ENVIRONMENTAL IMPACT ASSESSMENT STUDY REPORT
FOR
THE PROPOSED CONSTRUCTION OF 310 METERS BOUNDARY RETAINING BEACH WALL (0.3m Height)ON PLOT/PARCEL NO: KWALE/DIANI/ 1816,1817& 1818, IN DIANI BEACH, MSAMBWENI SUB COUNTY, KWALE COUNTY

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This Environmental Impact Assessment (EIA) Comprehensive Project Report has been prepared in compliance with the Environmental Management and Coordination Act (EMCA), Cap 387 and Subsidiary Regulation (Environmental Impact Assessments and Environmental Audits) Regulations, 2003

GPS Coordinates: -4.3043259S and 39.5827598E

November 2025

Document Certification

This Environmental Impact Assessment (EIA) Comprehensive Project Report is hereby submitted to the National Environment Management Authority (NEMA) in strict compliance with the Environmental Management and Coordination Act (EMCA), Cap 387, and the Environmental (Impact Assessment and Audit) Regulations, 2003. The report presents a comprehensive and independent evaluation of the potential environmental and social impacts associated with the construction of a retaining beach wall located in Diani Beach, Kwale, Kenya.

To the best of the consultant's knowledge and belief, the information contained herein is a true, complete, and accurate representation of the findings and analyses conducted regarding the proposed development. The assessment has been undertaken using scientifically accepted methodologies and is based on documentation, data, and information provided by the project proponent, as well as findings from site inspections, stakeholder consultations and reports, and expert evaluations carried out during the study period.

We, the undersigned, hereby confirm that this Environmental and Social Impact Assessment (ESIA) Report faithfully presents the findings, assessments, and recommendations arising from the EIA study undertaken for the construction of the retaining beach wall.

Project Proponent Contact Details

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Non-Technical Summary

Overview

Kenya lies on the eastern coast of Africa, along the Indian Ocean, with a coastline of about 574 km. The coastal area experiences two main monsoon seasons, which influence the tides, waves, and overall coastal environment. Diani Beach, in Kwale County, is one of the areas affected by coastal erosion and flooding from waves and tides. The proposed project involves building a retaining beach wall near Kivulini Beach Villa to protect the shoreline, properties, and infrastructure from erosion and tidal impacts. These walls act as barriers between the land and the sea, helping to stabilize the shore, retain soil, and reduce damage from waves and storms.

Coastal areas like Diani Beach face challenging conditions due to strong waves, tides, and the effects of saltwater, which makes durable and well-maintained structures essential. The beach wall will help protect valuable land and buildings, stabilize the shoreline, and support sustainable development, including tourism and recreational activities. It will also improve the area's resilience to climate change impacts such as rising sea levels and stronger storms.

Project Location

The proposed site for the construction of retaining beach wall is located in Diani Beach, along the shoreline adjacent to Silver Sand Hotel off Diani Beach Road. The site is situated immediately behind Trade Winds Lodge, bordered to the north by Kivulini Beach Villa and Cottages and to the south by Diani Sea Resort. The geographical reference for the site is represented by the GPS coordinates**: Latitude -4.304326S, Longitude 39.582760E**.

Proposed Project Design

The project will involve shoreline protection through the construction of a retaining beach wall along the shoreline of Silver Sand Hotel at Diani Beach, Kwale County. The key components of the project include, but are not limited to:

a) Gabion Bands.
b) Revetments and Shoreline Structures, and
c) Ancillary facilities.

Revetment

The proposed retaining beach wall at Silver Sand Hotel, Diani Beach, is designed as a robust shoreline protection structure, constructed using locally sourced, environmentally friendly rock boulders. The design will ensure both structural stability and resistance to wave action while minimizing environmental impacts. The key technical features of the structure will include but are not limited:

- Height and Alignment: The wall will rise approximately 0.4 meters above Mean Sea Level (MSL), providing adequate protection against high tides and moderate wave overtopping,
- Sloped Concrete Slab with Risers and Threads: A sloped concrete surface, reinforced with risers and threads, will form the primary barrier against incident waves, helping to dissipate wave energy safely,
- Precast Blocks: Strategically positioned precast blocks will enhance resistance to direct seawater impact and prevent scouring at the face of the wall,
- Foundation Walling: The structure will include a 200 mm thick foundation wall, constructed on a well-dressed earth base, ensuring uniform load distribution and stability of the retaining feature,
- Footing Concrete Strip: A continuous concrete strip footing will provide additional stability, anchoring the wall and preventing undercutting or sliding due to wave action, and
- Stone Arrangement: Large, interlocked stones will be carefully placed and bonded with cement and sand to form the core structure. Medium-sized rubble stones will be compacted and arranged to fill gaps, increasing mass, stability, and resistance to erosion.

The combination of these elements sloped concrete surfaces, precast blocks, bonded boulders, and reinforced foundations ensures that the retaining beach wall will provide long-term shoreline stabilization, protect landward areas, and minimize erosional impacts while remaining environmentally sustainable. The total length of the retaining wall is approximately 350m.

Proposed Activities

The construction of the retaining beach wall at Silver Sand Hotel, Diani Beach, will involve a series of carefully planned activities designed to ensure structural stability, long-term durability, and minimal impact on the surrounding environment. The key construction activities are as summarized in the table below.

Table 1: Planned Activities

Construction Activity	Description / Method
Site Preparation and Clearing	Removal of vegetation, debris, and loose material within the construction footprint, while preserving surrounding vegetation where possible.
Excavation	Shallow excavation to create a level foundation, not exceeding 2meters in depth. Excavated material temporarily stockpiled for reuse.
Compaction	Mechanical compaction of the excavated base to achieve required soil density.
Foundation and Footing Construction	Construction of 200mm thick concrete foundation wall and continuous concrete strip footing on compacted base.
Gabion Band and Wall Assembly	Placement and interlocking of locally sourced rock boulders, bonded with cement and sand. Installation of precast blocks and sloped concrete slabs.
Backfilling and Compaction	Backfilling behind the wall using suitable material in layers, with each layer compacted.
Finishing Works	Final leveling, dressing, and integration with the surrounding shoreline. Incorporation of drainage features.

Summary of Impacts

Project Component / Impact	Mitigation Measure
Construction Phase	
Solid Waste Management	• All site personnel will undergo training on proper waste handling, segregation, storage, and disposal procedures, with emphasis on minimizing environmental harm and promoting general environmental stewardship. • Solid wastes will be segregated at the source into organic, recyclable, and hazardous categories to facilitate proper handling and disposal. • Hazardous wastes will be collected, stored in designated containment areas, and disposed of according to the Environmental Management and Co-ordination Act (EMCA), Cap 387, and the Waste Management Regulations, 2024. This ensures compliance with national standards for handling, transportation, and final disposal. • Inorganic construction debris, such as excess rock, gabion mesh offcuts, and sand, will be reused where possible or transported to authorized disposal sites, minimizing environmental contamination. • Regular site inspections will be conducted to ensure that waste management practices are adhered to, and corrective actions will be taken immediately if deviations occur
Liquid Waste / Effluent	• Install temporary sand or silt barriers to prevent mobilized sediments from entering the marine environment; • Locate construction compounds, material stockpiles, and spoil areas away from shallow shoreline zones to reduce direct sediment runoff; • Ensure that all construction debris and materials are contained and removed promptly to prevent entry into the marine environment; • Conduct regular monitoring and supervision of construction activities to ensure compliance with sediment control measures; • Schedule major excavation and placement works to coincide with low tide periods and avoid the high-energy Southeast Monsoon season wherever possible; • Adjust sediment control measures in response to observed turbidity or sediment transport patterns during construction
Noise and Vibration	• All equipment will be turned off when not in use to minimize unnecessary noise; • Temporary hoarding and barriers will be installed around active work areas to reduce noise propagation;

Project Component / Impact	Mitigation Measure
	• High-noise operations will be scheduled during daytime hours to minimize disturbance to resort guests and the public; • Regular servicing of construction equipment will ensure efficient operation and reduce noise levels; • Periodic noise monitoring will be conducted to ensure that levels remain within acceptable limits in accordance with national environmental standards (EMCA (Noise and Vibration) Regulation 2009
Air Quality / Dust	• Regular spraying of water on exposed soil surfaces prior to excavation shall be undertaken to minimize particulate emissions, • Periodic wetting of internal access roads to suppress dust nuisance and maintain safe air quality levels shall be undertaken, • Enforce a maximum speed limit of 30 km/h for all construction vehicles on site and display appropriate speed limit signage at strategic points, • Provide suitable Personal Protective Equipment (PPE) such as dust masks and strictly enforce compliance with PPE use, especially for workers engaged in excavation and soil handling, • Conduct routine visual inspections of dust emissions from excavation areas and haul roads, with immediate corrective actions implemented if excessive dust is observed, and • Ensure construction vehicles and machinery are well maintained and regularly serviced to minimize exhaust emissions and improve fuel efficiency.
Worker Health and Safety	• Ensure proper storage, segregation, and disposal of solid and liquid wastes in accordance with EMCA (Waste Management Regulations, 2024). Hazardous materials must be stored securely and handled by trained personnel. • Limit noisy operations to daytime hours, maintain machinery in good condition, and use temporary noise barriers where needed. • Apply water spraying on exposed soils, maintain haul roads, and cover transported materials to reduce dust generation. • Provide personal protective equipment (PPE) to all workers, enforce safe working procedures, and ensure proper training in handling machinery and construction materials. • Restrict public access to active construction zones using hoarding or signage and inform the nearby community of construction schedules and potential hazards. • Establish a site-specific health and safety plan including first aid, emergency response procedures, and reporting mechanisms for incidents.
Visual / Landscape Impacts	• Schedule works during periods of low visitor activity to minimize disruption to resort guests and beach users; • Use temporary visual barriers or hoarding around active construction zones to reduce visual intrusion; • Ensure that construction materials, debris, and equipment are neatly stored within the site boundary to prevent unsightly clutter; • Implement daily clean-up routines to maintain the visual quality of the construction site; • Select revetement materials and colors that blend with the natural beach and dune environment to reduce visual contrast; • Restore disturbed sand and beach areas to a natural profile, and where feasible, introduce coastal vegetation behind the retaining wall to enhance aesthetic integration; • Inform nearby stakeholders and resort operators of construction schedules and expected visual changes to reduce complaints and improve acceptance
Water Quality / Pollution	• Storage and handling of fuels and lubricants, ensuring containment to prevent accidental spills • Protection of adjacent watercourses and nearshore areas during construction; • Controlled use of concrete and other construction materials to prevent accidental discharge into coastal waters; • Wastewater management from construction activities to prevent contamination of the surrounding environment
Ecological Impact	• Schedule construction during periods of low marine animal activity, avoiding peak nesting or hatching times where feasible; • Ensure revetment and construction debris remain strictly within the project footprint to prevent any intrusion into the nearshore environment; • Limit noise, vibrations, and artificial lighting during construction to reduce potential stress on marine animals;

Project Component / Impact	Mitigation Measure
	• Train construction workers on the presence of marine species and enforce protocols to avoid unnecessary disturbance; • Conduct basic site inspections during construction to identify any inadvertent impacts on marine animals, with immediate corrective measures if required; • Restore any minor areas of disturbed sand to a natural profile post-construction to maintain existing habitat conditions
Operation Phase	
Shoreline Morphology & Sediment Transport	• Implement a robust environmental monitoring program to regularly track changes in shoreline morphology, sediment movement, and the adjacent marine and terrestrial environments. • Make adaptive adjustments to the coastal protection structures as necessary based on monitoring results. • Undertake additional beach nourishment, where practicable, to counteract localized erosion and maintain beach stability
Wave Energy & Structural Integrity	• Provide adequate design protection to the toe of the revetement using rubble mound, concrete units, or equivalent stabilizing methods. • Ensure placement of sufficient beach sediment along the entire length of the structure to maintain natural beach profiles and support sediment transport processes. • Conduct periodic inspections and maintenance of the wall and beach sediment levels to address any localized erosion or structural issues promptly
Sediment Transport Regime	• Ensure that adequate beach sediment is replenished along the entire length of the shoreline retaining wall to maintain natural sediment balance. • Implement periodic monitoring of sediment movement and beach profiles to detect and address any unintended erosion or deposition patterns early. • Where necessary, undertake targeted beach nourishment in areas showing significant sediment loss to maintain shoreline stability and beach usability
Marine Environment / Ecology	• Conduct quarterly surveys of marine species in the nearshore area, recording presence, abundance, and behavior. • Focus on indicator species sensitive to sedimentation or shoreline modification, such as sea turtles, crabs, and small benthic organisms. • Record any mortality, nesting disruption, or unusual behavior that may indicate environmental stress • Maintain beach and revetment structures to prevent erosion and runoff into the marine zone. • Conduct visual inspections and, where feasible, turbidity measurements at nearshore waters, especially after storms or maintenance events.

Conclusion

The Environmental Impact Assessment for the proposed construction of the shoreline retaining wall along the Silver Sands Hotel shoreline indicates that the project is largely compatible with the surrounding coastal environment and existing land use. The construction activities are expected to have minor to moderate environmental impacts, primarily localized within the immediate construction footprint. Key physical impacts include temporary alterations to sediment transport along the shoreline and minor disturbances to benthic communities, which are estimated to affect approximately 2% of the lagoon and reef-flat area. These impacts are expected to be short-term and manageable through proper construction practices, including sediment control and careful placement of revetment materials.

The marine environment, while not highly sensitive in the project area, could experience temporary disturbances; however, with mitigation measures in place, these effects are expected to be minimal and localized. Socially, the project may temporarily affect the operations of nearby resorts and beach users, but the overall development is recognized as necessary to protect the shoreline from erosion, thereby safeguarding infrastructure and supporting long-term socio-economic benefits. Overall, the proposed shoreline retaining wall offers significant benefits in terms of coastal protection, shoreline stabilization, and preservation of economic and social assets, while the environmental impacts remain limited, short-term, and manageable with appropriate mitigation and monitoring measures.

Recommendations

Based on the findings of this Environmental Impact Assessment, the proposed shoreline protection project is expected to provide significant benefits in safeguarding beachfront infrastructure and mitigating coastal erosion. To ensure the long-term effectiveness of the intervention and minimize environmental impacts, the following recommendations are proposed for implementation during the construction and operational phases.

- Monitoring programme focusing on sedimentation levels on the reef, water quality and clarity, lateral shoreline erosion, and beach profile changes. This programme should commence immediately upon approval of the EIA and continue throughout the operational phase to ensure the effectiveness of the shoreline protection measures,
- An active monitoring and evaluation system should be maintained to track the performance of the shoreline protection measures. Lessons learned from the monitoring programme should be integrated into broader coastal management initiatives along the shoreline,
- Longer-term strategies should be developed to enhance shoreline resilience, support climate change adaptation, and harmonize beach protection measures. This may include complementary interventions such as the construction of artificial reefs or other sustainable coastal protection structures.

The project is environmentally and socially feasible, provided that all recommended mitigation and monitoring measures are strictly implemented during the construction and operational phases. Long-term monitoring of coastal processes, sediment transport, and marine life should continue to ensure the effectiveness of the revetment and to inform any necessary adaptive management actions. In conclusion, the proposed shoreline retaining wall will significantly enhance shoreline protection, reduce erosion risks, and support sustainable coastal development while maintaining minimal environmental disruption

Abbreviations

AEZ	Agro- Ecological Zone
BMU	Beach Management Unit
CEMP	Construction Environmental Management Plan
CPP	Consultations and Public Participation
d(BA)	Decibels
EIA	Environmental Impact Assessment
EMCA	Environmental Management and Coordination Act
EMP	Environmental Management Plan
HIV/Aids	Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome
HWM	High Water Mark
IAP	Interested and Affected Persons
ICZM	Integrated Coastal Zone Management Policy
KPHC	Kenya Population & Housing Census
L. R. No.	Land Reference Number
MOU	Memoranda of Understanding
NEAP	National Environment Action Plan
NEMA	National Environmental Management Authority
OHS	Occupational Health and Safety
PAP	Project Affected Persons
PPE	Personal Protective Equipment
SDG	Sustainable Development Goals
SEA	Strategic Environmental Assessment
SHEQ	Safety Health Environment and Quality
TOR	Terms of Reference
WRA	Water Resources Authority

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CHAPTER 1: INTRODUCTION

1.1. Overview Introduction

Kenya is located on the eastern coast of Africa, straddling the equator between latitudes 5°40' north and 4°4' south, and longitudes 33°50' and 41°45' east, with the Indian Ocean forming its eastern boundary. The country has a coastline of approximately 574 km, extending from Kiunga in the north to Vanga in the south. The Kenyan coast is influenced by two distinct monsoon seasons: the northeast monsoon, occurring from December to March, and the southeast monsoon, from May to October, with transitional periods in between. These climatic patterns play a critical role in shaping the physical, chemical, and biological characteristics of the coastal and marine environment. The coastline experiences semi-diurnal tides, with spring tides reaching up to 4.0 meters and neap tides up to about 1.8 meters.

The proposed project involves the construction of a retaining boundary beach wall along the shoreline of Diani Beach (next to Kivulini Beach Villa), Kwale County, aimed at protecting coastal shoreline, infrastructure, and properties from the impacts of wave-induced erosion, tidal inundation, and other coastal hazards. Retaining beach walls are engineered structures that delineate the interface between land and sea, retain landward soil, stabilize slopes, and provide a barrier against the dynamic forces of waves and currents. The design, dimensions, and materials of the wall are guided by site-specific conditions, including wave energy, tidal fluctuations, coastal geomorphology, and soil characteristics. Depending on these factors, retaining walls may be vertical or sloping, rigid or flexible, and can be constructed using reinforced concrete, stone, rock-filled gabions, timber, steel, geotextile sandbags, or combinations thereof.

Coastal environments such as Diani Beach present particularly challenging conditions for construction. Structures in this area are subjected to repeated and often extreme loading from breaking waves, storm surges, tidal variations, and the corrosive effects of seawater and salt-laden winds. These forces are highly variable and may exceed typical design loads over the lifetime of the structure, making durability, robustness, and maintenance critical considerations in the design of the retaining beach wall.

The construction of the retaining beach wall is justified by the need to protect valuable properties and infrastructure along the shoreline, which are currently threatened by coastal erosion and landward encroachment of the sea. In addition to safeguarding private and public assets, the retaining wall will mitigate natural erosional processes, stabilize the shoreline, and help preserve the integrity of the beach and adjacent coastal ecosystems. By reducing the risk of land loss and slope failure, the structure will support sustainable coastal development, including residential, tourism, and recreational activities, while enhancing the resilience of the area to climate change impacts such as sea-level rise and increased frequency of extreme weather events.

1.2. Project Objectives

The primary objective of the proposed project is to protect the Silver Sand Shoreline, Diani Beach, Kwale, from ongoing erosion and wave-induced damage, thereby safeguarding coastal land, properties, and infrastructure. The construction of the retaining beach wall is intended to stabilize the shoreline, retain landward soil, and mitigate the adverse impacts of wave action and tidal fluctuations. Specific objectives of the project include:

- To prevent further loss of land and undercutting of the shoreline caused by wave scour and tidal action;
- To safeguard commercial and recreational assets located along the beachfront from damage due to coastal erosion and storm surges;
- To provide a long-term adaptation measure against sea-level rise, extreme weather events, and other climate change-related impacts affecting the coastline; and
- To ensure continued usability of the beachfront for tourism, recreation, and community activities while preserving the coastal environment.

1.3. Need and Scope of EIA

In accordance with the Environmental Management and Coordination Act (EMCA), Cap 387 particularly Sections 58 and 59 and the Environmental Impact Assessment (EIA) Regulation of 2003, it is mandatory for a project proponent to undertake, or cause to be undertaken at their own expense, an Environmental Impact Assessment study and prepare a corresponding report. A project proponent must not implement any project likely to have significant negative environmental impacts, or any project for which an EIA is required under the Act or its Regulations, unless an EIA has been concluded and formally approved by the National Environment Management Authority (NEMA).

Additionally, EMCA Cap 387 identifies specific activities under the Second Schedule that cannot be undertaken without an EIA. The proposed construction of a retaining beach wall is one such listed activity, thereby necessitating the preparation and approval of an EIA prior to commencement. In line with these statutory requirements, the proponent, herein referred to as **Silver Sand Hotel**, contracted **Lakers Consultancy Limited** to undertake the Environmental Impact Assessment for the proposed construction of the retaining beach wall, as provided for under the relevant provisions of the law.

1.3.1. Scope

The scope of this Environmental Impact Assessment (EIA) was defined in accordance with the Terms of Reference (TOR) and covers all phases of the project, from planning and design through construction, operation, and eventual decommissioning. Specifically, the assessment addressed:

- Baseline studies-Documentation of the current status of the natural and socio-economic environment within the project area, including baseline environmental quality parameters.
- Positive impacts-Identification and evaluation of potential environmental and social benefits associated with the proposed development.
- Negative impacts – Identification, screening, and prediction of possible adverse impacts likely to occur during the construction, operation, and decommissioning phases.
- Mitigation measures – Formulation of strategies to prevent, minimize, or offset identified adverse effects.
- Environmental and Social Management Plan (ESMP)-Development of a comprehensive ESMP outlining mitigation, monitoring, and reporting measures to ensure effective environmental and social safeguards throughout the project lifecycle.
- Final development of Comprehensive Project (EIA) report for NEMA submission and eventual EIA license issuance.

1.4. Methodology

The Environmental Impact Assessment (EIA) process applied a range of methodologies in full compliance with Section 58 of the Environmental Management and Coordination Act (EMCA), Cap 387, and the Environmental Assessments and Environmental Audits Regulations, 2003. The approach was further guided by Scope and Terms of Reference (ToR) for the study. The methodologies employed included, but were not limited to, the following.

a) **Desktop Literature Review:** A comprehensive review of existing information was undertaken using published literature, project-specific documents, government reports, and relevant policy and legislative frameworks. This process established the environmental and socio-economic context of the project area, identified potential environmental and social issues, and informed the design of field studies and stakeholder engagement activities.

b) **Geospatial Mapping and GIS Analysis:** Satellite imagery, topographic maps, and Geographic Information System (GIS) tools were utilized to accurately delineate the project location, identify sensitive environmental features, analyse existing land use patterns, and define potential impact zones. This spatial analysis provided a precise geographic framework to support environmental baseline assessments, impact prediction, and the integration of mitigation measures into project planning.

c) **Field Surveys and Site Inspections:** On-site reconnaissance was conducted to assess the physical, biological, and socio-economic conditions within and adjacent to the project area. These

surveys served to verify baseline environmental parameters, ground-truth secondary data, and identify site-specific features or constraints that could influence project design, implementation, and impact mitigation.

d) **Stakeholder Engagement and Public Consultation:** Structured consultations were conducted with Tatu City Management, project-affected persons (PAPs), government agencies, and other relevant stakeholders to identify concerns, capture local knowledge, and incorporate stakeholder perspectives into project planning. This process ensured compliance with the public participation requirements of the Environmental Management and Coordination Act (EMCA) Cap 387 and *Environmental Impact Assessment and Environmental Audit Regulation 2003* and promoted transparency, inclusivity, and social acceptability of the proposed development. The engagement process was primarily facilitated through the active involvement of Tatu City management, who played a pivotal role in mobilizing residents, providing local context, and coordinating communication between the project team and the community/project affected persons during the public participation phase.

The aim of public participation was to ensure that all stakeholders, particularly those directly or indirectly affected by the proposed project, are informed, consulted, and involved in the decision-making process. It is important to emphasize that public consultation and stakeholder engagement is not a one-time event, but a continuous process. Stakeholder input will remain integral throughout the implementation, operation, and where applicable, decommissioning phases of the proposed project.

1.5. Impact Identification

The impacts associated with the proposed Project were classified according to their **Effect Level.** Each identified adverse impact will be systematically categorized and analysed to ensure a transparent and consistent assessment framework. Impacts will first be assigned an **Effect Level Classification** categorized as *Low/Negligible, Minor, Moderate, or Major/High* considering feasible mitigation measures. This means that impacts are evaluated not only in their raw form but also in terms of their **residual effect** once mitigation is applied. In order to determine the significance of each impact, two overall factors were considered:

- The importance and/or sensitivity of the environmental and social receiving parameter, as determined during the assessment of baseline conditions; and
- Magnitude and Nature of the impacts.

1.5.1. Sensitivity of the Receiving Parameter

Receiving parameter sensitivity was determined using information taken from the baseline description on the importance, significance or value of the social or environmental component under examination. It is important to understand the sensitivity of the receiving parameter, as this is a measure of the adaptability and resilience of an environmental parameter to an identified impact. The following categories of sensitivity were applied to the assessment:

Significance	Narrative
High	The environmental parameter/receptor is fragile, and an impact is likely to leave it in an altered state from which recovery would be difficult or impossible.
Medium	The parameter/receptor has a degree of adaptability and resilience and is likely to cope with the changes caused by an impact, although there may be some residual modification as a result
Low	The parameter/receptor is adaptable and is resilient to change

1.5.2. Magnitude and Nature of the Impact

The magnitude of the impact is the scale of change which the impact may cause compared to the baseline and how this change relates to accepted thresholds and standards. The following categories were applied to the assessment of the anticipated project impacts:

Criteria	Category	Description
Magnitude of Impact	*High*	A large change compared to variations in the baseline. Potentially a clear breach of accepted limits.
	Medium	Change which may be noticeable and may breach accepted limits.
	Low	When compared with the baseline, change may only just be noticeable. Existing thresholds would not be exceeded.
Type of Impact	*Positive*	Impacts that have a beneficial environmental result, such as enhancement of existing environmental and social conditions.
	Negative	Impacts that have a harmful aspect, such as loss or degradation of environmental resources.
Type of Effect	*Direct*	Impacts clearly and directly attributed to a particular environmental or social parameter (e.g., generation of dust directly impacts air quality).
	Indirect	Impacts associated with or subsequent to a particular impact on a certain parameter (e.g., high dust levels leading to nuisance and health effects to workers).
Duration	*Short Term*	Effects disappear within 1 year or once construction activities are completed.
	Medium Term	Effects disappear within a 5-year period.
	Long Term	Effects last for more than 5 years.
Reversibility	*Reversible*	Impact significance will reduce and disappear over time (naturally or artificially) once the impacting activity ceases.
	Irreversible	Impact significance will not reduce or disappear over time, even after the activity ceases.

A qualitative assessment was conducted using professional experience, judgment, and available knowledge, and including the consideration of stakeholder views. Where there are limitations to the data, and/or uncertainties, these were recorded in the relevant chapters in the EIA report, along with any assumptions that were taken during the assessment.

1.5.3. Impacts Scoping

Potential impacts as per the Leopold matrix were identified in relation to their effects on potential receptors. These steps facilitated the elimination and scoping out irrelevant impacts taking into consideration the following:

- Type of project
- Location
- Characteristics of the surrounding environment.
- Receptor sensitivity or importance depends on its nature, value, scarcity etc.

There are three types of receptors:

- On site receptors encompassing soil and workplace.
- Receptors surrounding the site such as ambient air, humans, plants and animals.
- Final sinks/receptors such as surface and groundwater/wetlands

1.5.4. Assessing the Significance of the Impacts

The concept of ‘significance’ is central to the EIA process and aids the identification and categorization of environmental and social effects. As noted, in order to determine impact significance, the sensitivity of each environmental and social parameter/receptor is considered in combination with the magnitude of the impact. The table below demonstrates how these parameters were considered in the assessment of significance.

Table 2: Assessment of the Significance of the Impact

Significance of the Impact		Magnitude and Nature of the Impact		
		Low	Medium	High
Sensitivity of Receptors	Low	Not significant	Minor	Minor
	Medium	Minor	Minor	Moderate
	High	Minor	Moderate	Major

1.6. Justification

The shoreline at Silver Sand shore, Diani Beach, currently lacks a significant natural buffer such as a wide sandy beach, leaving the coast directly exposed to the forces of the ocean. While a fringing reef is present, providing some protection by dissipating wave energy, the shoreline remains vulnerable to direct impact from waves, particularly during high tides, storm surges, and periods of increased wave activity associated with seasonal monsoons. The absence of an extensive protective beach zone means that the landward areas, including properties, infrastructure, and vegetation, are continually exposed to erosive processes. Wave action along this stretch of the coast has resulted in wave scour, leading to undercutting of the shoreline and progressive erosion of both sand and soil. This erosional activity has destabilized slopes, reduced land availability, and increased the risk of property loss and damage to coastal infrastructure. Additionally, the erosional processes can lead to retreat of the shoreline, adversely affecting the long-term stability and usability of the beachfront. Without intervention, these processes are expected to intensify over time due to climate change-related sea-level rise, increasing storm intensity, and changes in wave patterns, further threatening coastal assets and the local environment.

The construction of a retaining beach wall is therefore justified as a necessary protective measure. The wall will serve as a physical barrier, retaining landward soil, preventing further undercutting, and reducing erosion caused by wave action. By stabilizing the shoreline, the structure will protect properties and infrastructure from damage, maintain the usability of the beachfront, and preserve the integrity of the coastal environment. Furthermore, the wall will act as a long-term adaptation measure against the impacts of rising sea levels and more frequent extreme weather events, contributing to climate resilience and sustainable coastal management in Diani Beach especially the shoreline abutting Silver Sand Hotel.

1.7. Project Estimated Cost

The proposed project is estimated to cost approximately **Ksh. 7,738,100.00** encompassing construction, procurement, and other related activities necessary for successful implementation of the proposed project. A detailed Bill of Quantities (BoQ) outlining the cost breakdown is provided in the report annexure.

CHAPTER 2: PROJECT DESCRIPTION

2.1. Project Location

The proposed site for the construction of retaining beach wall is located in Diani Beach, along the shoreline adjacent to Silver Sand Hotel off Diani Beach Road. The site is situated immediately behind Trade Winds Lodge, bordered to the north by Kivulini Beach Villa and Cottages and to the south by Diani Sea Resort. The geographical reference for the site is represented by the GPS coordinates: **Latitude -4.304326S, Longitude 39.582760E.**

Figure 1: Proposed Site Location (Diani Beach)

Plate 1: Pictorial Representation of Site Location

2.2. Project Design and Components

The project will involve shoreline protection through the construction of a retaining beach wall along the shoreline of Silver Sand Hotel at Diani Beach, Kwale County. The key components of the project include, but are not limited to:

d) Gabion Bands.
e) Revetments and Shoreline Structures, and
f) Ancillary facilities.

2.2.1. Revetment

The proposed retaining beach wall at Silver Sand Hotel, Diani Beach, is designed as a robust shoreline protection structure, constructed using locally sourced, environmentally friendly rock boulders. The design will ensure both structural stability and resistance to wave action while minimizing environmental impacts. The key technical features of the structure will include but are not limited:

- Height and Alignment: The wall will rise approximately 0.4 meters above Mean Sea Level (MSL), providing adequate protection against high tides and moderate wave overtopping,
- Sloped Concrete Slab with Risers and Threads: A sloped concrete surface, reinforced with risers and threads, will form the primary barrier against incident waves, helping to dissipate wave energy safely,
- Precast Blocks: Strategically positioned precast blocks will enhance resistance to direct seawater impact and prevent scouring at the face of the wall,
- Foundation Walling: The structure will include a 200 mm thick foundation wall, constructed on a well-dressed earth base, ensuring uniform load distribution and stability of the retaining feature,
- Footing Concrete Strip: A continuous concrete strip footing will provide additional stability, anchoring the wall and preventing undercutting or sliding due to wave action, and
- Stone Arrangement: Large, interlocked stones will be carefully placed and bonded with cement and sand to form the core structure. Medium-sized rubble stones will be compacted and arranged to fill gaps, increasing mass, stability, and resistance to erosion.

The combination of these elements sloped concrete surfaces, precast blocks, bonded boulders, and reinforced foundations ensures that the retaining beach wall will provide long-term shoreline stabilization,

protect landward areas, and minimize erosional impacts while remaining environmentally sustainable. The total length of the retaining wall is approximately 350m.

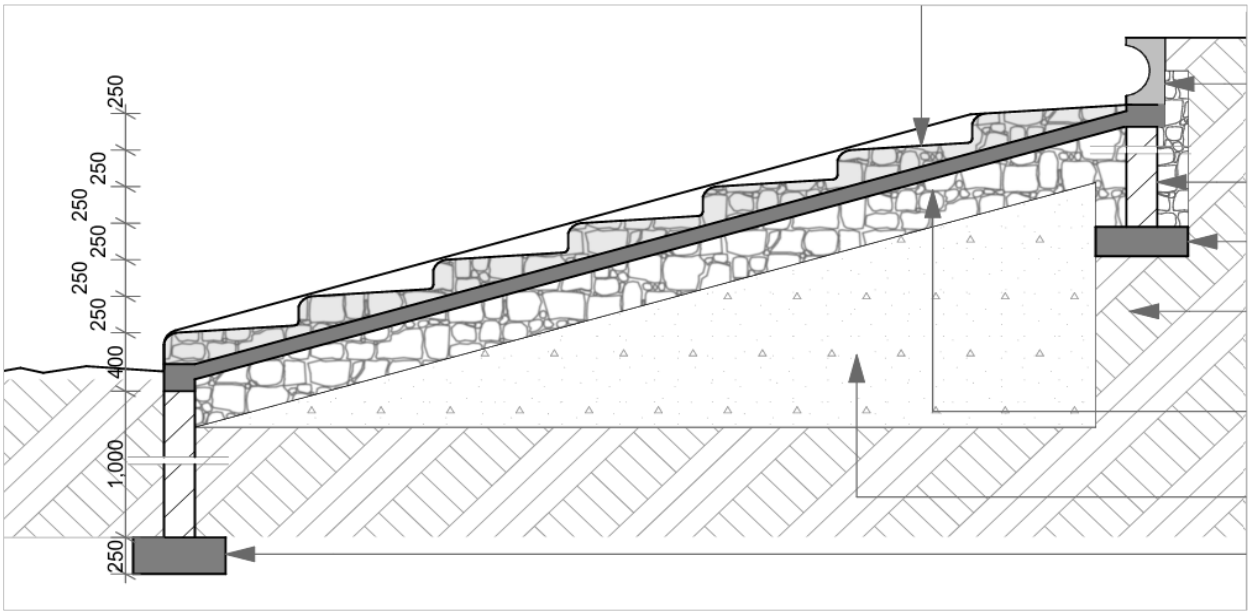


Figure 2: Proposed Revetment

2.2.2. Proposed Activities

The construction of the retaining beach wall at Silver Sand Hotel, Diani Beach, will involve a series of carefully planned activities designed to ensure structural stability, long-term durability, and minimal impact on the surrounding environment. The key construction activities are as summarized in the table below.

Table 3: Planned Activities

Construction Activity	Description / Method
Site Preparation and Clearing	Removal of vegetation, debris, and loose material within the construction footprint, while preserving surrounding vegetation where possible.
Excavation	Shallow excavation to create a level foundation, not exceeding 2meters in depth. Excavated material temporarily stockpiled for reuse.
Compaction	Mechanical compaction of the excavated base to achieve required soil density.
Foundation and Footing Construction	Construction of 200mm thick concrete foundation wall and continuous concrete strip footing on compacted base.
Gabion Band and Wall Assembly	Placement and interlocking of locally sourced rock boulders, bonded with cement and sand. Installation of precast blocks and sloped concrete slabs.
Backfilling and Compaction	Backfilling behind the wall using suitable material in layers, with each layer compacted.
Finishing Works	Final leveling, dressing, and integration with the surrounding shoreline. Incorporation of drainage features.

2.2.3. Machinery

The construction activities will require the use of standard construction machinery and equipment to ensure efficiency, safety, and quality. The anticipated machinery includes:

- Excavators
- Compactors / Rollers

- Concrete Mixers / Transit Mixers
- Cranes / Hoists.
- Vibrators and Trowels:
- Hand Tools and Small Equipment

CHAPTER 3: POLICY, LEGAL & INSTITUTIONAL FRAMEWORK

3.1. Introduction

The management of environmental concerns in Kenya is guided by a robust legal, policy, and institutional framework. The principal national legislation is the Environmental Management and Coordination Act (EMCA), Cap 387, which empowers stakeholders to participate in the sustainable management of natural resources (Section 58). Projects likely to cause environmental impacts are required to undergo an Environmental Impact Assessment (EIA) study. It is under this provision that the current study for the proposed construction of a retaining beach wall at Silver Sand Hotel shoreline, Diani Beach is being undertaken. This chapter assesses the relevant policies, legislation, and institutional frameworks governing the project and identifies the applicable compliance requirements.

3.2. The Constitution of Kenya, 2010

The Constitution of Kenya, 2010, provides the overarching legal framework for environmental governance in the country. Article 42 guarantees **every person the right to a clean and healthy environment**, including the right to have the environment protected for the benefit of present and future generations. This encompasses the protection of air, water, soil, and biodiversity from pollution, degradation, and unsustainable exploitation.

Article 69 further places a duty on the State to ensure the conservation and sustainable management of the environment and natural resources. This includes measures to protect biological diversity, safeguard ecosystems, and prevent activities that may degrade or endanger the environment. The Constitution also recognizes the importance of public participation in environmental decision-making, promoting community involvement in the sustainable use and management of natural resources.

Article 70 makes these environmental rights enforceable in a court of law, allowing individuals or groups to seek legal redress in case of violations. This provides a strong mechanism to hold project proponents and authorities accountable for environmental harm.

Relevance: The construction of the retaining beach wall at Silver Sand Hotel, Diani Beach, will be undertaken with full adherence to the Constitution. Specifically, the project will:

- Implement measures to prevent pollution of the coastal and marine environment, including proper management of construction waste, runoff, and effluents; and
- Protect existing biodiversity, including coastal vegetation and marine life, by ensuring minimal disturbance during construction and employing environmentally sensitive design features.

3.3. Sessional Paper No. 10 of 2014 on the National Environment Policy

The National Environment Policy, as outlined in Sessional Paper No.10 of 2014, provides a framework for the sustainable management and use of the environment and natural resources in Kenya, with the overarching goal of improving the quality of life for both present and future generations. The policy recognizes that infrastructure development, including coastal and shoreline protection structures, must be undertaken in a manner that safeguards environmental integrity while supporting socio-economic development. Section 5.6 specifically addresses infrastructure development and environmental sustainability, emphasizing the need for:

- Strategic Environmental Assessments (SEA), Environmental Impact Assessments (EIA), Social Impact Assessments (SIA), and public participation, ensuring that all potential environmental and social impacts are identified, assessed, and mitigated prior to project implementation;
- Development of environmentally friendly infrastructure strategies, promoting designs and construction methods that minimize environmental degradation, reduce resource consumption, and enhance resilience to climate and natural hazards;
- Periodic environmental audits of infrastructure projects, to monitor performance, ensure compliance with environmental standards, and implement corrective measures when necessary.

Relevance: The preparation and submission of this Environmental and Social Impact Assessment (ESIA) for the proposed retaining beach wall at Silver Sand Hotel shoreline, Diani Beach is fully aligned with the policy's provisions. Specifically, the project will:

- Ensure that the wall's design and construction methods minimize disruption to the coastal and marine environment, including protection of shoreline vegetation and coral reef areas.

3.4. National Policy on Water Resources Management and Development, 1999

The National Policy on Water Resources Management and Development (1999) provides a framework for the sustainable development, utilization, and conservation of water resources in Kenya. It recognizes water as a vital resource for human, ecological, and economic activities and emphasizes the importance of protecting water quality from contamination and overexploitation. The policy further underscores the need for appropriate wastewater management systems to prevent pollution of water bodies, including rivers, lakes, groundwater, and coastal waters. It also encourages integrated water resource management, promoting coordination between industrial, domestic, agricultural, and recreational activities to ensure that water resources are used efficiently and sustainably. Compliance with the policy is essential for safeguarding public health, protecting aquatic ecosystems, and maintaining the ecological balance of freshwater and marine systems.

Relevance: The construction and operation of the retaining beach wall will be carried out with strict adherence to this policy. Specific measures include:

- Management of wastewater and construction effluents to prevent discharge of harmful substances into the Indian Ocean.

3.5. Legal and Regulatory Framework

3.5.1. Environmental Management and Coordination Act (EMCA), Cap 387

The Environmental Management and Coordination Act (EMCA), Cap 387 is the principal legal framework for environmental management and conservation in Kenya. The Act provides the foundation for sustainable environmental governance, ensuring that economic development is harmonized with environmental protection. Under EMCA, the National Environment Management Authority (NEMA) is designated as the lead agency responsible for overseeing and enforcing environmental regulations, including the implementation of policies, standards, and guidelines for sustainable natural resource use.

EMCA mandates that any project likely to have significant environmental impacts, or any activity listed under the Second Schedule, must undergo a comprehensive Environmental Impact Assessment (EIA) prior to commencement. The Act empowers NEMA to review, approve, or reject EIA reports, issue licenses, and impose conditions for compliance. It also provides mechanisms for environmental monitoring, auditing, restoration orders, and enforcement actions in cases of non-compliance.

The Second Schedule of EMCA specifically lists coastal and marine infrastructure projects, including shoreline protection works and construction along the coastline, as activities that require mandatory EIAs. This ensures that potential environmental and social impacts are assessed and mitigated before project implementation, particularly for sensitive coastal ecosystems.

Relevance: The construction of the retaining beach wall is classified as a medium-risk coastal infrastructure project, triggering the requirement for a full EIA under EMCA. In line with the Act:

- The project proponent has commissioned an ESIA study to identify, assess, and propose mitigation measures for potential environmental and social impacts;
- An Environmental and Social Management and Monitoring Plan (ESMMP) has been developed and will be implemented throughout the construction and operational phases to ensure compliance with environmental standards; and
- NEMA approval will be obtained prior to commencement, ensuring that all legal, environmental, and social requirements are met.

3.5.2. Environmental (Impact Assessment and Audit) Regulations, 2003

The Environmental (Impact Assessment and Audit) Regulations, 2003, enacted under the Environmental Management and Coordination Act (EMCA) Cap 387, provide the legal and procedural framework for conducting Environmental Impact Assessments (EIA) and Environmental Audits (EA) in Kenya. The regulations outline the steps, requirements, and responsibilities for project proponents and environmental experts in assessing potential environmental and social impacts of proposed developments.

Relevance: The construction of the retaining beach wall falls under the Second Schedule as a coastal infrastructure project with potential environmental impacts. In accordance with these regulations:

- The EIA has been carried out by a registered environmental consultancy firm with expertise in coastal projects.

By strictly following these regulations, the project ensures that environmental protection, social considerations, and sustainable coastal development are integrated into all phases of the retaining wall construction, from planning to operation.

3.5.3. Summary of Subsidiary Regulation under EMCA

Regulation	Purpose / Key Provisions	Relevance to the Proposed Retaining Beach Wall
EMCA (Waste Management) Regulations, 2024 (Legal Notice No. 178 of 2024)	Provides a framework for the management, handling, storage, transportation, segregation, and destruction of waste. Ensure compliance with constitutional guarantees for a clean, safe, and sustainable environment.	The project proponent will develop and implement a Waste Management Plan (WMP) to manage construction and operational waste, ensuring proper segregation, collection, transportation, and disposal in compliance with these regulations.
EMCA (Noise and Excessive Vibration Pollution) (Control) Regulations, 2024	Prohibits unreasonable, unnecessary, or harmful noise. Sets maximum permissible noise levels for construction sites, residential areas, silent zones, commercial areas, and sensitive receptors.	Construction activities will be planned to limit excessive noise and vibration, particularly near sensitive receptors such as nearby hotels, residences, and marine areas. Workers will be provided with PPE to mitigate occupational exposure.
EMCA (Water Quality) Regulations, 2024 (Legal Notice No. 177 of 2024)	Protects water resources from pollution, including drinking water, industrial water, agricultural water, and recreational water. Sets standards for wastewater management and disposal.	Qualified site operators will ensure that all effluents and wastewater generated during construction are managed properly, preventing contamination of the Indian Ocean and complying with the Environmental Management Plan (EMP).
EMCA (Air Quality) Regulations, 2024 (Legal Notice No. 180 of 2024)	Provides for prevention, control, and abatement of air pollution. Covers emissions from internal combustion engines, industrial premises, and other sources. Includes emission testing and monitoring.	The project implementers will maintain machinery and equipment, conduct routine emission monitoring, and implement dust control measures to comply with permissible air quality standards.

3.6. Sustainable Waste Management Act, 2024

The Sustainable Waste Management Act, 2024 provides a comprehensive legal and institutional framework for the sustainable management of waste in Kenya. The Act aims to ensure the realization of the constitutional right to a clean and healthy environment (Article 42), while promoting safe, environmentally sound, and socially responsible practices in the generation, handling, storage, transportation, treatment, and disposal of all types of waste. Section 19 (1) requires private sector entities to prepare and implement three-year Waste Management Plans (WMPs).

Relevance: The Sustainable Waste Management Act, 2024, is directly applicable to the proposed construction of the retaining beach wall at Silver Sand Hotel, Diani Beach. Compliance with this Act ensures that all solid and liquid wastes generated during the project are managed in an environmentally sound and socially responsible manner. The proponent will prepare and implement a Waste Management Plan (WMP) to guide the collection, segregation, transportation, and disposal of construction and operational wastes.

3.7. Water Act, 2016

The Water Act, 2016 provides a comprehensive legal and institutional framework for the management, protection, and sustainable use of water resources in Kenya. The Act establishes the Water Resources Authority (WRA) as the lead institution responsible for regulating, monitoring, and overseeing all activities affecting water resources, including abstraction, use, conservation, and pollution control. The Act prohibits any obstruction, interference, or diversion of natural watercourses without authorization and restricts the discharge of effluents, trade waste, or other pollutants into water bodies in ways that could degrade water quality or harm aquatic ecosystems (Sections 72–75).

It also requires any entity intending to abstract, use, or discharge water to obtain the necessary permits from WRA and ensures that water use remains within licensed quantities while maintaining environmental sustainability (Sections 81–84). The Act promotes integrated water resource management, encouraging efficient wastewater and stormwater systems to prevent contamination from industrial, commercial, or construction activities (Section 5, Part III). Non-compliance is punishable through fines, imprisonment, or both, with provisions for enforcement actions including restoration of contaminated watercourses and remediation measures to mitigate environmental damage (Sections 152–156).

Relevance: All construction activities near the shoreline, including excavation, backfilling, and concrete works, will comply with the provisions of the Water Act, ensuring no obstruction of natural water courses or pollution of marine waters.

3.8. Occupational Health and Safety Act (OSHA), 2007

The Occupational Health and Safety Act (OSHA), 2007 provides a comprehensive legal framework for protecting the health, safety, and welfare of workers and other persons lawfully present at workplaces in Kenya. Part VI (General Health Provisions) requires employers to ensure safe working conditions, provide safe equipment, and supply adequate personal protective equipment (PPE) including helmets, gloves, boots, high-visibility vests, and eye protection.

Part X (Welfare of Workers) mandates the provision of first aid facilities, drinking water, sanitation, and appropriate rest areas. Section 53 specifically requires suitable protective clothing and appliances for workers exposed to injurious or offensive substances. Rules made under the Act, including the Safety and Health Committee Rules, require the formation of workplace safety committees to monitor compliance and oversee safety measures. The First Aid Rules set out requirements for first aid provisions and training, while the Hazardous Substances Rules, Noise Rules, and Medical Examination Rules provide guidance for managing exposure to chemicals, excessive noise, vibrations, and occupational health monitoring.

Section 15 and Section 16 outline employer and employee responsibilities for hazard identification, risk mitigation, emergency preparedness, and continuous safety training. **Relevance**: Compliance with these sections ensures workers are protected during excavation, concrete works, heavy rock handling, and machinery operation. PPE will be provided.

3.9. The Wildlife Conservation and Management Act, 2013

The Wildlife Conservation and Management Act, 2013 provides a legal framework for the protection, conservation, and sustainable use of wildlife and biodiversity in Kenya. Under Section 3, the Kenya Wildlife Service (KWS) is established as the lead authority responsible for wildlife management and enforcement of conservation measures.

Section 25 requires the preparation and implementation of management plans for protected areas to ensure sustainable use and habitat conservation, while Section 34 prohibits activities that may disturb or degrade wildlife habitats within or near protected areas without prior authorization. Section 44 empowers

KWS to regulate access to wildlife areas and enforce compliance, and Section 87 stipulates penalties for activities that negatively impact wildlife or their habitats.

Relevance: The project will comply with the above provisions by implementing measures to avoid impacts on coastal and marine biodiversity. Construction activities will be planned to prevent habitat degradation, disturbance to marine life, or interference with protected areas.

CHAPTER 4: BIOPHYSICAL & SOCIO-ECONOMIC BASELINE INFORMATION

4.1. Kwale County Administrative Location

Kwale County is located in the coastal region of Kenya, approximately 30 km southwest of Mombasa Town and 72 km from the Kenya–Tanzania border at Lunga Lunga. The area lies at Longitude 39º33'59" East and Latitude 04º17'06" South. Administratively, Ukunda and Diani form an urban centre within Msambweni Sub-County, encompassing Gombato and parts of Ukunda, Bongwe, and Mkoyo sub-locations. Ukunda is the largest urban centre in the South Coast region, characterized by predominant trading and tourism activities, and serves as a major hub for commerce, services, and coastal tourism.

The proposed site for the construction of a retaining beach wall is located along the Diani Beach shoreline, adjacent to Silver Sand Hotel off Diani Beach Road. The site is positioned immediately behind Trade Winds Lodge, bordered to the north by Kivulini Beach Villa and Cottages and to the south by Diani Sea Resort. The site's precise location is defined by the GPS coordinates: **Latitude -4.304326 S, Longitude 39.582760 E,** placing it within the highly developed coastal tourism corridor of Diani Beach.

Plate 2: Site Location

4.2. Physical and Topographic Features

Ukunda/Diani is renowned for its striking white-sand beaches, formed primarily from eroded reef material mainly coral sand that is deposited along the inshore side of the fringing reef system. This geomorphological feature comprises the Coastal Plain, a narrow, low-lying strip extending approximately 25 km along the shoreline. The coastal plain lies at less than 30 m above sea level and stretches up to 10 km inland, covering part of the proposed project area (Silver Sands Hotel) shoreline protection works. The sediments within this zone consist predominantly of corals, fine sand, silts, and alluvial deposits, which result in a highly dynamic and easily erodible coastline.

The coral reef complex along the Indian Ocean runs almost parallel to the shoreline at distances ranging from 300 m to 1,000 m offshore. It is considered one of Kenya's most productive and ecologically significant reef systems, comprising coral flats, lagoonal systems, reef platforms, and fringing reefs. The reef complex occupies an estimated 50,000 hectares, with average stony coral cover of 30–40%. These

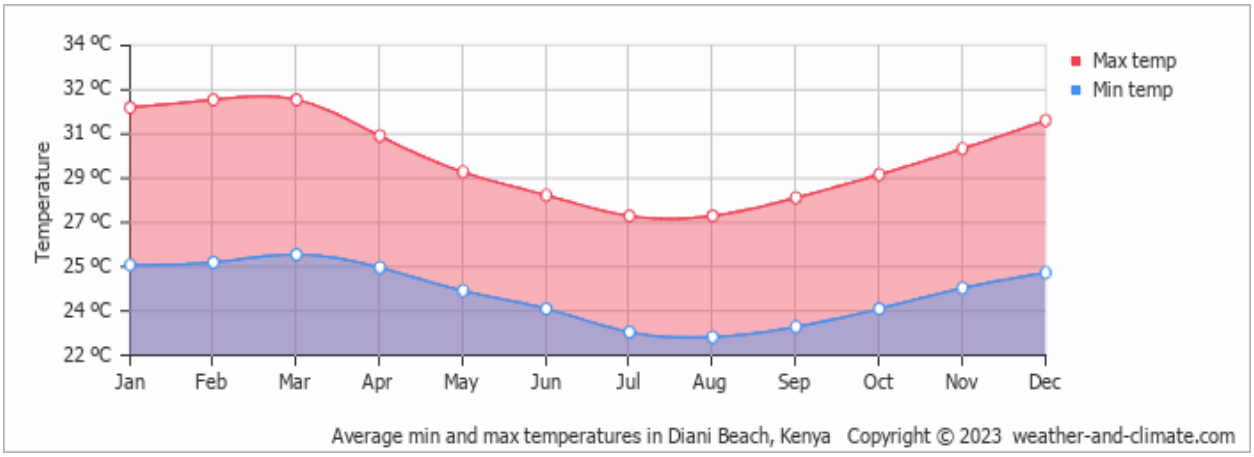
reefs play a critical role in shoreline protection by dissipating wave energy before it reaches the beach, while also supporting fisheries, marine biodiversity, and the overall ecological integrity of the coastal zone.

Behind the coastal plain, the land rises steeply to the Foot Plateau, characterized by a relatively flat terrain composed of highly permeable sand hills and loamy soils. This zone is underlain by Jurassic sedimentary formations and extensive Magarini sand deposits, which are agriculturally productive and known to support crops such as sugarcane. Further inland lie the Coastal Uplands, notably the Shimba Hills, located within Matuga Sub-County, forming an ecologically sensitive highland area that influences regional hydrology and microclimatic conditions.

4.3. Climatic Conditions

Ukunda/Diani, and Kwale County in general, experience a monsoon-type tropical climate governed by the seasonal reversal of the northeast and southeast monsoon winds. The area is typically hot and dry from January to April, transitioning to cooler and wetter conditions between June and August, when the southeast monsoon dominates and brings moist air from the Indian Ocean. Rainfall distribution in Ukunda/Diani follows a bimodal pattern. The long rains occur between April and June, with peak precipitation often recorded in May, while the short rains fall between October and December. These rainfall seasons influence coastal hydrology, beach stability, groundwater recharge, and construction scheduling.

Average temperatures in the coastal lowlands of Ukunda/Diani range from 26.3°C to 26.6°C, reflecting the strong moderating effect of the Indian Ocean. In the hinterland, temperatures vary between 24.6°C and 27.5°C, with slightly cooler conditions at higher elevations such as the Shimba Hills. Mean temperatures are generally highest from November to April, coinciding with the dry monsoon period and increased solar radiation. This climatic regime characterized by high humidity, warm temperatures, and seasonally intense rainfall has significant implications for shoreline management and construction activities. High-energy wave action during the southeast monsoon season and episodic heavy rainfall events may influence sediment dynamics, erosion rates, and the timing of construction works along the coastline.



4.4. Geology and Soil

Kwale County is predominantly underlain by rocks of sedimentary origin, reflecting the geological characteristics of much of Kenya's coastline. Only the western parts of the county expose basement rocks, similar to other sections of the Coastal Region. The sedimentary formations in this area fall within three major geological zones: the Duruma Sandstone Series, the Tertiary Sediments, and the Quaternary Sediments. These geological units have played a major role in shaping the coastal landscape, influencing soil development, hydrology, and land use across the region.

Geologically, Kwale County is underlain by four primary groups of rocks. The oldest of these are the Basement Complex rocks, consisting of gneisses, schists, quartzites, granitoids, and crystalline limestone. These formations are largely found in the northwestern parts of the county and represent the deeply weathered metamorphic core that forms the structural foundation of the Shimba Hills region. Moving eastward, the landscape transitions into a broad band of Karoo (Duruma) Sandstone formations,

which include the Taru, Maji-ya-Chumvi, Mariakani, and Mazeras formations. These sandstones stretch across the central portion of the county to the foot slopes of the Shimba Hills and consist of grits, coarse-to-fine sandstones, and interbedded shales.

Below the coastal strip lie the Jurassic–Cretaceous sedimentary formations, which include the Kambe Limestone, extending from the northeastern Shimba Hills to the western shores of Mombasa Island. These formations are composed of limestone, marls, and associated marine sediments that reflect past shallow marine depositional environments. Overlying these units are the Recent (Quaternary) deposits, which include the Marafa and Magarini formations that dominate the modern coastal landscape. These are largely composed of coral limestone, lagoonal deposits, calcareous sands, and quartz-rich sands, forming the wide coastal plain characteristic of Diani and the greater South Coast. The Duruma Sandstone Series is composed of a vertical succession of grits at the base, sandstones at the mid and upper layers, and alternating finer sandstones and shales within the sequence. The Tertiary Sediments consist of extensive layers of sand and gravel with an estimated thickness of about 130 metres, indicating long-term terrestrial sedimentation processes. The Quaternary Sediments, which dominate the coastal strip, are mostly composed of coral rag, reef limestone, calcareous marine sands, and associated lagoonal deposits. These sediments define the low-lying beach environments and contribute to the high permeability and loose soil structure typical of the Diani coastline.

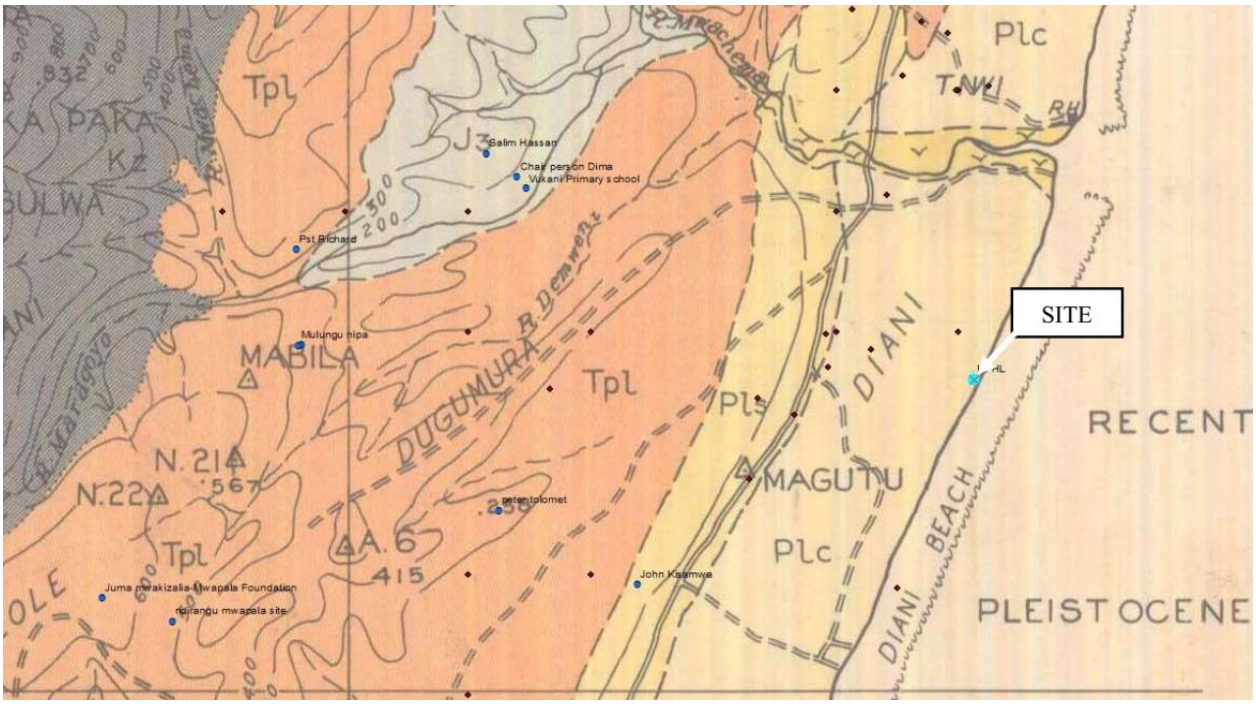
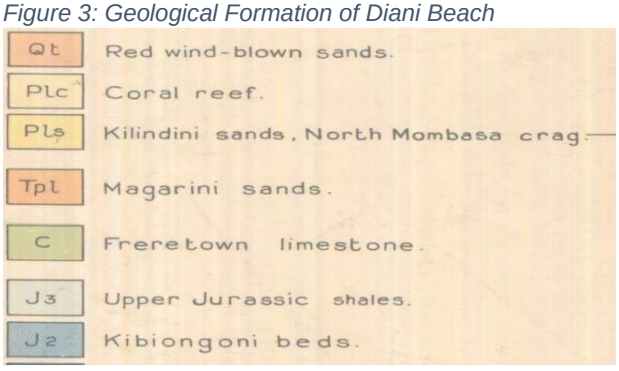


Figure 3: Geological Formation of Diani Beach



Soils within Kwale County vary greatly depending on the underlying geology and topography. The coastal plains, such as those in Diani, contain unconsolidated coral sands, clay, loam, and alluvial deposits, resulting in soils that are generally shallow, highly permeable, and prone to erosion. Towards the Foot Plateau, the soils become deeper and more permeable, consisting mainly of loamy textures that are well suited for agriculture. Further inland, along the coastal range and Shimba Hills, the soils derived from

sandstone and grit formations are moderately fertile and support extensive cultivation due to better structure and nutrient retention. The proposed project area lies within the Diani coastal plain, a belt dominated by loose sand, coral fragments, and alluvial deposits. The geological nature of this zone results in high coastal sensitivity to erosion and wave action. The coral reef system, located approximately 300 m to 1,000 m offshore, runs parallel to the coastline and forms a critical natural breakwater that influences sediment deposition and shoreline stability.

Plate 3: Coastal Shoreline Sand Deposition

4.5. Drainage (Surface Water)

Kwale County exhibits a well-defined surface water drainage system comprising seven principal rivers Ramisi, Marere, Pemba, Mkurumuji, Umba, Mwachema, and Mwachi supported by numerous ephemeral and intermittent streams that flow seasonally during the long and short rains. Of the seven major rivers, three are perennial, maintaining flow throughout the year due to sustained baseflow contributions from groundwater aquifers and the region's relatively high rainfall in the hinterland areas such as the Shimba Hills. All river systems in Kwale drain eastwards into the Indian Ocean, forming an integrated coastal catchment that influences sediment load, water quality, and littoral processes along the shoreline.

The Marere and Mwaluganje rivers have been strategically harnessed to supply piped water through surface abstraction infrastructure, highlighting their reliability and hydrological stability. In the immediate vicinity of the proposed project location in Diani, there are no permanent freshwater bodies, wetlands, or river channels that directly interact with the site. The nearest surface water body is the Indian Ocean, approximately 1 km east, which plays a dominant role in shaping local drainage, tidal dynamics, and sediment distribution patterns.

From a hydrogeological perspective, Kwale County has considerable groundwater potential, driven by the permeability and porosity of the underlying sedimentary formations, including coral rag, Magarini sands, and weathered sandstones. Groundwater occurrence is strongly influenced by lithology:

- Deep aquifers, often associated with the Duruma Sandstone Series, contain water of variable quality, at times saline due to marine intrusion or mineralization.
- Shallow aquifers along the coastal plain typically occur within coral limestone, beach sands, and lagoonal deposits, offering relatively fresh and potable water due to rapid recharge from rainfall infiltration.

The coastal belt is characterized by six major groundwater catchments and reservoir units, which supply water to residential areas, tourism establishments, and commercial developments. These aquifers are recharged primarily during the long rains, although recharge rates vary depending on soil permeability, vegetation cover, and surface runoff patterns. The local drainage behaviour in Diani is shaped by the flat

topography of the coastal plain, the high infiltration capacity of sandy soils, and the absence of well-defined surface water channels.

4.6. Biological Resources (Fauna and Flora)

Kwale County is characterized by distinct agro-ecological zones that influence its biological resources. Medium-potential and marginal lands account for approximately 15% and 18% of the total land area, respectively, while the remaining 67% comprises rangelands, arid, and semi-arid areas suitable primarily for livestock rearing and limited cultivation of drought-tolerant crops. As part of this assessment, environmental studies including surveys and flora and fauna inventories were undertaken to identify key ecological features within the proposed project area (Ukunda–Diani).

4.6.1. Flora

Vegetation distribution in Kwale County is influenced by climatic conditions, geological formations (particularly soil types), and anthropogenic activities such as tree cutting, land clearing, and grazing. Forest cover in the county is estimated at approximately 7%, amounting to about 54,544 hectares of which 35,043 hectares are gazetted forests and 19,500 hectares remain ungazetted. The county hosts several indigenous and culturally significant forest patches known as *Kaya* forests. These small, remnant forest ecosystems ranging in size from roughly 10 to 400 hectares are protected by the Mijikenda Councils of Elders and are valued for their ecological, cultural, and historical importance.

Within the Ukunda–Diani area, vegetation is generally sparse due to extensive development and land conversion. However, important pockets of coastal and shoreline vegetation remain, comprising:

- Coastal thickets and scrublands, dominated by species such as *Premna serratifolia*, *Dalbergia melanoxylon*, *Cocos nucifera*, and *Euphorbia tirucalli*;
- Coastal dune vegetation, including salt- and wind-tolerant grasses and shrubs adapted to sandy substrates;
- Shoreline vegetation, predominantly creepers such as *Ipomoea pes-caprae* and *Canavalia rosea*, which play a critical role in stabilizing sand dunes, protecting the shoreline, and reducing erosion; and
- Mangrove stands in localized wetland and tidal creek areas, supporting species such as *Rhizophora mucronata*, *Avicennia marina*, and *Ceriops tagal*.

These vegetation types provide essential ecological services, including shoreline stabilization, soil protection, micro-climate regulation, and habitat provision for coastal fauna. Despite ongoing pressure from urbanization and tourism activities, remnant coastal and shoreline vegetation remains a key ecological component of the Diani landscape.

Plate 4: Vegetation Along the Proposed Shoreline Site

4.6.2. Terrestrial Mammals

The faunal assessment covered mammals, birds, reptiles, and amphibians, with emphasis on identifying any threatened, rare, or conservation-significant species that occur or are likely to occur within the project/study area. No faunal species of conservation concern were recorded during the assessment. This is largely attributed to intense human activities and land-use transformation within the project area, particularly along the shoreline zone, which is dominated by commercial tourism facilities, residential developments, and high levels of human presence. Kwale County hosts a variety of terrestrial wildlife, particularly within remaining natural habitats and protected areas. Key wildlife habitats in the wider region include:

- Shimba Hills National Reserve, an important biodiversity hotspot supporting elephants, sable antelope, primates, and various small mammals; and
- Mwaluganje Elephant Sanctuary, which functions as part of the larger Shimba ecosystem and provides a critical refuge and migratory corridor for elephants.

In contrast, the Ukunda–Diani shoreline environment near the beach is highly modified and offers limited habitat for terrestrial mammals. The narrow beach strip, dune zone, and immediate hinterland are heavily urbanized and lack natural forest cover, continuous bushland, or wetlands that could support large wildlife populations. The dynamic coastal environment characterized by sandy substrates, salt spray, human foot traffic, and extensive recreational use further restricts the presence of most terrestrial mammals. As a result, only a few small, disturbance-tolerant species are likely to occur within or near the shoreline, including:

- Small rodents;
- Insectivorous mammals (e.g., shrews); and
- Other small carnivores associated with human settlements.

In addition to terrestrial fauna, the coastal and near-shore marine environment supports a variety of marine fauna, including:

- Marine fish species common in near-shore reef and lagoon systems;
- Crustaceans such as crabs and prawns found in intertidal zones;
- Marine mollusks, including shells, gastropods, and bivalves;

- Sea turtles, which occasionally use sections of the Diani coastline for nesting, although at low frequency in developed zones;
- Coral reef–associated species, including invertebrates and reef fish, found further offshore.

Although these marine species are part of the broader coastal ecosystem, their occurrence near the project area is influenced by shoreline modification, coastal developments, and general human activity along the beach.

4.7. Socio-Economic Baseline

4.7.1. Population and Demography

Population distribution in Kwale County is strongly influenced by topography, availability of natural resources, and the prevailing agro-ecological conditions. Significant variations in population density occur at the divisional level. According to the 2019 Kenya Population and Housing Census (KPHC), the County had a total population of 866,820, comprising 425,820 males (49%) and 441,681 females (51%), with an average population density of 104.9 persons/km².

Matuga and Msambweni Constituencies are among the most densely populated areas in the County. Their strategic location along the Mombasa–Lunga Lunga highway, coupled with well-developed infrastructure such as road networks, electricity supply, water services, and commercial facilities, has significantly contributed to their high population concentration. Within Msambweni Sub-County, the Ukunda Sub-Location stands out with a population density of 2,162 persons per square kilometer (2019 KPHC). Ukunda/Diani has evolved into one of the fastest-growing urban centres in Kwale County. With ongoing and proposed infrastructural developments—such as improved road networks, utilities, and tourism investments Diani is expected to continue attracting a high number of migrants, leading to increased urbanization, expansion of commercial activities, and emerging industrial opportunities.

4.8. Land Tenure and Land Use

4.8.1. Surrounding Land Uses

The dominant land use in the Ukunda/Diani area is Residential Land Use, forming the largest share of developed land. Commercial activities are also significant, particularly concentrated along Diani Beach Road and the A14 Highway (Lunga Lunga–Likoni Road). This land-use pattern is driven largely by the extensive tourism industry, improved accessibility, and enhanced mobility along the A14 corridor. According to the latest spatial planning data, Residential Land Use covers approximately 1,722 hectares, accounting for 66.1% of total land in Ukunda. Commercial Land Use covers about 381 hectares (14.6%), reflecting the concentration of hospitality establishments, retail centres, and tourism-support services. Industrial Land Use is negligible, with minimal allocation and low representation within the area.

Along the Diani beach shoreline, sections of the coastal frontage have undergone modification to support tourism infrastructure and protect property. The project site, including its land development activities, is under the ownership and management of Silver Sand Limited, the project developer. As part of coastal property development in the area, sections of the Diani shoreline have been modified to protect beachfront assets. This includes the construction of retaining beach walls in certain developed stretches to mitigate coastal erosion, protect infrastructure, and stabilize vulnerable beach zones.

The site is positioned immediately behind Trade Winds Lodge, bordered to the north by Kivulini Beach Villa and Cottages and to the south by Diani Sea Resort. The immediate neighbouring facilities along the shoreline include a mix of resorts and villas, reflecting the highly developed tourism-oriented nature of the area.

4.9. Transport and Communication Infrastructure

Kwale County has a total of 1,483.1 km of classified roads, comprising 187.7 km of bitumen (paved) surface, 425.2 km of gravel surface, and 871.2 km of earth surface/rural access roads. The County is traversed by an international trunk road connecting Mombasa to Lunga-Lunga at the Kenya–Tanzania

border. To the north, the Mombasa–Nairobi Highway forms the boundary between Kwale and Kilifi Counties. The County also has approximately 4km of railway line and four (4) airstrips, including the Ukunda/Diani Airstrip and Shimba Hills Airstrip.

4.9.1. Road Network

The primary transport infrastructure serving Ukunda/Diani includes the A14 Road, which connects Mombasa to Tanzania through Lunga-Lunga. These facilities play a critical role in supporting tourism, trade, and local mobility. The proposed project site is accessed through a well-maintained 6-metre-wide marram road, which branches off from Diani Beach Road and provides direct connectivity to the Diani shoreline. No new road construction is required, as the current access route is sufficient for construction materials, personnel movement, and future operational activities.

4.9.2. Sanitation

The project area (Diani) currently lacks a centralized sewerage system. Wastewater and effluent disposal are predominantly managed through on-plot sanitation systems, including pit latrines, soak-away pits, and septic tanks. Many of the existing beach-front facilities, including resorts and villas along Diani Beach, similarly rely on individual septic systems for wastewater management. A major challenge in the area is the absence of proper sludge handling facilities, such as sludge drying beds or waste stabilization ponds, for the safe disposal of septage when these on-plot systems are desludged. Consequently, septage from both residential and tourism-related sanitation systems is often discharged directly into the environment, posing potential environmental and public health risks. For the proposed development, effluent will be managed using the existing on-plot sanitation facilities, including septic tanks and soak-away pits, complemented by leach pits where necessary to handle stormwater.

4.10. Economic Activities and Household Income

Tourism is the predominant economic activity in Ukunda/Diani, with its white sandy beaches, beach resorts, villas, and recreational facilities serving as key attractions. Tourism is the primary driver of socio-economic growth in the area, generating employment opportunities, stimulating small and medium enterprises, and contributing significantly to government revenue. Formal sector activities in commerce, trade, and services are largely concentrated along the A14 Mombasa–Tanzania (Lunga-Lunga) Road. This corridor not only enhances access and mobility but also contributes to the economic development of Ukunda by serving as a strategic stopover for travelers and facilitating the movement of goods and services.

Agriculture in the area is practiced on a small scale, primarily for subsistence in the hinterland. The main food crops include maize and beans, while cash crops such as coconuts, citrus, mangoes, pineapples, and cassava are also cultivated. Fishing is practiced at a limited scale, mostly by local artisanal fishers. Along Diani Beach Road, the hospitality sector is highly developed, with numerous five-star hotels and resorts. These establishments are central to the local economy, supporting employment, business opportunities, and ancillary services, further reinforcing tourism as the core economic activity in Ukunda.

CHAPTER 5: CONSIDERATION OF ALTERNATIVES

5.1. Introduction

This section evaluates alternative approaches for undertaking the proposed shoreline protection project. Two fundamental options exist: (1) maintain the status quo (No-Project Option), or (2) implement measures to address the shoreline erosion problem (Project Option). If the project proceeds, it is essential to consider economic, ecological, and social factors in a balanced manner. Both the potential benefits and associated environmental and social impacts must be carefully weighed to identify the most effective and sustainable solution. The Alternative considerations included:

- No-Project Alternative
- Site Alternatives
- Technological Alternatives

5.2. No-Action Option

The no-project or no-action alternative involves taking no measures to control shoreline erosion or protect beachfront properties from storm damage. Under this scenario, the project objectives such as erosion control and protection of resort infrastructure would not be achieved. Key implications of the no-action option include:

- Ongoing threats to existing resort infrastructure along the shoreline would persist;
- Current shoreline erosion processes would continue unchecked.

Without intervention, the shoreline's vulnerability is expected to increase, potentially resulting in further undercutting, destabilization, and seaward collapse of beachfront areas exposed to high-energy wave events in the short- to medium-term. From an ecological perspective, the no-action scenario is not expected to generate significant impacts on benthic or terrestrial communities, as there are no critical nearshore habitats within the immediate project footprint. Significant benthic habitats, such as seagrass beds, are located sufficiently offshore to remain unaffected. However, the continued erosion poses a substantial risk to property, tourism infrastructure, and local economic activities.

The primary advantage of the no-action option is the avoidance of construction-related environmental impacts. Nonetheless, given the ongoing erosion, resort operations, marketability, and long-term viability of beachfront properties would be severely compromised. In the absence of engineered shoreline protection, the no-action alternative would lead to continued deterioration of the beach and associated coastal landforms due to wave, wind, and storm-induced processes.

5.3. Alternative Coastal Protection Measures

Several technical options are available for mitigating shoreline erosion were analyzed . One of the explored potential measures is the submerged nearshore breakwater, which functions by dissipating wave energy before it reaches the shoreline. By reducing the intensity of incoming waves, this option effectively minimizes beach erosion and protects the shore. It is particularly useful where beach preservation is the primary objective. However, submerged breakwaters are cost-intensive and require precise engineering to ensure stability and effectiveness. Additionally, these structures often demand ongoing maintenance to prevent displacement or degradation due to high-energy wave events, which can increase long-term operational costs.

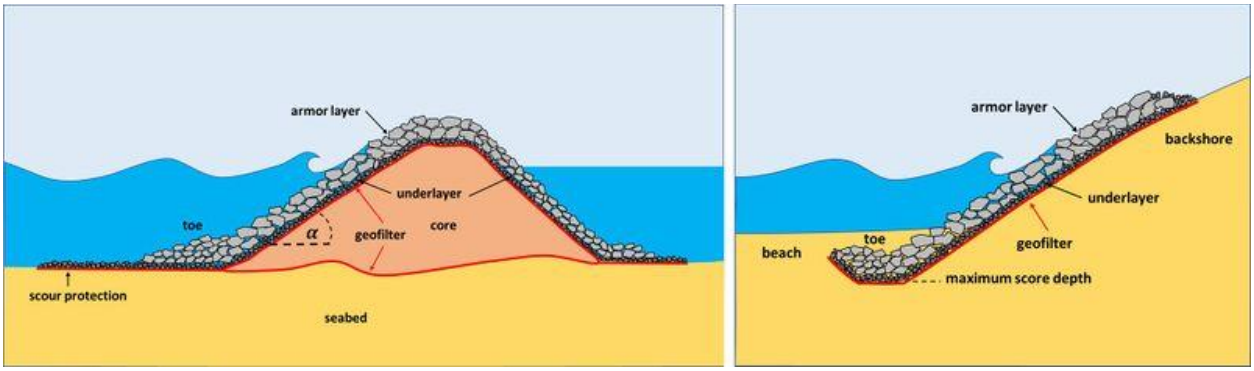


Figure 4: Typical Offshore Rubble-Mound Breakwater

Another option is the construction of seawalls, which provide a rigid vertical barrier along the shoreline to shield properties from wave attack. Seawalls are highly effective in high-energy coastal environments, offering immediate protection to infrastructure. Despite this advantage, seawalls can accelerate scouring at their base, potentially destabilizing the shoreline immediately in front of the structure. Furthermore, seawalls may interfere with natural sediment transport processes, resulting in long-term beach narrowing or loss if not carefully designed to accommodate local littoral dynamics.


Plate 5: Typical Sea Wall

Offshore breakwaters or artificial reefs represent another alternative. These structures reduce wave energy offshore and promote sediment deposition behind the reef, thereby contributing to beach stabilization. They are particularly suitable in areas where beach expansion and recreational use are priorities. However, offshore breakwaters or artificial reefs are significantly more expensive than nearshore alternatives. Their implementation often requires beach nourishment, the relocation or removal of existing coastal structures, and extensive engineering, all of which increase both financial and environmental costs. The potential for disruption to nearshore marine habitats also needs to be carefully assessed prior to construction.

Finally, revetments constructed from gabion band structures provide a flexible, environmentally compatible approach. Gabion revetments are rock-filled wire mesh structures that follow the natural slope of the beach, allowing them to dissipate wave energy gradually while minimizing interference with sediment transport. Unlike vertical seawalls, revetments absorb and diffuse wave forces, reducing erosion while maintaining the natural beach profile. This option is cost-effective, technically feasible, and adaptable, as it can utilize locally sourced rock and existing gabion units, reducing the need for imported materials. Gabion revetments are also less intrusive to offshore habitats, making them environmentally compatible, while effectively protecting infrastructure and minimizing sediment loss.

In conclusion, each shoreline protection measure presents a balance of technical feasibility, cost, and environmental impact. Submerged breakwaters and offshore reefs are effective for beach preservation but are expensive and require complex maintenance. Seawalls provide robust protection for high-energy coasts but may negatively affect sediment dynamics. Gabion revetments, by contrast, offer a practical, flexible, and environmentally sound solution that protects the shoreline, minimizes erosion, and can be implemented with locally available materials, making them particularly suitable for the Diani Beach project area

5.4. Preferred Alternative

The preferred shoreline protection measure for the project site is the installation of gabion band structures along the beachfront. This approach involves using locally sourced rock, making it both economically viable and technically effective for controlling shoreline erosion. While the initial cost may be slightly higher than simpler solutions, the long-term environmental benefits, protection of resort infrastructure, and stabilization of the beach justify the investment. Key mitigation measures to be observed during construction include:

- Ensuring that boulders or construction materials do not fall onto adjacent reef areas outside the project footprint;
- Minimizing marine environmental impacts during construction, including disturbance to nearshore flora and fauna;
- Controlling and monitoring oil spills, fuel leaks, and other potential contaminants from construction machinery to prevent water pollution and protect marine life.

Upon completion, the gabion band revetments are not expected to generate significant adverse impacts on coastal processes or the biophysical environment. These structures are designed to absorb and dissipate incident wave energy, offering effective protection against high-energy wave events. This will prevent shoreline scour, undercutting, and potential collapse, thereby safeguarding both the natural beach profile and beachfront properties. To ensure the long-term success of the intervention, a robust beach monitoring program is recommended. This program should track changes in littoral drift, storm impacts, beach morphology, and coastal processes, generating valuable data to guide adaptive management and future interventions. Continuous monitoring will help refine coastal protection strategies, mitigate emerging risks, and enhance the sustainability of shoreline management efforts over time.

Plate 6: Typical Beach Protection Using Boulder Revetment

CHAPTER 6: PUBLIC CONSULTATION, PARTICIPATION & INFORMATION DISCLOSURE

6.1. Introduction

Public participation is a vital component of the Environmental and Social Impact Assessment (ESIA) process and should be incorporated throughout the entire project lifecycle from design and construction to operation and eventual decommissioning. It provides an opportunity for stakeholders to express their opinions, concerns, and suggestions regarding the proposed project. This consultative and inclusive approach fosters transparency, enhances project acceptability, and ensures that decision-making is informed by the views and interests of the affected and interested parties.

6.2. Objectives of Public Consultation

Kenya, recognized as one of the African countries with a progressive constitution, upholds the public's right to participate in decision-making processes that may affect them. Article 10(2)(a) of the Constitution identifies public participation as a fundamental principle of governance. This commitment is further reflected in the Environmental Management and Coordination Act (EMCA), Cap 387, and the EMCA (Environmental Impact Assessment and Audit) Regulations of 2003, both of which contain clear and stringent provisions mandating public involvement in environmental decision-making processes. The process ensures that all stakeholders are provided with this opportunity as part of a transparent process which allows for a robust and comprehensive environmental study.

Public participation in Environmental and Social Impact Assessments (ESIA) is designed to provide sufficient and accessible information to Interested and Affected Parties (I&APs) in an objective manner, enabling them to understand the potential impacts of proposed projects and to contribute meaningfully to the decision-making process. Key objectives of public participation include but are not limited to:

- Disseminate information about the proposed project to the community members or project affected parties,
- Collect views and concerns to be considered in the ESIA,
- Evaluate community perceptions of the project's positive and negative impacts, and
- Gather concerns regarding Environmental and Social Impacts, as well as potential implementation challenges.

6.3. Identification of Interested and Affected Parties (I&APS) Stakeholders

This exercise was undertaken to ensure that all stakeholders likely to be affected or influenced by the Project were identified and involved in the detailed ESIA study. The table below presents details of stakeholders who were mapped and engaged in the ESIA process.

Institution	Stakeholder
Kwale County Government	Lands and Physical Planning Department
National Government	Local Administration, Senior Assistant Chief (Ukunda Sub-Location)
Other Interested Parties	Beach Management Unit officials Beach Operators (Diani Association of Boat Operators Representative) Project Affected Persons (PAPs), including landowners adjacent to Silver Sand Resort

To comply with the relevant statutes, consultations were conducted with key stakeholders within the project area during the preparation of the ESIA Project Report. Engagements with the public and other interested parties were carried out through public meetings, key informant interviews, and mobile phone discussions targeting affected parties. Summaries of the issues discussed, as well as the outcomes of these consultative meetings, are documented as minutes in the annexure.

CHAPTER 7: ANTICIPATED PROJECT IMPACTS AND MITIGATION MEASURES

7.1. Introduction

This Environmental and Social Impact Assessment (ESIA) has been systematically conducted to evaluate the potential adverse impacts of the proposed project on the environment. The assessment has been guided by the Environmental Management and Co-ordination Act (EMCA), Cap 387, which provides the legal and statutory framework for conducting environmental and social impact assessments in Kenya. The anticipated impacts presented in this chapter are based on a thorough analysis of the project environment in relation to the proposed development. Impacts are considered across all phases of the project, including construction, operation, and decommissioning, and have been categorized as follows:

- Impacts on the biophysical environment;
- Health and safety impacts;
- Socio-economic impacts, including potential loss of property;
- Impacts on the marine environment, including effects on marine life.

This chapter provides a structured framework for identifying, evaluating, and mitigating the potential environmental and social consequences of the project.

7.2. Definition and Classification of Environment Impact

An environmental impact is any change to the existing condition of the environment caused by human activity or an external influence. Impacts may be:

- Positive (beneficial) or negative (adverse);
- Direct or indirect, long-term or short-term in duration, and wide-spread or local in the extent of their effect.

Impacts are termed cumulative when they add incrementally to existing impacts. In the case of the project, potential environmental impacts would arise during the construction and the operations phases of the Project and at both stages positive and negative impacts would occur.

7.2.1. Positive Impacts during Construction Phase

The construction Phase normally includes Pre-Construction Phase and Construction Phase. Construction period depends on the nature of the Project activities and normally varies. The positive impacts are summarized below:

- Employment opportunities during construction, unskilled and mid-skilled level labor will be sourced from the local market. This will include employment opportunities;
- Provision of ready market for construction materials such as quarry stones (rock boulders) and cement that will be sourced from local market, this will lead to injection of money into the local economy
- The Project will be associated with technological and knowledge transfer to the local sector, this will be through the artisans who will be employed and trained by the Project;
- Protection of shoreline against unprecedented erosion threatening the investment and destruction of property.

7.2.2. Sensitive Receptors Likely to be impacted

The assessment identified key sensitive receptors located within close proximity between 100m to 500m to the proposed shoreline that might be affected by Project civil activities at the time of construction. The receptors might suffer damage associated with the Project activities, for instance, destruction of nesting grounds, pollution of the water resource. Likely impacts that the Project can pose to the receptors are summarized below.

- Health and Safety risks associated with accidents involving contractor’s equipment and plant, open excavations;

- Noise and excessive vibrations beyond 60 dBA;
- Narrowing public access beachline
- Sedimentation

7.3. Impact Identification and Analysis

Environmental Impact identification was made by a combination of matrices along with expert opinions and experiences from similar projects in the past. The environmental impacts were examined using an adaptation of the Leopold matrix method. The Leopold matrix (Leopold et al, 1971) implements a two-dimensional checklist, where the columns of the matrix contains the project's activities while the rows list the environmental receptors under the three main categories:–

- Physical components,
- Biological components, and
- Socio-economic and Cultural components.

This interaction matrix helps to identify impacts on individual factors of the three main categories of the impacts. This method analyses three aspects of each action which may have an impact on the environment: – Magnitude, Duration, and Probability.

- Probability – Likelihood of an impact to be produced from a said activity.
- Duration – Defines the duration of which the environmental impacts would persist.

Magnitude – Defines the severity of the impact, for both positive and negative. A score is given from a scale of +10 to -10. +10 being major positive and -10 being major negative impacts

7.4. Uncertainty and Limitations in Impact Prediction

Prediction of environmental impacts inherently involves a degree of uncertainty, as natural and human-induced impacts can vary spatially and temporally due to even minor differences in ecological, geomorphological, or socio-economic conditions at a given site. For the proposed retaining wall construction along the Diani shoreline, uncertainties arise from factors such as variability in wave energy, coastal sediment transport, and local hydrodynamic processes, which can influence shoreline response to engineering interventions. Additionally, there is a lack of long-term data on key parameters, including shoreline dynamics, nearshore currents, coastal erosion rates, and seasonal tourist activities. Such data are crucial for accurate prediction of both immediate and cumulative impacts of construction and operation phases.

Uncertainty is further compounded by the potential for changes to the project design or scope. Even minor modifications to the retaining wall alignment, dimensions, or construction methodology could alter the type, magnitude, and distribution of environmental impacts. Therefore, impact predictions should be interpreted with caution, and a flexible, adaptive management approach is recommended, including periodic monitoring and design adjustments to respond to observed coastal and environmental conditions.

7.5. Environmental Impact During Construction Phase

7.5.1. Socio-Economic Impacts

The proposed shoreline retaining wall project is expected to generate positive socio-economic impacts during the construction phase. Temporary employment opportunities will be created for skilled, semi-skilled, and unskilled laborers, with preference given to workers from the nearby communities. This will provide a direct source of income and contribute to the local economy.

In addition, local suppliers of construction materials such as rocks, sand, cement, and gabion materials will benefit from increased demand, resulting in further economic stimulation in the area. However, there are potential negative socio-economic impacts if appropriate mitigation measures are not implemented. For instance, sedimentation resulting from excavation or gabion placement could spread to nearby marine areas, including habitats used by marine life, particularly during adverse weather conditions. Such

impacts could indirectly affect stakeholders who rely on these resources for income, including local fishers or tourism operators. Given that the project involves small-scale excavation and construction confined to the existing shoreline footprint, the risk of sediment spreading is relatively low. Proper containment measures, such as localized sediment barriers and careful timing of construction activities during favorable tidal and weather conditions, will minimize disturbance to marine environments and protect livelihoods associated with nearby coastal resources.

Enhancement Measures

- Hire local labor to maximize economic benefits for the community.
- Procure construction materials from local suppliers where feasible.
- Implement sediment control measures to prevent dispersal into adjacent marine areas.
- Schedule construction during low tide and calm weather conditions to minimize impacts on the marine environment.
- Conduct community awareness programs to inform stakeholders about construction activities and potential impacts

7.5.2. Negative Impacts

The overall environmental impact of constructing the shoreline retaining wall is primarily negative, though most effects are temporary and manageable with proper mitigation. Key construction activities, including excavation, placement of revetments, and installation of gabion boxes, are likely to affect multiple environmental components. In terms of the physical environment, excavation and placement of gabion structures may temporarily disrupt the coastal zone, causing minor alterations to sand movement patterns along the beach and potentially disturbing nearshore coral reef habitats if materials are inadvertently placed outside the project footprint. The marine environment is expected to experience localized effects, mainly through sedimentation and disturbance, highlighting the need for careful site management to minimize turbidity and prevent damage to sensitive habitats.

Additionally, socio-economic and aesthetic impacts may arise, such as accident risks to workers and beach users, as well as temporary visual disruption affecting recreational activities. These social impacts are generally short-term and of lower magnitude compared to the physical disturbances associated with excavation and gabion placement.

Mitigation Measures: To minimize environmental impacts during the construction phase, the following measures should be implemented:

- Employ environmentally friendly construction techniques that minimize disturbance to the shoreline and marine habitats;
- Schedule construction activities to avoid sensitive periods for marine life, beach use, or peak tourist seasons;
- Implement strict safety protocols when handling heavy machinery, gabion materials, and tools to prevent accidents;
- Ensure that construction materials are securely placed to prevent them from rolling or washing into the marine environment;
- Conduct ongoing environmental monitoring to detect and manage potential impacts in real time.

7.5.3. Waste Management (Solid Wastes)

Improper management of solid waste during construction can have detrimental effects on both the marine and terrestrial environments. For the proposed shoreline retaining wall project, solid waste generated during the construction phase is expected to include organic waste, construction debris (inorganic materials), and hazardous substances such as paints, solvents, and lubricants. If not properly managed, these wastes can result in leaching into the coastal waters, potentially impacting nearshore coral reefs, increasing sedimentation, and causing localized pollution. Additionally, improper storage and disposal of waste can lead to air pollution and unpleasant odors, though such impacts are typically temporary in nature.

Mitigation Measures: To mitigate these potential impacts, the following measures will be implemented:

- All site personnel will undergo training on proper waste handling, segregation, storage, and disposal procedures, with emphasis on minimizing environmental harm and promoting general environmental stewardship.
- Solid wastes will be segregated at the source into organic, recyclable, and hazardous categories to facilitate proper handling and disposal.
- Hazardous wastes will be collected, stored in designated containment areas, and disposed of according to the Environmental Management and Co-ordination Act (EMCA), Cap 387, and the Waste Management Regulations, 2024. This ensures compliance with national standards for handling, transportation, and final disposal.
- Inorganic construction debris, such as excess rock, gabion mesh offcuts, and sand, will be reused where possible or transported to authorized disposal sites, minimizing environmental contamination.
- Regular site inspections will be conducted to ensure that waste management practices are adhered to, and corrective actions will be taken immediately if deviations occur.

7.5.4. Siltation and Sedimentation

Construction activities associated with the excavation of trenches and placement of gabion boxes for the shoreline retaining wall have the potential to disturb the soil structure and mobilize sediments. While the impact on soil along the project corridor is expected to be minor, shoreline wash during high tides and periods of strong winds particularly during the Southeast Monsoon season may lead to siltation and sedimentation in the adjacent marine environment. This could temporarily reduce water clarity and affect nearshore habitats, including coral patches and benthic communities.

Mitigation Measures

- Install temporary sand or silt barriers to prevent mobilized sediments from entering the marine environment;
- Locate construction compounds, material stockpiles, and spoil areas away from shallow shoreline zones to reduce direct sediment runoff;
- Ensure that all construction debris and materials are contained and removed promptly to prevent entry into the marine environment;
- Conduct regular monitoring and supervision of construction activities to ensure compliance with sediment control measures;
- Schedule major excavation and placement works to coincide with low tide periods and avoid the high-energy Southeast Monsoon season wherever possible;
- Adjust sediment control measures in response to observed turbidity or sediment transport patterns during construction.

7.5.5. Noise and Vibration

Temporary noise and vibration disturbances are expected during the construction phase of the shoreline retaining wall due to the operation of construction machinery. The primary sources of noise will include:

- Excavators for trenching and placement of foundation structures;
- Trucks and delivery vehicles transporting construction materials to the site.

No unusual or high-intensity noise sources are anticipated. Noise disturbances are expected to be localized and temporary, occurring primarily during active construction hours. The construction period is estimated to last approximately 4–6 months, and measures will be implemented to minimize impacts on nearby resorts, beach users, and local resident.

Mitigation Measures

- All equipment will be turned off when not in use to minimize unnecessary noise;
- Temporary hoarding and barriers will be installed around active work areas to reduce noise propagation;

- High-noise operations will be scheduled during daytime hours to minimize disturbance to resort guests and the public;
- Regular servicing of construction equipment will ensure efficient operation and reduce noise levels;
- Periodic noise monitoring will be conducted to ensure that levels remain within acceptable limits in accordance with national environmental standards (EMCA (Noise and Vibration) Regulation 2009.

7.5.6. Water Quality (Pollution)

The proposed construction of the shoreline retaining wall is not expected to pose significant risks to water quality, as all works are located at or above the High-Water Mark (HWM) and will be scheduled to consider tidal cycles. Boulders and gabion boxes will be placed in-situ, and repairs will utilize reinforced concrete applied in a controlled manner to prevent leaching or runoff into the marine environment. To further minimize potential impacts, a site-specific Construction Environmental Management Plan (CEMP) will be implemented, addressing:

- Storage and handling of fuels and lubricants, ensuring containment to prevent accidental spills
- Protection of adjacent watercourses and nearshore areas during construction;
- Controlled use of concrete and other construction materials to prevent accidental discharge into coastal waters;
- Wastewater management from construction activities to prevent contamination of the surrounding environment.

All works will comply with relevant environmental legislation, including the Wildlife Conservation and Management Act, 2013, and the Water Act, 2016, ensuring that both coastal and marine ecosystems are safeguarded during the construction process. With these measures, potential pollution of nearshore waters is expected to be minimal and short-term, while maintaining the ecological integrity of the shoreline.

7.5.7. Ecological Impact

The proposed construction of the shoreline retaining wall will be carried out along the shoreline adjacent to Silver Sands Hotel. The area within and immediately surrounding the project zone provides habitat for a few marine species, including marine animals that occasionally use the shoreline as nesting grounds. However, the site is heavily modified and largely urbanized, with ongoing commercial and tourism activities, and does not constitute a highly sensitive or ecologically critical environment. Vegetation is sparse, and natural habitats are fragmented, limiting the presence of significant marine fauna. While construction activities are largely confined to the existing coastal footprint, there is potential for temporary and localized disturbance to any marine species present, particularly during nesting or hatching periods. Such disturbances are expected to be minor due to the degraded nature of the habitat, the absence of critical or protected ecosystems, and the limited density of wildlife in the immediate area.

Mitigation Measures

- Schedule construction during periods of low marine animal activity, avoiding peak nesting or hatching times where feasible;
- Ensure revetment and construction debris remain strictly within the project footprint to prevent any intrusion into the nearshore environment;
- Limit noise, vibrations, and artificial lighting during construction to reduce potential stress on marine animals;
- Train construction workers on the presence of marine species and enforce protocols to avoid unnecessary disturbance;
- Conduct basic site inspections during construction to identify any inadvertent impacts on marine animals, with immediate corrective measures if required;
- Restore any minor areas of disturbed sand to a natural profile post-construction to maintain existing habitat conditions.

7.5.8. Landscape and Visual Impacts

The proposed coastal defence works along the shoreline may cause temporary disturbance to the landscape and visual amenity during the construction phase. Activities such as excavation, placement of gabion boxes/revetment, and movement of construction equipment may create a visual disruption for beach users and nearby resort guests. However, these impacts are short-term and confined to the construction period. Upon completion, the installation of gabion box structures will enhance the coastal landscape by providing a defined and stable shoreline. The completed works will offer long-term protection against shoreline erosion, wave attack, and flooding during extreme weather events, while integrating with the existing beach profile. The structures are designed to be visually compatible with the coastal environment, and careful placement and material selection will minimize visual intrusion, maintaining the aesthetic appeal of the beachfront area.

- Schedule works during periods of low visitor activity to minimize disruption to resort guests and beach users;
- Use temporary visual barriers or hoarding around active construction zones to reduce visual intrusion;
- Ensure that construction materials, debris, and equipment are neatly stored within the site boundary to prevent unsightly clutter;
- Implement daily clean-up routines to maintain the visual quality of the construction site;
- Select revetement materials and colors that blend with the natural beach and dune environment to reduce visual contrast;
- Restore disturbed sand and beach areas to a natural profile, and where feasible, introduce coastal vegetation behind the retaining wall to enhance aesthetic integration;
- Inform nearby stakeholders and resort operators of construction schedules and expected visual changes to reduce complaints and improve acceptance

7.5.9. Workers, Community Health and Safety Risks

Workers' and community health and safety risks are commonly associated with construction-phase activities, affecting both on-site personnel and the nearby community. Effective management of these risks is guided by the Occupational Health and Safety Act (OSHA, 2007), Public Health Act, Noise and Excessive Vibration Regulations (2009), Air Quality Regulations (2024), and Waste Management Regulations (2024). Potential risks include improper handling and disposal of solid and liquid wastes, generation of excessive noise and vibrations from machinery, dust and air pollution, and the risk of accidents at the work site. Improper waste management can lead to contamination of soil, groundwater, and nearshore marine environments, while mishandling of hazardous materials such as fuels, lubricants, and chemicals can further increase environmental and health risks. Noise and vibration from excavation, revetment placement, and heavy vehicle movement may cause temporary discomfort to workers and nearby resort guests. Dust generation from material handling and movement of construction vehicles can reduce air quality and pose respiratory risks. Accidents such as slips, trips, falls, or equipment-related injuries may occur, with potential impacts extending to the public if beach access is not properly controlled.

Mitigation Measures

- Ensure proper storage, segregation, and disposal of solid and liquid wastes in accordance with EMCA (Waste Management Regulations, 2024). Hazardous materials must be stored securely and handled by trained personnel.
- Limit noisy operations to daytime hours, maintain machinery in good condition, and use temporary noise barriers where needed.
- Apply water spraying on exposed soils, maintain haul roads, and cover transported materials to reduce dust generation.
- Provide personal protective equipment (PPE) to all workers, enforce safe working procedures, and ensure proper training in handling machinery and construction materials.
- Restrict public access to active construction zones using hoarding or signage and inform the nearby community of construction schedules and potential hazards.

- Establish a site-specific health and safety plan including first aid, emergency response procedures, and reporting mechanisms for incidents.

7.6. Environmental Impact During Operation Phase

Upon completion, the shoreline retaining wall is not expected to generate any significant negative impacts on coastal processes, benthic habitats, or terrestrial ecosystems. The project will provide long-term benefits by dissipating wave energy and stabilizing the shoreline, thereby protecting adjacent beachfront properties and infrastructure from erosion and storm-related damage. No impacts to nearshore or offshore water quality are anticipated, as the construction footprint is confined to the shoreline and does not interfere with water circulation or sediment transport beyond the project site. Minimal, localized impacts to marine habitats may occur immediately adjacent to the retaining wall due to slight shading or changes in wave dynamics, but these are expected to be negligible and will not compromise the ecological integrity of the area.

Similarly, no significant negative impacts on terrestrial habitats are expected, as the project site is heavily modified and urbanized, lacking natural vegetation or sensitive wildlife habitats. Overall, the operation phase of the project will result in environmental benefits, contributing to long-term shoreline stabilization, improved coastal resilience, and the protection of existing infrastructure.

7.6.1. Changes to Shoreline Morphology

The installation of shoreline revetments may alter natural coastal processes, including the movement of currents and sediment along the shoreline. Such changes can lead to localized erosion or increase, representing a potential long-term impact if coastal protection structures are not optimally designed. While the project is intended to stabilize the shoreline, poorly designed or misaligned structures could inadvertently exacerbate beach erosion in certain areas. Additionally, the presence of coastal protection structures may influence the visual landscape; this impact is subjective and may be perceived as positive or negative, with the overall magnitude considered negligible.

Mitigation Measures

- Implement a robust environmental monitoring program to regularly track changes in shoreline morphology, sediment movement, and the adjacent marine and terrestrial environments.
- Make adaptive adjustments to the coastal protection structures as necessary based on monitoring results.
- Undertake additional beach nourishment, where practicable, to counteract localized erosion and maintain beach stability.

7.6.2. Sediment Transport Regime

The general longshore sediment transport along the project shoreline appears to be in a northerly direction, as indicated by the accumulation of sand and the comparatively wider beach observed in the northern sections. This pattern aligns with local current circulation and prevailing wave directions associated with the Northeast and Southeast Monsoon winds, as reported by residents.

Sediment particle sizes vary along the shoreline, with larger grains observed in the southern section. This suggests that the southern area experiences higher wave energy, resulting in greater sediment mobilization and transport, as well as increased susceptibility to coastal erosion. The proposed installation of retaining beach wall and revetments may influence these natural sediment transport processes, potentially causing localized erosion or deposition if not properly accounted for in design and placement.

Mitigation Measures:

- Ensure that adequate beach sediment is replenished along the entire length of the shoreline retaining wall to maintain natural sediment balance.
- Implement periodic monitoring of sediment movement and beach profiles to detect and address any unintended erosion or deposition patterns early.

- Where necessary, undertake targeted beach nourishment in areas showing significant sediment loss to maintain shoreline stability and beach usability.

7.6.3. Impact of Wave Energy

The proposed stepped retaining wall will feature a back-splash reflector face, providing an effective means of coastal protection. This design helps to physically safeguard the structures behind it, while serving as a medium for wave breaking and energy dissipation, reducing the potential for shoreline erosion. Proper horizontal and vertical positioning of the wall, along with an appropriate slope gradient, is essential to ensure that waves break safely along the structure rather than at its toe, which could compromise stability and lead to scour.

Given the relative vulnerability of the coastline to storm events and high-energy waves, the toe of the structure requires additional protection. This can be achieved using a rubble mound, concrete units, or other suitable armoring techniques to prevent undermining and ensure long-term stability. The correct design and placement of the gabion wall, combined with ongoing beach sediment management, are critical for maintaining shoreline resilience.

Mitigation Measures:

- Provide adequate design protection to the toe of the revetement using rubble mound, concrete units, or equivalent stabilizing methods.
- Ensure placement of sufficient beach sediment along the entire length of the structure to maintain natural beach profiles and support sediment transport processes.
- Conduct periodic inspections and maintenance of the wall and beach sediment levels to address any localized erosion or structural issues promptly.

CHAPTER 8: ENVIRONMENTAL AND SOCIAL MANAGEMENT AND MONITORING PLAN (ESMMP)

8.1. Introduction

This chapter of the Environmental Study provides an outline of the arrangements that will be implemented to ensure that mitigation measures and other actions to control or reduce predicted impacts are properly executed and effective.
This section describes the environmental management requirements for the operation of the proposed revetment construction along the shoreline at Diani, Kwale County. The ESMP provides an environmental management framework to comply with the requirements of the Environmental Management and Coordination Act, Cap 387, relating to the prevention, abatement, and mitigation of environmental impacts resulting from the operation of the proposed project.

8.2. Objective of the Environmental and Social Management Plan (ESMP)

The ESMP provides a structured framework to ensure that environmental, social, and safety considerations are integrated into all stages of the proposed shoreline revetment construction project at Diani, Kwale County. Its primary goal is to ensure that sound environmental practices are adopted, compliance with statutory requirements is achieved, and mitigation measures identified in the Environmental and Social Impact Assessment (ESIA) report are effectively implemented during both the construction and operational phases of the project. Specifically, the objectives of the ESMP are to:

- Ensure Regulatory Compliance;
- Prevent and Mitigate Environmental Impact;
- Promote Sustainable Construction and Operational Practices;
- Establish Environmental Monitoring and Audit Program;
- Enhance Stakeholder Engagement and Social Responsibility; and
- Facilitate Adaptive Management

8.3. Roles and Responsibilities

The ESMP describes mitigation measures and is partly prescriptive, identifying specific people to undertake specific tasks, in order to ensure that impacts on the environment are minimized during the proposed project. This section outlines the roles and responsibilities of those involved in the project and the reporting procedures to be followed.

a) **Construction Contractors:** Contractors will be responsible for the installation. They will be responsible for implementing all the Health, Safety and Environment (HSE) requirements and environmental management procedures relevant to the tasks.

b) **Safety Health Environmental and Quality (SHEQ) Manager**: The SHEQ Manager will be Silver Sand employee who will be responsible for reviewing and approving the Contractors Health Environment and Safety Plan as well as their Safe Work Practices Procedures. The SHEQ Manager will conduct random safety audits during the construction.

Project Component / Impact	Mitigation Measure	Responsible Party	Monitoring Indicator	Monitoring Frequency	Estimated Cost
Construction Phase					
Solid Waste Management	• All site personnel will undergo training on proper waste handling, segregation, storage, and disposal procedures, with emphasis on minimizing environmental harm and promoting general environmental stewardship. • Solid wastes will be segregated at the source into organic, recyclable, and hazardous categories to facilitate proper handling and disposal. • Hazardous wastes will be collected, stored in designated containment areas, and disposed of according to the Environmental Management and Co-ordination Act (EMCA), Cap 387, and the Waste Management Regulations, 2024. This ensures compliance with national standards for handling, transportation, and final disposal. • Inorganic construction debris, such as excess rock, gabion mesh offcuts, and sand, will be reused where possible or transported to authorized disposal sites, minimizing environmental contamination. • Regular site inspections will be conducted to ensure that waste management practices are adhered to, and corrective actions will be taken immediately if deviations occur	Contractor / SHEQ Manager	Waste properly disposed; no waste in marine or shoreline environment	Daily for active waste generation; Weekly reporting	
Liquid Waste / Effluent	• Install temporary sand or silt barriers to prevent mobilized sediments from entering the marine environment; • Locate construction compounds, material stockpiles, and spoil areas away from shallow shoreline zones to reduce direct sediment runoff; • Ensure that all construction debris and materials are contained and removed promptly to prevent entry into the marine environment; • Conduct regular monitoring and supervision of construction activities to ensure compliance with sediment control measures; • Schedule major excavation and placement works to coincide with low tide periods and avoid the high-energy Southeast Monsoon season wherever possible; • Adjust sediment control measures in response to observed turbidity or sediment transport patterns during construction	Contractor / Site Supervisor	Functioning of on-site sanitation; absence of effluent leakage	Weekly inspections	

Project Component / Impact	Mitigation Measure	Responsible Party	Monitoring Indicator	Monitoring Frequency	Estimated Cost
Noise and Vibration	• All equipment will be turned off when not in use to minimize unnecessary noise; • Temporary hoarding and barriers will be installed around active work areas to reduce noise propagation; • High-noise operations will be scheduled during daytime hours to minimize disturbance to resort guests and the public; • Regular servicing of construction equipment will ensure efficient operation and reduce noise levels; • Periodic noise monitoring will be conducted to ensure that levels remain within acceptable limits in accordance with national environmental standards (EMCA (Noise and Vibration) Regulation 2009	Contractor / SHEQ Manager	Noise levels at nearest receptors; compliance with OSHA 2007 noise standards	Daily during active machinery use; weekly summary reporting	
Air Quality / Dust	• Regular spraying of water on exposed soil surfaces prior to excavation shall be undertaken to minimize particulate emissions, • Periodic wetting of internal access roads to suppress dust nuisance and maintain safe air quality levels shall be undertaken, • Enforce a maximum speed limit of 30 km/h for all construction vehicles on site and display appropriate speed limit signage at strategic points, • Provide suitable Personal Protective Equipment (PPE) such as dust masks and strictly enforce compliance with PPE use, especially for workers engaged in excavation and soil handling, • Conduct routine visual inspections of dust emissions from excavation areas and haul roads, with immediate corrective actions implemented if excessive dust is observed, and • Ensure construction vehicles and machinery are well maintained and regularly serviced to minimize exhaust emissions and improve fuel efficiency.	Contractor / Environmental Officer	Dust levels; visibility impairment	Daily during dry periods or high activity	
Worker Health and Safety	• Ensure proper storage, segregation, and disposal of solid and liquid wastes in accordance with EMCA (Waste Management Regulations, 2024). Hazardous materials must be stored securely and handled by trained personnel. • Limit noisy operations to daytime hours, maintain machinery in good condition, and use temporary noise barriers where needed.	Contractor / SHEQ Manager	PPE compliance; accident reports; first-aid records	Daily	

Project Component / Impact	Mitigation Measure	Responsible Party	Monitoring Indicator	Monitoring Frequency	Estimated Cost
	• Apply water spraying on exposed soils, maintain haul roads, and cover transported materials to reduce dust generation. • Provide personal protective equipment (PPE) to all workers, enforce safe working procedures, and ensure proper training in handling machinery and construction materials. • Restrict public access to active construction zones using hoarding or signage and inform the nearby community of construction schedules and potential hazards. • Establish a site-specific health and safety plan including first aid, emergency response procedures, and reporting mechanisms for incidents.				
Visual / Landscape Impacts	• Schedule works during periods of low visitor activity to minimize disruption to resort guests and beach users; • Use temporary visual barriers or hoarding around active construction zones to reduce visual intrusion; • Ensure that construction materials, debris, and equipment are neatly stored within the site boundary to prevent unsightly clutter; • Implement daily clean-up routines to maintain the visual quality of the construction site; • Select revetement materials and colors that blend with the natural beach and dune environment to reduce visual contrast; • Restore disturbed sand and beach areas to a natural profile, and where feasible, introduce coastal vegetation behind the retaining wall to enhance aesthetic integration; • Inform nearby stakeholders and resort operators of construction schedules and expected visual changes to reduce complaints and improve acceptance	Contractor / Environmental Officer	Construction site tidiness; public complaints	Weekly	
Water Quality / Pollution	• Storage and handling of fuels and lubricants, ensuring containment to prevent accidental spills • Protection of adjacent watercourses and nearshore areas during construction; • Controlled use of concrete and other construction materials to prevent accidental discharge into coastal waters; • Wastewater management from construction activities to	Contractor / Environmental Officer	Absence of oil/fuel spills; turbidity levels in nearshore water	Daily during active works	

Project Component / Impact	Mitigation Measure	Responsible Party	Monitoring Indicator	Monitoring Frequency	Estimated Cost
	prevent contamination of the surrounding environment				
Ecological Impact	• Schedule construction during periods of low marine animal activity, avoiding peak nesting or hatching times where feasible; • Ensure revetment and construction debris remain strictly within the project footprint to prevent any intrusion into the nearshore environment; • Limit noise, vibrations, and artificial lighting during construction to reduce potential stress on marine animals; • Train construction workers on the presence of marine species and enforce protocols to avoid unnecessary disturbance; • Conduct basic site inspections during construction to identify any inadvertent impacts on marine animals, with immediate corrective measures if required; • Restore any minor areas of disturbed sand to a natural profile post-construction to maintain existing habitat conditions				
Operation Phase					
Shoreline Morphology & Sediment Transport	• Implement a robust environmental monitoring program to regularly track changes in shoreline morphology, sediment movement, and the adjacent marine and terrestrial environments. • Make adaptive adjustments to the coastal protection structures as necessary based on monitoring results. • Undertake additional beach nourishment, where practicable, to counteract localized erosion and maintain beach stability	Project Engineer / Environmental Officer	Shoreline profile; beach width; erosion/accretion rates	Quarterly; after major storms	
Wave Energy & Structural Integrity	• Provide adequate design protection to the toe of the revetement using rubble mound, concrete units, or equivalent stabilizing methods. • Ensure placement of sufficient beach sediment along the entire length of the structure to maintain natural beach profiles and support sediment transport processes. • Conduct periodic inspections and maintenance of the wall and beach sediment levels to address any localized erosion or structural issues promptly	Project Engineer / Contractor	Structural integrity; signs of wave undercutting	Annual; After high-energy events	
Sediment Transport	• Ensure that adequate beach sediment is replenished	Environmental Officer, Project	Shoreline profile changes (erosion/accretion	After major storm events or high	

Project Component / Impact	Mitigation Measure	Responsible Party	Monitoring Indicator	Monitoring Frequency	Estimated Cost
Regime	along the entire length of the shoreline retaining wall to maintain natural sediment balance. • Implement periodic monitoring of sediment movement and beach profiles to detect and address any unintended erosion or deposition patterns early. • Where necessary, undertake targeted beach nourishment in areas showing significant sediment loss to maintain shoreline stability and beach usability	Engineer, Site Supervisor	measurements) Beach width and slope along the project stretch Sediment particle size distribution along the shoreline	wave energy events	
Marine Environment / Ecology	• Conduct quarterly surveys of marine species in the nearshore area, recording presence, abundance, and behavior. • Focus on indicator species sensitive to sedimentation or shoreline modification, such as sea turtles, crabs, and small benthic organisms. • Record any mortality, nesting disruption, or unusual behavior that may indicate environmental stress • Maintain beach and revetment structures to prevent erosion and runoff into the marine zone. • Conduct visual inspections and, where feasible, turbidity measurements at nearshore waters, especially after storms or maintenance events.	Environmental Officer / Contractor	Presence of marine species; health of benthic habitats	Quarterly; intensified during nesting season	

8.4. Environmental and Social Monitoring Plan

The purpose of the Environmental and Social Monitoring Plan for the proposed project is to initiate a mechanism for implementing mitigation measures for the potential negative environmental impacts and monitor the efficiency of these mitigation measures based on relevant environmental indicators. The Environmental and Social Management Plan identified certain roles and responsibilities for different stakeholders for implementation, supervision and monitoring. The objectives of the Environmental and Social Monitoring Plan therefore are:-

- To ensure that the recommendations in the approved ESIA report are adhered to by the various institutions
- To ensure that the environmental and social mitigation and their enhancement actions are well understood and communicated to all stakeholders involved;
- To ensure that the proposed environmental and social remedial measures are implemented during the project execution stage; and
- To evaluate the effectiveness of environmental and social remedial measures.

Equally, environmental monitoring provides feedback about the actual environmental impacts of the project. Monitoring results also help judge the success of mitigation measures in protecting the environment. A monitoring program, backed up by powers to ensure corrective action when the monitoring results show it is necessary, is a proven way to ensure effective implementation of mitigation measures. By tracking the project's actual impacts, monitoring reduces the environmental risks associated with the project and allows for project modifications to be made where required.

Table 4: Monitoring Programme

Phase	Environmental Component	Parameters to be monitored	Location	Measurements	Frequency
Construction phase	Water Quality (Sedimentation)	Suspended materials/ sediment. Water transparency (Secchi disk)	All construction site along the shoreline	Water transparency (Secchi disk) Visual observations	Daily Operations
	Noise Pollution	Noise level	Work site	Level of noise (Using sound level meter) Documentation on complaints about noise	During the construction period
	Health and Safety Risks	Appropriate signage and demarcated areas	Construction site	Level of community awareness	During the construction period
	Social Disturbances and Benefits	Mechanisms in place for Community concerns to be recorded	Works sites	Level of awareness And compliance	Ongoing
	Site Related Oil Spills	Presence of oil spillage due to the construction activities	Along the shoreline	Physical inspection Number of complaints	Monthly
Operational Phase	Impact on sediment transport process	Beach profiles using levels at designated locations	Beachline	Beach profiles as outline in the Survey Act Cap 299. Beach dynamics	4 months
	Siltation	Quantity of sediment	Benthic areas	Quantitative assessment of sediment loading using Sediment traps	After 2 months, there after once a year

	Erosion	Undercuts	Along the shoreline	Observation	Periodically

CHAPTER 9: CONCLUSION AND RECOMMENDATIONS

9.1. Conclusion

The Environmental Impact Assessment for the proposed construction of the shoreline retaining wall along the Silver Sands Hotel shoreline indicates that the project is largely compatible with the surrounding coastal environment and existing land use. The construction activities are expected to have minor to moderate environmental impacts, primarily localized within the immediate construction footprint. Key physical impacts include temporary alterations to sediment transport along the shoreline and minor disturbances to benthic communities, which are estimated to affect approximately 2% of the lagoon and reef-flat area. These impacts are expected to be short-term and manageable through proper construction practices, including sediment control and careful placement of revetment materials.

The marine environment, while not highly sensitive in the project area, could experience temporary disturbances; however, with mitigation measures in place, these effects are expected to be minimal and localized. Socially, the project may temporarily affect the operations of nearby resorts and beach users, but the overall development is recognized as necessary to protect the shoreline from erosion, thereby safeguarding infrastructure and supporting long-term socio-economic benefits. Overall, the proposed shoreline retaining wall offers significant benefits in terms of coastal protection, shoreline stabilization, and preservation of economic and social assets, while the environmental impacts remain limited, short-term, and manageable with appropriate mitigation and monitoring measures.

9.2. Recommendations

Based on the findings of this Environmental Impact Assessment, the proposed shoreline protection project is expected to provide significant benefits in safeguarding beachfront infrastructure and mitigating coastal erosion. To ensure the long-term effectiveness of the intervention and minimize environmental impacts, the following recommendations are proposed for implementation during the construction and operational phases.

- Monitoring programme focusing on sedimentation levels on the reef, water quality and clarity, lateral shoreline erosion, and beach profile changes. This programme should commence immediately upon approval of the EIA and continue throughout the operational phase to ensure the effectiveness of the shoreline protection measures,
- An active monitoring and evaluation system should be maintained to track the performance of the shoreline protection measures. Lessons learned from the monitoring programme should be integrated into broader coastal management initiatives along the shoreline,
- Longer-term strategies should be developed to enhance shoreline resilience, support climate change adaptation, and harmonize beach protection measures. This may include complementary interventions such as the construction of artificial reefs or other sustainable coastal protection structures.

The project is environmentally and socially feasible, provided that all recommended mitigation and monitoring measures are strictly implemented during the construction and operational phases. Long-term monitoring of coastal processes, sediment transport, and marine life should continue to ensure the effectiveness of the revetment and to inform any necessary adaptive management actions. In conclusion, the proposed shoreline retaining wall will significantly enhance shoreline protection, reduce erosion risks, and support sustainable coastal development while maintaining minimal environmental disruption.

APPENDICES

Annex (A): Water Resources Authorization Report

WATER RESOURCES AUTHORITY

Coastal Athi Sub Region,
P.O. Box 41090 – 80100,
Mombasa– Kenya.

Tel: 0797545995
Email: mombasawra2018@gmail.com
Website: www.wra.or.ke

SITE ASSESSMENT FOR CONSTRUCTION OF A RETAINING WALL ON PLOTS L. R. NO. 1816,1817&1818 IN DIANI AREA MSAMBWENI SUB-COUNTY IN KWALE COUNTY

The site as seen from the shoreline

Project Name: Proposed Retaining Wall

Proponent: Silver Sands Kenya Limited

P.O. BOX _____

Diani

Contents

Introduction

This is a site assessment report for proposed construction of a retaining wall along the riparian reserve for Plots No. 1816,1817& 1818 in Diani area, Diani Beach, Msambweni Sub-County, Kwale County belonging to Silver Sands Kenya Limited.

By virtue of this parcel of land bordering a water body (Indian Ocean), it justifies the rationale behind consulting Water Resources Authority (WRA) to offer guidance with regard to Indian Ocean Riparian Reserve in the best interest of the riparian habitat and safeguarding the plot from erosion as a result of the powerful wave action.

Water Resources Authority is the lead agency tasked with regulation and management of water resources by the Government of Kenya as indicated in the Water Act 2016 Section 6. A water resource in the Act is defined as any lake, pond, swamp, marsh, stream, watercourse, estuary, aquifer, artesian basin or other body of flowing or standing water, whether above or below the ground, and includes sea water and transboundary waters within the territorial jurisdiction of Kenya.

Water Act 2016 describes riparian habitat as the dynamic complex of plant, animal and micro-organism communities and their non-living environment adjacent to and associated with a watercourse while Water Resources Regulation 2021 define "riparian area" as land which by virtue of the proximity of the land to a water body, management obligations shall be imposed on the owner of the land by the Authority;

Further in the Act Section 22. (1) specifies that Where the Authority is satisfied that in order to conserve a vulnerable water resource, special measures are necessary for the protection of a catchment area or a part thereof, it may by Order published in the Gazette declare such catchment area to be a protected area. (2) The Authority may impose such requirements or regulate or prohibit such conduct or activities, in or in relation to the protected catchment area as the Authority may consider necessary for the protection of the area and its water resources. Riparian reserve at Diani Beach area forms the area to be protected in this case.

Objective

To carry out site assessment prior to construction of a retaining wall along the shoreline of Plots No 1816,1817 &1818 in Diani, Diani Beach, Msambweni Sub-County, Kwale County.

Site Description

WRA officers visited the site on Friday 14th Marc 2025, for site survey, consultation with the proponent on site and subsequent preparation of a field report.

The site is located in Diani, at Diani Beach off Beach Road, approximately 350 meters to the east of the road branching at the Trade Winds sign board. The site is right behind Trade Winds Lodge, it neighbors Kivulini Beach Villa and Cottages to the north and Diani Sea Resort to the south.

By the time of this site visit, no development was ongoing and the entire plot is covered with thick shrubs, casuarina and palm trees. The shoreline has been fenced by use of wooden planks covering the entire length along the beach and the proponent intends to construct a retaining wall to safeguard his plot from erosion by wave action.

GPS Coordinates taken of the stretch where the proposed retaining wall will be constructed are as follows;

Point_Name	X (m)	Y (m)	Z (m)
Edge_North	564666	95242095	8
Edge_South	564543	9523921	7

The blue line shows the length of the plot to be protected by the retaining wall

Discussion

A beach retaining wall reinforces the line between the water and the shore by building a physical wall. When water crashes against the coast, it breaks it down over time causing land to recede overtime. With a retaining wall in place, the land is safeguarded from erosion and remains intact.

Construction of such structures should be done in such a way thay they do not interfere with the riparian ecosystems that serve the following functions;

- **Water Quality enhancement**: The use of riparian areas for pollution abatement is well documented and vegetated buffers are known to be efficient and cost effective, this may help in reducing adverse effects to marine life from untreated effluent discharge

- **Slope stability at the shoreline**: Vegetation affects both the surficial and mass stability of slopes in significant and important ways, ranging from mechanical reinforcement and restraint by the roots and stems to modification of slope hydrology as a result of soil moisture extraction via evapotranspiration. Vegetation, once established, provides a self-perpetuating and increasingly effective permanent erosion control. Removal of the vegetation that helps to stabilize the face, or excavation along the face, increases the chance of slumping, which results in imperiled structures, lost land, a disruption to the ecological edge-zone, and increased sedimentation to the aquatic environment.

- **Sediment Control:** The control of sediments entering waterways is one of the most commonly identified functions of riparian areas in freshwater and coastal riparian studies. Most discussions of sediment control are addressed in the context of functional mechanisms of pollution abatement and soil stability provided by riparian buffers. In addition to the various pollutants associated with sediments, fine sediments can have a dramatic physical effect on aquatic organisms. Siltation can clog the breathing apparatus (i.e., gills) of fishes and invertebrates, inhibit proper respiratory function in eggs and larvae (suffocation), alter substrates, and bury benthic organisms. The inherent qualities of riparian vegetation to slow runoff, stabilize soils, take up nutrients and other contaminants, and reduce siltation are common knowledge and serve even greater functions in protecting water bodies from contamination.

- **Wildlife Habitat:** Healthy (i.e., intact and functional) riparian systems along marine shorelines support abundant and diverse assemblages of wildlife. Many wildlife species are dependent upon riparian areas for their entire life cycle, with requirements for feeding, breeding, refuge, cover, movement, migration, and climate that are intricately interwoven into the ecological balance of riparian structure, functions, and processes.

Conclusion and Recommendations

- Carry out an Environmental Impact Assessment for the proposed retaining wall, WRA will make sectoral comments once the Environmental Impact Assessment Project Report is in place and has been submitted to National Environment Management Authority (NEMA)

- The proponent is advised to adhere to Water Act Section 143. (1) (b) not to throw, convey, cause or permit to be thrown or conveyed, any rubbish, dirt, refuse, effluent, trade waste or other offensive matter or thing into or near to

any water resource in such manner as to cause, or be likely to cause, pollution of the water resource.

- The proponent is advised to conserve and maintain the riparian reserve and ensure, the activities to be undertaken within the riparian area are those with zero impact on its ecological status and integrity. The following activities are specifically proscribed in a protected area:

    1) Tillage or cultivation;
    2) Clearing of indigenous trees or vegetation;
    3) Building of permanent structures
    4) Disposal of any form of waste;
    5) Excavation of soil or development of quarries;
    6) Planting of exotic species that may have adverse effect to the water resource.

- The proponent is advised to seek approval from WRA to carry out a proscribed activity listed above if need be. Further development will require the opinion of WRA in the best interest of conserving the riparian reserve in this area.

Susan Mwangi

Ag. Sub-Basin Area Coordinator

Annex (B): Land Ownership Documents

Annex (C) Certified Bill of Quantity (BOQ)

Annex (D): Architectural Drawings

Annex (F): Firm and Lead Expert NEMA Practicing License