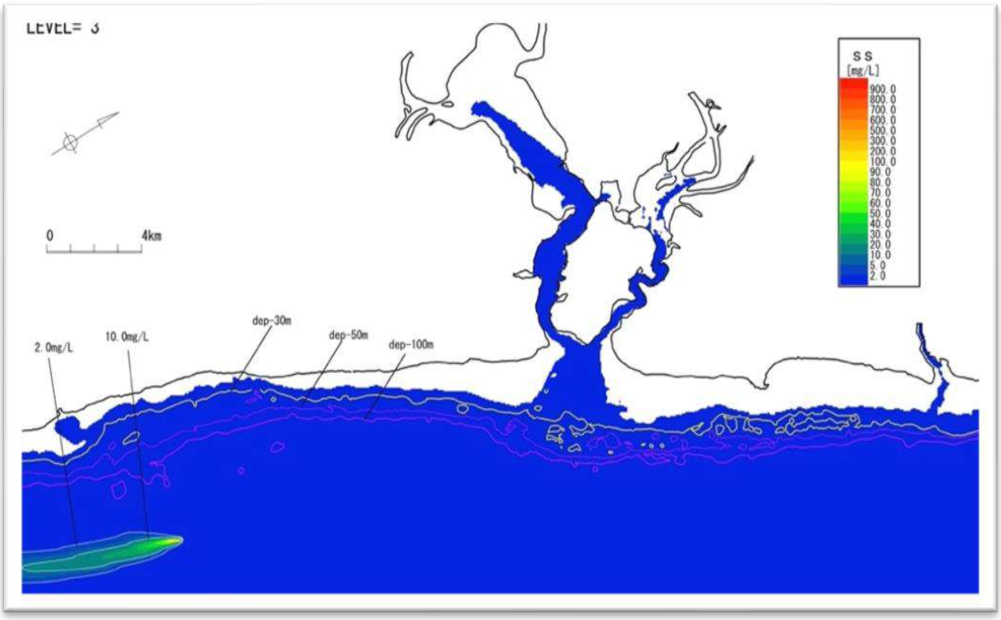


FIGURE 72 - TURBID WATER DISPERSION AT OVERFLOW POINT-C (NE/BOTTOM LAYER)

b. Southeast monsoon (SEM)

The following **Figure 73 – Figure 81** shows the simulated suspended sediment dynamics during the southeast monsoon (SEM) in the three layers (surface, middle and bottom) and during high and low tides.

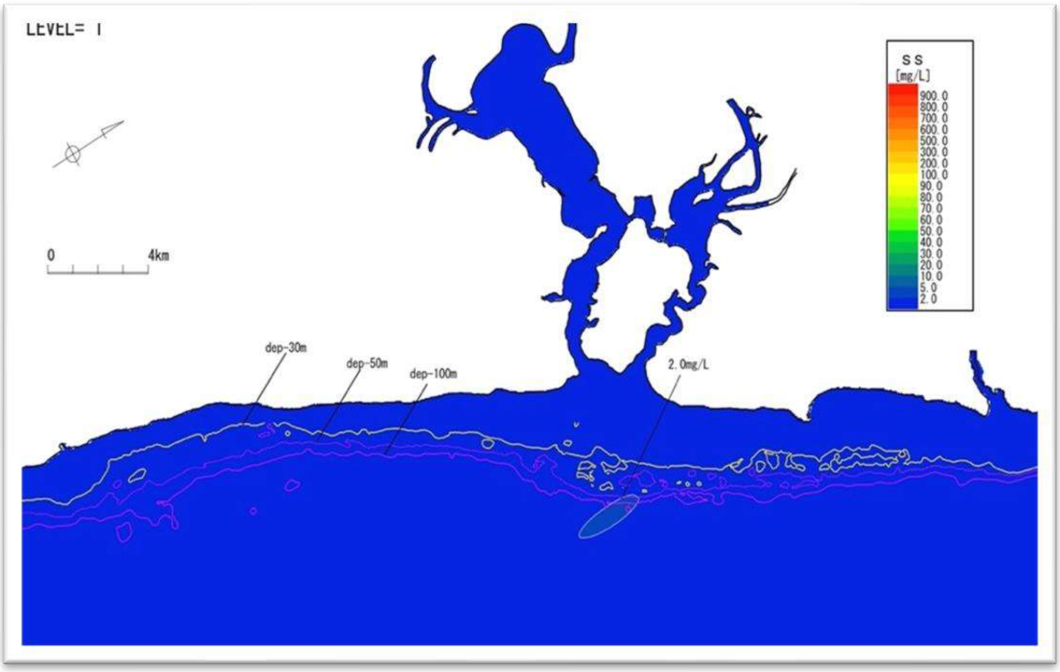


FIGURE 73 - TURBID WATER DISPERSION AT OVERFLOW POINT-A (SE/SURFACE LAYER)

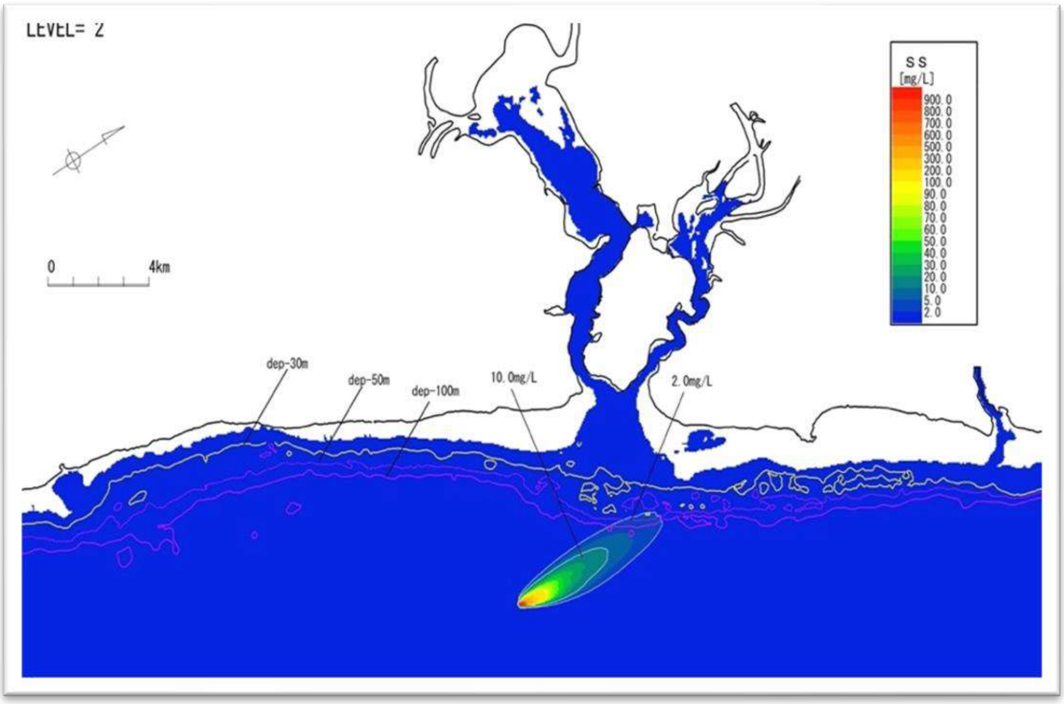


FIGURE 74 - TURBID WATER DISPERSION AT OVERFLOW POINT-A (SE/MIDDLE LAYER)

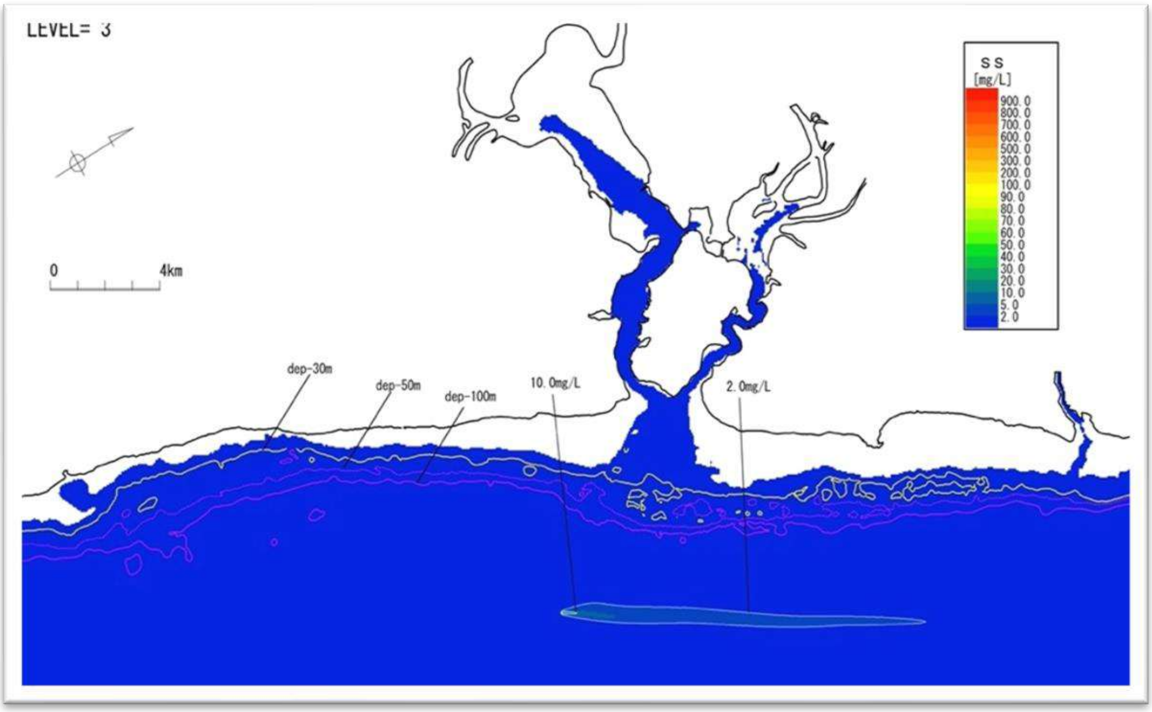


FIGURE 75 - TURBID WATER DISPERSION AT OVERFLOW POINT-A (SE/BOTTOM LAYER)

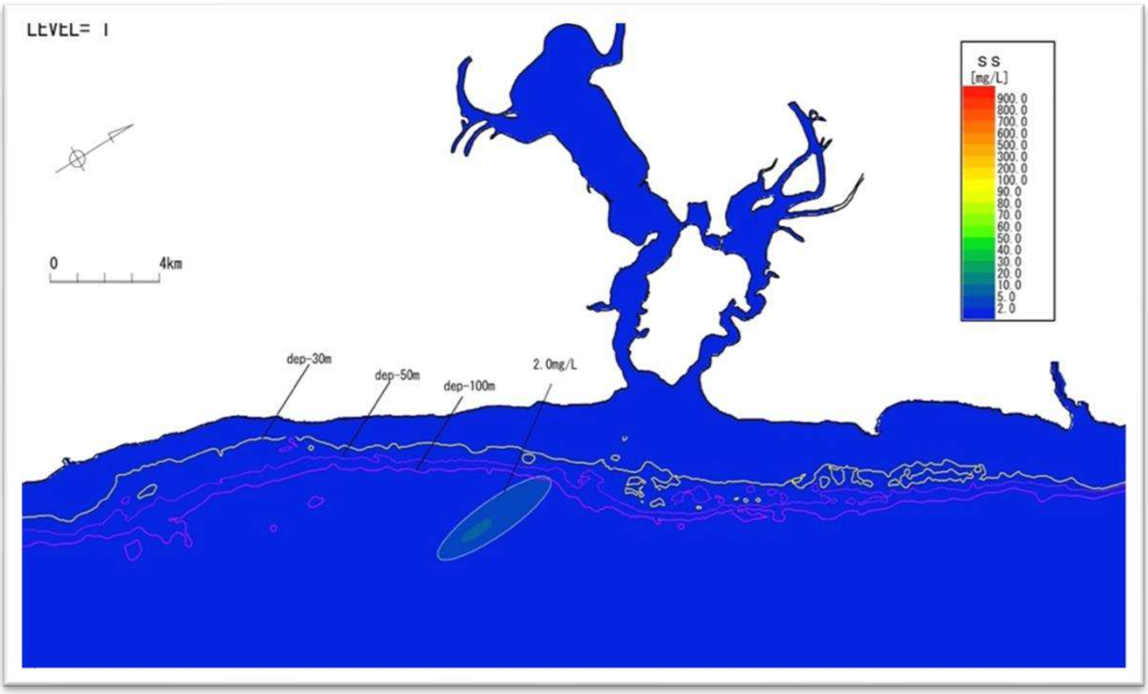


FIGURE 76 - TURBID WATER DISPERSION AT OVERFLOW POINT-B (SE/SURFACE LAYER)

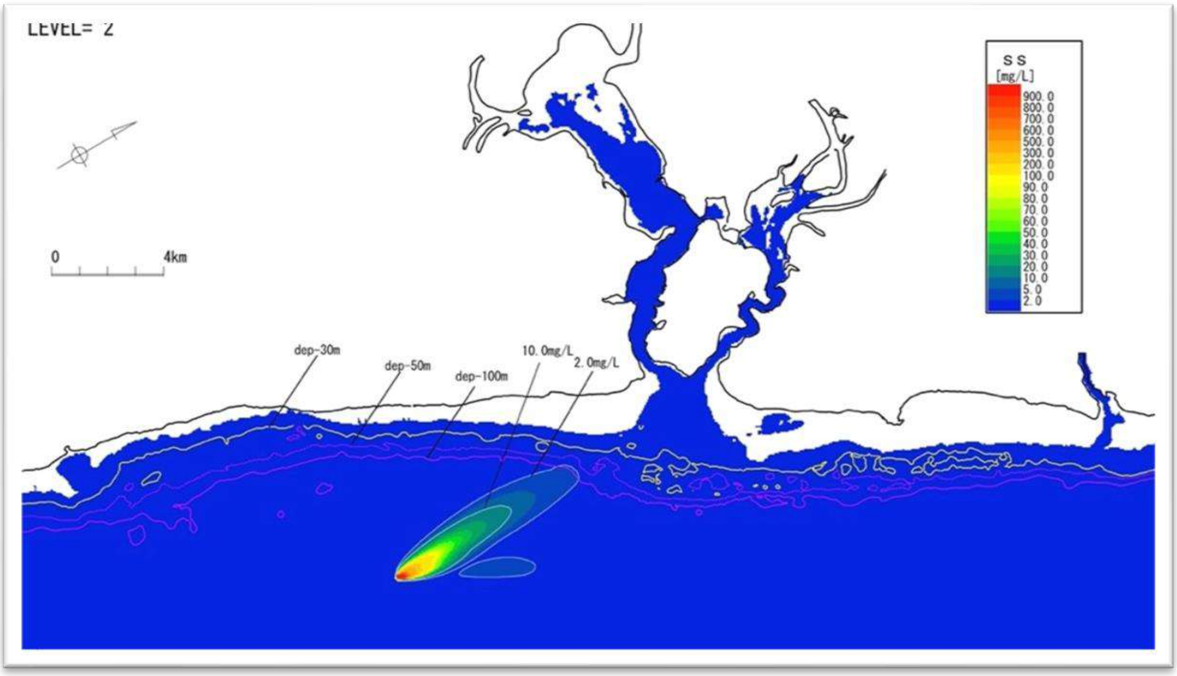


FIGURE 77 - TURBID WATER DISPERSION AT OVERFLOW POINT-B (SE/MIDDLE LAYER)

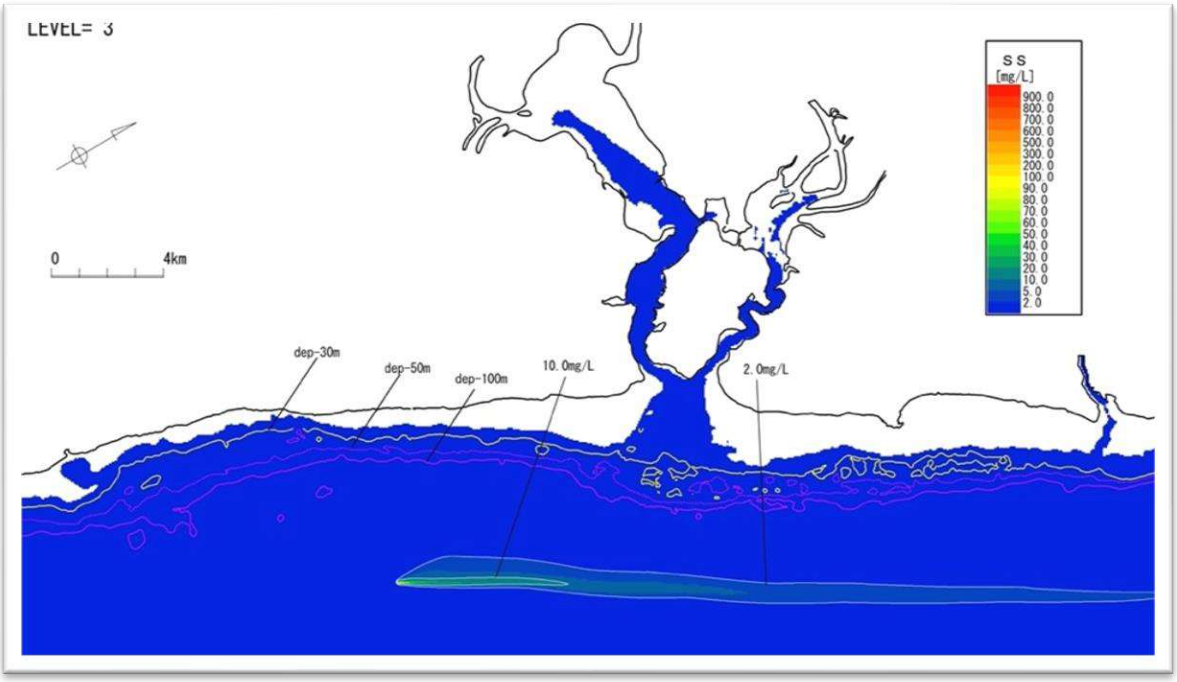


FIGURE 78 - TURBID WATER DISPERSION AT OVERFLOW POINT-B (SE/BOTTOM LAYER)

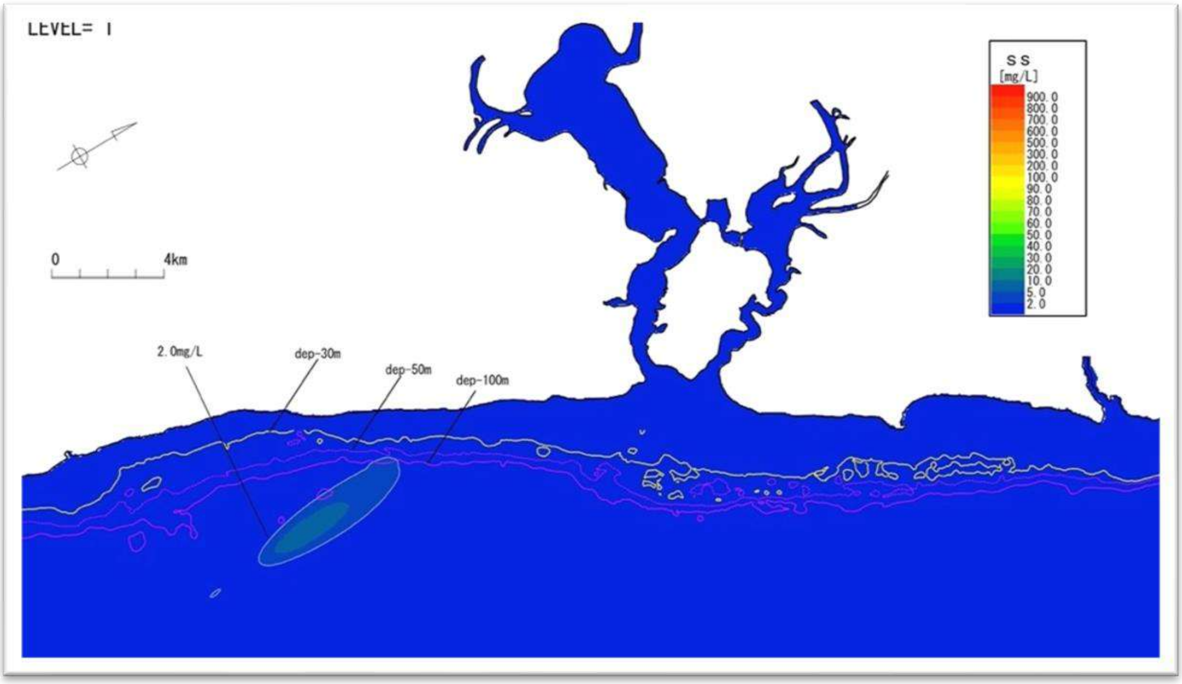


FIGURE 79 - TURBID WATER DISPERSION AT OVERFLOW POINT-C (SE/SURFACE LAYER)

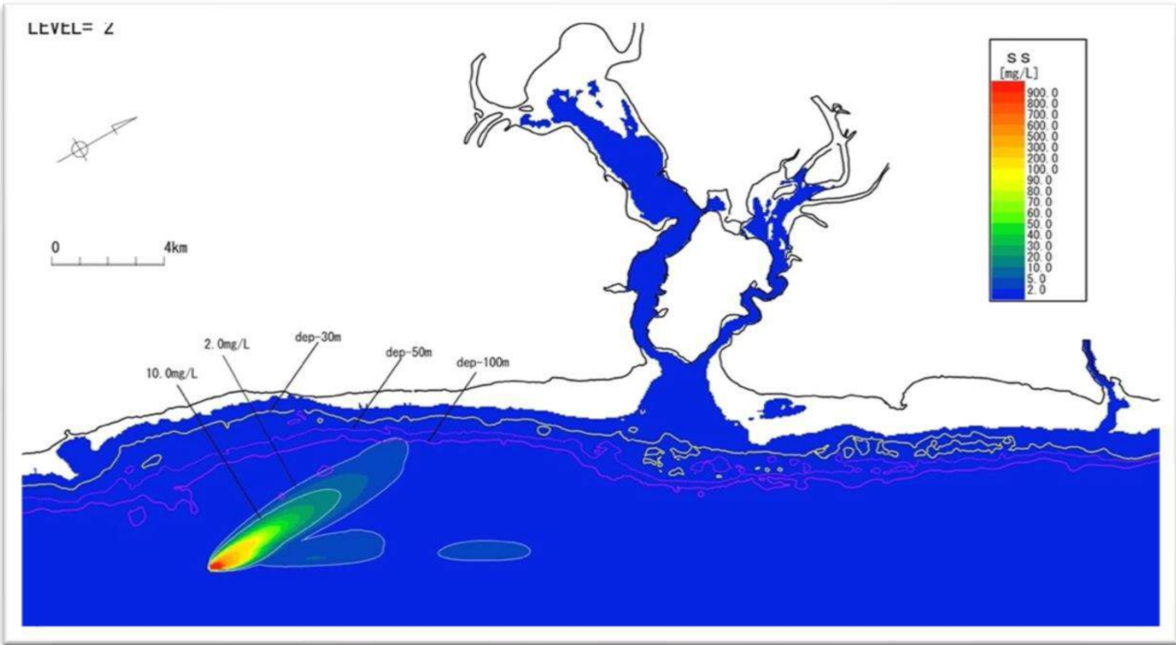


FIGURE 80 - TURBID WATER DISPERSION AT OVERFLOW POINT-C (SE/MIDDLE LAYER)

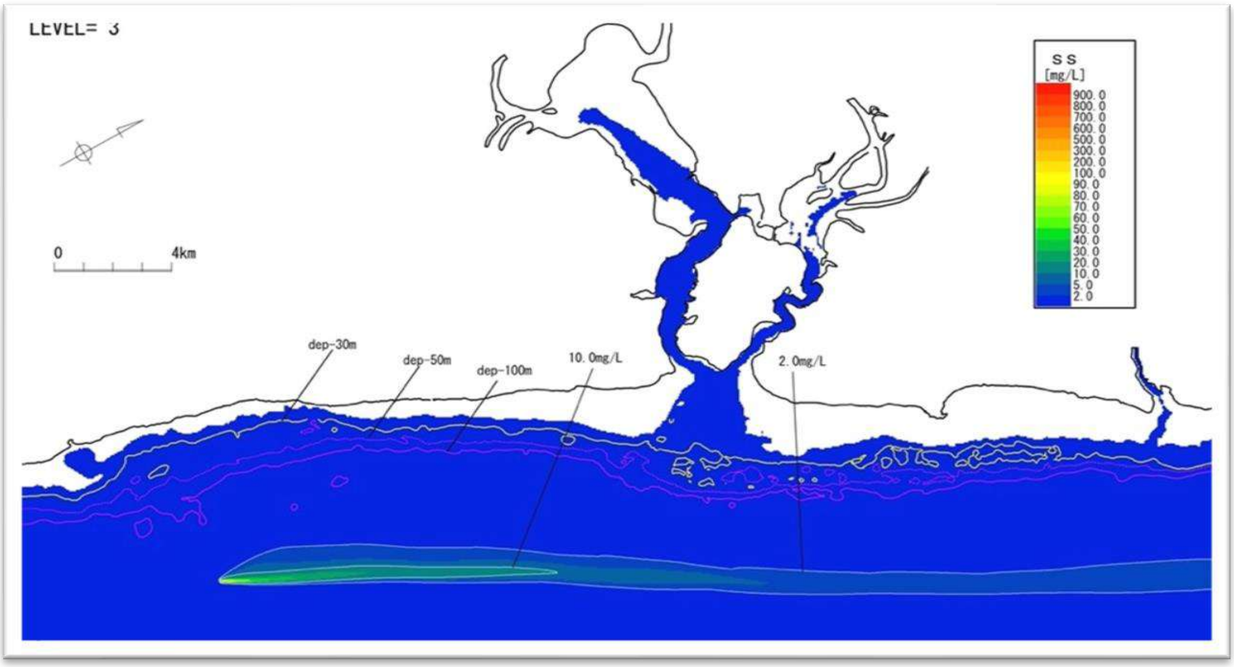


FIGURE 81 - TURBID WATER DISPERSION AT OVERFLOW POINT-C (SE/BOTTOM LAYER)

5.4.3 Other MetOcean Characteristics

(1) Regional and Seasonal Large-Scale Offshore Currents

The coastal current system off the shore of Kenya exhibits a regular cycle driven by the Southeast Monsoon (SEM) and Northeast Monsoon (NEM). It is marked by the Somali Current (SC), which changes direction seasonally, and the northward-flowing East African Coastal Current (EACC) (**Figure 82**). These currents are primarily influenced by the interplay between the South Equatorial Current (SEC) and the African coastline. The EACC originates from the northward diversion of the SEC upon reaching the African mainland in southern Tanzania and northern Mozambique.

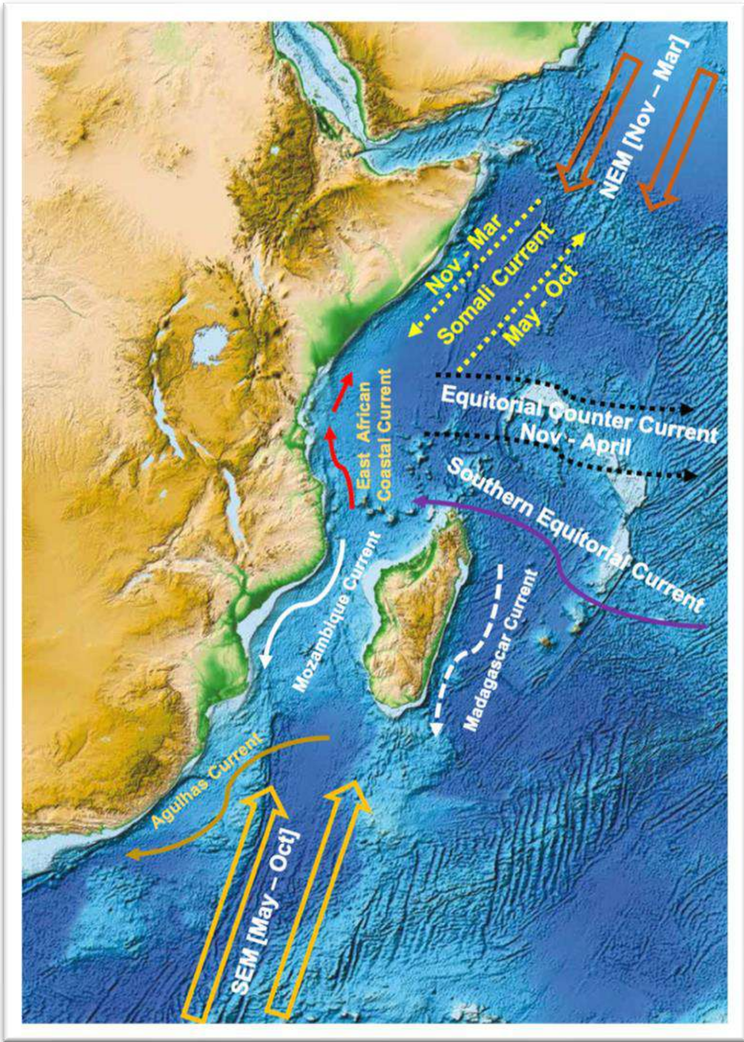


FIGURE 82 - A SCHEMATIC DIAGRAM OF THE OCEAN CIRCULATION DURING THE NORTH-EAST MONSOON (NEM) AND THE SOUTH-EAST MONSOON.

The EACC flows northward throughout the year, gaining velocity during the SEM due to intensified winds, reaching speeds of 0.5-0.75 m/s. Conversely, during the NEM, when the monsoon winds oppose the current, it decelerates to speeds below 0.25 m/s (Obura et al., 2002). In the NEM, the SC shifts its course southward, moving at a rate of 1.5-2 m/s. The reversed SC intersects with the EACC around latitude 2.25°S, resulting in the formation of the eastward-flowing Equatorial Counter Current (ECC), functioning as an undercurrent (Düing and Schott 1978, Johnson et al. 1982). The EACC spans a width of 160-200 km and reaches a maximum depth of approximately 400 m. Its average annual velocity is about 0.8 m/s, and its volume flux varies between 19.8 - 4.8 Sv (Swallow et al., 1983, Schott and McCreary, 2001).

5.4.1 Sea-level Variation

The Kenya Marine and Fisheries Research Institute (KMFRI) operates a tide gauge in Mombasa as part of the Global Ocean Observation System (GOOS) and Tsunami Early Warning System.

The data collected at the coordinates (Latitude 4° 4' 12" and Longitude 39° 23' 47.65") in Mombasa shows that the mean sea level (MSL) is rising at a rate of 3.8 mm per year, as indicated by the linear trend slope in **Figure 83** below.

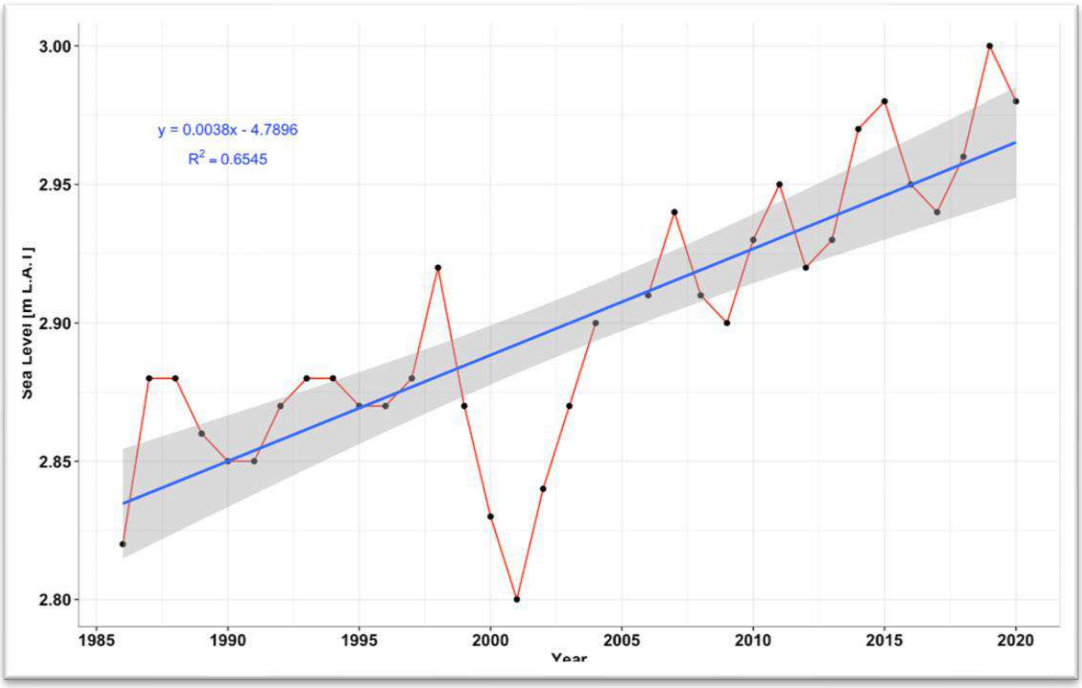


FIGURE 83: PLOT SHOWING A RISING (INCREASING) TREND OF SEA-LEVEL IN MOMBASA DERIVED FROM TIDE GAUGE DATA BETWEEN JUNE 1986 AND DECEMBER 2020. [SOURCE: KIMELI ET AL., 2022].

The sea level is referenced to the mean lowest astronomical tide (LAT), which stands at 0.81 m, calculated from the tide gauge data by averaging all monthly mean low water (MLW) values. The observed rate of sea-level rise (SLR) in Mombasa, at 3.8 mm per year, aligns with the global average of 3.0 mm per year, often attributed to climate change.

5.4.2 Implication of Current Speeds and Direction on Sediment Transport

Sediment transport is the movement of solid particles (sediment) such as sand, silt, and clay in water bodies, influenced by various factors including water velocity, turbulence, sediment characteristics, and channel morphology. Current speeds affect the size of sediment particles that can be carried and the distance the particles will be transported. Therefore, the speed and direction of water currents have a significant impact on sediment transport in aquatic environments. Higher current speeds increase the erosive force of water, making it more effective at dislodging, resuspending and entraining sediment particles from the bed and banks of the water body. The direction of the current can determine which areas of the bed and banks are more susceptible to erosion and deposition. Additionally, the capacity of the water to transport sediment increases with higher current speeds. As the speed of the water current increases, it can carry larger and heavier sediment particles. The direction of the current affects the distribution of sediment transport. Sediment may be transported downstream, laterally, or in a helical (spiral) motion depending on the current direction and channel morphology. When the current speed decreases, the sediment transport capacity decreases, leading to sediment deposition. This occurs when the current is no longer capable of carrying the sediment load and drops it, resulting in sedimentation in the water body. The direction of the current determines where sediment will be deposited. Deposition often occurs in areas of decreased flow velocity, such as in the lee of obstacles or in areas with changing channel morphology. Based on the compass plots, the current direction of mid and bottom currents, the Kilindini channel shows a bi-directional direction. This implies that the channel is well flushed with inward transportation of sediments by flood tides and outward transportation by the ebb tide. In addition to the influence of river inflow, dredging activities and the stirring of sediment (resulting from port anchorages) have the potential to transport materials to the channel banks, impacting the mangroves, nearshore coral reefs, and seagrass beds located in that area. Therefore, understanding the interplay of current speed and direction is crucial for predicting and managing sediment transport in rivers, estuaries, coastal areas, and other aquatic environments. It helps in designing structures, managing erosion, maintaining navigability, and preserving aquatic habitats.

5.4.3 Cumulative Impacts of other sediment sources

The seasonal Mwache River discharges into the Kilindini Channel. During the flash floods and the rainy season, river discharges increases and sediment supply increases. This is both advantageous for the replacement of the sediment within the critical habitats. However, we suggest that dredging and sand harvesting is undertaken during the dry season to allow the accurate determination monitoring of spill overs and overflows. The seasonal Mwache River flows into the Kilindini Channel. During flash floods and the rainy season, the river discharge increases, enhancing sediment supply. This influx is beneficial for replenishing sediment in critical habitats and the coasts. However, we recommend conducting dredging and sand harvesting during the dry season to facilitate accurate monitoring of spillovers and overflows void of the influence of the Mwache flows.

5.4.4 Sediment grain-size

From the grain size analysis, we observe that the sand to be harvested contains very minimal fine material, less than 5%. Fine sediment consists of silt (between 63 μm and 2 μm) and clay (<2 μm). As the current speed or river flow decreases, larger sediment particles settle first while smaller particles are carried further. Larger sediment particles tend to be more angular compared to smaller ones. Small particles are prone to flocculation, which aids in their settling out of suspension. Consequently, the minimal fine sediments in the sand to be harvested mean there will be less material transported, reducing the potential impact on critical habitats. Flocculation is most pronounced during slack water (low tide) due to very low current velocities (Zhu et al., 2022). Therefore, we recommend dredging during low tide to facilitate flocculation and the settling of suspended sediments further minimizing potential dispersal and impacts. The Kilindini channel is also well flushed. This means that the flood and ebb tide facilitate material mixing bringing them in and out of the channel. This consequently assist to dilute suspended material that would be harmful to critical habitats and reduce the toxicity of sediments. The minimal fine material will also be easily dissolved and re-distributed within the channel and into the open waters.

5.5. BIOLOGICAL ENVIRONMENT

There is a wide variety of land and marine ecosystems, home to a wide diversity of plant and animal species, that make up the biological environment in and around Mombasa Port. Marine life, including fish, crabs, mollusks, marine animals, and sea turtles, can be found in the seas surrounding Mombasa Port. These species live in a variety of environments, including open water areas, mangrove forests, seagrass meadows, and coral reefs.

Mombasa Port sustains significant fisheries that support coastal populations economically and provide a means of subsistence. Many commercially significant species, including as pelagic and demersal fish, prawns, crabs and lobsters, are the focus of the local fishery. Adjacent to Mombasa Port, mangrove forests are found along the coast. They provide vital habitats for a variety of fish, bird, and wildlife species. Important ecological benefits offered by mangroves include fish nidification grounds, carbon sequestration, and coastal protection. Another significant environment close to Mombasa Port is seagrass meadows, which are home to a wide variety of marine creatures, including fish, crustaceans, and invertebrates. Seagrasses are essential to coastal ecosystems because they stabilise sediments, filter water, and give many different species food and habitat.

A variety of avian species, both migratory and resident, frequent Mombasa Port. Important feeding and nesting habitats for waterbirds like herons, egrets, kingfishers, and shorebirds are found in coastal areas, mangroves, and wetlands.

Mombasa Port, like many other ports across the world, has to deal with invasive species that are brought in by shipping operations, hull fouling, and ballast water discharge. Native ecosystems can be upset by invasive species, which can also outcompete native species and impact the environment and economy.

Through programmes including habitat restoration, marine protected areas, pollution control techniques, and sustainable fisheries management, efforts are being made to preserve and safeguard the biological ecosystem in and around Mombasa Port.

The sustainability of marine resources and coastal populations, as well as the maintenance of ecosystem health and biodiversity, depend on an understanding of and commitment to protecting Mombasa Port's biological environment. The goals of environmental conservation and port growth must be balanced, and this can only be achieved by using integrated management techniques that take ecological, social, and economic aspects into account.

5.4.1 Critical Habitat Assessment (Criterion 1-3)

A Critical Habitat Assessment typically involves evaluating specific criteria to identify and prioritize areas that are ecologically significant and require conservation or protection measures. Here's an outline of how criteria 1-3 might be applied in such an assessment:

Criterion 1 assesses the species Diversity and Rarity. Under this criterion, diversity and abundance of species within a given area, including both flora and fauna. Rare, threatened, or endangered species present in the area are also identified as well as consideration of species with restricted ranges or specialized habitat requirements. Areas with high species diversity, endemism, or populations of rare or vulnerable species for conservation efforts are also identified.

Criterion 2 assesses Habitat Diversity and Integrity. It focuses on variety and quality of habitats present within the area, including terrestrial, aquatic, and transitional ecosystems. It also considers the extent of intact, undisturbed habitats versus degraded or fragmented areas. It also evaluates the connectivity and ecological function of habitats, including corridors for wildlife movement and gene flow. Lastly it seeks to prioritize areas with diverse, intact habitats that support key ecological processes and provide essential resources for species survival.

Under **Criterion 3**, Ecological Functions and Services are assessed. The ecological functions and services provided by the habitat, including nutrient cycling, water purification, carbon sequestration, and erosion control are assessed. The role of habitat in supporting biodiversity, ecosystem resilience, and adaptation to environmental change is also evaluated. The socio-economic benefits derived from the habitat, such as fisheries, tourism, and cultural values are considered under the criterion as well. Priority is provided to ecological functions and services, particularly those that contribute to the overall health and resilience of the ecosystem and provide tangible benefits to human communities.

By applying these criteria systematically, conservation practitioners can identify and prioritize critical habitats for protection, restoration, and sustainable management. This helps ensure the long-term viability of ecosystems, safeguard biodiversity, and support the well-being of both wildlife and human populations.

According to the criteria, there are several critical habitats that are evident at the coast.

The Kenyan coast is home to thriving coral reef ecosystems, especially in the vicinity of Marine Protected Areas such as Watamu Marine National Park and Kisite-Mpunguti Marine National Park. Invertebrates, corals, and a variety of colorful fish are among the many marine creatures that call these reefs home.

Kenya's coast is home to mangrove forests, especially in places like Gazi Bay and the Lamu Archipelago. These mangrove forests are vital to the preservation of the coast because they offer a home for a variety of marine animals and act as fish and other marine critters' nurseries. Along Kenya's coast, salt marshes, lagoons, and estuaries are examples of coastal wetlands that are vital habitats. In addition to serving as breeding and feeding grounds, these sites are also important for migrating bird species. Along with helping to preserve water quality, they act as barriers against coastal erosion.

Seagrass beds provide a vital ecosystem along Kenya's coast, offering sustenance and refuge to a diverse range of marine organisms such as fish, sea turtles, and dugongs. Additionally, essential to the stabilization of coastal sediments and the sequestration of carbon is seagrass meadows.
Sand dunes are crucial coastal habitats that offer specialized plant species acclimated to the harsh coastal environment as well as sea turtle nesting locations. They also act as storm surge and coastal erosion defenses in the natural world.

Establishing marine protected areas, managing fisheries sustainably, and implementing community-based conservation programs are all essential to preserving these vital habitats along Kenya's coast. The maintenance of ecosystem services that are vital to the livelihoods and general well-being of coastal communities is ensured by protecting these habitats, which also helps to maintain biodiversity.

1. Marine Protected Area

(1) Mombasa Marine National Park and Reserve

Mombasa Marine National Park and Reserve is located within the surveys area of this baseline assessment and faces both natural and anthropogenic disturbances due to its proximity to human activities and environmental factors. It is close to densely populated urban areas, including Mombasa city and its port. These urban centers generate pollution, waste, and other forms of environmental stressors that can adversely impact marine ecosystems within the protected area. Industrial activities, shipping, and coastal developments in the adjacent areas of the MMNPR can introduce pollutants, sedimentation, and habitat destruction, posing risks to biodiversity. Habitat degradation and loss are occurring due to coastal development, and pollution runoff from urban areas. These activities can degrade coral reefs, seagrass beds, and other critical habitats that support diverse marine life. Climate change impacts, such as ocean warming, acidification, and sea level rise, pose additional risks to biodiversity within MMNPR. These changes can lead to coral bleaching, altered species distributions, and habitat loss, affecting the overall resilience of marine ecosystems. Already coral bleaching is expected to ravage the health of coral reef communities in the month of April and May 2024 (CORDIO Bleaching Alerts).

TABLE 34 - EXISTING THREATS TO CORAL REEF HEALTH

Environmental conditions prevalence	Coral Garden	Nyali	Ras Iwatine	Mtwapa re	Kuruwitu	Kanamai	Kasa-Stingr	Tiwi Dive 1	Tiwi Dive 2	Diani Reef	Leopard re	Waa reef	Kaya Waa re
Bleaching	10%	5%	5%	10%	5%	2%	20%	10%	5%	5%	5%	10%	5%
Disease	20%	20%	5%	10%	10%	10%	5%	5%	5%	5%	5%	5%	5%
Sedimentation	5%	5%	5%	20%	5%	5%	5%	2%	2%	2%	2%	2%	2%
Pollution	Low	High	High	High	Moderate	Low	Low	Low	Low	Low	Low	Low	Low
Crown of thorns	2%	2%	2%	2%	2%	2%	0%	0%	2%	2%	2%	2%	2%
Abrassion due macroalgae	30%	30%	45%	45%	20%	30%	10%	25%	5%	5%	5%	5%	5%
Fishing pressure	Low	Moderate	Moderate	High	low	High	Low	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate

Despite these challenges, MMNPR is recognized as a critical area for biodiversity conservation, encompassing diverse marine habitats such as coral reefs, seagrass beds, and mangrove forests. Certain species within the MPA may be vulnerable or endangered, including coral reef species, marine mammals, sea turtles, and various fish species.

Some of the recommendation for conservation and management of MMNPR include:

- Implementing strict regulations to protect key habitats within the Mombasa MPA, including coral reefs.
- Develop and implement habitat restoration projects to rehabilitate degraded areas and enhance ecosystem resilience.
- Implement measures to reduce pollution inputs into MMNPR, including wastewater treatment, litter control, and runoff management.

- Monitor water quality parameters regularly to assess pollution levels and mitigate impacts on marine ecosystems.
- Develop climate change adaptation strategies to mitigate the impacts of ocean warming, acidification, and sea level rise on marine habitats and species.
- Implement coral reef monitoring programs to track coral health, bleaching events, and recovery trajectories.
- Establish a comprehensive monitoring and evaluation program to assess the effectiveness of management interventions and track changes in biodiversity over time.

5.4.2 Coral

Coral reefs are very sensitive ecosystems, any human activities in their vicinity need to be conducted in a way that minimizes harm and preserves these vital habitats. Baseline assessments for coral reefs serve as crucial starting points for understanding the current state of these ecosystems. They involve comprehensive evaluations of various aspects of coral reefs, including their biodiversity, health, and surrounding environmental conditions. Baseline assessments provide a snapshot of the reef's condition at a particular time, creating a reference point against which future changes can be measured. This helps in monitoring and understanding any alterations or degradation over time.

Baseline studies were conducted to assess coral reef health and conditions including the identification of coral species with IUCN red list categories, and evaluation of coral community health and risks to sea water temperature rise and other factors. The assessment covered the pre-identified sites along the Mombasa to Diani reef stretch which includes key conservation areas hosting National Marine Protected Areas (MPAs).

The geographical scope of the surveys area covered about 50 kilometers from the northern border of Mombasa Marine Park and National Reserve (MMNPR) going southwards to Shelly, Waa, Tiwi and the Diani-Chale Marine Reserve. Underwater surveys were conducted at 22 study locations along this coral reef stretch. A total of 9 locations were sampled within the MMNPR, 2 sites within unprotected area between Shelly beach and Tiwi, and and 11 locations down-south in the Diani-Chale Marine Reserve (**Figure 84**). We made sure that we have selected locations that represent different reef habitats such as 1. inner sheltered reefs and outer exposed reefs, 2. deep (more than 7m depth) and shallow reefs (less than 6m depth).

Underwater surveys were conducted by scuba diving at deep reef locations and by snorkeling on shallow reef locations mostly on reef lagoons. A team of 4 divers and 1 GIS and remote sensing expert conducted underwater surveys at the 22 locations for 6 days and recorded the following information at each of the surveyed sites.

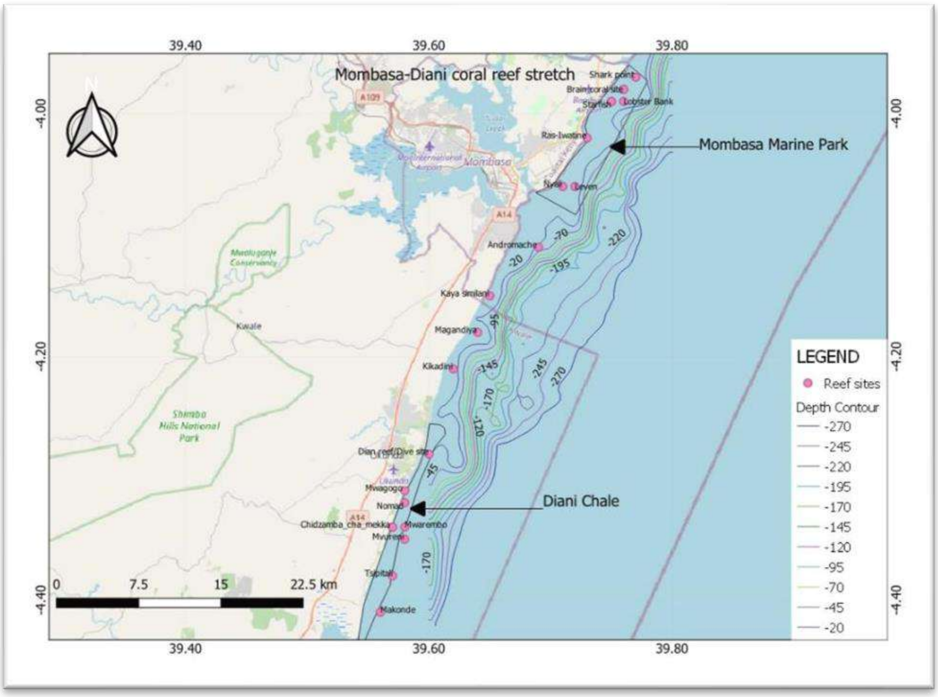


FIGURE 84 - SAMPLING LOCATIONS

TABLE 35 - CORAL SURVEY

	
Photo 1: Diving to Survey a Deep Reef Site	**Photo 2: Snorkelling to Survey a Shallow Lagoon Reef**

(1) Sampling Methods

1) Benthic Cover Including Live Hard Coral Cover

Two 50m by 1m belt transects were sampled to determine the benthic percentage cover at each location. A 50m tape was laid on the substrate and using an underwater camera 25 photos were taken at an interval of 1m along the 1m belt transect. In total, 50 photoquadrats were sampled at each location. A desktop software for analysis called Coral Point Count with excel extension (CPCe) was used to extract data from the photoquadrats. Data recorded included benthic cover of 15 major benthic categories and this report puts more highlight on the following five categories:

1. Live hard coral
2. Macroalgae
3. Turf algae
4. Soft coral
5. Recently dead coral
6. Silt

2) Coral Community Composition

Using the photoquadrats, identification of corals was done to the lowest possible taxa. In addition, random swims were conducted along the 50m transect with an estimated 10m-width on both sides of the transect to record IUCN listed coral species, including other coral taxa generally known to be sensitive to turbidity, sedimentation and susceptibility to bleaching. The data from this section put more highlight on:

1. Coral general composition and abundance with a focus on sensitive coral taxa
2. IUCN listed coral species

3) Coral Colony Health Condition

In order to determine the health condition of coral colonies, consultants conducted visual assessment of all colonies occurring within the 50m by 1m belt transect. This included observation of bleaching or any other form of discoloration, mucus secretion, disease, dead tissue and sediments on the surface of coral colony.

4) Georeferenced Sites and Data

GPS points for all survey locations was recorded and the respective data georeferenced. The footage taken representing specific habitats for each location was also collated.

(2) Results

1) Benthic cover

The benthic cover at the 22 studied reefs showed composition and abundance of various organisms and substrates that characterized the seafloor at these sites. The levels of hard coral cover, which is the foundational functional group in the reefs, was similar to previous and recent studies that have been done in this area (Obura, 2021 unpublished). Highest hard coral cover was 27% but some sites had as low as 3 % cover. Some sites in the south had high macroalage abundance with the highest being 32% at Mvureni. Coral gardens in MMNPR recorded the highest cover of recenltly dead coral (12 %) even though it is a protected area. The surveyed sites had a considerable amount of sand patches or sand cover, the highest being at Mekka with 20 % sand cover. Magandiya and Makonde had high levels of silt cover of 36 % and 20%, respectively. Almost all fore-reef sites had a high cover of soft corals with highest cover of 25% at Leven and Mekka.

2) Coral Community Composition

Coral community composition was done by focusing on the species/ taxa listed under the IUCN red list of species, and also including other coral taxa generally known to be sensitive to turbidity, sedimentation and susceptibility to bleaching.

1. IUCN listed coral species
2. Coral genera composition and abundance with a focus on sensitive coral taxa

33% of coral species are listed on the on the International Union for Conservation of Nature (IUCN) Red List of endangered species. Most corals in this region fall under the vulnerable categories mainly because of the threats they face such as population decline, habitat loss.

Pocillopora dermiconis (Cauliflower coral) is one of the species that is described as vulnerable under the IUCN red list of species and was found in plenty in the shallow warm habitats of the survey sites (**Table 36**, Photo 3). Other species shown in Photo 4-8 indicate taxa that are described vulnerable due to declining numbers and habitat destruction.

TABLE 36 - IMAGES OF CORALS

		
Photo 3: Pocillopora Damicornis	**Photo 4: Pocillopora Elegans**	**Photo 5: Acropora Species**

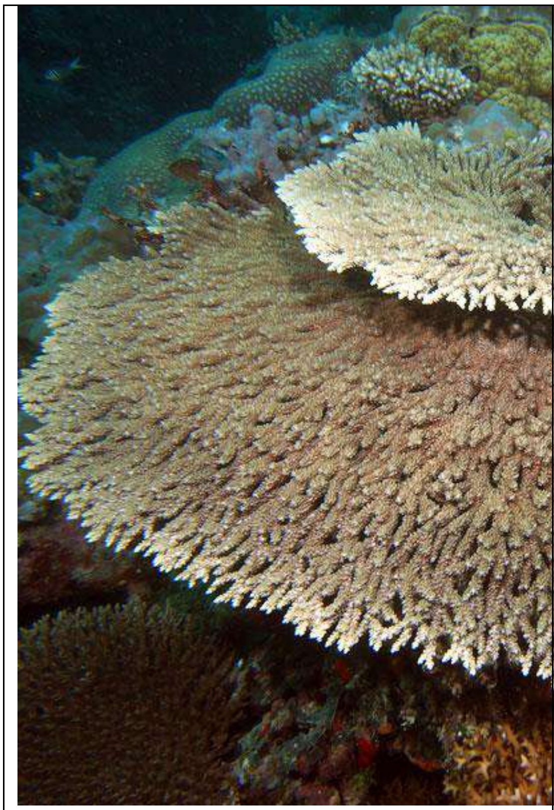
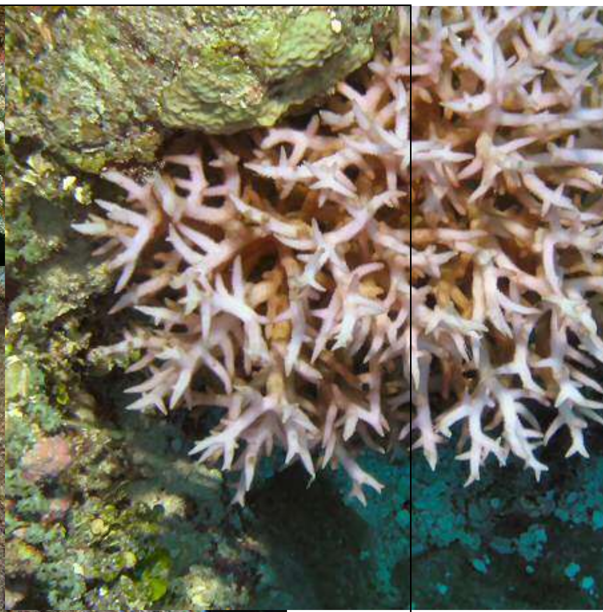
		

Photo 6: Acropora Species	**Photo 7: Stylophora Pistillata**	**Photo 8: Seriatopora Hystrix**

There are 23 corals genera that have been described as important in terms of their sensitivity to bleaching, pollution and sedimentation (Obura & Grimsditch 2009). These are further grouped into 3 categories: 1. Sensitive, 2. Intermediate, 3. Resistant (

Table 38). Of the 22 sites surveyed, Kaya Similani hosted the highest number (14 genera) of the 23 listed (

Table 37). The percentage cover of each genera sensitivity category was recorded at each site. It is important to note that most sites had high percentage cover of resistant corals and low cover of sensitive corals (**Figure 87**), most likely a consequence of high survivorship of resistant corals and low survivorship of vulnerable genera from environmental stress.

3) Coral Colony Health Condition

Most of the coral colonies showed healthy condition exhibiting vibrant coloration, intact tissue and polyps, and well-structured growth forms. However, there are some coral colonies **Figure 88** that displayed diseased in (photo panel 3, column 1), predation (photo panel 3, column 2) and sediment load on top of the colony (Photo panel 11, column 1).

TABLE 37 - PERCENTAGE COVER (%) OF 7 BENTHIC CATEGORIES ALONG THE MOMBASA TO DIANI REEF STRETCH WITH 22 SURVEYED SITES

Survey area	Site no.	Latitude	Longitude	Benthic category	% Cover of Benthic Category						
					Macro algae	Turf algae	Hard coral	Recently dead coral	Soft coral	Sand	Silt
MMNPR	1	-3.97	39.77	Shark point	12	8	3	0	23	18	0
	2	-3.98	39.76	Kasa reef	5	15	13	5	22	7	0
	3	-3.98	39.76	Brain coral site	15	12	7	0	25	15	0
	4	-3.99	39.75	Starfish	19	17	15	2	4	5	0
	5	-3.99	39.75	Coral garden	18	13	27	12	3	0	0
	6	-3.99	39.76	Lobster Bank	24	11	5	2	13	5	0
	7	-4.02	39.73	Ras-Iwatine	7	11	20	0	24	12	0
	8	-4.06	39.72	Leven	1	12	20	0	25	5	0
	9	-4.06	39.71	Nyali	13	17	21	0	21	8	0
SHELI - TIWI	1	-4.11	39.69	Andromache	5	42	4	9	19	5	9
	2	-4.15	39.65	Kaya similani	16	18	17	0	18	14	3
DIANI-CHALE MARINE RESERVE	1	-4.18	39.64	Magandiya	6	11	27	0	15	13	36
	2	-4.21	39.62	Kikadini	25	9	15	0	19	7	4
	3	-4.28	39.60	Diani reef	12	17	10	1	23	15	0
	4	-4.31	39.58	Mwagogo	15	10	7	0	16	3	0
	5	-4.32	39.58	Nomad	6	19	22	2	22	6	0
	6	-4.34	39.57	Mtengo	13	12	24	0	20	2	0
	7	-4.34	39.58	Mekka	5	9	16	0	25	20	4
	8	-4.34	39.57	Mwarembo	9	34	11	0	7	3	8
	9	-4.35	39.58	Mvureni	32	20	17	0	0	0	0
	10	-4.38	39.57	Tsipitali	30	15	3	0	0	0	0
	11	-4.41	39.56	Makonde	14	13	7	0	7	0	20

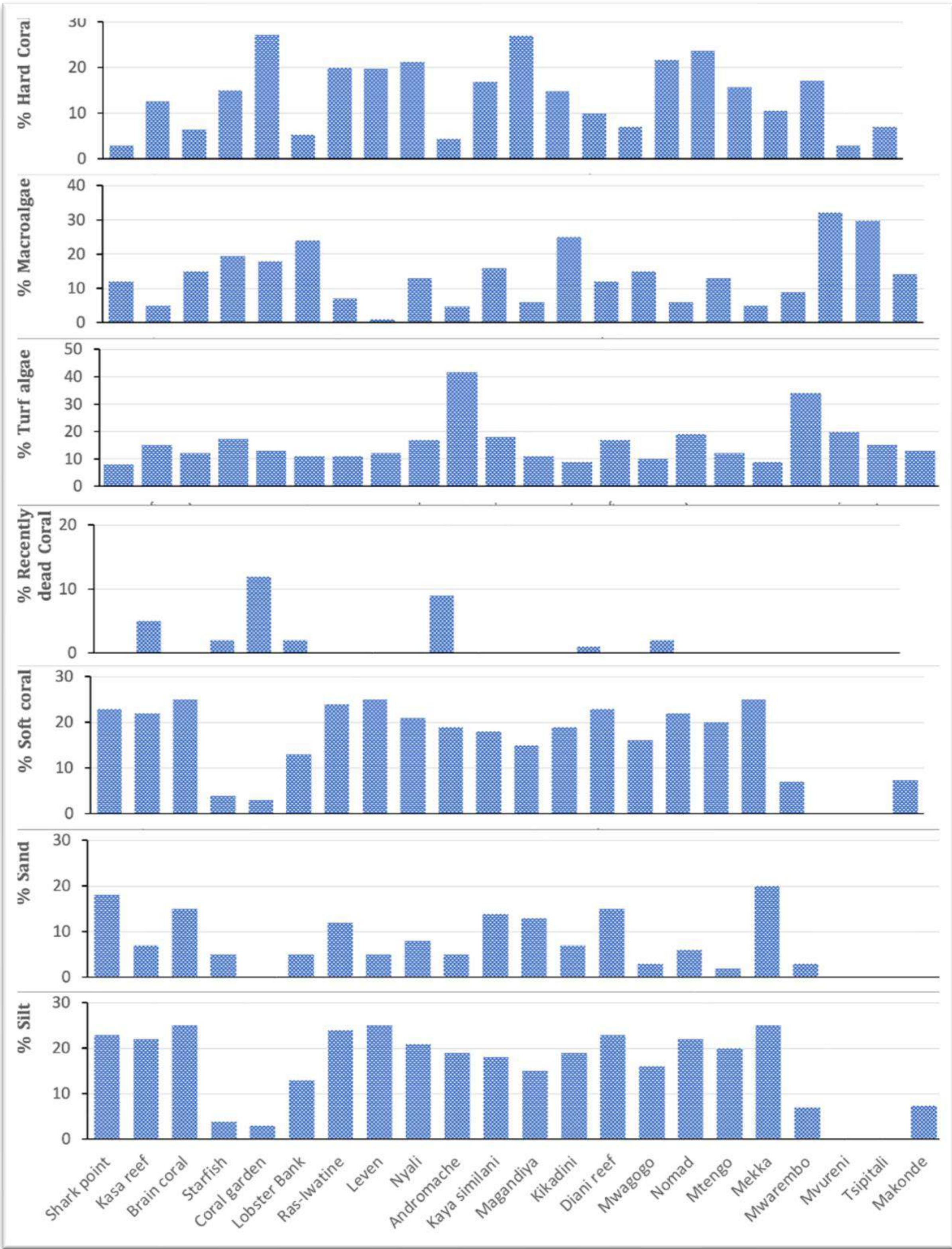


FIGURE 85 - PERCENTAGE COVER (%) OF 7 BENTHIC CATEGORIES ALONG THE MOMBASA TO DIANI REEF STRETCH AT 22 SURVEYED SITES

TABLE 38 - ABUNDANCE OF CORAL TAXA ALONG THE MOMBASA TO DIANI REEF STRETCH AT 22 SURVEYED SITES

					Sensitive taxa						Intermediate taxa													Resistant taxa			
Survey area	Site no.	Latitute	Longitude	Benthic category	Acropora	Montipora	Pocillopora	Oxypora	Seriatopora	Stylophora	Acanthastrea	Coscinaraea	Echinopora	Favia	Favites	Fungia	Galaxea	Goniastrea	Hydnophora	Leptastrea	Lobophyllia	Platygyra	Turbinaria	Porites (b)	Porites (m)	Pavona	Total no. of taxa
MMNPR	1	-3.97	39.77	Shark point	12	72	4				2		44	12	28		24		1		32	76			36		9
	2	-3.98	39.76	Kasa reef	4		8				4		36	4	2	4	4		1			16			2		9
	3	-3.98	39.76	Brain coral	4		12							8	8			4	4			32		44	32		7
	4	-3.99	39.75	Starfish																					56		1
	5	-3.99	39.75	Coral garden									4		4				8					36	4		5
	6	-3.99	39.76	Lobster Bank	8		12							4	4		24				12				2		5
	7	-4.02	39.73	Ras-lwatine																					4		1
	8	-4.06	39.72	Leven	4	4	24								28		12	4	7			36		8	4		7
	9	-4.06	39.71	Nyali									4		8							4		16	4		5
SHELI - TIWI	1	-4.11	39.69	Andromache	2	1	3	1				2	4	12	3	1	5		1			16			2		9
	2	-4.15	39.65	Kaya similani	1	12	11		5		9	1	42	21	23	4	3		1	3	9	18	5	5	9		14
DIANI-CHALE MARINE RESERVE	1	-4.18	39.64	Magandiya	23	21	6				15	3	1	13	18		8		14	3		48		6	37		11
	2	-4.21	39.62	Kikadini	15	25	5				5	3	23	2	16	4	8		7	4	6	26			18		12
	3	-4.28	39.60	Diani reef	8	5	1				4	2	11	22	18	2	18		1	3	4	21			13	2	13
	4	-4.31	39.58	Mwagogo																							0
	5	-4.32	39.58	Nomad	2	6					8		96	12	36	8	16					16			8		8
	6	-4.34	39.57	Mtengo																							0
	7	-4.34	39.58	Mekka	2	12	4	16						4	56		28					12		36	28		6
	8	-4.34	39.57	Mwarembo																							0
	9	-4.35	39.58	Mvureni	4						12		56	4	4	4	4					16			16		8
	10	-4.38	39.57	Tsipitali																							0
	11	-4.41	39.56	Makonde	2	8	4	4					4		24		12			8		36		4	4	4	8

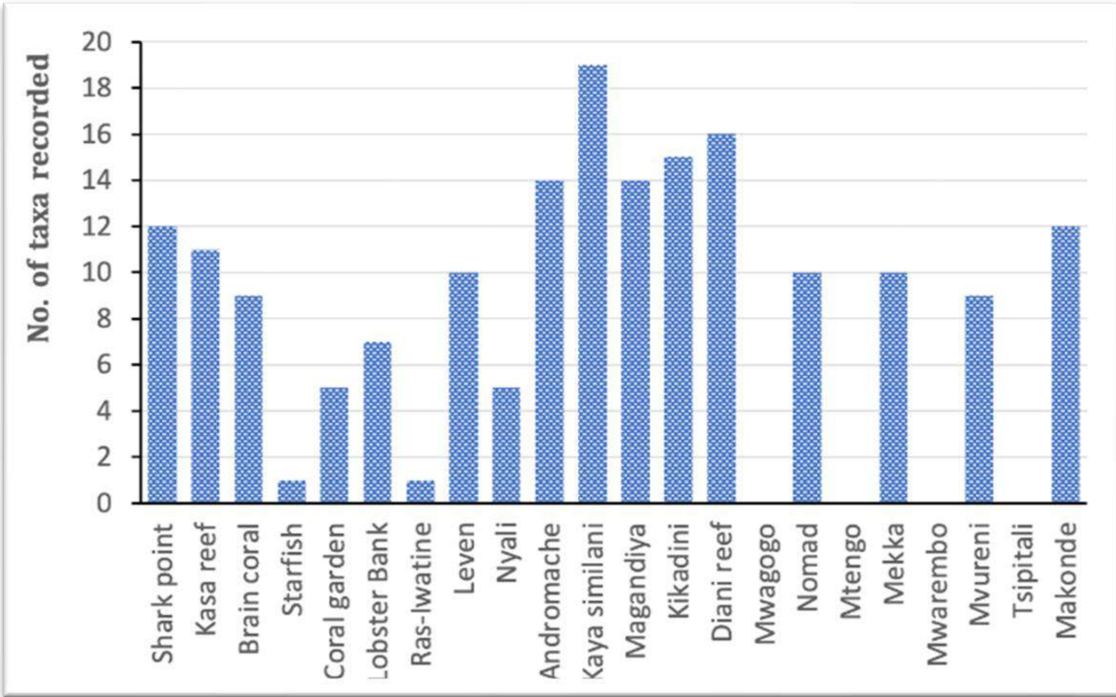


FIGURE 86 - NO. OF TAXA RECORDED OUT OF THE 23 PRE-SELECTED TAXA BASED ON THEIR SENSITIVITY TO ENVIRONMENTAL CONDITIONS AT EACH OF THE 22 SURVEYED LOCATION.

TABLE 39 - ABUNDANCE (%) OF SENSITIVE CORAL GENERA ALONG THE MOMBASA TO DIANI REEF STRETCH AT 22 SURVEYED SITES

Survey area	Site no.	Latitute	Longitude	Benthic category	Sensitive taxa	Intermediate taxa	Resistant taxa
MMNPR	1	-3.97	39.77	Shark point	29	27	36
	2	-3.98	39.76	Kasa reef	6	9	2
	3	-3.98	39.76	Brain coral	8	11	38
	4	-3.99	39.75	Starfish			56
	5	-3.99	39.75	Coral garden		5	20
	6	-3.99	39.76	Lobster Bank	10	11	2
	7	-4.02	39.73	Ras-Iwatine			4
	8	-4.06	39.72	Leven	11	17	6
	9	-4.06	39.71	Nyali		5	10
SHELI - TIWI	1	-4.11	39.69	Andromache	2	6	2
	2	-4.15	39.65	Kaya similani	7	12	7
DIANI-CHALE MARINE RESERVE	1	-4.18	39.64	Magandiya	17	14	22
	2	-4.21	39.62	Kikadini	15	9	18
	3	-4.28	39.60	Diani reef	5	10	8
	4	-4.31	39.58	Mwagogo			
	5	-4.32	39.58	Nomad	4	27	8
	6	-4.34	39.57	Mtengo			
	7	-4.34	39.58	Mekka	9	25	32
	8	-4.34	39.57	Mwarembo			
	9	-4.35	39.58	Mvureni	4	14	16
	10	-4.38	39.57	Tsipitali			
	11	-4.41	39.56	Makonde	5	17	4

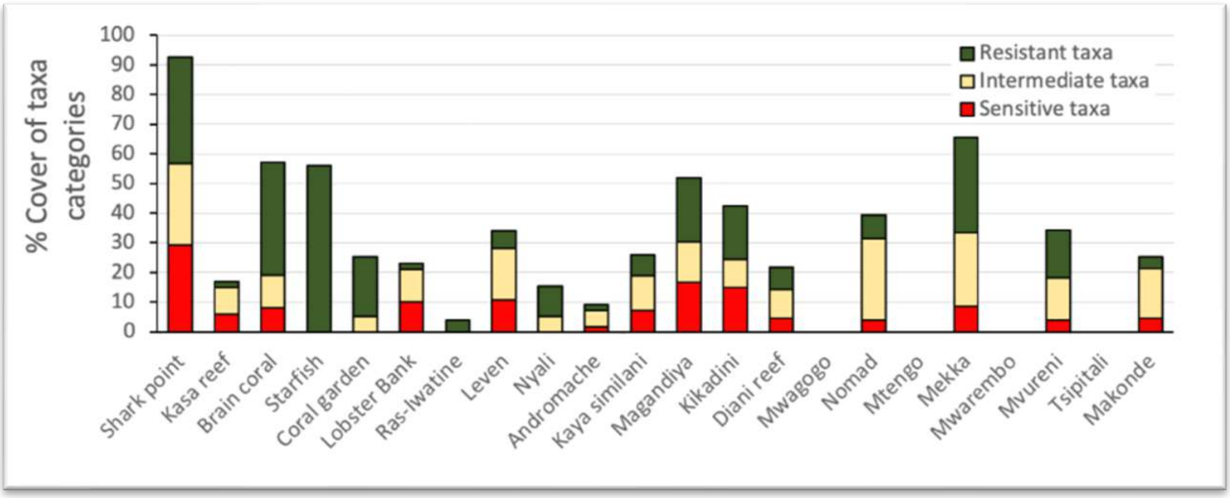
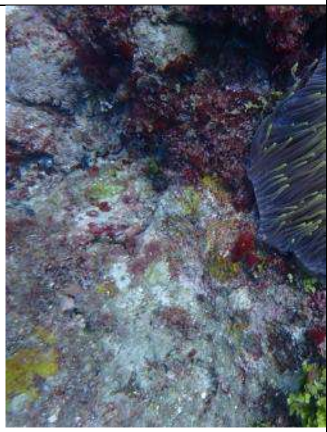
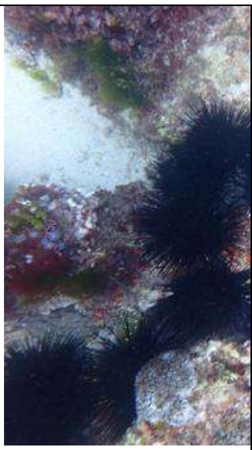
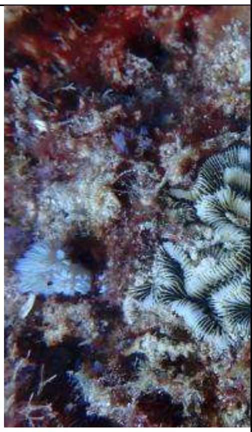
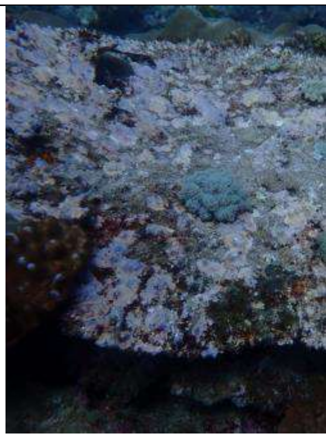
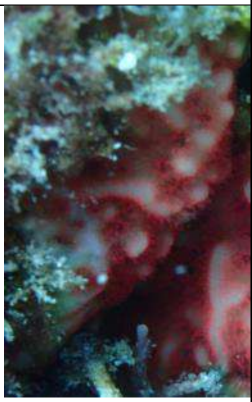


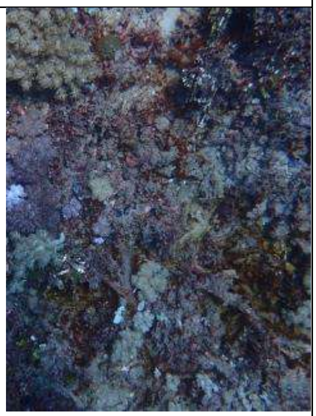
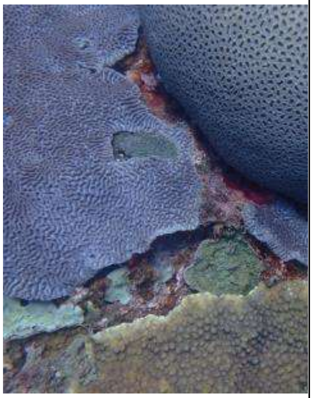
FIGURE 87 - PROPORTION OF % COVER OF THREE CORAL SENSITIVITY CATEGORIES AT 22 SURVEYED SITES

4) Coral Condition

Diani Reef **Photo Panel 1:**			
Andromoche **Photo Panel 2**			

Andromoche **Photo Panel 3**			
Kaya Similani **Photo Panel 4**			
Kikadini **Photo Panel 5**			
Migandiya **Photo Panel 6**			

Makonde **Photo Panel 7**			
Mvureni **Photo Panel 8**			
Photo Panel 9			
Coral Garden **Photo Panel 10**			

Ras Iwatine **Photo Panel 11**			
Starfish **Photo Panel 12**			
Brain Coral **Photo Panel 13**			
Leven **Photo Panel 14**			

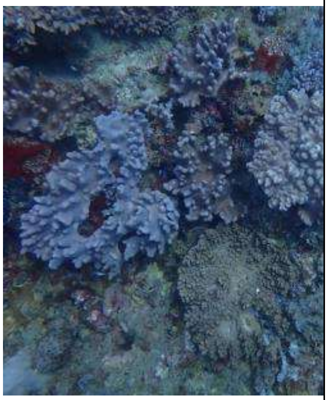
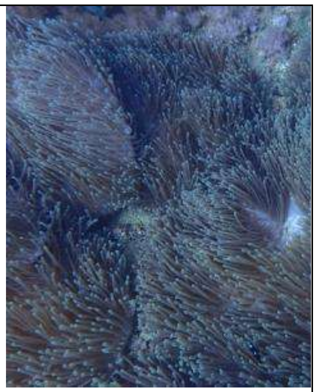
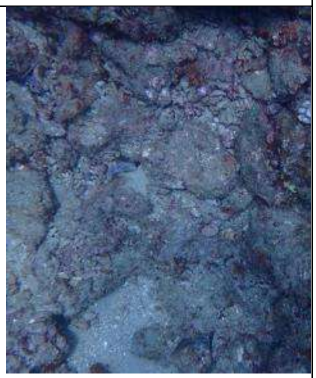
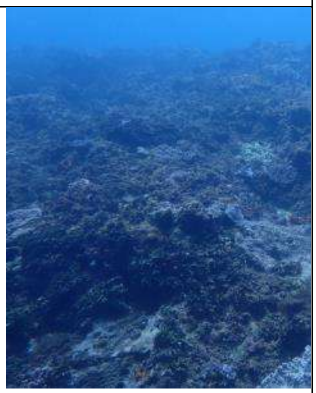
Kasa Point **Photo Panel 15**			
Shark Point **Photo Panel 16**			
Lobster Bank **Photo Panel 17**			

FIGURE 88 - CORAL CONDITION

5.4.3 Sea Grass

The project area of influence (at 10- and 50-km) has seagrass beds (Mombasa MPA, Shelly Beach, Waa, Tiwi, and Diani). Seagrass in these areas were analysed from satellite data from Copernicus Sentinel (2 images). The images were processed to identify seagrass areas/zones and images classes generated. The image classes were used to produce training data for image supervised classification and validation studies. The resulting image was be used to generate seagrass map classes in ArcMap 10.5.

At representative sites (9 sites between Kikambala – Mtwapa – Mombasa - Shelly Beach, Waa, Tiwi, and Diani) belt transect running shore to reef were set (**Figure 89** for the Diani-Challe belt). 10m^2 quadrats were set out for detailed seagrass community analysis. The GPS readings of these quadrats were taken, and readings recorded in field data sheets. **Figure 90** gives some pictorial scenarios of seagrass-related work.

At each marked seagrass quadrats, the following seagrass parameters were measured:

a) Seagrass community structure: species types, abundance, and percentage cover structure (canopy cover).
b) Health status of seagrass beds and threats (e.g., sedimentation, pollution, fishing) at the respective sampling locations.
c) Associated fauna including species listed as protected/ threatened under Kenyan law and /or IUCN Red List, at the respective sampling locations.

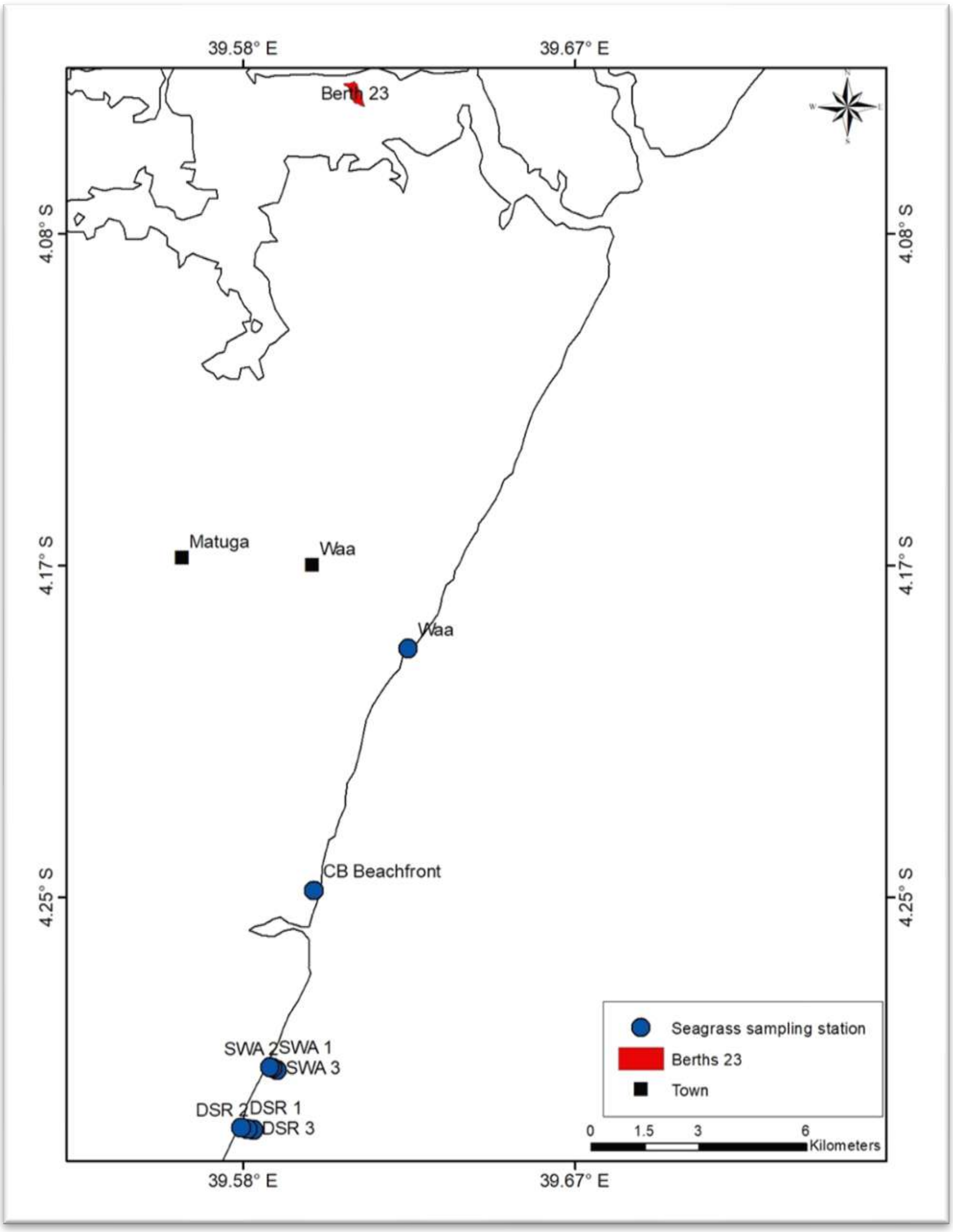


FIGURE 89 - SEAGRASS SAMPLING SITES (4 SAMPLING SITES SHOWN FOR THE WAA – TIWI – DIANI – CHALLE BELT)

Plate-2A & B: Seagrass sampling along transects: abord survey vessel (left, A); underwater healthy seagrass at one site (right, B)

Plate-2A & B: Sea-urchin predatory on seagrass at one site (left, C) and sparse unhealthy seagrass at another site (right, D)

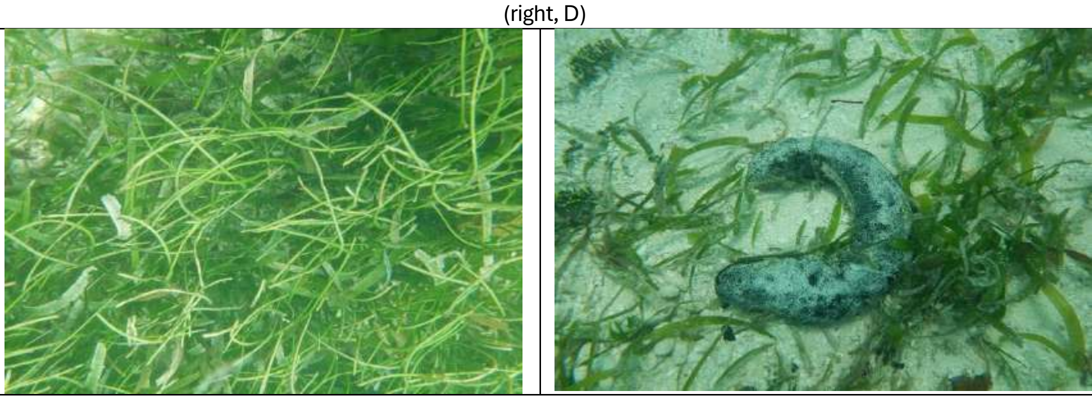


Plate-1E & F: Other formations of seagrass as seen under water: syringodium (left, E) and cymodocea (right, F)

FIGURE 90 - SEAGRASS SAMPLING PICTURES

(1) Seagrass Areas

The seagrass beds at the project area of influence of at 10- and 50-km buffer are shown in **Figure 91** and **Figure 92**.

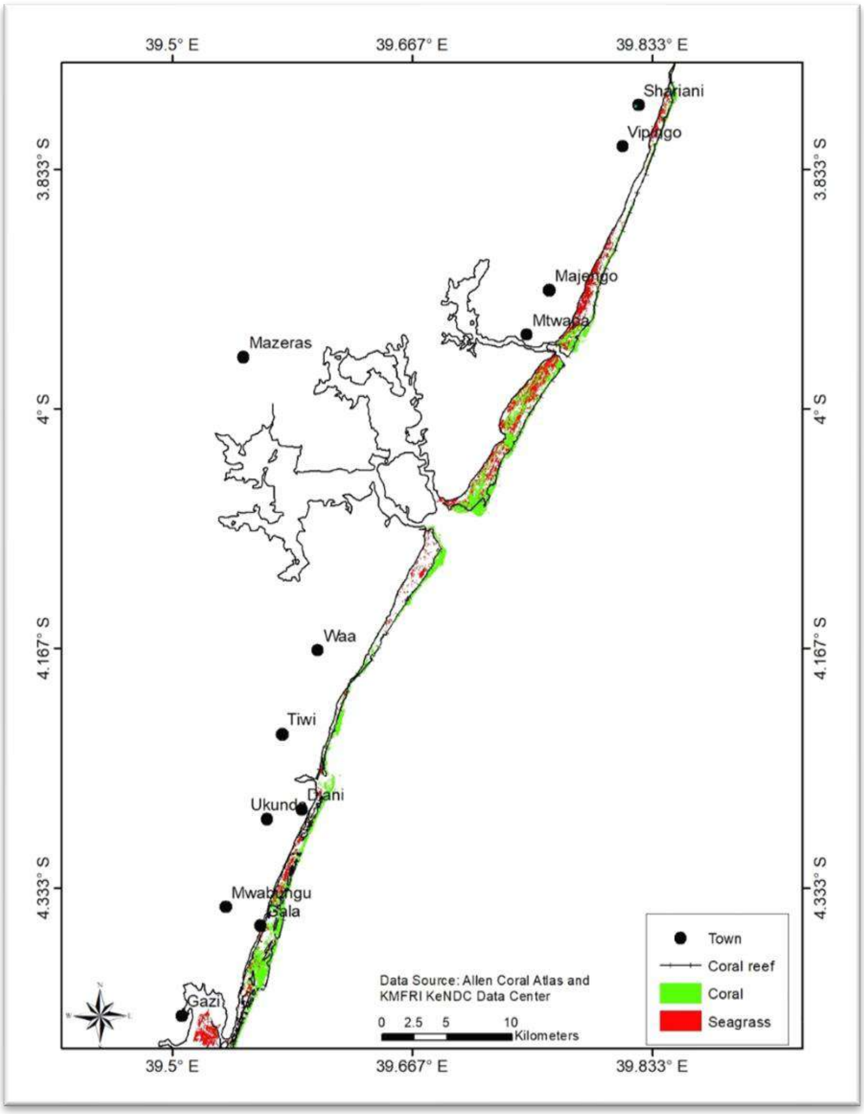


FIGURE 91 - SEAGRASS AREAS BETWEEN GAZI IN SOUTH COAST TO KURUWITU (SHIRAZI)

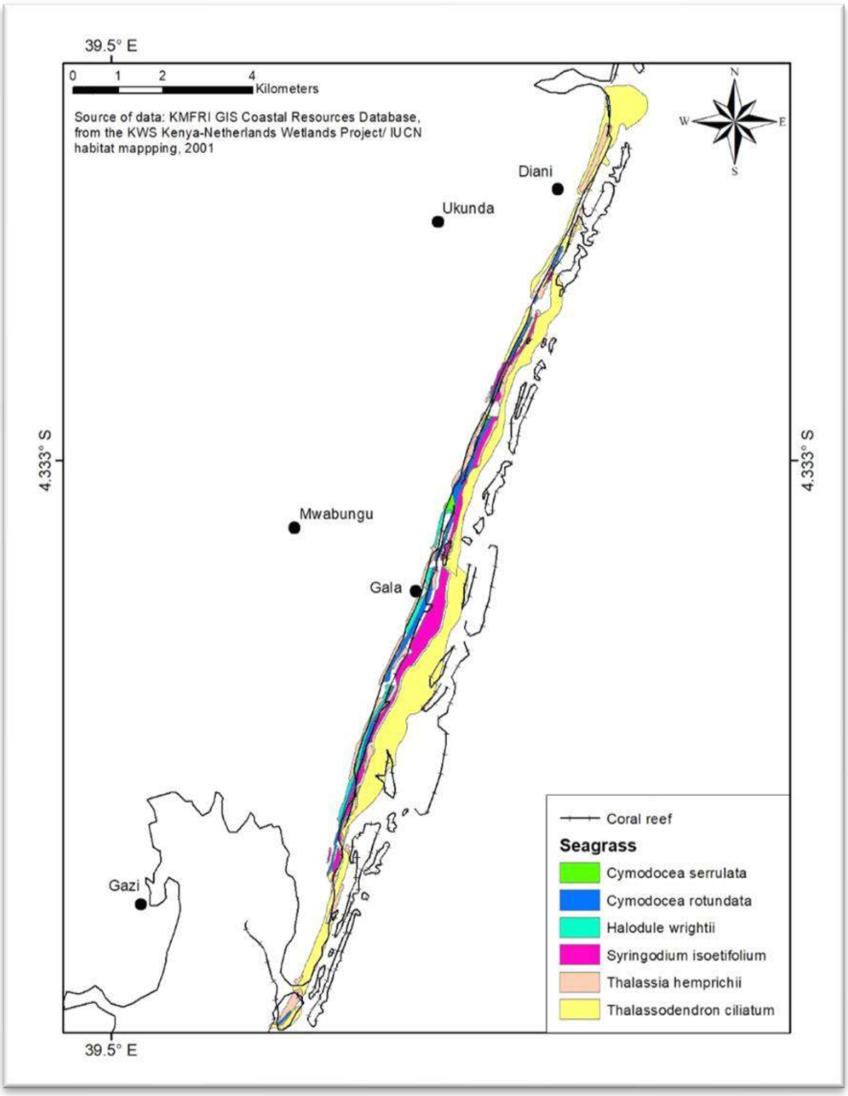


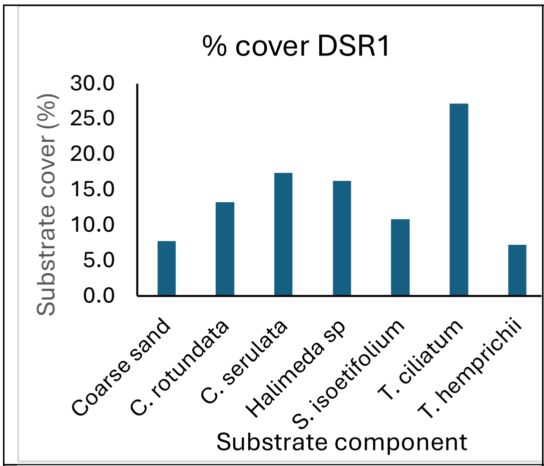
FIGURE 92 - SEAGRASS SPECIES ZONES WITHIN DIANI-CHALLE IN SOUTH COAST.

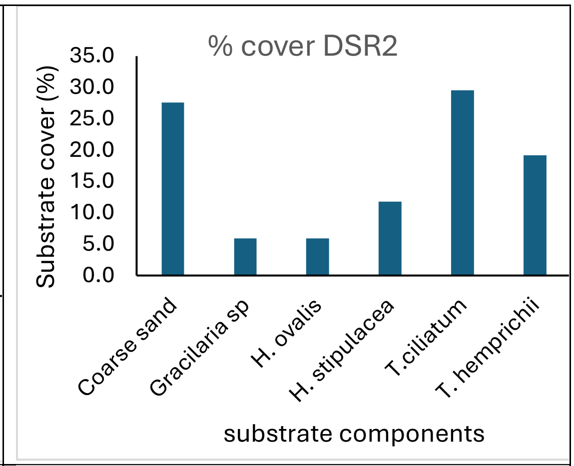
(2) Seagrass Cover

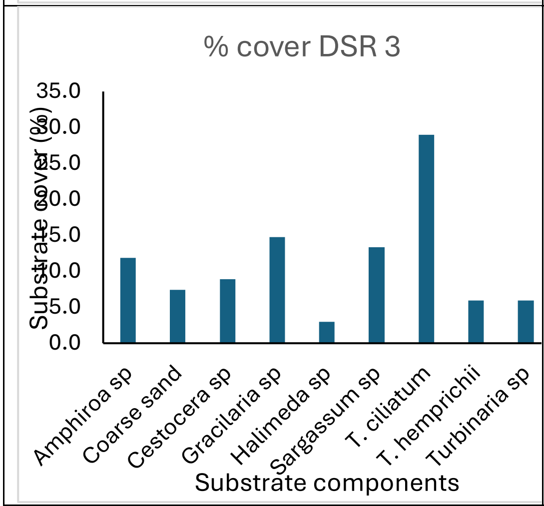
In the six transects covered for validation and paying particular attention to south coast where sand harvesting points have been proposed, the seagrass cover varied across sites as shown in **Figure 93**.

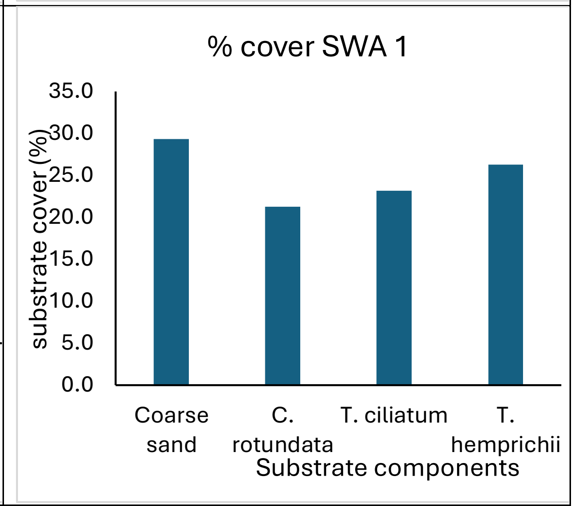
(3) Seagrass Associated Fauna (macro-invertebrates)

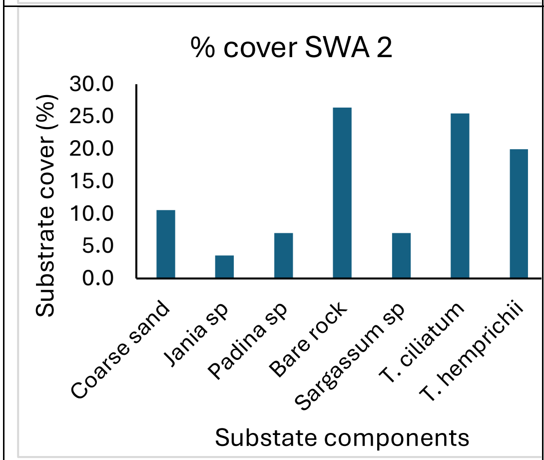
In the six transects covered for validation, the macro-fauna associated with seagrass were as presented in **Figure 94** and. **Figure 95**. None of the species listed are listed under IUCN categories.

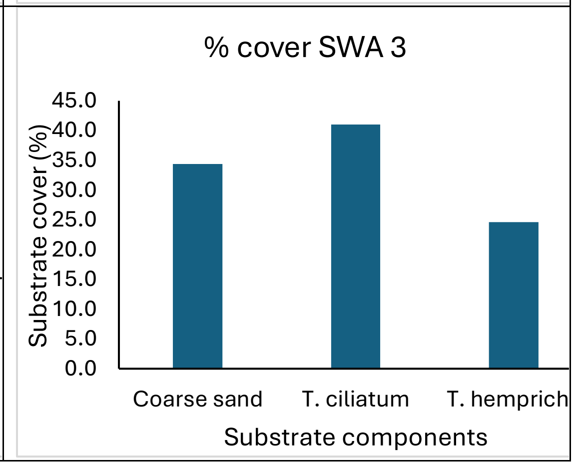

% cover DSR1
Substrate cover (%)
Coarse sand
C. rotundata
C. serulata
Halimeda sp
S. isoetifolium
T. ciliatum
T. hemprichii
Substrate component


% cover DSR2
Substrate cover (%)
Coarse sand
Gracilaria sp
H. ovalis
H. stipulacea
T.ciliatum
T. hemprichii
substrate components


% cover DSR 3
Substrate cover (%)
Amphiroa sp
Coarse sand
Cestocera sp
Gracilaria sp
Halimeda sp
Sargassum sp
T. ciliatum
T. hemprichii
Turbinaria sp
Substrate components


% cover SWA 1
substrate cover (%)
Coarse sand
C. rotundata
T. ciliatum
T. hemprichii
Substrate components


% cover SWA 2
Substrate cover (%)
Coarse sand
Jania sp
Padina sp
Bare rock
Sargassum sp
T. ciliatum
T. hemprichii
Substate components


% cover SWA 3
Substrate cover (%)
Coarse sand
T. ciliatum
T. hemprich
Substrate components

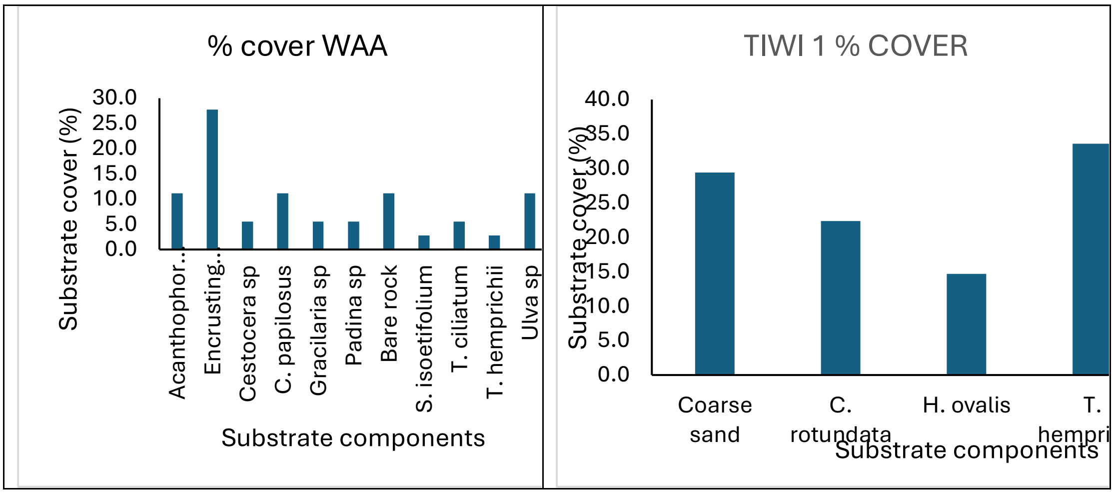


FIGURE 93 - SOUTH COAST PERCENT SEAGRASS COVER AT SAMPLED SITES SHOWING SEAGRASS SPECIES AND COVER VALUES ALONGSIDE OTHER BENTHIC SUBSTRATES. KEY: DSR – DIANI SEA RESORT; SWA – SWAHILI BEACH; TIWI – COCONUT CRAB HOTEL, TIWI BEACH; WAA – WAA AREA. AREA (DATA SOURCE GWADA 2023; OCTOBER 2023).

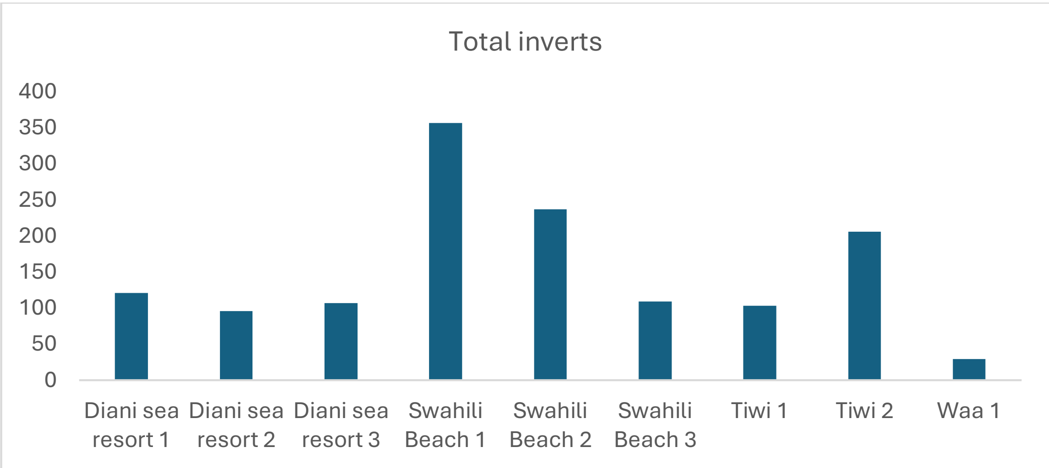


FIGURE 94 - SOUTH COAST SEAGRASS ASSOCIATED FAUNAL COVER AT SAMPLED SITES BASED ON TOTAL COUNTS OF MACRO-INVERTEBRATES

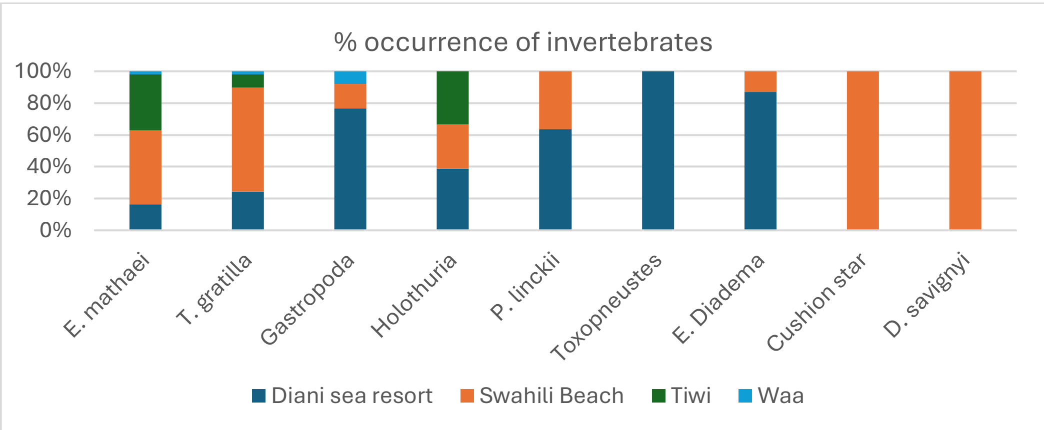


FIGURE 95 - SOUTH COAST SEAGRASS ASSOCIATED FAUNAL COVER AT SAMPLED SITES BASED ON DOMINANT MACRO-INVERTEBRATES' TAXA.

5.4.4 Mangrove

(1) Status of The Mangrove Forest in The Project Area

FGDs participants reported that the mangrove forest in the area has greatly reduced over the course of time. Along Port Reitz creek, several reasons were highlighted as what has contributed to mangrove degradation and they included, excessive cutting of mangrove to pave way for the previous development project in the area i.e., bridge construction, SGR, previous port expansion, and oil station construction; mangrove dieback caused by sedimentation from high rainfall, soil deposition from constructions and drying of mangroves from increased drought; and illegal mangrove harvests. All harvests from the mangrove forest were reported to be illegal except firewood collections where the locals were allowed to collect dead mangrove for subsistence. There were no records to show how mangrove was collected from the forest as mangrove harvesting were done illegally and fuel wood collections were done at a small scale.

Mangrove forest was said to be a habitat and fish breading site, an ideal location to develop ecotourism projects, and a home to specific birds and wildlife. The riparian community reported to utilize different species of mangrove differently and this included, “Mwangala, mkomafi, & Muchu” for medicine purposes, “Mkoko” to make dye, “Mkoko” roots for making fishing gear (“uzio”), all species for firewood, and “Mchu flowers” useful in apiculture. Respondents reported that, to sustain the quality of mangrove along the creek, there was need to establish zones and employe forest guards to curb illegal harvests, the locals should be educated on the importance of healthy mangroves to the ecosystem, establish mangrove nurseries (**Figure 96**), more mangroves to be planted in the areas where they are degraded, ban on mangrove harvesting, and put a lot of beehives in the forest to deter people from harvesting as they will be stung by bees.

FIGURE 96 - MANGROVE NURSERY AT TSUNZA CENTRAL BMU

(2) Source of Fuel used in the project Area.

Most respondents reported to use firewood as the main source of fuel, Shelly-Waa-Tiwi-Diani beach stretch (62.8percent) and Ngare village (79.6percent) (**Figure 97**). Firewood was mostly used because it was cheaper to obtain compared to other sources of fuel. In Ngare village, firewood was obtained either by harvests from the mangroves forest (76.3percent), picking of dead wood from the beach (13.2percent) and buying firewood from the dealer (10.5percent). Along Shelly-Waa-Tiwi-Diani beach stretch respondents reported to obtain fuel wood from mangrove forest harvests (43.7percent), terrestrial forest (33.8percent), own farms (11.3percent) and buy from firewood dealer (11.3percent). Mangrove forest was the most convenient source of wood fuel because of its proximity to the villages. The project proponent can come up with innovative ways to reduce on the consumption of mangrove wood fuel by providing improved cooking jikos this will help conserve the stressed mangrove forest.

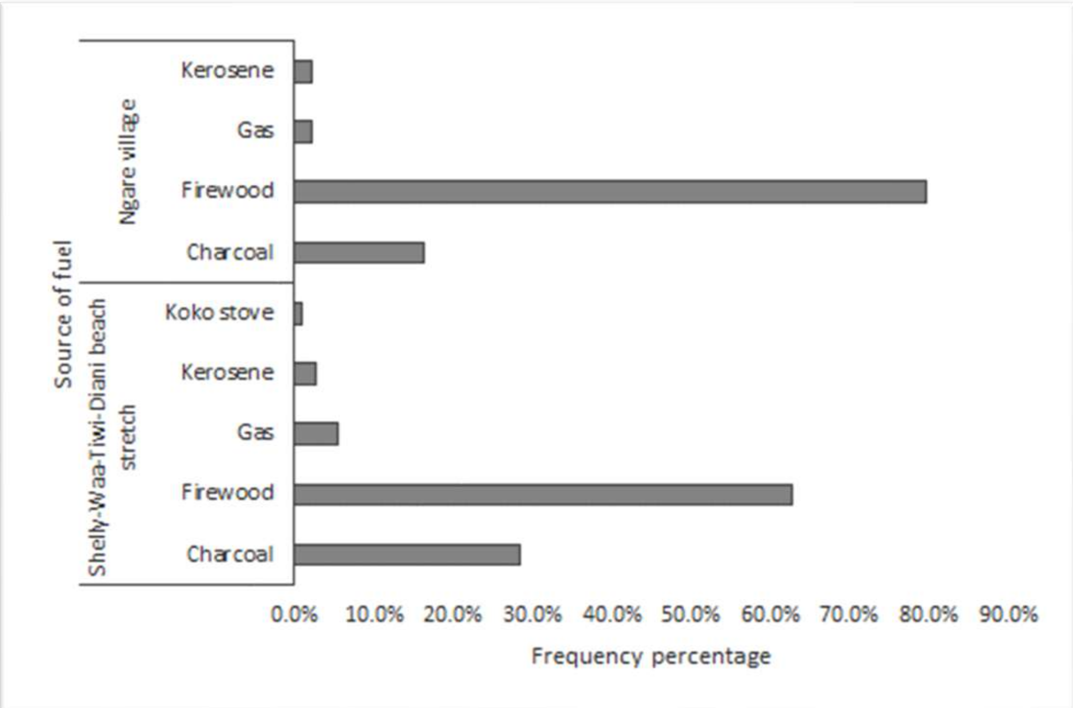


FIGURE 97: SOURCES OF FUEL IN THE PROJECT AREA

5.4.5 Sea Turtle

The Kenyan Sea turtle species and their IUCN categorization status and breeding ecology is presented in **Table 40**. The project area has a number of turtles' nestling sites as shown in **Figure 98** and **Figure 99**. Turtle nestling sites are likely to be found at 10-km and at 50-km from Berth-23 project development site, so the baseline assessment study was conducted at these sites. Turtle-specific data and information were also gleaned from engagement with experts. Experts in research, conservation and management of sea turtles were identified at a turtle conservation meeting held on 18th June 2023 at Safari Beach in Ukunda and attended by consultants. Turtle conservation stakeholders were engaged during the 2023 annual Sea Turtle Festival to identify key persons, contacts, sites, species, and threats to turtles in Kenya.

TABLE 40 - KENYAN SEA TURTLE SPECIES AND THEIR IUCN CATEGORIZATION STATUS AND BREEDING ECOLOGY

Species	Common name	Conservation Status IUCN	Kenyan Conservation status	Breeding frequency
Lepidochelys olivacea	Olive Ridley	VU	-	Sporadically throughout the year
Eretmochelys imbricata	Hawksbill Turtle	CR	Protected	Every 2 or 3 years
Caretta caretta	Loggerhead Turtle	VU	-	Once a year, summer period
Dermochelys coriacea	Leatherback Turtle	VU	-	Every 2 or 3 years
Chelonia mydas	Green Turtle	EN	Protected	Every 2 or 3 years
IUCN Red List of Threatened Species:				

Key: VU-Vulnerable; EN-Endangered; CR-Critically Endangered; DD-Data deficient; LC-Least concern.

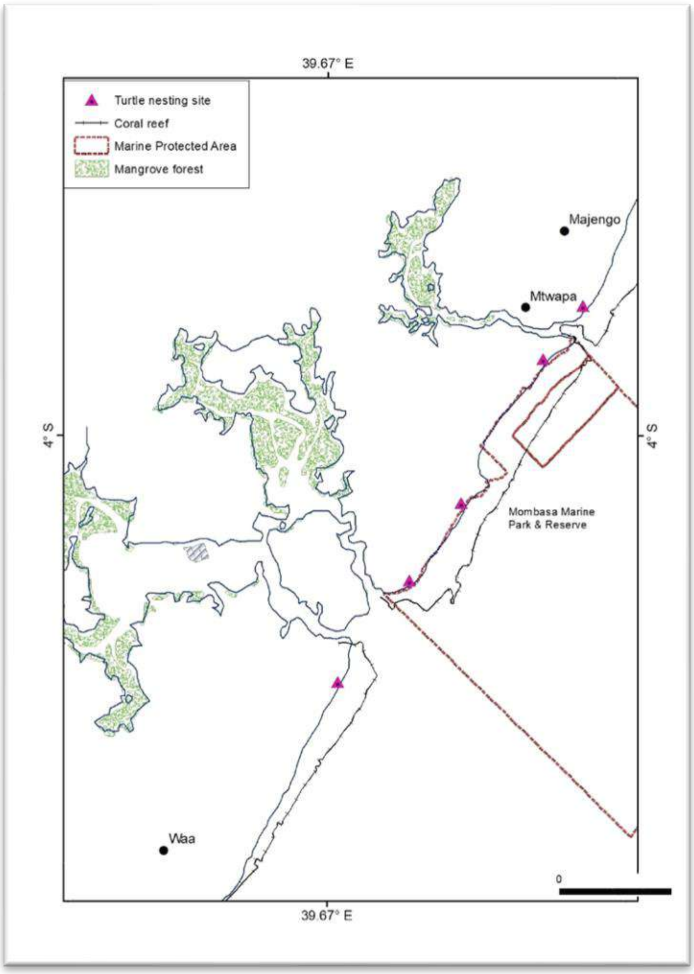


FIGURE 98 - MARINE TURTLES BREEDING/NESTLING AREAS IN MOMBASA

Source: KMFRI KeNODC, 2023

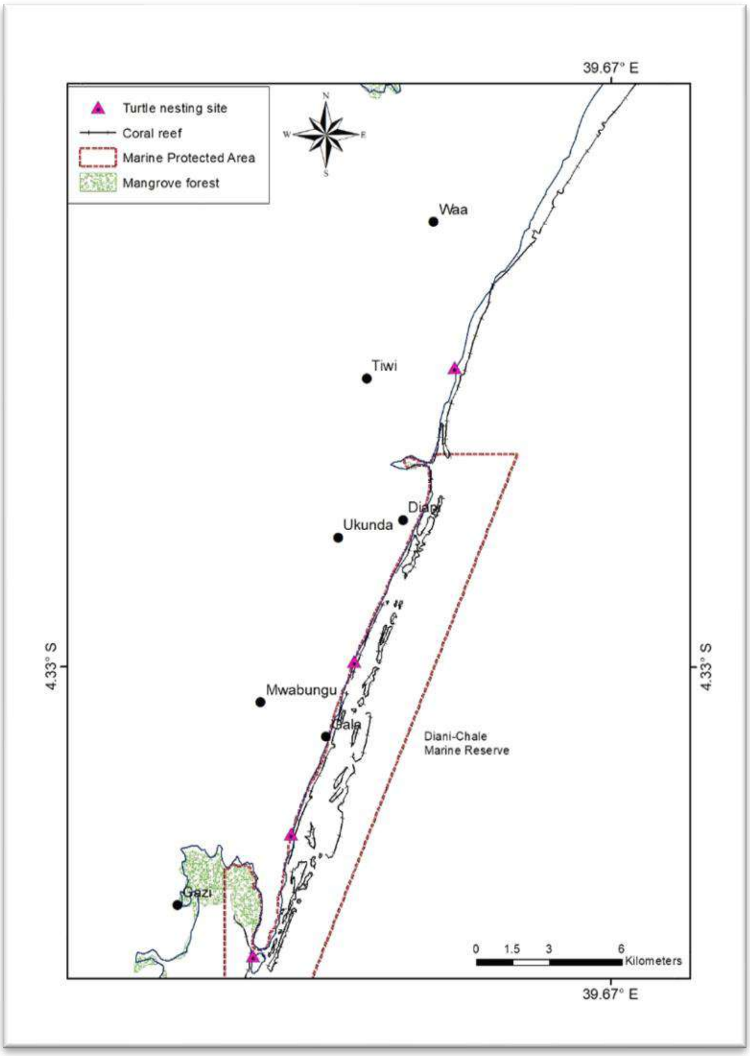


FIGURE 99 - MARINE TURTLES BREEDING/NESTLING AREAS IN KWALE

Source: KMFRI KeNODC, 2023

The IBAT screening tool reported existence of turtle species within the project area of influence, with indications that ALL of the turtle are classified as endangered (IUCN – EN) and with populations decreasing. Turtle nestling areas are shown for both north coast and south coast (**Figure 119** & **Figure 130**), indicating nestling sites are likely to be found at 1-km and up to 10-km zone of the project area of influence (sand harvesting sites and dredge spoil disposal areas). Presence of IUCN-flagged turtles in these areas was a major trigger for the project that called for detailed turtle presence and area use assessments as per plan described earlier. The results of these assessments are presented in (**Table 42**, and **Figure 100**). The consultants appreciate the following groups for their contribution through answering questions and sharing of data and photos that made the assessment a success: Bureni Fishermen Community and Marine Conservation, Diani Turtle Watch, Olive Ridley Project, Mwagandizo, and Tiwi Turtle Police.

TABLE 41 - SUMMARY OF NESTING SITES IN DIANI ALONE BETWEEN 2020-2023

Nest Site	2020	2021	2022	2023
Afrochic	0	3	10	13
Beau Soleil	0	0	0	1
Chale Island	1	2	0	2
Kinondo Kwetu	0	0	0	2
Kongo River	0	0	0	4
Leisure Lodge	0	0	0	16
Sands at Nomads	0	28	12	26
The Maji	0	19	23	37
Diani House	0	15	8	0
Almanara Luxury Resort	0	3	0	0
TOTAL	1	70	53	101

Source: Local Ocean Conservancy and Diani Turtle Watch

FIGURE 100 - SOUTH COAST NESTLING SUITABILITY BETWEEN WAA AND DIANI

Source: Local Ocean Conservancy and Diani Turtle Watch

Table 42 shows the locations visited and contacts met, their turtle conservation activities and concerns. Some groups visited were fairly well coordinated and advanced in their monitoring programs and data reporting. For instance, Diani turtle watch have a robust monitoring program for turtle siting, nestling incidences, and egg relocations, spanning over 65 sites (Agape, Almanara Luxury Villas, Bidi Badu, Chale Island, Diani House, Diani Reef, Forty thieves, Hillpark, Kinondo Kwetu, Kivulini, Leisure Lodge, Leopard Beach Resort, Marijani, Mwaepe, Mzame, Safari Beach, Sand Island, Sands at Nomads, Tiwi Beach, Tiwi House Beach, Two Fishes, Watano Watatu, White Shell, Wireless, Bahari Dhow, Beachalets, Brooks, Copa Cabana, Diani Marine, Diani Sea Lodge, Funzi Island Mzame, Funzi Mzame, Galu, Galu-Kinondo Beach House, Jacaranda, Jadini, Kim 4 Love, Kinondo Chale, Kivulini, Mizipah, Navy, Ocean Village, Papillon Lagoon, Shamba la Salama, Son Riza, The Maji, Tradewinds, University, Villa Kalista, Amigos, Camp Kenya, Golden Beach, Golden Sand, Congo River, La Gusta, Southern Pearls, Watatu Watano, Zumzum, Whitehouse, Southern Palms, Shemshem, Searenity, Massage Beach, Chale Jeza, Asilia Beach, Asha Cottage) and regularly reported.

Figure 101 show summary of nestling sites and nestle relocations for data under the custody of Diani turtle watch for the years 2021, 2022, and 2023 and shows pictorial representation of turtle survey work in representative areas.

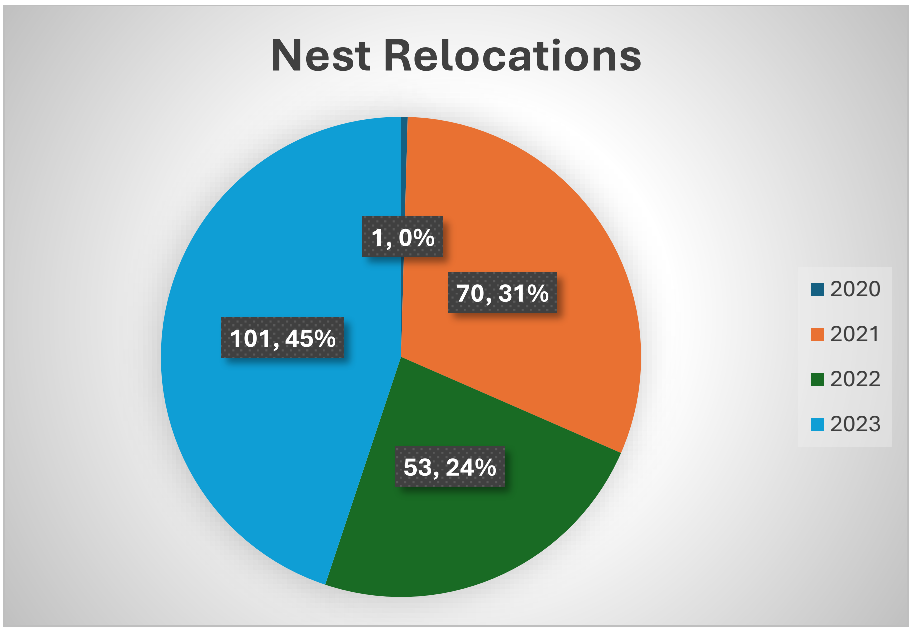


FIGURE 101 - SUMMARY OF NESTING SITES IN DIANI BETWEEN 2020-2023
Source: Local Ocean Conservancy and Diani Turtle Watch

Table 42 - Locations Visited and Contacts Met, Their Turtle Conservation Activities and Concerns.

Date	Location	Organization BMU/CBO	Contact Person / Designation	Conservation Actions Taken	Major Concerns Raised by SH
20/09/2023	Bureni, Vipingo Beach 03.829765 039.815415	Bureni Fishermen Community and Marine Conservation	Joseph Chamanga Chairman	• Beach Patrols • Protection of turtles, nests and hatchlings • Education and awareness creation • Beach clean-up • Data logging	• Funding constraints • Equipment constraints • Lack of infrastructure • Transport constraints • Access restrictions • Enhancement of awareness
21/09/2023	The Sands at Nomads, Diani Beach 04.327124 039.572064	Diani Turtle Watch	Dempsey Mai Project Manager	• Education and awareness creation • Community outreach • Bycatch and release • Data logging • Morning patrols • Habitat protection and Beach clean-ups	• Predators • Lack of proper standard protocols for turtle handling • Absence of night patrols
21/09/2023	Safari Beach Hotel, Diani 04.331031 039.570528	Olive Ridley Project	Leah Mainye Project Manager	• Monitoring and identification • Habitat survey • Training • Population data collection • Education Research	• Funding • Collaborations • Bureaucracy • Lack of proper management of the reserve • Skilled personnel shortage
22/09/2023	Ngombeni location 04.157937 039.641223	Mwagandizo	Juma Swaleh MwaBwogo Secretary	• Nest relocation • Patrols • Beach clean-ups • Creating awareness • Protection of turtles, nests and hatchlings	• Poaching • Equipment for eggs transfer • Night patrols • Funding
22/09/2023	Coconut Village Beach Resort, Tiwi 04.249012 039.601463	Tiwi Turtle Police	Said Hamisi Mwaito Senior Ranger	• Beach patrols • Nest relocation • Daily beach clean-ups • Creating awareness • Data logging • Protection of turtles, nests and hatchlings	• Predators • Skilled personnel • Tagging expenses

TABLE 43 - PICTORIAL REPRESENTATION OF TURTLE SURVEY WORK IN REPRESENTATIVE AREAS.

	
A: turtle survey team at Bureni, Vipingo Beach	B: turtle relocation site at Maji area, Diani Beach
	
C: turtle survey team with KWS officers at Mombasa Marine Park offices	D: turtle survey team with Diani turtle watch staff at their offices in Diani
	
E: Tiwi marine turtle police	Turtle nestling site being protected by local community in Diani

5.4.6 Fisheries

1. Background

The project target area is mostly characterized by fishing activities at small scale with full and part-time fishers, varying fishing gears and sizes, and setting technics, different types of fishing boats/crafts and landing sites where fish is landed. In addition, coastal communities dependent highly on marine ecosystem and aquatic resources as source of livelihood. As ports expansion continue, efforts to minimise the environmental and social are key to safeguard the habitats and marine resources.

Fisheries production and yield are constrained by a number of factors which can be classified as biological, ecological and environmental, technological, social and cultural, and economic considerations. There are frequently also considerations imposed by other users of the fishing grounds and neighbouring areas.

The environment of fish is very rarely static and conditions, particularly of the aquatic environment, can vary substantially over time, from hourly variability, such as the tides, to seasonal variability, for example, water temperature and currents, to decadal variability. These changes frequently affect the population dynamics of fish populations, resulting in changes in growth rates, recruitment, natural mortality rates or any the combinations. Such variability can also affect the availability of fish resources to fishing gear and in general affecting the success of the fishing industry.

Changes in any of the biological, chemical, geological or physical components of the ecosystem can have impacts on the resource population and community. Destruction of coastal habitats for development or the direct impact of fishing on the substrate or on other species impacting the resources, are majorly due to human action.

What is of main concern in fisheries assessment is the understanding of the fishery in terms of the catch trends, species composition, seasonality of the fishery, fishing capacity (gears, crafts and fishers), fishers' distribution in the different fishing grounds and their interactions as Beach Management Units (BMUs)in the fishing areas. It is therefore important to know the quantities and species compositions of fish landed by boat-gear in space and time.

2. The General Overview Fishery

The fishery is small scale and mainly fishing is conducted in shared fishing grounds along the creek area with a few of the fishers in the open sea. The area is characterized by unique marine habitats, with small islands and migratory marine fauna, diverse flora and extensive mangrove habitats in the peninsular. Fish production is influenced by the North-East monsoons (NEM) between November-March and South-East monsoons (SEM) between May-September resulting hence the fishing patterns in the area. 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.

Available information indicates that most fishers within the creek solely depended on the creek fishery resources and only a few fishers access the open sea. Most of these creek fishers target the shallow water prawns, mangrove crabs and those species that thrive in brackish and freshwater ecosystems. Several species/or families of fish have been documented from fish catch reported at the BMUs and fisheries departments in Kwale and Mombasa Counties. The fishery has not been documents at species levels and specifically with regard to identifying the indicator species that could be monitored during project implementation. Some of the species are reported to migrate to the creek during high tides and in search of food, especially the pelagic species and demersal fish predators while other species are resident in the mangrove ecosystem. Eels and Tilapia species have also been reported in the catches and their distribution and seasonality is not well known. Fish catches is not reported at species level. Some of such fish species or groups are indicated in the **Table 44**.

TABLE 44 - SPECIES COMMONLY CAUGHT IN THE CREEK AREA (GOK FISHERIES STATISTICS)

Ecological group	Species /taxa	Family
Demersal predators	Dory snapper	Lutijanidae
	Red Snappers	Lutijanidae
	Grunters	Terapontidae
	Goat fish	Mullidae
	Silver biddy	Gerreidae
	Seabream	Sparidae
	Smelt–whitings	Sillaginidae
	Sweetlips – Grunts	Haemulidae
	Grouper (seabasses), rockcods	Serranidae
	Butterflyfishes	Chaetodontidae
	Eel (Mkunga samaki)	Muraenidae
Medium pelagics	Blue Trevallies	Carangidae
	Baraccuda (toa,	Sphyraenidae
Large pelagics	Kingfish	Scombirdae
Small pelagics	Sardines	Sardinella
Mesopelagics	Mullets	Mugilidae
Sharks, rays	Sharks	Carcharhinidae
	Rays	Mobulidae
Crustacea	Prawns	Penaeidae
	Mud crabs (mangrove crabs)	Portunidae

3. Objective of the Study

The main objective was to conduct an assessment of the fisheries resource within the proposed project area and quantify any possible and likely impacts to the fisheries resource and habitats and the fishery dependents.

Specifically, the study was meant to

1. Assess and identify fish taxa and other associated marine mega-fauna in proximity to disturbance areas and associated risks
2. Identify any locally, nationally and/or regionally rare and/or endangered species of fish that might potentially be impacted by the proposed project

3. Identify Beach management Units (BMU), landings sites, bandas, and access to fishing grounds that occur within the proposed project areas (dredging or sand harvesting)
4. Identify impacts fisheries infrastructure e.g. landings sites, bandas, and accessibility of proposed relocation sites
5. The likely impacts on the fishery resources and habitats due to implementation of the project

4. Methodology and Approach

(1) Study Sites

The most important landing stations to be considered during the fisheries assessment include; Tudor (along makupa creek) Kitanga Juu/Ngare and Mkupe (PortReizt) Mwangala, Mwakuzimu, Mtongwe and Likoni (Likoni Mtongwe), all in Mombasa County and Guya, Mwadumbo and Tsunza central in Kwale County (**Figure 102**). The study also targetted Nyari Kikadini, Tiwi and Mwakamba BMU/landing sites in Kwale county based on the location of the proposed sand harvesting sites. Other important fishing areas are in the open sea off the Likoni channel considered are Likoni, Timbwani and Shika adabu owing to their location with regard to project site sand harvesting and the port expansion at the Port Reitz creek.

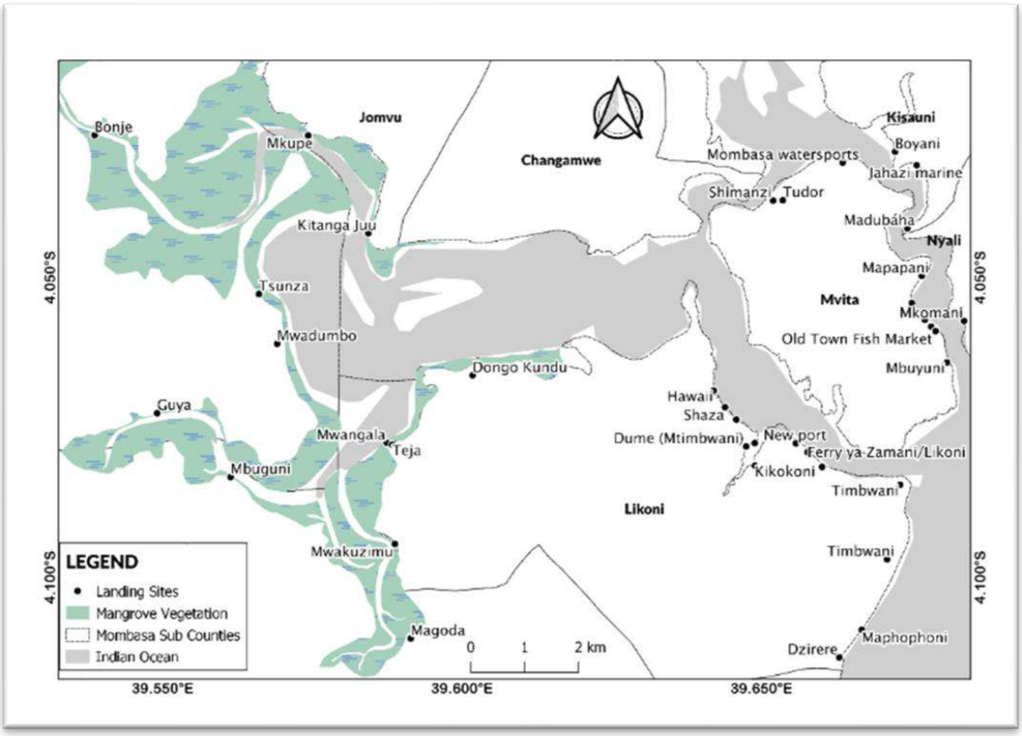


FIGURE 102 - A MAP OF THE PORT-REITZ AND TUDOR CREEKS AND OPEN SEA, SHOWING THE DISTRIBUTION OF LANDING SITES AND THEIR LOCATION.

The fishery was categorized into creek for the purpose of dredging activities and open sea for the sand harvesting activities as shown in **Table 45**.

TABLE 45 - FISH LANDING SITES SAMPLED DURING THE SURVEY CATEGORIZED AS WITHING PROPOSED DREDGING AND SAND HARVESTING/DUMPING SITES

Category1: Dredging site			**Category 2: Sand Harvesting and Dumping site**		
Fishing/landing area	**County**	**Ecosystem**	**Fishing/landing area**	**County**	**Ecosystem**
Mkupe	Mombasa	Creek	Likoni	Mombasa	Channel/Open Sea
Kitanga Juu	Mombasa	Creek	Timbwani	Mombasa	Open sea
Ngare	Mombasa	Creek	Shika adabu	Mombasa	Open sea
Tudor- Shimanzi	Mombasa	Creek	Nyari Kikadini	Kwale	Open sea
Mtongwe	Mombasa	Creek/Channel	Tiwi	Kwale	Open sea
Tunza	Kwale	Creek	Mwakamba	Kwale	Open sea
Madumbo	Kwale	Creek	**Other BMUs**	Mombasa	Open sea
Guya	Kwale	Creek			

(2) Data Collection and Methods

Data collections was through observations, consultations with the stakeholders through questionnaire-based study, literature review of relevant documents and baseline monitoring of Fisheries catch, effort and BMUs. The main source of data was:

- Annual statistics from National government statistical bulletin
- Previous environmental study reports or published literature
- Other Relevant technical reports
- Field based survey

The data collection method employed both quantitative and qualitative data gathering to establish fisheries information. This was done through interviews and literature review. Primary information and data were generated through structured questionnaires or interviews with fishers, traders and boat owners. Each questionnaire was aligned with each stakeholder or sector contacted. Production data was obtained from county governments departments of fisheries and national statistics from government. Data on trade routes was collated by a questionnaire survey targeting the fish traders

Secondary information involved a review of existing relevant information including review of previous environmental study reports from State Department for the Blue Economy and Fisheries, the Fisheries Livelihood Restoration Plan (2019) prepared by Kenya Ports Authority, Strategic Environmental Assessment (SEA), the Comprehensive Environmental and Conservation Management (CECM) plans for the Special Economic Zone (SEZ) 2018) among others.

Fish ground information was collected during the field surveys and fishing locations from previous studies that had mapped the fishing grounds.

(3) Field Survey

The creel survey design, two-stage sampling units, with landing sites as the Primary Sampling Units (PSUs) and boat-gears as the Secondary Sampling Units (SSUs) was adopted. The primary sampling units are landing sites and associated to Beach Management Units (BMUs). The secondary sampling units are fishing vessel-gear type at the identified landing sites was based on frame survey information 2022.

The questionnaire-based survey was conducted in 18 landing stations looking into the type of fish landed, sizes, fishing patterns gears and overall fishing effort in the area. Information on fishing vessels details and the market and trade was also collected.

Individual fish were weighed to the nearest kilogram using weighing balances and measuring tapes and measuring boards and individual weights for each fisher, boat or trader recorded in standard data sheet.

(4) Statistical Data Analysis

In order to ensure a comprehensive report on the Mombasa Port Infrastructure Development on fisheries resources, the data was analysed to understand the following.

- Species composition (diversity),
- Size distribution by species,
- Weight by species and
- Total weight of the fish landed

5. Results

(1) Fishing Activities

A questionnaire-based survey was used at 18 landing stations looking into the type of fish landed, sizes, fishing patterns gears and overall fishing effort in the area. Information on fishing vessels details and the market and trade is also being collected. A total of 1678 fishers, 1410 traders and 434 vessel owners (**Figure 103**) were interviewed during the 12 field surveys.

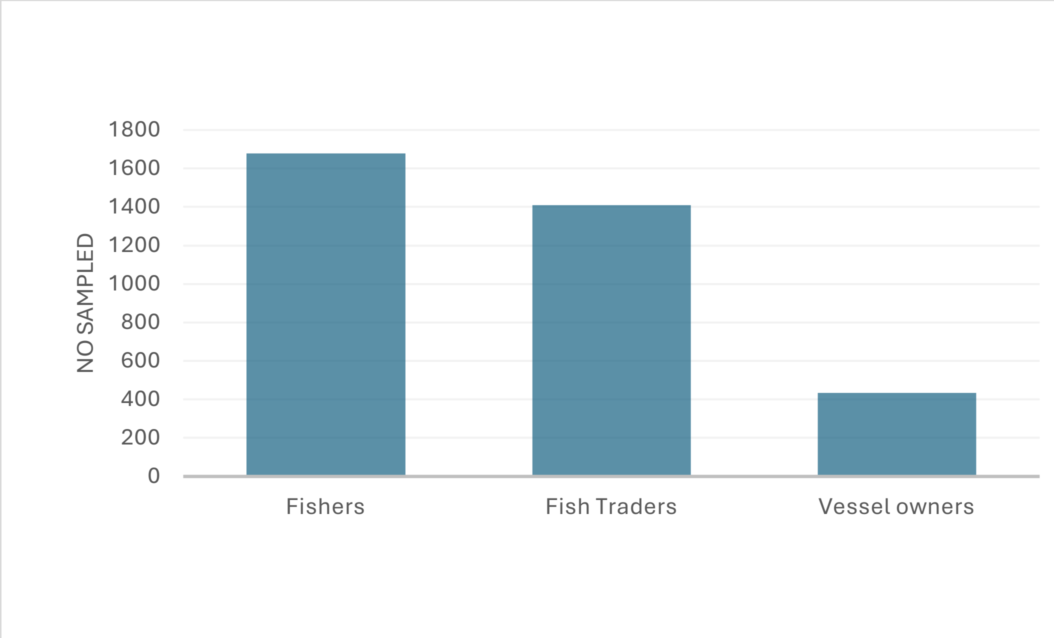


FIGURE 103 - NUMBER INTERVIEWED

(2) Distribution of Fishers

There are estimated 1,275 fishing crew within the proposed Mombasa Port development area who use different types of fishing crafts while 252 are foot fishers distributed as indicated in **Table 46**. The Foot fishers access to the nearshore fisheries grounds is limited thus livelihoods are highly vulnerable.

TABLE 46 - FISHERS DISTRIBUTION AT LANDING SITES

Row Labels	Foot Fishers	Fisher -crew
Kwale		
Guya	43	103
Mkunguni	7	141
Mwadumbo	8	110
Mwagandizo	35	61
Mwakamba	5	52
Tiwi	38	109
Trade Winds	28	90
Tsunza	41	170
Mombasa		
Dongo Kundu	3	17
Kitanga Juu		35
Mikunguni	1	10
Mkupe	4	115
Mwangala	1	6
Mweza	7	22

Ngare		44
Nyali Reef	6	70
Shaza	3	32
Shimanzi	1	10
Timbwani	21	78
Grand Total	**252**	**1275**

Source: GoK Frame Survey, 2022

(3) Distribution of Fishing Crafts

The area under assessment has 448 fishing crafts of different types. Landing sites in kwale have 276 crafts comprising of Mtumbwi 40%, Dau 37% and Mashua, 4%. While Mombasa County landing sites have 172 crafts consisting of Mtumbwi 87%, Dau 7%, Mashua 3%, and Hori 1% distributed along the landing sites in proximity to the port. The fishers with Mtumbwi, Hori, Mtori and Surf accessibility to the fishing grounds may be interfered with.

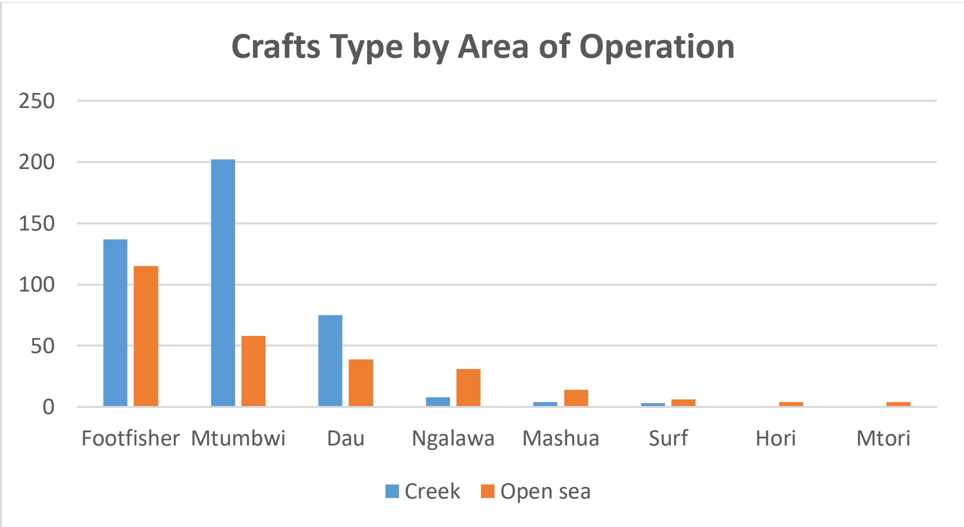


FIGURE 104 - DISTRIBUTION OF CRAFT TYPE BY AREA OF OPERATION (CREEK AND OPEN SEA)

Most fishers from both assessment areas use boats made from Wooden and Fibreglass material. In creek areas, wooden boats accounts for 96%, while fibreglass 4%. For open sea area landing sites Wooden 80%, fibreglass 17% and plastic/rubber 3%. The boat length ranges from 2 to 20 m in length and fish for 6 days a week (Frame survey 2022 and field survey)

TABLE 47 - DISTRIBUTION OF FISHING CRAFT BY LANDING SITES

Kwale			**Mombasa**		
Landing sites	**Craft Type**	**Number**	**Landing sites**	**Craft Type**	**Number**
Guya	Mtumbwi	35	Dongo Kundu	Mtumbwi	10
	Dau	2	Kitanga Juu	Mtumbwi	14
	Mtori	1		Dau	1
Mkunguni	Ngalawa	23	Mikunguni	Mtumbwi	6

	Dau	21	Mkupe	Mtumbwi	56
	Mtumbwi	1		Dau	2
	Mashua	1	Mwangala	Mtumbwi	4
Mwadumbo	Mtumbwi	68	Mweza	Mtumbwi	5
Mwagandizo	Mtumbwi	7		Dau	3
	Ngalawa	2	Ngare	Mtumbwi	32
	Surf	1	NyaliReef	Hori	4
Mwakamba	Ngalawa	5		Dau	2
	Mashua	4	Shaza	Mashua	5
	Dau	3		Mtumbwi	4
	Mtori	3	Shimanzi	Mtumbwi	6
	Surf	1	Timbwani	Mtumbwi	12
Tiwi	Ngalawa	6		Dau	4
	Mashua	4		Surf	1
	Surf	2		Mashua	1
	Dau	2			
Trade Winds	Dau	6			
	Surf	4			
	Ngalawa	3			
	Mashua	3			
Tsunza	Dau	68			

There are different propulsion modes for fishing boats, with most of the fishers in open sea using fishing boats with Paddles (51%) Sails 31% and motorized engines (18%). In the creeks majority of fishers reported the use of paddle boats (93%), sailboats (2%), and motorized boats (3%). This is an indication that Majority of the fishers in the two zones have limited capacity to venture into offshore and high sea fishing.

Figure 105 and **Figure 106** show the distribution of different fishing crafts (boats) with over 90% crafts in Mwandumbo while in other BMUs fishers on foot are majority with over 80% in Nyari-Kikadini and over 70% reported in Bonje and Tiwi.

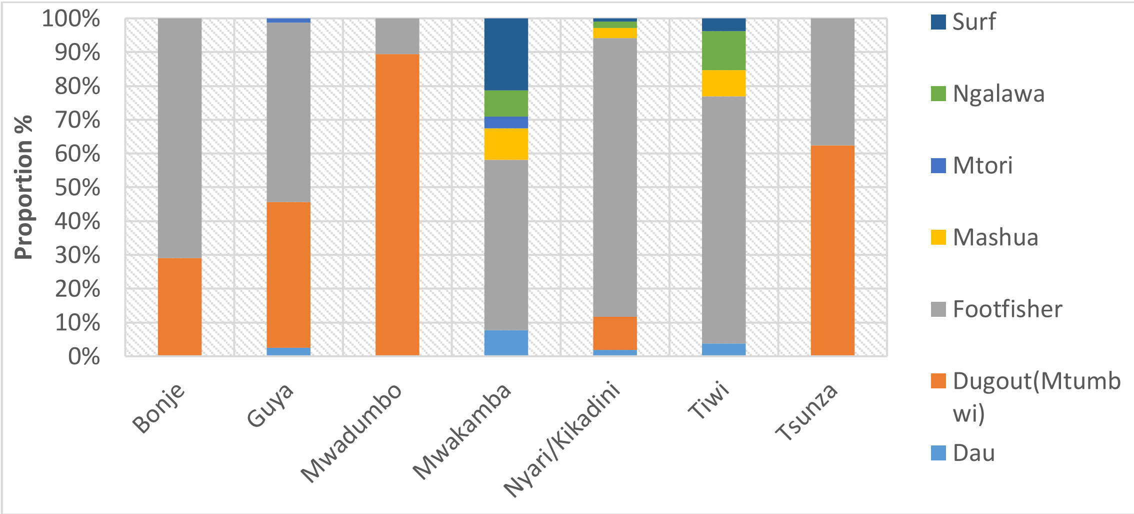


FIGURE 105 - CRAFT DISTRIBUTION WITHIN BEACH MANAGEMENT AREAS IN MOMBASA (FRAME SURVEY REPORT 2022)

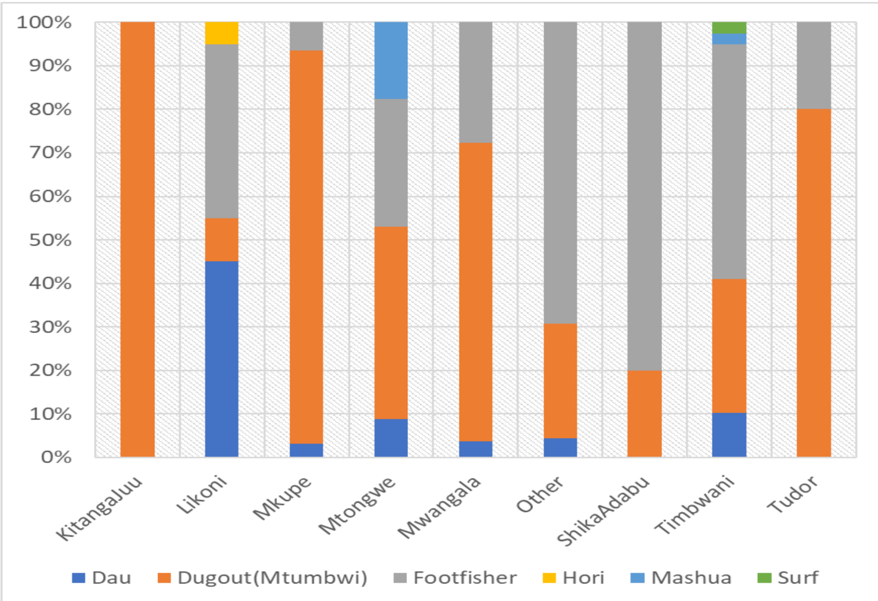


FIGURE 106 - CRAFT DISTRIBUTION WITHIN BEACH MANAGEMENT AREAS IN MOMBASA

Kitanga Juu, Mkupe, and Tudor have over 80% Dugout canoes while the rest are dominated by foot-fisher.

(4) Fishing Crafts Propulsion Mode

The most common propulsion mode is by paddles both in the creek and open sea fishing areas as shown in **Figure 107**.

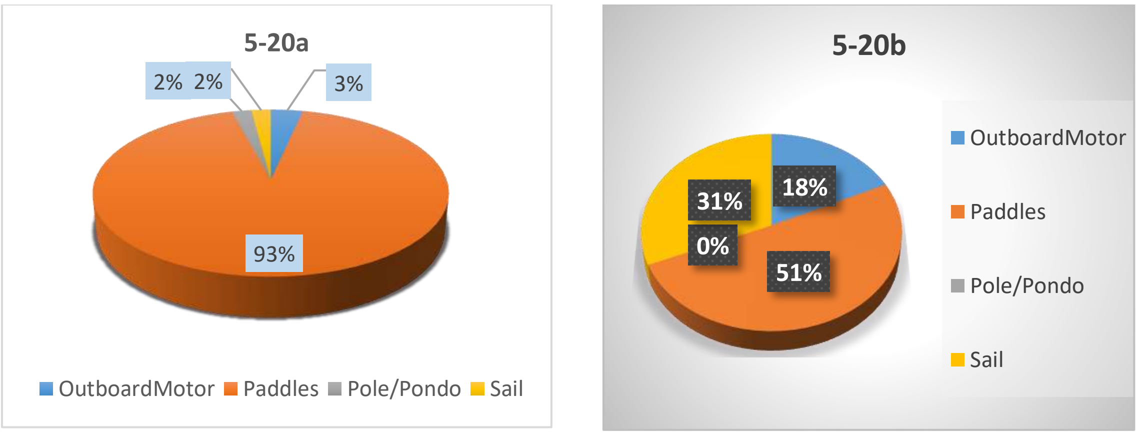


FIGURE 107 - MODE OF PROPULSION IN THE CREEK AND OPEN SEA

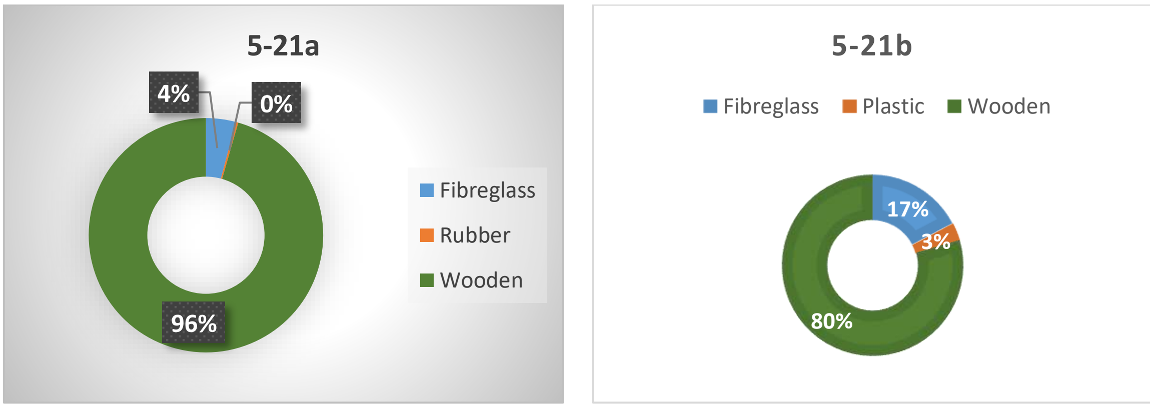
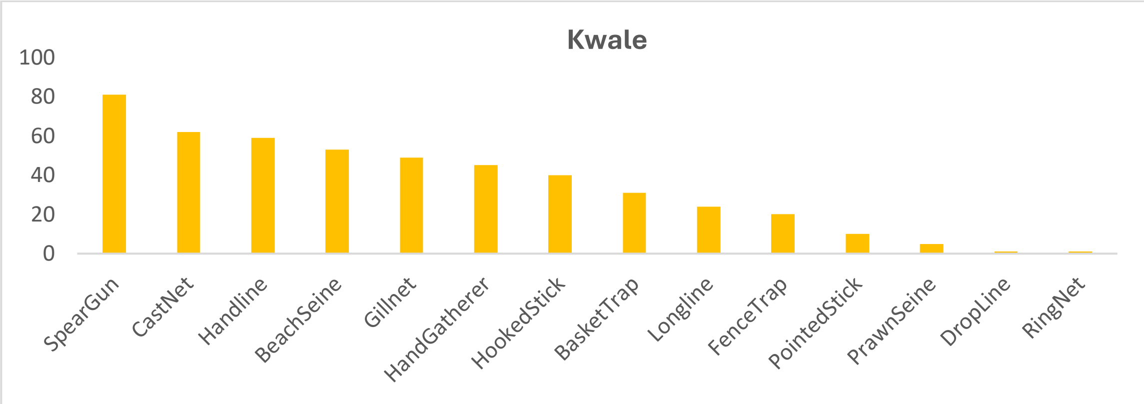


FIGURE 108 - DISTRIBUTION OF CRAFT TYPES BY MATERIAL

(5) Fishing Gears

Based on the survey, a total of 481 and 219 varied fishing gear types were sampled in landing sites of Kwale and Mombasa respectively. The majority of fishing gears in Mombasa landing sites are handlines 24%, Cast nets 20%, Gillnet 11% and Prawn Seine 6% while in Kwale landing sites, Speargun (17%), Cast nets (13%), Handlines (12%), and Beach seines (11%).



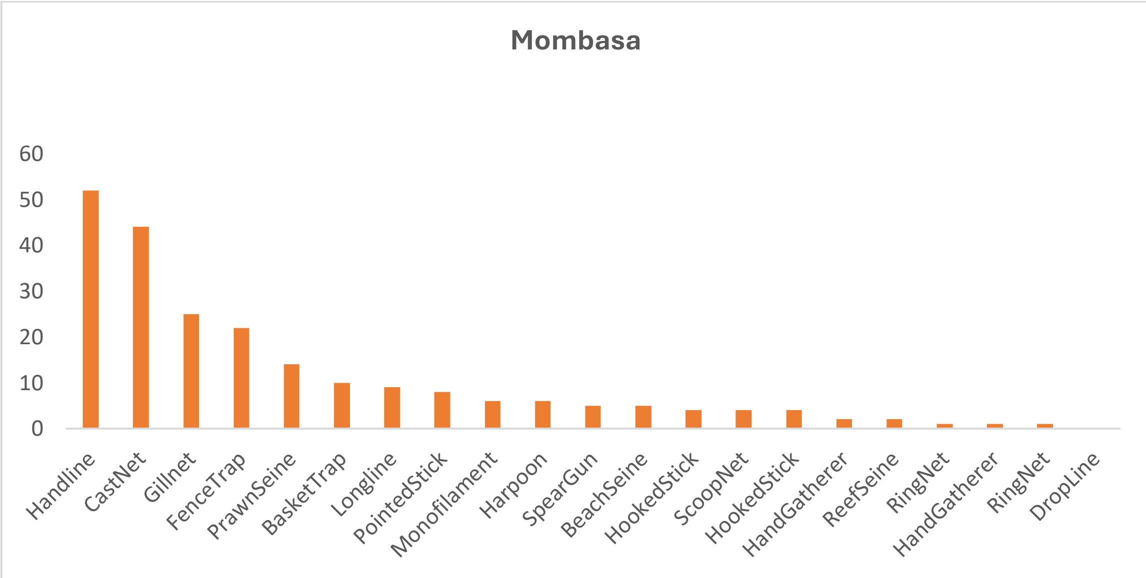


FIGURE 109 - FISHING GEAR DISTRIBUTION BY AREA

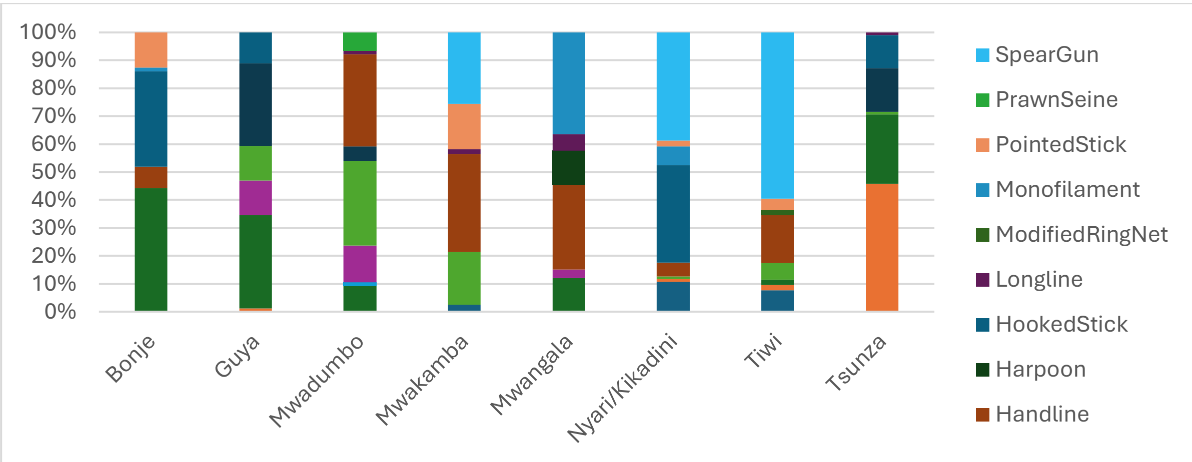


FIGURE 110 - GEAR DISTRIBUTION WITHIN BEACH MANAGEMENT AREAS IN KWALE

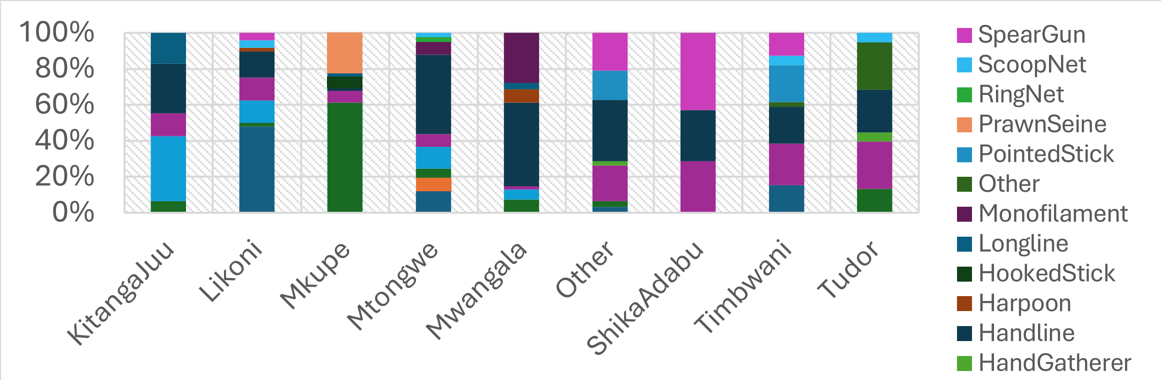


FIGURE 111 - GEAR DISTRIBUTION WITHIN BEACH MANAGEMENT AREAS IN MOMBASA

(6) Fish Production

TABLE 48 - FISH PRODUCTION OF BMU IN 2023 (COUNTY FISHERIES DEPARTMENT)

	Mwaepe	Mwakamba	Tiwi	Nyari/ Kikadini	Tsunza	Bonje	Guya
Dermasal	**Kgs**	**Kgs**	**Kgs**	**Kgs**	**Kgs**	**Kgs**	**Kgs**
Dermersals	11,212	95,602	56,816	**532,246**	123,510	**44,407**	13,234
Pelagics	109,104	43,951	6,512	175,190	11,673	28,627	-
Sharks and Rays	98,654	48,377	**307,482**	24,615	119,625	34,136	-
Crustacean	694	25,400	4,246	33,444	**148,775**	6,102	**467,878**
Molluscs	**127,866**	**210,601**	8,736	60,104	6,261	5,499	42,550
GRAND TOTAL	**347,530**	**423,931**	**393,792**	**1,025,599**	**409,843**	**178,772**	**523,662**

The total production by species groups based on estimated 2023 landed catch. Mullusc especially octopus are commonly caught in Mwaepe (128 tons) and Mwakamba (210 tons). In the creek fishery prawns dominate the fishery with Guya and Tsunza landing 468 tons and 149 tons respectively.

(7) Species Composition

1) Landing Sites within the Creeks

For the targeted fishes, most fishers in both within the creek and open sea landing sites targeted demersal fish families that are often found nearshore or near creeks. In the creeks the most dominant species are Peneaus Spp, Cephalopholis argus, Pomadasys operclare , Scylla spp and Mugil cephalus while in the open sea landing sites Penneaus spp, Siganus Spp, Cephalopholis argus, Lethtrinus Spp and Euthynnus pelamis as indicated in figure 5-24. The fish composition varies across the landing sites in the two counties.

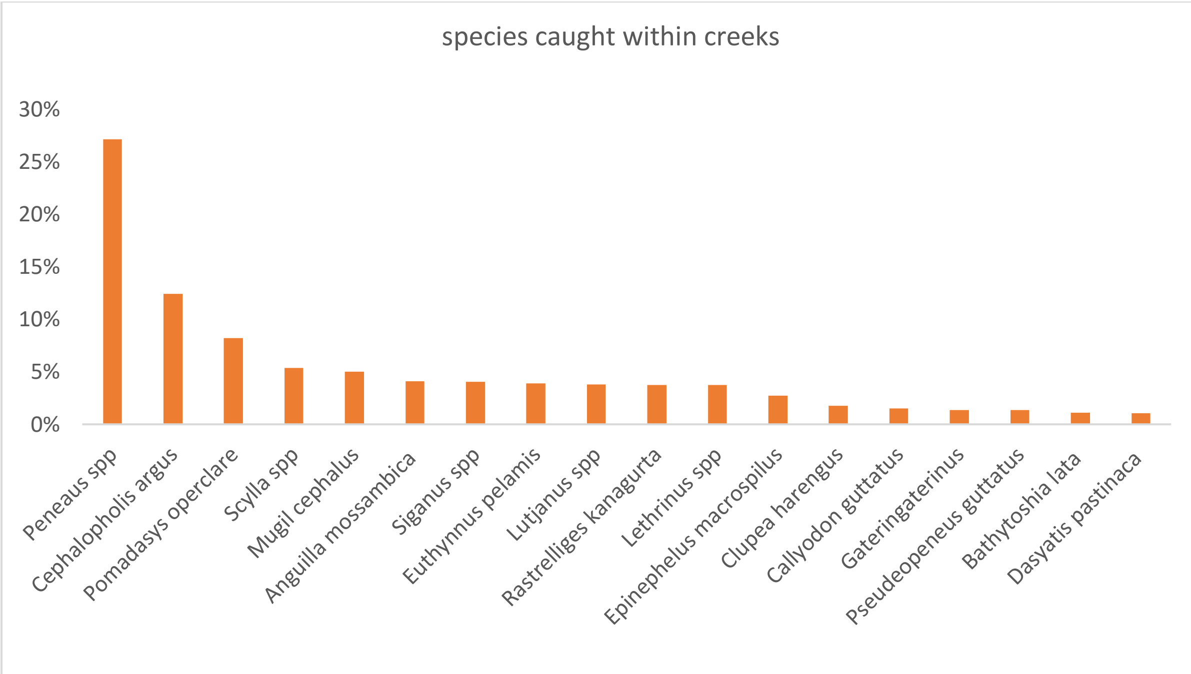


Figure 112 - Species Composition of Fish Landed by BMU within the Creeks

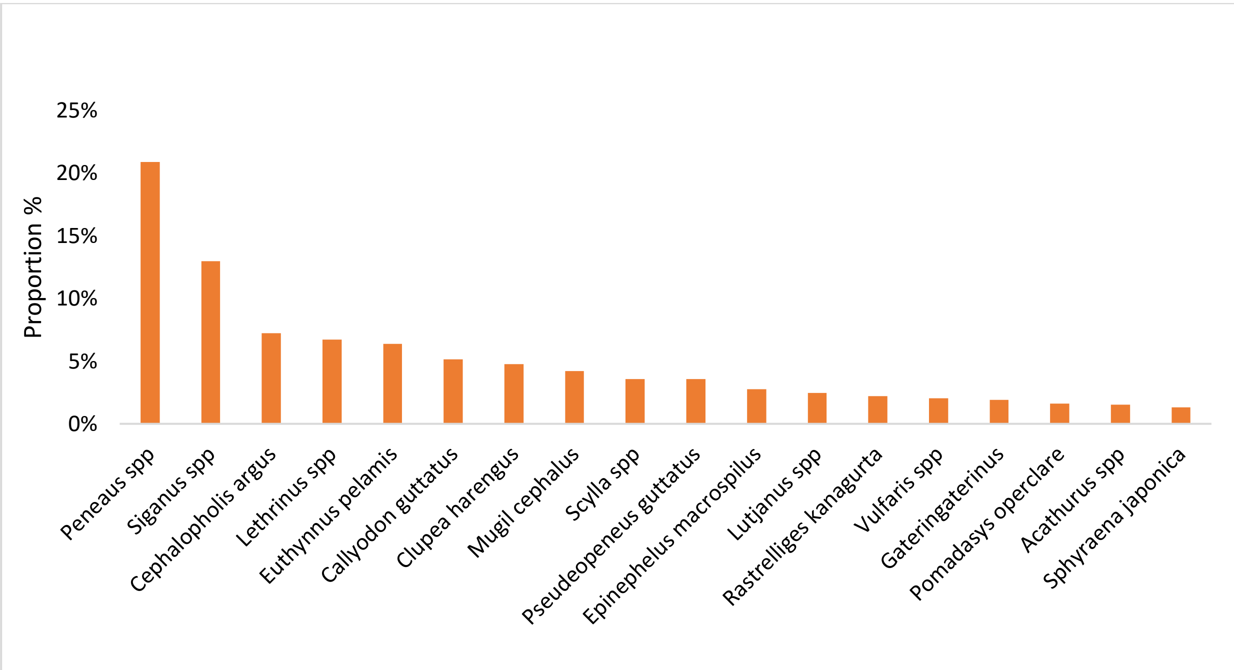


Figure 113 - Fish species caught Open Sea fishing areas

(8) Fishing Grounds

The fishing grounds in the assessed landing sites are mainly in the creeks and open sea. The more preferred fishing grounds are coral reefs and mangroves were identified as the most preferred fishing habitats. Fishing grounds with the highest fishing intensities mostly overlapped with by fishers from several landing sites are Dongo kundu, Mwangala, Tonesa, Mweza, Kiomeni, Ngare and Mkupe (**Figure 114**).

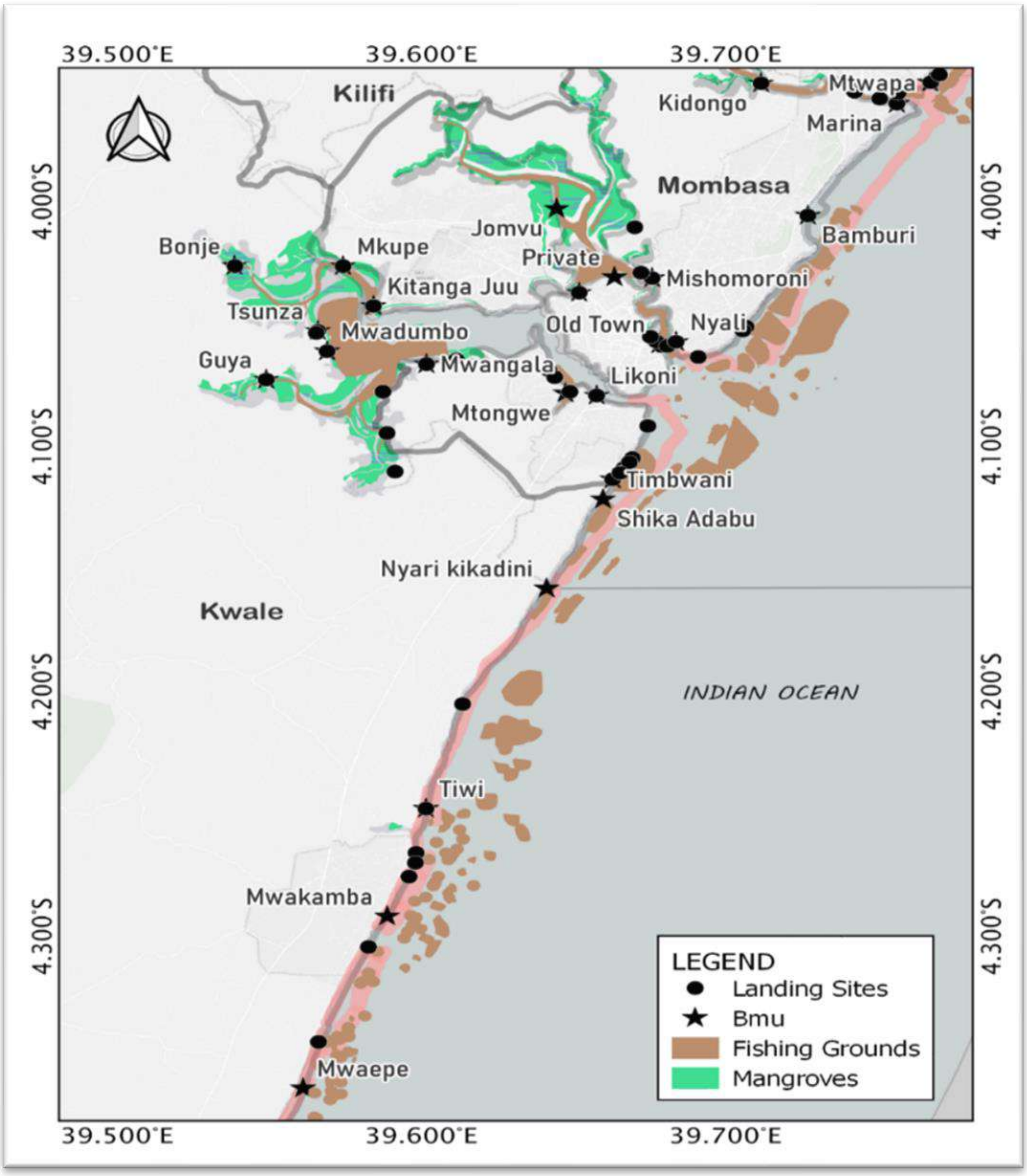


FIGURE 114 - MAP SHOWING BMU, LANDING SITES, FISHING GROUNDS AND MANGROVES AREA

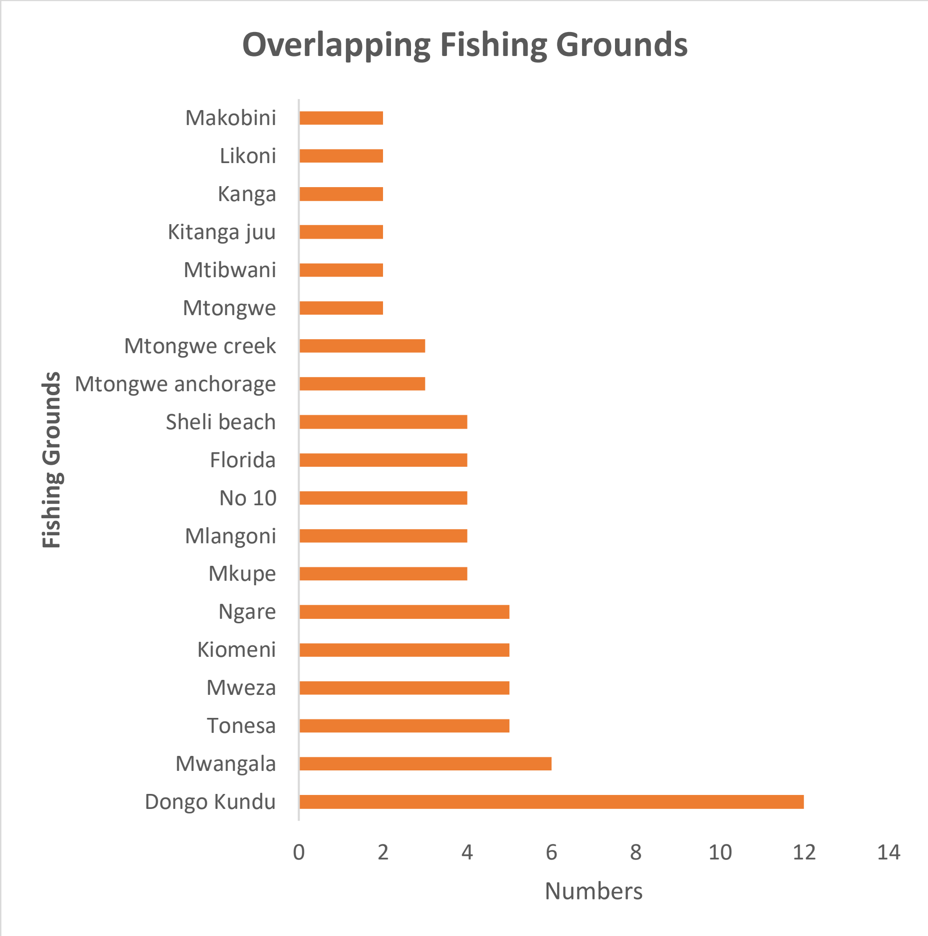


FIGURE 115 - COMMONLY FISHED FISHING GROUNDS BY LANDING SITES

TABLE 49 - COMMON FISHING GROUNDS FOR VARIOUS LANDING SITES

Fishing Grounds	Landing Sites
Dongo Kundu	Dongo Kundu, Guya, Kiboponi, kitanga juu, Kwamapengo,Kwasowa, Mkunguni, Mkupe, Mwadumbo, Ngare, Shimanzi, and Tsunza Central.
Mwangala	Dongo Kundu, kiboponi, kitanga juu, kwasowa, mwadumbo and ngare
Tonesa	Kitanga juu, Kwasowa, Mwadumbo, ngare, Tsunza
Mweza	Hawaii, Likoni-Ferry,Mweza creek , Shaza, Shimanzi,
Kiomeni	Kiboponi, kitanga juu, Kwamapengo,Kwasowa, Mwadumbo,
Ngare	kitanga juu, Mwadumbo, Ngare, Shimanzi, Tsunza Central
Mkupe	Kitanga juu, Mkupe, ngare, Tsunza
Mlangoni	kitanga juu, Mwagandizo, Pungu, Timbwani,
No 10	Hawaii, Likoni-Ferry, Shaza
Florida	Hawaii, Kiboponi, Likoni-Ferry, Shimanzi.
Sheli beach	Hawaii, Likoni-Ferry, Mwagandizo, Shimanzi.
Mtongwe anchorage	Hawaii, Mweza creek, Shaza
Mtongwe creek	Hawaii, Shaza, Shimanzi,

Mtongwe	Mweza creek, Shaza
Mtibwani	Mweza creek, Shaza.
Kitanga juu	kitanga juu, Mwadumbo
Kanga	Mweza creek, Shaza
Likoni	Mweza creek, Shaza
Makobini	Kiboponi. Mwadumbo

(9) Size Distribution by Species

In the size range of 1-10cm most landed fish in both the creeks and open sea, were prawns and pouter, range of 11-30cm, Larger proportion of fish sizes landed in creek were in the range of 11-30cm; Cavilla Jacks, Blackskin, Parrot Fish, Mullets and Scavengers. Fish of size >30 cm were mostly Snappers and grunters while in the open sea; Cavilla Jacks and Octopus.

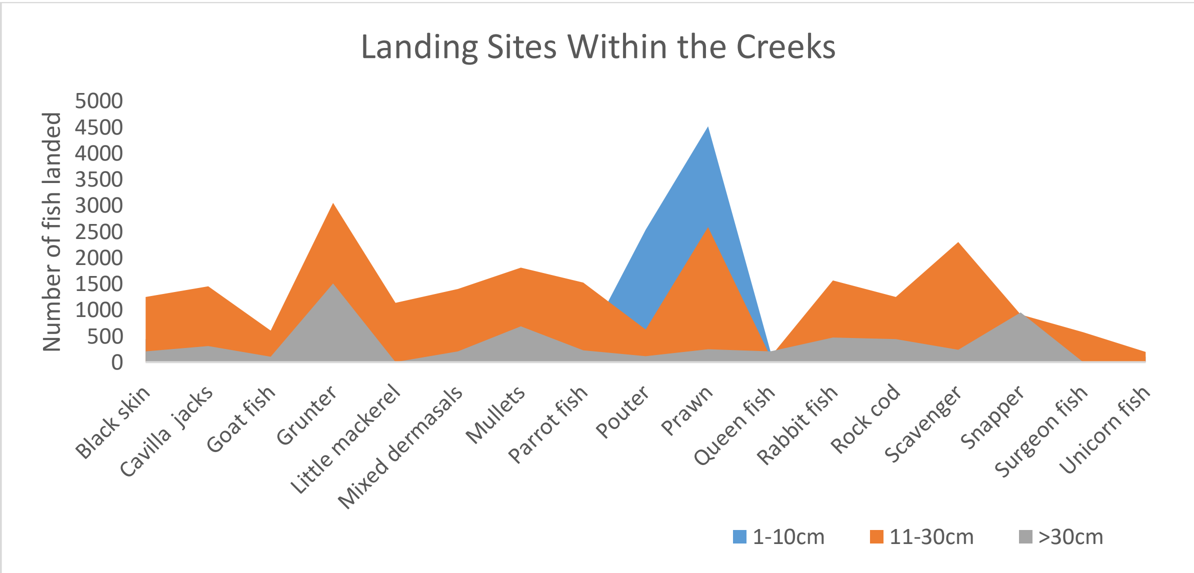


TABLE 50 - SIZE DISTRIBUTION BY SPECIES OF FISH CAUGHT IN CREEKS

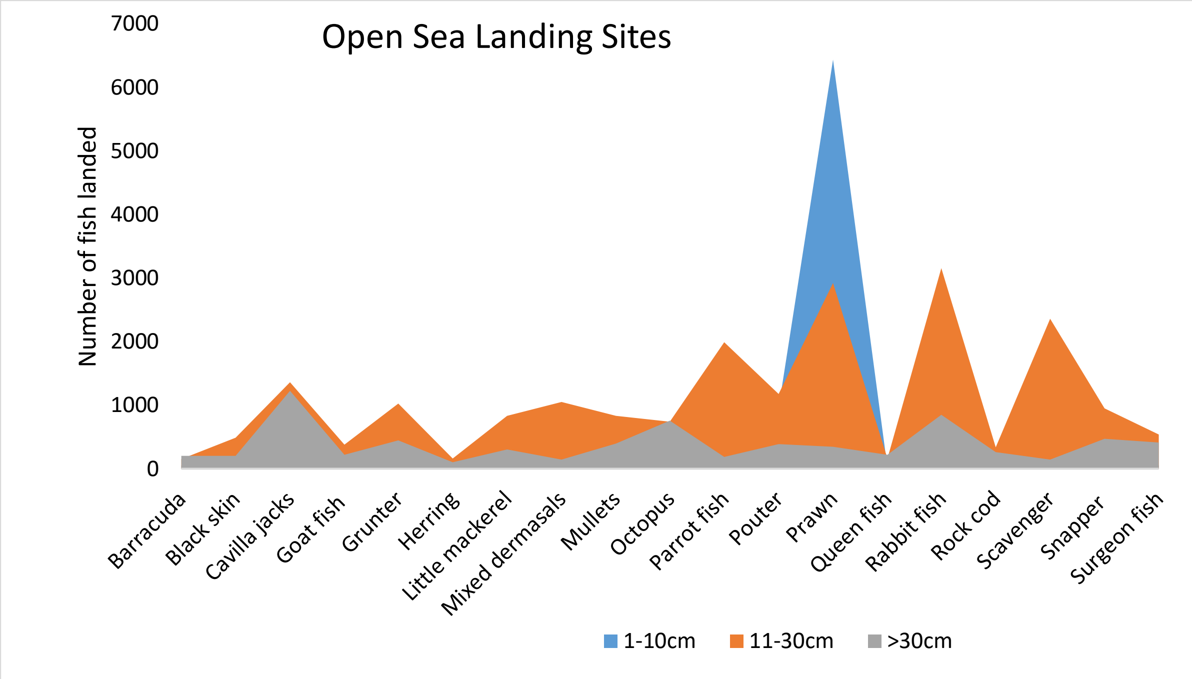


FIGURE 116 - SIZE DISTRIBUTION BY SPECIES OF FISH CAUGHT IN THE OPEN SEA

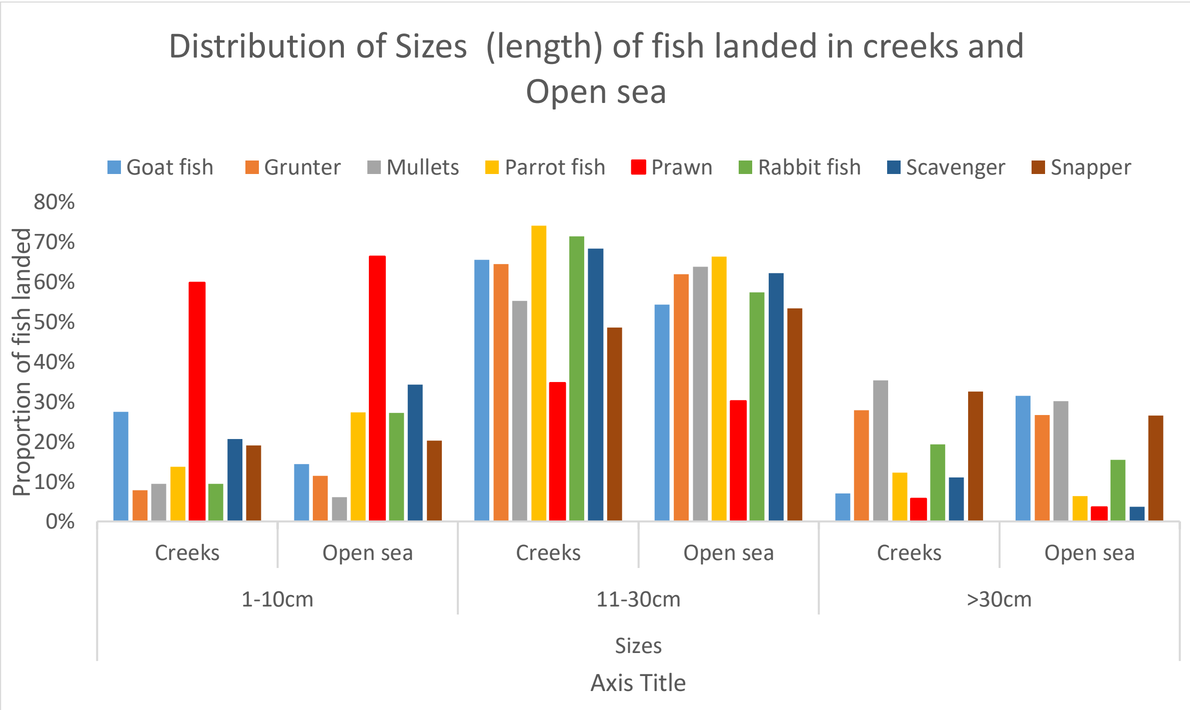


FIGURE 117 - DISTRIBUTION OF FISH SIZES LANDED IN CREEKS AND OPEN SEA

(10) Size-Specific Selectivity of Selected Gears

Based on gear selectivity, basket trap caught majority of fish in size class 11-30cm for the open sea and creeks landings, while for size class 1-10cm and >30cm registered marginal landings in the creek area. Most of fish landed by cast nets were size class of 1-10cm in both the creeks and open Sea. With minimal sizes above >30cm total length landed in in both areas Cast net landed.

Notably the Gillnets caught most fish in size range 11-30cm and 1-10cm as compared to those caught in the open sea. The monofilament landed most fish in the range of 11-30cm in the open sea. The prawn seines were effective landing fish size range 1-10cm in the open sea and creeks.

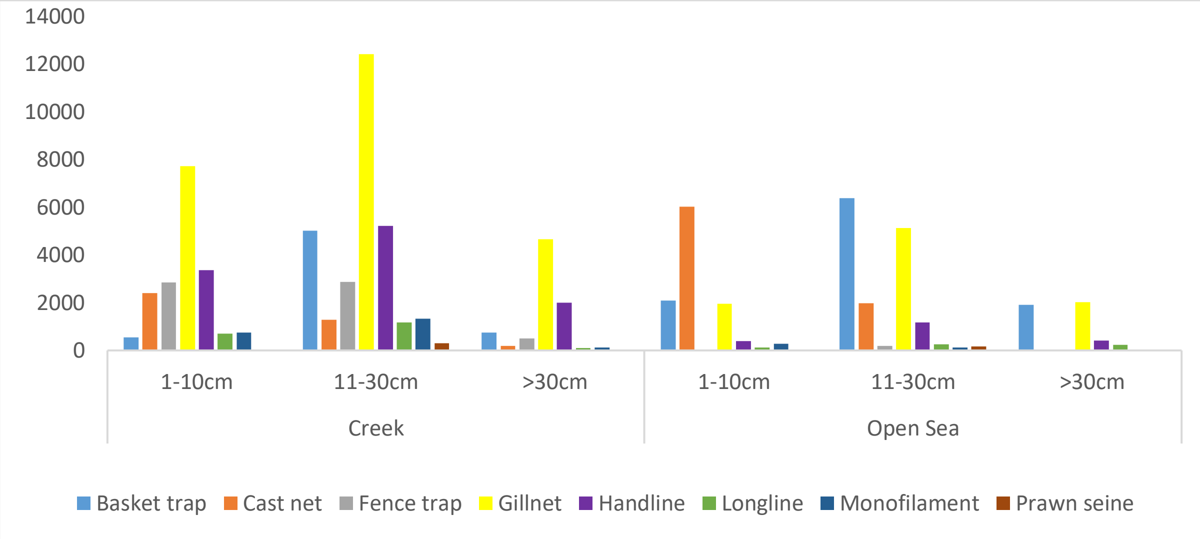


FIGURE 118 - FISH SIZES BY GEAR TYPE IN THE CREEK AND OPEN SEA

(11) 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. The registers for the resource users and BMU membership are updated regularly. Data for this assessment was obtained from the county fisheries BMU registers. BMUs are guided by Fisheries management and development Act Cap 378 of 2016 and BMU Regulations of 2007 revised 2024 (GoK, 2024) and the participation of fisher-folks is in line with the general principles of Code of Conduct for Responsible Fisheries (FAO, 1995).

TABLE 51 - DISTRIBUTION OF BMU MEMBERS CATEGORY (AS PER COUNTY BMU REGISTERS)

BMU Name	Total No. of members	No. of males	No. of females	Total No. of Fishers	Total No. of Boats
Kwale					
Mwaepe	279	244	35		

Mwakamba	941	600	341	360	35
Tiwi	163	172	17	163	18
Nyari Kikadini	460	289	171	192	23
Mwadumbo	360	160	193	167	50
Tsunza Central	950	530	420	414	70
Guya	289	166	123	170	36
Bonje	1095	445	650	310	17
Mombasa					
Likoni	439			274	
Mtongwe	269			192	
Timbwani	201	156	45	105	
Mwangala	229	130	99		
Shikaadabu	148	114	34	78	
Tudor	132			82	
Kitanga Juu	363			252	
Mkupe	396	250	146	219	
Others					

(12) Fish Community Characteristics

Fishing is done communally or in groups although some fishers reported to be undertaking fishing activities on their own. Based on previous studies 70- 80% of the fishermen use hired crafts within the creek while only 5-10 % own fishing crafts. The fishery is male dominated while women are involved in fish trade and value addition.

One or two landing sites are likely to be in fish landing sites.

TABLE 52 - DISTRIBUTION OF FISH LANDING SITES

County	Landing sites	Vessel Owners	Fishers	Traders
Kwale	Guya	26	61	23
	Kiboponi	9	26	54
	Kwamapengo	1	9	13
	Kwasowa	4	14	13
	Mkunguni	26	141	47
	Mwadumbo	12	48	39
	Mwagandizo	24	23	65
	Mwakamba	26	54	98
	Tiwi	22	109	88
	Tradewinds	20	90	93
	Tsunza Central	25	46	97
	Total	**195**	**621**	**630**
Mombasa	Dongo Kundu	13	42	81

	Hawaii	18	33	105
	kitanga juu	28	62	154
	Likoni-Ferry	18	124	71
	Mkupe	19	72	28
	Mwangala	15	64	15
	Mweza creek	19	22	74
	Nyali kikadini	14	70	56
	Ngare	24	50	37
	Pungu	34	102	138
	Shaza	34	68	66
	Shimanzi	25	72	79
	Timbwani	12	78	30
	Tudor	15	72	58
	Sub-total	**288**	**931**	**992**
	Grand Total	**483**	**1552**	**1622**

5.6. ARCHAEOLOGICAL AND CULTURAL SIGNIFICANCE

5.6.1 Important Cultural Sites in The Project Area

The survey was keen to identify cultural sites that maybe affected by the port construction activities. In the south coast of Kenya, respondents identified different cultural sites that are adjacent to the marine environment. These sites include Kaya Tiwi, Kaya Waa, Kaya Chale, Kaya Magaoni, Kaya Kinondo, Kaya Ngaraani, Kongo river, Kaya Mgombeni, Mabambani, Kaya Kioto, Kaya Fuzo, and Milangini. Though all these cultural sites were identified along the Shelly-Waa-Tiwi-Diani beach stretch, none of them will be affected by the planned sand harvesting in the area as the sand harvesting exercise is planned to take place miles offshore.

Along Kilindini stretch, the respondents identified cultural sites where prayers, sacrifices and traditional rituals were performed to appease the gods and spirits. The identified cultural sites along Kilindini creek include *Mzimu wa wajomvu* also known as *Mwishimo* which is found in Ngare village, *Mzimu wa Kiweni* also known as *Jiwe la Kutuzwa* which is found in the water, *Shesheni, Kaya Panga* next to the flyover, *Kaya Mikadini* in the mangroves near Mkupe BMU, *Kaya Mtogwe*, *Kaya chonyi*, and *Kaya semani/kiweni/kiuyu (mpemba shetani)* where an evil spirit from Pemba was brought and placed there for worship and rituals.

FIGURE 119: MZIMU WA WAJOMVU IN THE MANGROVES AT NGARE VILLAGE

During FGDs respondents reported that it will be very important if the project proponent was able to map where all cultural sites are located and evaluate if they will be affected by the project. There was a concern that four cultural sites may be affected by the port construction (Berth 23) and construction of the 3.1Km access road. The *Mzimu wa Kiweni* also known as *Jiwe la Kutuzwa* which is found in the water is believed that it will be affected by the port expansion plan, *Mzimu wa wajomvu* also known as *Mwishimo* which is found in the mangroves at Ngare village is believed to be getting vulnerable since it may be affected by the 3.1 Km access road that will pass though the mangrove in Ngare. *Kaya Panga* next to the flyover and *Kaya Mikadini* in the mangroves near Mkupe BMU are also likely to be affected by the 3.1 Km access road construction.

The local community requested that, before any constructions is done, those who use these cultural sites for rituals and prayers should be consulted first and an agreement reached between them and the project proponent. There are rituals that must be performed by those using these cultural sites to prevent the occurrence of the unlikely events that may occur during the construction and operation of the project. The unlikely events that may occur include, stalling of the project, accidents during construction, accidents during operation, or even loss of life to those who will directly destroy the cultural sites before rituals and prayers are performed.

The National Musuems of Kenya carried out a detailed Archeological Impact Assessment Study in 2011 for the Proposed Capital Dredging Works at the Kilindini Channel and Second Container Terminal.

Key Study findings were:

- The project area at Port Reitz has high potential for paleontological remains such as fossil ammonite remain and petrified wood and archeological lithis implements which suggest the presence of Stone Age Culture.
- Port Reitz has remain of early colonial history and global war of 1940s, as shown by World War II ammunition.
- In the project area there are traditional African sacred places still in the use by local people.
- The study has produced documentation such as maps and GPS coordinates of locations with potential cultural heritage significance.

5.7. SOCIO-ECONOMIC ENVIRONMENT

5.7.1 Introduction

An Environmental and Social Impact Assessment Study has been undertaken to support the planned construction of Phase III Container Terminal (Berth 23) of the Mombasa Port Development Project (MPDP). The ESIA has been carried out in line with Environmental Management and Coordination Act (EMCA) and JICA environmental and social guidelines. The planned construction of Phase III Container Terminal will include excavation of the seabed and offshore dumping, sand harvesting and reclamation, construction of Berth and Container Terminal with buildings and facilities, and construction of access road. The socioeconomic study is an integral part of the ESIA and has been conducted to provide baseline information on the social and cultural environment. The information generated include demographic characteristics, information about the Beach Management Units (BMUs), fish landing sites and catch statistics, among others.

This study took both quantitative and qualitative approaches. In the quantitative approach, a cross-sectional survey design was adopted. Adoption of cross-sectional survey made it possible to collect data within a reasonable duration of time. Some limitations of cross-sectional studies were identified to include cohort differences, potential reporting biases associated with non-response and difficulty in making causal inference. However, these limitations were addressed through appropriate sampling technique and data collection procedure adopted by this study. The target population covered communities that dwell in and around the project site in Mombasa as well as communities who dwell at Waa-Tiwi-Diani-Chale area where sand will be harvested from.

The study covered communities that dwell in and around the project site in Mombasa County as well as communities who dwell at Waa-Tiwi-Diani area in Kwale County where sand will be harvested from. In Mombasa County, the study was undertaken at Ngare village and the adjacent fish landing sites along the Likoni/Kilindini channel and Shelly beach area. In Kwale County, the study was conducted at Waa, Tiwi and Diani. The impact that was projected to be caused by the excavation of the seabed, construction of the new Berth (Berth 23) and construction of the 3.1Km access road was expected to affect Mwache creek and Likoni/Kilindini channel, while the impact caused by sand harvesting was projected to affect fishing and tourism activities along the Shelly-Waa-Tiwi-Diani stretch. Data was collected from the community that lived and depended on marine resources in the affected areas. Questionnaire surveys were carried out at Ngare Village in Mombasa and at Shelly-Waa-Tiwi-Diani beach stretch (Chale-jeza BMU, Mkunguni BMU, Mwaepe BMU, Mwakamba BMU, Nyari-kikadini BMU, and Tiwi-bandarini BMU). Questionnaire surveys were complimented by Focus Group Discussions that were conducted at Ngare BMU, Tsunza central BMU, Mwangala BMU and Mwakamba BMU. At Ngare village, a census was done because of the village's proximity to the project area, MPDP Phase III and the 3.1Km access road will pass through the village before joining the Dongo Kundu Bypass. Consequently, the households in this village are likely to be physically displaced particularly by the access road.

Questionnaire was the main research instrument used in the quantitative approach. The questionnaire was constructed taking into account the objectives of the research. It consisted of two parts with part 1 having questions on basic social information, while part 2 having questions on the main variables in the study namely: - population, land use, planned development activities, community structure, gender, employment and labour market, sources and distribution of income, cultural properties, among others. Part 2 will also be covered potential environmental impacts particularly socio-economic factors that include the impacts of: population change and migration, socio-economic characteristics of the different target groups near the project sites, physical and social infrastructure, change in economic activities, development resources, vegetation clearance, effects of changes in air quality; improved access and accident rates among others. A check-list was used in the traffic survey to capture details about traffic flow by type of vehicles.

A pilot study was carried out to evaluate the suitability of the questionnaire before it was used. The pilot study was conducted at a location outside the project site in Mombasa. It helped to detect flaws in the administration of the questionnaires and ensure reliability and validity of the questionnaires. Content validity was considered through a subjective assessment of the questionnaires' appropriateness and the extent to which the questionnaire captured the variables and indicators from the objectives of the study that needed to be measured.

Guided questionnaire administration was adopted in this study since it provides an opportunity to capture a representative sample of the target population and control for non-verbal behaviour. To ensure accuracy in reporting, each respondent was informed that their personal details would remain anonymous and confidential. The overall purpose and objectives of the study was clearly explained to them and informed consent obtained with a clarification that the questionnaire will be filled on voluntary grounds.

The qualitative approach was exploratory in nature and was used to gain an understanding of the basic social information and perceptions about the impacts of the project. It was used to establish the social and cultural reality of local communities, in order to understand their opinions, experiences and motivations for their dependence on the local marine resources. It was used to study people in their natural settings to provide insights in to the research problem. The qualitative data collection methods that were used in this study include key-informant interviews, focus group discussions and direct observation.

Key-informant interview technique expounded by Bunce *et al.* (2000) and de la Torre-Castro *et al*. (2008) was used to gather information from the opinion leaders. These key-informants were people who are knowledgeable and hold some respected positions in the society such as location chief, village headmen, BMU leaders, fisheries officer, and other opinion leaders. The snowball method was used to identify key informants in the project site. The key informants provided insight on many issues about the perceived socio-cultural and economic impacts of the project. The focus group discussions (FGDs) were used to collect and validate data on the perceived socio-cultural and economic impacts of the project. FGDs are a commonly used qualitative approach to data collection. The importance of qualitative approaches in understanding social realities has been recognized by many social scientists. It addresses the limitations of adopting quantitative approaches to explain changes in social phenomena (Nyariki 2009). A set of open-ended questions were used to prompt participants into free discussions focusing on the issues under the study. The focal groups consisted of 5 to 12 people. One Hundred and fourteen (114) respondents were interviewed in this study and 4 Focus Group Discussions were held.

The team contacted the local area Chief by phone as he was unable to join the research team at the time. The team explained the purpose of the exercise and was able to get consent for the survey to continue. Communication was made with the BMU heads a few days before the data collection exercise to determine the most convenient time. Prior to the commencement of each interview and the Focus Group Discussion, the research team explained the purpose of the Focus Group Discussion and reassured the participants that the information was being collected for research purposes and did not harbor any ulterior motives. Each questionnaire was administered for approximately 20-30 minutes, while each Focus Group Discussion took about 90 minutes.

Data was compiled in Ms. Excel and coded in IBM SPSS v.22. Data coding allowed for the identification of patterns, themes, and relationships within the data set. Data analysis was performed in Ms. Excel v.365 software and IBM SPSS v.22 software. Descriptive analyses were done first to display data in a form that could summarize a set of factors in a way that was easy to understand and interpret. Cross tabulations were performed to examine relationships between different variables. Measures of central tendency and dispersion, graphical summaries, and frequency tables, were the products of these analyses for the various cases. For the qualitative data, content analysis was employed to interpret all data that expressed detailed perceptions or explanations.

Overall, participants in the study consisted of 77.4percent male and 22.6percent female respondents. To get a better understanding of how the local community depends on the marine resources for their social, cultural, and economic well-being, the study assessed socio-demographic characteristics of the community, the livelihood options in the community, and the cultural aspects of the community in relation to the marine environment. Also, the study gauged the participants perceptions with regards to Mombasa Port Development Project, assessed the perceived potential impacts of the project to the environment and the community and evaluated the project's and community sustainability options.

5.7.2 The Economic Activity on The Project Area

The survey results indicated that there are different economic activities in the project area (**Figure 120**). Among the diverse economic activities in the project area, fishing was identified to be the main economic activity in Ngare village (59.1 percent), and at Shelly-Waa-Tiwi-Diani beach stretch (69.7 percent). In addition, FGD results demonstrated that fishing was also the main activity at Mwangala, Tsunza and Mwakamba BMUs. Besides tha main economic activity, other economic activities in the project area included, fish trading, palm wine harvesting, small scale business, tourism, casual labour, turtle conservation, motorbike transport, driving, water vending and formal employment. Results indicate that most of the economic activities practiced by the local communities highly rely on marine resources, with about 93 percent of the respondents at Shelly-Waa-Tiwi-Diani beach stretch relying on marine resources and about

77 percent at Ngare village also relying on marine resources. The reliance on marine resources for livelihood options indicates the need for a healthy marine ecosystem, and the project must put up measures that will ensure the marine ecosystem is not degraded, and livelihoods remain sustainable.

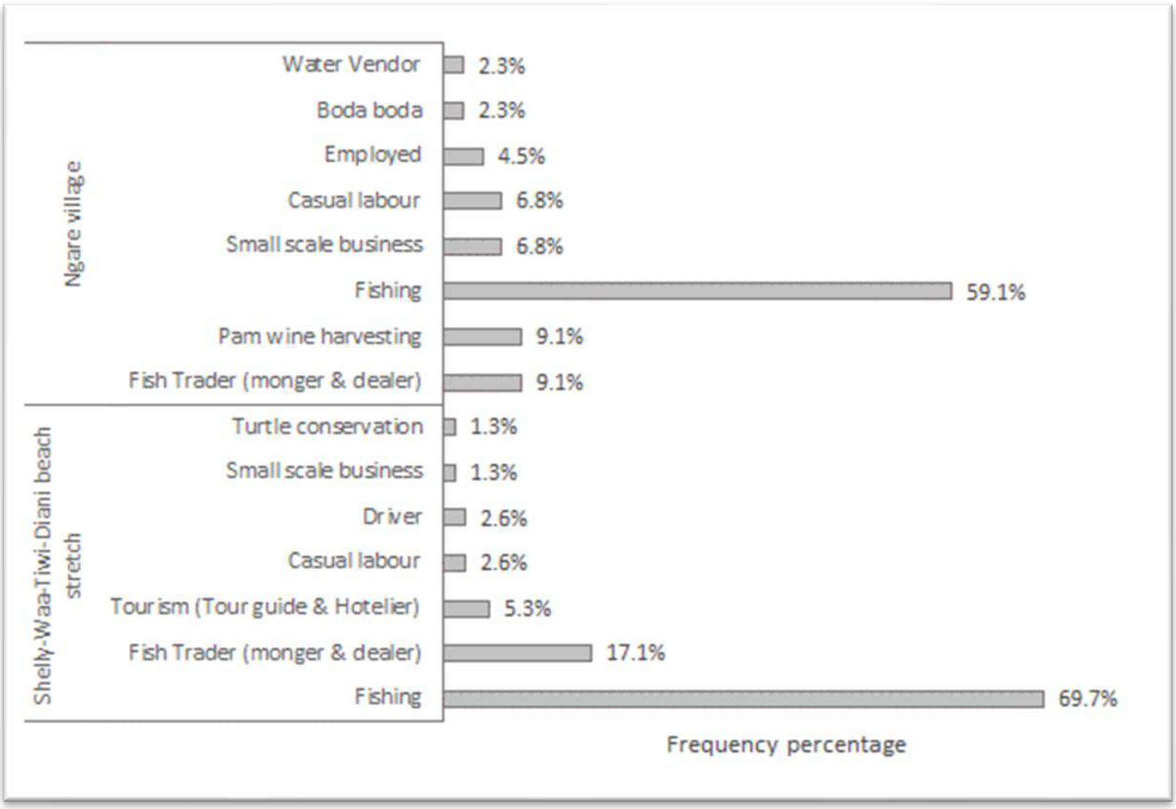


FIGURE 120 - ECONOMIC ACTIVITIES IN THE PROJECT AREA

The ranking of economic activities in order of importance during FGDs showed that at Mwangala BMU, fishing, crop farming, fish trade and small-scale business were the main economic activities practiced in the area. At Ngare BMU, fishing was identified as the main economic activity followed by farming, while other economic activities practiced by the local community included fish trade, small-scale business, animal rearing, apiculture, boat making, gear making, mangrove seedling sales, traditional healing, renting out of fishing vessels, and transport. At Tsunza central, respondents ranked fishing, agriculture, livestock rearing, fish farming, apiculture, and fish trade (dealer and mama karanga) as the most important livelihoods in the area. Respondents from Mwakamba BMU observed that fishing and fish dealing were the main economic activities in the area.

Economic activities that were linked to Kilindini channel or Portreitz creek included fishing, fish trade, boat transport, mariculture (Plate 1 and 4), apiculture, growing of mangrove seedlings for sale, traditional medicine from the mangroves, boat making (Plate 3), and mangrove planting.

TABLE 53 - ECONOMIC ACTIVITIES LINKED TO KILINDINI CHANNEL OR PORT REITZ CREEK.

	
Plate 1: Fishpond at Tsunza Central BMU	**Plate 2:** Coconut trees at Ngare village for Pam wine
	
Plate 3: Boat building at Ngare BMU	**Plate 4:** Crab fattening cage at Kitanga Juu BMU

5.7.3 Basic Social Information

The study established that most respondents were of Islamic faith with 98.7 percent of the respondents at Shelly, Waa, Tiwi and Diani beach and 76.9 percent of the respondents at Ngare village being Musllims (Table 2). Further, it was established that the nearest mosque at Shelly-Waa-Tiwi-Diani beach stretch was about 0.05 Km away from a respondent's household, while a church was about 0.1 Km away from the respondent's household. At Ngare village, the nearest mosque was located at an average distance that one covers in 10 minutes walking from their households. On the other hand, the nearest church was located at a distance that one covers in about 20 minutes walking. There was no church or mosque located in Ngare village (**Table 54**).

TABLE 54 - SOCIAL ATTRIBUTES OF THE COMMUNITY LIVING IN THE PROJECT AREA.

Attribute		N	
Religion	Shelly-Waa-Tiwi-Diani beach stretch	Muslim (98.7percent)	Nearest mosque (0.05Km)
		Christian (1.3percent)	Nearest church (0.1Km)
	Ngare village	Muslim (76.9percent)	Nearest mosque (10Min)
		Christian (23.1percent)	Nearest church (34Min)
Health services	Shelly-Waa-Tiwi-Diani beach stretch	Chale dispensary, Diani hospital, Ganja health center, Ibinisia dispensary, Kaydee Hospital, Kinondo dispensary, Kombani	Nearest hospital (0.5Km)

		Dispensary, Kwale Dispensary, Madege dispensary, Makongeni dispensary, Manyatta referral hospital, Mwaembe hospital, Mwalima hospital, Ngomeni dispensary, Tiwi rural health center, Waa dispensary	
	Ngare village	Portreitz hospital (97.4percent) Miritini CDF hospital (2.6percent)	Nearest hospital (40 Min)
Household roles	Shelly-Waa-Tiwi-Diani beach stretch	Male	Breadwinner & Household head (81.3percent)
		Female	Bread winner & Household head (6.7percent); Housewife and supportive breadwinner (12percent)
	Ngare village	Male	Breadwinner & Household head (64.9percent); Support breadwinner (2.7percent)
		Female	Breadwinner & Household head (16.2percent); Housewife & Support breadwinner (16.2percent)

At Shelly-Waa-Tiwi-Diani beach stretch, the respondents had access to several heath service providers and the nearest health facility to a respondent was about 0.5 Km away from the household. In Ngare village, the respondents had access to only two health facilities, Portreitz hospital and Miritini CDF hospital, that are located in the neighborhood. Most (97.4 percent) of the respondents visited Portreitz hospital because it was nearer, about 40 minutes walking distance from the village. The respondents noted that Miritini CDF hospital was far from the village but they often visit it because it offers free medical treatment to children. From the Focus Group Discussions (FGDs), respondents from Tsunza central BMU visited Tsunza medical center for their health care needs while the respondents from Mwangala BMU obtained health care services from Mbuta dispensary. It was observed that no place of worship or health facility will be affected by the port development project since they are all located away from the project area.

In terms of household roles, the study established that breadwinners and household heads were mostly men. Men actually accounted for 81.3 percent of breadwinners and household heads at Shelly-Waa-Tiwi-Diani beach stretch and 64.9 percent of breadwinners and household heads at Ngare village. Women also contributed as breadwinners, household heads, housewife and supportive breadwinners. The same was observed at Mwangala BMU, Ngare BMU and Tsunza BMU during FGDs. The role of men as breadwinners and household heads included provision of income for daily subsistence, paying of hospital and other bills, provision of money to buy clothing, giving direction to the family and being depended on for decisions. On the other hand, in some households, women had similar tasks as men in the village. In addition, the women were also expected to do domestic chores, take care of their home, and take care of their children. The results also indicate that the financial burden in the community rested on both men and women hence, during the implementation of the project, equal opportunities should be given to both men and women. More consideration should be given to women who are the sole breadwinners in their households.

5.7.4 Community Perception About Sand Harvesting, Port Expansion and Access Road Construction

About 82 percent of the respondents were aware of the phase III (berth 23) Mombasa port development project. Out of the 82 percent of the respondents who were aware of the project, 56 percent were from Shelly-Waa-Tiwi-Diani beach stretch while 26 percent were from Ngare village. During FGD respondents from Kilindini creek also reported to be aware of the new port expansion plan. Respondents noted that they came to know about the project through communication from their respective BMUs (56 percent), through government officials (26.4 percent), through hearsay from the villagers (16.5 percent), and through the radio (1.1 percent). About the level of involvement, only local leaders and officials reported that they were involved in the project through meetings where they were made aware about the project and the perceived impact of the project. So far, no education has been given to the community yet.

The community along Kilindini creek reported that they will support the implementation of the project if their concerns are considered, and they are compensated for any loss of livelihood, land, assets and shelter or are relocated to a different area where they will continue to enjoy same marine ecological benefits. 100 percent of the local community living along Kilindini creek reported that, they will be affected by the project. In their view, when the ecology of the creek is affected, the fishery will be affected, and this will consequently affect other economic activities as fisheries was their main economic activity in the area. Fishers believed that their most important fishing grounds such as Dongo kundu fishing ground, maybe affected by port construction and this will disrupt fishing activities along the creek. It was also reported that the road construction may lead to displacement of people, loss of cultural sites, landing sites, fishing grounds, land, shelter, and assets. Other negative impacts that were identified by the community included, increased dust during construction that may affect people's health, loss of mangroves, environmental degradation and restriction of access to their fishing grounds as people may not be allowed to pass through the construction area.

Along the Shelly-Waa-Tiwi-Diani beach stretch, about 97 percent of the respondents reported that they will be affected by the project. Though they all support the implementation of the project the respondents want the proponent to put up measures that will limit destruction of the marine environment, educate the local community about the effects of the project, and fairly compensate fisher, fish treaders and tour guides for the loss of livelihood. There is fear that the offshore sand harvesting/excavation may affect fishing activities, tourism activities and may lead to the degradation of the marine ecosystem that may increase the community vulnerability to poverty and food insecurity.

Despite the concerns raised about the potential negative impacts of the project, the community highlighted some of the benefits they believe they would gain from the projects. The benefits include employment opportunities, better access road, and increased market for small business in the area such as sale of food.

5.7.5 A Win-Win Scenario for Port Development Project and The Community Living In The Marine Environment

The study established a hypothetical scenario where Portreitz creek will remain healthy, community livelihoods and welfare will remain stable while the planned construction of phase

III (Berth 23) of Mombasa Port Development project will be implemented. To achieve this, the community was probed to give their views. The community noted that, once the port construction activities start, the marine ecosystem will be altered and consequently this will affect fisheries and other economic activities that depend on the health of the marine ecosystem. Given the case, the community wanted to know how they will make a living when the fishery is disrupted. The recommendations given by the community included:

1. Empower the local fishermen by training them on the modern fishing techniques using modern fishing technology to enable them to go for offshore fishing. Once they are trained, there is need to buy them bigger boats, and modern fishing gears.
2. Adequate compensation for loss of livelihood. The local communities want fishers and fish traders to be compensated fairly so that they can have enough money to enable them invest in an alternative livelihood.
3. The local communities suggested that the old fishers in the community who cannot engage in deep sea fishing be given monthly stipend, to enable them to provide for their families.
4. The BMUs requested if the project can construct for them better BMU offices with improved facilities for fish storage and market.
5. The people living in Ngare village reported that, compensation should first be made to people likely to be affected by the construction of the access road before the road construction start.
6. The local communities requested that the project proponent should consider their school going children for bursary and older children be considered for employment opportunities at Kenya Ports Authority.
7. The community requested that the compensation should be made directly to them and not through a third party to enable them fully benefit from the process.
8. Give an earlier notice to fishermen to know when the sand harvesting will happen to help them plan appropriately.
9. The community requested to be made aware of the Mombasa port development project and be involved in decision making process.

5.7.6 Demographic Profile of Project Area

Overall, participants in the study consisted of 77.4 percent male and 22.6 percent female respondents. To get a better understanding of how the local community depends on the marine resources for their social, cultural, and economic well-being, the study assessed socio-demographic characteristics of the community, the livelihood options in the community, and the cultural aspects of the community in relation to the marine environment. Also, the study gauged the participants perceptions with regards to Mombasa Port Development Project, assessed the perceived potential impacts of the project to the environment and the community and evaluated the projects and community sustainability options.

1. Characteristics Of the Community in Ngare Village and Fishers Along the Shelly-Waa-Tiwi-Diani Beach Stretch

Demographic characteristics were assessed per site. Regarding age, the respondents from Shelly-Waa-Tiwi-Diani beach stretch, had a mean age of 47±11.2 years and an age range of 55 years while those from Ngare village had a mean age of 37±14.5 years, with the oldest respondent being 70 years and youngest being 18 years (**Table 55**). Results show that respondents from Shelly-Waa-Tiwi-Diani beach stretch were older than respondents from Ngare village, and majority had lived in their respective villages for 30 years compared to Ngare village where most of the respondents had lived for 10 years.

Considering the maximum age and maximum number of years lived in the area of residence, a respondent from Shelly-Waa-Tiwi-Diani beach stretch was 70 years old and had loved in the area for 70 years. The analysis further shows that respondents from Shelly-Waa-Tiwi-Diani beach stretch were natives of the area who had lived in the area since birth. On the other hand, there was a 70-year-old respondent at Ngare village who had lived in the same village for 60 years. The analysis further shows that the residents of Ngare village had migrated into the area from another place. Some of the residents of Ngare had moved in recently. The results have shown that about 82 percent of the households had migrated to Ngare village from nearby villages and majority migrated after they were displaced from their villages by the different projects that have been implemented in the area such as Airport construction and expansion, construction of Standard Gauge Railway (SGR), construction of Dongo Kundu bypass, and Mombasa port expansion. Other households had migrated to Ngare village because of its proximity to good fishing grounds.

TABLE 55 - DEMOGRAPHIC CHARACTERISTICS

Attribute		N	
		Shelly-Waa-Tiwi-Diani beach stretch	Ngare Village
Age (Years)	Mean	47.7±11.2	37±14.5
	Max	70	70
	Min	25	18
	Mode	50	30
Period lived in the area (Years)	Mean	42±16.2	18±14.8
	Max	70	60
	Min	1	0.08 (1month)
	Mode	30	10
Level of education	None	14.5percent	28.9percent
	Primary	67.1percent	60.5percent
	Secondary	17.1percent	2.6percent
	Tertiary	1.3percent	7.9percent
Marital status	Single	5.3percent	10.3percent
	Married	85.5percent	69.2percent
	Divorced	3.9percent	2.6percent

	Separated	2.6percent	10.3percent
	Widow/er	2.6percent	7.7percent
Household Size	Mean	7±2.5	5±2.9
	Min	1	1
	Max	13	13
Children <18 years	Mean	3±1.6	3±2.1
	Min	0	0
	Max	7	8
Children >18 years	Mean	3±1.9	2±1.3
	Min	0	0
	Max	8	5
Relatives supported	Mean	1±1.1	1±1.2
	Min	0	0
	Max	5	4

In terms of levels of education, results (**Table 55**) indicate that 81.6 percent of the respondents at Shelly-Waa-Tiwi-Diani beach stretch, and 89.4 percent of the respondents at Ngare village had obtained primary level of education and below. The low levels of education imply that majority of the respondents did not have the necessary academic qualifications that could enable them obtain formal employment and therefore depended on the marine environment for their livelihoods. High dependency on the marine resources for livelihoods means any change in the health of the marine environment will impact negatively on the community income and livelihoods hence there is need to come up with measures to ensure the marine ecosystem is not degraded beyond acceptable levels.

In both sites, results (**Table 55**) shows that majority of the respondents were married, with 85.5 percent of the respondents in Shelly-Waa-Tiwi-Diani beach stretch being married and 69.2 percent in Ngare village being married. In Shelly-Waa-Tiwi-Diani beach stretch, a household had an average of 7±2.5 persons with a mean of 3±1.6 children below the age of 18 years, 3±1.9 children above the age of 18 years and supported at least 1 relative. In terms of household size, a household in Ngare village had an average of 5±2.9 members with a mean of 3±2.1 children below the age of 18 years, 2±1.3 children above the age of 18 years and supported at least 1 relative. Results further show high dependency levels and given most families depend on marine environment for livelihood options, disturbances to marine ecosystem may disrupt household earnings and livelihoods with negative impacts on the functioning of a household.

2. Social Attribute of The Community Living in The Project Area.

The study established that most respondents were of Islamic faith with 98.7 percent of the respondents at Shelly, Waa, Tiwi and Diani beach and 76.9 percent of the respondents at Ngare village being Muslims. Further, it was established that the nearest mosque at Shelly-Waa-Tiwi-Diani beach stretch was about 0.05 Km away from a respondent's household, while a church was about 0.1 Km away from the respondent's household. At Ngare village, the nearest mosque was located at an average distance that one covers in 10 minutes walking from their households. On the other hand, the nearest church was located at a distance that one covers in about 20 minutes walking. There was no church or mosque located in Ngare village.

TABLE 56 - SOCIAL ATTRIBUTES OF THE COMMUNITY LIVING IN THE PROJECT AREA.

Attribute		N	
Religion	Shelly-Waa-Tiwi-Diani beach stretch	Muslim (98.7%)	Nearest mosque (0.05Km)
		Christian (1.3%)	Nearest church (0.1Km)
	Ngare village	Muslim (76.9%)	Nearest mosque (10Min)
		Christian (23.1%)	Nearest church (34Min)
Health services	Shelly-Waa-Tiwi-Diani beach stretch	Chale dispensary, Diani hospital, Ganja health center, Ibinisia dispensary, Kaydee Hospital, Kinondo dispensary, Kombani Dispensary, Kwale Dispensary, Madege dispensary, Makongeni dispensary, Manyatta referral hospital, Mwaembe hospital, Mwalima hospital, Ngomeni dispensary, Tiwi rural health center, Waa dispensary	Nearest hospital (0.5Km)
	Ngare village	Portreitz hospital (97.4%) Miritini CDF hospital (2.6%)	Nearest hospital (40 Min)
Household roles	Shelly-Waa-Tiwi-Diani beach stretch	Male	Breadwinner & Household head (81.3percent)
		Female	Bread winner & Household head (6.7percent); Housewife and supportive breadwinner (12percent)
	Ngare village	Male	Breadwinner & Household head (64.9percent); Support breadwinner (2.7percent)
		Female	Breadwinner & Household head (16.2%); Housewife & Support breadwinner (16.2%)

At Shelly-Waa-Tiwi-Diani beach stretch, the respondents had access to several heath service providers and the nearest health facility to a respondent was about 0.5 Km away from the household. In Ngare village, the respondents had access to only two health facilities, Port Reitz hospital and Miritini CDF hospital, that are in the neighborhood. Most (97.4 percent) of the respondents visited Portreitz hospital because it was nearer, about 40 minutes walking distance from the village. The respondents noted that Miritini CDF hospital was far from the village but they often visit it because it offers free medical treatment to children. From the Focus Group Discussions (FGDs), respondents from Tsunza central BMU visited Tsunza medical center for their health care needs while the respondents from Mwangala BMU obtained health care services from Mbuta dispensary. It was observed that no place of worship or health facility will be affected by the port development project since they are all located away from the project area.

In terms of household roles, the study established that breadwinners and household heads were mostly men. Men accounted for 81.3 percent of breadwinners and household heads at Shelly-Waa-Tiwi-Diani beach stretch and 64.9 percent of breadwinners and household heads at Ngare village. Women also contributed as breadwinners, household heads, housewife and supportive breadwinners. The same was observed at Mwangala BMU, Ngare BMU and Tsunza BMU during FGDs. The role of men as breadwinners and household heads included provision of income for daily subsistence, paying of hospital and other bills, provision of money to buy clothing, giving direction to the family and being depended on for decisions. On the other hand, in some households, women had similar tasks as men in the village. In addition, the women were also expected to do domestic chores, take care of their home, and take care of their children. The results also indicate that the financial burden in the community rested on both men and women hence, during the implementation of the project, equal opportunities should be given to both men and women. More consideration should be given to women who are the sole breadwinners in their households.

3. House, Sanitation, Land, Water, and Social Amenities Accessibility

Majority of the respondents owned houses they were living in, Shelly-Waa-Tiwi-Diani beach stretch (90.5percent), Ngare village (94.6percent). At Shelly-Waa-Tiwi-Diani beach stretch, respondents reported that most houses were semi-permanent (52.9percent) while in Ngare village most houses were temporary structures (44.7percent). However, some respondents lived in houses that they had rented. At Ngare village, there is a likelihood that some houses maybe affected by the access road. The study further revealed that about 69 percent of the respondents at Shelly-Waa-Tiwi-Diani beach stretch had access to safe drinking water that was mainly obtained from boreholes/well. At Ngare village respondents obtained most of their water from the BMU water kiosk. In Ngare village, 83.3 percent of the respondents stated that there was no piped water and they relied on water that was brought in by water buzzer and sold at the water kiosk in the village. So far, there was only one well in the village.

In terms of sanitary conditions, a section of the population at both Shelly-Waa-Tiwi-Diani beach stretch and Ngare village did not have access to latrines or toilets. In Ngare village, there was only one pit latrine, which was depended on by the villagers hence there is need for improved sanitation in the area.

Regarding the use of electricity, the study revealed that 74.4 percent of the respondents at Shelly-Waa-Tiwi-Diani beach stretch and 48.7 percent of the respondents at Ngare village used solar energy. Results have shown that solar lighting was cheaper compared to other forms of lighting as it did not require extra charge when using it. In addition, there was no power grid at Ngare village. In terms of land tenure arrangements, the study established that at Shelly-Waa-Tiwi-Diani beach stretch, most people lived on family land (55.9 percent) and self-owned land (41.2 percent). However, there were a few people who lived on the government land. At Ngare village, land ownership was either with the BMU (36 percent), family (36 percent) or government (28 percent). Those who stated that the land that they lived in was owned by the BMU had moved into the area after being evicted from the neighboring villages that were affected by the previous projects and settled near Kitanga Juu landing site. Residents who were living on family land observed that they obtained the land from their parents or spouses. Those who obtained land from their parents were born in that area. Those who were living on government land said they were not sure who the land belonged to and so they believed it was government land.

TABLE 57 - HOUSE, SANITATION, LAND, WATER, AND SOCIAL AMENITIES ACCESSIBILITY

Attributes		N	
House ownership	Shelly-Waa-Tiwi-Diani beach stretch	Self-owned	90.5%
		Rented	9.5%
	Ngare village	Self-owned	94.6%
		Rented	5.4%
Type of house	Shelly-Waa-Tiwi-Diani beach stretch	Permanent	45.6%
		Semi-permanent	52.9%
		Temporary	1.5%

	Ngare village	Permanent	31.6%
		Semi-permanent	23.7%
		Temporary	44.7%
Potable/ Drinking water	Shelly-Waa-Tiwi-Diani beach stretch	Borehole/ well	68.7%
		Buy from water kiosk	8.4%
		Piped water	19.3%
		Buy from water vendor	3.6%
	Ngare village	Buy from BMU water kiosk	83.3%
		Borehole/ Well	9.5%
		Rains	4.8%
		Buy from water vendor	2.4%
Sanitation (*pit latrine, modern toilet, bush etc.*)	Shelly-Waa-Tiwi-Diani beach stretch	Bush/ Mangrove	12%
		Modern toilet	20%
		Pit latrine	68%
	Ngare village	Bush/ Mangrove	35.9%
		Pit latrine	61.5%
		Temporary dug toilet	2.6%
Source of lighting	Shelly-Waa-Tiwi-Diani beach stretch	Candles	1.3%
		Grid	39.5%
		Kerosene lamp	10.5%
		Solar	48.7%
	Ngare village	Kerosene lamp	23.1%
		Solar	74.4%
		Phone light	2.6%
Land Ownership	Shelly-Waa-Tiwi-Diani beach stretch	Family land	55.9%
		Government	2.9%
		Self-owned	41.2%
	Ngare village	BMU	36.0%
		Family land	36.0%
		Government	28.0%

To carry out day-to-day activities' respondents used various means of transport. The most used means of transport in the project area included the motorbike (31.4 percent), boat (31 percent), and walking (17.1 percent) (Figure 13-21). Other means include use of a tricycle (tuktuk), vehicle and bicycle. Boat was mostly used for fishing activities taking place in the visited villages while motorbike transport was commonly used because it was the most convenient and fastest way to move from one place to another such as from fish landing site to the marketplace or from home to the fish landing site. Though Ngare village had a good transport network passing near the village, Dongo Kundu bypass, and SGR railway line, the village had a bad access road that could not be accessed during the rainy season.

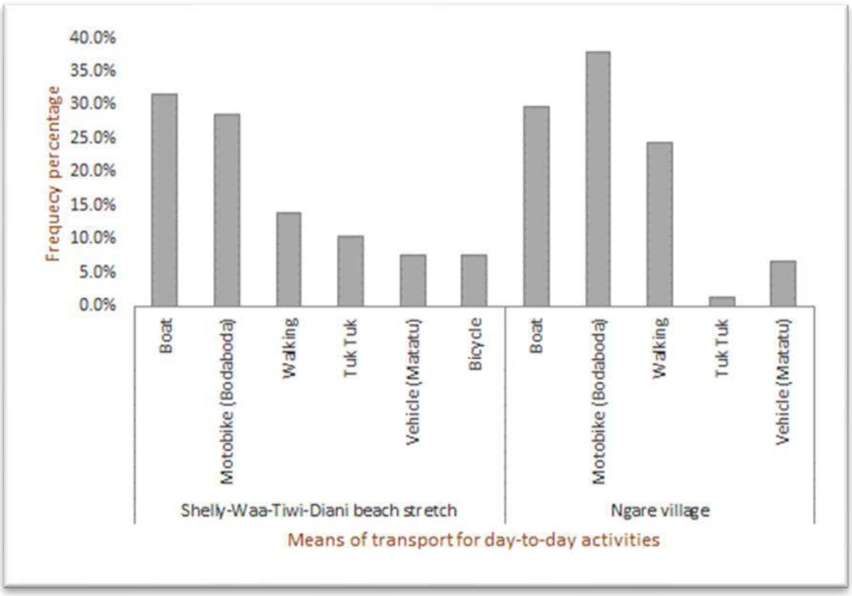


FIGURE 121 - MEANS OF TRANSPORT USED BY RESPONDENTS.

FIGURE 122 - RAILWAY TRANSPORT PASSING NEAR NGARE VILLAGE AND THE ACCESS.

4. The Economic Activity in The Project Area

The survey results indicated that there are different economic activities in the project area. Among the diverse economic activities in the project area, fishing was identified to be the main economic activity in Ngare village (59.1 percent), and at Shelly-Waa-Tiwi-Diani beach stretch (69.7 percent). In addition, FGD results demonstrated that fishing was also the main activity at Mwangala, Tsunza and Mwakamba BMUs. Besides tha main economic activity, other economic activities in the project area included, fish trading, palm wine harvesting, small scale business, tourism, casual labour, turtle conservation, motorbike transport, driving, water vending and formal employment. Results indicate that most of the economic activities practiced by the local communities highly rely on marine resources, with about 93 percent of the respondents at Shelly-Waa-Tiwi-Diani beach stretch relying on marine resources and about 77 percent at Ngare village also relying on marine resources. The reliance on marine resources for livelihood options indicates the need for a healthy marine ecosystem, and the project must put up measures that will ensure the marine ecosystem is not degraded, and livelihoods remain sustainable.

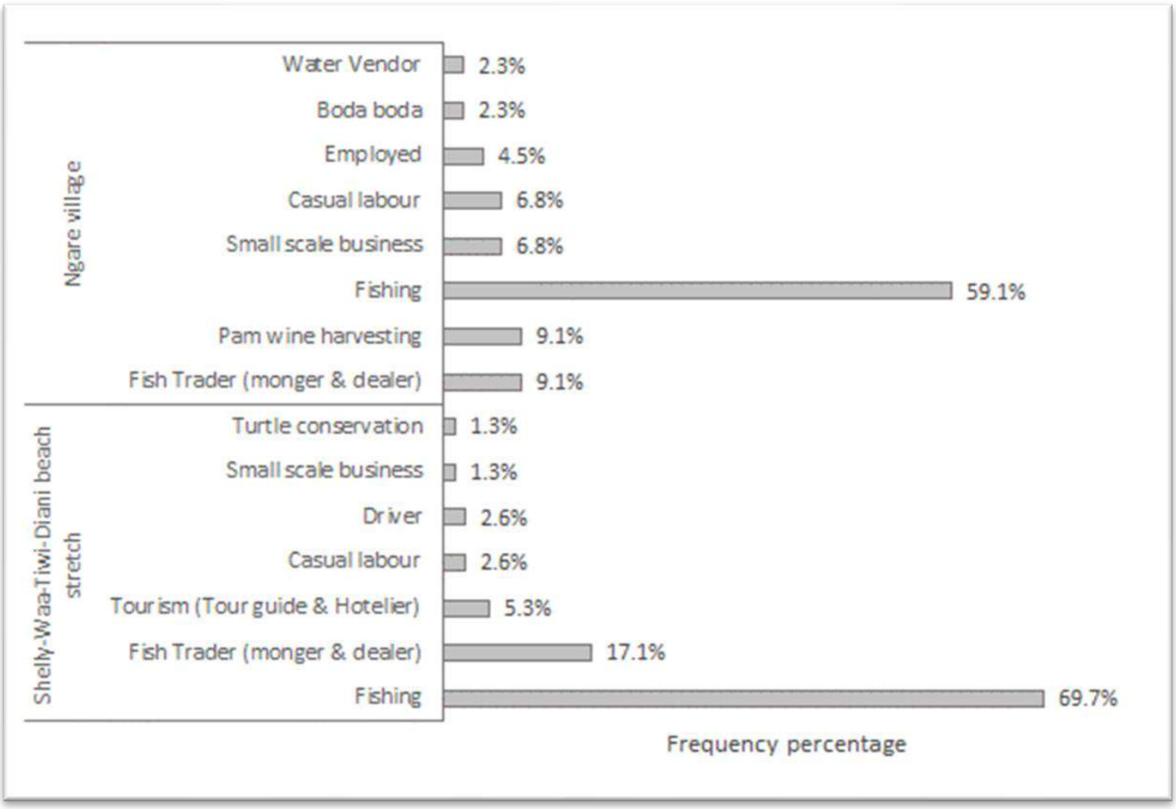


FIGURE 123 - ECONOMIC ACTIVITIES IN THE PROJECT AREA

The ranking of economic activities in order of importance during FGDs showed that at Mwangala BMU, fishing, crop farming, fish trade and small-scale business were the main economic activities practiced in the area. At Ngare BMU, fishing was identified as the main economic activity followed by farming, while other economic activities practiced by the local community included fish trade, small-scale business, animal rearing, apiculture, boat making, gear making, mangrove seedling sales, traditional healing, renting out of fishing vessels, and transport. At Tsunza central, respondents ranked fishing, agriculture, livestock rearing, fish farming, apiculture, and fish trade (dealer and mama karanga) as the most important livelihoods in the area. Respondents from Mwakamba BMU observed that fishing and fish dealing were the main economic activities in the area.
Economic activities that were linked to Kilindini channel or Port Reitz creek included fishing, fish trade, boat transport, mariculture, apiculture, growing of mangrove seedlings for sale, traditional medicine from the mangroves, boat making, and mangrove planting.

TABLE 58 - ECONOMIC ACTIVITIES LINKED TO KILINDINI CHANNEL OR PORTREITZ CREEK.

Plate 1: Fishpond at Tsunza Central BMU

Plate 2: Coconut trees at Ngare village for Pam wine

Plate 3: Boat building at Ngare BMU

Plate 4: Crab fattening cage at Kitanga Juu BMU

5. Important Cultural Sites in the Project Area

The survey was keen to identify cultural sites that maybe affected by the port construction activities. In the south coast of Kenya, respondents identified different cultural sites that are adjacent to the marine environment. These sites include Kaya Tiwi, Kaya Waa, Kaya Chale, Kaya Magaoni, Kaya Kinondo, Kaya Ngaraani, Kongo river, Kaya Mgombeni, Mabambani, Kaya Kioto, Kaya Fuzo, and Milangini. Though all these cultural sites were identified along the Shelly-Waa-Tiwi-Diani beach stretch, none of them will be affected by the planned sand harvesting in the area as the sand harvesting exercise is planned to take place offshore.

Along Kilindini stretch, the respondents identified cultural sites where prayers, sacrifices and traditional rituals were performed to appease the gods and spirits. The identified cultural sites along Kilindini creek include *Mzimu wa wajomvu* also known as *Mwishimo* which is found in Ngare village, *Mzimu wa Kiweni* also known as *Jiwe la Kutuzwa* which is found in the water, *Shesheni,* Kaya *Panga* next to the flyover, Kaya *Mikadini* in the mangroves near Mkupe BMU, Kaya *Mtogwe, Kaya chonyi*, and Kaya *semani/kiweni/kiuyu* (*mpemba shetani*) where an evil spirit from Pemba was brought and placed there for worship and rituals.

6. Vulnerable and Marginalized Groups in the Project Area

The study did not identify any ethnic minorities in the project area. However, about 66.2 percent of the respondents along the Shelly-Waa-Tiwi-Diani beach stretch reported that there were vulnerable and marginalized people in the community. These people included orphans, widows, elderly people in the village, disabled persons, and drug addicts who may need special care. These are the people who lived in the same area along Shelly-Waa-Tiwi-Diani beach stretch. In Ngare village, about 65.8 percent of respondents reported that there were vulnerable and marginalized people in the village. These people included all those people living in Ngare village because of the land ownership issues, and limited livelihood options that make the community vulnerable to poverty.

7. Fishing Profile in the Project Area

Fishing came out as the main economic activity being carried out in the project area. On average, fishermen from Shelly-Waa-Tiwi-Diani beach stretch have been fishing for 25±11.6 years, while those form Ngare village (Kitangaa Juu BMU) have been fishing for 21±13.5 years. The fisherman who had been fishing for the longest period from Shelly-Waa-Tiwi-Diani beach stretch had been fishing for 54 years and the one who had been fishing for the shortest period had been fishing for 5 years. In Ngare village, the fisherman who had been fishing for the longest period had been fishing for 50 years and the one who had been fishing for the shortest period had been fishing for 4 years. The study further established that at Shelly-Waa-Tiwi-Diani beach stretch and Ngare village (Kitangaa Juu BMU) fishing had been in existence for more than 50 years.

The study revealed that fishers chose fishing as a career due to a number of reasons - inadequate employment options, tradition and culture since most of those who took up fishing as their occupation grew up in fisher communities, fishing does not need formal training, and small-scale fishing required less startup capital. In addition, some fishers inherited fishing equipment from their parents. Further, social responsibility to take care of family after getting married or loss of parent pushed some people to join fishing as a means of livelihood. It was also observed that some fishermen believed that there was adequate fish and other seafood for everyone in the sea. For some, fishing was a hobby. Some fishers took up fishing after developing sickness that they attributed to their former occupations such as painting. They could not continue with their earlier occupation (painting) that was deteriorating their health. From the survey, it was established that all households in the project area either had a person who was actively involved in fishing or involved in fishing support activities. About 80 percent of fishers were members of the Beach Management Unit (BMU), with 61 percent of fishers from Shelly-Waa-Tiwi-Diani beach stretch being members of their BMUs and 19 percent of fishers from Ngare village also being members of their BMU. Respondents reported to represent different BMU, and they included, Kitangaa Juu BMU, Mwadumbo BMU, Tsunza central BMU, Mwangala BMU, Ngare BMU, Chale-jeza BMU, Mkunguni BMU, Mwaepe BMU, Mwakamba BMU, Nyari-kikadini BMU and Tiwi bandarini BMU.

(1) Fishing Grounds

The study assessed fishing grounds to establish common areas that were shared by fishermen and that are likely to be affected by the project. The study revealed that fishers from different BMUs conducted their fishing operations in different areas (**Table 59**). Fishermen fished in different fishing grounds to maximize on their catch. They visited different fishing grounds depending on the availability of fish at different sites in different seasons. Fishers who were fishing along Kilindini creek shared several fishing grounds which included Dongo kundu, Mwishimo, Mwangala, Mwangoa, Mkupe, Pangwa, Maweni, Mshahame, Maweni, Kiomoni, Mavuzoni, and Hodi. It is interesting to note that, fishers from Tsunza central observed that some fishing grounds maybe lost when the new port (berth 23) is developed, and the fishing grounds likely to be lost to the new port include, Mshahame, Ngai Boto, Dongo Kundu, Mwishimo, Hodi, Fungu ya Kati, and Kibuyuni.

Survey and FGD results indicated that the most fished fishing ground along the Kilindini creek, was Dongo kundu fishing ground. Dongo kundu fishing ground was said to be the richest fishing ground along the creek because it was being supplied by three different creeks namely Mteza creek, Bombo creek and Mwache creek, with Mwache creek being the biggest creek. Fishers stated that Dongo Kundu fishing ground had fish all year round and all fishermen from Mwache creek to Kilindini creek preferred to fish there. It is therefore believed that Dongo kundu fishing ground is the main source of livelihood for fishermen in the area.

Fishermen from Shelly-Waa-Tiwi-Diani beach stretch carried out their fishing operations in a number of fishing grounds from Waa to Diani (**Table 59**). Fishers were concerned that most of their fishing grounds may be affected by sand harvesting or excavation that will take place off their coast line. The fishers requested if a timetable for sand harvesting can be shared so they can be able to plan appropriately for the fishing activities. Results showed that, fishermen share fishing grounds, and there was fear among fishermen that some of their fishing grounds maybe lost due to port construction or severely degraded from sand harvesting and port construction activities. The fishers recommended that appropriate measures be put in place to reduce or mitigate the negative impact from port construction activities that may affect fishing activities. The fishers further observed that the project proponent should consider providing compensation for lost fishery livelihood.

TABLE 59 - FISHING GROUNDS ALONG IN THE PROJECT AREA

Study site	BMU	Fishing ground	Common fishing ground	Fishing grounds believed will be taken by the new Port development (Berth 23)
Ngare Village	Kitanga Juu BMU	Chamba cha mani, Funguni, Dongo kundu, Mwishimo, Mwangala, Kiuyu, Mwakuzimu, Mashazani, Mwangoa, Mkupe, Pangwa, Maweni, Mshahame, Mwangala, Maweni, Kipevu, Tonesa, Chamba cha amani, Kiomoni, Nagre, Kitanga, Changane, Kiiweni, Mavuzoni, Mwenyikai, Hodi, Kaguzoni, Ngazini, Agol area, Kibuyu mali	Dongo kundu, Mwishimo, Mwangala, Mwangoa, Mkupe, Pangwa, Maweni, Mshahame, Mwangala, Maweni, Kiomoni, Mavuzoni, Hodi	
Ngare BMU	Ngare BMU	Dongo kundu, Mwishimo, Hodi, Kiguzo pofu, Mwangala, Kitanga Juu, Ngare, Tumbulioni, Mshahame, Kwa Mwandi, Mikadini, Mkupe, Bofa shilingi (Mkisi wa Panya), Mikwekwe, Nyange, Kwa Ngovi, Mgongo Tisa, Mwangoa, Maweni	Dongo kundu, Mwishimo, Mwangala, Mwangoa, Mkupe, Hodi, Maweni, Mshahame	
Tsunza Central	Tsunza Central BMU	Mwinyi kai, Dogo kundu, Kibuyuni, Hodi, Mwishimo, Chiweni, Mwangala, Makobeni, Kiomoni, Fungu ya kati, Jungu kuu, Mshahame, Mwamlocha, Ngai Boto, Mkupe, Pangwa, Mkwangovi, Mavuzoni, Gutu, Mwana Mungani, Maweni, Bonje	Dongo kundu, Mwishimo, Mwangala, Mkupe, Hodi, Pangwa, Maweni, Mshahame, Kiomini, Mavuzoni	Mshahame, Ngai Boto, Dongo Kundu, Mwishimo, Hodi, Fungu ya Kati, Kibuyuni

Mwangala BMU	Mwangala BMU	Dongo kundu, Mwangala	Dongo kundu, Mwangala	
Shelly-Waa-Tiwi-Diani beach stretch	Shelly-Waa-Tiwi-Diani beach stretch BMUs	Chale island, Chambani, Denyenye, Fuzo, Keuke, Kichwani, Kidutuni, Kikadini, Makonde, Mkwiro, Mlangoni, Mwagandizo, Mwakadide, Mwanyundo, Mwalumbi, Ngombeni, Nyari, Sabasaba, Shimo la mlango, Tiwi, Kochini, Melini, Mnyerere, Sengera, Bat juu, Diani, Jumbale, Kihilu, Kijiwenuni, Kionyo, Kongo, Makonde, Mwalumbi, mwana nyamala, Rigagana, Sabasaba, Waa, Zambani, Zangaraweni, Chanda kidongo, Chidzewe nguvu, Doteni, Mwandizo, Waufa, Changaraweni, Jadini, Juu ya congo river, Kilaga-ngoma, Machagwe, Mavovo, Mavumuzini, Mkwazo, Mwayizindo, Mzambani, Shimole, Bororiani, Bwanga, Choni, Isondoifo, Kichwani, Mabarani (has sand), Mwanzaa, Zimilani, Bokima, Boyani, Kina, Mavumuzini, Ziweni, Mwakande, Alambe, Mwanamochi		

(2) Fish Landings in the Project Area

From the household survey, fishers from Ngare village landed their catch at Kitanga Juu landing site and Ngare landing site (**Table 60**) At Shelly-Waa-Tiwi-Diani beach stretch fishers landed their catch on a number of landing sites with the most popular landing sites being Tiwi bandarini landing site (30.4percent), Nyari kikadini landing site (30.3percent) and Chale-jeza landing site (14.3percent). From FGDs, fishers from Mwangala BMU landed most of their catch at Mwangala landing site while those from Ngare BMU landed most of their catch at Ngare landing site. Results showed that fishermen shared landing sites and there was cohesion among fishers that brought them together and allowed them to work freely in any area without restriction.

TABLE 60 - FISH LANDINGS IN THE PROJECT AREA

Attribute		**N**	
Landing site	Ngare village	Kitanga Juu	95.8percent
		Ngare	4.2percent
	Shelly-Waa-Tiwi-Diani beach stretch	Chale-jeza	14.3percent
		Fuzo	1.8percent
		Magandizo	1.8percent
		Mkunguni	1.8percent
		Mpunguti (coconut hotel)	1.8percent
		Mwaepe	5.4percent
		Mwagandizo	7.1percent
		Mwakamba	5.4percent
		Nyari kikandini	30.3percent
		Tiwi bandarini	30.4percent

Type of fish landed	Ngare village (Kilindini creek)	Prawn, Lobster, Tuna, Shark, Barracuda, Red snapper, Marlin, Kipanga, Crabs, Parrot fish, Mackerel, Mullet, Squid, King fish, Spotted grunter, Ray, Grouper, One-spot snapper, Brassy chub, Sonyo, Korokoro, Emperor, Kiunge, Rabbitfish, Purse mouth, Sardine, Mudfish, Conger eel, Trevally, Sardine, Tala, porcupine fish, Threadfin butterflyfish,	
	Shelly-Waa-Tiwi-Diani beach stretch	Rabbitfish, Parrotfish, Emperor, Mullet, Sail fish, Jacks, Minstrel, Marlin, Honeycomb rod cod, King fish, Snapper, Minstrel, Black spot emperor, Purse mouth, Parrot fish, Grouper, Barracuda, Red snapper, White snapper, Tiger cowrie, Sardine, "*Toa*", Caesio/rainbow flasher, Lobster, Octopus, Shark, Indian goat fish, Ray, Squid, Snubnose pompano, Cut throat emperor, Yellow needlefish, Convict surgeon, Spotted ray, Humpback Unicom-fish, Black-bar triggerfish, Tuna	
Fish landing (Kgs)	Ngare village	Mean	9.6±8
		Max	30
		Min	1.7
	Shelly-Waa-Tiwi-Diani beach stretch	Mean	21.1±21.5
		Max	100
		Min	2.3

The study established that fishers from different areas landed different species of fish. Almost similar species of fish were landed at Kilindini creek and Shelly-Waa-Tiwi-Diani beach stretch. However, there were fish species that were unique to specific sites, prawns were only landed at Kilindini creek while octopus was only landed at Shelly-Waa-Tiwi-Diani beach stretch. Both prawns and octopus are high valued fisheries that were targeted by fishers because they fetched better prices in the market. Fishers landed different quantities of fish at each fishing expedition, but on average, fishers from Ngare village landed about 9.6±8 kgs of fish in a day while fishers from Shelly-Waa-Tiwi-Diani beach stretch landed about 21.1 kgs of fish in a day. Fishing effort varied with changes in seasons, Northeast Monsson (NEM) season and Southeast Monsoon (SEM) season. Along Kilindini channel, the peak prawn fishing season was October-April, peak lobster fishing season was September-April, while crabs and other fisheries were harvested all year round.

It is important to note that there had been a significant change in the quantity of fish landed over the years. Fishers attributed the reduction in catch to shrinking working space because of increased project activities in the area. Fishers from Shelly-Waa-Tiwi-Diani beach stretch observed that they have experienced two incidences of sand harvesting in the area, and this led to increased turbidity and sedimentation in some important fishing grounds, and the ocean ecosystem has not yet fully recovered from the previous disturbance hence poor catch records. Fishers from Kilindini creek also reported a reduction in fishery production in the area and this was attributed to increased project activities in the area which have affected the creek ecosystem health. Fishers also complained of not being able to access some of the fishing grounds that they previously fished and there were fears that more fishing grounds may not be accessed once the new port is constructed (Berth 23).

Table 61 - Fish landing site along Kilindini channel/ Portreitz creek

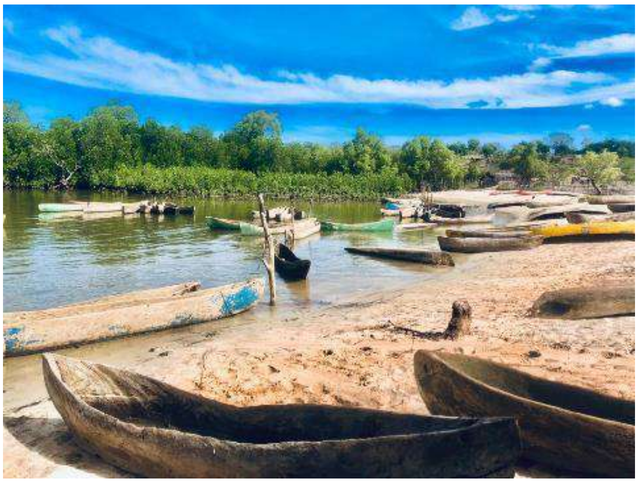


Plate 5: Tsunza central Landing site	**Plate 6:** Uzio fishing trap and boats at Tsunza central landing site
	
Plate 7: Catch composition at Kitangaa Juu BMU	**Plate 8:** Fish catch at Shelly-Waa-Tiwi-Diani beach stretch

(3) Fishing Effort/ Practices

Most fishers from Ngare village went fishing for 4 days in a week, while at Shelly-Waa-Tiwi-Diani beach stretch most fishers fished for 6 days in a week (**Table 62**). Fishermen from Ngare village conducted fishing for less number of days than fishers from Shelly-Waa-Tiwi-Diani beach stretch because fishing along Kilindini creek requires a boat and most fishers did not own boats. Survey data showed that about 83.3 percent of the fishers did not own fishing boats. The fishers obtained fishing boats by renting them from the BMU of other fishermen, sharing a family boat and from their employers. The most used fishing gear at Shelly-Waa-Tiwi-Diani beach stretch was a fishing net more than 2-inch (≥2”) (45.9percent). Similarly, in Ngare village, the most used fishing gear was Net ≥2" (33.3percent) and Monofilament net (33.3percent). Most fishers owned their fishing gears, with 75 percent of fishers at Shelly-Waa-Tiwi-Diani beach stretch owning their fishing gears and 58.3 percent of fishers from Ngare village owning their fishing gears.

The most used fishing vessel was Dhow/ Canoe (*Dau/ Hori*). At Shelly-Waa-Tiwi-Diani beach stretch the Dhow/ Canoe accounted for 69.7 percent of the vessels used while at Ngare village it accounted for 100 percent. Most fishers preferred to use Dhow/ Canoe (*Dau/ Hori*) because it was cheaper to build compared to other fishing vessels, it was easier to maintain, and it was cheaper to use. On average, a fishing expedition along Shelly-Waa-Tiwi-Diani beach stretch involved 4 fishermen while in Ngare village a fishing expedition involved 2 fishermen, at both sites, most fishing activities involved 2 fishermen (**Table 62**). On average, fishers from Shelly-Waa-Tiwi-Diani beach stretch earned an income of Ksh. 1420±1025 in a day, while fishers from Ngare village earned an income of Ksh. 1159±797 in a day. The same earning estimates were recorded from FGD with fishers from Mwanga BMU, Tsunza central BMU, Ngare BMU and Mwakamba BMU.

TABLE 62 - FISHING EFFORT IN THE PROJECT AREA

Item		**N**	
No. days fishing in a week	Shelly-Waa-Tiwi-Diani beach stretch	Mean (5.5±1.4)	***Use of fishing boat***
		Mode (6) *46.3percent*	Yes (59.3percent)
		Min (2)	No (40.7percent)
		Max (7)	
	Ngare village	Mean (4.5±1.4)	Yes (100percent)
		Mode (4) *33.3percent*	
		Min (2)	
		Max (7)	
Fishing gear	Shelly-Waa-Tiwi-Diani beach stretch	Handline (8.2percent)	***Gear Ownership***
		Net ≥2" (45.9percent)	Hire from a fisher (9.6percent)
		Net <2" (1.6percent)	Jointly owned (11.5percent)
		Spear gun (14.8percent)	Employer (3.8percent)
		Basket trap (24.6percent)	Self-ownership (75percent)
		Flippers (1.6percent)	
		Gill net (1.6percent)	
		Longline (1.6percent)	
	Ngare village	Handline (7.7percent)	Hire from a fisher (8.3percent
		Net ≥2" (33.3percent)	Employer (33.3percent)
		Net <2" (2.6percent)	Self-ownership (58.3percent)
		Gill net (10.3percent	
		Longline (12.8percent)	
		Monofilament (33.3percent)	
Fishing boat	Shelly-Waa-Tiwi-Diani beach stretch	Dhow/ Canoe (*Dau/ Hori*) (69.7percent	***Boat ownership***
		Fiber boat (12.1percent)	Hire from a fisher (27.3percent)
		Outrigger canoe (*Ngarawa*) (18.2percent)	Joint ownership (15.2percent)
			Self-owned (33.3percent)
			Employer (24.2percent
	Ngare village	Dhow/ Canoe (*Dau/ Hori*) (100percent)	Hire from BMU (20.8percent)
			Hire from fisher (41.7percent)

			Family boat (12.5percent)
			Employer (8.3percent)
			Self-owned (16.7percent)
Boat carrying capacity	Shelly-Waa-Tiwi-Diani beach stretch	Mean (3.5±3)	***Earning in day***
		Mode (2) *27.8percent*	Mean (Ksh. 1420±1025)
		Min (1)	Mode (Ksh. 1800) *10.8percent*
		Max (20)	Min (Ksh. 300)
			Max (Ksh. 5000)
	Ngare village	Mean (2±0)	Mean (Ksh. 1159±797)
		Mode (2) *100percent*	Mode (Ksh. 1000) *18.2percent*
		Min (2)	Min (Ksh. 400)
		Max (2)	Max (Ksh. 3500)

Results indicate diversity in the fishing activities in the project area and this should be considered when planning mitigation measures for the likely impacts of the project.

(4) Value of Fishery Products in the Project Area

Different types of fish attracted different prices in the market (**Table 63**). On average, lobster and prawns attracted higher prices in the market than other types of fish and fishery products. The mean market price of fish at Shelly-Waa-Tiwi-Diani beach stretch was Ksh. 360.64 while the mean fish prices at Ngare village was Ksh. 387.32.

TABLE 63 - DIFFERENT FISHERIES AND THEIR PRICES

Item	Site	Type of fish	Price
Average price for fish (Ksh)	Shelly-Waa-Tiwi-Diani beach stretch	Rabbit fish	325
		Kingfish	350
		Variegated emperor	283.33
		Parrot fish	237.5
		Honeycomb rod cod	250
		“Badu”	250
		Octopus	350
		Red snapper	200
		Lobster	1000
		Mean price	**360.64**
	Ngare village (Kilindini channel)	Spotted grunter	325
		Prawns	514.64
		king fish	350
		Red snapper	400
		Lobster	800
		Mullet	300

		Marlin	300
		Tuna	200
		Shark	300
		Barracuda	300
		Mean price	**387.32**

To estimate the value of fisheries products in the project area, fisheries data was obtained from Ngare BMU who shared the same fishing area and market with other BMUs along Kilindini channel and Mwache creek. The obtained data was for mixed fisheries from the month of January 2023 to June 2023 (**Table 64**) During the analysis, data for the month of June 2023 was left out because of the inconsistencies in the data, therefore the analysis was done for the month of January 2023 to the month of May 2023.

TABLE 64 - ESTIMATED VALUE OF FISHERIES AT NGARE BMU BASED ON FIVE MONTHS DATA

Site	Month	Quantity of fisheries (Mixed) landed in Kg	Average price	Value
Ngare BMU	January 2023	6538		2,532,298.16
	February 2023	5535		2,143,816.2
	March 2023	8583	@387.32	3,324,367.56
	April 2023	80915		31,339,997.8
	May 2023	67255		26,049,206.6
	Total estimated value of fisheries at Ngare BMU in five-month period			**65,389,686.32**

Source: Ngare BMU Records

Ngare BMU generated an ex-vessel value of Ksh. 65,389,686.32 between the month of January 2023 to the month of May 2023. Results show that Kilindini channel is rich in highly valuable fisheries and therefore there is need for the proponent to minimize negative impact on the channel during port construction so as not to degrade the fisheries resource to a scale of no recovery as it will adversely affect sustainability of the community.

Fishers reported retaining part of their catch for home consumption (*Kitoweo*). Most fishers about 60percent sold all their target catch and only used by-catch for home consumption "*kitoweo*". On average, fishers from Shelly-Waa-Tiwi-Diani beach stretch retained 2.5±2.7 Kgs while fishers from Ngare village retained 0.88±0.48 Kgs of fish for own consumption "*kitoweo*".

(5) Fish Market

About 93.8 percent of fishermen sold their catch at the landing site. Out of the total catch sold at the landing site, 75 percent was sold to fish dealers/ traders while 18.8 percent was sold to fishmongers/*mama karanga*. Other fishers sold their catch to restaurants or hawked in the village. The study further established that there was high demand for fish and other fish products and buyers were readily available.

8. Disadvantaged and Vulnerable Groups

The study did not identify any ethnic minorities in the project area. However, about 66.2 percent of the respondents along the Shelly-Waa-Tiwi-Diani beach stretch reported that there were vulnerable and marginalized people in the community. These people included orphans, widows, elderly people in the village, disabled persons, and drug addicts who may need special care. These are the people who lived in the same area along Shelly-Waa-Tiwi-Diani beach stretch. In Ngare village, about 65.8 percent of respondents reported that there were vulnerable and marginalized people in the village. These people included all those people living in Ngare village because of the land ownership issues, and limited livelihood options that make the community vulnerable to poverty.

9. Physical Infrastructure

(6) House, sanitation, land, water, and social amenities accessibility

Majority of the respondents owned houses they were living in, Shelly-Waa-Tiwi-Diani beach stretch (90.5percent), Ngare village (94.6percent). At Shelly-Waa-Tiwi-Diani beach stretch, respondents reported that most houses were semi-permanent (52.9percent) while in Ngare village most houses were temporary structures (44.7percent). However, some respondents lived in houses that they had rented. At Ngare village, there is a likelihood that some houses maybe affected by the access road. The study further revealed that about 69 percent of the respondents at Shelly-Waa-Tiwi-Diani beach stretch had access to safe drinking water that was mainly obtained from boreholes/well. At Ngare village respondents obtained most of their water from the BMU water kiosk. In Ngare village, 83.3 percent of the respondents stated that there was no piped water and they relied on water that was brought in by water buzzer and sold at the water kiosk in the village. So far, there was only one well in the village.

In terms of sanitary conditions, a section of the population at both Shelly-Waa-Tiwi-Diani beach stretch and Ngare village did not have access to latrines or toilets (**Table 65**). In Ngare village, there was only one pit latrine, which was depended on by the villagers hence there is need for improved sanitation in the area.

Regarding the use of electricity, the study revealed that 74.4 percent of the respondents at Shelly-Waa-Tiwi-Diani beach stretch and 48.7 percent of the respondents at Ngare village used solar energy. Results have shown that solar lighting was considered to be cheaper compared to other forms of lighting as it did not require extra charge when using it. In addition, there was no power grid at Ngare village. In terms of land tenure arrangements, the study established that at Shelly-Waa-Tiwi-Diani beach stretch, most people lived on family land (55.9 percent) and self-owned land (41.2 percent). However, there were a few people who lived on the government land. At Ngare village, land ownership was either with the BMU (36 percent), family (36 percent) or government (28 percent). Those who stated that the land that they lived in was owned by the BMU had moved into the area after being evicted from the neighboring villages that were affected by the previous projects and settled near Kitanga Juu landing site. Residents who were living on family land observed that they obtained the land from their parents or spouses. Those who obtained land from their parents were born in that area. Those who were living on government land said they were not sure who the land belonged to and so they believed it was government land.

TABLE 65 - HOUSE, SANITATION, LAND, WATER, AND SOCIAL AMENITIES ACCESSIBILITY

Attributes		N	
House ownership	Shelly-Waa-Tiwi-Diani beach stretch	Self-owned	90.5percent
		Rented	9.5percent
	Ngare village	Self-owned	94.6percent
		Rented	5.4percent
Type of house	Shelly-Waa-Tiwi-Diani beach stretch	Permanent	45.6percent
		Semi-permanent	52.9percent
		Temporary	1.5percent
	Ngare village	Permanent	31.6percent
		Semi-permanent	23.7percent
		Temporary	44.7percent
Potable/ Drinking water	Shelly-Waa-Tiwi-Diani beach stretch	Borehole/ well	68.7percent
		Buy from water kiosk	8.4percent
		Piped water	19.3percent
		Buy from water vendor	3.6percent
	Ngare village	Buy from BMU water kiosk	83.3percent
		Borehole/ Well	9.5percent
		Rains	4.8percent
		Buy from water vendor	2.4percent
Sanitation (*pit latrine, modern toilet, bush etc.*)	Shelly-Waa-Tiwi-Diani beach stretch	Bush/ Mangrove	12percent
		Modern toilet	20percent
		Pit latrine	68percent
	Ngare village	Bush/ Mangrove	35.9percent
		Pit latrine	61.5percent
		Temporary dug toilet	2.6percent
Source of lighting	Shelly-Waa-Tiwi-Diani beach stretch	Candles	1.3percent
		Grid	39.5percent
		Kerosene lamp	10.5percent
		Solar	48.7percent
	Ngare village	Kerosene lamp	23.1percent
		Solar	74.4percent
		Phone light	2.6percent
Land Ownership	Shelly-Waa-Tiwi-Diani beach stretch	Family land	55.9percent
		Government	2.9percent
		Self-owned	41.2percent
	Ngare village	BMU	36.0percent
		Family land	36.0percent
		Government	28.0percent

To carry out day-to-day activities' respondents used various means of transport. The most used means of transport in the project area included the motorbike (31.4 percent), boat (31 percent), and walking (17.1 percent). Other means include use of a tricycle (tuktuk), vehicle and bicycle. Boat was mostly used for fishing activities taking place in the visited villages while motorbike transport was commonly used because it was the most convenient and fastest way to move from one place to another such as from fish landing site to the marketplace or from home to the fish landing site. Though Ngare village had a good transport network passing near the village, Dongo Kundu bypass, and SGR railway line, the village had a bad access road that could not be accessed during the rainy season.

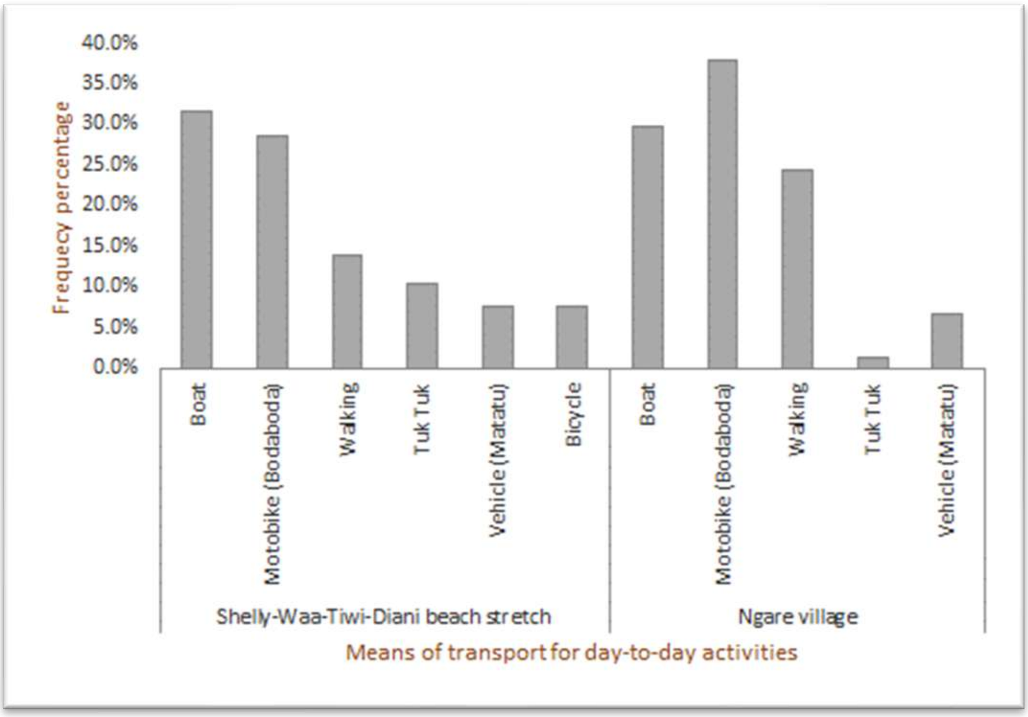


FIGURE 124 - MEANS OF TRANSPORT USED BY RESPONDENTS.

5.7.7 Tourism

This section covers the socioeconomic baseline assessment of tourism activities including tourism facilities and recreational activities namely snorkeling, diving, sand bathing, recreational fishing, swimming and surfing, and tourism hotels in and around the project area. The official statistics (Kenya National Bureau of Statistics, 2020), demonstrate that the number of tourists who visited the Mombasa, Watamu and Kisite-Mpunguti Marine Parks and Reserves increased steadily between the year 2015 and 2019 (**Table 66**). In particular, there was a steady rise in the number of tourists that visited the Mombasa Marine Park and Reserve which is located close to the project area. The steady increase was however significantly interrupted by the COVID-19 pandemic in the year 2020.

TABLE 66 - NUMBER OF VISITORS TO MARINE PARKS AND RESERVES IN THE COAST OF KENYA, 2015-2019

Park/Reserve	2015	2016	2017	2018	2019

Mombasa Marine Park and Reserve	26200	29500	32200	39800	40800
Malindi Marine Park and Reserve	29300	31500	31600	29100	28800
Kisite-Mpunguti Marine Park and Reserve	24800	34400	38400	50300	53300
Watamu Marine Park and Reserve	24300	33900	43500	67500	72600
Total	**104600**	**129300**	**145700**	**186700**	**195500**

Source: Kenya National Bureau of Statistics (2020). Economic Survey 2020

It is worth noting that the Mombasa nearshore areas and the Shelly-Waa-Tiwi-Diani stretch are characterized by diverse tourist attractions and activities. The main tourist activities in the different sites in are presented in **Table 67**.

TABLE 67 - TOURIST ATTRACTIONS AT EACH SITE

S. No	Site	Attraction
1	Severin	• Coral viewing, watching of fish, lobsters, turtles & octopus • Diving also takes place in this site during high tides
2	Coral garden	Coral viewing & swimming
3	Mombasa marine park	Coral viewing, swimming, diving & watching different types of fish
4	Reef	• Swimming, sun bathing & photography • Bird watching in December
5	Starfish garden	Diving, viewing different species of starfish & fish
6	Jomo Kenyatta	Snorkeling, boat rides, fishing and swimming activities
7	Creeks village	Swimming, canoeing & fishing activities.

1) Sites Visited for Snorkeling and Sea-Based Recreation Activities in Mombasa

The most popular sites in Mombasa that were visited by most tourists for snorkeling and other sea-based recreational activities included Mombasa Marine Park and the Coral Garden that is located within the park. These sites are characterized by high fish abundance thus making them more attractive. Results indicate the sites that most tourists frequently visit for snorkeling and other sea-based recreational activities respectively. The survey results in **Figure 125** indicate that the highest number of visitors in the Mombasa sites is taken to Mombasa Marine Park and Coral Garden for snorkeling. This is followed by Reef, Severin and Creeks valley. The other sites are visited by a smaller number of tourists in a year. It is also evident that a few visitors from Mombasa visit Wasini and Funzi in the south coast of Kenya for snorkeling. This signals the importance of Kisite-Mpunguti Marine Park and Reserve. It was observed that the frequency of visits to all snorkeling sites is generally very low during the Southeast Monsoon. The distance to the snorkeling sites is generally short.

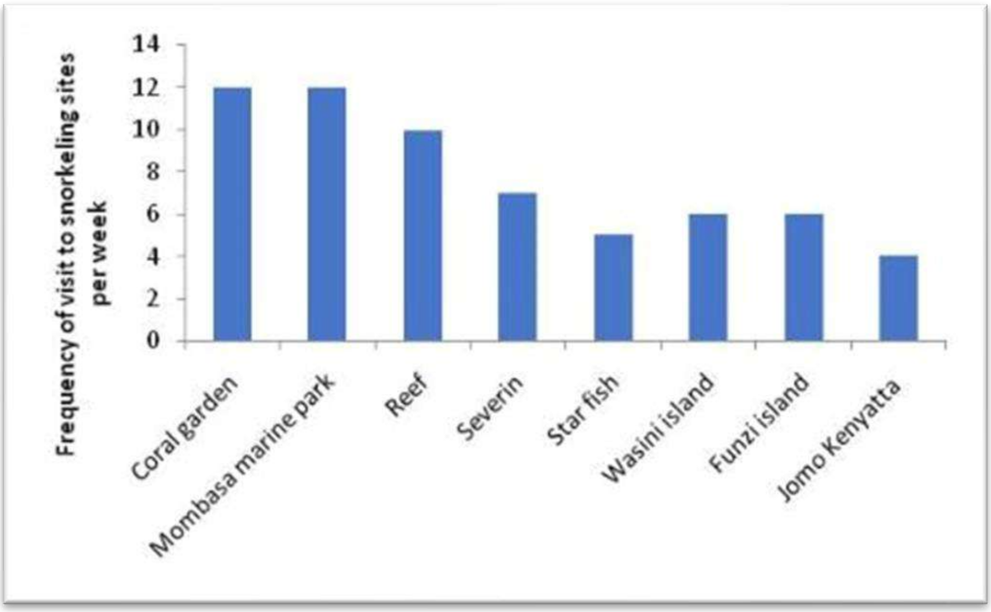


FIGURE 125 - DETAILS OF EACH SNORKELING SITE

Figure 126 indicates that the highest number of tourists visited Coral Garden and Reef for other sea-based recreational activities during the North East Monsoon season followed by Mombasa Marine Park and Reserve and Star fish. The Coral Garden has emerged to be popular for both snorkeling and other sea-based recreational activities. **Figure 126** further shows that the sites for other sea-based recreational activities are mainly visited during the North East Monsoon season and not the South East Monsoon (SEM) season. The frequency of visit to these sites was highest during the North East Monsoon when the sea is calm.

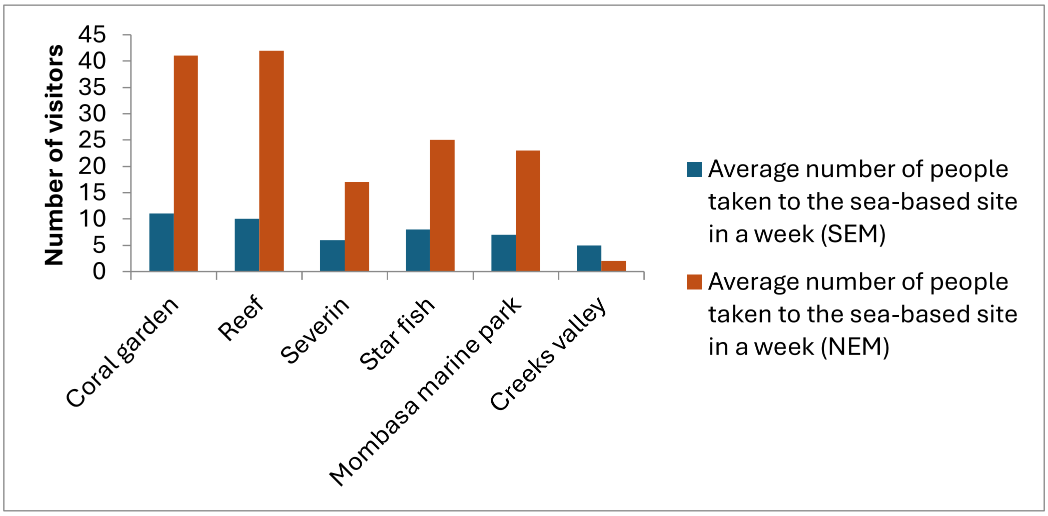


FIGURE 126 - NUMBER OF VISITORS TO EACH SITE IN MOMBASA FOR SEA-BASED RECREATIONAL ACTIVITIES

2) Sites visited for Snorkeling and Sea-Based Recreation Activities in Diani

At Diani, on average five (5) snorkeling sites were popular with the tourists. Robinson sand island, Mtengo, Reef and Tradewinds Island were some of the major snorkeling sites visited. Mtengo is known for different types of corals found in the area such as potato corals, brain corals, mushroom corals, finger corals and 'Kilimanjaro' corals. Visitors can also watch different types of fish such as parrot fish, starfish, clone fish, butterfly fish, among others, and take pictures. Robinson coral garden is visited mainly for corals viewing. However, during high tides, the visitors just engage in swimming due to abundance of sea urchins. In this site, the visitors also feed the fish found in the area, by throwing slices of bread in the water. Reef is known for swimming, sunbathing and photography. During the month of December, the visitors can also watch birds. The area covers over 15 km long connecting to Congo River.

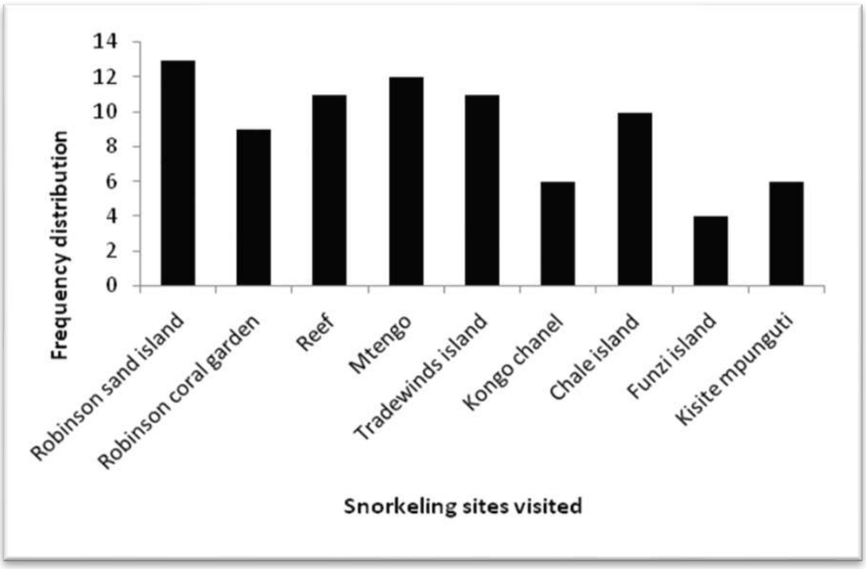


FIGURE 127 - SNORKELING SITES VISITED IN DIANI

3) Details of the Snorkeling Sites visited in Diani

Number of people who visited the snorkeling sites in Diani is presented in **Figure 128**. The average distance (km) of Robinson sand Island, one of the popular snorkeling sites, from the interview site was 2km. The tourists visited the site during south east monsoon and north east monsoon 4 times per week and 11 times per week respectively, while the average number of visitors taken to the site in a week during south east monsoon and north east monsoon was 6 and 20 visitors respectively. The average distance (km) of Mtengo, another popular snorkeling site, from the beach where interview was conducted was 1.7km. The tourists visited the site 4 times per week during south east monsoon and 11 times per week during north east monsoon while, the average number of visitors taken to the site in a week during south east monsoon and north east monsoon was 6 and 22 visitors respectively. The average distance (km) of Reef from the interview site was 1km. The frequency of visits to the site in a week during south east monsoon and north east monsoon was 3 and 9 times respectively while, the average number of visitors taken to the site in a week during south east monsoon and north east monsoon was 6 and 21 visitors respectively. The average distance (km) of Tradewinds Island from the interview site was 1.7km. The frequency of visits to the site during south east monsoon and north east monsoon was 3 times per week and 9 times per week respectively, and the average number of visitors taken to the site in a week during south east monsoon and north east monsoon was 6 and 16 visitors respectively. It was also observed that many visitors from Diani are also taken for snorkeling to Kisite-Mpunguti which is located far to the south outside Diani.

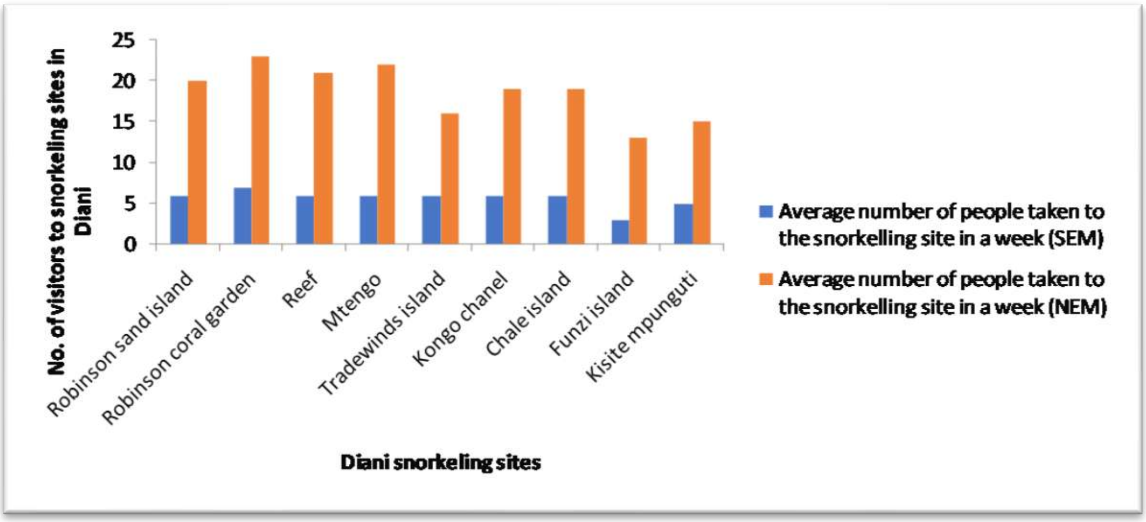


FIGURE 128 - NUMBER OF VISITORS TAKEN TO THE DIANI SNORKELING SITES

4) Diving sites at Diani

The study established that diving is done at Diani during high tides. During the month of October to early January, diving is done in the deep sea. Two (2) diving sites were identified but the names are unknown.

5) Other recreational activities at Diani sites

Sun bathing usually takes place around Robinson Sand Island and reef during low tides. Both local and foreign tourists engage in this activity. Surfing is conducted during low tides. The visitors engage themselves in this activity mainly along the shore and near the reef. Majority of the tourists involved in this activity are mostly locals. Some tourists engage in fishing activities mainly in the deep sea. This activity is usually done for non-consumptive purposes, with participants only allowed to take pictures and return the fish to the sea. On average two recreational fishing sites were visited by tourists, with deep sea site accounting for 67% of recreational fishing and inshore site accounting for 33% of recreational fishing. On the one hand, the average distance (km) of the deep sea recreational fishing site from the interview site was 2km. The frequency of visits to the site in a week during south east monsoon and north east monsoon was 1 and 3 times respectively, and the average number of visitors taken to the site in a week during south east monsoon and north east monsoon was 3 and 7 visitors respectively. On the other hand, the average distance (km) of inshore recreational fishing site from the interview site was 1km. The frequency of visits to the site in a week during south east monsoon and north east monsoon was 2 and 4 times respectively, while the average number of visitors taken to the site in a week during south east monsoon and north east monsoon was 2 and 4 visitors respectively.

6) Origin of Guests Visiting Snorkeling and other Sea-Based Recreational Sites

It is evident from **Figure 129** and **Figure 130** that both local and foreign guests visit the snorkeling and sea-based recreational sites in Mombasa. Most of the local guests that visit the snorkeling and other sea-based recreational sites come from Nairobi, Nakuru and Naivasha. The foreign guests who visit the snorkeling sites mostly come from France, Poland and Germany while those visiting Mombasa for the other sea-based tourism and recreational activities mostly come from USA, France and Germany (**Figure 129**).

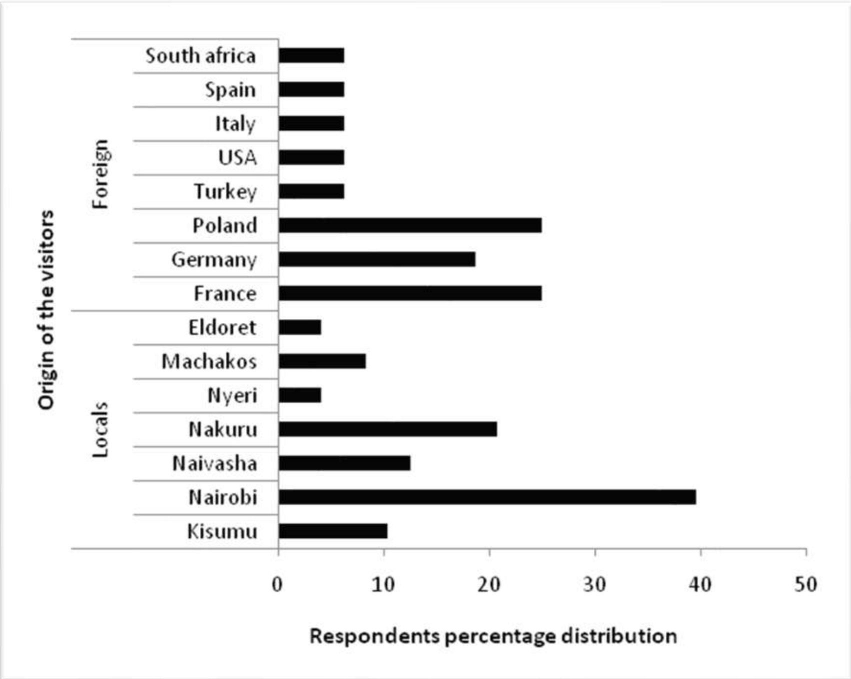


FIGURE 129 - ORIGIN OF SNORKELING VISITORS AT MOMBASA SITES

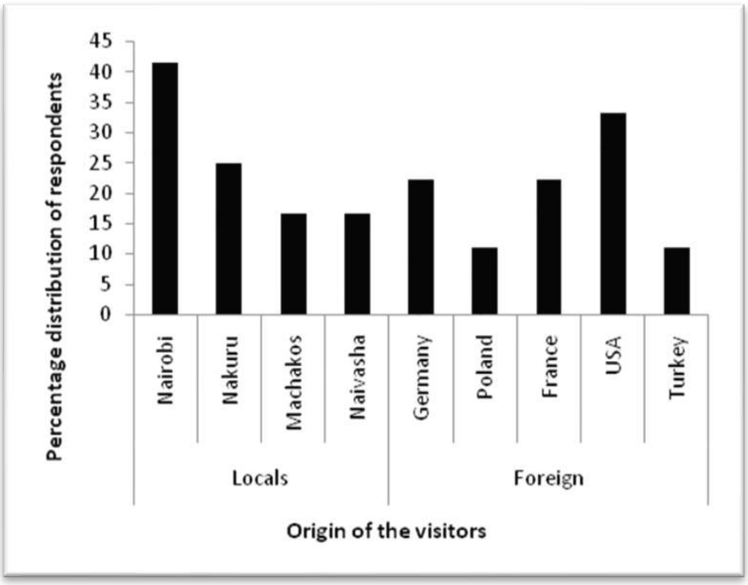


FIGURE 130: ORIGIN OF GUESTS VISITING MOMBASA SITES FOR OTHER SEA-BASED RECREATIONAL ACTIVITIES

At Diani, both local and foreign tourists visited the snorkeling sites. Majority of the local tourists were from Nairobi and Nakuru while majority of foreign tourists were from France, Germany, Spain and Belgium (**Figure 131**).

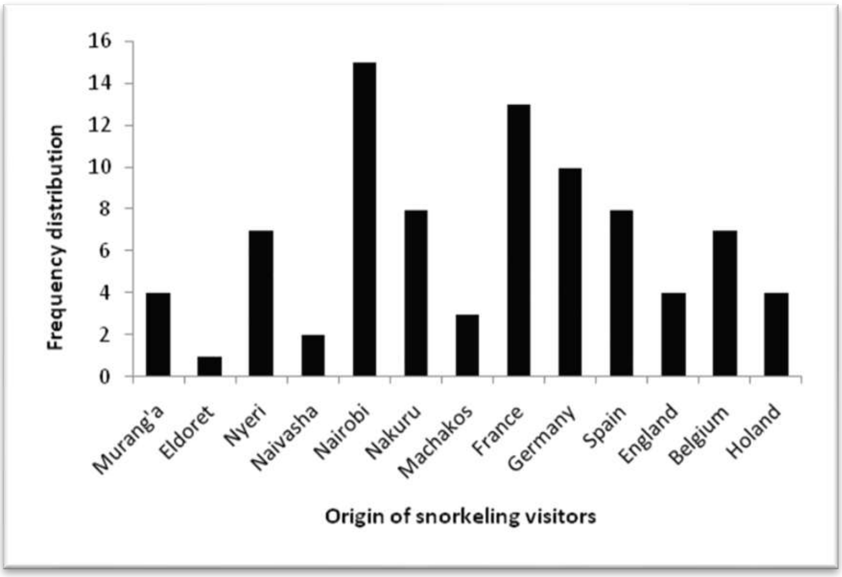


FIGURE 131 - ORIGIN OF SNORKELLING SITES VISITORS AT DIANI SITES

Majority of the local tourists who visited the Diani recreational fishing sites were from Nairobi and majority of the foreign tourists came from France, Germany and Belgium (**Figure 132**).

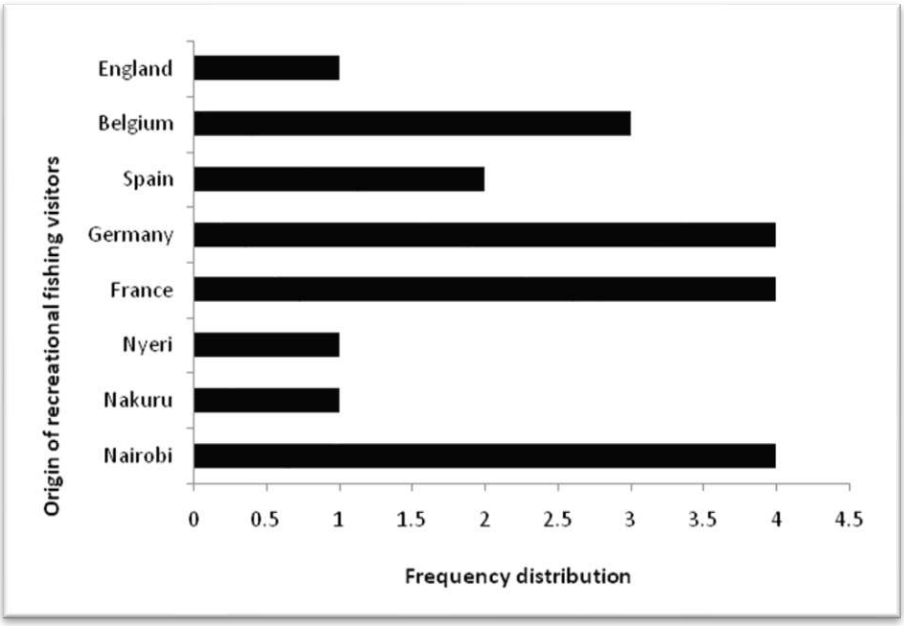


FIGURE 132 - ORIGIN OF DIANI RECREATIONAL FISHING SITES VISITORS

7) Income from snorkeling and guests visiting sea-based recreational sites

The sea-based recreational activities has employed many people who work as tour-boat operators, captains, tour guides, as well as those involved in the repair and maintenance of tourist boats, curio-vendors who sell their wares at these sites, and kiosk operators who sell food stuffs including coconut juice (‘madafu’). The average weekly income from snorkeling was KSh.2,790.4 (USD 27.9) during the South East Monsoon and KSh.40,393.6 (USD 403.9) during the North East Monsoon while, for other sea-based recreational activities, the average weekly income was KSh.2,717 (USD 27.2) during the South East Monsoon and KSh.27,414.3 (USD 274.1) during the North East Monsoon (**Table 68**).

TABLE 68 - INCOME FROM SEA-BASED ACTIVITIES

Weekly income from snorkeling South East Monsoon		Weekly income from snorkeling North East Monsoon		Weekly income from guests visiting sites for other sea-based recreational activities (South East Monsoon)		Weekly income from guests visiting sites for other sea-based recreational activities (North East Monsoon)	
Max.	6000	Max.	126000	Max.	3600	Max.	49500
Min.	300	Min.	14000	Min.	2400	Min.	15000
Average	2790.38	Average	40393.59	Average	2717.14	Average	27414.28

5.7.8 Agriculture

The study established that about 60 percent of the respondents practiced small scale agriculture, with about 47 percent of those involved in small scale agriculture coming from Shelly-Waa-Tiwi-Diani beach stretch while 13 percent were from Ngare village. At both sites, the agricultural produce was primarily used for food at home and on rare occasions some agricultural produce was sold when in surplus. From FGDs, respondents from Mwangala BMU, Ngare BMU, Tsunza central BMU and Mwakamba BMU also reported that locals in their respective villages practiced subsistence farming and mostly sold fruit crops. In addition, it was established that the locals did not practice commercial agriculture because it was expensive for them.

Respondents from Shelly-Waa-Tiwi-Diani beach stretch planted different food crops such as maize, cassava, banana, beans, vegetables (*Kunde, mchicha, Sukuma*), pawpaw, watermelons, passion fruits, green grams, coconut, okra, tomatoes, cashew nuts, sweet potatoes, *mbaazi*, pumpkins, wheat, oranges, and mangoes. From Kilindini stretch, respondents planted vegetables (cowpeas, *‘mchicha’*), maize, sugarcane, beans, pawpaw, pumpkin, cassava, cowpeas, green grams (*pojo*), banana, cashew nuts and ground nuts. The community was also involved in rearing animals like chicken, goat, cow, sheep, duck, rabbit, and sheep for food and domesticated dogs and cats for security. Respondents reported that they farmed around their homesteads for vegetables and maize but also had other land away from the village where they grew more crops for food.

In terms of land ownership, respondents from Shelly-Waa-Tiwi-Diani beach stretch who were involved in farming activities farmed on their self-owned land (50.5 percent), inherited land (16.3 percent) and family land (29.1 percent). Along Kilindini stretch, respondents farmed on self-owned land (64.3 percent), friend’s land (14.3 percent), family land (14.3 percent) and public land (7.1 percent). In Ngare village, most of those who farmed practiced it away from the village. They farmed in neighboring villages because of inadequate land in Ngare village. In addition, 69.2 percent of the respondents from Ngare village and 80 percent of the respondents from Shelly-Waa-Tiwi-Diani beach stretch owned less than 2 acres of land each. Farmers from Shelly-Waa-Tiwi-Diani beach stretch earned a mean income of Ksh 41,142±36,735 per season, with a famer who had the highest earning making Ksh 100,000 while a farmer with least earnings making Ksh 8,000 in a season. In Ngare village, farmers earned a mean income of Ksh 15,100±12,022 in a season with a farmer who had the highest earning making Ksh 30,000 while a farmer who had the least earnings making Ksh 3,500.

5.7.9 Earnings From Small-Scale Businesses

About 17 percent of the respondents engaged in small scale business activities as their main source of income. On average, the monthly income from small-scale business was Ksh. 13,537. The small scale businesses included sale of clothing, ecotourism, fish trade, and cargo carrying. The best earning business was fish trade with an average monthly income of Ksh. 25,000 while the least earning business was sale of seedlings with an average monthly income of Ksh. 4,000. Given the communities living around the marine and coastal ecosystems were engaged in different economic activities, the diversity of economic activities in the project area may need to be considered when planning for measures to mitigate the likely adverse impacts of the project.

5.7.10 Change And Diversification of Livelihoods in The Project Area

Sixty-six (66) percent of the respondents had experienced changes in their livelihood in the past five years. The changes were said to have been caused by increase in development projects in the marine environment, offshore oil and gas exploration, dredging, oil spills, pollution, changing climate, corona pandemic, unsustainable fishing practices and economic recession. Fishers are fishing for longer hours than before to get a useful catch, and some fishers change fishing gears towards more efficient but destructive gears so that they maximize their catch. Tour guides had lost good snorkeling sites from sand harvesting effect which had reduced tourism activities in the south coat of Kenya. Climate change was also thought to have affected fishing and farming activities, both in Kwale and in Mombasa Counties, and local communities had diversified their incomes generating activities to cope with harsh conditions.

Many years of using unsustainable fishing gears was also thought to have contributed to the degrading of the marine environment which has also contributed to unsustainability of other economic activities that depend on fisheries. Covid-19 shock disrupted a lot of economic activities along the Kenyan coast and some sectors such as tourism have not yet recovered from the shock. Covid-19 pandemic also led to influx of fishers and increased stress in the already degraded fisheries resources. Economic recession was also said to have had a negative impact on the livelihoods, since maintaining a business became too expensive with increased price of fuel affecting all sectors of the economy.

About 77.6 percent of the respondents indicated that they had plans to diversify their livelihoods. The livelihood diversification options that were identified by respondents from Shelly-Waa-Tiwi-Diani beach stretch included investing in shops, venturing in to irrigation farming if supported, animal rearing for sale, own bigger fishing boat and gears to do deep sea fishing, buy equipment to venture into fish trading business, hotelier, train younger fishermen on better and improved modern fishing skills and empower them, horticulture, poultry farming, and venture into tourism activities. The livelihood diversification options that were identified by the respondents from Kilindini stretch included, expansion of the mariculture enterprise, planting more mangroves to venture into blue carbon trade, apiculture, bigger fishing vessels and modern fishing gears to venture into deep sea fishing, improved market for their fisheries products, poultry farming, own more boats to rent at a fee, own a working station to repair boats, improved landsites with adequate storage facilities that will reduce post-harvest losses, investing in shops, rentals, fish frying, firewood sales, hotelier, invest in transport (*boda boda and tuktuk*), form a group and apply for funds from Kenya Marine Fisheries and Socioeconomic Development Project (KEMFSED) to support development projects, and build rental house.

5.7.11 Other Goods and Services Obtained from Marine Environment

As earlier reported, communities from both Shelly-Waa-Tiwi-Diani beach stretch and Kilindini creek have been living in the marine environment for more than 50 years. Over the years, the community has interacted with the marine environment and depended on the marine ecosystem for subsistence. Respondents from Shelly-Waa-Tiwi-Diani beach stretch reported that, apart from obtaining income from the marine ecosystem, they also depended on the marine environment in other ways including, obtaining fisheries for food, using beach for recreation (**Figure 133**), ocean view for aesthetic value, mangroves for building material and clean air, Kayas for worship and cultural rituals, sea water to treat skin rush, coral caves for worshiping, use of sea water to remove evil spirits, medicine from marine animals and mangrove, and landing sites for prayers and sacrifice for better catch i.e. done every 9th month (tambiko la wavuvi).

From Kilindini stretch, respondents reported to obtain firewood from the mangroves for cooking, poles from the mangroves for construction, fisheries for food, pam wines from coconut trees, beach for recreation, kayas and spiritual sites in the ocean for animal sacrifice and prayers, and water transport across the creek. Respondents also reported to obtain dye from the mangroves that they use to decolorize new nets (white) before fishing expedition, that way the net is not easily seen by the fish. Washed plant material on the beach when burned is used to chase away mosquitoes when fishermen are resting at the beach, the smoke is also used to cure flue and yellow fever from younger children. Mangroves were said to produce medicine for various ailments, the stomach (mwangala), hernia/ mshipa (mkomafi/ mdanzi mvuu), and anti-poison (mchu). Mangrove roots were also used to make fishing gear (Uzio and Malema) and were fish breeding areas. Fish bait was also obtained from the mangrove area. Respondents also reported obtaining salt from sea water for home use. Sea water was also used to treat skin diseases and eye disease.

FIGURE 133: CHILDREN ENJOY SWIMMING AT NGARE LANDING SITE.

5.7.12 Source Of Fuel Used in The Project Area.

Most respondents reported to use firewood as the main source of fuel, Shelly-Waa-Tiwi-Diani beach stretch (62.8percent) and Ngare village (79.6percent) (**Figure 134**). Firewood was mostly used because it was cheaper to obtain compared to other sources of fuel. In Ngare village, firewood was obtained either by harvests from the mangroves forest (76.3percent), picking of dead wood from the beach (13.2percent) and buying firewood from the dealer (10.5percent). Along Shelly-Waa-Tiwi-Diani beach stretch respondents reported to obtain fuel wood from mangrove forest harvests (43.7percent), terrestrial forest (33.8percent), own farms (11.3percent) and buy from firewood dealer (11.3percent). Mangrove forest was the most convenient source of wood fuel because of its proximity to the villages. The project proponent can come up with innovative ways to reduce on the consumption of mangrove wood fuel by providing improved cooking jikos this will help conserve the stressed mangrove forest.

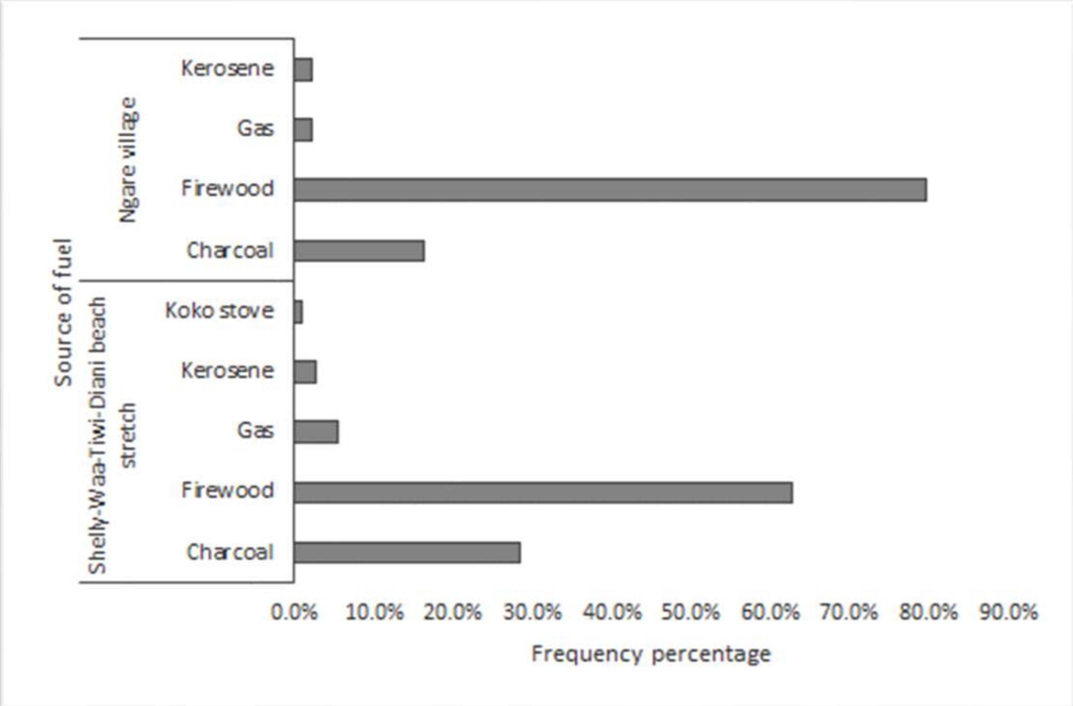


FIGURE 134 - SOURCES OF FUEL IN THE PROJECT AREA

5.7.13 Local Administration

From the survey, respondents from Shelly-Waa-Tiwi-Diani beach stretch reported the villages were governed by the village chairman assisted by "Balozi" (74.8percent), and the area chief assisted by assistant chief (25.2percent). The household that was nearest to the chief camp was about 10 mins walking distance while the household that was furthest from the chief camp was 90 mins walking distance. In Ngare village, people reported that they were managed by the village chair, assisted by assistant village chair and "Balozi" (86.8percent), and the Beach Management Unit chairman (13.2percent). In case of a conflict in the village, the village chairman together with his administration involved village elders to help solve the issue and if not solved they seek help of administrative police. From Ngare village, the chief camp was about 45 mins to 60 mins walking distance.

When assessing security people in Ngare village reported that security in the area was managed by the village chairman (50percent), police on patrols (44.7percent) and community policing (5.3percent). The nearest police post was 15 mins walking distance, while the nearest police station was 30 to 45 mins walking distance. At Shelly-Waa-Tiwi-Diani beach stretch, respondents reported that security in the area was managed by the village chairman (64.9percent), community policing (21.6percent) and patrolling police (13.5percent). The nearest police station to a household was 25 mins walking distance.

Results indicate that local leadership if highly regarded in the villages and the local leaders are the opinion and decision makers. The local leadership gives the community the direction on how to cope with various challenges regarding conflicts, land ownership, security, and development opportunities. It is best for the project proponent to take these aspects into account and involve local leadership into the project for acceptance of the project by the local community.

5.7.14 Important Cultural Sites in The Project Area

The survey was keen to identify cultural sites that maybe affected by the port construction activities. In the south coast of Kenya, respondents identified different cultural sites that are adjacent to the marine environment. These sites include Kaya Tiwi, Kaya Waa, Kaya Chale, Kaya Magaoni, Kaya Kinondo, Kaya Ngaraani, Kongo river, Kaya Mgombeni, Mabambani, Kaya Kioto, Kaya Fuzo, and Milangini. Though all these cultural sites were identified along the Shelly-Waa-Tiwi-Diani beach stretch, none of them will be affected by the planned sand harvesting in the area as the sand harvesting exercise is planned to take place miles offshore.

Along Kilindini stretch, the respondents identified cultural sites where prayers, sacrifices and traditional rituals were performed to appease the gods and spirits. The identified cultural sites along Kilindini creek include *Mzimu wa wajomvu* also known as *Mwishimo* which is found in Ngare village, *Mzimu wa Kiweni* also known as *Jiwe la Kutuzwa* which is found in the water, *Shesheni, Kaya Panga* next to the flyover, *Kaya Mikadini* in the mangroves near Mkupe BMU, *Kaya Mtogwe*, *Kaya chonyi*, and *Kaya semani/kiweni/kiuyu (mpemba shetani)* where an evil spirit from Pemba was brought and placed there for worship and rituals.

FIGURE 135 - MZIMU WA WAJOMVU IN THE MANGROVES AT NGARE VILLAGE

During FGDs respondents reported that it will be very important if the project proponent was able to map where all cultural sites are located and evaluate if they will be affected by the project. There was a concern that four cultural sites may be affected by the port construction (Berth 23) and construction of the 3.1Km access road. The *Mzimu wa Kiweni* also known as *Jiwe la Kutuzwa* which is found in the water is believed that it will be affected by the port expansion plan, *Mzimu wa wajomvu* also known as *Mwishimo* which is found in the mangroves at Ngare village is believed to be getting vulnerable since it may be affected by the 3.1 Km access road that will pass though the mangrove in Ngare. *Kaya Panga* next to the flyover and *Kaya Mikadini* in the mangroves near Mkupe BMU are also likely to be affected by the 3.1 Km access road construction.

The local community requested that, before any constructions is done, those who use these cultural sites for rituals and prayers should be consulted first and an agreement reached between them and the project proponent. There are rituals that must be performed by those using these cultural sites to prevent the occurrence of the unlikely events that may occur during the construction and operation of the project. The unlikely events that may occur include, stalling of the project, accidents during construction, accidents during operation, or even loss of life to those who will directly destroy the cultural sites before rituals and prayers are performed.

6. PUBLIC CONSULTATIONS, STAKEHOLDER ENGAGEMENT PLAN AND GRIEVANCE REDRESS MECHANISM

6.1 INTRODUCTION

Stakeholder engagement is a continuing and interactive process which makes it possible to appropriately and timely identify, communicate and facilitate a two-way dialogue with persons (individuals, groups and organizations) not only likely to be affected by the proposed project but also those with an interest in the project. The engagement took cognizant of different stakeholder communication and access needs including physical accessibility challenges. Stakeholder engagement that was carried out was open and transparent not just as a matter of international best practice but also aimed at facilitating improved environmental and social sustainability of the proposed project. The process was and will remain inclusive and will be sustained throughout the project life cycle. The stakeholder engagement was initiated at early design stage of proposed project so that it could remain an integral part of early project decisions, assessments, management and monitoring of potential environmental and social risks and impacts of the proposed project. The consultative engagement was carried out in a culturally appropriate manner devoid of manipulation, interference, coercion, discrimination and or intimidation.

6.2 IDENTIFIED AND CONSULTED STAKEHOLDERS

Stakeholders who were identified and or consulted were from various institutions including National Government State Departments and Agencies, County Governments of Mombasa and Kwale, Academia, Political leadership in Mombasa and Kwale Counties, Non-Governmental Organisation, Associations and Associations, Marine cable companies, Private companies, Beach Management Units in Mombasa and Kwale Counties and the general public from Mombasa and Kwale Counties.

6.2.1 National Government Agencies

- Communications Authority of Kenya, Coast Region Office
- The Managing Director, Coast Development Authority
- Kenya Fisheries Service, Mombasa Region
- Kenya Marine Fisheries Research Institute
- Kenya National Highway Authority, Coast Office
- Director General, Kenya Coast Guard Services
- The Chief Executive Officer, Kenya Fishing Industries Cooperation
- The Managing Director, Kenya National Shipping Line Limited
- Head of Coast Conservancy, Kenya Forest Service - Coast Conservancy
- Director General, Kenya Maritime Authority

- Assistant Director, Kenya Wildlife Service, Coast Station Headquarters
- The Executive Secretary, The Permanent Secretariat of the Northern Corridor, Transit and Transport Co-ordination Authority
- County Forest Conservator- Kwale County
- County Forest Conservator- Mombasa County
- The Managing Director Kenya Railways Headquarters
- Director General, **National Museums of Kenya Corporate** Headquarters
- The Director General Kenya National Highway Authority
- Water Resources Authority (WRA)
- Kenya Airports Authority
- Communications Authority of Kenya Head Office
- Kenya Pipeline Company Limited
- Kenya Tourism Federation (KTF)
- Kenya Fisheries Service Kwale
- National Museums of Kenya Kwale
- Water Resource Authority Kwale
- CDE NEMA Kwale
- Senior Warden KWS Kwale

6.2.2 National Government Administration

- County Commissioner, Mombasa County
- Deputy County Commissioner Changamwe Sub-County
- County Commissioner, Kwale County
- Deputy County Commissioner Matuga Sub-County
- Assistant County Commissioners
- Chiefs
- Assistant Chiefs

6.2.3 Mombasa and Kwale County Governments

- H.E Abdulswamad Shariff Nasir, Governor Mombasa County
- He Tatuma Mohamed Achani, Governor Kwale County, Kwale County
- County Secretary – Kwale County Government
- C.E.C - Lands Environment and Natural Resources Kwale County Government

- C.E.C - Agriculture Livestock and Fisheries Kwale County Government
- C.E.C - Tourism Promotion & ICT Kwale County Government

6.2.4 Academia

- The Director, JKUAT, Mombasa CBD Campus
- The Director, Kenya Methodist University, Mombasa Campus
- The Director, Kenyatta University, Mombasa Campus
- The Director, Mount Kenya University, Mombasa Campus
- The Dean, School of Environmental and Earth Sciences, Pwani University
- The Chairperson, Environmental and Health Sciences Department, TUM
- The Director, University of Nairobi, Mombasa Campus
- The Director, Bandari Maritime Academy
- Wildlife Research Trainings Institute

6.2.5 Political Leadership

- Hon. Shimbwa Omar Mwinyi, Member of Parliament Changamwe Constituency
- Hon. Bady Bady Twalib, Member of Parliament Jomvu Constituency
- Hon. Machele Mohamed Soud, Member of Parliament Mvita Constituency
- Hon. Mohamed Ali, Member of Parliament Nyali Constituency
- Hon. Mboko Mishi Juma Khamisi, Member of Parliament, Likoni Constituency
- Hon. Kasim Sawa Tandaza, Member of Parliament, Matuga Constituency
- Hon. Bader Salim Feisal, Member of Parliament, Msambweni Constituency
- Sen. Boy Issa Juma, Senator Kwale County
- Sen. Faki Mohamed Mwinyihaji, Senator Mombasa County
- Hon. Fatuma Masito, Women Rep, Kwale County
- Hon. Zamzam Mohamed, Women Rep, Mombasa County
- Hon Member of Parliament, Kisauni Constituency
- Member of County Assembly - Waa –Ng'ombeni
- Member of County Assembly – Tiwi

6.2.6 NGOs, Civil Society Groups & Associations

- World Wide Fund for Nature World Wide Fund for Nature, Head Office
- Coastal and Marine Resource Development (COMR ED)

- CORDIO East Africa
- Wildlife Conservation Society
- Eco Ethics International Union- Kenya (Eco-Ethics)
- Kenya Association of Hotel Keepers and Caterers
- South Coast Resident Association (SCRA)
- Kenya Association of Tour Operators (KATO)
- Kenya Transporters Association Limited (KTA)
- Kenya Tourism Federation (KTF)
- Kenya Coast Tourism Association
- South Coast Association of Tour Operators

6.2.7 Marine Cable Companies

- SEACOM LTD
- The East African Marine System TEAMS (Kenya) LTD
- Eastern Africa Submarine System (EASSy).
- LION1 & LION2. (Lower Indian Ocean NetWork)
- The Djibouti Africa Regional Express 1 (DARE1)
- Pakistan & East Africa Connecting Europe (PEACE)

6.2.8 Private Companies

- Grain Bulk Handlers, MOMBASA
- The Chairman, Kenya International Freight and Warehousing Association, Mombasa
- Africa Gas and Oil Limited (AGOL)
- Kahia Transporters Limited

6.2.9 Beach Management Units – Mombasa County

- The Chairman, Bonje BMU
- The Chairman, Guya BMU
- The Chairman, Kitanga Juu BMU
- The Chairman, Mkupe BMU
- The Chairman, Mtongwe BMU
- The Chairman, Mwadumbo BMU
- The Chairman, Mwangala BMU

- The Chairman Ngare BMU
- The Chairman Tsunza BMU
- The Chairman, Tudor-Shimanzi BMU

6.2.10 Beach Management Units – Kwale County

- The Chairman, Bodo BMU
- The Chairman, Chale Jeza BMU
- The Chairman Funzi BMU
- The Chairman, Gazi BMU
- The Chairman Mkunguni BMU
- The Chairman, Munje BMU
- The Chairman Mwaembe BMU
- The Chairman Mwaepe BMU
- The Chairman Mwakamba BMU
- The Chairman Mwandamu BMU
- The Chairman Nyari Kikadini BMU
- The Chairman TIWI BMU

6.3 STAKEHOLDER CONSULTATION METHODS AND TECHNIQUES

Introductory letters were sent out to each of the stakeholder introducing the proposed Mombasa Port Development Project (MPDP) Phase III indicating project location, objectives and scope. Further the introductory letter also served to inform each stakeholder the commencement of the Environmental and Social Impact Assessment (ESIA) for MPDP III. The letters were received and dually acknowledged by the stakeholders (**Annex 3**). To ensure effective stakeholder participation that was inclusive and consultative, stakeholders were segregated into relevant Focused Groups (FG). Consultations were carried based for each of the established focused groups in Focused Group Discussions (FGDs). Letters of invitation to FGDs were sent out to each member of the FG inviting members to the FGD Receipt of each of the invitation letter sent out was dually acknowledged (**Annex 4**). Consultation with the general public drawn from the Counties of Mombasa and Kwale was done in public open-air meetings (Baraza). Notice inviting general public to the barazas was through the Office of the Deputy County Commissioner Changamwe and Matuga Sub-Counties in the Counties of Mombasa and Kwale respectively (**Annex 7**).

6.4 STAKEHOLDER CONSULTATION AND PUBLIC PARTICIPATION RESULTS

6.4.1 Consultations with Waa-Ng'ombeni-Tiwi-Diani Community Liaison Committee

The Consultative meeting with the Waa-Ng'ombeni-Tiwi-Diani Community Liaison Committee was held at Leopard Beach Resort on the 28th of July 2023. The workshop brought together 25 participants, 1 from the proponent, 4 from the Consultant and 20 from the Liaison Committee (**Annex 6** & **Figure 136**). This was the first preliminary meeting that brought together the Proponent, the Consultant and fishing community Liason Committee to introduce the proposed project to the fishing community in preparation to start baseline surveys and stakeholder consultations. Two key issues of concern were brought out from the discussions in this FGD namely:

a. Memoranda of Understanding signed between KPA and the Community Members at the time of Mombasa Port Development Project Phase II (MPDP II) on various Corporate Social Responsibility (CSR) projects is yet to be actualized to completion.

b. KPA should purpose to conclude the MPDP phase II CSR projects as a matter of priority before community meetings are convened for the proposed MPDP phase III.

FIGURE 136 - COMMITTEE MEMBERS DELIBERATING DURING THE FGD

6.4.2 Pre-Baseline survey consultation with BMUs from Kwale County

This consultative workshop was held at Leopard Beach Hotel on 7th October, 2023. The workshop was convened before commencement of baseline surveys to gain understanding from the BMUs what aspects they will want to be captured in the baseline survey. The meeting also served to notify the BMUs the commencement of baseline studies and to seek BMU support during the baseline. The meeting brought together thirty-nine participates, twenty-seven of them from the Kwale BMUs, two from the Proponent side and ten from the Consultant side (**Annex 7**). The following were the key issues of concern that the

- ✓ Fishing community will be negatively affected from sand harvesting activities based on past experiences from MPDP Phase I & II. Compensation of fishing communities likely to be affected from sand harvesting activities under MPDP phase III needs to be clearly addressed. Therefore, fisheries baseline to be thorough.
- ✓ Various species of marine fauna and flora including turtles will potentially be affected. The Consultant to explain what mitigation measures that will be put in place and their effectiveness.
- ✓ The proponent and the Consultant to work out a way to achieve a balance between potential positive and negative impacts.

- ✓ Critical analysis of effects of sand harvesting on fish spawning grounds to be done.
- ✓ Potential impacts of the proposed project on mangrove ecosystem to be thoroughly analyzed.
- ✓ Socioeconomic baseline to be thorough and to include recommendations of Corporate Social Responsibility (CSR) projects that KPA will implement for the community.

6.4.3 Consultations with Stakeholders from Government, Civil Society and Academia

This workshop was held on January 23rd 2024 at Royal Castle Hotel Mombasa. The workshop brought together 42 participants drawn from National and Government, Political leadership, Academia, Marine cable companies, NGOs, Associations, Proponent and Consultant (**Annex 8** & **Figure 137**). During the workshop results of the baseline survey were presented by the Consultant and discussed in the plenary. Besides the meeting was a forum for the participants to present their views, concerns and suggestions on the proposed project. Eight key issues of concerns were brought out from the discussions as follows:

- ✓ Proposed sand harvesting at Tiwi area will destroy the marine ecosystem in Kwale. This will in turn destroy tourism in Kwale which is depended in local marine environment.
- ✓ Impact of the project to the indigenous kaya sacred forests at Tiwi/Waa areas have not been covered in the baseline studies.
- ✓ Underwater archaeological studies at the proposed project sites have not been covered in the baseline studies.
- ✓ Comprehensive and timely implementation of Environmental and Social Management Plan (ESMP) by the Proponent is of concern based on the Proponent's performance on implementation of ESMPs for MPDP I & II.
- ✓ Mapping of existing locations of marine fibre optic cables and providing adequate safeguards for the cables has not been covered in the baseline studies.
- ✓ Diani Beach erosion due to sand harvesting need to be thoroughly investigated.
- ✓ Waste to be generated and its appropriate management and disposal has not been covered in the baseline.
- ✓ Impacts to mangrove ecosystem and planned safeguards require in-depth analysis.

FIGURE 137 - STAKEHOLDERS KEENLY FOLLOWING PRESENTATIONS AND DISCUSSION DURING THE WORKSHOP

6.4.4 Post-Baseline consultations with BMUs from Kwale County

This consultative workshop was held at Leopard Beach Hotel on 24th January 2024. The meeting brought together thirty-eight participants, of which twenty eight were from various MBUs in Kwale, three were Proponent representatives and seven from the Consultant (**Annex 9** and **Figure 138**). The meeting served to communicate findings of the baseline survey to the BMUs of Kwale together with predicted potential impacts likely from the proposed project. Besides the meeting was a forum for the BMU members to present their views, concerns and suggestions on the proposed project The following were the main issues and concerns that were brought out:

- ✓ Clarification on which of the identified potential impacts outweigh the other positive or negative was need.
- ✓ There should be a mechanism in place that ensures that BMUs are actively involved during project implementation.
- ✓ Provide alternative sources of sand.
- ✓ A detailed economic evaluation on the potential negative impacts of sand harvesting on Kwale sandy beaches which are ranked the world best beaches needs to be done.
- ✓ Compensation of project affected person from MPDP Phase II not done up to date.
- ✓ A detail social impact assessment need to be done, what is presented is too shallow.

FIGURE 138 - BMU STAKEHOLDERS PARTICIPATING IN THE DISCOURSE OF THE PROPOSED PROJECT

6.4.5 Post-Baseline consultations with BMUs from Mombasa County

The workshop for BMUs from Mombasa County was held at Royal Castle Hotel on 25th January 2024. The meeting brought together fifty-seven participants of which fifty of them were from BMUs in Mombasa County, three from Project Proponent - 3 and seven from the Project Consultant. The meeting served to communicate findings of the baseline survey to the BMUs of Kwale together with predicted potential impacts likely from the proposed project. Besides the meeting was a forum for the BMU members to present their views, concerns and suggestions on the proposed project. **Annex 10** is the attendance list and minutes of the proceedings. The following were the main issues and concerns discussed:

- ✓ All BMUs in Mombasa County will be negatively affected by the proposed project and not the stated nine. The assessment should therefore also include BMUs of Old Town, Likoni and Tudor.

- ✓ Turbidity of marine water during dredging and disposal of dredged material negatively affected fishing equipment including boat engines. Assessment for appropriate compensation should be done.
- ✓ Impacts of sand harvesting are adverse including destruction of fish spawning grounds and fishing grounds.
- ✓ Local people should be prioritized in employment opportunities in all phases of the proposed project.
- ✓ Clear alternatives for mangrove ecosystem restoration need to come out strongly.
- ✓ The social assessment to be enhanced to cover all BMUs.

FIGURE 139 - PARTICIPANTS KEENLY FOLLOWING PRESENTATIONS AND DISCUSSIONS

6.4.6 Consultation with Kwale County Leadership

The consultative workshop for Kwale County leadership brought together national government agencies, Kwale County government departments, political leadership, tourism and business community representatives from the County. The meeting was held on 24th April 2024 at NDMA Boardroom Kwale. The consultative workshop was critical as it was through this meeting the KPA got to formerly introduce the proposed project to the County Government of Kwale. It was in this workshop that KPA got the input from the County Government of Kwale that will go along way in informing the design and implementation of the proposed project thereafter. The following were the main issues that were discussed:

- ✓ Sand harvesting will potential destroy Diani sandy beaches.
- ✓ Tourism activities in Kwale are likely to be impacted negatively due to destruction of sandy beaches from sand harvesting activities.
- ✓ It is very important that KPA considers alternative sand sources to ease pressure on the current sources at South Coast.
- ✓ Cumulative impacts of MPDP I, II and III need to be considered.
- ✓ Lessons learned from MPDP I& II should inform design and implementation of MPDP IIII.
- ✓ Potential impacts of MPDP III need to be thoroughly discussed and analyzed and presented to all stakeholders.
- ✓ KPA to consider Kwale people for employment opportunities.
- ✓ Community and special interest groups must be consulted and their input factored into the project design and implementation.

- ✓ Impacts of nesting sites for marine fauna must be investigated in detail, potential impacts assessed and appropriate mitigation measures proposed.

6.4.7 Public participation meeting in Mombasa County

The public baraza was held at Mikadini-Lilongwe Gardens, Mombasa County On 7th May 2024. **Annex 11** is the attendance list and minutes for the public baraza held in Mombasa County. The following were the main issues and concerns discussed:

- ✓ Proper compensation for all project affected persons.
- ✓ KPA to facilitate the community to venture into deep sea fishing to compensate for fishing grounds that will be lost.
- ✓ Benefits to the community to be clear.
- ✓ All concerns for BMUs to be clearly factored in the design and implementation of the project.
- ✓ Proper RAP and associated compensation for Ngare village residents who will be displaced.
- ✓ Fishers' concerns to be adequately addressed.

6.4.8 Public participation meeting in Kwale County

The public baraza was held at Kitai Grounds-River Mwachema, Kwale County on 9th May 2024. Error! Reference source not found. is the attendance list and minutes for the public baraza held i n Kwale County. The following were the main issues and concerns discussed:

- ✓ Consider alternative source of sand.
- ✓ Compensation for BMUs from Kwale County that will be negatively affected
- ✓ CSR projects for local schools and health facilities.
- ✓ Proper implementation of mitigation measures to minimize negative impacts.
- ✓ Employment opportunities in the project for local people.
- ✓ Coral reefs that will be degraded to be fully restored.
- ✓ Details on how much the compensation for those will be who will be negatively impacted need to be disclosed.

6.5 SUMMARY OF KEY ISSUES RAISED FROM STAKEHOLDER AND PUBLIC PARTICIPATION MEETINGS

	Issues raised	**Action to address the issue**
▪	KPA to fully implement CSR projects listed in MoU signed with the community under MPDP III before implementation of MPDP IIII	KPA in consultation with the implementation committee will iron out the few hiccups and conclude the implementation of the CSR project.
▪	Effects of sand harvesting on fishing community, compensation to be the clearly addressed, fisheries baseline to be thorough.	A scientific research and study will be done extensively to establish if any fish species will be affected and how , compensation will be done if there is reduction in catch income to fill the gap for the time dredging occurs, equity and equality will be observed during compensation,
▪	Consultants to explain mitigation measures to be put in place	A detailed mitigation plan of all potential negative impacts will be documented in the final copy of the ESIA report and will be explained in the stakeholder meetings
▪	Critical analysis of effects of sand harvesting on fish spawning grounds to be done	Sand harvesting is proposed to be done in the deep sea past the outer reef approximately 60-100 meters deep. A scientific research and study will be done extensively to establish if any fish species will be affected and how
▪	Balance between potential positive and negative impacts to be worked out	A detailed analysis of both potential positive and negative impacts will be documented in the final ESIA report
▪	Potential impacts on mangrove ecosystem to be thoroughly analyzed	Potential effects on mangrove ecosystem will be analysed include the actual acreage of mangrove forest that will be affected. Proposals of appropriate mitigation measures to minimize potential negative impacts on mangrove ecosystem will be documented in the final ESIA report
▪	Socioeconomic baseline to be thorough and to include recommendations of CSR projects that KPA will implement for the community	An experienced Socioeconomic will undertake the socioeconomic baseline. In consultations with the project affected persons and other stakeholder appropriate interventions will be proposed that will include priority CSR community support projects.
▪	Sand harvesting at Tiwi will destroy marine ecosystem in Kwale	Alternative sources of sand including river sand were considered and are still being considered

	Issues raised	**Action to address the issue**
▪	Impact of the project to the indigenous kaya sacred forests at Tiwi/Waa areas not covered in the baseline studies	Discussion with the proponent will be done to avail finances to support heritage impact assessment including kayas
▪	Underwater archaeological studies not covered in the baseline studies	Discussion with the proponent will be done to avail finances to support marine archaeological studies and heritage impact assessment including kayas
▪	Implementation of ESMP is of concern based on the Proponent's performance on implementation of ESMPs for MPDP I & II	Whereas mangroves were cut during MPDP I & II, replacement planting was done at Tudor creek at Ganahola area. KPA has supported mangrove restoration in various creeks to about 55,000 trees.
▪	Mapping of existing locations of marine fibre optic cables and providing adequate safeguards for the cables has not been covered in the baseline studies	KPA will get in touch with fiber optic companies to access location coordinates of their cables to be plotted on the design drawings for information
▪	Diani Beach erosion due to sand harvesting need to be thoroughly investigated	There is extensive erosion at the beach areas because of longshore currents, climate change, sea level rise increase erosion in terms of sediment movements
▪	Waste to be generated and its appropriate management and disposal has not been covered in the baseline	KPA has documents on the nature of waste generated
▪	Impacts to mangrove ecosystem and planned safeguards require in-depth analysis	KPA will undertake restoration of degraded adjacent creeks to compensate any mangroves that will be cut to create room for the proposed project. 55,000 mangroves trees have already been planted by KPA
▪	Alternative sources of sand to be provided	Alternative sources of sand including river sand were considered and are still being considered
▪	Detailed economic evaluation on the potential negative impacts of sand harvesting on Kwale sandy beaches to be done	An experienced Socioeconomic will undertake the socioeconomic baseline. In consultations with the project affected persons and other stakeholder appropriate interventions will be proposed that will include priority CSR community support projects.
▪	Compensation of PAPs	KPA is undertaking a RAP that will identify PAPs and advice on their compensation

	Issues raised	**Action to address the issue**
▪	A detail social impact assessment need to be done, what is presented is too shallow	An experienced Socioeconomic expert will undertake the socioeconomic baseline. In consultations with the project affected persons and other stakeholder appropriate interventions will be proposed that will include priority CSR community support projects.
▪	BMUs to be actively involved during project implementation	KPA will explore ways to ensure affected BMUs are involved throughout the project cycle
▪	Turbidity during dredging & disposal of dredged material negatively affected fishing equipment including boat engines	Comprehensive EMP will be developed to mitigate all impacts including impacts on marine crafts engines
▪	Sand harvesting will destroy fish spawning grounds and fishing grounds	The dumping site will be in deep sea some 3-5 KM from the port area. Alternative analysis is being undertaken including that of sand harvesting site. Mitigation measures are being proposed to mitigate potential negative impacts of sand harvesting.
▪	Prioritize local people when employing	Conditions on the contract of the Contractor who will be implementing the proposed project will have a close that requires that local people to be given first priority when recruiting.
▪	Restoration of mangrove ecosystem	KPA will rehabilitate more mangrove creeks as part of the EMP of the proposed project to offset for any mangrove trees that will be lost.
▪	Social impact assessment to cover all BMUs	Socioeconomic assessment is ongoing and will be updated to ensure all identified gaps are addressed
▪	Sand harvesting will potential destroy Diani sandy beaches	Sand regeneration is a natural phenomenon where erosion takes place then deposition takes place and chronical climate change impacts like the beaches at the Bamburi suffer erosion but beaches at the south gain in deposition. In a period of 2-7 years there is likeliness there will be sand regeneration nourishing the beaches since shoreline of the south coast is suit for deposition
▪	Tourism activities in Kwale are likely to be impacted negatively	KPA is mandated to make tourism thrive by development of the port.

	Issues raised	Action to address the issue
▪	KPA to consider alternative sand sources to ease pressure on the current sources at South Coast	Alternative sources of sand including river sand were considered and are still being considered
▪	Cumulative impacts of MPDP I & II need to be considered	This will be captured and appropriate mitigation measures will be proposed in the final ESIA report
▪	Lessons learned from MPDP I& II should inform design and implementation of MPDP IIII	True the design of the proposed project is being informed from experiences and lessons learned from MPDP I & II
▪	KPA to consider Kwale people for employment opportunities	There is an affirmative action policy on employment at the port.
▪	Impacts of nesting sites for marine fauna to be investigated in detail	The bseline report outlines the species and habitats under threat complete with measures to mitigate adverse negative impacts
▪	Community & special interest groups be consulted & their input factored into the project design & implementation	All stakeholders will be consulted and their views considered in the deign and implementation of the proposed project
▪	Compensation of PAPs	RAP is carried out that will identify PAPs and proposes how they will be compensated
▪	KPA to facilitate the community to venture into deep sea fishing to compensate for fishing grounds that will be lost	This is noted and will be explored accordingly
▪	All concerns for BMUs to be factored in the design & implementation of the project	This will be done
▪	Proper RAP & compensation for Ngare village residents who will be displaced	This will be done
▪	Fishers' concerns to be adequately addressed	A detailed livelihood assessment will be done that will inform how the fish community will potentially be affected
▪	Alternative source of sand to be considered	Alternative sources of sand including river sand were considered and are still being considered
▪	Compensation for BMUs from Kwale County that will be negatively affected	Alternative sources of sand including river sand were considered and are still being considered

	Issues raised	**Action to address the issue**
▪	CSR projects for local schools & health facilities	KPA will consider that as will be advised from the socioeconomic baseline survey
▪	Proper implementation of mitigation measures to minimize negative impacts	The final ESIA will detail appropriate mitigation measure for each predicted potential adverse negative impact. The contractor who will implement the project will timely and conclusively implement all mitigation measure under strict supervision of KPA
▪	Employment opportunities in the project for local people	Conditions on the contract of the Contractor who will be implementing the proposed project will have a close that requires that local people to be given first priority when recruiting.
▪	Coral reefs that will be degraded to be fully restored	Whereas the design of the project will strive to avoid any adverse impacts on coral reefs, in the event of such effects a coral restoration plan will be developed that will be implemented
▪	Details on how much will be the compensation for those who will be negatively impacted need to be disclosed	RAP will address this concern. Affected PAPs will be duly informed on the potential effects and compensation plan

7. IMPACT ASSESSMENT AND MITIGATION MEASURES

7.1 METHODOLOGY OF IMPACT ASSESSMENT

In this chapter an analysis of both the positive and negative impacts that will be associated with the proposed project throughout its life cycle. Equally, proposed measures to enhance the positive impacts and mitigate against and ameliorate any negative impacts arising from the implementation of the proposed project will also be highlighted. The identification of the impacts is based on an analysis of the baseline information gathered through various methods such as observation made during site visits, public consultations and literature review. The classification of the impacts is based on the type of environment that will be impacted.

Impact prediction, as formulated by Thrivel & Wood[3], will include assessment of:

- **Direct/ primary impact** – that are a direct result of a development.
- **Indirectly/ secondary impacts** – that maybe "knock-on" effects of (and in the same location as) direct impacts but are often produced in other locations and/or as a result of a complex pathway.
- **Cumulative impacts** – that accrue over time and space from a number of development or actions, and to which a new project may contribute.
- **Impact interactions** – between different impacts of the project and impacts of other projects.

The Identification of the impacts of the development on environment and social were considered the three stages of the project (construction, operation and decommissioning phases). It proceeded through a process that considered three key elements: prediction of the magnitude of impacts on the environment and 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. The identified impacts and mitigation measures are discussed under the following subsections.

The assessment focused on the entire project cycle from planning, implementation, operation and operation phases of the project. The area of focus included too on the coastal counties of Kwale and Mombasa as well as the nation and the region as a whole.

7.2 IMPACT SUMMARY

Based on the baseline results, the following impacts were predicted for the proposed project:

TABLE 69 - SUMMARY OF POSITIVE IMPACTS

Item		Summary of Assessment
Socio-economic	Job Creation	Job opportunities shall be created in both the Construction and Operational phases of the project
	Economy	The Project will increase the country's strength as a gateway port I the region. Commerce opportunities will arise from the Construction phase by providing services and supplies for the project.

[3] Methods of Environmental and Social Impact Assessment, Thrivel and Wood, 4th Edition 2018

	Access	The access road and associated infrastructure will improve access to facilities and services by decongesting the existing road networks
	Security	Improved security due to lighting
	Gentrification	Improvement of the standard or living in the area and the price of land.
	Safety	Alternate new access will divert traffic and therefore reduce the risk of accidents in the existing road network.
	HIV-AIDS Awareness	Implementation of HIV-AIDS Programs increases awareness and access to health services for the surrounding communities through outreach programs.
	Alcohol, Drugs and Substance Abuse Awareness	Implementation of Alcohol and Drug Adherence Programs increases awareness and reduced ADSA prevalence in the surrounding communities as implemented in Phase 1 and 2.

TABLE 70 - SUMMARY OF NEGATIVE IMPACTS

Item		**Summary of Assessment**
Pollution Control	Air Quality	It is anticipated that dust emitted from the reclamation area and access road will reach nearby residential areas during construction. During operation, the fugitive emissions of NOx, CO, PM and SOx from the port are anticipated, however, the impact at the residential areas will be minor as seen in the operation of Phase 1 and 2.
	Water Quality	During the excavation, sand harvesting and reclamation, turbid water will be generated. If not mitigated, turbidity can have a negative impact on the marine ecosystem such as corals, fish, etc.
	Noise & Vibration	During construction, construction equipment and heavy vehicles will generate noise and vibration. During operation, port operations (24hrs) will generate increased noise and vibration from cargo, handling equipment, portbound and outbound traffic.
	Odor	From the experience of Phase 1 and 2, there will be no odor such as H_2S emitted from the excavated seabed.
	Sediment	As there is no industry other than oil & gas facilities around the port, there is little chance of heavy metal contamination of the seabed within the harbour ref. Sediment results of baseline study show contamination level below the target values. As Kenya is not a signatory country of London dumping treaty, there is no restrictions, but the heavy metal contents of the sediment will be checked before dumping.
	Waste	Waste during construction generated by the contractor and transported to landfill sites by the licensed companies (sub-contractors). Waste during operation will be managed by KPA and treated/dumped by licensed companies.
Natural Environment	Protected area	The sand harvesting activities will be conducted between Diani Chale and Mombasa marine protected areas. However, turbidity propagation will disperse from the sand harvesting areas and into the Marine Protected Areas.
	Ecosystem	Impacts on the ecosystem can potentially happen if high low levels of water quality (turbidity, BOD, COD, etc.) occur in the environmentally sensitive area such as the MPA's, coral reef and fishing grounds. It is also anticipated that the sand harvesting activities may affect Sea Turtles and other marine mammals. Mangroves shall be fell to allow for construction of the new access road.
	Hydrology	The construction of the port may affect the currents within the port. To confirm the effect, simulation was be conducted.
Social Environment	Resettlement	For the construction of the access road, physical relocation will be required. The number of PAP to be physically displaced will be approx. 69 PAP's, 7 households.

		KPA have conducted a detailed survey, and the resettlement action plan has been prepared.
	The Poor	Those PAPs may be categorized as the poor. And special attention will be paid to restore their living.
	Livelihood (Fishery)	The fishery activities may be affected by the sand harvesting activities and the construction of access road. For the sand harvesting activities, KPA will have MOUs with local communities to assist them as agreed in them. A livelihood restoration plan shall be implemented.
	Cultural Heritage	There is no cultural heritage to be affected by the project.
	Tourism	The sand harvesting activities may affect the scenery of the tourist destinations such as Tiwi. The project has communicated with the industry in advance to disseminate the environmental protection measures.
	HIV/AIDS	HIV prevention activities will be implemented with a new VCT center and Peer education activity within the port for construction workers. The project will have some HIV prevention activities outside the port as well.
	Occupational Safety	The HIV prevention activities will take care of the mental health of construction workers as well, especially for those who need to find new jobs at the end of the project.

7.3 STAGE 1: POTENTIAL IMPACTS AND MITIGATION MEASURES DURING SITE DEVELOPMENT AND CONSTRUCTION

7.3.1 Environmental Impacts & Mitigation Measures

A. Potential Impact to Soil and Sediment

(1) Impacts

The **quality of soil and sediment** can be significantly impacted by the project. Dredging, excavation, and land reclamation operations can disturb the seabed during marine works. Benthic habitats can become choked by sedimentation, which can also change the purity of the water and hinder marine life's ability to feed and reproduce.

Movement of heavy construction machinery, stockpiling of heavy materials can potentially change the **soil structure** in the nearby environs. This could reduce the quality of favorable topsoil which can be used for restoration of temporary sites. This could also subsequently change drainage patterns around the project site.

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. The suspension of fine sediments in the water column may create turbidity, which scatters and attenuates light levels and potentially affects the growth of plants indirectly by reducing the availability of light and consequently the photosynthetic process in plants.

Excavation, clearing of land for the infrastructure and road, and the destruction of mangrove and other vegetation are some of the ways that the project can exacerbate **soil erosion**. Degradation of water quality, increased sedimentation in water bodies, and loss of productive topsoil are all possible outcomes of soil erosion.

The building of the berth may cause the release of **hazardous material/ pollute** such as fuels, lubricants, construction materials, and other chemicals into the soil and sediment. Heavy metals, hydrocarbons, and other dangerous compounds that can linger in the environment and endanger aquatic life as well as human health are examples of these contaminants.

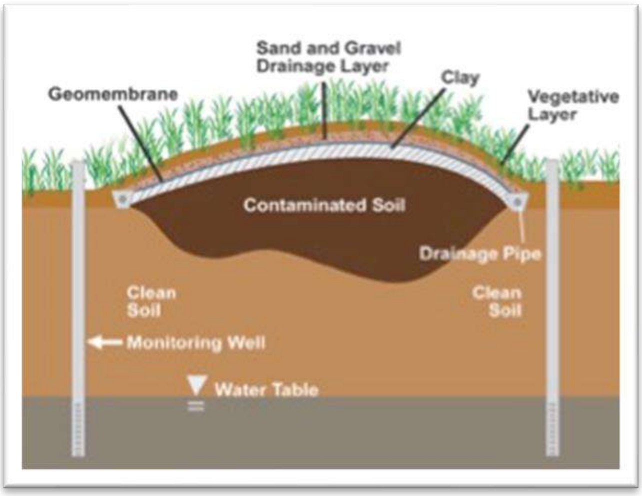
Dredging and land reclamation operations related to port development may cause the **loss of significant ecosystems**, including seagrass beds, wetlands, and mangroves. Critical ecosystem services that these habitats offer include water filtering, coastal protection, and habitat for a wide variety of plant and animal species.

Because of the entry of construction materials and modifications to hydrology, port construction may result in **changes to the pH** and salt levels of soil and sediment. The growth and survival of plants and animals that are acclimated to particular soil and sediment conditions may be impacted by these changes.

(2) Mitigation Measures

In order to mitigate against the adverse impacts of the project on the soil medium. The project can implement measures.

a. **Testing** of all material prior to disposal or importation as fill material to avoid introduction of contamination.
b. **Careful handling** of hazardous materials that could contaminate the soil at the project site. The contractor shall implement clear methodology on handling of such material such as “Bunding” of fuel and Oils/ Lubricants.
c. Removal of contamination for **off-site licensed disposal**. The contaminated material has to be disposed in a licensed disposal area or treated by the disposal contractor.
d. Where possible, the Contractor shall **re-use or contain unsuitable material** on site provided the method ensures no adverse risk to the environment.
e. If contaminated soil material is excavated, this material can be **contained and capped** to break the pathway. This method of mitigation requires the placing of a cap of suitable material and thickness



Typical Capping Method[4]

The proponent will enforce **designated delivery and movement routes** to mitigate against the damage to nearby soil structure and drainage patterns.

B. Potential Impact on Ambient Air Quality

(1) Impacts

During construction, there are numerous potential anthropogenic sources of pollutants that can enter the environment. **Table 71** is an assessment of potential sources in the proposed project

TABLE 71 - POTENTIAL AIR POLLUTANTS AND THEIR SOURCES

No	Pollutant	Project Sources
1	Nitrogen Oxides (NO_x, NO and NO_2)	• Exhaust Emissions from Vehicles • Exhaust Emissions from Generators • Exhaust Emissions from Dredgers • Batching Plant Emissions
2	Sulphur Dioxide (SO_2)	• Exhaust Emissions from Vehicles • Exhaust Emissions from Generators • Exhaust Emissions from Dredgers • Batching Plant Emissions
3	Particulates (dust, smoke, PM_{10})	• Materials handling (delivery and storage) • Batching Plant operations, • Excavation Works • Reclaimed area
4	Carbon Monoxide	• Fuel Combustion
5	Volatile Organic Compounds (VOCs)	• Paint • Petrol Engine Exhaust Emissions
6	Toxic Metals	• Metal Fabrication Yards • Battery Storage • Batching Plant Emissions
7	Toxic Chemicals	• Chemical storage and use • Metal Fabrication Yards
8	GHG	• CO2

[4] A Citizens Guide to Capping, *EPA*, (http://clu-in.org/download/Citizens/a_citizens_guide_to_capping.pdf) retrieved October 16, 2014.

		• Fuel Combustions • Welding Gas leaks
9	Ozone	• Secondary pollutant formed from VOCs and nitrogen oxides
10	Odours	• Sewage • Chemicals • Paintworks • Waste

(2) Proposed Mitigation Measures

The following mitigation measures will be implemented should monitoring results exceed allowable limits for air quality and to redresss grievances from affected persons:

a. The proponent can encourage Contractors and suppliers to use **low Sulphur diesel fuel** could reduce pollutants emissions.

b. **Route planning** to avoid populated areas can also reduce the risk of exposure or exhaust emissions for persons living in the project AOI. Vehicle speed restrictions should also be implemented.

c. The vehicle **wheels-wash** and **weighbridges** shall be constructed and the project site.

d. Appropriate **handing of construction material** such as cement, fill material carried in vehicles should properly be covered. Loading and unloading of bulk construction materials should be in areas protected from the wind and carried out in calmer conditions.

e. **Stockpiling handling** either by watering or covering should be done to reduce the amount of dust generated. Locations of stockpiles should also be

f. High moisture content on exposed surface and roads should be maintained by spraying water routinely, particularly in areas of high vehicle use.

g. **Engine maintenance** checking for construction vehicles, generators and equipment should be adhered to ensure optimum performance and reduced emissions.

h. Use of **water-based paints** will be adhered to where possible. Most water-based paints have low to nil VOC emissions.

i. Provision and use of **appropriate PPE** by construction personnel that protect against exposure air pollutants shall be mandatory. Training and instructions should be given to the personnel (particularly the vehicles and machinery drivers) before the commencement of the works

j. In case public complaints, there should be adequate identification and registration of complaints and appropriate corrective action put in place. (**Effective GRM framework**)

k. Deployment of the generators and other equipment away from the **sensitive receptors**. Dust screens can also be installed at any nearby receptor.

l. The proponent shall control vehicle engines or operating on the **minimal turnover**, when they are not in use.

m. **Wetting/ sprinkling** the passage of vehicles twice a day to prevent the removal of dust. This is especially effective terrestrial construction mainly for the road and related infrastructure.

n. Final surfaces of any earthworks should be well **compacted** and the subsequent permanent work or **surface protection** should be carried out immediately after the final surfaces are formed to prevent erosion and generation of dust.

C. Potential Impact on Coastal Morphology

(1) Impacts

The study of the shape, form, and structure of the coastal zone, including the landforms, sediment deposits, and processes that sculpt the shoreline, is known as coastal morphology. It includes a broad variety of features and activities, such as the dynamic processes of erosion, sediment transport, and deposition that shape features like beaches, dunes, cliffs, estuaries, tidal flats, and barrier islands.

Many elements affect coastal morphology, such as tides, currents, sea level fluctuations, sediment supplies, and coastal landforms. Coastal morphology can also be dramatically altered by human activity, including urban growth, land reclamation, and coastal engineering.

Because changes in coastal landforms and processes can have a substantial impact on coastal communities, ecosystems, and infrastructure, an understanding of coastal morphology is essential for coastal management and planning. Studies of coastal morphology are useful in determining trends in erosion and sedimentation, evaluating coastal risks, and creating plans for managing and protecting the coast.

The following are some of the of the major effects of port construction on the morphology of the coast:

i. The natural processes of coastal sediment movement can be affected by port construction. Port construction-related dredging operations have the potential to **alter patterns of sediment deposition**, increasing erosion in certain locations and sedimentation in others. This may lead to **sediment loss** from coastal systems, **changes in beach morphology**, and **coastal erosion**.

ii. Land reclamation is a common part of port construction, and it can **change the shoreline's natural configuration**. Coastal habitats like wetlands, mangroves, and beaches may disappear as a result of land reclamation, while coastal landforms like barrier islands and coastal lagoons may alter in size and shape.

iii. Building the port and related infrastructure, such as jetties and breakwaters, can modify the coast's natural wave and current patterns. These alterations may result in **altered sediment distribution** throughout the coast as well as enhanced erosion or deposition in specific locations.

iv. The creation of new the port **can trap coastal habitats**, such as mangroves and salt marshes, between the water and the newly built port infrastructure. This may result in the disappearance of these habitats, which offer crucial ecosystem services like carbon sequestration, fish and wildlife habitat, and coastal protection.

v. Coastal towns may be more susceptible to natural hazards such as coastal erosion, storm surges, and sea level rise as a result of changes to the coastline morphology brought about by port building. Changes to the naturally occurring coastal processes might **lessen the protective capacity of coastal ecosystems** against these disasters, raising the dangers to infrastructure and human populations.

(2) Proposed Mitigation Measures

KPA has carried out environmental and social impact assessments before beginning development in order to lessen the effects of the proposed project on the coastal morphology. KPA will put into place measures to ensure water quality do not exceed target values:

a. Sand Harvesting method statement shall be prepared which will include **regular bathymetry** and **shoreline monitoring**. The proponent shall modify sand harvesting techniques and locations to mitigate any negative effects.

b. The proponent shall consider **shoreline stabilization**, **habitat restoration**, and **coastal protection structures** if coastal morphology monitoring show adverse impacts of the projects.

c. KPA can encourage the maintenance and development of **natural barriers** such as mangroves as part of a Mangrove Conservation Plan for the project. This can involve the planting of seedlings of affected coastlines where road construction, dredging and sand harvesting works are being carried out.

D. Potential Impact on Water Quality

(1) Impacts

Marine works is predicted to have significant impacts on the water column, primarily during dredging, reclamation and sand harvesting works. These activities increase the amount of sediment (**Total Suspended Solids/ Turbidity**) in the water and therefore reducing the quality of water in the surrounding marine environment. Sediments can lead to stress in corals and also be harmful to fish spawning.

During the dumping of dredge material, there is a potential for contaminants such as heavy metals contained in the seabed material **pollute the water column** at the dredge dump site. Pollutants in water will then have a subsequent impact on the nearby marine ecology. Bioaccumulation is a process that allows contaminants from dredging material to build up in the tissues of marine life. Eating infected fish may raise **health concerns** for human beings.

The construction of the port may **modify the way that water flows** by changing the topography of the surrounding area and natural waterways. These alterations have the potential to upset ecosystem balance, which would result in a decline in water quality and biodiversity.

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 as **effluent** 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.

Poor **waste management** during construction close to the can lead to the surface run-off of waste downstream into the ocean. The proponent will enforce a proper waste management plan is implemented. Waste can be a source of nutrients which can lead to **eutrophication** and potential algal bloom.

The proponent can potentially introduce **pathogens** in the aquatic environment by **poor sanitation** facilities for construction workers. It is anticipated that over 1,000 workers will work on the proposed project. Poor sanitation can lead to microbial pollutants such as bacteria, viruses and protozoa finding their way into the marine ecosystem.

The expansion of the turning basin can have an impact of the **hydraulic characteristics** of the channel. Increased hydraulic effects can lead to sedimentation which can impact marine flora and fauna.

Through **hull fouling** and **ballast water discharge**, increased maritime activity during construction may act as a conduit for the introduction of invasive species. Invasive species' ability to outcompete native species, upend food webs, and change the structure and function of ecosystems can result in cascade ecological consequences.

(2) Proposed Mitigation Measures

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

a. To mitigate against the impact of sand harvesting on the sensitive marine habitat, the project shall discharge of overflow material 5km from the sand harvesting area on each cycle as a mandatory. This "**looping" mitigation** measure has been simulated in the proposed area to ascertain its effectiveness. The purpose of discharging away from the reef was to prevent the build-up of sediments in waters over the reef. Factors affecting the optimal distance include:

    - The further from the reef, the less the delivery to the reef edge.
    - The stronger the offshore current, the greater/faster dissipation. A stronger longshore current allows for less distance offshore.
    - Onshore transport by the southeast (*kusi*) wind was very strong, so stronger winds in May-July required larger distances.
    - Tidal flow pushed water on and off the reef front. The degree of onshore/offshore transport needs to be determined by observation.

    The mitigation measure was implemented from April to August 2019, upon completion of offshore sand harvesting activates. Based on the results of the Phase II monitoring observations, and daily water quality monitoring, the mitigation measures are deemed to have been successful.

b. All unsuitable dredge material shall be dumped at a **designated offshore dump site** that maintain a 3km buffer from the boundary of the marine protected areas and at a depth of between 180m – 200m. the coordinate are as indicated below.

TABLE 72 - OFFSHORE DUMP SITE COORDINATES

	X	Y	Latitude	Longitude
1	578952.769	9544962.009	4^0 6.9889249862 S	39^0 42.679999182 E
2	579683.865	9544279.665	4^0 7.3589240329 S	39^0 43.075523578 E
3	579001.642	9543548.546	4^0 7.7560845032 S	39^0 42.7070998444 E
4	578270.547	9544230.890	4^0 7.3860825317 S	39^0 42.311574501 E
mid	578977.206	9545255.278	4^0 7.3725045255 S	39^0 42. 693549411 E

The above designated offshore disposal site that was authorized by NEMA IN 2011.

Projects that have used the offshore disposal site since then include among others “New Kipevu Oil Terminal Project” and “Mombasa Port Development Project” and has closely monitored the effect on the surrounding ecosystem. There has been no negative impact observed.

An Environmental Audit was conducted on March 2022. In this study, alternative disposal site were considered by establishing site selection criteria in reference to IMO guideline and through stakeholder consultation. Based on the site selection criteria and through discussion with KPA, two alternative sites (Option A and B) were selected. Option A and B are around 5 km and 10 km from the current disposal site respectively. Focusing on the impacts of suspended sediment that are inevitably generated and dispersed during dumping of dredged material. A comprehensive environmental and social baseline study was implemented to understand the status of the coastal area sensitive to SS impacts. The extent of SS dispersion and subsequent sedimentation was predicted by employing a 3D simulation model, which calculates the SS concentration and based on the hydrodynamic of the study area. The simulation was conducted for multiple scenarios taking into consideration different dredging/disposal method, seasonal variation and dredging mitigation measures.

According to the simulation, although SS was predicted to disperse over a wide area from the disposal site, the SS concentration and sedimentation along sensitive coastal environment e.g (Coral reef, fishing ground) were predicted to be significant lower that the set threshold levels for all the simulated scenarios. Therefore, it was concluded that SS dispersion from the offshore disposal site will likely not have significant impact on sensitive coastal environments providing that dredging and disposal work are conducted within the simulated range.

Based on the results of the study, disposal of dredged material at the current offshore disposal site will likely have no significant impact on the coastal marine ecosystem (e.g. coral reefs and seagrass) and human activities (e.g marine tourism and fishing). Hence the current offshore disposal site is considered suitable for continuous use providing the disposal volume is within the range planned.

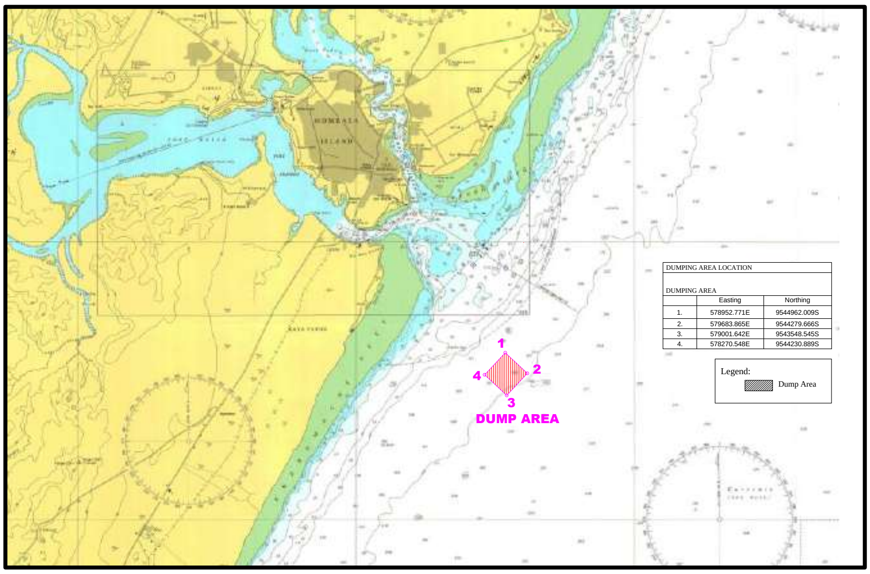


FIGURE 140 - DUMPING GROUND MAP

c. A **site plan** needs to be prepared to ensure surface run-off channels and areas are **segregated** from the concrete batching plant and casting area as far as possible and diverted to the storm water drainage system. Surface run-off contaminated by materials in a concrete batching, plant or casting yard should be adequately treated before disposal into drains.

d. Construction sites are prone to accidents of marine vessels. The proponent shall prepare a **Oil Spill Accident Plan** on how to manage and mitigate the effects of large oil spills. 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. KPA shall liaise with OSMAG prior to construction

e. Preventive and periodic **maintenance of machines** and vehicles to avoid breakdowns and the subsequent spillage of oil and fuel as well as the use of qualified and experienced staff for maintenance and operation exercises is a precautionary approach to dealing with accidents and spills.

f. 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/ bunds** that retain and permit the collection of possible spills.

g. **Liquid Waste Management** - 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 waste collection firms licensed by NEMA.

h. **Concrete batch plant** should be located no less than **100 meters away** from the shoreline with permanent control and safety measures for preventing water contamination.

i. KPA will promote water conservation and re-use of water and treatment to reduce the amount of effluent being discharged into the marine environment.

j. **Waste containers** with lids must be placed in strategic locations in working areas. They should have sufficient capacity for the estimated amount of waste to be produced.

Biodegradable and non-biodegradable wastes must be placed in separate waste bins that are labelled accordingly.

E. Potential Impact of Ambient Noise and Vibration

(1) Impacts

Port construction can create substantial noise disturbances that can impact nearby human communities and wildlife. The proposed project main facility is more than 400m from the nearest residential area and lies at sea level which will naturally mitigate noise and vibrations. However, Ngare village (access road), port users and construction workers will be proximity with construction works.

The impacts can differ based on factors such as the construction stage, equipment types, and the presence of sensitive receptors like residential areas, schools, hospitals, and natural habitats.

TABLE 73 - SOURCES AND RECEPTORS OF NOISE & VIBRATION

No	Source of Noise/ Vibration	Sound Level at 10m	Potentially Affected Receptor
1	Pile Driving	220 (underwater)	Underwater Marine Life Fishermen Construction Workers Port Users
2	Bulldozer (41 tonne)	80	Construction Workers Port Users Nearby Settlements – Ngare Village and Port Reitz
3	Dump Truck	79	
4	Hydraulic Hammer Rig	89	
5	Large Concrete Mixer	76	
6	Tower Crane	76	
7	Generators	65	
8	Dredging	186 at 1m (underwater)	Underwater Marine Life Fishermen Construction Workers
9	Traffic	-	Construction Workers Port Users Nearby Settlements – Ngare Village and Port Reitz

Source: Thrivel & Wood, 2019
www.dosits.org

One of the loudest activities, which entails the insertion of piles into the ground to provide support for docks, piers, and other structures. The sudden noise it produces can be particularly annoying. The main source of noise in this project will be **pile driving**, where the construction anticipated to drive approx. 200 steel pipe piles into the seabed up to depths of 50m for the berth structure.

Dredging by use of a TSHD involves removing sediments and debris from the bottom of water bodies to create deeper channels. The dredging machinery and support vessels create constant noise during the process. The main processes that contribute to noise associated with dredging are collection noise, pump noise, transport noise (material being lifted from the seafloor to the dredger), deposition noise (placing material within a barge or hopper), and ship/machinery noise from the dredging vessel itself. Sound Pressure Levels can vary widely depending on dredger type, operational stage, or environmental conditions. Noise levels also depend on the materials being extracted, with harder sediment extraction generating higher noise levels than loose or soft sediment extraction[5].

Utilizing **Construction Machinery** such as excavators, bulldozers, cranes, and trucks for earth-moving, material handling, and construction tasks generates both constant and sporadic noise and vibration.

Traffic volume is significantly higher due to the movement of construction vehicles carrying materials to and from the site. The construction activities result in increased noise and vibration levels on access roads and in the surrounding area.

The use of **construction facilities** such as concrete batching plants, is located close to nearby receptors are another potential source of noise and vibration.

(2) Mitigation Measures

In order to minimize the exposure of excess noise and vibrations emanating from the construction site, KPA will adopt the following mitigation measures:

a. High noise and vibration sources shall be planned to be an appropriate distance from sensitive receptors such as residential and office areas. Similarly, **route planning** for heavy vehicles delivering materials to site shall be designated for suppliers. The proponent shall prepare a **layout plan** for construction works prior to commencing.
b. **Scheduling** noisy activities for specific times of the day to minimize their impact, especially at night can mitigate against the harmful effects on noise. This will apply to activities that are close to sensitive receptors and monitoring results exceed the allowable limits.
c. To minimize noise transmission to nearby areas, erect temporary **noise barriers or beams** around the source when allowable limits are exceeded.

FIGURE 141 - TEMPORARY NOISE BARRIERS

[5] https://dosits.org

Source: Acoustical World. Envirotech Systems Ltd

d. Consistently prioritize the maintenance and upgrades of construction **equipment** to optimize its quiet operation. Use of more modern, less noisy models of machinery and equipment will also reduce noise exposure with the use of silencers, and mufflers.
e. Using technology can help reduce the impact of underwater noise on marine life.
f. Plan construction activities strategically to minimise disruptions to marine species during critical periods, such as breeding or migration seasons. Noise attenuation should be practiced for noisy equipment by employing suitable techniques such as **acoustic controls**, **insulation** and **vibration dampers**.
g. **Training of personnel** to adhere to operational procedures that reduce the occurrence and magnitude of individual noisy events.
h. Personnel exposed to noise levels beyond threshold limits should be provided with **protective gear** like earplugs, muffs, etc

F. Potential impact on Marine Ecology

(1) Impacts

The development of a port in Mombasa, Kenya, has the potential to impact maritime biodiversity in various ways along the entire coastline. Extent and intensity will be determined by studies on deviations with the baseline conditions.

Dredging and land reclamation operations will be part of the construction process, which may cause disturbance to marine ecosystems like coral reefs, seagrass beds, and mangrove forests. The loss of these habitats could result in a **decline in biodiversity** and ecosystem services, as they provide vital areas for marine animals to reproduce, eat, and find refuge.

Dredging operations have the potential to increase sedimentation in adjacent marine areas, **suffocating coral reefs and benthic habitats** while **lowering their productivity** and **overall health**.

Additionally, sedimentation can reduce light penetration and water clarity, which can **hinder photosynthesis** and marine plant growth.

Construction operations have the potential to **contaminate maritime environments** with heavy metals, building materials, and sediment discharge. These contaminants have the potential to damage marine life, impair ecological processes, and deteriorate water quality. The port's increased maritime traffic may also result in unintentional pollution accidents and oil spills, which would worsen the effects on the marine environment.

Port building can impact the distribution of nutrients, plankton, and larval animals in marine ecosystems, potentially altering natural water flows, currents, and sediment transport patterns. **Changes in hydrodynamics** can impact the interconnectedness of marine species and the ability of coastal habitats to withstand natural disturbances like storms and sea level rise.

Potential environmental impacts associated with **coral reef degradation** include habitat destruction, sedimentation and water quality degradation. The likelihood of this happening varies at different areas and so does the severity.

TABLE 74 - IMPACT IDENTIFICATION FOR CORALS

Potential Impact	Likelihood to happen	Severity
Habitat destruction	Moderate	Moderate
Sedimentation	High	High
Water quality degradation	High	High

The expansion of the Mombasa port may introduce and spread **marine invasive species** through a variety of paths. Ships arriving in Mombasa port and departing from it are permitted to release ballast water that they have acquired in other the port. Ballast water frequently contains plankton, larvae, and even adult organisms. If left untreated, discharged ballast water has the potential to create invasive populations in the local maritime environment by introducing non-native organisms. Dredging, land reclamation, and habitat modification are examples of port expansion construction operations that can also introduce marine invasive species.

(2) Mitigation

The proponent can mitigate the impacts on marine ecology as follows:

a. Where possible, use of **silt curtains** (silt screens) in the dredging or marine works area to ensure that suspended sediments at burrow sites are contained. The silt curtains should properly be deployment at certain areas, 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. These sediment barriers or sediment curtains must have characteristics that provide maximum efficiency in any possible local conditions (waves, currents, wind speed, depth, etc.)

FIGURE 142 – TURBIDITY CURTAIN USE IN MARINE CONSTRUCTION
Source: ABASCO

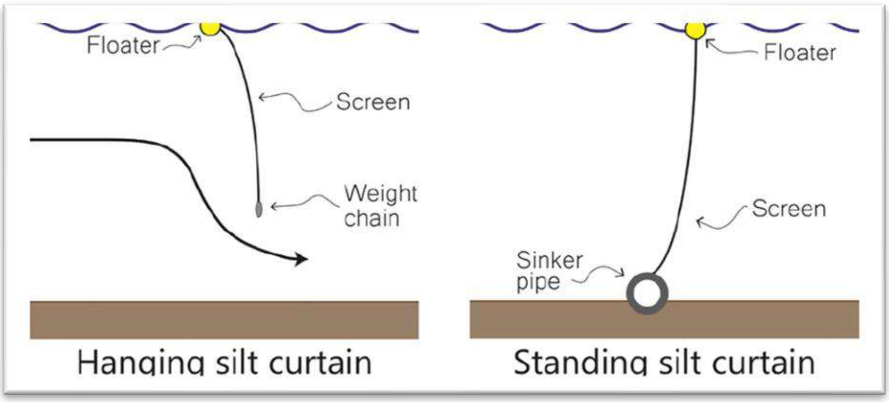


FIGURE 143 - TYPES OF SILT CURTAINS[6]

b. Another measure should be **reduction of the time** over which the dredging operation is to be carried out to minimize the duration for re-suspension of sediments.
c. The proponent should **schedule marine works** to calmer seasons in which the turbidity is taken away from the shallow areas. Confining dredging and sediment transport operations to calmer sea states to reduce resuspension of sediments.
d. Prior to undertaking any dredging work, the proponent should submit **method statement** and an **Environmental Management and Monitoring Plan** to demonstrate that the proposed works will not result in suspended sediment above the allowable levels. Reducing overflow discharge at sensitive/ shallow water will include the following; It is generally understood that marine rich areas occur at depths of <-30m CDL. Depths beyond will have reduced coral, sea grass and therefore are less sensitive. To mitigate against the turbid water plums generated during sea sand extraction, the project can discharge the turbid overflow water at a distance of 5km from the -30-contour line as a standard method. This “loop” methodology showed to be highly successful in Phase 2 when there was concern raised on the rate of siltation on corals close to the sand harvesting locations.

   The overflow pipe is an outlet pipe on the dredger that discharges fine silt in water back out to ensure only suitable material remains in the vessel. In this case the vessel will move away from the borrow pit area to discharge the silt water and return to fill.

   The cycle shall be repeated up until the vessel attains the desired volume of reclamation sea sand.

e. **Support** coral reef restoration initiatives, such as coral transplantation and artificial reef construction, to enhance the resilience of coral reefs to climate change impacts.
f. **Engage local communities** in coral reef and mangrove restoration activities to foster stewardship and ownership of marine resources.
g. **Invest in scientific research** and monitoring programs to better understand the effects of climate change on marine ecosystems in Mombasa.

[6] Efficiency of Hanging Silt Curtains in Crossflow, Radermacher et al, 2016

h. Ensure there are clear guidelines for **sustainable sand extraction** techniques (e.g., seasonal harvesting, depth limits, site rotation)
i. Monitoring and **control measures** to prevent over-extraction and habitat degradation
j. Establishment of **long-term monitoring** protocols to assess the health and condition of coral reefs, mangroves, sea grass, etc. Partnerships with research institutions and academic organizations for scientific monitoring and knowledge sharing.
k. **Ballast water management**; hull cleaning and inspection procedures; biosecurity measures, early detection, and fast response programs are some of the steps that can be taken to lessen the possible impact of marine invasive species from Mombasa port expansion.

G. Impact of Transport

1 Impacts

Numerous variables, including the port's location, the scope of the project, the state of the infrastructure, and the degree of planning and mitigating measures put in place, can affect how a port's construction affects traffic.

During the construction phase, heavy machinery, construction vehicles, and worker vehicles may cause **traffic congestion** on the highways leading to and from the port site. This may have an impact on regional and local traffic patterns, especially as it neighbours an operational port and train station not far from Mombasa City itself.

In order to facilitate construction work, it may be necessary to **temporarily close** certain roads or create detours during certain specific activities. This can cause delays for both freight and passenger traffic, as well as disrupt usual traffic patterns.

Local businesses, especially those that depend on accessible and efficient transportation, may suffer financially as a result of **traffic interruptions** brought on by port and access road construction.

As a result of port construction, there may be an increase in vehicle traffic, which raises the possibility of **air pollution** and **greenhouse gas emissions**. Construction-related dust and other particulate matter may also be harmful to the local air quality and public health.

Traffic-related construction can pose **safety risks** to drivers, cyclists, and pedestrians. This is especially true if the vicinity of the construction sites lacks the implementation of speed restrictions, appropriate signs, and traffic control measures.

2. Mitigation Measures

To lessen the effects of port building on traffic, port authorities and local governments may make investments in **traffic management strategies** and **infrastructure upgrades**. These actions could involve building new intersections, or bridges in addition to implementing truck routing plans, synchronizing traffic signals, and enhancing public transportation.

Proactive planning and effective **community involvement** can reduce the adverse effects of port construction on traffic. The planning process should consult stakeholders such as local companies, residents, and transportation agencies to address concerns, identify appropriate mitigating measures, and ensure construction activities minimize community disturbance.

H) Potential Impact on Ecosystem Services

1. Impacts

The many benefits that people receive from robust, healthy ecosystems are collectively referred to as ecosystem services. These are either provisioning services that provide sustenance and livelihoods; regulating services that support environmental stability; supporting functions for all other ecosystems and cultural services which connect people and nature.

The provision of certain ecosystem services is impacted by changes in other services, which are interrelated and frequently mutually dependent. Loss of mangroves, for instance, may lessen the availability of provisioning services like food and lumber, undermine cultural values associated with intact mangroves, and lower the provision of regulating services like carbon sequestration and water purification.

2. Mitigation

There is a chance that the Mombasa Port development in will affect the ecosystem services in both positive and negative ways. The following are some possible outcomes:

a. The port's extension may promote commerce and economic growth, which would enhance the availability of services like jobs and revenue generation, as well as the advantages associated with trade for local and regional trade. If improperly managed however, the expansion may also lead to pollution, habitat damage, and overexploitation of natural resources, all of which could have a detrimental effect on the availability of services like water quality, fisheries, and timber resources.

b. By improving regulating services like flood control, erosion prevention, and coastal protection which will be part of the project activities, improvements in infrastructure and management techniques may result from port development, strengthening the resilience of coastal ecosystems and communities to natural hazards. On the other hand, dredging, land reclamation, and increased maritime traffic linked to port expansion may interfere with regulating services such as nutrient cycling, sediment transport, and coastal stability, resulting in habitat degradation, erosion, and biodiversity loss.

c. Well-managed port development projects may contribute to the preservation and restoration of auxiliary services like wetlands, coral reefs, and mangrove forests, which offer vital habitat for marine biodiversity, control water quality, and boost coastal productivity. Port expansion activities may, however, deteriorate supporting services through habitat destruction, pollution, and disturbance if they are not sufficiently planned for and mitigated. This might lead to the loss of biodiversity, ecosystem function, and resilience.

d. The port's expansion, through investments in cultural heritage preservation and promotion, may open up opportunities for cultural services like tourism, recreation, and cultural exchange. It may also strengthen cultural identity and community pride. On the other hand, unchecked port expansion may result in the loss of traditional livelihoods and cultural practices, the uprooting of local communities, and cultural disturbances, which would threaten the region's social cohesiveness and cultural services.

e. In order to address the possible adverse effects of port expansion on Mombasa's ecosystem services, a thorough environmental impact assessments coupled with a robust monitoring regime must be carried out, along with stakeholder engagement involving local communities and conservation organizations, and efficient management and mitigation strategies must be put in place. To ensure that the advantages of port expansion are balanced with the preservation and sustainable use of coastal ecosystems and their services, community development programs, pollution prevention and control, habitat restoration, and sustainable resource management will be required. This should be coupled with benefit sharing with the affected communities as opposed to just compensation for temporary loss of livelihoods.

I) Potential Impact on Fishing Activities

(1) Impacts

The Mombasa port expansion could affect the region's fishing industry in several ways: The expansion of port infrastructure, such as piers, docks, and shipping channels, may result in the **relocation** of traditional fishing grounds. To reach productive fishing locations, fishermen could have to drive further, which would raise fuel expenses and decrease fishing efficiency.

Port development activities such as dredging, land reclamation, and construction may **destroy** or **degrade fish habitats** such as seagrass beds, coral reefs, and mangrove forests. Fish populations can decline due to habitat loss, which also lowers local fisheries' productivity.

Changes in coastal morphology, such as modified currents, sedimentation patterns, and erosion, brought about by port expansion may impact the **availability** and **distribution of fishing resources**. For instance, if changed currents spread planktonic larvae away from customary nursery locations, it could impact fish recruitment.

Due to the port's expansion, there may be more ships in the water, which could put commercial and industrial ships in **competition** with fishing vessels for fishery resources. Competition increases for available space, fish populations, and fishing grounds—especially in places with high traffic.

Port operations, including cargo handling, dredging, and vessel traffic, can lead to the **pollutant discharge** of waste materials, chemicals, and oil into marine environments. Pollution can negatively impact the health and viability of nearby fisheries, damage fish populations, contaminate seafood, and deteriorate water quality.

Port expansion-related construction activities, such as dredging, and underwater blasting, reclamation and rock placing which can interfere with fishing operations and lower catch rates due to **reduced water quality**.

Other activities such as pile driving will generate disturbance due to effects of increased noise and vibration in the marine environment. This can therefore affect and reduce the fish catch in the nearby fishing grounds.

For safety reasons, there may be **restrictions** or closures for fishermen in areas close to construction zones.

In certain situations, local fishing communities may **lose their traditional fishing rights** as well as their **access to fishing grounds** as a result of the development of port infrastructure. If forced to leave fishing regions or lose their sole source of income, fishermen and their families may face severe socioeconomic consequences.

(2) Mitigation

In order to mitigate the impacts of the projects on the fishing community, KPA shall implement the following measures:

a. Mitigation of **water quality** to remain withing allowable limits for elements that affect fish spawning and mortality.

b. KPA, as the proponent shall implement a **Livelihood Restoration Plan** with affected BMU's prior to construction.

c. To ensure the long-term sustainability of local fisheries, this may entail putting in place **habitat restoration** and **enhancement programs**, creating marine protected areas, creating alternate livelihood options for impacted fishermen, and implementing sustainable fishing methods and fisheries management techniques.

J) Impacts on Waste Management

1) Impacts

Port construction can significantly impact waste management in various ways, both during the construction phase and after the port becomes operational. Here are some key impacts during the Construction Phase:

a. Increased Waste Generation:
   - Construction Debris - Large quantities of waste materials such as concrete, metal, wood, and packaging materials are generated.
   - Dredged Material - Excavation of seabed or riverbed material can produce dredged sediments that need proper disposal or reuse.
   - Hazardous Waste - Use of chemicals and fuels can lead to hazardous waste, including contaminated soil or water.

b. Disposal Challenges:
   - Landfill Pressure - Increased waste can put pressure on existing landfill sites.
   - Marine Disposal - Inappropriate disposal of dredged material in marine environments can lead to pollution and ecological damage.

2) Mitigation Measures

Mitigation measures that can be implemented include:

a. Contractors should prepare a **Intergrated Waste Management Plan** defining adequate measures for waste collection, segregation, reuse and disposal during construction. The plan should also implement due diligence of major suppliers in their waste stream.
b. The use of **NEMA licensed** Waste Management Licensing company to handle all waste generated during construction.
c. Wastes (particularly the construction debris) should be maximally **separated** and **recycled/ reused** where possible/appropriate.
d. Strict control on the waste management process i.e., maintenance of the special chain of custody book for **recording** the quantity of the generated wastes, types and further management process.
e. Only personnel with proper **training and education** should be assigned the duty of waste management. All staff shall also be educated on waste reduction, housekeeping, segregation practices.
f. Where possible, the proponent shall Implement advanced **waste treatment** and recycling technologies to handle waste efficiently.
g. The proponent will carry out **Stakeholder Engagement** by engaging with local communities and stakeholders to ensure transparency and address concerns related to waste management.

7.3.2 Socio-Cultural Impact and Mitigation Measures

A. Potential Impacts on Socio-economic Opportunity

(1) Positive Impacts

There are a number of potential socioeconomic effects of the Mombasa port expansion, both favorable and unfavorable:

Port development projects typically require labor to construct, operate, and maintain them, thereby **creating jobs** for locals. A variety of industries and skill levels, including support services, logistics, construction, and transportation, offer these positions. Most jobs are medium to high skilled and attract people from far and wide.

By boosting the capability and effectiveness of maritime transportation and logistics services, port expansion can **promote trade** and **economic growth**. Better port infrastructure enhances the competitiveness of regional industry, facilitates international commerce, attracts investment, and boosts overall economic development.

Building related infrastructure, such as roads, railroads, storage facilities, and utilities, is frequently required for port expansion projects. This can **enhance the area's efficiency**, **accessibility**, and **connectedness**. Local companies and communities can benefit from these infrastructure improvements by promoting regional growth and improving transportation networks.

Taxes, tariffs, fees, and lease agreements are some of the major ways that the port help **governments generate revenue**. The government can finance public services, infrastructure improvements, and social welfare initiatives through the additional revenue streams that expansion projects generate. These revenue sources include increased port activity and cargo throughput.

Roads leading into and from the port environs currently experience high traffic volumes. The construction of the new access road will help **ease traffic congestion** by diverting bulk trucks headed to Nairobi to the proposed access road.

Importers, exporters, and other parties participating in international commerce can all benefit from a more streamlined and expanded port that **lowers logistical costs** and **shortens supply chains**. Improving trade facilitation can boost access to international markets for regional exporters and manufacturers, encourage economic integration, and draw in foreign investment.

(2) Negative Impacts

Among the negative effects, port expansion projects will **physically displace** and **resettle** people living within the project areas along the access road. Displacement of communities can cause social tensions and conflicts, as well as the loss of assets, income, and access to resources. It can also disrupt livelihoods, social networks, and cultural relationships.

Port expansion projects may require **land purchase** and evacuation, potentially causing social unrest and livelihood loss. Addressing these issues requires community engagement, impact assessments, and compensation programs. Implementing mitigation measures and considering safety and health implications is crucial for sustainable development and economic growth. Collaboration among stakeholders is essential.

Environmental changes may compromise ecosystem services, harm biodiversity, and impact the welfare of nearby communities reliant on natural resources for subsistence and livelihood. It is anticipated that fishing communities and tourism communities will suffer variant scales of **loss of livelihood**.

Port expansion projects have the potential to worsen already-existing inequities and **social inequalities**, especially when it comes to opportunities and benefit access. Social exclusion and marginalization may result from difficulties that marginalized groups, such as women, youth, indigenous peoples, and informal workers, experience when trying to participate in port-related business possibilities, employment, and decision-making processes.

Port operations, including cargo handling, industrial processes, and vehicle traffic, can lead to noise & vibration pollution, air and water **pollution**, and **occupational health concerns**. These factors can jeopardise the public's health and well-being. Communities adjacent to port operations may disproportionately feel the effects of these environmental health issues.

Port expansion projects may have an adverse effect on local communities' customs, holy sites, and sites of cultural significance. This could result in a **loss of social cohesiveness** and **cultural identity**. Cultural consequences could lead to the loss of traditional knowledge and values, the dispersal of cultural practices, and the disruption of cultural landscapes.

Influx of migrant workers into the region can have a negative impact on the spread of **HIV-AIDS** and **STI's** in communities either in close proximity or associated (accommodation) with the construction site.

(3) Mitigation

The proponent has prepared a **Resettlement Action Plan** to compensate, acquire land and resettle Project Affected persons adequately.

The proponent shall implement a **Livelihood Restoration Plan** prior to construction to identify persons whose livelihood shall be affected by the Construction and implement strategies and programs that will allow for their livelihood to be restored and enhanced during and after the construction works.

The project shall engage affected community to provide **job opportunities** to project affected persons and vulnerable groups. Where training is required, the proponent shall ensure that persons are provided with adequate **training and certification** for the skills required.

The proponent shall put in place a **EMMP** and **Safety Plan** that will ensure that nearby communities are not exposed to pollutants and disturbances that affect their quality of life and health.

KPA will also carry out **Baseline studies** prior to construction on HIIV-AIDS and STI risk and prevalence as well as ADA and implement a **Prevention Program** with the aid of an NGO to target construction workers and surrounding communities. The objectives as follows:

- To increase HIV/AIDS and ADSA awareness and of the Construction Workers in the project so as to promote behavior change and practices in order to minimize new HIV infections.
- To promote health and wellness through Employee Assistance Program that help Construction Workers realize how they should avoid risky behaviors.
- Expansion of awareness raising activities with more focus on BCC and strengthen referral and linkages for HIV care and treatment services;
- Intensify HIV Testing Services (HTS) and linkage to HIV services;
- Improved and Expanded care and support for people and families affected by HIV and ADSA.
- Monitoring, Evaluation, Reporting and Learning.

B. Potential Impact on Tourism Activities

The construction of ports can significantly impact tourism in both positive and negative ways. These impacts vary depending on the scale of the port project, the type of tourism in the area, and the measures taken to mitigate adverse effects. Here's a detailed analysis:

(1) Positive Impacts

a. **Enhanced Accessibility**: The construction of Berth 23 and its access roads will increase accessibility to existing and new tourist sites

b. **Increased Connectivity**: The proposed project can improve connectivity to tourist destinations, making them more accessible to cruise ships and other marine traffic.

c. **Infrastructure Development**: Ports often bring about improvements in local infrastructure, such as roads, lighting, security which benefit tourists.

d. **Job Creation**: Port construction and subsequent operations create jobs in both direct (e.g., dockworkers, engineers) and indirect (e.g., retail, hospitality) sectors.

e. **Boost to Local Economy**: increased migrant workers and job revenue lead to higher spending in local businesses such as hotels, restaurants, and shops.

f. **Increased Cruise Tourism**: A well-developed port can attract more cruise ships, leading to a significant influx of tourists.

g. **Waterfront Development:** Port construction can lead to the revitalization of waterfront areas, turning them into attractive destinations with parks, shopping centers, and cultural venues.

(2) Negative Impacts

Environmental Degradation through Habitat Destruction such as the felling of mangroves can lead to the destruction of marine and coastal habitats, affecting biodiversity and natural attractions.

Increased marine traffic and port activities can increase potential of **pollution** which can contribute to water and air pollution, negatively impacting the environment and health of residents and tourists.

Cultural and Social Displacement through **Loss of Heritage Sites**. Construction can lead to the demolition or alteration of historical sites and cultural landmarks, which can detract from the area's tourism appeal. **Community Disruption** can also occur due to the influx of workers and tourists can strain local resources and infrastructure, leading to potential social tensions.

The proposed project and further port expansion can have Aesthetic Impact. **Visual Pollution** will occur due large port structures and increased ship traffic can alter the visual appeal of coastal areas, making them less attractive to tourists seeking natural beauty.

Noise Pollution. Construction and ongoing port activities can generate noise that disturbs both residents and tourists. Estimated source levels for dredging range between 168 and 186 underwater dB at 1m[7]. This will affect underwater tourism such as snorkeling and diving.

Overreliance on port-based tourism can make local economies vulnerable to **fluctuation**s in the shipping and cruise industries due to overreliance.

Tourism Saturation. An excessive focus on port tourism can lead to overcrowding, which diminishes the quality of the tourist experience and strains local resources.

(3) Mitigation Measures

The following mitigation measures will be implemented by KPA

a. Environmental Protections: KPA Implementing strict environmental regulations and conservation programs that can help protect local ecosystems such as mangrove replantation schemes, community waste management programs and coral reef conservation programs.

b. Where possible, KPA will utilize **green technologies** and **sustainable practices** in port construction such as waste management.

[7] https://dosits.org/galleries/audio-gallery/anthropogenic-sounds/dredging/

c. Community Engagement. The project will Involve local communities in planning and decision-making processes to ensure their needs and concerns are addressed.

d. KPA will provide adequate compensation and relocation assistance to those displaced by port projects. A **livelihood restoration program** shall be prepared prior to construction.

e. KPA will support the Ministry of Tourism and the County Governments of Mombasa & Kwale to **promoting diverse tourism activities** to avoid overdependence on port-based tourism. This will ensure that tourism development is balanced with the preservation of natural and cultural resources.

f. Through **CSR programs**, KPA will invest in infrastructure that supports both port operations and local community needs, such as healthcare, education, and public services. Communities whose tourism has been impacted by the proposed project shall get preference.

By carefully planning and implementing port construction projects with these considerations in mind, it is possible to maximize the positive impacts on tourism while minimizing the negative ones.

C. Interference with Existing Public Utilities

There are several ways that the expansion of the Mombasa Port can conflict with currently operating public utilities. More traffic accessing the port area and, in the neighborhood, could result from the project, putting pressure on the area's current roads, bridges, and other **transportation infrastructure.** This stress may lead to more traffic, delays, and road wear and tear, which would affect all road users.

The expansion can include moving or altering already-existing **public utilities**, like electricity, sewage, and water lines. Because it would entail excavating pavements, roads, and other infrastructure to make room for the new port facilities, this procedure could be expensive, time-consuming, and disruptive to nearby populations.

In addition to increased pollution, the expansion may result in habitat degradation. To lessen these effects, it might be necessary to update or alter currently operating public utilities, which would further interrupt service delivery and raise expenses for both utility providers and customers.

Communities residing close to the port may be uprooted by the expansion, causing social unrest and economic hardships. Because of this displacement, public utilities that serve areas towns may need to **relocated**, which would complicate the expansion process and possibly result in disputes over resource allocation.

D. Potential Impact on Archaeological and Cultural Sites

Port development projects can significantly **impact archaeological and cultural sites**, particularly those located within or near the project area. These sites have the potential to be disturbed or destroyed, jeopardizing the integrity and significance of these efforts. Port development can also **disrupt cultural landscapes**, resulting in a loss of cultural relevance and value. The development of ports can also disrupt coastal and marine history, affecting indigenous knowledge systems and traditional cultural practices.

To minimize these effects KPA carried out an **Archeological Impact Assessment (AIA)**, through the National Museums of Kenya in 2009 for Phase 1, 2 & 3 of the proposed project. Cultural sites on land to be acquired for construction of Site camps and access road have been identified and shall be **relocated** with the assistance of the affected community prior to construction.

The proposed project will **comply to international treaties** and environmental impact assessment guidelines to ensure cultural heritage values are protected.

7.4 STAGE 2: POTENTIAL IMPACTS AND MITIGATION MEASURES DURING OPERATIONAL STAGE

The Mombasa Port extension could lead to increased traffic, noise and air pollution, strain on roads, bridges, and utilities, and environmental damage. It could also cause social and economic shifts, such as gentrification and changes in land use, property values, and employment prospects. Additionally, the port could introduce security threats like terrorism, smuggling, and theft, which could affect local norms and the safety of port assets, staff, and goods. Mitigating these impacts requires effective environmental management plans and sustainable practices.

After the port opens for business, local traffic patterns could see major adjustments. More large vehicles on the surrounding roads due to increased freight traffic to and from the port may have an impact on road safety and infrastructure deterioration.

It will be essential to keep positive relations with local communities and stakeholders while the port operates and grows. Open lines of communication, community involvement, and prompt and transparent handling of complaints and issues can facilitate the building of trust.

In summary, the growth of Mombasa Port presents prospects for economic advancement; nevertheless, cautious strategizing and administration are imperative to mitigate possible consequences and guarantee the port's sustainable and conscientious functioning over an extended period of time.

A. Potential Impact on Surface Water Quality

(1) Impact

Port operations, including vehicle movements, ship traffic, and cargo handling, can release **pollutants** into adjacent surface waters, causing ecological imbalances and contaminating water bodies.

Routine **maintenance dredging** operations will be required to maintain the depths of the port expansion which can disturb seafloor sediments, causing turbidity and sedimentation.

Ballast water from ships can introduce **non-native species**, affecting flora and fauna.

Increased nutrient **runoff** and **effluent discharge** from port operations and buildings can promote algal growth, causing fish mortality and oxygen depletion.

(2) Mitigation

In order to mitigate the impact of port and access road operations, KPA will implement the following measures:

a. KPA will maintain and **build the capacity** of the Pollution Control Department. **Training** and **education** in international best practices shall be planned for staff.

b. KPA will install **water and sewer treatment plants** in the new facility to meet water Quality Regulations, 2006.

c. KPA will carry out **annual environmental audits** to ensure compliance with national and international standards for environmental protection.

d. KPA will have a clear **Waste Management Plan** that will incorporate the following:

- Recycling
- Identify sources of waste
- Identify waste handling options
- Establish a waste management team
- Identify waste streams
- Waste audits

e. **Careful handling** of hazardous materials that could contaminate the soil at the project site. KPA shall implement clear protocols on handling of such material such as “Bunding” of fuel and Oils/ Lubricants.

f. Removal of contamination for **off-site licensed disposal**. The contaminated material has to be disposed in a licensed disposal area or treated by the disposal contractor.

B. Potential Impact on Air Quality

(1) Impact

Various factors, such as **ship emissions**, **cargo handling machinery**, and **port-related vehicle traffic**, influence air pollution at the project site. Ships, container cranes, and truck traffic release pollutants such as PM, CO2, SO_2, and NO_x, which can reduce ambient air quality and potentially exceed standards.

The port's cargo handling machinery and back-up generators releases pollutants like PM, NO_x, and VOCs.

Diesel trucks transporting cargo also release pollutants. Idling equipment and vehicles can cause unnecessary emissions.

These factors can lead to poor air quality in and around port regions, affecting the health and welfare of the local population.

Spoil and impounded cargo such as vegetables and food can be a source of **odor** as sometimes experienced in refrigerated (reefer) containers.

(2) Mitigation

To reduce air pollution, ports can implement initiatives such as:

- **Electrifying Operations** e.g. EV's, ship loaders, conveyors, etc.
- Use of **shore power** for docked vessels
- Promote the use **cleaner fuels** such as low Sulphur Diesel
- Streamlining logistics/ **reducing congestion** to reduce exhaust emissions
- **Monitoring** air quality as part of the annual Environmental Audits.
- **Dust suppression** measures should be implemented at loading points, unloading points, and internal roads.
- **Truck speed regulation** and **periodic cleaning** of cargo spills are also recommended
- Ship operators should develop air quality management procedures, follow international regulations, and minimize dust emissions in dry cargo storage facilities.

C. Green House Gas Emissions

(1) Impact

The main source of greenhouse gas (GHG) emissions from ports is the burning of fossil fuels for a variety of port operations. The following are some of the major sources of greenhouse gas emissions in the port.

a. **Shipping vessels**—such as tankers, bulk carriers, and container ships—emit greenhouse gases (GHGs) like carbon dioxide (CO_2), methane (CH4), and nitrous oxide (N2O) when they burn bunker fuel or marine diesel oil. The main greenhouse gas that ships release, CO_2, has a significant role in global warming.

b. When in use, **diesel-powered trucks**, **cranes**, **forklifts**, and other **cargo handling equipment**, they release greenhouse gases through exhaust emissions, including CO_2. These emissions increase the total carbon footprint of port operations.

c. **Energy consumption**, **material transportation**, and other activities can result in greenhouse gas emissions from the construction, upkeep, and operation of port infrastructure, which includes roads, buildings, and utilities.

d. Offices, warehouses, and storage spaces are common examples of **support facilities** found in ports. These buildings use **energy** for lighting, heating, and cooling, among other things, which contributes to greenhouse gas emissions.

(2) Mitigation

It takes a combination of tactics to reduce greenhouse gas emissions from ports, including increasing energy efficiency, switching to cleaner fuels, and implementing low-carbon technologies.

Using **shore power** (cold ironing) to supply electricity to ships while they are berthed eliminates the need for onboard generators and the pollution they produce. Emissions can also be reduced by retrofitting or swapping out diesel-powered cargo handling equipment with electric or hybrid versions.

Installing **energy-saving enhancements** such as LED lighting, energy-efficient HVAC systems, and improved insulation in port buildings and infrastructure is crucial. We are promoting the use of greener fuels, such as hydrogen, biofuels, or liquefied natural gas (LNG), for automobiles and ships.

Making investments in **clean energy technologies** like wind and solar to power port operations and lessen dependency on fossil fuels.

Furthermore, port authorities can collaborate with terminal operators, shipping firms, and other interested parties to develop and implement **sustainability programs** that reduce greenhouse gas emissions and mitigate the negative environmental effects of port operations.

D. Potential Impact on Noise & Vibration

(1) Impact

Port activities can significantly impact noise and vibration levels in surrounding areas. Sources of noise and vibration pollution during port operations include:

c. Ship movements
d. Cargo handling equipment
e. Container Ship Reefers
f. Continuous movement of trucks and vans can cause high-frequency noise, which can be annoying to those living close to port facilities.
g. Generators
h. Repair and Maintenance Works (demolition works, etc)
i. Public Address Systems
j. Alarms

(2) Mitigation Measures

Receptors to noise and vibration pollution during operations are:

- Port User
- Dock Workers
- Port Offices
- Ngare Village (access road)
- KPA Medical Clinic

Mitigation strategies include erecting sound-absorbing materials and **noise barriers**, implementing programs to monitor vibration and noise levels, minimizing noise generation through the use of machinery and equipment, and **regular maintenance**. Port authorities and operators can also proactively address noise and vibration concerns, maintaining ambient noise levels below threshold levels and monitoring them regularly. Personnel exposed to noise levels beyond threshold limits should be provided with **protective gear**. These measures can help reduce the environmental impact of port activities and maintain positive relations with neighboring communities.

E. Potential Impact on Aquatic Ecology

(1) Impacts

Port operations can significantly harm ecosystems and marine life by **contaminating water** with sediments, pollutants, and other substances. These pollutants can include chemicals, heavy metals, and oil. Port facilities can also lead to the degradation of coastal habitats, disrupting sedimentation patterns and marine biodiversity. **Ship ballast water discharges** can introduce non-native species, causing ecological imbalances. **Underwater noise and vibration** can disturb aquatic species, while dredged debris can resurface, affecting marine vegetation and ecosystems. **Unsafe spills** from ships can also pose serious threats to aquatic ecosystems.

(2) Mitigation

Implementing effective management practices for **spill response** and **pollution prevention** can significantly reduce the likelihood of water pollution occurrences. **Monitoring programs** and **environmental audits** to evaluate the ecological consequences of port operations should be carried out pinpoint problem areas so that effective mitigation measures can be taken.

Habitat restoration/ conservation (e.g. Mangroves and Coral) should be a continuous activity along the entire coastline potentially affected by the port operations.

Collaboration with various stakeholders, including local communities, government agencies, and conservation groups, to develop and implement strategies for sustainable port growth and management should be adopted as well as integrating of environmental factors into port planning, design, and operations can mitigate adverse effects on aquatic ecology and facilitate economic expansion and advancement.

F. Potential Impacts on Socio-economic Opportunity

Port expansion can have both positive and negative socioeconomic effects on communities and regional economies. It can **create jobs** in industries like manufacturing, logistics, and transportation, leading to higher earnings and a better quality of life for residents. Ports are critical trade and commerce centers, attracting investment and increasing trade volumes. Port development projects often involve building new transportation infrastructure, making the area more accessible for local businesses. Increasing port capacity can **attract new companies**, shipping lines, and trade routes, resulting in opportunities for international investment and trade diversification.

However, port expansion can also lead to **social unrest**, **habitat loss**, pollution, environmental problems, increased traffic, congestion, **safety issues**, and exacerbate social inequalities.

It is essential to plan for port expansion while considering indigenous rights, traditional livelihoods, and cultural heritage locations.

G. Potential Impact on Occupational Health and Safety

Port expansion projects pose significant health and safety risks to surrounding communities and employees during operations. **Table** 75 shows H&S prevention measures**.**

TABLE 75 – H&S RISKS AND PREVENTION MEASURES FOR PROPOSED PROJECT

No	Area	Risks	Preventive Measures

1	**Heavy Machinery and Equipment Operation**	• Accidents involving cranes, forklifts, and other heavy machinery. • Injuries from improper use or malfunctioning equipment. • Collisions between vehicles and workers.	• Regular maintenance and inspection of all equipment. • Proper training for operators. • Implementation of traffic management systems. • Use of protective barriers and clear signage
	Manual Handling and Lifting	• Musculoskeletal injuries from lifting heavy containers. • Strains and sprains from repetitive movements	• - Ergonomic training for workers. • - Use of lifting aids and equipment. • - Rotating tasks to avoid repetitive strain.
	Falls from Heights	• Falls from container stacks, cranes, or other elevated areas.	- Use of fall protection systems (e.g., harnesses, guardrails). - Proper training on working at heights. - Regular inspection of safety equipment.
	Hazardous Substances	• Exposure to hazardous materials being transported. • Chemical spills or leaks.	• Proper labelling and handling procedures for hazardous materials. • Availability of Material Safety Data Sheets (MSDS). • Emergency response plans and spill kits.
	Noise Exposure	• Hearing loss or damage from prolonged exposure to high noise levels	• Use of personal protective equipment (PPE) such as earplugs or earmuffs. • Regular noise monitoring and implementing noise reduction measures. • Providing quiet zones or breaks away from noisy areas.
	Weather Conditions	• Heat stress • Dust	• Adequate shelter and hydration in hot weather. • Proper clothing
	Confined Spaces	• Suffocation, toxic exposure, or entrapment in confined spaces such as inside containers.	• Training on confined space entry and rescue. • Use of gas detection equipment. • Implementation of permit-to-work systems.
	Fatigue	• Increased risk of accidents and injuries due to worker fatigue.	• Adequate rest breaks and shift scheduling. • Monitoring and managing work hours. • Providing rest facilities.
	Fire Hazards	• Fires from flammable materials or electrical faults.	• Fire detection and suppression systems. • Regular fire drills and emergency preparedness training. • Safe storage practices for flammable materials.
	Security Threats	• Unauthorized access or theft. • Terrorism or sabotage.	• Implementation of security protocols (ISPS) • Use of surveillance systems. • Coordination with local law enforcement and security agencies.

H. Potential Impact from Unplanned Event

The nature and intensity of an unforeseen incident at the Mombasa port could have a variety of effects. The following are some possible effects from unplanned events. Such events include floods, terrorism, major oil leaks or gas explosion, collision of vessel, fire among others.

Depending on the type of occurrence, such as a fire, explosion, or security breach, port operations may undergo **temporary suspension** or **disturbance**. This disruption could impact the transit of goods through the port, vessel schedules, and the loading and unloading of cargo, potentially causing delays and logistical difficulties for importers, exporters, and shipping companies.

Companies and industries that rely on the port to import and export commodities may suffer **financial losses** as a result of any disruption to port operations. Shipment delays may result in more expenses, less income, and fines for making late deliveries.

Because the Mombasa port is a major trade entry point into East Africa, any issues there could have a knock-on effect on the supply networks in the area. **Shortages** or **delays** in industries that rely on imported consumer items, machinery, and raw materials may impact production schedules and consumer availability.

Depending on the circumstances surrounding the incident, there may be negative effects on the environment, such as fuel leaks, **contamination** from dangerous materials, or harm to marine ecosystems. Cleanup and containment measures may be required to reduce environmental damage and prevent further harm to nearby ecosystems and communities.

Port employees, adjacent neighbours, and emergency responders may be at risk of **injury** or **death**, depending on what caused the unanticipated event. It can be critical to conduct medical emergencies, evacuations, and security measures to ensure the safety and wellbeing of those affected by the incident.

Any unforeseen incident could harm the Mombasa port's **reputation** as a reliable and effective trading hub. The event's negative publicity could discourage businesses and shipping companies from using the port in the future, which could have long-term effects on the port's competitiveness and revenue.

Mitigation

Port authorities must have comprehensive **emergency response plans** in place to lessen the possible effects of unforeseen events. These plans must include procedures for communication, coordination with pertinent authorities, and backup plans to reduce port operations disruptions and lessen the effects on the local economy, environment, and public safety.

Regular training sessions and drills can ensure port staff members are prepared to confront crises head-on.

7.5 STAGE 3: POTENTIAL IMPACTS AND MITIGATION MEASURES DURING DECOMMISSIONING STAGE

1) Decommissioning of the Construction Site

Decommissioning a construction site involves dismantling and removing all temporary structures, equipment, and materials, and restoring the site to its original state or preparing it for its next intended use. This process has several environmental, social, and economic impacts, and requires careful planning and implementation of mitigation measures to minimize adverse effects.

(1) Environmental Impacts

a. **Soil Erosion and Contamination**: Removal of structures and ground disturbance can lead to soil erosion and potential contamination from leftover construction materials.

b. **Waste Generation**: Large amounts of waste, including concrete, metal, wood, and hazardous materials, may be generated.

c. **Air and Noise Pollution**: Demolition activities can produce dust and noise, affecting local air quality and disturbing nearby residents.

d. **Water Pollution**: Improper disposal of hazardous materials can lead to water contamination.

e. **Loss of Vegetation and Habitat**: Clearing the site can result in the destruction of local flora and fauna habitats.

(2) Social Impacts

a. **Health and Safety Risks**: Demolition activities pose risks to workers and the public, including exposure to hazardous materials and accidents.

b. **Community Disruption**: Noise, dust, and traffic from decommissioning activities can disrupt the daily lives of local residents.

(3) Economic Impacts

a. **Cost**: Decommissioning can be expensive, including costs for waste disposal, site restoration, and potential environmental remediation.

b. **Loss of Jobs**: Workers employed during the construction phase may face job losses once the site is decommissioned. This can lead to mental health issues such as depression, abuse of substances and even suicide.

(4) Mitigation Measures

a. Environmental Mitigation:

- **Erosion Control**: Implement measures such as silt fences, erosion control blankets, and revegetation to prevent soil erosion.
- **Waste Management**: Develop a waste management plan that prioritizes recycling and safe disposal of materials. Hazardous waste should be handled according to regulations.
- **Dust and Noise Control**: Use water sprays, dust suppressants, and noise barriers to minimize air and noise pollution. Schedule high-noise activities during less disruptive times.
- **Water Protection**: Install sediment traps and barriers to prevent runoff into local waterways. Ensure proper disposal of hazardous materials to prevent contamination.
- **Habitat Restoration**: Replant native vegetation and restore natural habitats to support local biodiversity.

b. Social Mitigation

- **Health and Safety Protocols**: Implement strict health and safety protocols, including personal protective equipment (PPE), training, and clear signage to protect workers and the public.
- **Community Engagement**: Inform local residents about decommissioning plans, timelines, and potential disruptions. Address their concerns and provide contact information for queries.

c. Economic Mitigation

- **Cost Planning**: Develop a detailed budget that accounts for all decommissioning costs, including waste disposal and site restoration.
- **Job Transition Support**: Provide support for workers, such as job placement services, retraining programs, or transitioning to other projects.

Decommissioning a construction site is a complex process with significant potential impacts. By implementing comprehensive mitigation measures, the adverse effects on the environment, community, and economy can be minimized. Proper planning, adherence to regulations, and active engagement with stakeholders are crucial for the successful and responsible decommissioning of construction sites.

2) Decommissioning of Berth 23 and Access Road

(1) Impact

The port of Mombasa is an important economic asset for Kenya and has been operation since 1890 and has continued to grow and expand to remain competitive in the region. It is highly unlikely that the proposed Berth 23 will be decommissioned. Container terminals are lucrative and strategic assets in global trade. The decommissioning of the Mombasa Port Berth 23, if ever considered, would significantly impact various factors such as the socioeconomic, environmental, and political dynamics of regional trade. Mombasa Port is an essential port for both Kenya and all of East Africa's economies. Decommissioning of the berth could result in **financial losses** for businesses, industries, and governments that rely on it for commodity import and export, as it would disrupt regional commerce and logistical networks. However, if it's only the berth, the impacts would be significantly lower compared to decommissioning of the whole port. The impacts are however similar.

The port employs thousands of people, both directly and indirectly, as port employees, truck drivers, customs officers, and logistical staff. Port decommissioning would result in **job losses**, which would also have an impact on the local economy and way of life.

Mombasa Port is an essential entry point to global markets, managing a substantial amount of East Africa's imports and exports. Decommissioning it would cause delays, higher shipping costs, and **supply chain disruptions** for companies in a variety of industries, thereby upsetting regional trade flows.

To preserve regional connection and promote trade, decommissioning the port would necessitate **large expenditures** in alternative transportation infrastructure, such as roads, railroads, and ports. The decommissioning process would become more complicated due to the need to coordinate these investments across numerous nations and parties.

Decommissioning the port without sufficient remediation and rehabilitation could have a **negative impact on the environment**. We would need to address contaminated soil, water pollution, and other environmental hazards related to port operations to reduce possible dangers to ecosystems and human health.

The decommissioning of Mombasa Port may have **social repercussions** for local residents, particularly those who rely on port-related activities for their livelihoods.

(2) Mitigation

Engagement with the community and support systems would be required to lessen the social effects of job losses and economic disruptions.

By boosting industries and promoting regional integration, Mombasa Port is essential to the economic growth of Kenya and its neighbours. Decommissioning it can impede or even reverse the progress of regional development objectives, affecting market accessibility, infrastructural growth, and the fight against poverty.

All things considered, Mombasa Port's decommissioning would be a difficult and varied process with significant effects on the environment, society, and economy. We would need to develop extensive plans to manage the transition efficiently and minimize negative repercussions for stakeholders, and carefully consider these impacts before deciding to decommission the port

8. INTEGRATION OF CLIMATE CHANGE VULNERABILITY ASSESSMENT

8.1 INTRODUCTION AND BACKGROUND INFORMATION

Kenya faces significant challenges in achieving its development goals, particularly due to climate change. Extreme weather events and variability, particularly in arid and semi-arid regions, pose a threat to millions of people and their social and economic activities. The Kenyan government has prioritized infrastructure expansion and restoration to support economic prosperity, as outlined in the Vision 2030 program. The Mombasa Port, a major regional hub, is one of Kenya's top priorities. Due to increased cargo traffic, the port must expand its handling capacity to maintain an effective cargo distribution system. The seaside city of Mombasa, located on a coastal plain, is highly susceptible to climate change due to its low height, high average temperature, and high humidity. Covering approximately 260 km2, Mombasa is the second-largest city in Kenya and serves as the primary port for East and Central Africa. The city's coastline is its main natural resource, providing access and advantages for locals and businesses, as well as attracting tourists due to its well-known beaches and marine environments.

8.2 CLIMATE RISKS PROFILE/CARBON FOOTPRINT IN MOMBASA PORT

8.2.1 Objectives

1. Identify climate risks and hazards of the project zone
2. Identify climate vulnerable groups and extent of vulnerability in the project zone
3. Identify Project Capacities for Climate Mitigation Measures, Actions, prioritizations and resilience during the Construction and Operation process.
4. Identify local capacities for climate change and how the project can support through a participatory process.

8.2.2 Mombasa County Climate Risk Profile

TABLE 76 - POPULATION ANALYSIS OF MOMBASA COUNTY

National population	47,564,296
Nairobi	4,394,073
Mombasa County	1,208,333
Mombasa [Metropolitan region]	3,528,940
Percentage annual growth [2009-2019]	
National [linear]	-2.5%
Coastal cities [estimate]	-5%

Source: Kenya Data Portal, “2019 Kenya Population and Housing Census”, November 15, 2019

(1) Livelihood Activities of the Project Zone

This area is a long, thin band that stretches the whole length of Kenya's coastline in the Indian Ocean. With the exception of July, which is the coolest month, the entire year is hot and muggy due to its monsoon-style environment. The average annual temperature is 26.5°C, with a range of 21°C to 32°C. The average rainfall during the short rainy season (October to December) is between 850 and 1,200 mm, while the long rainy season (March to June) sees up to 1,400 mm of rain. The Bajuni, Somali, Mijikenda, Arab, Pemba, Digo, and Kauma ethnic groups are those that make up the zone. The zone is home to over 90% of its permanent residents. People who worked in tourism, mixed farming, fishing, and mangrove harvesting, among other livelihood activities.

Up to 85% of the overall household income comes from fishing, either in the ocean or on land. Additional revenue-generating activities include mangrove harvesting, food crop cultivation, small trading, animal production, cash crop production, and casual labor. A normal household has up to 15 chickens, 0–2 sheep, 4-5 cattle, and 5-8 goats. Cattle contribute the most to livestock production's total food production and financial income. Livestock often accounts for 20% of household income, especially in wealthier homes with larger herds. Most people grow crops in primitive, rain-fed conditions during both rainy seasons. Production of cash crops and food accounts for 10–20% of total income. Mangoes, cashews, coconuts, and sesame are examples of cash crops. Apart from personal consumption, people also sell maize, millet, and cassava.

(2) Meteorological Data

1) Annual Rainfall

The summary annual rainfall statistics for the Project Zone and Mombasa's County from 1961 to 2022 are as follows:

a. Count: 62 years of data
b. Mean: 1052.43 mm
c. Standard Deviation: 333.13 mm
d. Minimum: 445.1 mm (in 2021)
e. 25th Percentile: 828.48 mm
f. Median: 1019.25 mm
g. 75th Percentile: 1188.73 mm
h. Maximum: 2244 mm (in 1997)

The trend line has a slight negative slope of approximately -2.49, suggesting a very gradual decrease in rainfall over the 62 years.

The line graph with a trend line for Mombasa's annual rainfall from 1961 to 2022 has been created, showing the yearly fluctuations and the overall trend. The trend line indicates a very slight negative slope, suggesting a marginal decrease in rainfall over the period. However, the data displays significant variability from year to year, with some years experiencing notably higher rainfall than others.

2) Statistical Analysis of the Annual Rainfall:

a. Slope of Trend Line

The slope of the trend line is approximately 2.4924*mm/year*, indicating a slight decrease in rainfall per year over the 61-year period. However, this value needs to be interpreted with caution given the variability in annual rainfall.

b. Correlation Coefficient (R^2)

The R-squared value is 0.01820.0182, which is very low. This indicates that only about 1.82% of the variability in the annual rainfall can be explained by the linear trend. This suggests that the annual rainfall in Mombasa is highly variable and does not strongly adhere to a simple linear trend.

c. Mean Annual Rainfall

The mean annual rainfall over the period is 1052.43*mm*.

d. Standard Deviation

The standard deviation is 333.13*mm*, indicating that there is substantial year-to-year variability in the rainfall amounts.

3) Graphical Analysis of Rainfall

The graphical representation shows the annual rainfall with a trend line. Despite the trend line indicating a slight decrease in rainfall, the actual data points show significant variation from year to year, with some years experiencing much higher than average rainfall and others much lower. This pattern reflects the complex nature of rainfall distribution, which can be influenced by a wide range of factors, including climatic cycles like El Niño and La Niña, and is not typically uniform or linear.

The variability is highlighted by the high standard deviation relative to the mean, which is a characteristic of precipitation data. The R-squared value further confirms the high variability and the limited predictive power of a linear model for this particular dataset.

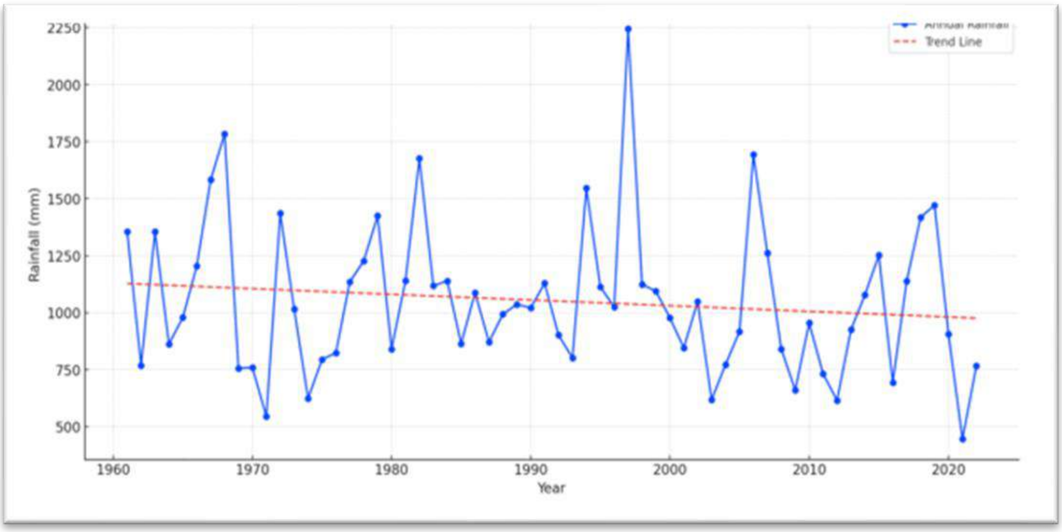


FIGURE 144 - ANNUAL RAINFALL TREND

Source: http://meteo.go.ke

4) Annual Maximum Temperature

The summary and trend analysis of the annual maximum temperature data from 1961 to 2022 are as follows:

i. The average maximum temperature over the 61-year period is approximately 30.4°C.

ii. The lowest recorded annual maximum temperature was in 1968 at 29.49°C.

iii. The highest recorded annual maximum temperature occurred in 2019 at 31.32°C.

iv. The last decade has shown a noticeable increase in maximum temperatures.

5) Trend Analysis of Temperature

i. There is a visible upward trend in the maximum temperatures, indicating a rise in annual maximum temperatures over time.

ii. The increase is more pronounced in the 2000s, with the majority of the highest temperatures occurring in the last 20 years.

iii. The 1960s and 1970s show relatively stable and lower temperature values compared to the 2000s and 2010s.

6) Graphical Representation of Temperature

The plot created from the data shows the year-on-year variation in maximum temperatures with a clear upward trajectory, especially from the early 2000s onwards. This suggests a long-term warming trend in Mombasa, aligning with global patterns of climate change. If you require a more in-depth statistical analysis, such as calculating the rate of temperature increase or a predictive model for future temperatures, that can also be provided.

The updated graphical representation includes a red trend line overlaid on the original data points, which emphasizes the upward trend in the annual maximum temperatures in Mombasa from 1961 to 2022. The trend line demonstrates that the maximum temperatures have been increasing over the years, with more significant increases observed in the recent decades.

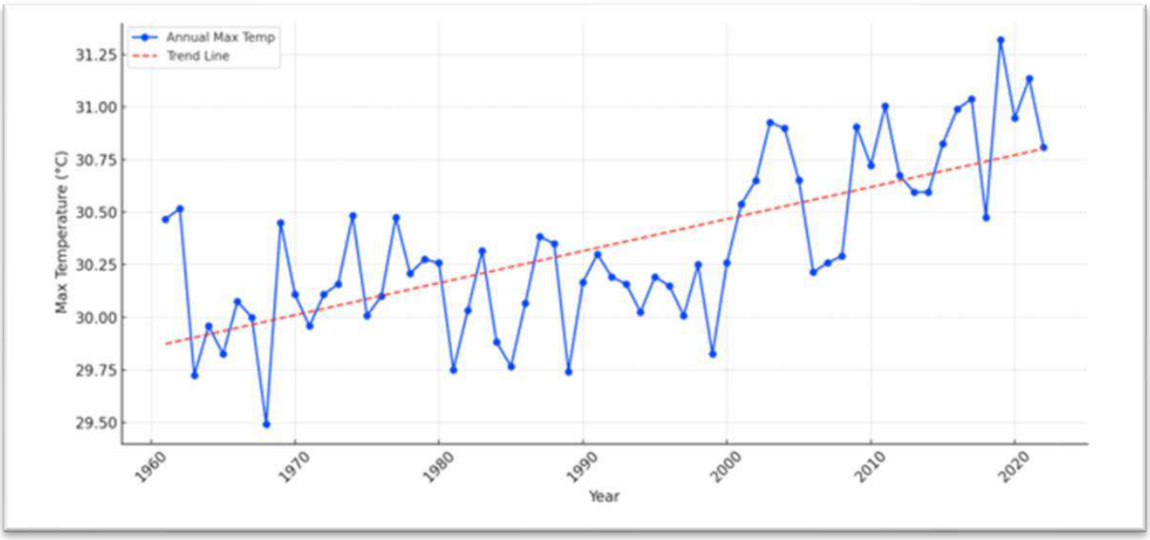


FIGURE 145 - TEMPERATURE TREND
Source: http://meteo.go.ke

7) Annual Minimum Temperature (1961-2022)

Statistical Analysis of Mombasa Annual Minimum Temperature:

a. **Slope of Trend Line**
   The slope of the trend line is approximately 0.0122°*C/year*, which suggests a slight increase in the minimum temperature each year over the period from 1961 to 2022.
b. **Correlation Coefficient (R^2)**
   The R-squared value is 0.12720.1272, indicating that about 12.72% of the variability in the annual minimum temperatures can be explained by the linear trend. This value suggests that while there is a trend, a lot of the variability is due to other factors not explained by a simple linear model.
c. **Mean Annual Minimum Temperature**
   The mean annual minimum temperature over this period is 22.47°*C*.
d. **Standard Deviation**
   The standard deviation is approximately 0.62°*C*, indicating that the annual minimum temperatures typically vary by this amount from the mean.

8) Graphical Analysis of Minimum Temperature

The graphical representation illustrates the annual minimum temperatures in Mombasa with a trend line. The upward slope of the trend line indicates a warming trend, albeit gradual. However, the data points show variability around this trend, which is typical in climate data. The R-squared value suggests that while there is a warming trend, it only moderately fits the data, leaving room for other factors influencing year-to-year changes in minimum temperature.

The standard deviation shows variability, but it is relatively small, which indicates that the minimum temperatures have not had dramatic fluctuations from year to year.

The trend analysis for the Mombasa annual minimum temperature from 1961 to 2022, as indicated by the slope of the trend line on the graph, shows a gradual increase. Specifically, the slope of 0.0122°*C*/*year* implies that the minimum temperature has been rising at this rate on average each year.

The R-squared value, which measures how well the trend line fits the data, is 0.12720.1272. This suggests that the trend line explains about 12.72% of the variation in the minimum temperature data. This value is relatively low, indicating that while there is a discernible upward trend, the majority of the variation in the data is due to other factors, which could include climatic variability, changes in local conditions, or measurement inconsistencies over time.

The mean annual minimum temperature over the 61 years is 22.47°*C*, and the standard deviation is 0.62°*C*, suggesting that while there is some year-to-year fluctuation, the variation is not extreme.

Overall, the trend analysis indicates a warming pattern in the minimum temperatures in Mombasa, consistent with the broader trends of global warming.

Summary of Mombasa's Annual Minimum Temperature (1961-2022):

i. The annual minimum temperature in Mombasa ranged from 20.71°C in 1994 to 23.87°C in 2020.

ii. There is a slight increasing trend in the annual minimum temperature over the years, with a linear regression slope of approximately 0.0249, indicating a gradual rise in minimum temperatures.

iii. The minimum temperature data shows some variability over the years, with 1994 having the lowest minimum temperature and 2020 having the highest minimum temperature during the analyzed period.

iv. The R-squared value (R^2) of 0.1462 suggests that the linear trend model explains a modest proportion of the variability in minimum temperatures, indicating that other factors may also influence the trends.

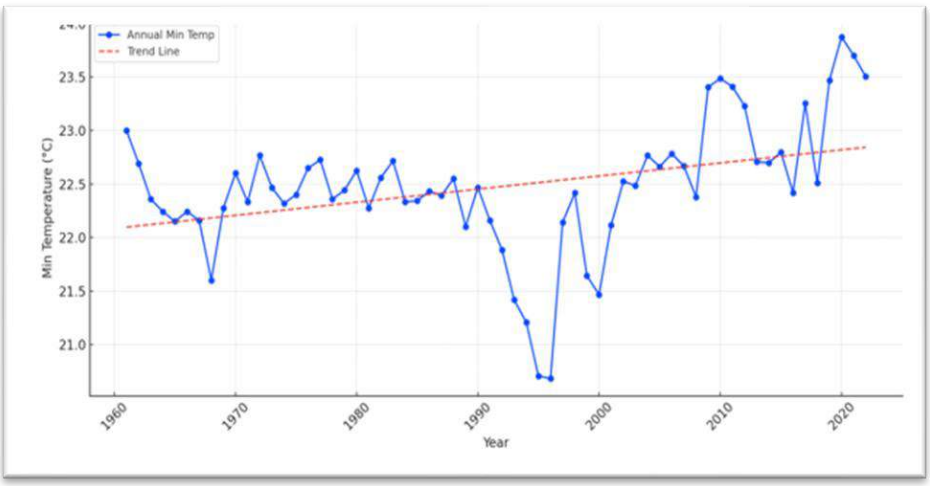


FIGURE 146 – MIN TEMPERATURE TREND
Source: http://meteo.go.ke

9) Annual Average Temperature (1961-2022)

a. **Trend Analysis**
The trend line in the graph indicates a gradual increase in average temperatures over the 61-year period. The upward trend becomes more noticeable from the late 1990s onwards, which suggests a warming trend in Mombasa's climate.

10) Average Temperature Statistical Analysis Results

a. **Slope of Trend Line**
The slope of the trend line is approximately 0.0137°C per year. This means that on average, the annual average temperature in Mombasa has increased by about 0.0137°C each year over the period from 1961 to 2022.

b. **Correlation Coefficient (R^2)**
The R-squared value is approximately 0.2860.286. This value suggests that approximately 28.6% of the variability in the annual average temperatures can be explained by the linear trend. While this indicates some level of linear trend, there is still a substantial amount of variability that is not captured by the trend line.

c. **Mean Annual Average Temperature**
The mean annual average temperature over this period is 26.40°C.

d. **Standard Deviation**
The standard deviation is approximately 0.463°C, which indicates that the annual average temperatures typically vary by this amount from the mean.
The statistical analysis confirms a slow but steady increase in temperatures over the years, with significant variability around the average temperatures. This variability is typical in climate data and reflects the influence of various climatic factors and events. The R-squared value suggests that while there is a trend, other non-linear factors also significantly influence annual temperatures.

11) Average Temperature Graphical Analysis

The graphical representation provides a visual indication of the overall warming trend, despite the year-to-year fluctuations. The highs and lows demonstrate variability within each decade, but the overall trajectory is upward, aligning with global patterns of warming.

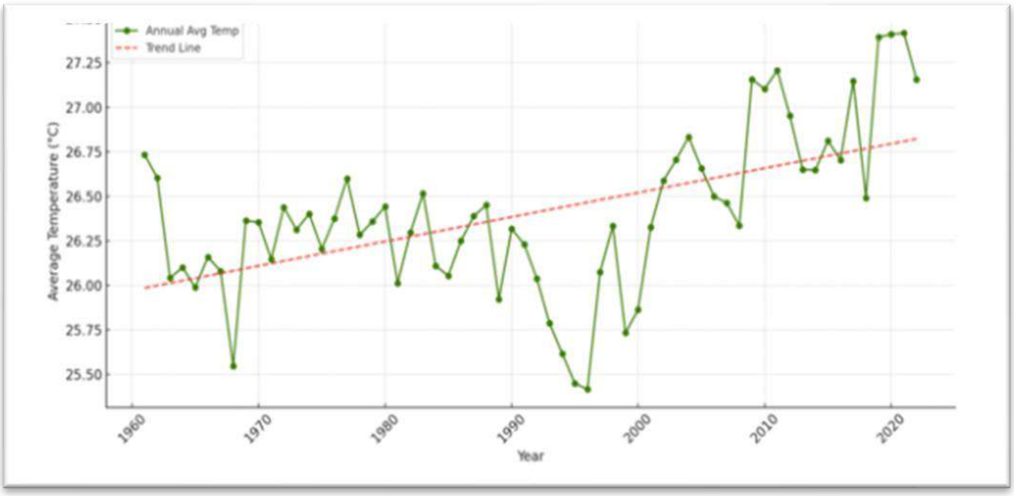


FIGURE 147 - AVERAGE TEMPERATURE TREND
Source: https://meteo.go.ke

8.2.3 Climate Change of The Project Zone

Climate change is a new and emerging threat but is not systematically addressed in the major planning documents. This leaves the city's infrastructure and near-term future highly vulnerable to chronic and acute stressors. Mombasa faces significant threats from direct and indirect impacts of climate change and its variability. Close to 10% of Mombasa's population was impacted by flooding in 2006, while 17% of the city has been cited as being at risk of submergence by a sea-level rise of 0.3m. Future projections of impacts using business-as-usual climate estimates find that while population exposure in Mombasa doubles, the cost of impacts balloons 30 times: from $470 million in 2005 to $15 billion in 2080 (Abiy Kebede et al.., 2012). Importantly, the increase in vulnerability and cost owes more to increased exposure driven by socio-economic factors than the magnitude of the climate hazard itself.

Climate impacts to Mombasa city are varied. Direct impacts include coral mortality in coral reefs. But mangroves and coastal vegetation are also vulnerable to warming and storms from the sea and to flooding and sedimentation from rivers during severe weather events. Mombasa is built on porous limestone bedrock from ancient reef growth, so is vulnerable to saltwater intrusion driven by storm surges and sea-level rise.

Impacts are exacerbated by intensified resource use and damaging practices (such as mangrove cutting) during times of economic and social stress, as well as poor solid waste management, which results in blocked drains and natural watercourses, and the flushing of pollution and litter into the sea.

Some of these shorelines along the sheltered creeks are becoming heavily populated with informal settlements as the city's population grows. The greatest inundation risk is clearly the low-lying areas along Bamburi Beach where tourism development is concentrated, and in the Bamburi Cement Company quarries where some areas (old quarries) are currently below high-tide level, some of the more elevated parts of Mombasa may be highly vulnerable to these other aspects of flooding, as well as salinization of groundwater and underground seepage.

1) Historical Timeline/Trends – Project Climatic Zone

A timeline of the Past Hazards and Events for the past 20-30 years.

TABLE 77 – PAST 20-30 YEAR TIMELINE OF HAZARDS AND EVENTS

Year	Hazard/ Event	Return Period	Impact Profile	Remarks
1947 **1961** **1997**	El Nino	Approximately 5years	Houses destroyed Property lost Livestock and crops lost Human lives lost Increased incidence of disease (cholera, typhoid	Most affected areas are estates located near the ocean that either lack or have poor drainage structures or systems
Frequently almost annually	Floods	Unpredictable	Houses destroyed Property lost Livestock lost (all types) Human lives lost Increased incidence of disease (cholera, typhoid)	Most affected areas are estates that either lack or have poor drainage structures or systems
2006	Tsunami	Unpredictable	Several fishing boats reportedly destroyed	One human life reportedly lost
2005/6	Drought	Every drought 4-5	All agricultural activities are affected Women spend more time looking for water	As time is spent looking for water, other activities suffer from time allocation; droughts also cause famine
Every year	Hunger/Famine	Every year	Loss of human lives from starvation (not quantified) Gross malnutrition and underfeeding leading to poor economic productivity	Effects are felt across all age groups and gender

Source: Adapted from Danda, M (2006), "Vulnerability and capacity assessment in Mombasa district", Survey Report for the Kenya Red Cross Society, Mombasa Branch, unpublished.

2) Climate Change Hazards, Impacts and Vulnerability Assessment

TABLE 78 - CLIMATE CHANGE ASSESSMENT

Climate Hazard	Causes	Effects/ Impacts	Vulnerable Group [s]	Reason for vulnerability
Prolonged Dry Periods	-Climate change -Rise in temperatures -Lack of rain over a long period of time -Deforestation	-Water scarcity -Food insecurity and malnutrition. -increase in prices of commodities. -Loss of livelihoods -Health and well-being -Ecosystem change -Species diversity -Loses to fisheries and tourism -Disruption to agriculture -Exacerbated biodiversity loss - Agricultural loses -Extreme heat events -Changing marine ecosystems.	-Women -Children - Elderly -Fishermen	- Women Spend long hours looking for water and food Children -Children drop out school as parents are unable to provide school fees -Elderly suffer from malnutrition due to lack of or inadequate food. - Fishermen – Unable to catch enough fish due to warm waters that lead to fish migration
Heat waves	-Climate Change -Rise in temperatures - Increase in humidity	-Ecosystem disruption -Migration -Extinction of some species of fauna, flora and micro-organisms. -Increase energy use to power air conditioners therefore leading to increased usage of fossil fuels. -Dehydration -Heat stroke -Death - Human health -increase usage of energy (air conditioners)	-Children - Pregnant women	Children –their bodies have trouble regulating temperature and rely on adults to protect them from heat. Pregnant women - Too much heat and dehydration can put the baby at higher risk of low birth weight, early birth and even stillbirth. - Pregnant women can be negatively affected and go into early labour, as well as develop gestational diabetes and hypertension.
Storms	-Climate change -Strong winds with rain -Heavy rainfall	-Loss of property -Loss of lives - Increases soil erosion -Destruction of infrastructure -Poses risk to humans and animals' health	-Children -Women -Elderly -Men	Children – Diseases Women- Displacement -psychological stress Men- Sourcing funds for repairs, replacement of property lost -Stress/Depression

		-Soil erosion -Reduced crop productivity		
Floods	-Increased rainfall -Low lying areas /Flat areas -Climate change -Rising water tables - Changes in the absorptive capacity of land due to urbanization - rising sea levels	-Destruction of property -Sedimentation of rivers. -Flooding of streets -Displacement -Loss of lives and animals -Waterborne diseases -Affects survival of mangrove seedlings in their seedlings -Water pollution -Spread of climate-sensitive diseases [cholera]. -Impacts tourism activities -Disrupt normal livelihood activities. -Disrupt school attendance. -Sea level rise -Coastal erosion -Water pollution -Positively impacts fishing activities -Impact agricultural activities	-People Living with Disabilities -Children -Women	PWDs – Issue with mobility to safe grounds -Drowning Children- Waterborne diseases -Drowning Women – Displacement, relocation and settling
Sea level rise **(about 2mm per year**	-Low elevation -High temperatures -High humidity	-Water salinization -Contaminated freshwater aquifers - Displacement -Destruction of infrastructure -Flooding -Impact tourism -Loss of livelihoods -Sea shore erosion - Saltwater intrusion into freshwater bodies -Loss of coral reefs -Changes in sedimentation patterns	Women Children	Women -Distance covered to fetch clean water -Psychological stress Children - Drop out of school -Diseases

Source: Field Survey, Nov. 2023

3) Non-Climate Risks Caused by Climate Risks

Table 79 - Non-Climate Risks

NON-CLIMATE RISK	CLIMATE RISK	CAUSES
Poverty	Floods Drought	Loss of livelihood sources Loss of property Displacement Lack of water Lack of food
Conflicts	Drought Floods	Displacement and resettlement Scarcity of resources Water shortage Loss of livelihood sources Overcrowding upstream
Political interference	Floods Drought	Resettlement Compensation/ livelihood restoration
Gender based violence	Droughts Floods	Scarcity of resources Compensation / Livelihood restoration
Emerging pests and diseases	Droughts Floods	Rise in temperatures Contaminated water
Unplanned settlement and structures	Floods	Displacement Encroachment Increase in population
Disruption of schooling and social activities	Floods Drought	Displacement

Climate issues	Traditional ways of addressing the climate issues	Effective [Yes or No]	Gaps [What's Missing]	What needs to be done?
Drought **Floods** **Storms**	Illegal charcoal burning as an alternative livelihood source. Accommodate the affected households.	No No	Alternative sources of livelihood / livelihood diversification Relocation/ resettlement to safer grounds. Lack of long-term monitoring data and technical support on	Linked meteorologists and end-users of seasonal forecasts Timely prediction of climate-related disasters and effective early warning systems Support to Disaster preparedness effective coordination of disaster relief and recovery. Facilitation of climate change adaptation, and restoration of communities' livelihoods

	Practice fishing Raise mangrove seedlings for sale. Cover long distances to fetch water	No No	morpho-dynamic processes Lack proper modern fishing tools. Inadequate market for their mangrove seedlings Clean and accessible Water Donations.	Livelihood diversification Implementation of the Environmental mitigation plans where feasible. Creating public awareness of climate change and associated communication and dissemination Support and reforest the degraded coastal areas to ensure a healthy sea wall Formulating an effective and enforceable coastal zone management policy Need for increased activity and a collective campaign for public awareness on climate change impacts and adaptation, Capacity building of fishermen on proper fishing methods as well as financing them to obtain proper fishing tools Create market for their mangrove seedlings. Support and provide clean and accessible water to the community

Source: Field Survey, Nov. 2023

4) Greenhouse Gases Emissions

According to the International Maritime Organization (IMO), maritime transport sector contributes to around 2.89% of global GHGs emissions due to its rapid growth. However, it has a greater potential to reduce its GHG emissions. The Port of Mombasa 2013 Carbon emissions were approximately 335,466 tCo2e while at 2022 they increased by 58% amounting to approximately 532,424.36tCo2e (as per the GPP). The total emissions are from sources directly controlled by KPA, utilization of purchased electricity and from KPA operations. As shown below.

TABLE 80 - GHG SOURCES AND ESTIMATES

EMISSIONS	SOURCES	GHG ESTIMATES (TCo2e)
Direct emissions	-Stationary combustion -Mobile combustion -Fugitive combustion	23,945.35
Indirect emissions	Purchased electricity	8,135.22
Emissions from KPA operations	-Transportation -Business travels -Employee commute -Water consumption -Private vehicles visiting the port	500,343.70

Source: Green Port Policy

Expansion of the Port means increased number of equipment and machines purchased as well as increased operations leading to more carbon emissions. In a business-as-usual scenario, by 2032 the GHG emissions will increase by 80%.

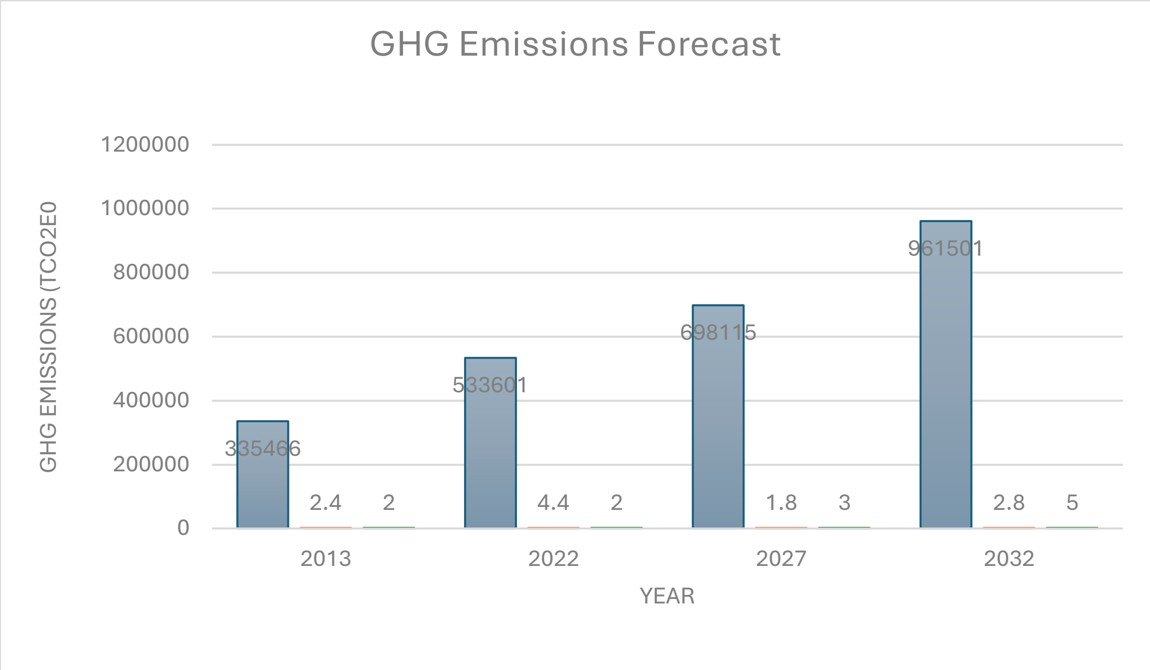


FIGURE 148 - GHG EMISSIONS FORECAST

Source: Green Port Policy

5) The Climate Action Plan - Mombasa Port Development Project Phase III

TABLE 81 - PROJECT CLIMATE ACTION PLAN

PROJECT PHASE	MITIGATION/ADAPTATION MEASURES
Project Planning, Construction Phase	• Conduct a full EIA study, with the aim to map vulnerable areas within the construction area and integrate with the physical plans. • Adhere to the existing laws on wetland regulation and shoreline management (integrated agency approach, rehabilitation of degraded areas) • Inter-agency coordination and collaboration. • Mainstreaming of climate change in the KPA plans, BQS, procurement and projects. • Invest in technologies with sensors to manage drainage to determine and manage blockage risks. • Proper drainage systems integrated with nature-based solutions (green-grey). • Green procurement/ procurement of hybrid and energy efficient equipment. • Construction of green buildings • Adoption of green energy e.g. biogas and solar by the project wherever feasible. • Promote climate smart technologies that support climate mitigation and/or adaptation where feasible. • Invest in nature-based flood control solutions, e.g., vegetation and mangrove rehabilitation. • Come up with preventive, mitigation measures against sediment buildup in vessel routes and moorages by dredging. • Develop internal disaster management strategies that are fully integrated across relevant sectors, and with social/business stakeholders. • Develop evacuation plans and conduct training on the same. • Monitoring of weather and strengthening of early warning systems. • Anti-sway measures for cranes in strong winds.

	• Set aside funds for carbon offsetting projects as well as projects to help generate carbon credits such as mangrove farming • Investment in research, development and innovation.
Project Operation Stage	• Promote measures to secure/stabilize containers. • Continuous monitoring of waves and sea level. • Ensure the frequent maintenance of drainage systems and other infrastructure at the post –Construction phase. • Utilization of SGR in transportation of long-distance cargo. • Regular monitoring and evaluation of processes to assess their effectiveness. • Educate and raise awareness of all stakeholder groups, specific to localized experiences of flooding and waste management, with the potential for solutions. • Improvement of climate information systems. • Resource mobilization. • Promote water efficiency (reduce, reuse, recycle).

6) The Climate Action Plan- The Project Affected Persons

TABLE 82 - PAP CLIMATE ACTION PLAN

HAZARDS	ACTIONS	RELEVANT INSTITUTION
Prolonged dry period/ Drought **Floods** **Storms** **Sea level rise**	Promotion of Climate Smart Agriculture. Increased vegetation cover and planting of cover crops. Vaccination and extension services. Practice soil erosion control (terracing, build gabions, trenching). Livelihood diversification. Afforestation and Reforestation programs. Practice Agroforestry. Restoration of degraded landscapes. Improvement of climate information systems. Communities' sensitization and capacity building. Rehabilitation and Conservation of water catchment areas such as rivers, streams. Enhance water harvesting and storage during rainy season. Promote water efficiency (reduce, reuse, recycle) Improvement of drainage systems. Maintaining buffer zones. Climate proof infrastructure. Resource mobilization. Promote green buildings. Building of flood barriers to protect infrastructure. Relocation from flood prone areas.	Department of Agriculture, Livestock and Fisheries Department of Environment Department of Water Kenya Meteorological department (KMD) Kenya Forest service (KFS) Kenya The port Authority (KPA) National government Civil society Private sector Farmers Fishermen

TABLE 83 - LIST OF STAKEHOLDERS' INTERVIEWED

S/NO	NAMES	REPRESENTING
1	Joto Mlandi Chaka	Ngare BMU (Beach Management Unit)
2	Roy Ndoro	Mkupe BMU
3	Masudi Mohammed Bakari	Mkupe BMU
4	Alex Ria Ndarawe	Kitanga Juu BMU
5	Ramadhan Juma	KPA –Environment department

TABLE 84 - PHOTOS OF CLIMATE CHANGE SITE VISIT

	
Site Visit	**Stakeholder Consultation**
	
Mangroves that will be Affected by the Project	**Coconut Trees in Project Area**

9. ENVIRONMENTAL AND SOCIAL IMPACTS MANAGEMENT & MONITORING PLAN

9.1. ENVIRONMENTAL MANAGEMENT SYSTEM

9.1.1. Legislative Framework

The principal law governing environmental impact assessments (EIAs) in Kenya is the Environmental Management and Coordination Act (EMCA) of 1999. The EMCA mandates an Environmental and Social Impact Assessment (ESIA) to evaluate the potential environmental effects of a project, under the management of the National Environmental Management Authority (NEMA). The National Environmental Management Authority (NEMA) is responsible for granting permits, evaluating project proposals, performing evaluations, and monitoring compliance with environmental regulations. In addition to interacting with stakeholders and finishing an EIA study, project proponents also need to secure an environmental and Social Impact Assessment license. NEMA not only provides review and appeal processes, but also oversees projects to ensure adherence to environmental laws and licenses. Kenya has also ratified international treaties and accords such as the United Nations Framework Convention on Climate Change (UNFCCC) and the Paris Agreement.

UNFCCC is an international treaty established in 1992 with the objective of addressing global climate change. It was adopted during the Earth Summit held in Rio de Janeiro, Brazil. The UNFCCC has near-universal membership, with 197 countries (known as Parties) and the European Union as signatories.

9.1.2. Corporate Environmental Responsibility

Kenya Ports Authority (KPA) is committed to advancing sustainable operations and environmental sustainability (CSR) through corporate environmental and social responsibility policies. KPA can reduce emissions, invest in renewable energy, and implement waste management and pollution control strategies to reduce its negative effects on the environment.

It should support education and skill development, generate employment opportunities, and involve local people in decision-making processes. Strong occupational health and safety regulations, training, and frequent risk assessments are required by KPA to safeguard the health and safety of its employees, subcontractors, and visitors. It should respect human rights, abide by the law and moral principles, and keep lines of communication open with all parties involved.

It is possible to increase accountability and demonstrate KPA's commitment to sustainability by regularly monitoring and assessing CSR programs. Long-term value for stakeholders and sustainable development can result from integrating CSR principles into KPA's activities.

9.1.3. Organizational Structure and Responsibility

The management of the environment and society is the responsibility of several departments and units within the Kenya Ports Authority (KPA). The Department of Environment oversees environmental management practices and puts policies in place to lessen the negative effects that port operations have on the environment. With an emphasis on infrastructure, healthcare, and education, the Department of Social Responsibility is in charge of social responsibility initiatives and community involvement. The Department of Health, Safety, and Quality ensures adherence to health, safety, and quality requirements through audits and risk assessments. The Department of Communications and Corporate Affairs coordinates public relations initiatives to promote accountability and transparency. KPA's environmental and social management initiatives receive strategic direction from the senior leadership and board of directors, which guarantees adherence to policies and objectives. Effective environmental and social management at KPA depends on departmental collaboration and cooperation.

9.1.4. Implementation of ESMP

The overall responsibility of implementation of the mitigation measures belongs to the proponent, KPA. Contracted and delegated responsibility for most of the environment and social impacts are spread over the project team with the contractor implementing most operational mitigation measures while the proponent implements the planning or preparatory phase mitigation measures. Supervision and monitoring responsibilities are spread along responsible parties reporting to the proponent.

The main contractor will be directly responsible for the implementation of the environmental mitigation measures. The project proponent will be responsible for overseeing that the projects are implemented according to best practice, regularly monitor the works progress and its compliance with adopted mitigation measures and statutory standards.

The key stakeholders involved in the implementation of this ESMP:

- Kenya Ports Authority
- National Environmental Management Authority (NEMA)
- The County Governments of Kwale and Mombasa
- Resident Engineer/ Consultant
- Main Contractor
- Local organized community, business and special interest groups

9.1.5. Capacity Building

Under this category are activities aimed at enhancing the capacity of project personnel, local communities, and relevant institutions to manage environmental and social risks effectively. The implementation of the ESMP responsibilities are assigned based of capacity and is accorded to individuals or entities as necessary. The costs are estimated based on specific measures being undertaken and the available resources.

The following training and capacity building is proposed:

- Sensitization of the Contractor and Proponent Representative on the importance of the Environmental and Social Management Plan (ESMP), its contents, how it is applied and who is responsible for the implementation of each part of the ESMP.

- Training and capacity building for construction labour on the importance and proper use of PPEs.
- Training and capacity building for Contractor and construction labour on acceptable waste management practices.
- Training and capacity building of the construction site occupational safety and health safety committee on construction site occupational safety and health requirements and individual safety obligations.
- Training and capacity building of construction site first aid.
- Training and capacity building on construction site fire safety.
- Sensitization on HIV and AIDS and other communicable diseases.

9.2. ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

An Environmental and Social Management Plan (ESMP) is a systematic framework which identifies, evaluates, and manages the potential environmental and social implications of a project or activity. It describes tactics and actions to maximize benefits and advance sustainable development while reducing, mitigating, or offsetting negative effects on the environment and nearby communities.

ESMP contains in brief the identified potential impacts of the project as identified in the studies, expert opinions and stakeholder engagement and proposes possible mitigation measures for addressing the identified impacts. The ESMP also contains estimate costs of Setting aside enough cash, manpower, and technological know-how to carry out the ESMP efficiently.

The ESMP, being a dynamic document, necessitates periodic reviews and modifications as new information emerges and the project progresses. It is a technique for encouraging conscientious project development, guaranteeing adherence to rules, and cultivating goodwill among stakeholders.

The proposed new berth at Mombasa Port will require an Environmental and Social Management Plan (ESMP) to minimize environmental and social impacts while maximizing benefits. Baseline studies will assess existing conditions, including marine biodiversity, air and water quality, socioeconomic profiles, and cultural legacy. Stakeholders will be surveyed to understand their concerns and potential impacts. Mitigation measures will be formulated, and a plan of action will be developed. Frequent monitoring will ensure successful implementation of mitigation strategies. The ESMP will also provide training and capacity-building programs for project workers and local communities.

In order for the Contractor to carry out environmental management activities during construction, the Contractor should draw up a Construction -Environmental & Social Management Plan (C-ESMP) of his own to show how he will address the mitigation measures during the construction period. The Supervising Engineer is responsible for assessing the Contractor’s Construction Environmental & Social Management plan.

In additional to submission of the Construction- Environmental and Social Management Plan (C-ESMP), the contractor shall also submit Key management plans as follows; Code of Conduct, Healthy and Safety Plan, Grievance Redress Mechanism, Waste Management Plan, stakeholder engagement Plan and Traffic Management Plan.

Other Key Management Plans need to be clear include; Emergency Preparedness and Response Plan, Gender based violence Sexual Exploitation and Response Plan, Air quality Monitoring Plan, Water quality Monitoring Plan, Noise and Excessive Vibration Monitoring Plan, Biodiversity Monitoring Plan

9.3. ENVIRONMENTAL MONITORING

9.3.1 General

Environmental monitoring is a systematic process that assesses the environment's state, analyses changes over time, and evaluates the effectiveness of environmental management measures. It involves various parameters such as habitat characteristics, biodiversity, soil, water, and air quality. Monitoring techniques range from laboratory analysis to on-site evaluations using remote sensing technologies. Data management and analysis use statistical analysis, geographic mapping, and trend analysis to identify patterns and cause-and-effect relationships. Regulatory authorities receive monitoring data for review and analysis, which is crucial for regulatory compliance. We develop early warning systems for environmental hazards and natural disasters to mitigate risks to ecosystems, infrastructure, and public health. Environmental monitoring programs improve transparency and accountability in environmental management, promote public education, and ensure proper implementation of mitigation measures. Port development projects must prioritize environmental monitoring, including baseline assessments, construction-phase monitoring, habitat and biodiversity evaluation, sediment and water quality monitoring, noise and vibration monitoring, air quality monitoring, waste management, pollution prevention, community involvement, and stakeholder interaction.

9.3.2 Tolerance/ Allowable Limits

(1) Water Quality

Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC, 2000)

(2) Sediment Quality

Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC, 2000)

TABLE 85 - SEDIMENT TRIGGER LIMITS

Determinant	ISQG low
Lead as Pb (mg/kg)	50
Cadmium as Cd (mg/kg)	1.5
Zinc as Zn (mg/kg)	200
Copper as Cu (mg/kg)	65
Nickel as Ni (mg/kg)	21
Mercury as Hg (mg/kg)	0.15
Total Chromium as Cr (mg/kg)	80
Arsenic as As (mg/kg)	20

PAH	
Naphthalene	160
Acenaphthylene	44
Acenaphthene	16
Fluorene	19
Phenanthrene	240
Anthracene	85
Fluoranthene	600
Pyrene	665
Benzo(a)anthracene	261
Chrysene	384
Benzo(a)pyrene	430

(3) Noise

The Kenyan Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations, 2009 and World Health Organization Guidelines for Community Noise

TABLE 86 - EMCA LEGAL NOTICE 61. FIRST SCHEDULE EXTRACT

ZONE		Sound Level Limits dB (A)L eq, 14 h		Noise Rating Level (NR)L eq, 14 h	
		DAY	**NIGHT**	**DAY**	**NIGHT**
A	Silent Zone	40	35	30	**25**
B	Place of worship	40	35	30	**25**
C	Residential: Indoor Outdoor	45 50	35 35	35 40	**25** **25**
D	Mixed Residential (with some commercial and places of entertainment)	55	35	50	**25**
E	**Commercial**	**60**	**35**	**55**	**25**

TABLE 87 - WHO GUIDELINE VALUE FOR COMMUNITY NOISE

Specific Environments	Critical Health effect(s)	LAeq (dBA)	Time base	LAmax (dB)
Industrial, commercia shopping and traffic areas, indoors and outdoors	Hearing impairment	70	24	110

(4) Vibration

The allowable limit is **50mm** per second EMC (Noise and Excessive Vibrations), Regulations, 2009.

(5) Air Quality

Standard - The Kenyan Environmental Management and Coordination (Air Quality) Regulations, 2014

TABLE 88 – AIR QUALITY REGULATIONS OF KENYA

	Pollutant	Time weighted Average			
	-	Duration	IndustrialArea	Residential, Rural& Other area	Controlled areas***
1	Sulphur Oxides (SOx)	24 hours**	125 µg/m^3	80 µg/m^3	**30 µg/m^3**
2	Oxides of Nitrogen (NOx)	24 hours	150 µg/m^3	80 µg/m^3	**30 µg/m^3**
3	Nitrogen Dioxide	24 hours	100 µg/m^3	0.1 ppm	-
4	Respirable particulate matter (<10 µg/m^3) (RPM)	24 hours**	150µg/Nm^3	100µg/Nm^3	**75µg/Nm^3**
5	PM2.5	24 hours	75 µg/m^3	-	-
6	Carbon monoxide / carbon dioxide	8 Hours	5 mg/m^3	2.0 mg/m^3	**1.0 mg/m^3**
7	Hydrogen Sulphide	24 hours**	150 µg/m^3	-	-
8	Non-methane hydrocarbons	Instant peak	700 ppb	-	-
9	Total VOC	24 hours**	600 µg/m3	-	-
7	Ozone	8 hours	120 µg/m^3	1.25 ppm	-

9.3.3 ESMP

Table 89 shows the ESMP for the proposed project.

TABLE 89 - ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN FOR THE CONSTRUCTION, OPERATION AND DECOMMISSIONING PHASES

<table>
<tr><th>Activity</th><th>Potential negative impacts</th><th>Proposed mitigation measure</th><th>Responsible person</th><th>Monitoring</th><th>Time</th><th>Budget (in million KSH)</th></tr>
<tr><td colspan="7">CONSTRUCTION STAGE</td></tr>
<tr><td rowspan="3">Berth 23 and Access Road Construction</td><td rowspan="2">Water Quality</td><td rowspan="2">• Loop Discharge of Overflow
• Reduced Operations
• Seasonal Considerations
• Silt Curtains
• Appropriate Stormwater and Sewage</td><td rowspan="2">• KPA Project Manager
• Contractor Implementing the project
• Consultant supervising project implementation
• Project Environmental Officer</td><td>• p.H,
• COD
• DO
• Perspective Degree
• TSS (mg/l)
• Relationship between Turbidity and TSS
• Total Nitrogen
• Total Phosphorus
• BOD
• E. Coli
• Total Coliforms</td><td>Baseline – 30 days

Monthly during Marine Works</td><td>6</td></tr>
<tr><td>• Turbidity (NTU)</td><td>Baseline – 30 Days
Twice a Day during Marine Works</td><td>20</td></tr>
<tr><td>Sediment Quality</td><td>• Containment
• Treatment
• Sediment discharge monitoring</td><td>• KPA Project Manager
• Contractor Implementing the project</td><td>• Heavy Metals (As, Pb, Cd, Zn, Cu. Cr. Hg and Ni.</td><td>Once before excavation</td><td>2.5</td></tr>
</table>

		• Dredged material quantity monitoring	• Consultant supervising project implementation • Project Environmental Officer	• Polycyclic Aromatic Hydrocarbons • Polychlorinated Biphenyls		
	Destruction of Mangroves	• Habitat restoration by replanting 3000 mangrove seedlings along the coastline conservation location • Community Conservation Capacity Building	• KPA Project Manager • Contractor Implementing the project • Consultant supervising project implementation • Project Environmental Officer	• Checking Survival rate (%) • Average Growth in Height • Average diameter at breast • No of leaves, internodes & branches	Monthly during construction	8
	Underwater piling noise	• Deployment and use of Bubble Curtains, Big Bubble Curtain, Little Bubble Curtain, Isolation Casings, Cofferdams and Hydro Sound Dampers (HSD) • Acoustic Improvement of the Piling Process • Vibratory Pile Driving • Drilled Foundations	• KPA Project Manager • Contractor Implementing the project • Consultant supervising project implementation • Project Environmental Officer	• Measurement of underwater acoustic noise levels	Weekly during piling and sand harvesting activities.	8

	Air Quality	• Water Suppression • Dust Screens • Cover/ Contain • Regular maintenance of vehicles • Inspection certificates to construction vehicles • Observing speed limits • Training to KPA and Contractors Environment and Social Safeguards Personnel • Asphalt plant to acquire emission license from NEMA	• KPA Project Manager • Contractor Implementing the project • Consultant supervising project implementation • Project Environmental Officer	• CO, • NO2, • NOx, • SO2, • H2S, • PM10, • Directional Dust • Temp & Humidity	Once for Baseline Monthly during Construction	10
	Noise	• Noise Barriers • Construction Planning • Regular maintenance/ /inspection to all equipment • Install safety warning signs	• KPA Project Manager • Contractor Implementing the project • Consultant supervising project implementation • Project Environmental Officer	• Leq (dBA) • L5 (dBA) • L50 (dBA) • L95 (dBA)	Once for Baseline Monthly during Construction	4
	Vibration	Construction Planning	• KPA Project Manager	• Velocity (mm/s) • Acceleration (m/s2)	Once for Baseline	3

			• Contractor Implementing the project • Consultant supervising project implementation • Project Environmental Officer	• Displacement (mm)	Monthly during Construction	
	Waste	• Put in place an elaborate waste management plan • Provide waste receptacles for dropping waste • Designate a temporally area for holding waste • Waste segregated on site before disposal. • Provide PPEs. • Waste to be disposed at Mwakirunge disposal site only. • Tracking documents and keeping records of waste movement and disposal to be enforced	• KPA Project Manager • Contractor Implementing the project • Consultant supervising project implementation Project Environmental Officer	• Waste Disposal Logbook • Valid Licensing • Annual Audit	Monthly during Construction	2
	Effluent	Include Monitoring Plan for: • Wastewater discharge from temporary construction facilities. • Uncontrolled discharge of concrete wash water	• KPA Project Manager • Contractor Implementing the project	• BOD • COD • TSS • PH	Monthly during Construction	2

			• Consultant supervising project implementation • Project Environmental Officer			
Sand Harvesting & Offshore Dumping	Seabed Biodiversity Loss from sedimentation and extraction	• Baseline Monitoring • Sensitivity Mapping • Establish guidelines for sustainable sand extraction techniques (e.g., seasonal harvesting, depth limits, site rotation, technology used) • Partnerships with research institutions and academic organizations	• KPA Project Manager • Contractor Implementing the project • Consultant supervising project implementation • Project Environmental Officer • Strategic Collaborator – KEMFRI		Once for Baseline Quarterly During Construction	4
	Destruction and Stress of Corals from TSS	Coral Reef Monitoring plan - **Table 90**		Coral Reef Monitoring plan - **Table 90**		3
	Sea Turtles Migration and Nesting Sites disruption	• Nesting Sites Status	• KPA Project Manager • Contractor Implementing the project	No. of Nesting Sites Nesting Locations	Once for Baseline	3

			• Consultant supervising project implementation • Project Environmental Officer • Strategic Collaborator – KEMFRI/ BMU, NGO's, CBO		Bi-annually During Construction	
Social	Physical Displacement	Relocation Land acquisition	• KPA Project Manager • Consultant supervising project implementation • Project Environmental Officer • NLC	Prepare and Implement Resettlement Action Plan	Once Before Construction	400
	Loss of Livelihood	Compensation Livelihood Restoration Job Opportunities	• KPA Project Manager • Consultant supervising project implementation • Project Environmental Officer	Prepare and Implement Livelihood Restoration Plan	Once Before Construction	tbt

	HIV-AIDS and ADSA Risk	Peer Education Testing Counselling	• KPA Project Manager • Contractor Implementing the project • Consultant supervising project implementation • Project Environmental Officer • Strategic Collaborator – Local NGO/CBO	• No. of Persons reached Peer Education • No. of Persons tested • No. of Referrals • No. of Persons Counselled	Monthly During Construction	50
Health and Safety	Injuries and Accidents	• WIBA & Insurance for workers • Training • Maintenance of Equipment • Provision of PPE • Dedicated H&S Department (Min. 3 pax) • Prepare Occupational Health and Safety Plan in accordance to OSHA 2007. • Provide a well-trained rescue and first aid team as well as a standby boat to act as an ambulance in the	• KPA Project Manager • Contractor Implementing the project • Consultant supervising project implementation • Project Environmental Officer	• No. of Near Misses • No. Injuries • No. of fatalities • Training Records • Equipment Records • Number of workers trained in Occupational Safety and Health	Weekly During Construction	4

		event of accidents in the sea. • Create awareness among the channel users on the presence of the dredger and its activities as well as the required safety precautions • Inform in advance marine users the construction plan. • Installation of buoys along construction boundary.				
	Traffic	• Traffic Management	• KPA Project Manager • Contractor Implementing the project • Consultant supervising project implementation • Project Environmental Officer	No. of Accidents No. of Trucks	Quarterly Reports	2
	Disturbance of Cultural Sites	• Stakeholder Engagement • Relocation of Sites	• KPA Project Manager • Contractor Implementing the project	Grievances Survey	Once Post Relocation	3

			• Consultant supervising project implementation • Project Environmental Officer			
	Overlap and or interference with other port operations	• Establish a liaison committee for the project to address overlaps and or interference with other port operations and projects.	• KPA Project Manager • Contractor Implementing the project • Consultant supervising project implementation • Project Environmental Officer	Minutes of meetings and reports of liaison committees.	Quarterly or on need basis.	3
LAND USE AND LOCAL RESOURCE						
	Land Use Changes, increased Urbanization	• EIA Studies on impacts and mitigation	• KPA Project Manager • Contractor Implementing the project • Consultant supervising implementation • Project Environmental Officer	ESIA License	Monitoring reports on license conditions Annual audits	2

	Ecosystem Disruption	• Sustainable design • Regulation and monitoring	• KPA Project Manager • Contractor Implementing the project • Consultant supervising project implementation • Project Environmental Officer	Monitoring plans and reports Noise Reports • Leq (dBA) • L5 (dBA) • L50 (dBA) L95 (dBA) Air quality assessment • CO, • NO2, • NOx, • SO2, • H2S, • PM10, • Directional Dust Temp & Humidity	Monitoring reports	2
	Water Resources depletion	• ESIA • Regulation and monitoring • Compensation and community development interventions	• KPA Project Manager • Contractor Implementing the project • Consultant supervising project implementation • Project Environmental Officer	Monitoring plans and reports Socioeconomic survey	Monitoring reports	2
	Community Displacement	• Resettlement Action Plan	• KPA Project Manager	RAP in place	RAP implemented	See RAP

			• Contractor Implementing the project			
	Limited Access to Resources	• Compensation • Community Engagement	• KPA Project Manager	Socioeconomic study with recommendations RAP	Successful resettlement	See RAP
	Disparities in Social Equity	• Create or protect opportunities for disadvantaged categories	• KPA Project Manager	Socioeconomic study with recommendations RAP	Successful resettlement	See RAP
	Adverse Cultural Impacts	• Community engagement and involvement in protection of cultural sites.	• KPA Project Manager	Restore and or preserve cultural and heritage sites	Monitoring report	2
OPERATION STAGE						
Cargo Operations	Water	• Capacity Building/ training of KPA staff • Installation and Maintenance of Biodigester • Clearing and cleaning of Storm Drains • Waste management	Port Environmental Officer	4^{th} & 5^{th} Schedule of the Water Quality Regulations (Legal Notice No 120)	Annual	10
	Injuries and Accidents	• WIBA & Insurance for workers • Training • Maintenance of Equipment • Provision of PPE	Port Environmental Officer	• No. of Near Misses • No. Injuries • No. of fatalities • Training Records • Equipment Records	Annual	4

	Air Quality	• Promotion of Cleaner Fuels • Reducing congestion • Regular Cleaning/ Sweeping • Maintenance of Equipment	Port Environmental Officer	• CO, • NO2, • NOx, • SO2, • H2S, • PM10, • Directional Dust • Temp & Humidity	Annual	5
	Noise	• Maintenance of Equipment	Port Environmental Officer	• Leq (dBA) • L5 (dBA) • L50 (dBA) • L95 (dBA)	Annual	2
	GHG Emissions/ Climate Change	• Shore Power Facility • Energy-saving Enhancements • Clean Energy Initiatives	Port Environmental Officer	Carbon footprint metrics		0.5
Social	HIV-AIDS and ADSA Risk	• Peer Education • Testing • Counselling • Outreach	• KPA Chief Medical Officer	Baseline Monitoring reports	Annual	3
DECOMMISSIONING PLAN						
ENVIRONMENTAL	Soil and Water Contamination	• Pollution Control Measures • Long-term Monitoring • Use of silt curtains	• KPA Project Manager	Monitoring report 4th & 5th Schedule of the Water Quality Regulations (Legal Notice No 120)	Quarterly	5
	Sediment Increase	• Long-term Monitoring • Sustainable demolition methods • Use of silt curtains	• KPA Project Manager • Contract manager	Monitoring report	Quarterly	2

	Runoff and erosion, Waste and Debris	• Sustainable waste management	• KPA Project Manager	Monitoring report	Quarterly	1
	Dust and Emissions	• Sustainable demolition methods	• KPA Project Manager	Monitoring report • CO, • NO2, • NOx, • SO2, • H2S, • PM10,	Quarterly	1
	Noise Pollution	• Servicing of equipment, proper timing and noise protection	• KPA Project Manager	Monitoring report • Leq (dBA) • L5 (dBA) • L50 (dBA) • L95 (dBA)	Quarterly	1
	Destruction of habitats	• Habitat Restoration Plans	• KPA Project Manager	Monitoring report	Once	3
SOCIAL	Disruption in economic activities	• Redevelopment Potential • Stakeholder engagement	• KPA Project Manager	ESIA and stakeholder engagement reports	Once	4

9.3.1. Proposed Monitoring Program for Corals

Below is a table outlining a monitoring plan for the coral reefs surveys in this study. The plan includes key parameters to monitor, frequency of monitoring, responsible parties, and potential monitoring methods:

TABLE 90 - MONITORING PLAN FOR THE CORAL REEFS SURVEYS

Monitoring Parameter	Frequency	Responsible Institution	Monitoring Methods
Coral Cover	Biweekly for the 1st 6 months and then Quarterly thereafter	• KPA Project Manager • Contractor Implementing the project • Consultant supervising project implementation • Project Environmental Officer • KMFRI • KWS	Line transect surveys
			Photo quadrat surveys
Fish Assemblages	Bi-annually		Underwater visual surveys
			Fish trap surveys
Coral Health	Biweekly for the 1st 6 months and then Quarterly thereafter		Coral health assessments (e.g., visual surveys, Coral Watch)
Sedimentation Rates	Biweekly for the 1st 6 months and then Quarterly thereafter		Sediment traps
			Water column turbidity measurements
Water Quality Parameters	Biweekly for the 1st 6 months and then Quarterly thereafter		Conductivity, pH, dissolved oxygen, nutrient levels (e.g., using handheld meters)
			Water sampling for laboratory analysis
Marine Debris	Monthly		Beach surveys
			Underwater clean-up dives
Benthic Community Structure	Bi-annually		Quadrat surveys
			Benthic photo surveys
Coral Recruitment	Bi-annually		Settlement tiles
			Video monitoring

9.4. REPORTING

The following reports will be prepared:

a. Monthly construction safety monitoring reports.

b. Monthly progress reports by the contractor on the implementation status of every obligation of the contractor on safeguards implementation specified in the ESMP. These monthly reports will be submitted by the contractor to the Proponent.

c. Periodic monitoring reports to be prepared by the proponent and submitted to NEMA. Specifically, bi-annual under water acoustic noise monitoring report, monthly marine water quality monitoring reports, quarterly ambient air quality monitoring report, quarterly air, noise and vibration monitoring report, quarterly effluent monitoring reports for effluent and or sewage generated and disposed into the environment.

d. Initial Environmental and Social Audit report to be prepared by the proponent and submitted to NEMA in the first year of operation of the project to confirm the efficacy and adequacy of the ESMP.

e. Self-environmental and social audit report to be prepared annually by the proponent and submitted to NEMA to report on the progress of implementation of the ESMP. The first self-environmental and social audit reports will be prepared one year after submission of the initial environmental and social audit report.

f. Reports responding to NEMA improvement orders to be prepared by the proponent and submitted to NEMA as and when such improvement orders are issued.

g. Monitoring and control measures to prevent over-extraction and habitat degradation

h. Establishment of monitoring protocols to assess the health and condition of coral reefs

i. Regular monitoring of key indicators (e.g., coral cover, colony health, sedimentation rates)

9.5. ENVIRONMENTAL AUDITING

The objectives of an environmental audit for the project, will typically include the following:

1. **Compliance Assessment**: To determine whether the project activities, operations, and facilities comply with applicable environmental laws, regulations, permits, and standards set by NEMA.
2. **Identification of Environmental Risks and Impacts**: To identify and assess potential environmental risks and impacts associated with the project throughout its lifecycle, including construction, operation, and decommissioning phases.
3. **Evaluation of Environmental Management Practices**: To evaluate the effectiveness of environmental management practices and systems implemented by KPA to prevent, mitigate, and manage environmental impacts.
4. **Verification of Environmental Performance**: To verify the actual environmental performance of the project against stated environmental objectives, targets, and commitments made during the planning and approval stages.
5. **Identification of Opportunities for Improvement**: To identify opportunities for improving environmental performance, enhancing resource efficiency, reducing waste generation, and implementing best practices in environmental management.
6. **Stakeholder Assurance and Transparency**: To provide assurance to stakeholders, including regulatory authorities, local communities, investors, and the public, regarding

the project's environmental performance and commitment to environmental responsibility.

7. **Support for Decision-making**: To provide objective, evidence-based information to support decision-making processes related to project management, environmental compliance, and strategic planning.
8. **Continuous Improvement**: To facilitate continuous improvement in environmental performance through feedback, corrective actions, and ongoing monitoring and evaluation.

Overall, the objectives of an environmental audit for the proposed project aim to ensure legal compliance, minimize environmental impacts, enhance sustainability, and maintain transparency and accountability throughout the project's lifecycle. This helps in achieving sustainable development goals while safeguarding environmental resources and community well-being.

10. GRIEVANCE REDRESS MECHANISM

10.1. ABOUT GRIEVANCE REDRESS MECHANISM (GRM)

Affected Persons (AP) by a development project may raise their grievances and dissatisfactions about actual or perceived impacts in order to find a satisfactory solution. These grievances, influenced by their physical, situational (e.g., employment), and/or social losses, can emerge at different stages of the project cycle. Some grievances may arise before construction, while others may come up during construction or operation. Not only should affected persons be able to raise their grievances and be given an adequate hearing, but also satisfactory solutions should be found that mutually benefit both the APs and the project. It is equally important that APs have access to legitimate, reliable, transparent, and efficient institutional mechanisms that are responsive to their complaints.

In the absence of a project-specific GRM, APs may seek solutions to their grievances through GRMs that exist outside the project such as the national judicial system, public administration, or the agencies that funds the project. Engagement of such external GRMs could lead to a number of adverse consequences for both the APs and the project implementers, for example:

- It would probably absorb a relatively longer time and substantial resources, which are generally unaffordable to many APs. People need relatively quick solutions or relief for their problems, particularly when projects are likely to cause property loss and displacement.
- Not all APs have equal access and the capacity to approach external GRMs. Thus, they would be deprived of their rights to be heard and to find a fair and just solution. This could further push the APs into a state of high vulnerability, insecurity, and impoverishment.
- Depriving APs access to GRMs could induce them to develop hostility toward the project and sometimes to engage in violent behavior that might hamper the smooth implementation of the project and its related activities, and delay its overall accomplishments.
- Delays in project implementation will increase government expenditures such as compensation to contractors for loss of work, and staff maintenance. Delay can also affect the reputation of the proponent.

In this document, “the project” means MPDP and/or “the Implementer” means “KPA”, “the Consultant”, “the Contractor” and “the sub-Contractor”. And “an aggrieved person or complainant” means an individual, group or organization who articulates a grievance to the Project.

10.2. OBJECTIVE OF GRM

This project sets the objective of GRM as follows in order to keep or restore good relationship with the communities.

- To ensure that grievances are addressed and resolved in a fair and transparent manner.
- To ensure careful documentation and reporting of grievance and corrective actions.

10.3. TYPES OF GRIEVANCES

Anyone will be able to submit a grievance to the Project if they believe a practice is having a negative impact on the community, the environment, or on their quality of life. They may also submit comments and suggestions.

Grievances could include:

- Negative impacts on a person or a community (e.g. financial loss, physical harm, nuisance)
- Dangers to health and safety or the environment
- Failure of KPA, its contractors and sub-contractors and their workers or drivers to comply with standards or legal obligations.

10.4. CONFIDENTIALITY

When requested, the Project will aim to protect a person's confidentiality, and the project will guarantee anonymity in public documents. Individuals will be asked permission to disclose their identity. Investigations will be undertaken in a manner that is respectful of the aggrieved party and the principle of confidentiality. The aggrieved party will need to recognize that there may be situations when disclosure of identity is required and the Project will identify these situations to see whether the aggrieved party wishes to continue with the investigation and resolution activities.

10.5. SCOPE OF APPLICATION

This Grievance Redress Mechanism applied to the project only. Since GRM is a requirement given by NEMA as part of EIA, KPA, the Consultant, the Contractor and the sub-Contractors are requested to follow this GMS.

This GRM applies to grievances raised formally by an aggrieved person or complainant who may feel resentment, bitterness or anger about a situation against the project related activities and the manner in which it is either being handled or ignored.

The statutory rights of the complainant to undertake legal proceedings remain unaffected by this procedure.

10.6. PROCEDURES

The steps in implementation of the GRM are shown below.

Step 1: Grievance Submission

Step 2: Recording, registering and acknowledgement

Step 3: Assessment of grievances

Step 4: Closure for irrelevant grievances

Step 5: Making decisions and implementing the resolution process

Step 6: Tracking, monitoring, documentation, and evaluation.

Should a complainant seek redress through legal means at any stage during the Grievance Procedure, KPA shall be informed immediately and will provide necessary guidance as required.

10.6.1. Step 1: Grievance Submission

Grievances may be submitted in the following ways.

- In writing by mail addressed to KPA, the Consultant, the Contractor or the sub-Contractor
- In writing via email addressed to KPA, the Consultant, the Contractor or the sub-Contractor
- Verbally via telephone (or SMS text message) to KPA, the Consultant, the Contractor or the sub-Contractor
- Verbally in person to KPA, the Consultant, the Contractor or the sub-Contractor

Since MPDP is a public project, some explanations about MPDP including this GRM should be made at this stage to ask for understanding at this stage.

10.6.2. Step 2: Recording, Registering, and Acknowledgement

The procedures that will be followed to register grievances are listed below:

- The Contractor and the sub-Contractors shall inform the Consultant and KPA once a potential grievance is identified regardless of the form of submission.
- Grievances will be recorded by KPA and/or the Consultant
- A registration form will be filled out within 24 hours of submission for all grievances including those that are verbally submitted. This form must be signed by the complainant.
- All the grievances will be reported to KPA after the registration form was completed.
- KPA and/or the Consultant will log the information on the grievance forms into the database register with a file number to enable tracking of the resolution progress.
- KPA and/or the Consultant will maintain records and related documentation for grievances in the database, as well as hard copies of official responses.
- KPA will send the letter of acknowledgement to the complainant within a week after the registration.

Again, at this stage, KPA and/or the Consultant should explain about MPDP and GRM to the complainant.

10.6.3. Step 3: Assessment of Grievance

1) Simple Grievance

For simple grievances, KPA and/or the Consultant will assess and resolve the grievance immediately. In other cases, KPA and/or the Consultant will carry out the assessment, which may involve baseline study, legal framework and impact analysis to identify what the grievance is all about. Before the commencement of the assessment, the complainant will be explained about the methodology of the assessment to be undertaken. KPA will keep record of the comments from the complainant on the methodology and take them into consideration in the assessment. An assessment report will be prepared and explained to the complainant in a transparent way. In case the complainant is a group, all the members should be given the opportunity to participate in the process.

In the assessment report, recommendation should be made to keep or restore good relationship with the communities. Grievances should be solved in an amicable way through proper communication with the complainant. Firstly, mitigation measures that avoid or reduce the impact to an acceptable level should be sought for the resolution if any impacts by MPDP are identified. Such mitigation measures might include the following.

- Watering for dust-suppression
- Changing working hours to avoid environmental and/or social conflicts
- Changing transportation route of construction materials
- Replanting Mangrove for the loss

2) Compensation for Economic Loss

It is generally difficult to find alternative measures for economic loss other than compensation. This sort of loss can be temporary or permanent. The loss the complainant suffered and/or will be suffered will be estimated taking into account the socio-economic conditions of the complainant that affect the capacity to approach external GRMs as mentioned “2.1 About GRM”. The loss shall be estimated based on proof data and information. The recommendation section of the report should propose compensatory measures to cover the loss. The compensatory measures may be provision of asset, employment opportunity, business opportunity and cash. However, cash compensation shall be the last resort so as not to induce problems among the complainants, their dependents, and others. The compensation should be rather proposed in a way to assist the complainant in restoring or improving the living condition of them in a sustainable way by making the best use of the opportunity. The compensation plan should be prepared in line with the international practice such as World Bank Operational Policy or IFC Performance Standards.

In case, impact by MPDP is not identified, then the process will be closed with a written agreement with the complainant. In case, the complainant will not agree, the process will go on to Step 5.

10.6.4. Step 4: Closure for Irrelevant Grievance

If the initial assessment found that the grievance is irrelevant to MPDP, then the process will be closed with a written agreement with the complainant. In case, the complainant will not agree, the process will go on to Step 5.

10.6.5. Step 5: Making Decisions and Implementing the Resolution Process

Where an agreement between the complainant and KPA is easily made on how the grievance will be resolved, a minute of the agreement will be drafted and signed by each of the parties. The minute will also indicate timeline for resolution based on the type and procedure for resolving the grievance, and this process will not exceed two weeks. After due implementation of the measures set out in the agreement, a new minute will be signed stating that the issue has been resolved.

Where an agreement cannot be easily reached, the grievance will be addressed on a case-by-case basis.

In the event that no amicable agreement can be reached through the above mechanisms, the complainant can resort to the court, public administration or others.

If the complainant appealed to public administration, and KPA is informed about the grievance from the public administration officially, then KPA will cooperate with it.

10.6.6. Step 6: Monitoring, Documentation, and Evaluation.

Whether agreements are reached through direct negotiation or mediation, all supporting documents used to achieve resolution will be maintained as part of the grievance/complaint file.

A grievance shall be considered resolved when all actions have been taken to close out the grievance and procedures are implemented that reduce the likelihood of this event reoccurring.

11. CONCLUSION AND RECOMMENDATION

11.1. CONCLUSIONS

Based on field observations, document reviewed, responses and feedback from stakeholder consultation and public participation and data collected and analyzed the following are the main conclusions drawn from ESIA study.

a. The project, Kenya Ports Authority is a state-owned corporation with the mandate to operate all scheduled seaports and inland waterways along the Kenyan coastline.

b. The Port of Mombasa is great source of revenue, business and trade opportunities, jobs for the surrounding communities and the Kenyan nation as a whole.

c. The Construction of Berth 23 and associated infrastructure is vital to the performance of the port of Mombasa as a competitive regional port of call. The Port of Mombasa has undergone numerous development project over the last 10-15 years in order to remain competitive which has put great pressure on the environmental and social fabric around the port environs and areas of resource.

d. KPA has demonstrated, through a feasibility study that the project is justified and economically viable for both the Government of Kenya and KPA.

e. **Major Environmental Impacts:**

- The port project will have significant environmental impacts, particularly on marine biodiversity due to dredging activities and potential habitat disturbance. The proposed sand harvesting activity, if not properly planned and mitigated can cause extensive damage to a fragile marine ecosystem anchored by an expansive coral fringes.
- The access road will necessitate the loss of Mangrove Habitat of approx. 30,000 trees. Mangroves are important in protecting the coastline and providing home for marine life.
- Air quality may be affected in the vicinity of the port area, especially during construction and operational phases. The location of the proposed site in relation to nearby communities creates a natural buffer. However, the village of Ngare will be in close proximity to the access road construction works.
- Water quality in the Indian Ocean could be temporarily impacted by sedimentation and pollutants during dredging and shipping activities.

f. **Social Impacts:**

- 69 PAP's are expected to physically displaced to allow for construction of the Access Road. KPA has prepared a Resettlement Action Plan to guide the process of resettlement and land acquisition.
- Local communities, particularly those reliant on fishing and tourism, may experience socio-economic disruptions due to changes in marine ecosystems and increased industrial activities.
- Increased traffic and noise pollution could affect nearby residential areas and cultural sites.

g. **Mitigation Measures:**

- Proposed mitigation measures include using advanced dredging technologies such as the proposed “looping” mitigation measure to minimize sediment release, implementing pollution control measures for air and water quality, and establishing buffer zones and multi-agency monitoring to protect sensitive habitats.
- Noise reduction strategies and traffic management plans should be implemented to minimize disruptions to local communities.
- KPA will prepare a Livelihood Restoration Plan prior and closer to construction to mitigate losses and disruptions to these communities.
- KPA will implement the already prepared Resettlement Action Plan to compensate Project Affected People.
- Employment and training opportunities should be provided to local communities to mitigate socio-economic impacts.

11.2. RECOMMENDATIONS

The following recommendations are made to ensure environmental and social sustainability of the proposed project.

a. KPA will develop and implement the comprehensive Environmental Management Plan (ESMP) in Chapter 9 that includes monitoring programs for water quality, air emissions, noise levels, and marine biodiversity.

b. KPA will appoint reputable Contractors and Consultants that have vast experience in marine engineering and environmental and social safeguards.

c. An EMMP, prepared by the Contractor shall be submitted to relevant stakeholder prior to commencement of Construction works.

d. The detailed project drawings of the proposed project to be submitted to relevant authorizes for the necessary approval before commencement of project implementation.

e. KPA and the contractor to pay special attention to concerns raised from stakeholder consultations as outlined in the ESIA. Deliberate efforts to be made to address recommendations from the stakeholders consulted.

f. The Grievance Redress Mechanism if to be implemented during construction.

g. Deliberate and conscious decision to be made by the contractor under the direction of the project proponent to source required construction labor locally from the project area.

h. To minimize on gender parity both male and female gender to equitably benefit from the proposed project in terms of considerations for jobs including sub-contracting to supply construction materials.

11.3. COMPLIANCE AND MONITORING

a. Ensure compliance with all relevant environmental regulations and standards set forth by the National Environmental Management Authority.

b. Conduct regular environmental audits and monitoring to verify compliance with mitigation measures and identify any emerging environmental concerns during operations.

11.4. LONG-TERM SUSTAINABILITY

a. Incorporate principles of sustainability into port operations and infrastructure design, aiming to minimize carbon footprint and enhance resilience to climate change impacts.

b. Explore opportunities for ecosystem restoration, conservation and enhancement initiatives in collaboration with local conservation organizations and research institutions.

11.5. CAPACITY BUILDING

a. Invest in capacity building programs for local communities and stakeholders to enhance their ability to participate in and benefit from port-related developments.

b. Foster partnerships with educational institutions to promote research and innovation in sustainable port management practices.

By implementing these recommendations, the port project in Mombasa can mitigate adverse environmental and social impacts, enhance stakeholder engagement, and promote long-term sustainability, thereby contributing positively to the local economy while safeguarding the region's natural resources and cultural heritage.

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