Environment and Social Impact Assessment Study (ESIAS)

Tanzania
Dar es Salaam - Zanzibar

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1.1 - INTRODUCTION

This document is a summary of the Environmental and Social Impact Assessment (ESIA) study reports for Submarine Cable System.

1.2 - EIA APPROACH

A comprehensive EIA process was carried out for the Project. The EIA process and reports were structured to meet the requirements in the respective countries.

Three separate reports were prepared and submitted to support the Project's application for environmental authorization in Seychelles, Kenya and Tanzania.

1.3 - POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

The cable will be installed in international waters as well as the national waters of Seychelles, Kenya and Tanzania. The Project will interact with both the marine and terrestrial environments. The Project would thus be subject to:

- Seychelles, Kenya and Tanzania administrative and legal requirements;
- International conventions and standards to which Seychelles, Kenya and Tanzania are signatory and with which the Project must therefore comply.

1.4 - PROJECT DESCRIPTION AND JUSTIFICATION

Project location

The submarine cable system would include installation of approximately 2 000 km of subsea cable running from Beau Vallon, Seychelles to shore crossing and landing sites in a east African country: Mombasa in Kenya or Dar es Salaam and Zanzibar in Tanzania (**Figure 1**).

The cable consists of an inner optical fibre, surrounded by a polyethylene or fibreglass core for strength and fibre separation.

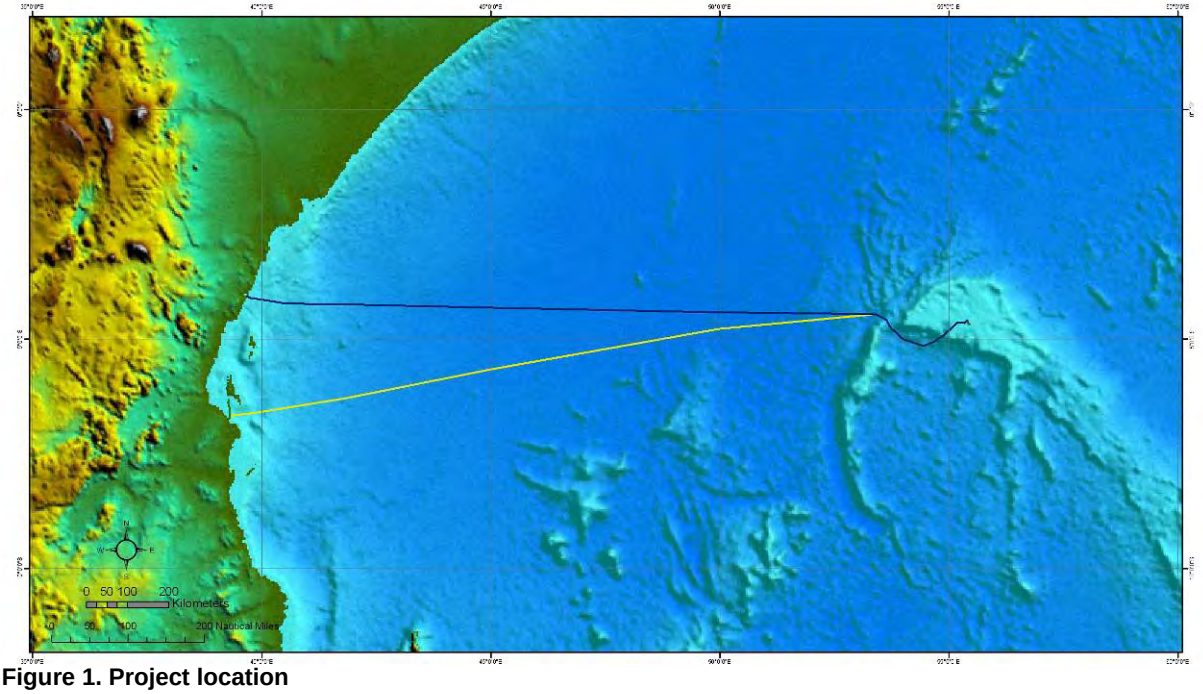


Figure 1. Project location

Seychelles landing site

The landing site in Seychelles is located at Beau Vallon (4°36.692' S, 55°25.793'E) (Figure 1).

View to west from the preferred landing site, Beau Vallon, Mahé

Kenya landing site

The GPS measured coordinates of the existing manhole at Fort Jésus are: 04º 03.715’ S, 39º 40.814’ E.

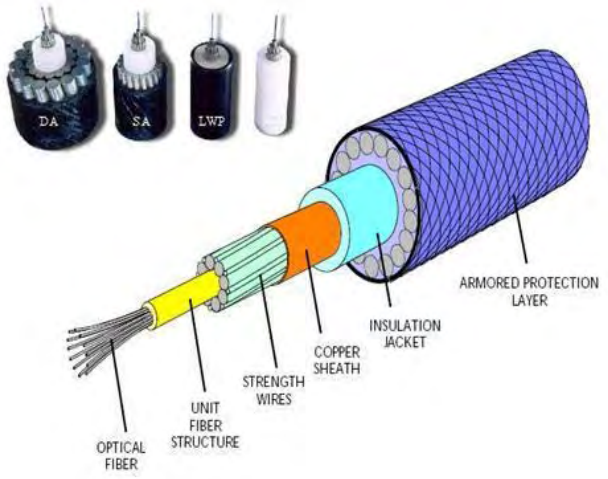
Tanzania landing site (Dar es salaam and Zanzibar)

The landing sites in Tanzania are located at (Figure 1): Dar es Salaam (Msasani Bay): 6°45.633’ S, 39°15.689’ E Zanzibar (Fumba): 6°19.118’ S, 39°17.145’ E

View to west from the preferred landing sites, Dar es Salaam (Msasani Bay) left and Zanzibar (Fumba) right

System components

The project comprises the laying of a subsea comminication between Seychelles and the East coast of Africa (Kenya or Tanzania). The Project will have direct benefits through the increase in available international transmission capacity and the lower cost for such access.



Installation

Prior to installation of the cable, a marine geophysical survey will be performed to investigate the safest route for the cable system. A detailed topographic survey will be performed to assess the conditions and feasibility of the landing. A limited seabed sampling program will also be conducted to supplement the side-scan sonar and subbottom profiler data in the areas where the cable will be buried.

For installation, a built ship will accurately place the cables on or under the seabed along the route determined by the pre-installation survey. Shallow water laying may be aided by scuba divers while deepwater laying is sometimes aided by remote operated vehicles. Due to the shallow water depth, cable burial at each of the shore ends may be undertaken by excavation of a trench using a single grab dredger and through the placing of the cable within the trench by divers. Offshore, cables would be buried in a narrow (<1 m wide) trench that would be cut by a water jet or plough while the cable is being laid.

Operations

Once in place and connected, the cable system requires no intervention. Cable repair and maintenance may be required as a result of damage…

Decommissioning

A full decommissioning plan will be developed near the end of the Project's expected 25-year lifetime. The plan will be based on best practices at the time and with consideration of environmental and safety issues.

Project justification

The proposed Submarine Cable System would include a new open-access fibre-optic submarine cable system which would expand International telecommunication services to

Republic of Seychelles and countries on the East Indian coast of Africa. The network would facilitate transmission of data, voice, internet and television signals allowing for inter country transmission of information, thereby bridging the information gap between Seychelles, East Africa and the rest of the world.

Project benefits include:

The Project will have direct benefits through the increase in available international transmission capacity and the lower cost for such access. The project also expects to offer wholesale costs 75% lower than that of existing systems.

For existing businesses, increased capacity and lower cost will allow faster and more reliable transmission for data and voice call. This can results in an improvement of business performance as well as create opportunities for expansion. Lower entry costs will also facilitate the start-up of new businesses.

The project will also improve the connectivity between Seychelles and African countries on the system.

The operating company will have its headquarters at Victoria making the Project the first Seychelles-based submarine cable company. Hiring of staff for the operation would draw from the local skills pool and employees would be trained in telecommunications operations and international best practices. The experience would further enhance the local skills base.

In addition to the direct economic benefits of increased telecommunications access and reliability in Seychelles, many other indirect social and economic benefits would be associated with the proposed development, these include:

- improved educational opportunities through increase in access to information and education resources;
- development of a regional sense of community through greater equality of information sharing across geographical regions and across groups in society;
- economic benefits from the enhanced opportunities for new and small enterprises that may have previously been excluded from technologies by high costs;
- macroeconomic benefits of the potential expansion of technology-reliant industries, such as information technology services and software development businesses.

1.5 - DESCRIPTION OF THE PROJECT ENVIRONMENT

Geology and soils

Geologically the area is stable, and the marine benthic habitat dominated by sandy/muddy environments.

Oceanography characteristics

Meteorology

Climate is influenced by the monsoon (North-east monsoon from November to February and South-east monsoon from April to September), and by tropical storms and cyclones. Windiest period: South-east monsoon; calmest and most variable in direction period: March, April and November; driest period: June to September; rainiest period: April-May (Zanzibar) and February to May (Dar es Salaam) Air temperature is between 26°C (July) to 30°C (January)Main directions of wind are South / South-east sector in Zanzibar and North-easterly and South-easterly in Dar es Salaam

Oceanography and Sea temperature and salinity

Semi-diurnal tide with highest tidal ranges in Zanzibar than in Dar es Salaam

In Dar es Salaam, sea surface temperature: highest during the North-east monsoon (maximum 30°C, March) and lowest during the South-east monsoon (minimum 25°C, July-August). In Dar es Salaam, surface salinity: influenced by the rainfall, in particular lower during May (following the peak freshwater outflow) and higher in November

In Zanzibar, swell characteristics, such as: significant heights mainly comprised between 0.6 and 2.5 m; periods mainly comprised between 6 and 10 s; main direction from south-east sector (exceptionally in the North-east sector. The current offshore of Dar es Salaam and Zanzibar is oriented northwards all round the year

Offshore the Tanzanian coasts salinity is slight varying round the year

Terrestrial habitats

The terrestrial areas surrounding the two sites shelter different natural habitats, each distinct from but often complementary to others, with their own species of flora and fauna. The coastal habitats are directly influenced by the sea, and in turn influence, directly or indirectly, the conditions prevailing in the marine areas close to shore.

Marine habitats

The marine and coastal ecosystems including coral reef, sea grass beds, mangroves, sandy beaches, sand dune.

Protected area and Ramsar site

The cable would enter the suggested beach landing site located to the west of the Msasani Peninsula via inshore waters between the marine reserve island of Bongoyo and Msasani Slipway. The three islands of Bongoyo, Pangavini and Mbudya together with Fungu Yasini constitute the Dar es Salaam Marine Reserves (DMRs) system.

The Menai Bay Conservation Area (MBCA), gazetted in 1995, is located in the south western tip of Unguja Island, of the Zanzibar Archipelago. It covers an area of 470 square km extending into two regions, of three districts which take in 17 villages. The area is rich in marine resources and one of the most famous fishing grounds. A rush of fishermen and use of none friendly fishing gears resulted in the degradation of marine resources.

Menai Bay is one of the Ecoreginal Priority sites in Eastern African Marine Ecoregion. WWF support, with funding from WWF-Switzerland, of Menai Bay has been utilised to establish the first ever Marine Protected Areas in Zanzibar.

Socio-economic and cultural environment

Economic activities in coastal areas include fishing, subsistence farming, trade and tourism.

1.6 - POTENTIAL IMPACTS ANDMITIGATION/ENHANCEMENT MEASURES

Positive impacts of the project

A number of positive benefits are predicted to be associated with the proposed development. Many of the positive aspects of the project relate to macro and micro-economic opportunities and benefits resulting from increased Information and communication technology connectivity, but many other secondary benefits including, social, employment and educational impacts will also be realized.

Negative impacts of the project

The different period of impacts were defined as:

- Marine survey (prior to cable installation (onshore, shallow water and offshore)
- Installation (onshore, shallow water and offshore)
- Operations/maintenance (onshore, shallow water and offshore)
- Decommissioning (onshore, shallow water and offshore)

The potentials impacts from the project are limited in scope and are mainly associated with the pre-installation and installation phases. Potential impacts during operations and decommissioning are negligible.This study indicates that there will be no impacts or negligible impacts on the following resources:

- Soils and geology
- Oceanography characteristics
- Hydrology
- Water quality
- Air quality
- Marine biology and fisheries
- Landscape and visual receptors
- Noise and vibration receptors
- Traffic
- Social and cultural structure

Detailed impact assessment was carried out for three potential impact areas

- Habitats, fauna and flora
- Human health and safety
- Menai Bay Conservation Area

Potential impacts were determined to be moderate or minor (localized short time scale...). Following application or mitigation measures the impacts for these areas was determinate to be negligible.

Table 1 below summarizes the potential negative or unexpected impacts from the global cable installation techniques.

Table 1. Summary of impacts without mitigation 0 : No impact, 1 : minimal impact, no need for specific mitigation ; 2: low to medium impact, need basic mitigation ; 3 medium to high, need specific mitigation measures and careful monitoring programme to ensure no adverse effects

Potential impact without mitigation			Project stage															
			Onshore				Shallow water						Offshore					
Area of impact	Description	Degree of impact	Construction (BMH)	Cable installation	Operation/Maintenance	Decommisioning	Marine Route Survey (e1cl. vessels)	Route Clearance (e1cl. Vessels)	Submarine cable installation	Vessels (All operations)	Operation/Repairs	Decommissionning	Marine Route Survey (e1cl. vessels)	Route Clearance (e1cl. Vessels)	Submarine cable installation	Vessels (All operations)	Operation/Repairs	Decommissionning
Environment																		
Geology and soils		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydrology		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Meteorology	Winds, rainfall…	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oceanography	Swell, currents…	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ecology	Terrestrial	Temporary, reversible,direct	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	Coral reef	Temporary, reversible,indirect	0	0	0	0	0	1	1	1	1	0	0	1	1	1	1	0
	Seagrass bed	Temporary, reversible,indirect	0	0	0	0	0	1	1	1	1	0	0	1	1	1	1	0
	Marine fauna/flora	Temporary, reversible,direct	0	0	0	0	0	1	1	1	1	0	0	1	1	1	1	0
	Marine habitats	Temporary, reversible,direct	0	0	0	0	0	1	1	1	1	0	0	1	1	1	1	0
Conservation Area	Menai Bay Conservation Area	Temporary, reversible,direct	0	0	0	0	1	1	2	2	1	0	1	1	2	2	1	0
Water quality	Sediment disturbance causing turbidity discharges	Temporary, reversible,indirect	0	0	0	0	0	1	2	1	1	0	0	1	2	1	1	0
	Discharges	Temporary, reversible,indirect	1	1	0	0	0	1	2	1	1	0	0	1	2	1	1	0
	Accidents which cause spills	Temporary, reversible,indirect	0	0	0	0	0	1	2	1	1	0	0	1	2	1	1	0
Waste	Generation of wastes	Temporary, reversible,indirect	1	1	1	0	0	1	1	1	0	0	0	1	1	1	0	0
Air quality (Local)	Dust	Temporary, reversible,indirect	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	Gazeous emissions	Temporary, reversible,direct	1	1	1	0	0	1	1	1	1	0	0	1	1	1	1	0
	Odour	Temporary, reversible,direct	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Heat/radiation		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Social																		
Traffic	Impacts on traffic in area	Temporary, reversible,direct	1	1	1	0	1	1	1	1	1	0	1	1	1	1	1	0
Noise		Temporary, reversible,direct	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Visual Pollution	creation of new building, landsacpe	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cultural and heritage	Impacts to sites of cultural or archeological interest	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Human activities	Impacts on fisheries activities	Temporary, reversible,indirect	0	0	0	0	1	1	2	2	1	0	1	1	2	2	1	0
	On tourism - diving sites, recreational activities	Temporary, reversible,indirect	1	1	1	0	1	1	2	2	1	0	1	1	2	2	1	0
	Impact on shipping and anchorage	Temporary, reversible,indirect	0	0	0	0	1	1	2	2	1	0	1	1	2	2	1	0
	Impact on mining activities	Temporary, reversible,indirect	0	0	0	0	1	1	1	1	1	0	1	1	1	1	1	0
	Impact on dredging/submarine cable/hydrocarbon activities	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Impact on employment	Positive																

1.7 - ANALYSIS OF ALTERNATIVES

The analysis of alternatives is a component of the ESIA process. Its purpose is to improve project design, construction and operation decisions based on feasible project alternatives. Early consideration of alternatives during the design phase of a project can result in the avoidance/minimization of impacts without the need for expensive or time consuming mitigation measures at a later stage.

The cable has a small diameter and is designed to be benign in the marine environment. Nevertheless some impacts are likely including:

- Impact to flora and fauna, ecosystems
- Disruption to recreational activities
- Disruption/loss of income to fishing communities
- Construction related nuisance (noise, dust, exclusion areas)
- Environmental and health risks

The impact of others, most notably exclusion areas where fishing and anchoring activity is prohibited, can be minimised if existing corridors (with existing exclusion areas) are used.

During the early stages of Project design an extensive desk top study (DTS) was undertaken to identify a preferred route. Throughout this study environmental issues were considered and potential impacts minimised through selection of the best route. The general philosophy included:

- Use of existing onshore facilities where possible;
- Avoidance of environmental sensitivities (protected areas, sensitive species...);
- Installation of pre fabricated facilities where exiting facilities were unavailable;
- Use of existing corridors (and existing exclusion areas)

For those potential impacts that remain following selection of an optimal route, appropriate mitigation measures are readily available. Where warranted, further consideration of route selection is provided in the country specific EIAs.

1.8 - CONCLUSION

Potential impacts were determined to be moderate or minor (localized short time scale...). Following application or mitigation measures the impacts for these areas was determinate to be negligible

Impact	Scope for Mitigation	Monitoring/ Implementation	Responsability
Environment			
Geology, soils, Hydrology, Meterology, Oceanography	not specific mitigation require		Contractors
Terrestrial	Limiting clearing and restoring areas of disturbance Controls to prevent incursion into adjacent areas Top soil will be segregated and laced on other back fill material to promote regeneration of vegetation. All soil that is disturbed during trench digging will be restored to approximate original depths as the trenches are backfilled	Hazardous materials management plan Construction site management plan	Contractors
Marine fauna/flora, Habitats	Marine vessels will be required to adhere to IMO regulations on bilge and ballast water discharge in order to avoid tensional introduction of non-native species to the marine environment Areas of habitat that are temporarily disturbed during cable installation will be restored upon the completion of the installation phase. Areas are disturbed during installation activities will be rehabilitated ASAP after the cable has been installed. The Project will ensure that measures are adopted to avoid incursion into areas adjacent to the work site or any secondary affects from pollution, sedimentation, or accidental spills The Project will also require that marine vessels have a similarly comprehensive plan for storage and handling of hazardous materials as well as a plan for containment and cleanup of accidental spills into the marine environment Contractors will implement a suitable system for spotting marine mammals and turtle whilst pre-installation and installation vessels are at sea. Should these species be observed in the vicinity of the work area, the vessels will execute measures to avoid collision or disturbance. Vessel operators will maintain a distance of 100 m or greater and will travel at 10 knots or less when safety permits until animals are more than 500 m away. Abrupt changes in direction will be avoided Vessel crews must report sightings of any injured or dead marine mammals and sea turtles immediately, regardless of whether the injury or death is caused by a Project vessel. The report should include the date and location latitude/longitude) of the animal/strike, the name of the vessel involved, and the species identification or a description of the animal. The report should be made to a designated ecology organisation Security lighting will be aimed on the area it is required at an adequate level of illumination only to avoid impacts on sensitive fauna. Spillage of illumination outside the direct work area will be avoided.	Construction site management plan Hazardous Materials Management Plan Marine Logistics Plan Waste Management Plan Marine Fauna Protection Procedure Daily fauna observation report Lighting plan	Contractors
Protected area/Ramsar	not specific mitigation require	Construction site management plan	
Water quality	Marine vessels will be required to comply fully with the requirements of the MARPOL Protocol (1978) at all times Marine vessel anchors will not be dragged along the seabed and they will be retrieved vertically to avoid unnecessary sediment disturbance The maximum speed of the cable laying will not exceed 5 knots per hour so that the amount of seabed sediment disturbed anddispersed during the cable laying process can be kept to a minimum	Marine logistic plan	
Waste	Waste management is required to avoid the risk of harm to the environment and human health.	Waste mangement plan	
Air quality (Local)	The Project should require that construction contractors operateonly well maintained engines Should considerable dust generation occur during construction, causing plumes of dust in the vicinity of the works and behind construction vehicles, a routine wetting program of all unpaved surfaces including roads and construction areas will be undertaken to ensure sufficient moisture content is maintained to suppress dust generation. Construction traffic speed control measures will be enforced on unpaved roads (reduced dust generation levels are often consistent with reduced traffic speeds). Operation in line with the requirements specified under MARPOL 73/78 Annex VI	Dust management measures Vehicle maintenance records Placement of traffic signs indicating the speed limit along the route used by construction vehicles Construction Site Management Plan	Contractors
Menai Bay Conservation Area	Minimize the resuspension of sediments. Special care has been taken to avoid projetc exposure of sensitives areas to prolonged high turbidity Schedule cable-laying activities have to coincide with projected periods of lower wave action	Marine Logistics Plan	Contractors
Heat/radiation	not specific mitigation require		

Social			
Traffic	Make contact with the other vessel to avoid collision or damage to equipment Vessels will increase watch when navigating in areas that are kwon to be used by fishermen and other vessels Make contact with the other vessel	Construction Site Management Plan	Contractors
Noise	Use equipment and vehicles in good working order, well maintained The Project will require contractors to use equipment and vehicles that are in good working order, well maintained, and that have all noise suppression equipment (mufflers, noise baffles) intact and in working order	Best driving practices Vehicle maintenance records	Contractors
Visual Pollution	Efforts will be made to minimize visual impacts; land disturbed by cable laying will be contoured to its original form as part of overall reinstatement		
Human activities (fisheries activities, On tourism - diving sites, recreational activities…)	Contractors will be required to wear suitable Personal Protective Equipment including hard hats, high-visibility vests, safety boots and gloves and life vests as appropriate in accordance with theEHS plan All construction and cable repair workers will be sufficiently trained in the safe methods of working with fiber optic cables to avoid injury associated with laser lights and fibers All open trenches and excavated areas will be backfilled as soon as possible after the construction has been completed. Access to open trenches and excavated areas will be secured to prevent pedestrians or vehicles from falling in Vessels will increase watch when navigating in areas that are known to be used by fishermen and other vessels. If other vessels are observed within the near vicinity, the Project vessel will stop moving, make contact with the other vessel if possible, and wait until it has been confirmed that the course of both vessels will not result in collision or damage to equipment While a ship is laying cable its manoeuvrability is restricted, as such it will display the day signals and lights of a hampered vessel to avoid collision with other vessels at sea. Trenches and excavated areas will be backfilled ASAP Require to wear suitable personnel protective equipment Require day signals and lights of a hampered vessel to avoid collision with other vessels at sea	Environmental, Health and Safety Plan Health and safety training and training records Health and safety incident register Marine Logistics Plan	Contractors

Globally, project activities are expected to have no effect on the environmental or social environment. This is mainly a result of the benign nature of the Project and the associated activities as well as the result of the integration of preventative measures into the project design.

The environmental assessment does indicate some potential for limited environmental and social impacts to habitats and flora; fauna; water quality; and human health and safety. The potential is reduced through the implementation of standard mitigation measures and industry best practices, none of which are excessive in cost.

Given the low potential for negative impacts and the high potential for significant positive benefits (both direct and indirect), the Project would be deemed to have a high level of environmental and social acceptability.

2 - INTRODUCTION

iXSurvey Sas, as part of the AXIOM/IXSURVEY/Terabit Consulting consortium, have been commissioned by the Seychelles government to provide a Desktop Study showing the optimum submarine routing for the fibre optic cable system (**Figure 2**).

The Cable System Project is a fibre optic telecommunications cable network that will link Seychelles Island to Dar Es Salaam, Zanzibar (Tanzania) and Mombasa (Kenya). The system includes approximately 2 000 km of fibre-optic cable, almost all of which will be located in the Indian Ocean. The cable will rest off the continental shelf on the sea bed in deep water and will be buried to a target depth of 1.0 metre below the sea bed in shallower waters (0-1000m).

The system will have a terrestrial component in three countries:

- Seychelles
- Tanzania
- Kenya

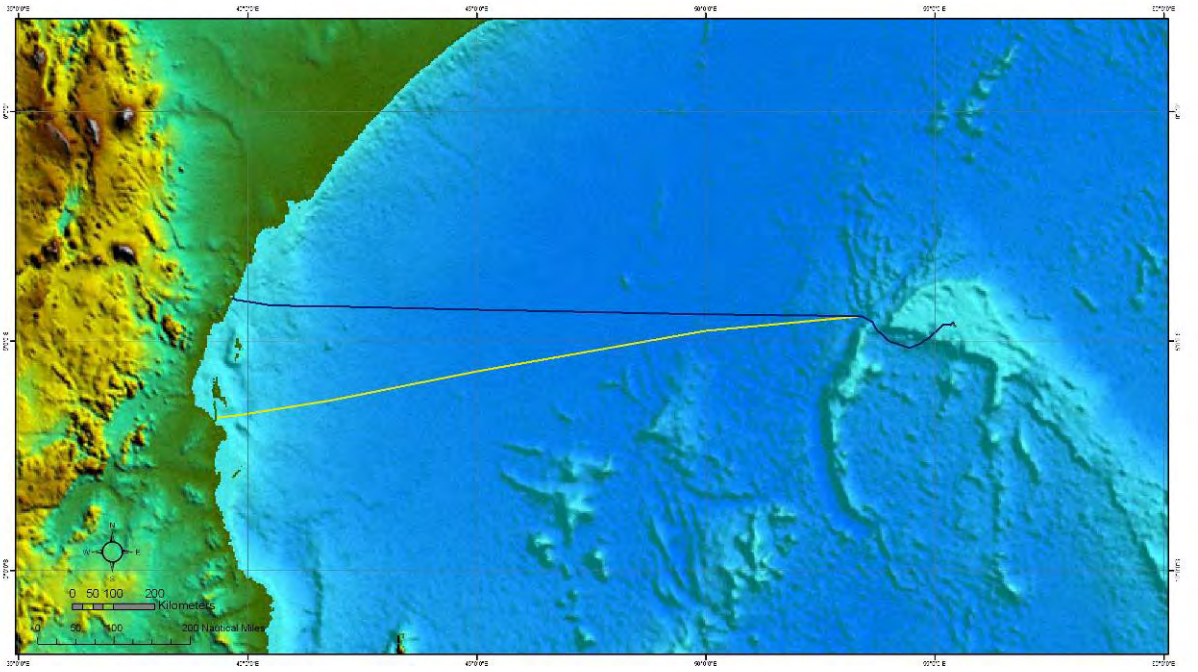


Figure 2. Map of the Fibre optic cable system (Fond ETOPO 2)

These terrestrial components provide the link between the marine component and the domestic telecommunications network in each of the three countries.

The tables 2 and 3 summarize the landing point location by country and local operators. All of the landfalls presented in the DTS have been visited.

Table 2. Cable landing site summary

Location	Country	Operator
Mahé	Seychelles	Unknown
Dar-Es-Salaam	Tanzania	Zanzibar Telecom Ltd (Zantel)
Zanzibar	Tanzania	Zanzibar Telecom Ltd (Zantel)
Mombasa	Kenya	Telkom Kenya Ltd

The cable lies within EEZ's of the country mentioned above and within international water.

Table 3. Summary of the cable DTS RPL

Option	Segment	RPL Version	Route Length (km)
Base Configuration	Mahé to Mombasa	Base Config_Mahe-Mombasa_Rev1	2000
Base Configuration	Mahé to Dar Es Salaam	Base Config_Mahe-Dar-Es-Salaam_Rev1	2000
Base Configuration	Dar-Es-Salaam to Zanzibar	Base Config_Dar-Es-Salaam-Zanzibar_Rev1	50

2.1 - THE SCOPE OF THE STUDY

This study comprises of two coastal states (Kenya and Tanzania) and one island state (Seychelles) (**Figure 3**).

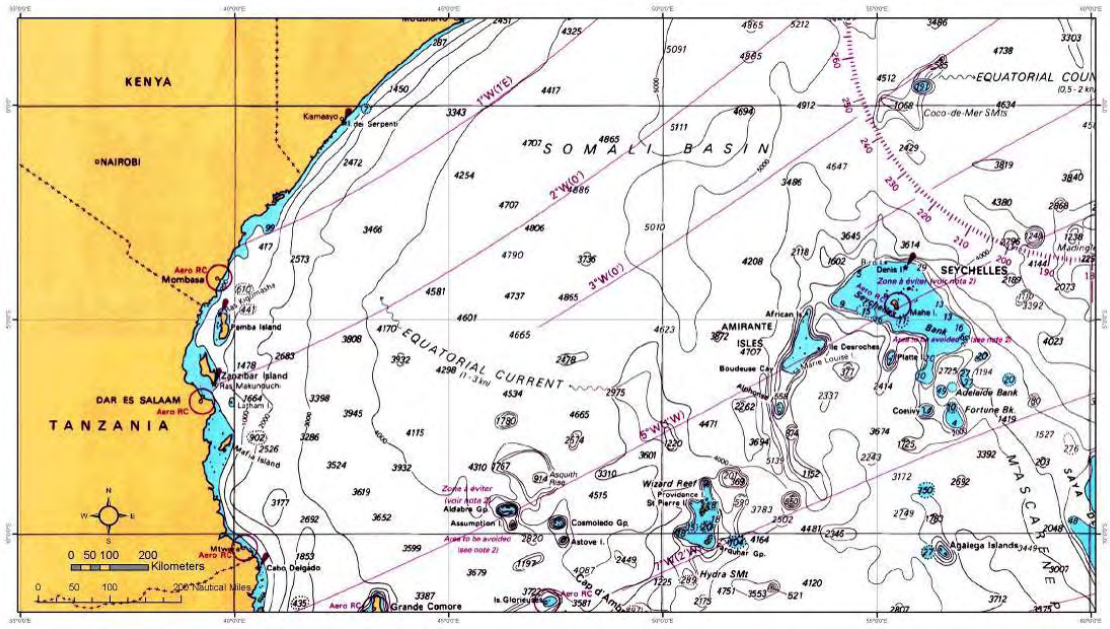


Figure 3. Scope of study – source SHOM chart n° 6684 Copyright license (in progress)

Further to the DTS findings, four areas will be exhaustively investigated and thoroughly analyzed when conducting the EASIAS:

- Cables installation and maintenance activities with environmental and social impacts
- Potential environmental and social impact assessment
- Identification of institutional arrangements for the management and monitoring of environmental and social impact
- Program for consultation with stakeholders and the public

2.2 - METHODOLOGY

A comprehensive ESIAS process was carried out for the Project. The ESIAS process and reports were structured to meet the requirements in the respective countries

The primary preparer of this ESIAS is IXSURVEY, an international environmental consulting company (www.ixsurvey.com). The ESIAS uses various data generated for the environmental approval documents prepared in the various landing countries. These documents have prepared with consultations of local administrations in each country, in cooperation with IXSURVEY.

2.3 - REPORTING

In accordance with the national guidelines for ESIAS reporting, the first five chapters present an overview of the project, location, proposed activities and the policy and legislative framework for the proposed project. The sixth chapter provide the socio-cultural biophysical environmental setting and chapter seven, the heart of this report, identifies and details all the impacts.

Chapter eight presents an analysis of alternatives. Chapter nine and ten are a managerial section presenting the monitoring and environmental and social management plan. In addition to the a number of appendices are included in this report.

3 - LEGAL REGULATORY AND INSTITUTIONAL FRAMEWORK

The project will be conceived and implemented strictly within the legal, institutional and regulatory framework ruling in the republic of Seychelles. Reference is specifically made to the following.

3.1 - NATIONAL ENVIRONMENTAL POLICY AND ENVIRONMENTAL MANGEMENT ACT N°20 2004

Environmental management is guided by the National Environmental Policy (1997) and the Environmental Management Act (No 20 of 2004). Due to the cross-cutting nature of environment conservation and protection, environmental management powers fall within a number of Central Government institutions. The Ministry of State responsible for Environment is located in the Vice President's Office and provides overall policy, planning and implementation oversight mandate on environmental matters.

The Ministry is also tasked to support and influence sector Ministries in carrying out their mandates with respect to the environment and for identifying and assessing strategic environmental concerns and key issues. The following institutions provide the technical and operational support to the Ministry:

- *The Division of Environment (DoE)*: originally created by the Ministry of Tourism and Natural Resources. The Vice President's Office DoE is headed by a Director and is responsible for the day-to-day supervision of environmental issues. Its primary activities include undertaking policy analysis, developing policy choices to influence decision making and coordinating broad-based environmental programmes, plans and projects. The DoE is also mandated in terms of the Environmental Management Act (No. 20 of 2004) to guide strategic environmental assessment in Tanzania, and is in the process of drafting Strategic Environmental Assessment Regulations that will be promulgated under this Act.

- *The National Environment Management Council (NEMC):* was established by Parliament in terms of the National Environmental Management Act (No 19 of 1983) to create environmental policies and make recommendations to government regarding their implications. This Act was repealed by the promulgation of the Environment Management Act in 2004. Headed by a Permanent Secretary, the NEMC has been reestablished with the following key functions: provision of a legal and institutional framework for the sustainable management of the environment; prevent and control pollution; waste management; setting environmental quality standards; public participation; and environmental compliance and enforcement. The NEMC is mandated to ensure enforcement, compliance, review and monitoring with respect to environmental impact assessment (EIA).

The EIA procedure is detailed in the Environmental Impact Assessment Procedure and Guidelines, Volume 1-5.

Environmental Impact Assessment Guidelines and Audit Regulations (2005)

The guidelines provide the legislative framework for the impact assessment process from screening of project to review. Report format and qualifications of parties to conduct an ESIA are well elaborated. This ESIA is presented in the recommended format for ESIA as per the guidelines.

3.2 - OTHER REGULATORY REQUIREMENTS

Telecommunications Policy, 1997

The National Telecommunication Policy objectives include:

- To ensure provision of adequate, sustainable and efficient telecommunication services in all sectors of development, and
- To put in place a reliable telecommunications infrastructure and ensure service inter-connectivity nationally and internationally

ICT Policy, 2003

The National ICT Policy advocates that "Tanzania to become a hub of ICT Infrastructure and ICT solutions that enhance sustainable socio-economic development and accelerated poverty reduction both nationally and globally

National Environmental Policy, 1997

The National Environmental Policy aims to ensure sustainability, security and equitable use of resources to meet the basic needs of the present and future generations without degrading the environment or risking health and safety.

National Land Policy, 1995

The Policy advocates equitable distribution and access to land by all citizens.

National Fisheries Sector Policy and Strategy Statement (1997)

The Policy addresses the degradation of fishery waters and promotion of their wise use.

The Land Acquisition Act 1967

The Act outlines modes of accepted use and recommendations for access to land in Tanzania.

The Road Act, 2007

Local Government Act, 1982

The Local Government Acts 7 & 8 (1982) gives authority to local governments to regulate matters that are local.

National Land Use Planning Commission Act 3/84

The Land (Assessment of the Value of Land for Compensation) Regulations, 2001

Fisheries Act (2003)

Marine Park and Reserve Act No. 29 of 1994

The Marine Parks and Reserves Act, requires EIA processes to be conducted for proposed activities in marine parks or reserves pursuant to legal requirements, policy, practice or general management plans or regulations.

Marine Parks and Reserves (Declaration) Regulations, 1999 (G.N. No. 85 of 1999)

Dar es Salaam Marine Reserves General Management Plan 2005

3.3 - ZANZIBAR ENVIRONMENTAL MANAGEMENT FOR SUSTAINABLE DEVELOPMENT ACT

Environmental governance in Tanzania is complicated by the existence of two different types of legislation for the Zanzibar Islands and the Tanzanian Mainland. Although Tanzania is a federal state comprising Tanzania Mainland and Zanzibar, the latter maintains administrative independence in most of its government matters. The National Assembly of the United Republic of Tanzania, which includes members from Zanzibar, legislates on all matters such as foreign affairs, finance, defence, immigration and citizenship. All other matters concerning Zanzibar are within the exclusive jurisdiction of the Zanzibar Government and its legislative body, the House of Representatives.

This Act was developed in 1996 (Integrated Coastal Area Management, ICAM) with the objectives of protecting and managing the country's environmental assets such that their capacity to sustain development is unimpaired and Zanzibar's rich environmental endowment is available for present and future generations to enjoy and use.

Others regulatory requirements:

The Fisheries Act, 1988

The act regulates the utilisation and conservation of marine resource. The directives are fully translated in the <fisheries regulation (1993) made under this Act.

The Commission of Lands and Environment (COLE) of 1989

The Act deals with all matters to land use and conservation of environment.

The town and country Planning Act, 1955

The Act gives comprehensive directives (designation for planning area, control of development via permit system....

District and Town Councils Act of 1994

This Act specifies the functions of the district councils (co-ordinate, supervise the implementation of the plans for economic, commercial, industrial and social development…).

3.4 - INTERNATIONAL TREATIES AND CONVENTIONS

Recognizing the value to humanity of international communications, cables are protected by international treaties:

- The International Convention for the Protection of Submarine Cables (1884)
- Geneva Convention on the High Seas (1958)
- United Nations Convention on the Law of the Sea (UNCLOS) (1982)

The International Convention for the Protection of Submarine Cables establishes that the breaking or injury of a submarine cable, done wilfully or through culpable negligence, and resulting in the total or partial interruption or embarrassment of telegraphic communications, shall be a punishable offence, but the punishment inflicted shall be no bar to a civil action for damages.

The Geneva Convention on the High Seas establishes the High Seas as being open to all nations; no State may validly purport to subject any part of them to its sovereignty. Freedom of the High Seas is exercised under the conditions laid down by the Articles of the Convention and by the other rules of international law. It comprises, inter alia, both for coastal and non-coastal States:

- Freedom of navigation;
- Freedom of fishing;
- Freedom to lay submarine cables and pipelines;
- Freedom to fly over the high seas.

Tanzania is signatory to the United nations Conventions on the Laws of the Sea (UNCLOS)(**Figure 4**). Under this Tanzania claims rights within a 12 nautical mile territorial water and a 200 nautical mile Exclusive Economic Zone (EEZ).

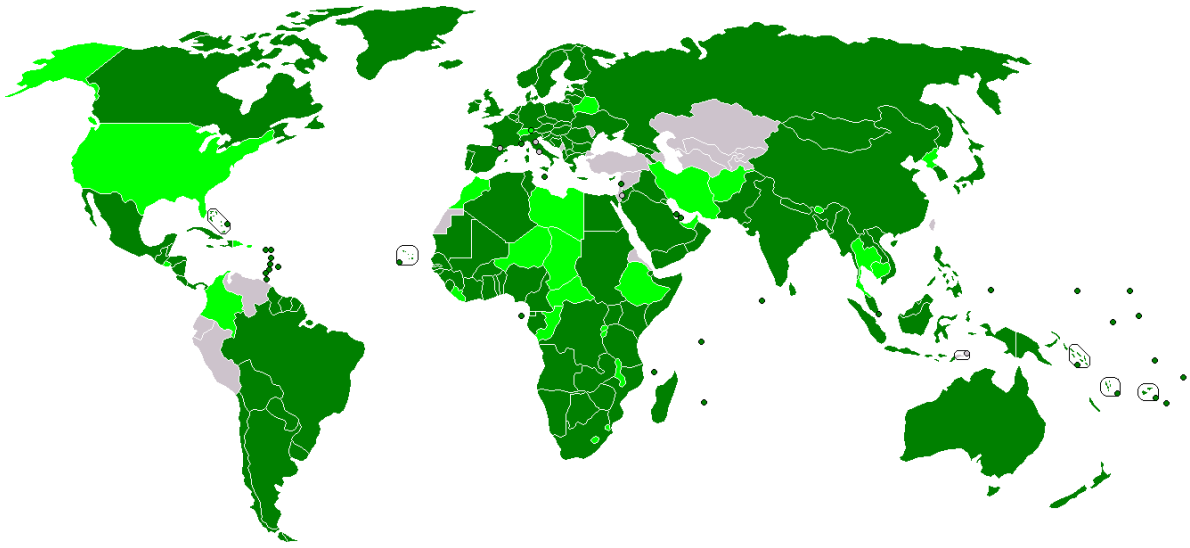


Figure 4. Signature and ratification of UNCLOS (Green ratified, green light signed, grey but not yet ratified, did not sign) (Source Wikipedia, 2010).

The EEZ and territorial waters are defined by UNCLOS and within which specific rules apply. Article 79 of UNCLOS, in particular, concerns the installation of submarine cable and pipelines on the continental shelf and specifies:

All States are entitled to lay submarine cables and pipelines on the continental shelf, in accordance with the provisions of this article.

- Subject to its right to take reasonable measures for the exploration of the continental shelf, the exploitation of its natural resources and the prevention, reduction and control of pollution from pipelines, the coastal State may not impede the laying or maintenance of such cables or pipelines.

- The delineation of the course for the laying of such pipelines on the continental shelf is subject to the consent of the coastal State.

- Nothing in this Part affects the right of the coastal State to establish conditions for cables or pipelines entering its territory or territorial sea, or its jurisdiction over cables and pipelines constructed or used in connection with the exploration of its continental shelf or exploitation of its resources or the operations of artificial islands, installations and structures under its jurisdiction.

- When laying submarine cables or pipelines, States shall have due regard to cables or pipelines already in position. In particular, possibilities of repairing existing cables or pipelines shall not be prejudiced.

Permitting of the cable will be undertaken by the navy's Hydrographic department. Full details of the survey route, vessel and equipment, master and crew are required for the permit application.

A number o the provisions and guidance outlined in the MARPOL Convention are relevant to marine activities, including general requirements over the control of waste oil, engine oil discharges and grey and black waste water disharges. In addition, a number of the Annexes of the Convention relevant such as Annex V (Prevention of Pollution by Garbage from ships) and Annex VI (Prevention of Air Pollution from ships).

Nairobi Convention (1985) and its Protocols

The Convention offers a legal framework and coordinates the efforts of the countries of the region to plan and develop programmes that strengthen their capacity to protect, manage and develop their coastal and marine environment sustainably.

Tanzania is a signatory to this Convention hence is bound by Articles 12 and 13 concerning EIA.

A summary of international treaties and conventions that could potentially be applicable to the Project are presented below:

- **Shipping**

  - International Convention for the Protection Submarine Telegraph Cables (1884)
  - Geneva Convention on the High Seas (1958)
  - UNCLOS (1982)

- International Convention for the Prevention of Pollution from Ships (MARPOL) London, 1973
    - MARPOL 73/78 Annex I/II
    - MARPOL 73/78 Annex III
    - MARPOL 73/78 Annex IV
    - MARPOL 73/78 Annex V
    - MARPOL 73/78 Annex VI
- International Convention on Standards of Training Certification and Watchkeeping for Seafarers (STEW)London, 1978
- International Convention on Civil Liability for Oil Pollution Damage Brussels, 1969
- International Convention on Oil Pollution Preparedness, Response and Co-operation (OPRC), 1990 (guidance) Oil Company International Marine Forum (OCIMF) Guidelines 1975
- International Convention on the Control of Harmful Anti-fouling Systems on Ships, October 2001
- The International convention for the control and management of ships' ballast water and sediments, 2004
- International Loadline convention, 1966
- Convention on the International Regulations for Preventing Collisions at Sea, (COLREGs)1972

- **Waste Management**
    - Convention on the Prevention of Marine Pollution by Dumping of Wastes and other Matter, 1972
    - Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and their Disposal

- **Habitats, Biological Diversity and Heritage**
    - Convention on Wetlands of International Importance especially as Waterfowl Habitat 1971
    - Convention on Biological Diversity, 1996
    - South Indian Ocean Fisheries Agreement, 2006
    - Convention for the Protection, Management and Development of the Marine and Coastal Environment of the Eastern African Region (the Nairobi Convention) 1996
    - Convention concerning the Protection of the World Cultural and Natural Heritage Paris, 1972

- Convention on the Conservation of Migratory Species of Wild Animals (CMS) (The Bonn Convention 1979) and agreement (Birds mammals and their habitats, 1994)

- **Social/Human rights/Consultation**

  - ILO Freedom of Association and Protection of the Right to Organise Convention. No. 87. 1948
  - UN Convention on the Rights of the Child 1989
  - ILO Worst forms of Child Labour Convention, No. 182 1999
  - ILO Discrimination (Employment and Occupation) Convention, No. 111 1958
  - ILO Equal Remuneration Convention. No. 100 1951
  - International Labor Organisation (ILO) Forced Labour Convention, No 29 1930

4 - PROJECT JUSTICATION

4.1 - INTRODUCTION

The proposed Submarine Cable System would include a new open-access fibre-optic submarine cable system which would expand International telecommunication services to Republic of Seychelles and countries on the Indian coast of Africa. The network would facilitate transmission of data, voice, internet and television signals allowing for inter country transmission of information, thereby bridging the information gap between Seychelles, East Africa and the rest of the world.

The proposed Project includes a new open-access fibre optic submarine cable system. The Project is intended to increase the capacity for international telecommunication services initially to Seychelles. This region has experienced explosive growth in phone and internet use in recent years. This region however remains severely constrained with respect to access to cable capacity for international transmission and global connectivity.

4.2 - EXISTING DATA TRANSMISSION CAPACITY IN SEYCHELLES

International telecommunication traffic was carried out by radio or satellite systems. One effect of the satellite pricing structure and the high demand for access is a relatively high price for usage.

4.3 - BENEFITS OF THE CABLE PROJECT

4.3.1 - Primary benefits

Increased capacity

The Project will have direct benefits through the increase in available international transmission capacity and the lower cost for such access. The project also expects to offer wholesale costs 75% lower than that of existing systems.

For existing businesses, increased capacity and lower cost will allow faster and more reliable transmission for data and voice call. This can results in an improvement of business performance as well as create opportunities for expansion. Lower entry costs will also facilitate the start-up of new businesses.

The project will also improve the connectivity between Seychelles and African countries on the system.

Local Content and Technology Transfer

The operating company will have its headquarters at Victoria making the Project the first Seychelles-based submarine cable company. Hiring of staff for the operation would draw from the local skills pool and employees would be trained in telecommunications operations and international best practices. The experience would further enhance the local skills base.

4.3.2 - Indirect Benefits

In addition to the direct economic benefits of increased telecommunications access and reliability in Seychelles, many other indirect social and economic benefits would be associated with the proposed development, these include:

- improved educational opportunities through increase in access to information and education resources;
- development of a regional sense of community through greater equality of information sharing across geographical regions and across groups in society;
- economic benefits from the enhanced opportunities for new and small enterprises that may have previously been excluded from technologies by high costs;
- macroeconomic benefits of the potential expansion of technology-reliant industries, such as information technology services and software development businesses.

4.4 - COMPATIBILITY WITH REGIONAL DEVELOPMENT PLANS

The project also supports President James Michel‘s goals to develop the technology sector in Seychelles and bridge the gap between Africa and the rest of the world. The project’s open access approach will make internet access accessible to a broader section of the population including youths and business.

The government of Seychelles as well has elucidated a plan which emphasises development of the information, communication and telecommunication infrastructure. The project supports this objective.

The African development Bank’s current mission also includes promoting the development of the information and telecommunications sector; the bank has undertaken a number of supporting activities such as workshops and business development conferences. The project is fully consistent with the goals of the banks programmes. The bank is also actively seeking opportunities for public and private investments in the sector.

4.5 - PROJECT ALTERNATIVES

4.5.1 - Technology alternatives

The use of fibre optic networks has a number of advantages over satellite and microwave transmissions and radio has largely been phased out due to restricted bandwidth and poor data transmission. Modern fibre optic networks transmit high volumes of voice and data traffic with higher security and reliability and at lower cost than satellite systems. Cable also has a more dependable installation and repair record. Bandwidth demand, particularly as a result of internet activity far exceeds satellite capacity at the present time (**Hogan and Hartson, 1999**).

4.5.2 - Routing alternatives

The Seychelles archipelago is found in the Western Indian Ocean. A submarine system therefore currently offers the best option given the project's objectives.

4.5.3 - No project Alternative

Assuming that no other cable was installed, in this scenario the region would continue to be constrained by the lack of telecommunications capacity, especially in the area of international data transfer; the demand for capacity would continue to grow along with the overall economic growth. At some point in time, a different transmission technology (satellite) may become more viable either due to the increased demands of the marketplace or the relative decrease in the cost of the technology. This would reduce the need for cable based system but maybe only temporarily.

4.5.4 - Conclusion

The project will provide open access to regional telecommunications operators and internet services. The system will ease the difficulties and reduce the costs telecommunications traffic system with the rest of the world. The network will facilitate transmission of data of various bandwidth, voice, internet and television signals allowing for inter country transmission of data thereby reducing the cost of data transfer and bridging the information gap between West Africa and the rest of the world.

5 - PROJECT DESCRIPTION

5.1 - INTRODUCTION

This chapter provides a technical description of the proposed project. It also provides an overview of the planned pre-installation, installation, operations, maintenance and decommissioning activities. A general description of the project setting is also given with additional detail on the baseline environmental and social conditions provided in chapter 6 of this report.

5.2 - PROJECT BACKGROUND

When ultimately completed, the system proposed will comprise a submarine communications cable that will run between Seychelles and east coast of Africa to provide telecommunications capacity for international and internet connectivity to countries between Seychelles and Kenya or Tanzania (**Figure 2**). The cable system will span up to approximately 2 000 km along the entire route.

The submarine cable system would include installation of approximately 2 000 km of subsea cable running from Beau Vallon, Seychelles to shore crossing and landing sites in a West African country: Mombasa in Kenya or Dar es Salaam and Zanzibar in Tanzania.

A desk top study (DTS) was completed as part of the feasibility studies. The DTS identified the preferred route for the cable between Seychelles, Kenya or Tanzania.

5.3 - OVERVIEW OF PROJECT COMPONENTS

The Project components and activities that are covered by this assessment include the pre-installation, installation, operation and maintenance.

5.4 - PROJECT SCHEDULE

Baseline route surveys and engineering commenced in December 2009 (Desk Top Study of route alignment and feasibility, IXSurvey 2009). The route survey would be started in august 2010.

The route survey would be started in august 2010. The BMH will be concreted and will have a metal cover for access (duration 2 weeks). Deep and shallow water cable laying is planned to start in September – October 2010 allowing for final commissioning in (2011). The decommissioning is planned for 2035.

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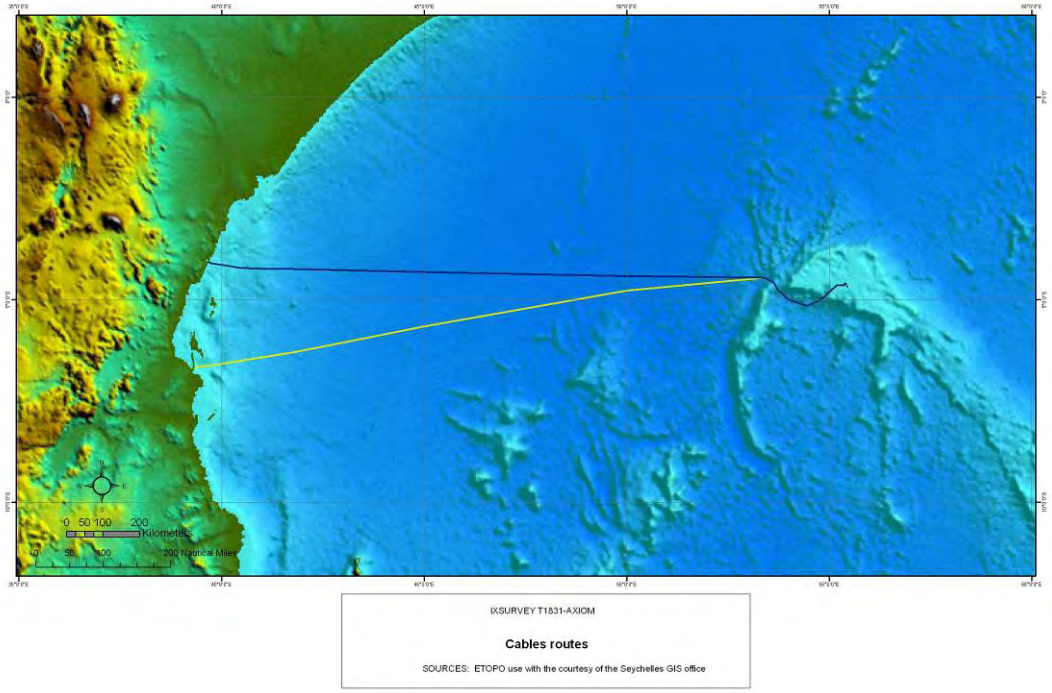
5.5 - PROJECT LOCATION

The submarine cable system would include installation of approximately 2 000 km of subsea cable running from Beau Vallon, Seychelles to shore crossing and landing sites in a West African country: Mombasa in Kenya or Dar es Salaam and Zanzibar in Tanzania.



5.6 - ROUTE DESCRIPTION

Table 4 below provides a summary of the cable route information. Tables 5, 6, 7 and 8 show the cable distance between events.

Table 4. Summary cable route information

Segment	From	To	Route Length (Km)	Min/max Water Depth (meters)
Base configuration	Seychelles (Mahé) Beau Vallon Beach BMH 4°36.737' S 55°25.753' E	Kenya Monbasa Fort Jesus 4° 03.715' S 39° 40.814' E	1 848,76	0/5000
Base configuration Variants	Seychelles (Mahé) Beau Vallon Beach BMH 4°36.737' S 55°25.753' E	Tanzania Dar es Salaam 6°45.633 S 39°15.689 E	1 918,50	0/5000
	Tanzania Dar es Salaam 6°45.633 S 39°15.689 E	Tanzania Zanzibar FUMBA 6°19.118 S 39°17.145 E	52,85	0/60
	Tanzania Dar es Salaam 6°45.633 S 39°15.689 E	Tanzania Zanzibar MBWEI 6°11.976 S 39°12.473 E	76,59	0/60

Table 5. Summary Cable Distances between Events (Segment Seychelles – Kenya)

Event	Latitude South		Longitude East		Cable Distance (km)		Approx
					Between	Cumulative	Depth
					Positions	Total	(m)
LP Mahé	4 °	36,737 '	55 °	25,756 '		0	0
					3,141		
AC1	4 °	35,871 '	55 °	24,313 '		3,141	35
					1,760		
AC2	4 °	36,259 '	55 °	23,454 '		4,900	40
					1,238		
AC3	4 °	36,646 '	55 °	22,915 '		6,138	40
					2,352		
AC4	4 °	37,689 '	55 °	22,204 '		8,490	35
					3,117		
AC5	4 °	38,641 '	55 °	20,831 '		11,608	50
					15,754		
AC6	4 °	38,400 '	55 °	12,400 '		27,361	48
					50,245		
AC7	4 °	56,000 '	54 °	52,000 '		77,606	200
					6,624		
AC8	4 °	57,900 '	54 °	49,000 '		84,230	1000

					7,139		
AC9	5 °	00,000 '	54 °	45,800 '		91,369	1500
					9,058		
AC10	5 °	03,000 '	54 °	42,100 '		100,427	2000
					30,602		
AC11	5 °	08,800 '	54 °	27,100 '		131,029	2418
					54,224		
AC12	5 °	00,000 '	54 °	00,000 '		185,252	3000
					42,109		
AC13	4 °	44,900 '	53 °	43,800 '		227,362	2000
					20,899		
AC14	4 °	35,000 '	53 °	39,000 '		248,261	2000
					31,077		
AC15	4 °	27,500 '	53 °	24,500 '		279,338	4000
					416,721		
AC16	4 °	24,785 '	49 °	45,800 '		696,059	5000
					592,028		
AC17	4 °	18,613 '	44 °	35,165 '		1288,087	4500
					161,888		
AC18	4 °	16,500 '	43 °	10,240 '		1449,975	4000
					155,504		
AC19	4 °	14,800 '	41 °	48,660 '		1605,478	3000
					64,777		
AC20	4 °	14,000 '	41 °	14,680 '		1670,255	2000
					32,601		
AC21	4 °	13,830 '	40 °	57,575 '		1702,856	1500
					58,897		
AC22	4 °	12,451 '	40 °	26,090 '		1761,752	1000
					50,499		
AC23	4 °	08,280 '	39 °	59,391 '		1812,251	700
					10,145		
AC24	4 °	07,442 '	39 °	54,028 '		1822,396	450
					12,608		
AC25	4 °	06,400 '	39 °	47,363 '		1835,004	310
					3,974		
AC26	4 °	06,072 '	39 °	45,262 '		1838,978	220
					4,063		
AC27	4 °	05,255 '	39 °	43,246 '		1843,042	50
					0,361		
AC28	4 °	05,182 '	39 °	43,066 '		1843,403	42
					0,079		
AC29	4 °	05,166 '	39 °	43,027 '		1843,482	50
					0,411		
AC30	4 °	05,084 '	39 °	42,823 '		1843,893	50

					0,689		
AC31	4 °	04,945 '	39 °	42,482 '		1844,582	20
					0,119		
AC32	4 °	04,921 '	39 °	42,423 '		1844,700	16
					2,083		
AC33	4 °	04,503 '	39 °	41,389 '		1846,783	16
					0,395		
AC34	4 °	04,372 '	39 °	41,223 '		1847,178	16
					0,185		
AC35	4 °	04,311 '	39 °	41,145 '		1847,363	16
					0,086		
AC36	4 °	04,267 '	39 °	41,131 '		1847,449	16
					0,465		
AC37	4 °	04,029 '	39 °	41,055 '		1847,914	16
					0,122		
AC38	4 °	03,965 '	39 °	41,041 '		1848,036	16
					0,214		
AC39	4 °	03,852 '	39 °	41,019 '		1848,249	17
					0,025		
AC40	4 °	03,841 '	39 °	41,011 '		1848,274	20
					0,113		
AC41	4 °	03,791 '	39 °	40,978 '		1848,387	26
					0,113		
AC42	4 °	03,748 '	39 °	40,934 '		1848,501	30
					0,076		
AC43	4 °	03,720 '	39 °	40,905 '		1848,577	22
					0,005		
AC44	4 °	03,718 '	39 °	40,903 '		1848,582	22
					0,011		
AC45	4 °	03,714 '	39 °	40,899 '		1848,593	22
					0,003		
AC46	4 °	03,712 '	39 °	40,898 '		1848,597	22
					0,033		
AC47	4 °	03,715 '	39 °	40,880 '		1848,630	21
					0,010		
AC48	4 °	03,715 '	39 °	40,875 '		1848,640	20
					0,079		
AC49	4 °	03,720 '	39 °	40,833 '		1848,719	0
					0,043		
LP Mombasa	4 °	03,707 '	39 °	40,814 '		1848,761	0

Table 6. Summary Cable Distances between Events (Segment Seychelles – Tanzania Dar es Salaam)

Event	Latitude South		Longitude East		Cable Distance (km)		Approx
					Between	Cumulative	Depth
					Positions	Total	(m)
LP Mahé	4 °	36,737	55 °	25,756		0,000	0
					3,141		
AC1	4 °	35,871	55 °	24,313		3,141	35
					1,760		
AC2	4 °	36,259	55 °	23,454		4,900	40
					1,238		
AC3	4 °	36,646	55 °	22,915		6,138	40
					2,352		
AC4	4 °	37,689	55 °	22,204		8,490	35
					3,117		
AC5	4 °	38,641	55 °	20,831		11,608	50
					15,754		
AC6	4 °	38,400	55 °	12,400		27,361	48
					50,245		
AC7	4 °	56,000	54 °	52,000		77,606	200
					6,624		
AC8	4 °	57,900	54 °	49,000		84,230	1000
					7,139		
AC9	5 °	0,000	54 °	45,800		91,369	1500
					9,058		
AC10	5 °	3,000	54 °	42,100		100,427	2000
					30,602		
AC11	5 °	8,800	54 °	27,100		131,029	2418
					54,224		
AC12	5 °	0,000	54 °	0,000		185,252	3000
					42,109		
AC13	4 °	44,900	53 °	43,800		227,362	2000
					20,899		
AC14	4 °	35,000	53 °	39,000		248,261	2000
					31,077		
AC15	4 °	27,500	53 °	24,500		279,338	4000
					391,928		
AC16	4 °	46,300	49 °	59,600		671,266	4692
					579,144		
AC17	5 °	39,800	45 °	0,000		1250,410	4200
					368,972		
AC18	6 °	17,200	41 °	49,500		1619,382	3000
					129,453		
AC19	6 °	28,000	40 °	42,200		1748,835	2000
					53,941		

AC20	6 °	32,800	40 °	14,200		1802,776	1500
					46,102		
AC21	6 °	36,500	39 °	50,200		1848,878	1000
					52,800		
AC22	6 °	40,063	39 °	22,059		1901,678	200
					10,461		
AC23	6 °	43,438	39 °	17,565		1912,139	16
					2,193		
AC24	6 °	-43,662	39 °	16,408		1914,332	16
					1,649		
AC25	6 °	-44,282	39 °	15,776		1915,981	10
					2,520		
LP Dar es Salaam	6 °	-45,633	39 °	15,689		1918,501	0

Table 7. Summary Cable Distances between Events (Segment Tanzania Dar es Salaam - FUMBA)

Event	**Latitude South**		**Longitude East**		Cable Distance (km)		Approx
					Between	Cumulative	Depth
					Positions	Total	(m)
LP Dar es Salaam	6 °	45,633 '	39 °	15,689 '		0	0
					2,520		
AC1	6 °	44,282 '	39 °	15,776 '		2,520	10
					1,649		
AC2	6 °	43,662 '	39 °	16,408 '		4,169	10
					2,193		
AC3	6 °	43,438 '	39 °	17,565 '		6,362	10
					4,696		
AC4	6 °	41,095 '	39 °	18,500 '		11,058	25
					13,048		
AC5	6 °	34,086 '	39 °	18,444 '		24,106	60
					9,875		
AC6	6 °	28,844 '	39 °	17,631 '		33,982	50
					10,008		
AC7	6 °	23,676 '	39 °	16,151 '		43,989	42
					3,055		
AC8	6 °	22,035 '	39 °	16,125 '		47,044	20
					0,212		
AC9	6 °	21,921 '	39 °	16,124 '		47,257	15
					4,564		
AC10	6 °	19,561 '	39 °	16,787 '		51,820	2
					1,028		
LP Fumba	6 °	19,143 '	39 °	17,148 '		52,848	0

Table 8. Summary Cable Distances between Events (Segment Tanzania Dar es Salaam - MBWEI)

Event	Latitude South		Longitude East		Cable Distance (km)		Approx
					Between	Cumulative	Depth
					Positions	Total	(m)
LP Dar es Salaam	6 °	45,633 '	39 °	15,689 '		0	0
					2,520		
AC1	6 °	44,282 '	39 °	15,776 '		2,520	10
					1,649		
AC2	6 °	43,662 '	39 °	16,408 '		4,169	10
					2,193		
AC3	6 °	43,438 '	39 °	17,565 '		6,362	10
					4,696		
AC4	6 °	41,095 '	39 °	18,500 '		11,058	40
					13,048		
AC5	6 °	34,086 '	39 °	18,444 '		24,106	42
					12,768		
AC6	6 °	27,228 '	39 °	18,543 '		36,875	50
					28,040		
AC7	6 °	16,343 '	39 °	08,136 '		64,915	30
					7,458		
AC8	6 °	13,127 '	39 °	10,523 '		72,373	20
					4,217		
LP MBWEI	6 °	11,976 '	39 °	12,473 '		76,590	0

Seychelles landing site

The preferred landing site in Seychelles is located at Beau Vallon, approximately 5 km South-West of Victoria.The GPS measured coordinates of the proposed manhole at Beau Vallon site were (WGS 84): (S) 4°36.692' (E) 55°25.793' (**Figure 5**).



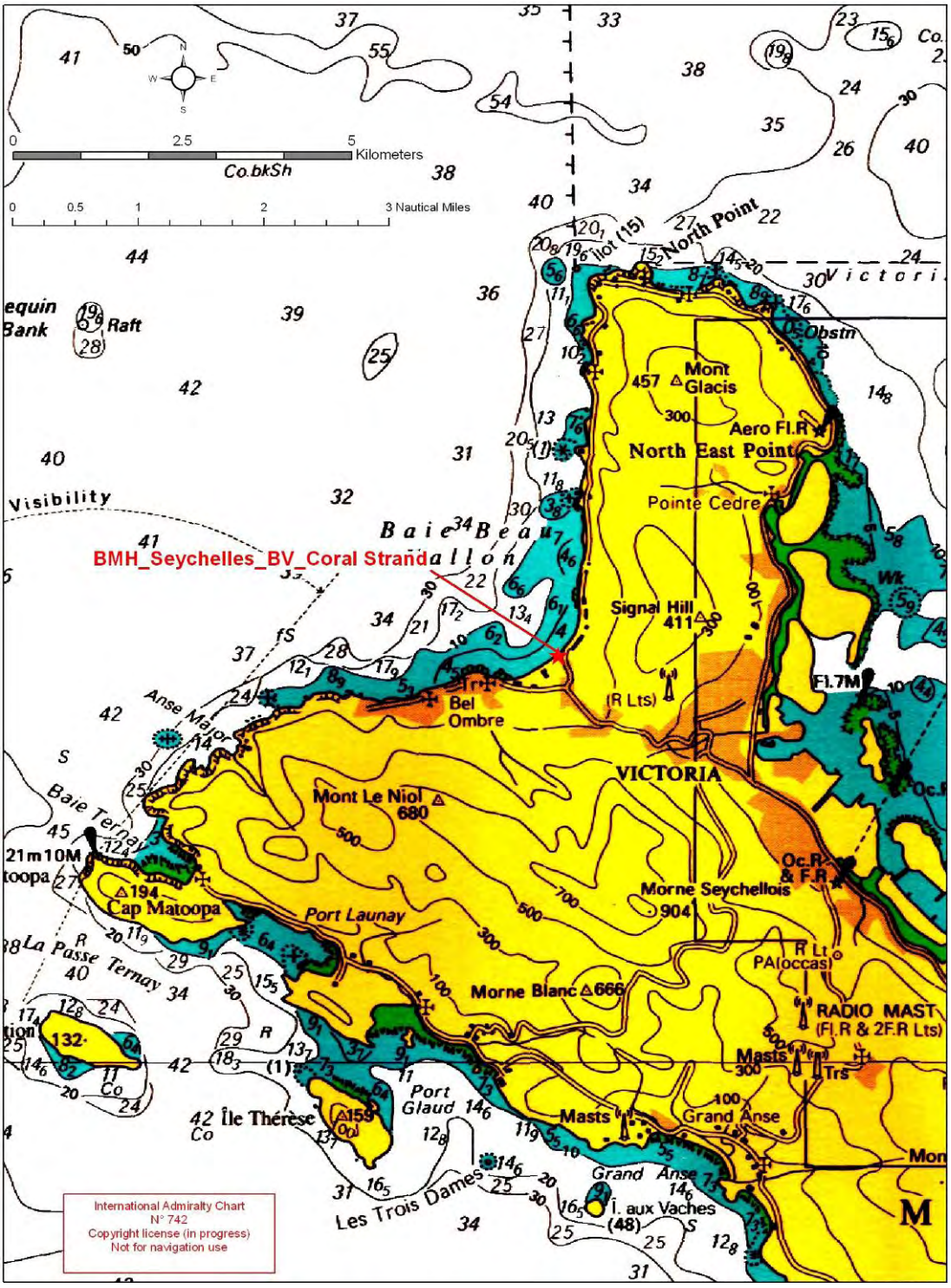



Figure 5. Location of BMA at beau Vallon – Seychelles - Mahé

Site Name	**Beau Vallon Beach**
Landing site information	**Prefered site** **between Coral Strand Hotel and Al mare restaurant**
Beach Manhole Location	(S) 4°36.692' (E) 55°25.793'
Beach Manhole status	No existing
Beach conditions	
Access to beach	Existing
Surf conditions	< 1 m during visit
Currents	No current observations were made during the site visit
Obstacles	Possible sunken logs
inaccessible areas	None known
Other	N/A
Sediments	
At the Landing Position (LP)	Sand
LP to 5 m contour	Sand
LP to 10 m contour	Sand
Backing	The beack is backed by long establishement road
Sediments movements	yes, strong < 1m (beach profil)
Existing services	
Other BMH	No existing
Planned cable	No existing
Other retired cables	None
Existing cable station	No
Power	Sufficient
Sewage	Yes
Electrivcity substation	Yes
Water treatment plant	Unknown
Land ownership	
Of the LP	Mahé - Government easement
Of the BMH	Unknown
Of the beach	Beau Vallon
Restricted areas	None observed
Permitting issues	Requires investigations
Marine Route Issues	
Distance BMH to 20 meters contour	1 800 m From admiralty chart 742
Distance BMH to 50 meters contour	11 650 m From admiralty chart 742
Survey Permit and Installation Permit	Not required for seychelles registred vessel - requires investigations
Fishing	
Type	Artisanal
Vessel type	Small boat (5 m)
Fish havens	None
Fish farms	None
Hydrocarbon activity	
Rigs/platforms	None
Field development	none
Dredging	
Mineral locations	yes
Sand mining	yes in front of the site
Development Plans	None
Shipping	
Anchorage zones	None in immediate vicinity
Frequency/vessel size	N/A
Shipping routes/channels	Shipping routes/ channels approx East 5 km of site (just East cost concened)
Ports	Victoria port (aprprox 5 km of preferred site)
Ferry	None in immediate vicinity
Development plans	Tourism hotel
Dump sites	
Onshore waste	None
Positive Aspects	Access and short distance from Victoria Back haul available Absence of coral reef barrier
Negative Aspects	The most frequented beach and maybe the most popular on the island

Option - Kenya landing site

The GPS measured coordinates of the existing manhole at Fort Jésus are (**Figure 6**):

WGS 84) : (S) 04º 03.715' (E) 39º 40.814'

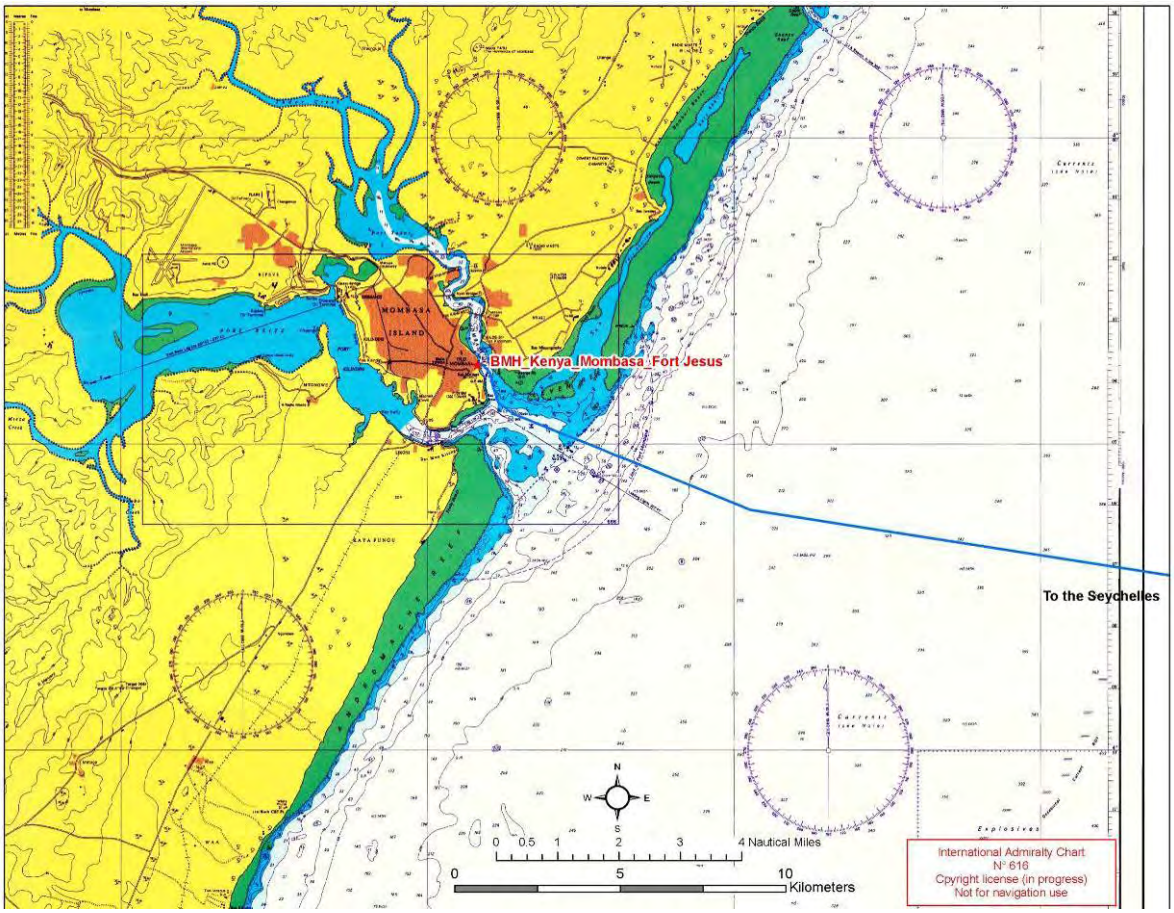


Figure 6. Location of BMH at Mombasa

Site Name	Fort Jésus
Landing site information	**Prefered site**
Beach Manhole Location	(S) 04° 03.715' (E) 39° 40.814'
Beach Manhole status	Existing
Beach conditions	
Access to beach	Existing
Surf conditions	Largest waves (2 m) occur during the South East Monsoon
Currents	East Africa Coastal Current (1.5 – 2 $m.s^{-1}$)
Obstacles	Possible sunken logs
inaccessible areas	None known
Other	N/A
Sediments	
At the Landing Position (LP)	rocky cliff
LP to 5 m contour	rocky cliff
LP to 10 m contour	rocky cliff
Backing	rocky cliff
Sediments movements	yes
Existing services	
Other BMH	Existing (SEACOM)
Planned cable	Eassy
Other retired cables	Yes
Existing cable station	Yes
Power	Sufficient
Sewage	Yes
Electrivcity substation	Yes
Water treatment plant	Unknown
Land ownership	
Of the LP	Kenya
Of the BMH	
Of the beach	Mombasa Island
Marine Route Issues	
Distance BMH to 20 meters contour	4 371 m From admiralty chart 616
Distance BMH to 50 meters contour	5 797 m From admiralty chart 616
Survey Permit and Installation Permit	Not required for Kenya registred vessel
Fishing	
Type	Artisanal
Vessel type	Small boat
Fish havens	None
Fish farms	None
Hydrocarbon activity	
Rigs/platforms	None
Field development	None
Dredging	
Mineral locations	None
Sand mining	None
Development Plans	None
Shipping	
Anchorage zones	None in immediate vicinity
Frequency/vessel size	Elevated
Shipping routes	Near the channel
Shipping channels	Yes
Ports	Yes
Ferry	yes
Development plans	N/A
Dump sites	
Onshore waste	None
Positive Aspects	Existing landing site with existing conduits existing cable station with space and power available back haul available
Negative Aspects	Proximity to existing cables Archeological sites Fort Jesus is one of Mombasa's biggest tourist attractions

Option - Tanzania landing site

Dar es Salaam

Msasani Bay (Dar es Salaam), the GPS measured coordinates of the existing manhole are: **(WGS 84): (S) 6°45.633 (E) 39°15.689 (Figure 7).**

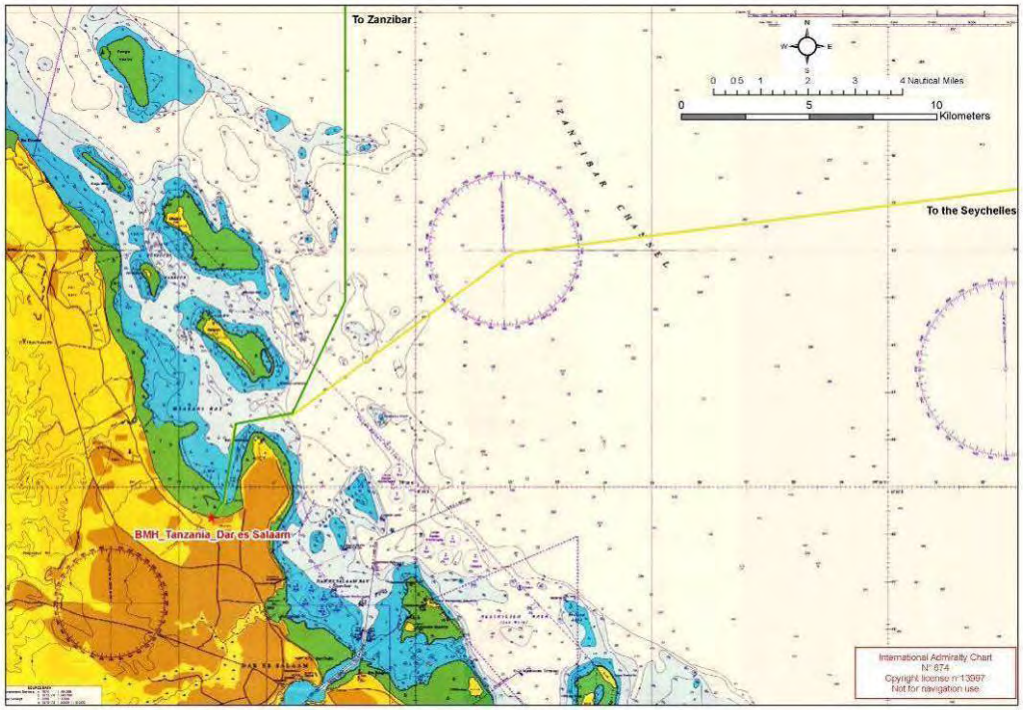


Figure 7. Location of BMH at Dar es Salaam - Tanznia

BMH_Zanzibar_FUMBA

(WGS 84): 6°19.118 (S) 39°17.145 (E) (Preferred and selected site – Figure 8)

Zantel antenna (100 meters of BMH proposed)

BMH_Zanzibar_MBWEI

(WGS 84): 6°11.976 (S) 39°12.473 (E)

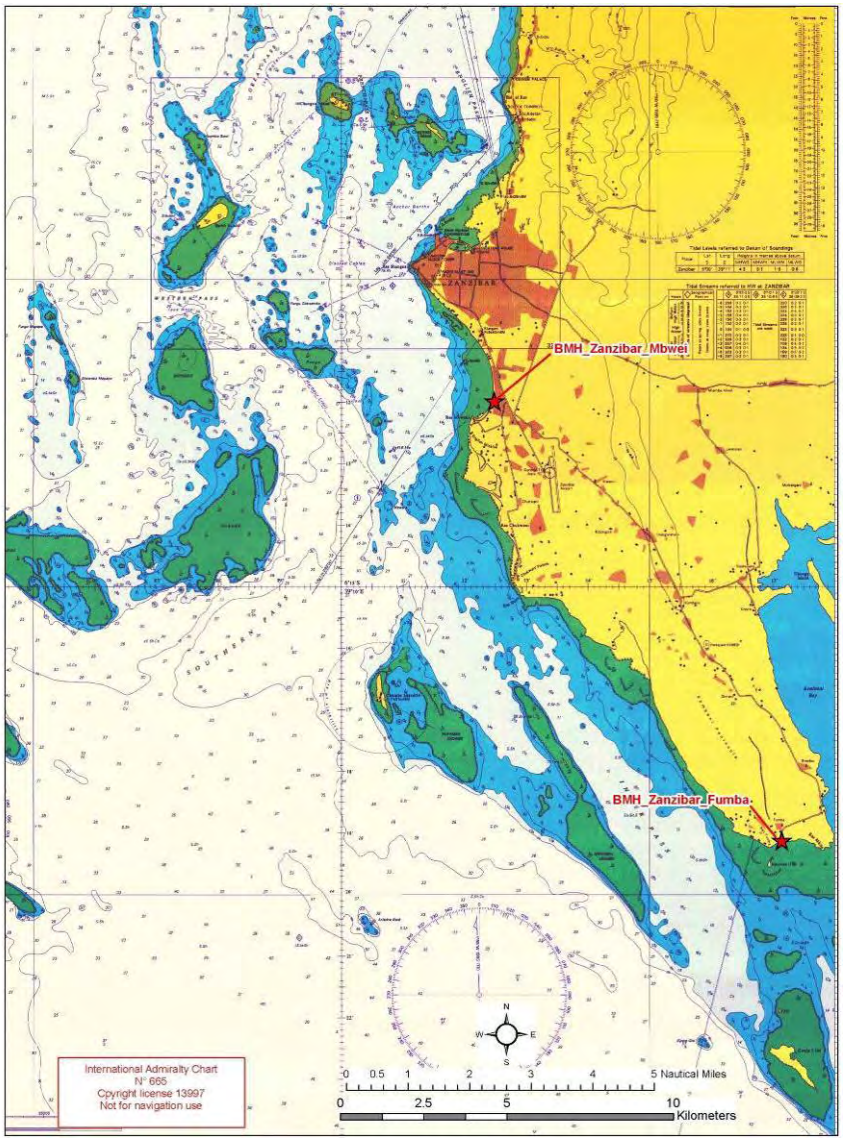


Figure 8. BMHs - Zanzibar

Tanzania	Tanzania mainland	Zanzibar	
Site Name	**Dar-Es-Salaam MSASANI Bay**	**FUMBA**	**BDWEI**
Landing site information	**Prefered site**	**Prefered site**	**Alternate site**
Beach Manhole Location	(S) 6°45.633 (E) 39°15.689	(S) 6°19.118 (E) 39°17.145	(S) 6°11.976 (E) 39°12.473
Beach Manhole status	Existing (ZANTEL)	No existing	No existing
Beach conditions			
Access to beach	Existing	Existing	Existing
Surf conditions	2-3m	< 0.5 m during visit	< 0.3 m during visit
Currents	strongest 3.5ms-1	weak <0.5ms-1	weak <0.5ms-1
Obstacles	none	coral patches	coral patches
inaccessible areas	none	None known	None known
Other	N/A	N/A	N/A
Sediments			
At the Landing Position (LP)	Sand	Sand	Sand
LP to 5 m contour	Sand	Sand	Sand
LP to 10 m contour	Sand	Sand	Sand
Backing	Sand	terrigenous	terrigenous
Sediments movements	yes	None	None
Existing services			
Other BMH	Yes (SEACOM)	no	no
Planned cable	EASSy (march 2010)	No existing	No existing
Other retired cables	none	None	None
Existing cable station	Yes	None	None
Power	No (coming soon)	None	None
Sewage	None	None	None
Electrivcity substation	None	None	None
Water treatment plant	Unknown	Unknown	Unknown
Land ownership			
Of the LP	Dar-Es-Salaam	Zantel	Zanzibar
Of the BMH	Zantel	N/A	N/A
Of the beach	Dar-Es-Salaam	Zanzibar	Zanzibar
Marine Route Issues			
Distance BMH to 20 meters contour	6 000	12 000 m	N/A
Distance BMH to 50 meters contour	12 800	12 000 m	N/A
Survey Permit and Installation Permit	Not required for local registred vessel	Not required for local registred vessel	Not required for local registred vessel
Fishing			
Type	Artisanal	Artisanal	Artisanal
Vessel type	Small boat (<5 m)	Small boat (5 m)	Small boat (5 m)
Fish havens	None	None	None
Fish farms	None	None	None
Hydrocarbon activity			
Rigs/platforms	None	None	None
Field development	None	None	None
Dredging			
Mineral locations	None	None	None
Sand mining	None	None	None
Development Plans	None	None	None
Shipping			
Anchorage zones	yes (permanent yacht club mo	temporary recreationnal moorin	temporary recreationnal moorin
Frequency/vessel size	small recreational craft	small recreational craft	small recreational craft
Shipping routes	None	None	closeby
Shipping channels	None	None	closeby
Ports		None	closeby
Ferry	local ferry to Bongoyo island	None	closeby
Development plans	None	None	None
Dump sites			
Onshore waste	None	None	None
Positive Aspects	Existing landing site with existing ducts existing cable station with space and power available back haul available at Zantel head Office	BMH prefered site owned by Zantel unhabited area easy access sandy beach	near Zantel Head Office easy access sandy beach
Negative Aspects	N/A	Coral patches far from head office of Zantel	Power cable crossing Coral patches

5.7 - SYSTEM OVERVIEW – SUBSEA CABLE

The proposal system will consist of subsea cables landings, repeaters and 1 branching unit if Tanzania option selected. A typical submarine cable system is shown in Figure 9.

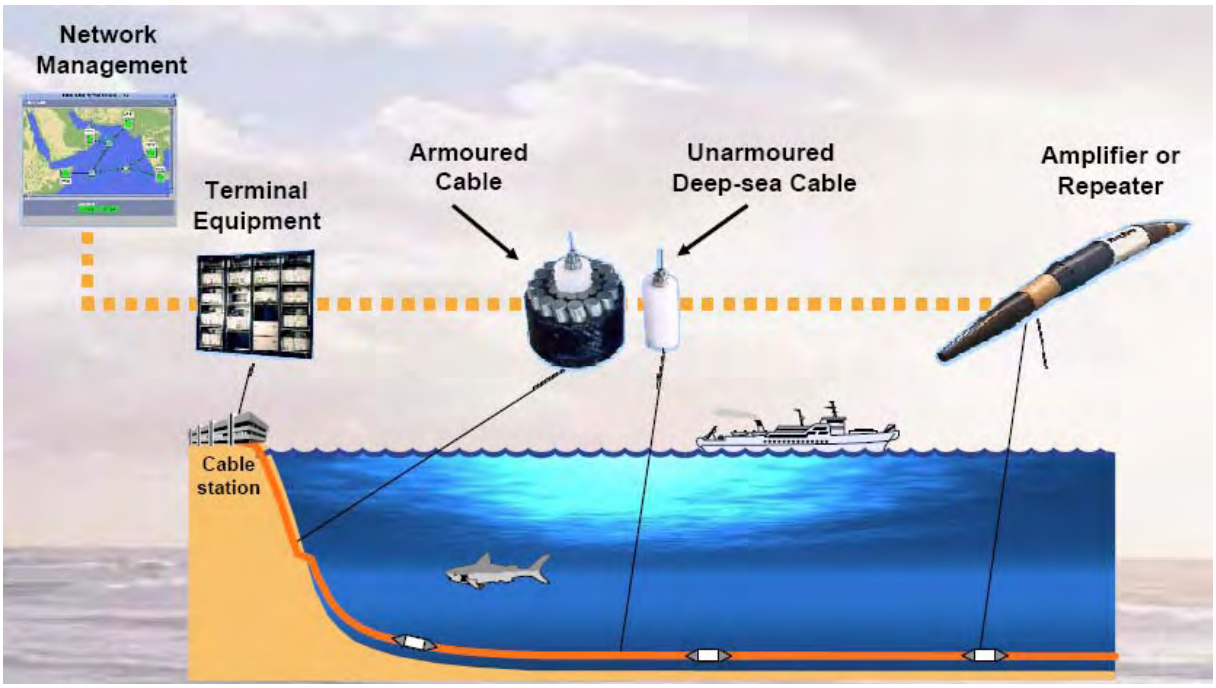


Figure 9. Typical submarine sytem (Source: U.K. Cable Protection Committee & Alcatel Submarine Networks)

Cable engineering specifications for the proposed Project will be based on cable industry standards. The diameter of the subsea cables will vary between 17 and 20 mm for sections without protective armor; armored cables may be as large as 50 mm in diameter.

The cable consists of an inner optical fibre (**Figure 10**), surrounded by a polyethylene or fibreglass core for strength and fibre separation.

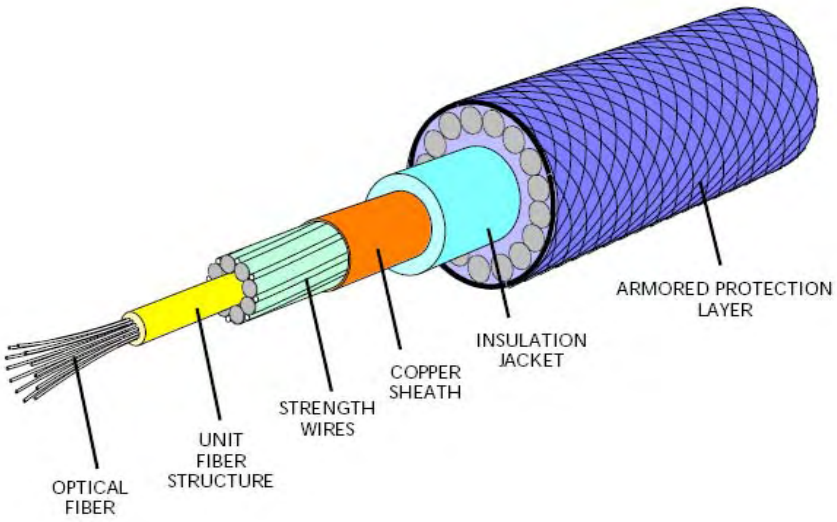


Figure 10. Illustration of cable design (Source Tyco)

Fibre optic cables transmit data via beams of laser-generated light that are internally reflected within the optical fibres. The strength of the light signal degrades with distance and therefore amplifiers are installed along the cable. In the project system optical amplifiers are installed in the marine cable at intervals of approximately 80km. These amplifiers are sometimes referred to as repeaters and are electrically powered.

Repeaters are installed along the cable to boost the signal because the signal loses strength en route. Approximately 20 repeaters are planned along the total route length (**Figure 11**).

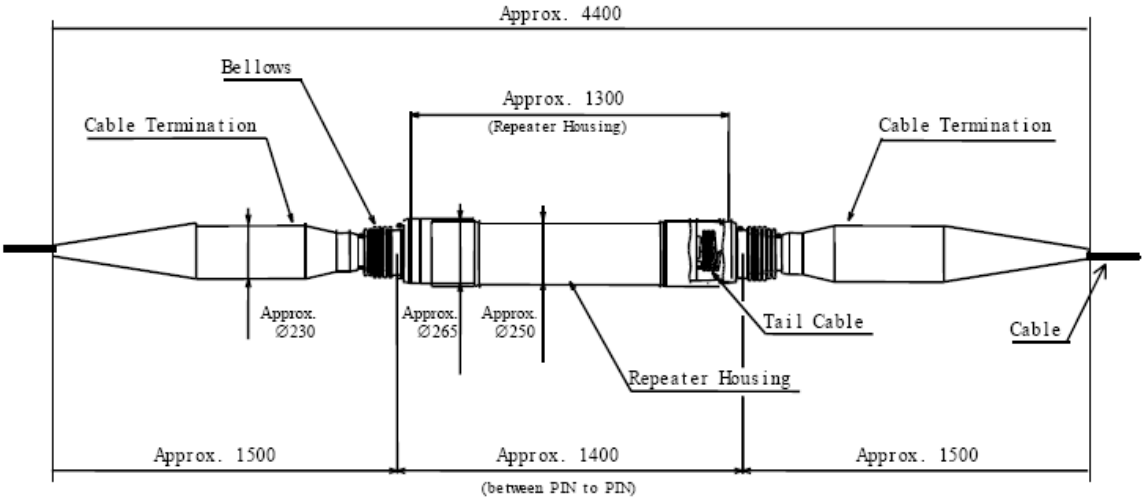


Figure 11. Repeaters plan source NEC

BUs are pieces of equipment used in submarine telecommunications cable systems to allow the cable to split to serve more than one destination (**Figure 12**). There is one BUs planned for the Tanzania route segments under consideration.

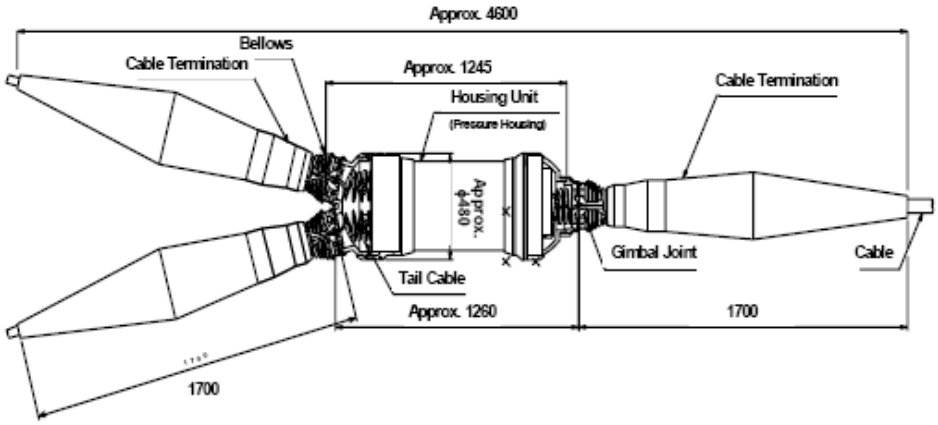


Figure 12. Branching Unit BU plan Source NEC

Wherever possible, it is desirable to engineer a route that requires the minimum length of armouring and burial due to cost. There are also time implications, as each layer of armouring requires a pass through the factory.

To achieve a secure cable system, some form of protection must be provided. This essentially falls into the categories of burial and / or armouring. On the continental shelf sections, protection can be most reliably achieved by burial, which places the cable below the depth of penetration of the threat.

Armouring of a cable is routinely performed in areas of high risk. All fibre optic cables are based around the core cable which changes little between different armouring types. The cable is armoured by placing layers of galvanised steel wires around this central core. While manufacturers offer a wide range of different cable constructions (**Figure 13**), the basic types of armouring available, and their typical characteristics, are summarised in Table 9.

Table 9. Typical cable armour characteristics <u>for guidance only</u> (refer to manufacture for specific properties).

Cable Type	Characteristics	Water Depth
Light weight (LW)	Deep water cable for areas where no significant hazards exist	< 2 500 m
Light weight protected (LWP)	Light weight cable with an abrasion resistant covering. Suitable for aras where rugged topography is crossed, suach as the mid Indian ridge	< 2 500 m
Single Armor Light (SAL)	A relativly light weight cable for use in areas where good burial is possible, and external threat risk is relatively low	1 500 - 2 500 m
Single Armor (SA)	Usually used in areas where only limited burial is possible	100 - 1 500
Double Armor (DA)	A well protected cable for use in areas where little or no burial is anticipated and for shore ends	0 - 100
Rock Armor (RA)	Similar to double armour but with improved impact resistance and more flexible, hence better able to conform to an undulating rock seabed	< 200

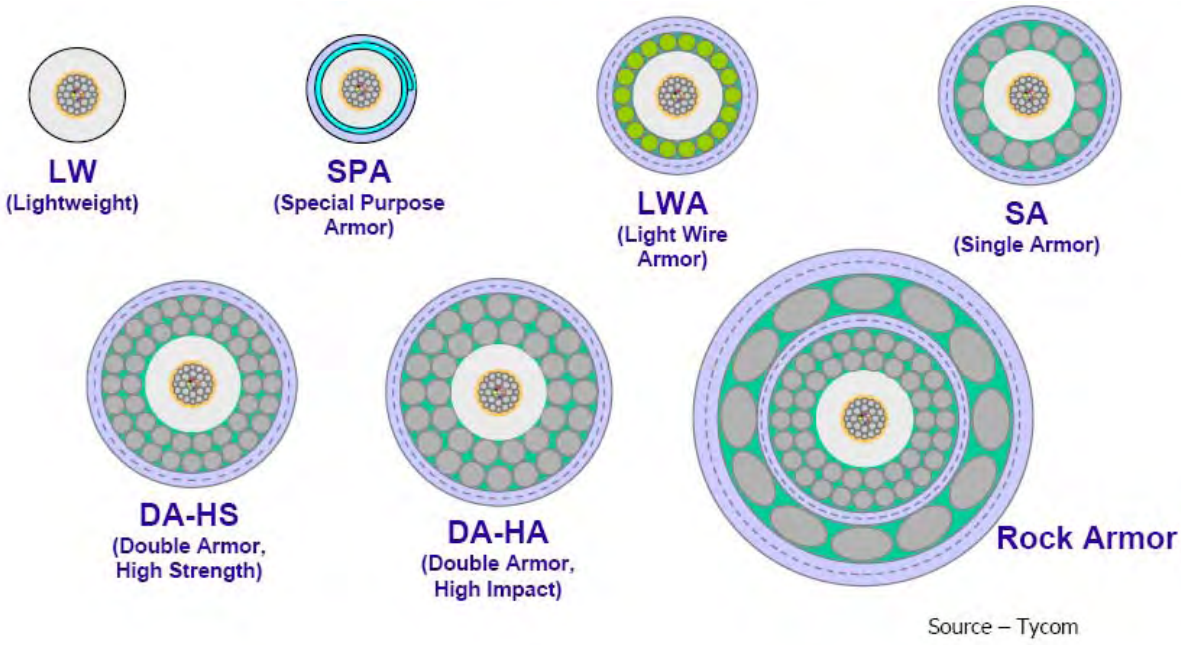


Figure 13. Cable Armouring (DA, SA, LWP, LW)

5.8 - WORKS DURING PRE-INSTALLATION

These activities include a detailed cable route survey to investigate the safest possible environment for the cable and prepare for installation as well as engineering design and fabrication of the subsea equipment.

5.8.1 - Cable route survey

Prior to installation of the cable, marine geophysical survey will be realized to investigate the better route (safest route) for the cable. This survey will be complemented by an inspection survey in the area of the shore approach to the landing sites (**Figure 14**).

Cable routes are carefully surveyed to minimize environmental impacts and to maximize cable safety. Seabed mapping systems accurately chart depth, topography, slope angles & seabed type.

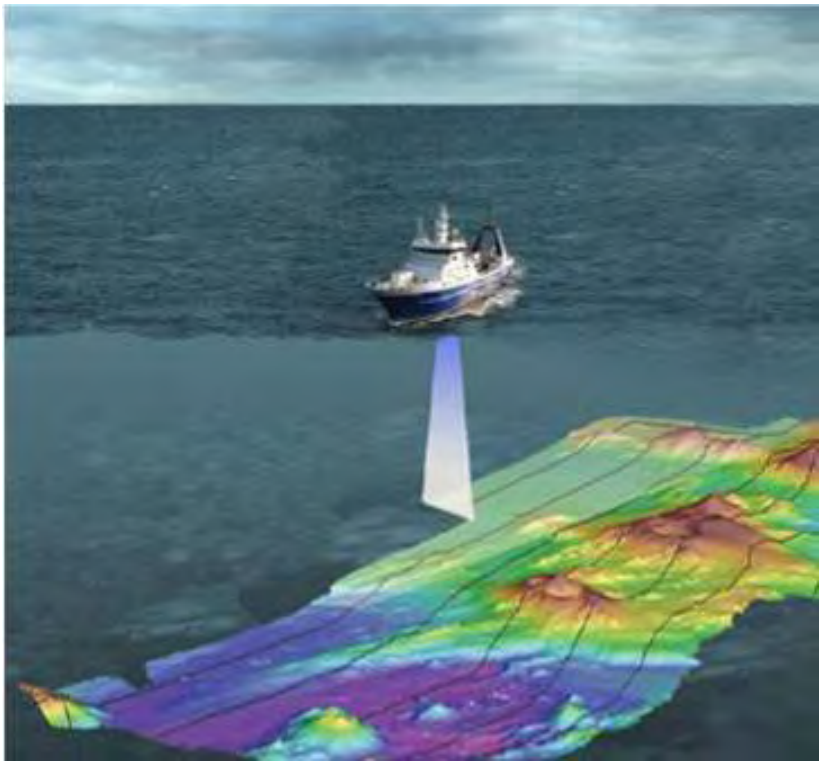


Figure 14. Cable route survey (Source NIWA)

In shallow water, the diver inspection will include probing of the seabed and visual recording in order to assess the feasibility of cable burial within a corridor width (300 m).

To complete, supplement the side-scan sonar and sub-bottom profiler date, a seabed-sampling program will also be conducted where the cable will be buried. The conditions of the seafloor and shallow subsurface layers, including sediment characteristic along a 600 m corridor between 3 m and 1 000 m water depth.

Before the cable is laid, a Pre Lay Grapnel Run (PLGR) is required along those sections of the route that require cable burial. This involves dragging a grapnel along the entire length of the buried cable route as an attempt to clear the sea bed of debris, i.e. wires

or hawsers, fishing equipment, etc., which may have been deposited along the route. Any debris recovered during these operations is discharged ashore upon completion of the operations.

5.8.2 - Engineering design and fabrication of subsea

Detailed cable design would be carried out in this phase using input from the cable route survey. Cables specifications will be developed to ensure protection of the cable in a manner appropriate for the marine environment. The equipment will be fabricated off-site (United States, France...).

5.9 - INSTALLATION OF THE SUBMARINE CABLE

Telecommunication cables are generally laid unburied on the seabed in deep waters off the continental shelf, where the risks of damage by activities such as fishing or vessel anchoring are minimal. In shallow waters cables are generally buried to a target depth of one metre below the seabed, using a towed plough.

For installation, a purpose built ship (**Figure 14**) will accurately place the cable on or under the seabed along the route determined by the pre-installation survey.

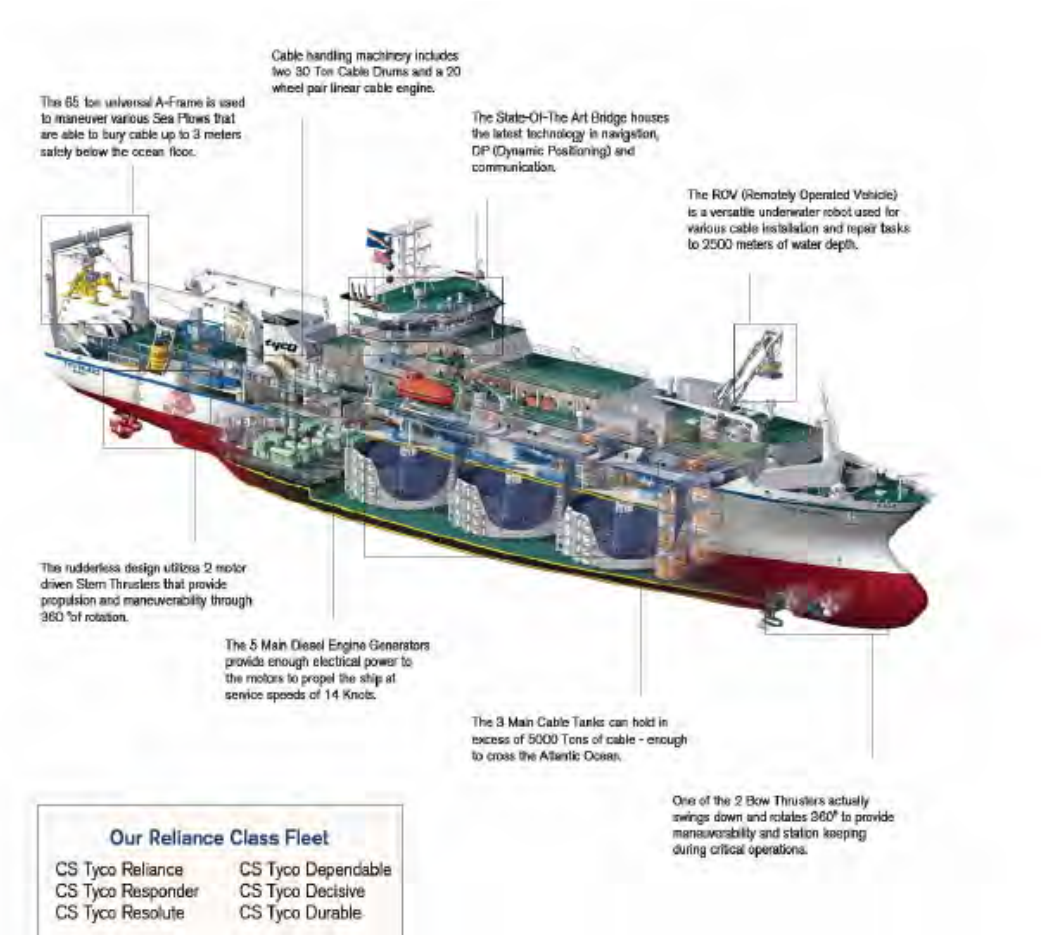


Figure 15. Typical cable lay vessel (Source Tyco)

5.9.1 - Cables burial

Subsea cables are usually buried to minimize the risk of damage by, for example, anchors and fishing gear. The cable burial depth depends on factors like types of threats present, the type of habitat, the hardness of the sediment or the depth of water.

Where cables cannot be buried, e. g. in areas of exposed bedrock, or where it is not legally required to bury them, they are layed directly on the sea bed and covered fully or partially with mechanical protection (e.g. dumped rocks), or, in unconsolidated sediments, the cable is expected to self-bury. Emu Ltd (2004) specifies typical burial depths dependent on seabed types (**Table 10**).

Table 10. Typical subsea cable burial depths (after Emu Ltd 2004).

Seabed type	Typical burial depths [m]
Exposed bed rock	0.0
Chalk	0.0 – 0.6
Stiff clay	0.4 – 0.8
Clay	0.6 – 1.2
Gravel	0.4 – 1.0
Coarse sand	0.4 – 1.0
Silty sand	0.6 – 1.2
Sand waves	0.0 – 3.0
Intertidal mud flats	0.6 – 3.0
Beach sand	1.0 – 2.0

According to the context at Beau Vallon site (longshore drift) cable would be buried at least 2 m below the seabed.

Indeed, the beach of Beau Vallon is ever changing. Erosion (the loss of beach sand) is usually caused by high, steep waves with relatively short periods whilst accretion (beach sand build-up) is usually associated with lower waves and longer periods. Also, because waves often approach the shore at an oblique angle, long shore currents can be created. There is a continuous interchange of sand between dunes, beaches, sand bars in the surf zone.

Nearshore

At locations where the cable comes ashore the cable ship is stationed offshore near its minimum working water depth of around 10m (**Figure 16**).

Due to the shallow water depth, cable burial at each of the shore ends may be undertaken by excavation of a trench using a single grab dredger and through the placing of the cable within the trench by divers. Shallow water laying may be aided by scuba divers while deepwater laying is sometimes aided by remote operated vehicles. After the cable has been laid inside the trench, it would be covered with concrete mats and backfill materials.

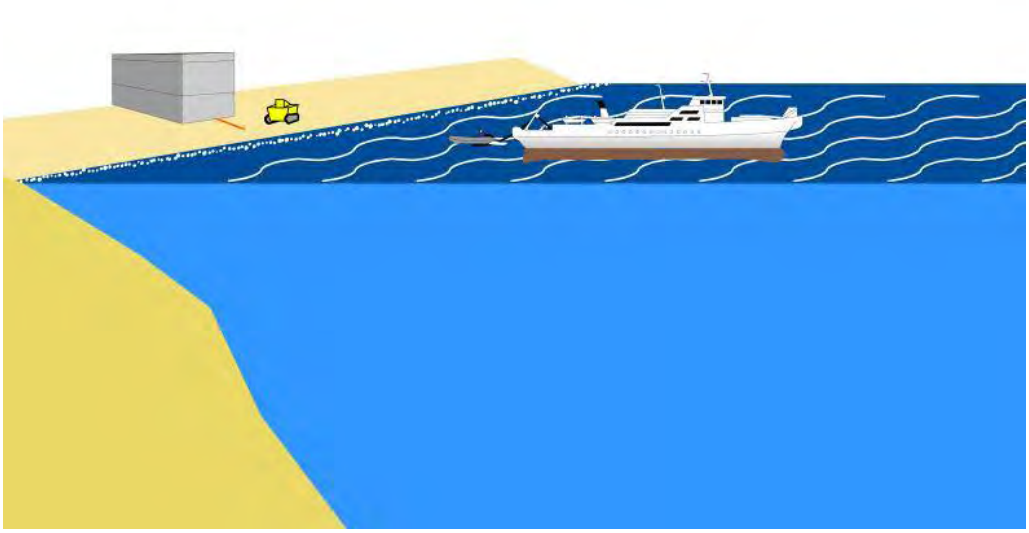


Figure 16. Cable ship is stationed offshore (Alcatel Submarine Networks)

A messenger line is passed ashore from the cable ship, and is wound onto a winch located on the beach, via the beach manhole (**Figure 17**).

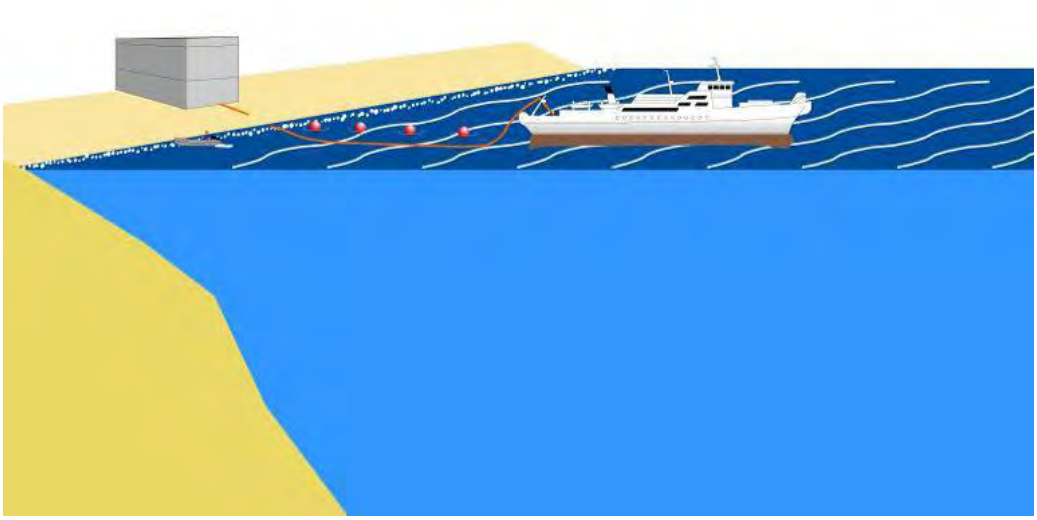


Figure 17. Messenger line (Alcatel Submarine Networks)

The cable will be paid out from a cable barge staying at deep water, floated on buoys and pulled to the landing manhole by a winch installed on land.

The messenger line is connected to the cable on the cable ship, and the line and cable are then winched ashore through the pre-dug trench and into the beach manhole. After the cable is secured in the manhole, the cable ship begins moving away from the beach to progress the offshore installation (**Figure 18**).

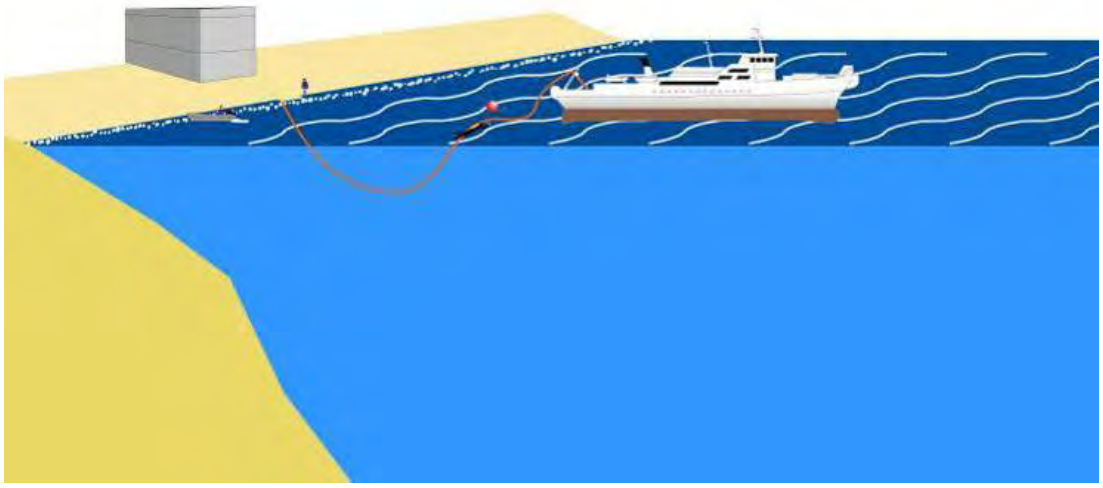


Figure 18. Progression to offshore installation (Alcatel Submarine Networks)

The shallow water segment of cable, between the low water level and 10 m water depth, lies on the seabed until divers with water jetting machines bury it, normally to a target depth of 1 m.

This process begins immediately after installation in order to avoid risk to the cable and potential interference with other activities. The diver-held water jetting machines remove and liquefy sediment, and the cable is placed in the trench they produce. The process produces some localized turbidity and disruption of bottom-dwelling flora and fauna.

The trench is allowed to backfill naturally at varying rates, depending on local currents, sediment characteristics and the resultant movement of sediments.

A short underwater trench of approx. 1m (W) x 1m (D) will be excavated by dredging at the shallow water using a small powered backhoe machine on a barge up to ~500m from shore or 40 m water depth. Beyond this point the water depth is expected to be sufficient for the cable burial machine to be employed (a plough) (**Figure 19 and 20**).

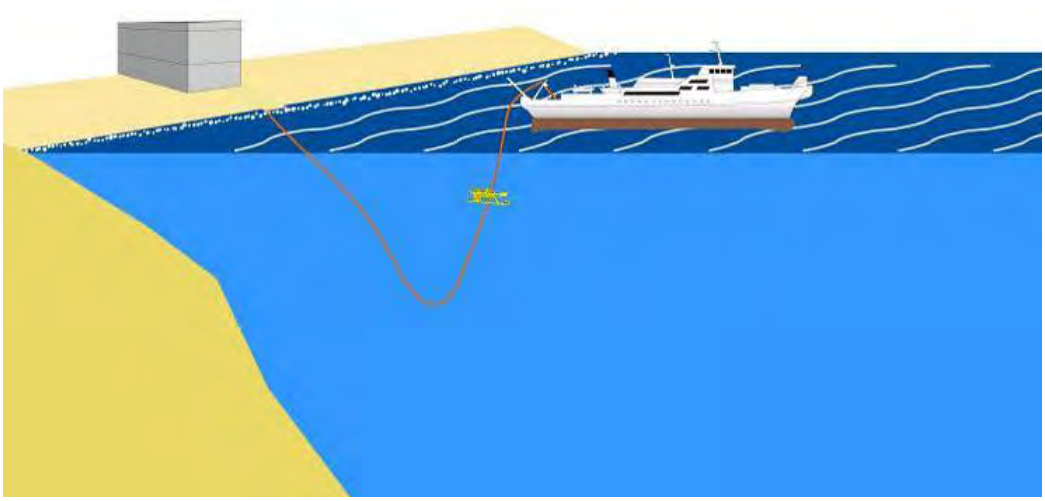


Figure 19. Cable burial machine (Alcatel Submarine Networks)

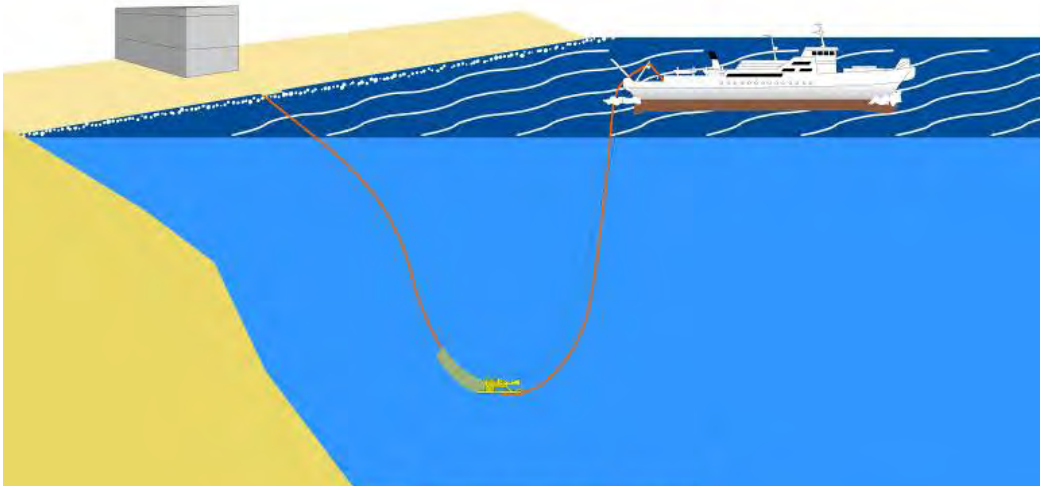


Figure 20. Cable burial machine started (Alcatel Submarine Networks)

Offshore

The cable is installed by the cableship, and buried wherever seabed conditions permit from the landing point until the cable reaches a depth of 1000m, or the edge of the continental shelf (**Figure 21**).

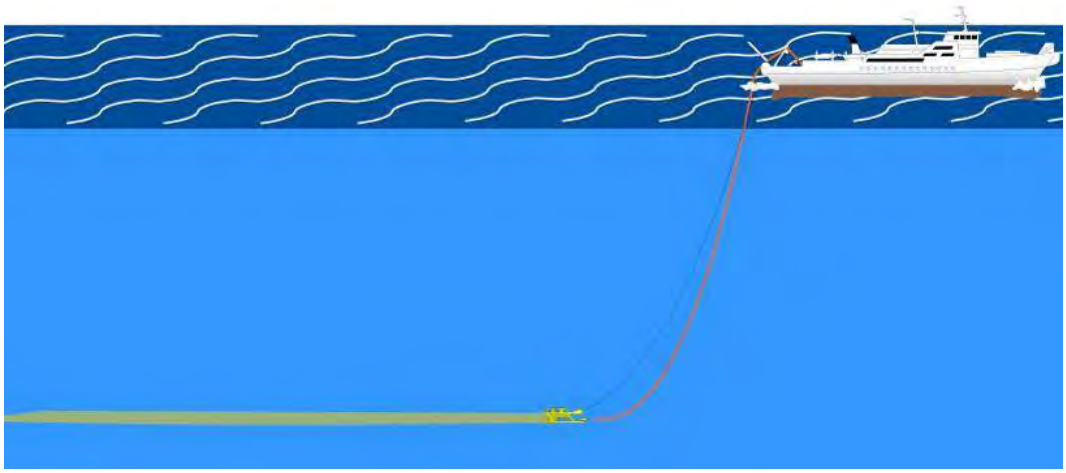


Figure 21. Cable buried with a plough offshore conditions (Alcatel Submarine Networks)

Offshore, cables would be buried in a narrow (<1 m wide) trench that would be cut by a water jet or plough while the cable is being laid.

The burial is accomplished by a sea plough. A plough towed by the cable ship opens a furrow in the seabed on the order of 0.75 m wide (**Figure 22**).

Figure 22. Typical sea plough

The communications cable passes through the plough and exits the plough share at the aft lower extremity. As the plough moves forward, the cable is left in the bottom of the furrow. The furrow fills by natural movement of sediment. Normal target burial depths are on the order of 1m.

In water depths greater than 15 m at points where the cable crosses an existing active cable, the plough is lifted off the seabed and the cable is laid on the seabed (a fly-over). Later the cableship returns with a Remotely Operated Vehicle (ROV) to bury the cable using water jets at this crossing point. In rocky areas, places with hard bottom or steep slopes, the cable is laid on the seabed.

Deep water

In deeper water, where burial is considered unnecessary, the plough is recovered and the cable is laid unburied on the seabed.

Onshore

Beach Manhole

The marine cable is connected to a land cable at the beach manhole. Since landing areas are often located in sandy places near city areas, beach manholes are often located in or near beaches that are used for recreation. There may be some localized disruption of recreational activities during construction with machines trenching and pulling cable, but after installation, recreational beachgoers are typically unaware of the cable and it has no effect on their activities.

On the beach, the cable is typically installed in flexible steel pipe with outside diameter on the order of 0.2m, in a trench two meters deep dug previously by equipment such as a backhoe. In cases of severe erosion, if the pipe becomes exposed it may be reburied.

The BMH provides a chamber situated above the high-tide level where the marine and terrestrial cables are connected. Once constructed, with the exception of the manhole cover, there is little or no visible evidence of a BMH. **The beach will be restored to its original state after the completion of cable installation.**

Installation of the manhole at each site will take less than two weeks at each site.

Construction of terminal station

From the BMH the cable will continue a short distance to a 'cable station' where it will connect with terrestrial networks (Figure 23).

A typical landing configuration is shown in Figure 23.

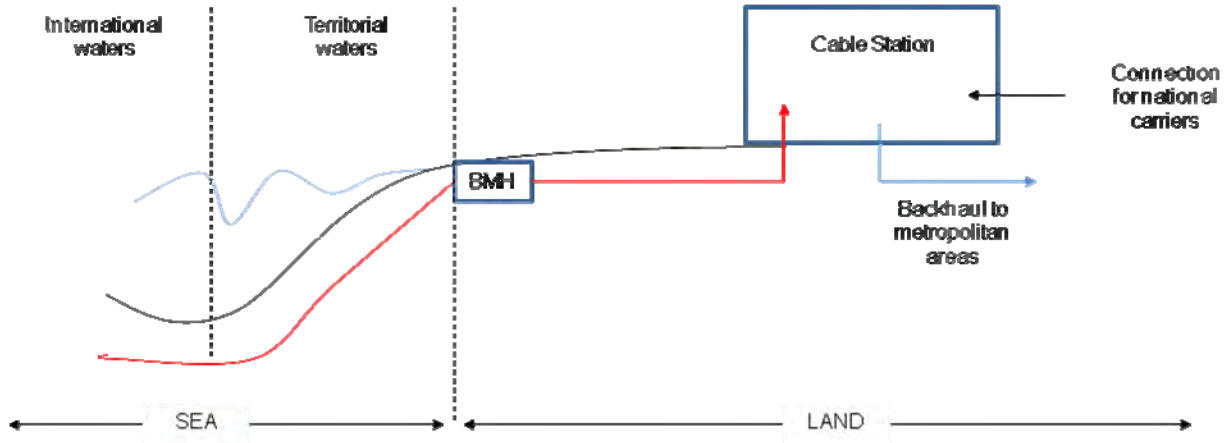


Figure 23. Typical landing configuration

A Cable Landing Station (CLS) will be required in order to connect the cable to the domestic cable infrastructure. The preferred location for the CLS is at Victoria. CLS will be located at Victoria in Cable and wireless office (4.5 km).

Construction of terrestrial ducted systems

The cable will be routed from the BMH to the CLS along an existing road. The cable will be installed in an existing conduit alongside the road.

Construction activities will include:

- Construction of the BMH
- Cable laying from the waterline to the BMH (20-30m trench on the beach)
- Cable laying via a trench (existing ducts) from the BMH to the Cable Station (cable and wireless)

Similar cable landing structure will be constructed at opposite shore (Kenya or Tanzania). When the cable laying barge reaches the opposite shore (Kenya or Tanzania), the cable will be detached from the burying machine and paid out from the cable laying barge to form a loop line on the sea surface.

5.9.2 - Operation and maintenance/repair

Once in place and connected, the cable system requires no intervention. The cable is to be regularly serviced during a standard 25 years design life. Power is provided to the system through electrical connection in the cable. This also provides power to the repeaters. The electrical current is fully shielded from the environment. Cable repair and maintenance may be required as a result of damage, failure, age /redundancy or clearance of congested routes.

Onshore, the CLSs will require power for their operations. Power will come from the national electricity grid with backup provided by diesel-powered generators.

Cables have to be recovered from the seabed for repairs, replacement or removal. Recovery may result from damage, failure, age/redundancy or clearance of congested routes (**Figure 24**).

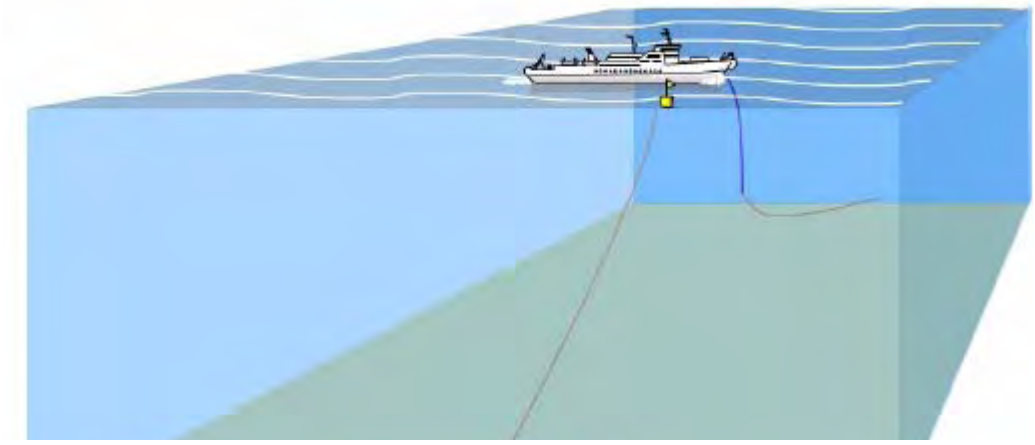


Figure 24. Replacement or removal of a cable (Alcatel Submarine Networks)

5.9.3 - Decommissioning activities

An evaluation should consider environmental issues in conjunction with technical, safety and cost implications to establish the best practicable environmental options for the decommissioning of the cable. An assessment ill also be conducted to ensure that nothing which could be constituted as an hazard for other users of the aera or for the environment with be left at the site. The site will be left in a safe and environmentally acceptable condition.

6 - INITIAL STATE OF ENVIRONMENT

6.1.1 - Geology

Most of the country lies on the Great African Plateau with altitudes ranging between 1000 and 2000 m above mean sea level, the exception being the narrow coastal belt.

The coastal plains are composed of both marine and terrestrial sediments. If we refer to the Geologic Time Scale, which is simply a list of the ages of the earth and its past life forms, the ages of sediments range from Jurassic through Cretaceous to Tertiary and Quaternary.

Much of the coast is of Pleistocene and Recent coral limestone. A belt inland from the coast, an area of continental and coastal deposition of Cretaceous and Tertiary period, includes limestone, sands and gravel. The marine rocks consist chiefly of marls, limestone and shells. The rocks of Zanzibar, Pemba and Mafia are composed of calcareous sediments with some marine clays, sandstone and coralline limestone and they range in age from Miocene to Recent.

Zanzibar and Pemba are part of the ancient Miocene Rufiji/Ruvu River delta. Due to periods of isostatic movement and block faulting over the coastal Tanzania and offshore deltaic zone, only Zanzibar, Pemba, Mafia and the Latham Island areas remain above sea level as land blocks of the original delta.

Tanzania is mostly underlain by rocks of igneous metamorphic origin, part of the crystalline complex that makes up the interior of Africa. Intense structural movements have caused a considerable variety of rock types.

6.1.2 - Soils

The soil types of coastal areas in Tanzania include: recently deposited alluvium that is mostly found in river estuaries; dark clays on older alluvial deposits which are found along the Rufiji Delta and Tanga; and grey bottomland soils, found mainly in the coastal plains (**Figure 25**).

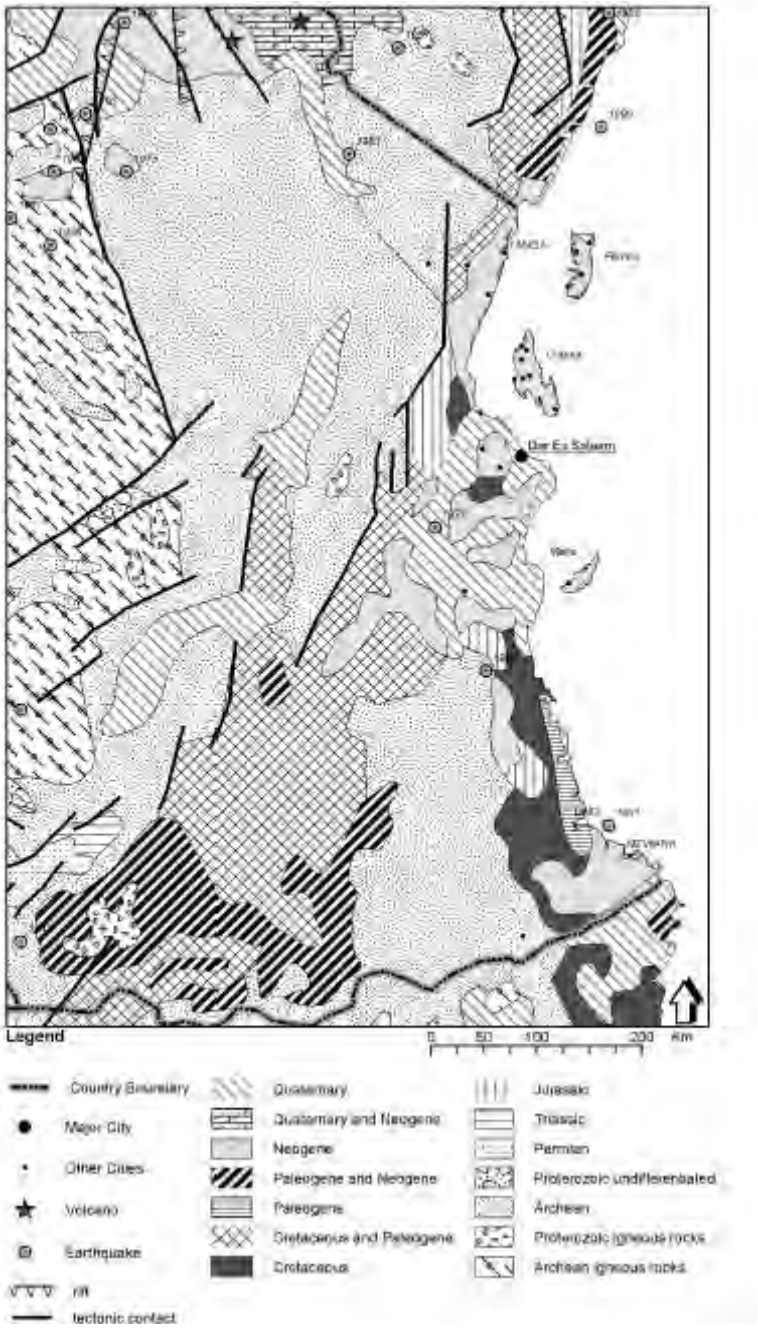


Figure 25. Geological map of coastal Tanzania (numbers indicate year of last earthquake)

In the coastal area and islands, the soils are predominantly sandy and coralline with poor moisture-holding capacity, extreme alkalinity and hard subsoil, resulting in poor drainage.

6.1.3 - Hydrology

According to the report of **UNEP** (2001), the main information concerning hydrology in the area, are the following:

The coast is strongly influenced by rivers that bring to it water, sediment, nutrients and pollutants. Tanzania is traversed by a number of rivers and streams.

The Rufiji, one of the largest rivers in Africa, contributes 50% of the surface runoff. The river has an annual discharge of 1133 m3/s.

The surface river flow regime and moisture conditions in the country correspond to the general rainfall pattern. The peak outflow from major rivers that discharge into the Indian Ocean occurs between March and May. Rivers and lakes start rising in November/December and experience a maximum in March–April, with a recession period from May to October/November.

The Pangani, Ruvu and Rufiji (south of Dar es Salaam) river basins experience frequent water use conflicts arising from increased competing demands on water for domestic use, irrigation and hydropower generation.

GROUNDWATER SOURCES

Groundwater potential in Tanzania, whose recharge is mainly from rainfall, varies from one locality to another and so does its development.

The country as a whole has a good potential of groundwater resources. With the exception of the Pangani river basin, groundwater development has mainly concentrated on shallow wells for domestic purposes.

The groundwater mineralisation process in various geological formations has resulted in differences in chemical water quality in different parts of the country. Along the coast and in islands, the groundwater is salty in most areas. In most cases, electrical conductivity exceeds 2000 S/cm thus making the water undrinkable and certainly unsuitable for irrigation. Such situations occur where boreholes are sunk into basement rocks. High levels of iron, colour, turbidity and COD (chemical oxygen demand) is a major problem in many water sources. Bacteriological quality of deep groundwater in the country is generally better than that of shallow wells and surface water. In most cases, the water does not need to be disinfected unless it has been contaminated, mostly with faecal matter.

6.1.4 - Meteorology

The general climate of Tanzania has been largely described in a document of UNEP (United Nations Environment Programme) concerning the project: Eastern Africa Atlas of Coastal Ressources (**UNEP Program, 2001**). The following paragraph is an extract of that report:

The climate of Tanzania can broadly be classified into four types: the hot, humid coastal plains; the hot, arid zone of the central plateau; the high, moist lake regions; and the temperate highland area. The climate is controlled mainly by two major factors:

- *its geographical location within 1°S – 12°S latitude, which creates a truly equatorial setting, with high temperatures, high humidity (60 to 80%), low wind speeds and absence of a cold season, and*

- *its position on the eastern edge of Africa, exposed to the large seasonal changes broughtabout by the general circulation of air over the Indian Ocean.*

The monsoons have the dominant influence on wind direction and strength, temperature and rainfall, among others. The word 'monsoon' is derived from an Arabic word meaning seasonally reversing winds. There are two monsoon seasons, namely the Northeast monsoon which prevails from November to February and is characterized by higher air temperatures (> 30°C) and weaker winds, and the Southeast monsoon which lasts from April to September and is marked by lower air temperature (approximately 25 °C) as well as stronger winds. Occasionally, the Southeast monsoons are associated with epidemic events such as storms and cyclones. The months of March/April and October/November are the inter-monsoon periods and usually are the calmest. June and July are the windiest months while March, April and November experience the lowest and most variable wind speeds.

Among the 4 recorded epidemic events (until 2001), 3 of them concerns the coasts of Dar es Salaam and Zanzibar:

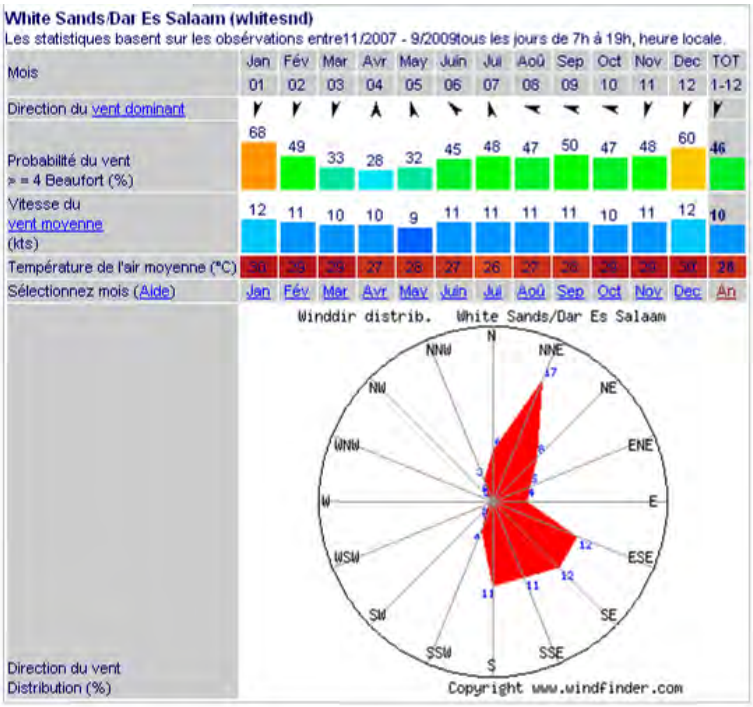
- Dar es Salaam: tropical storm - 1989 (7 deaths)

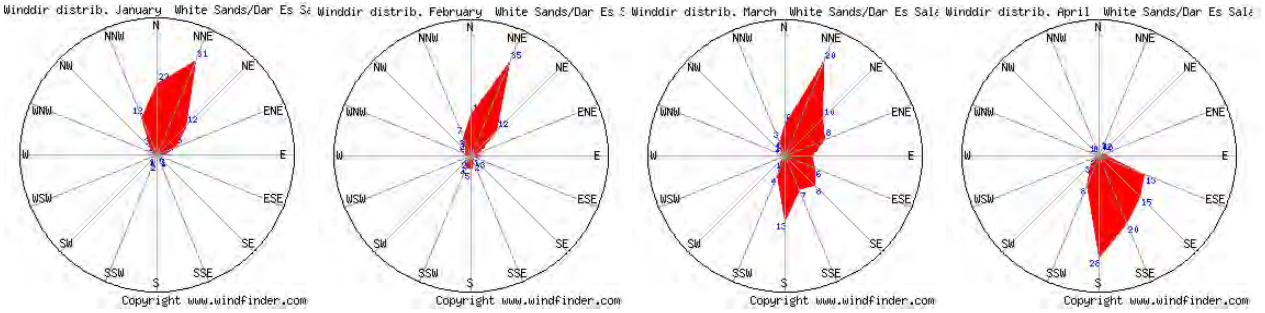
- Zanzibar: cyclone - april 1872 cyclone – august 1994 (5 deaths)

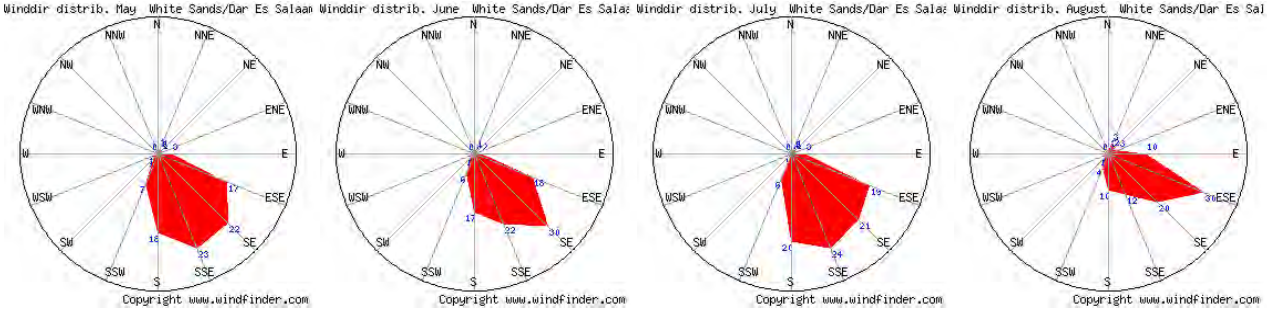
WIND CONDITIONS and AIR TEMPERATURES

Monthly and yearly meteorological conditions (wind speed and air temperature) of Dar es Salaam and Zanzibar can be retrieved on the internet website *windfinder.com* (**Figure 26**).

Dar es Salaam:







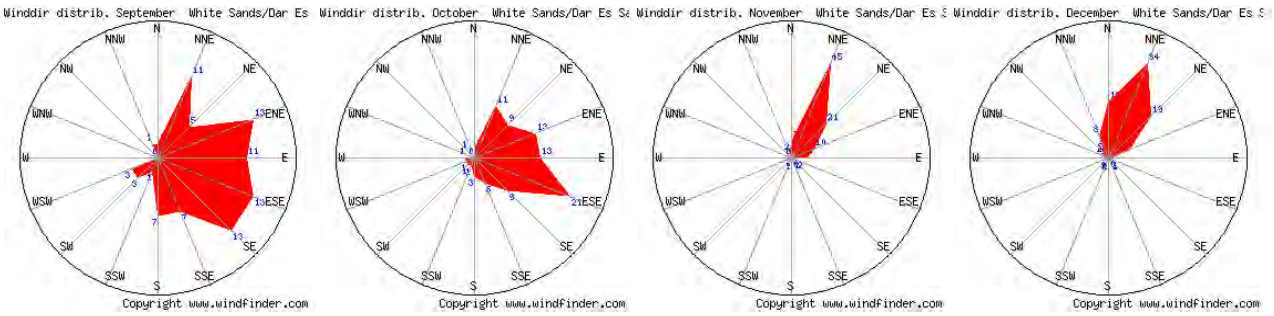
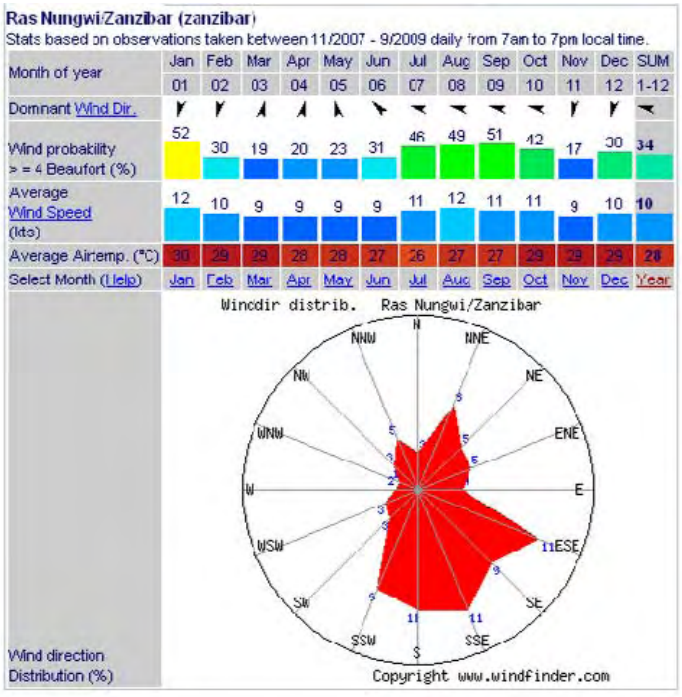


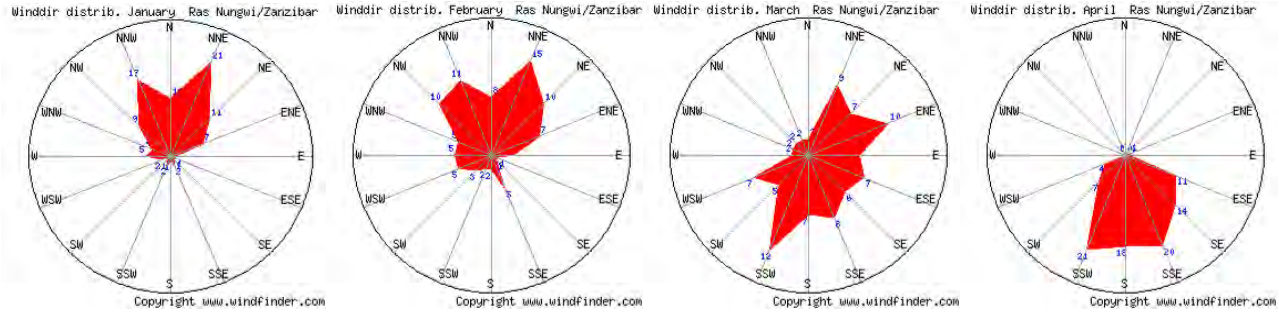
Figure 26. Wind characteristic at Dar Es Salaam

The average air temperature is slightly varying: only between 26°C and 30°C around the year (minimum: July, maximum: January-December).

The yearly average wind speed is 10 knots (monthly averages varying between 9 and 12 knots).The wind speed roses show two main sectors of incoming directions: north-easterly and south-easterly (**Figure 26**).

*Zanzibar (***Figure 27***):*





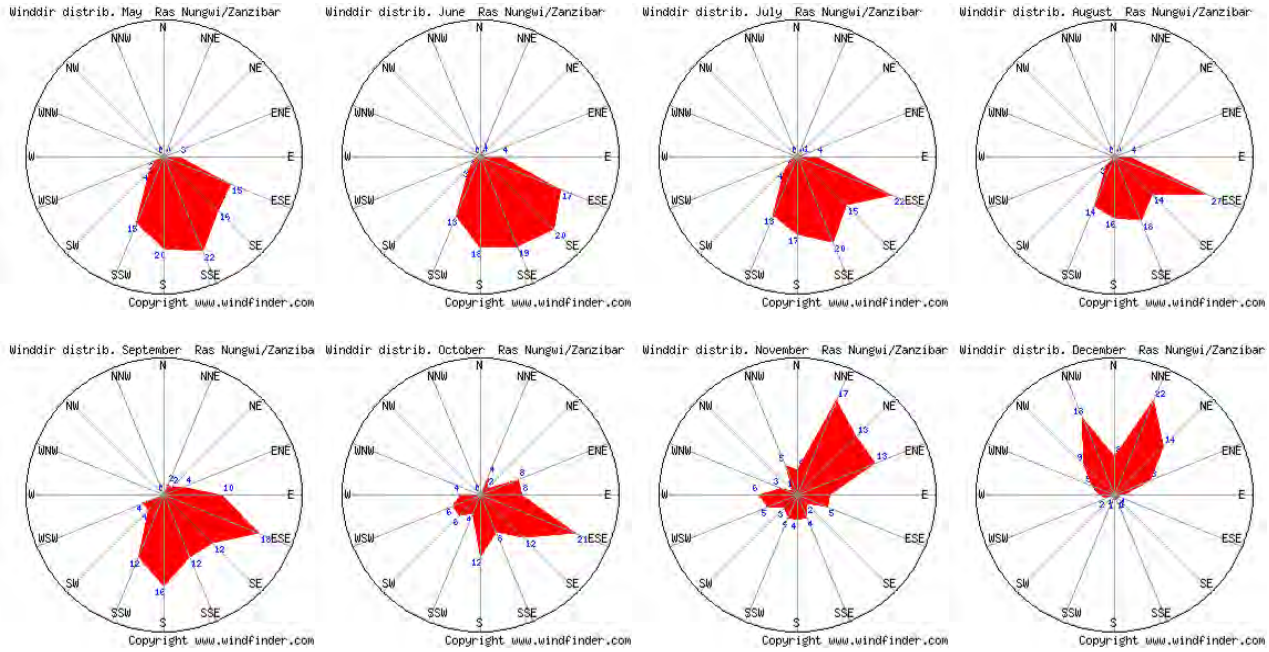


Figure 27. Wind characteristics at Zanzibar

The average air temperature is slightly varying: only between 26°C and 30°C around the year (minimum: July, maximum: January) (**Figure 27**).

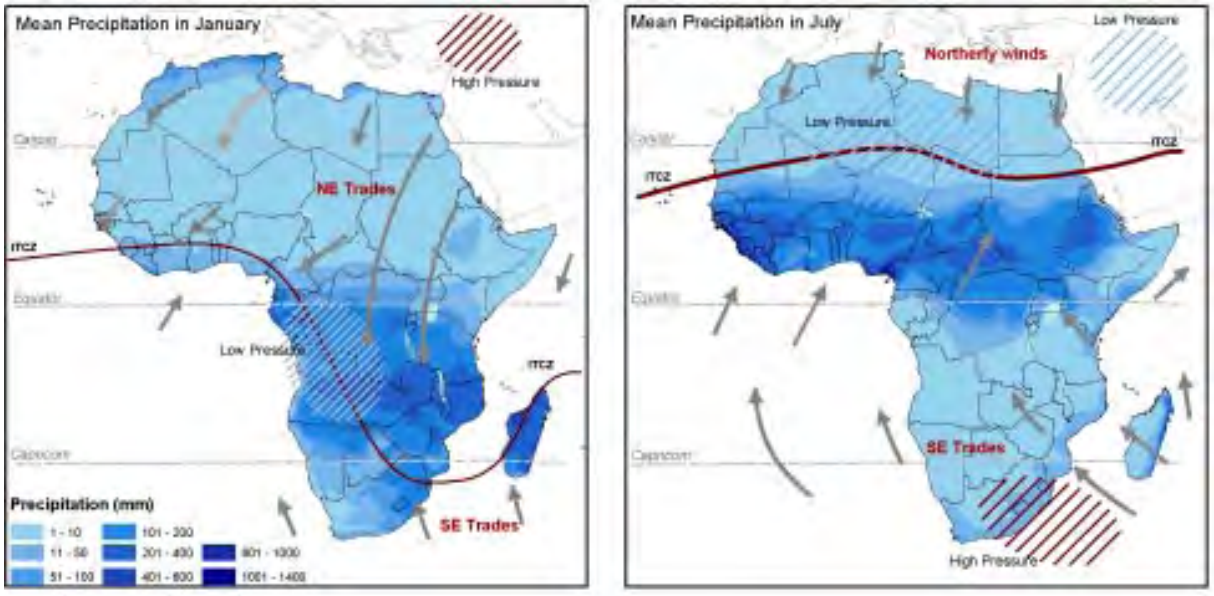
The wind speed direction is mainly from south / south-east sectors. The yearly average wind speed is 10 knots (monthly averages varying between 9 and 12 knots).

RAINFALL CONDITIONS

The Rainfall observed over Tanzania has also been largely described by the UNEP (2001):

Rainfall in the tropics depends mainly on the movements of the air masses that cover the globe. The sun is overhead at the Equator on 21 March, the Tropic of Cancer on 21 June, the Equator again on 21 September and the Tropic of Capricorn on 21 December. The sun's heat causes a low-pressure zone that encircles the earth roughly parallel to the Equator and that moves north and south following the sun. This zone is often called the inter-tropical convergence zone (ITCZ). Map 2 shows the rough location of the ITCZ over the Indian Ocean in January and July.

The dry season that prevails in the northern coastal areas during the period January–February arises from the effect of the Northeast monsoons, since the air masses that move mainly over land, having originated from the dry Arabian Gulf, are dry. From March to May, the ITCZ has moved northward to the Equator such that the southern and northern air masses now converge over Tanzania and convection currents cause rainfall.



Map 2. Prevailing winds and approximate location of the inter-tropical convergence zone (ITCZ) over Africa, January (left) and July (right) (after Ker et al., 1978)

Between June and September, the winds turn and Southeast monsoons prevail. Although these have crossed the Indian Ocean, a dry period ensues as the high ground of Madagascar has caused most of the moisture to fall. By October, the ITCZ is on its way south and remains over Tanzania for a short while, bringing the short rains.

Besides being close to the Equator, Tanzania is generally rather dry, with more than half of the country receiving on the average less than 800 mm of rainfall per annum. The entire coastal area, which rises from sea level to about 200 m, has a mean annual rainfall ranging from 900 to 2000 mm. Rainfall increases northwards and it is highest on the islands. The island of Pemba receives the highest amount of rain (1916 mm/year), followed by Mafia (1877 mm/ year) and Zanzibar (1565 mm/year). Lindi receives the

lowest amount of rainfall (917 mm/ year). Map 3 provides an overview of rainfall and wind speeds at the Tanzania coast.

Two types of rainfall regimes prevail on the Tanzanian coast:

- A unimodal type with a single annual maximum, generally between December and April, which prevails in the southern areas such as Mtwara, Lindi and Mafia. These areas receive the heaviest rains in April except Mtwara, which receives the heaviest rainfall in January. The rainy season in Mafia extends from November to May and the island receives the heaviest rains of 577 mm in April, which is the highest in the country.

- A bimodal type composed of a long rainy season (March–May) and a short one (November–December) which prevails in the northern areas such as Pemba, Tanga, Dar es Salaam and Zanzibar. The long rains are heavier than the short rains, while the heaviest rains are received in either April or May.

Statistical meteorological data for Tanzania (Dar es Salaam and Zanzibar) can be collected on the Weather Online internet site (address: http://www.weatheronline.co.uk).

Among the available data, information concerning, humidity, rainfall and sunshine are resumed hereafter. The period concerned runs from January 2000 to December 2008.

Dar es Salaam:

The following table 11 provides information on relative humidity, precipitation and sunshine:

Table 11. Humidity, precipitation and sunshine at Dar es Salaam

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
HR (%)	77	76	83	87	83	83	81	79	78	77	80	80
Acc. Prec. (mm)	20.6	130.2	73.8	102.9	63.7	17.4	2.1	6.1	10.0	33.9	104.7	47.1
Days with precip.	2.1	2.2	8.6	12.5	8.9	3.5	1.7	3.6	4.2	5.5	7.2	5.3
Daily hours sunshine	8.3	8.1	7.3	6.5	7.3	8.2	8.9	8.4	9.7	9.1	8.8	8.5

The relative humidity is varying between 76% (February) to 87% (April).

The rainiest season concern the months of February to May and the driest one, the months of June to September. It can be noted that those statistics concern the period running from year 2000 to year 2008, and that there are some variations year to year.

Zanzibar

The following figure 28 illustrates the measured precipitations:

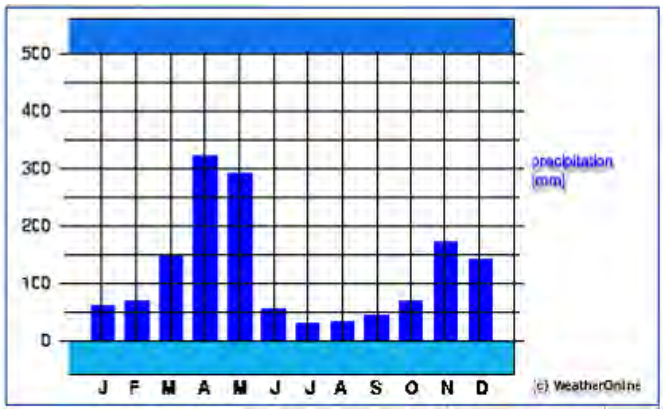


Figure 28. Precipitations at Zanzibar

The following table 12 provides the daily hours of sunshine:

Table 12. Daily hours of sunshine at Zanzibar

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Daily hours sunshine	8.2	8.3	7.2	6.9	6.4	7.6	7.7	7.6	8.6	8.6	7.3	8.1

The rainiest period is April-May with about 300 mm of precipitation. The driest period is July-August-September with monthly less than 50 mm of precipitation.

Daily hours of sunshine are comprised between 6.4 (May) to 8.6 (September-October).

6.1.5 - Oceanographic characteristics

According to UNEP report (**2001**):

The tides along the Tanzanian coast are of semi-diurnal type, characterized by two occurrences of both high and low waters within a day. These are the mean spring tide of about 3.5 m and mean neap tide of about 2.5 m. The age of the tide (time lag between the new or full moon and the peak of spring tide) in most of the areas ranges from one to two days.

The tidal levels in the potential areas (Dar es Salaam, Zanzibar), are reported in the following table 13.

Table 13. Tidal levels referred to datum soundings (data approximate) according to chart N°665 and N°674 UKHO (respectively for Zanzibar and Dar es Salaam)

Place	Lat S	Long E	Heights in metres above datum			
			MHWS	MHWN	MLWN	MLWS
Zanzibar	6°09’	39°11’	4.3	3.1	1.9	0.6
Dar es Salaam	6°50’	39°17’	3.6	2.5	1.5	0.4

The tidal ranges are highest in Zanzibar than in Dar es Salaam. Menai Bay is rather flat area with very few prominent topographic features. This explains the presence of large intertidal flats, extending in some places to more than one kilometre. The average amplitude of the tides in the bay is between 1.5 and 2m, during spring tides, it can exceptionally reach up to 4 meters.

The environmental conditions can induce deviations from the predictions reported in the tide table.

6.1.5.1 - Swell

Some numerical data of the coast of Africa are archived on the internet website windguru (internet address: http://www.windguru.cz/). In Tanzania, data are available for Paje Beach (Zanzibar) and has been analysed. The Paje area is located South-East of Zanzibar.

The time step is 6 hours. Histograms of heights and periods of the swell, for the period running from 6/11/2008 to 6/11/2009, are presented hereafter (**Figure 29**).

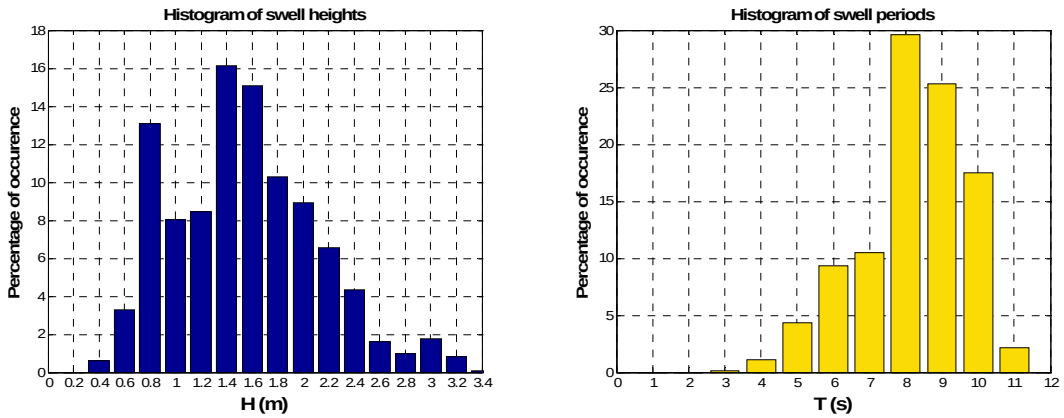


Figure 29. Histograms of significant height and period of well at Zanzibar

The swell heights are rarely higher than 3 meters and most of the time comprised between 0.6 and 2.4 meters.

The swell periods are mainly comprised between 6 and 10 seconds.

The corresponding swell directions are oriented in the South-east sector, and episodically (rarely) in the North-east sector.

Consequences

Dar es Salaam is geographically oriented in front of the open ocean, in a similar way than the Paje area. The sea state is then also probably mainly influenced by south-easterly swells.

The site in Zanzibar (Fumba) are located South-West of Zanzibar. They are sheltered from North-East swells (little occurring) but are probably submitted to an influence of South-east swell (modified and deviated according to the theory of diffraction and refraction of the swell).

6.1.5.2 - Currents

The dominant major currents prevailing in the coastal waters of Tanzania are:

- the South Equatorial current: it flows westwards permanently at around 12° S
- the East African Coastal Current: it flows northward

During the South-east monsoon (April to October), the East African Coastal current is strongest. Its average speed is of about 2 m/s and it occasionally reaches 3.5 ms.

During the North-east monsoon (November to March), it is weaker. The average current velocity is less than 0.5 m/s.

Consequence: The current offshore of Dar es Salaam and Zanzibar is oriented northwards all round the year.

6.1.5.3 - Particular features of the different sites

Dar es Salaam :

The distance between the site in Dar es Salaam and the coral reef in front of the site is of about 1100 meters (straight line).The distance between the site in Dar es Salaam and the end of the foreshore area, in an oblique direction is of about 700 meters.

Zanzibar:

The length of the coral reef in front of the Fumba site is of about 1800 meters. Menai Bay Conservation Area (MBCA) is influenced by the Eastern African sea-current that crosses the Zanzibar Channel all year round in a northerly direction, although specific areas are more directly influenced by various smaller, local currents created by the presence of coral formations, sand banks, islets or islands.

6.1.5.4 - Salinity and sea water temperature

Dar es Salaam

Monthly averages sea surface temperatures data, measured at Dar es Salaam, are available on the Weather Online website (address: http://www.weatheronline.co.uk). They are reported in following table 14.

Table 14. Sea water temperature at Dar es Salaam

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Tw (°C)	29	28	30	29	28	27	25	25	26	27	27	28

The sea surface temperature in Dar es Salaam varies between 25°C (July-August) and 30°C (March). The lowest sea surface temperatures occur during the South-east monsoon, and the highest ones during the North-east monsoon.

Salinity values are lower during May following the peak freshwater outflow and highest in November. The salinity values start to decrease in February before the beginning of rains.

This is attributed to the advection of lower salinity water from the south. In Open Ocean, salinity values normally range from 34.0 to 35.5‰. However, the salinity is low nearer the coast due to freshwater runoff (UNEP, 2001).

UNEP (**2001**) has described the three main water masses identified off the Tanzanian coast:

- Surface water (depth < 100 m): temperature of 22–30°C and salinity of less than 35.4‰.It is brought to the west from the Bay of Bengal and the eastern Indian Ocean by the South Equatorial current.
- High salinity water found at a depth of 150–250 m. This is thought to originate from the Arabian Sea and/or the subtropical surface waters.
- The Indian Ocean Central water, which is found at 250–500 m depth and has temperature of below 18°C.

6.1.6 - Coastal terrestrial habitats

According to UNEP report 2001, the main characteristics of coastal forests and coastal grasslands are the following:

Coastal forests

Coastal forests in Tanzania cover about 350 km2. However, they are small, highly fragmented, separate forest patches, most of which are less than 500 ha in size and some carry a conservation status. These are individually distinct, with a high level of local forest endemism and a great array of different communities and endemism. Tanzanian coastal forests have 105 endemic plants, 20 endemic reptiles, 40 endemic butterflies, 5 endemic birds, 5 endemic mammals and 5 endemic amphibians.

Many coastal plants are exploited for medicinal use.

The five species of mammals that are endemic to coastal forests are the golden-rumped elephant shrew (*Rhynchocyon chrysopygus*), Ader's duiker (*Cephalophus adersi*), African woolly bat (*Kerivoula africana*), Pemba fruit bat (*Pteropus voeltzkowi*) and the bat species *Rhinolophus deckenii*. Rare species found in the coastal forests and elsewhere are the lesser pouched rat (Beamys hindei), the eastern tree hyrax (*Dendrohyrax validus*), Seychelles fruit bat (*Pteropus seychellensis*) and the African elephant (*Loxodonta africana*). The Jozani forest in Zanzibar is the main habitat of the endemic red colobus monkey (*Colobus kirkii*). There are many invertebrates.

Communities that depend on the forest resources surround the coastal forests. The most important income-generating uses of the coastal forests are the production of charcoal, firewood and timber. The forests also provide non-wood products such as medicine, honey, mushrooms, fruits and thatch grass. Charcoal making is a major means of generating income, followed by timber selling. Carpentry, carving and weaving of mats or baskets are also income-generating activities that utilise forest resources.

Presently, the coastal forests in Tanzania are under heavy pressure. They are threatened by unsustainable human activities including logging of canopy trees for timber and fuel, removal of hardwood poles to build houses, burning of woody plants to produce charcoal and wholesale removal of woody vegetation for conversion of the land to agriculture. Uncontrolled bushfires (which are usually started by humans) are the worst threat in some forest reserves.

The coastal thickets are mainly characterised by scattered trees and shrubs with climbers and lianas. The canopy cover is less than 40% and dominated by trees such as *Dalbergia melanoxylon, Sclerocarya caffra* and *Annona senegalensis*. Common shrubs include *Suregada zanzibariensis*, *Phyllanthus reticulatus, Strychnos spinosa* and *Catharanthus roseus*. Common lianas and climbers include *Macrotyloma axillare, Cissus quadrangularis, Landolphia kirkii, Tinospora oblongifolia* and *Ipomoea coptica*. The herb layer comprises species such as *Waltheria indica, Triumfetta rhomboidea* and *Agathithanthemum bojeri*.

Coastal grasslands

In the coastal areas the dominant grass species is *Hyparrhenia rufa*. Other abundant grass species include *Sporobolus marginatus, S. pyramidalis* and *Heteropogon contortus*. The woody vegetation is dominated by *Combretum* spp. Others are *Acacia seyal, Dichrostachys glomerata* and *Baphia kirkii*, while the palm *Hyphaene* is common on the poorly drained soils. In the Rufiji floodplain, for example, there are palm savanna *Borassus aethiopum* and *Kigelia Africana* trees.

The following figure 30 describes of the distribution of coastal habitats (corals and mangroves) and selected terrestrial land cover types.

Figure 30. Map of the distribution of coastal habitats (corals and mangroves) and selected terrestrial land cover types (from UNEP, 2001)

FUMBA, landing Point - Menai Bay Conservation Area MBCA

The terrestrial areas surrounding MBCA shelter different natural habitats, each distinct from but often complementary to others, with their own species of flora and fauna. The coastal habitats are directly influenced by the sea, and in turn influence, directly or indirectly, the conditions prevailing in the marine areas close to shore.

Currently, there is no specific inventory that was conducted in the MBCA to know the status of flora. Apart from mangrove species and sea-grasses no botanical surveys of other flora that has been conducted. Only Chumbe Island has been surveyed its flora and has all the list of vegetations that occurs in the area. Serious study is required to be done in order to know the status of floras that are found within the MBCA.

6.1.7 - Mangrove forests and coastal wetlands

According to UNEP report 2001, the main characteristics of the mangroves are the following:

The mangrove forests of Tanzania Mainland cover about 115,500 ha and those in Zanzibar cover 18,000 ha (Unguja Island 6000 and Pemba Island 12,000 ha). There are nine species of mangrove trees in Tanzania, though not all are found in every forest. *Xylocarpus mulluccensis* is very rare but *Avicennia marina*, *Rhizophora mucronata* and *Ceriops tagal* are abundant. The mangrove ecosystem, however, includes much more than just the trees and encompasses terrestrial, freshwater, marine and estuarine systems. Therefore, the mangrove habitats in Tanzania are diverse and are best-developed in estuaries such as the Rufiji delta. Mangrove tree species normally occupy specific habitats in the forest.

Most mangrove species have extensive root systems, which are adapted to the conditions of fine-grained soils that are, to varying degrees, low in oxygen and poorly consolidated.

FUMBA, landing Point - Menai Bay Conservation Area MBCA

Mangrove stands cover the sheltered bays and inlets in the northern and Northeastern parts of MBCA. According to Muhando (1995), mangrove vegetation in Menai Bay is found in the bays at Nyamanzi, Kisakasaka, and North of Uzi Island and at the Northern part of Pete channel.

A thin belt of mangrove occurs south of Muungoni to northern part of '*Diko la Ng'ombeni'*. The most extensive mangrove forest can be found near Uzi-Nyeke. Mangrove forests are dominated by mangrove trees, which are perfectly adapted to the very specific conditions prevailing in the brackish, half terrestrial, half marine habitat. Ten species of mangroves are found in Menai. The most common species are *Rhizophora mucronata, Avicennia marina, Bruguiera gymnorrhiza* and *Ceriops tagal.* Others are *Sonneratia alba, Xylocarpus granatum, Xylocarpus molucensis, Heritiera littoralis, Pemphis acidula* and *Lumnitzera racemosa* (Shunula and Whittick 1996, Juma *et al*. 2001, Shunula 2002).

Mangrove forests are an essential component of the coastal ecosystem. Numerous marine and terrestrial organisms use them as breeding grounds. Crabs (like the red-clawed fiddler crab) and mudskippers are numerous in mangrove forests.

Long stretches of the Menai bay coastline are fringed by rocky limestone cliffs, the rocks are shelters for numerous creatures adapted to the ever-changing conditions created by waves and tides, such as the yellow grasped crab or the eight-plated chiton snail.

Seventy plants species belonging to ten (10) main vegetation types have been observed by Akil and Jiddawi (1999) in Menai bay mangroves. In their observation mangroves and lower plant species, including algae, sea grass, lichen, ferns, climbers and mangroves epiphytes were found in water, sand and coral areas. The lichens, ferns, climbers and epiphytes were mainly observed in areas under the shade of mangroves (Akil and Jiddawi 1996). Most sea grass species are characteristically rhizotricetous and are able to withstand tidal pressure of the seashore (Ronald and Menez, 1988).

6.1.8 - Marine ecosystems

6.1.8.1 - Coral reef

This is the country with the largest area of coral reef in the region with 3,580 km^2 with fringing reefs being found along the coast of most of mainland Tanzania and the three main offshore islands: Pemba, Zanzibar and Mafia (**Figure 31**).

Figure 31. Map displaying coral reef ecosystem in Tanzania

Dar-es-Salaam

Figure 32 shows location of coral reef near beach manhole (BMH) proposed.

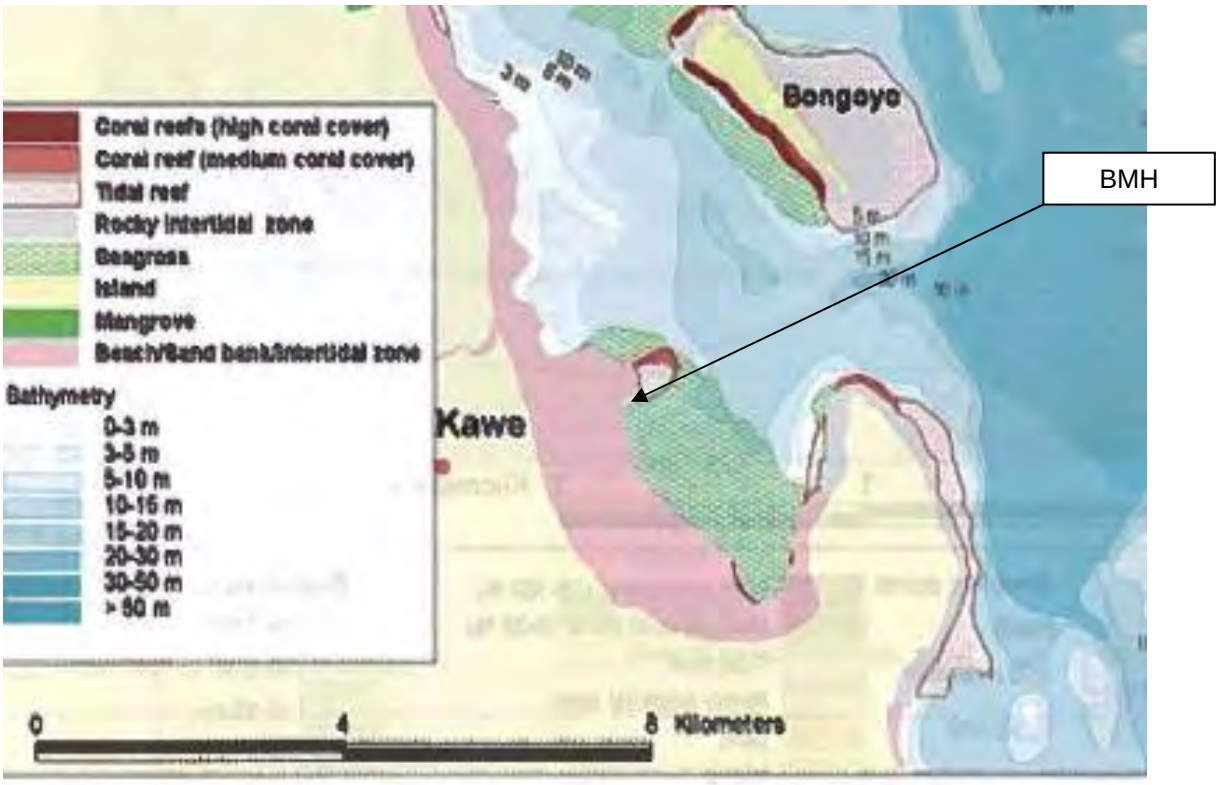


Figure 32. Map showing the main habitat types near BMH proposed (MNRT, URT, 2005)

FUMBA – Zanzibar

Fumba site is dominated by patch reefs, which fringe small islets and sandbanks (**Figure 33 and 34**).

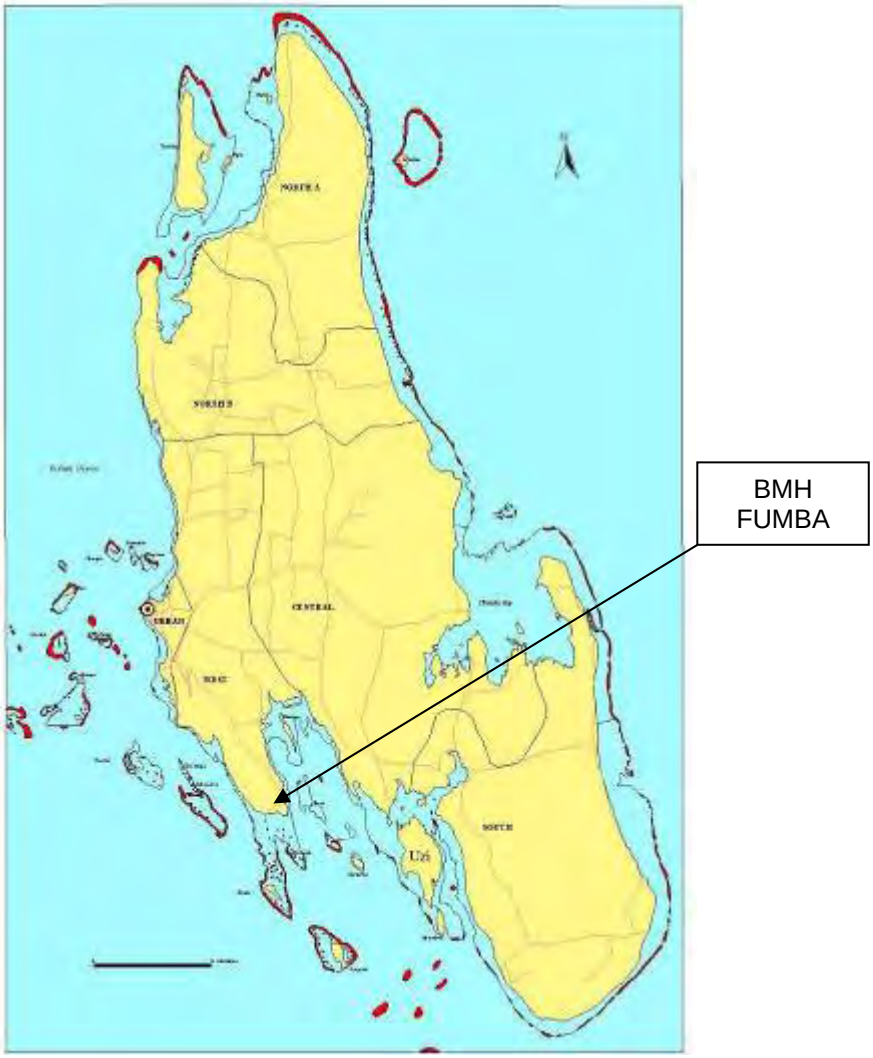


Figure 33. The distribution and location of major coral reef areas in Zanzibar (East African Regional Seas Technical Reports Series No. 7UNEP/FAO/PAP, 2000)

The most dominant genera are *Acropora, Montipora, Porites, Millepora, Lobophyilla, Echinopora* and *Favia*. Good coral reefs in the area are found adjacent to the islets and sand banks and dominated by one or two genera (Horrill et al., 1994; Muhando, 1995). Coral reef habitats in the area host a variety of fish species some of which are commercially important. Fishing is performed directly on the reef. Coral reefs also attract hundreds of tourists who visit Menai Bay for snorkeling.

Coral reefs support food webs, life cycles and productivity of the adjacent shallow water fisheries and contribute to offshore fisheries beyond the islets. Coral reefs also serve as a natural protective barrier, deterring beach erosion, retarding storm waves and allowing mangroves to prosper (Muhando, 1995).

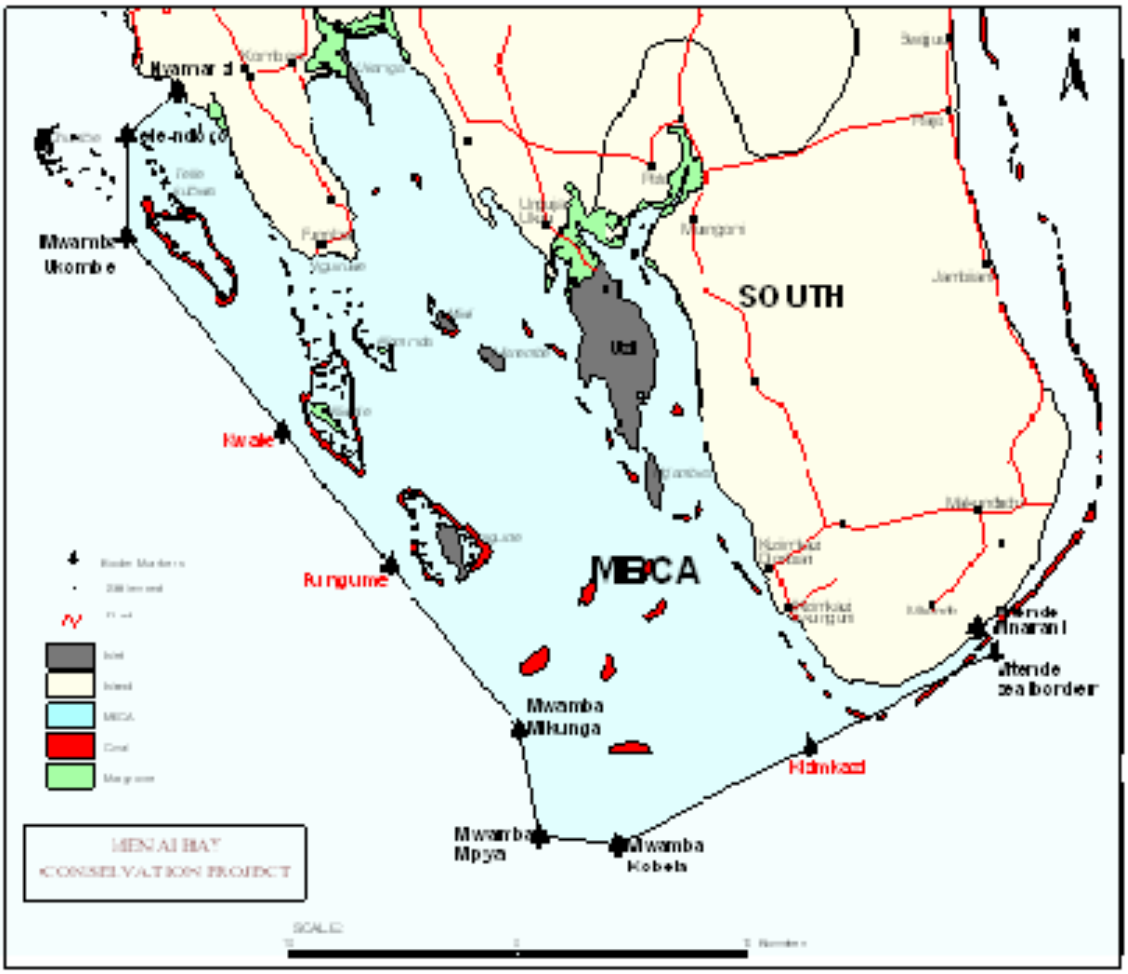


Figure 34. coral reef in Menai Bay Conservation Area MBCA

6.1.8.2 - Seagrass bed

Twelve types of seagrass have been identified in the country. Submerged sea grasses are abundant in the intertidal and sub tidal environment of the area.

Sea grasses form dense beds which cover large areas of coastal waters (Dar-es-Salaam and Zanzibar). Major seagrass areas include Pemba, Unguja and Mafia Islands (Ochieng and Erftemeijer, 2001).

FUMBA, landing Point - Menai Bay Conservation Area MBCA

Submerged sea grasses are abundant in the intertidal and sub tidal environment of the area. They occur as dense turfs in shallow water where wave and tides action are not excessive (Muhando, 1995). Very few studies have been conducted to assess sea grasses at Menai Bay Conservation Area. However, the following genera are found; *Halodule*, *Cymodocea*, *Thalassia, Syringodium* and *Thalasodendron* (pers. observ.).

Sea grasses form dense beds which cover large areas of coastal waters and perform a wide spectrum of biological and physical functions. They serve as breeding, nursery and feeding areas for many invertebrates and vertebrate species including commercially important species of finfish and shellfish. Sea grasses are a source of food for herbivorous invertebrates, fish and green turtle. Additionally, sea grass beds are known to trap and bind sediments thereby reducing particulate pollutants over coral reefs and providing protection to shorelines (by dissipating wave energy). No direct uses of sea grasses by man have been recorded so far in Menai Bay Conservation Area.

6.1.8.3 - Rocky shores and sandy beaches

This description is issued of following report UNEP

Many localities along Tanzania's shoreline are of raised coral limestone, generally with wide erosional platform that rise to the level of mean neap tide (Hartnoll, 1976). Around Dar es Salaam the shore is divided into three zones: lower eulittoral up to mean tide level, with a dense cover of small algae and characteristic fauna which does not extend to higher levels; an upper eulittoral to about mean high water springs, with algae only under shading overhangs and an abundant fauna dominated by polychaetes (*Pomatoleios*), barnacles (*Chthamalus*, *Tetraclita*, *Lithotrya*, *Acmaea*) and bivalves (*Sarcostrea cucculata*); and a littoral fringe characterized by littorinides and *Nerita* snails, extending in some areas more than 5 meters above mean high water springs.

Marine Biology of Msasani Bay

The intertidal zone surrounding the Project Area comprises small sandy beaches as well as coral based rocky flats. The underwater habitat ranges from shallow gently sloping coral reefs, sandy expanses to sea grass beds.

FUMBA, landing Point - Menai Bay Conservation Area MBCA

The MBCA is found adjacent to the coral rag bush characterized by red soils. The bay conceals a number of small-uninhabited islands (islets) (Figure 2), which are mainly used (some of them) for camping during fishing operations. The islets, which are covered by coral bush, are surrounded by coral reefs and sea grass beds near shores, which act as major fishing grounds for the artisanal fishermen and provision of forest-related products to the community

6.1.9 - Marine Fauna

The coastal waters of Tanzania contain diverse species of flora and fauna. In particular, it can be found marine turtles, marine mammals, birds (migratory and other), and some species at risk.

They are largely described in the document of UNEP (2001).

Marine Turtles

The following five species of marine turtles are found in the waters of Tanzania: green turtle, *Chelonia mydas* (locally known as 'kasa' or 'nduvi'); hawksbill turtle, *Eretmochelys imbricate* ('ngamba'); leatherback turtle, *Dermochelys coriacea*; olive ridley turtle, *Lepidochelys olivacea* and loggerhead turtle, *Caretta caretta* ('mtumbwi', 'ranga'). The most common type is the green turtle followed by the hawksbill, which is smaller. The loggerhead and leathery turtles are less common, while the olive ridley is very rare.

The following figure 35 present the major nesting sites of the main species of marine turtles:

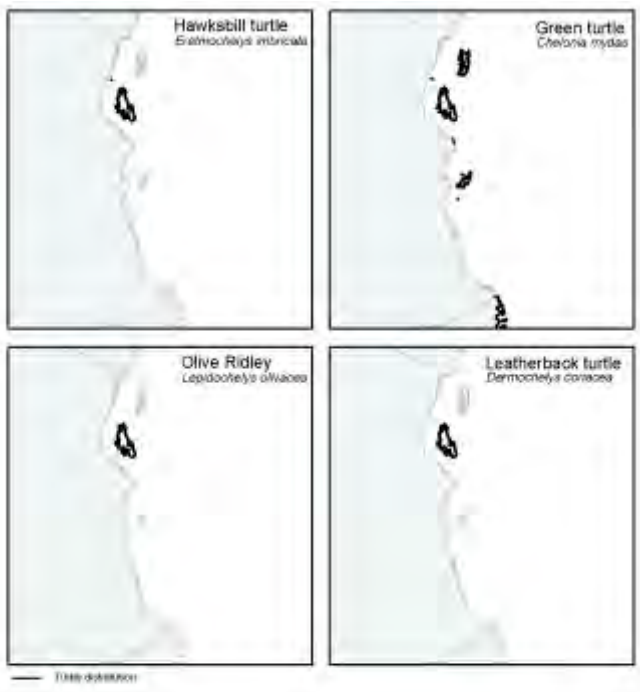


Figure 35. Map distribution of the main marine turtles species

.

The development of hotels along beaches is also another reason for the decline of nesting sites. Turtles are exploited for their meat and eggs and the hawksbill for the carapace, which is used for ornamental purposes. It is the epidermal plate material of this species that is inaccurately termed 'tortoise shell'. Fishermen using gill nets for fishing also catch the turtles incidentally.

Although turtles are officially protected, in Tanzania there is little effective policing and their status continues to be threatened through active hunting, egg collection, nesting disturbance and incidental catches in nets. In Zanzibar, marine turtles are protected by the 1993 fisheries regulations under the 1988 Fisheries Legislation. Although these regulations prohibit the capture of sea turtles, the law does not prohibit possession of turtle products or meat. Transporting turtle meat from rural to urban areas in Zanzibar was recently prohibited. This has somewhat curtailed the sale of turtle meat in urban areas.

FUMBA, landing Point - Menai Bay Conservation Area MBCA

Five species of turtles occur in Tanzania waters. These are green turtle Chelonia mydas, hawksbill Eretmochelys imbricata, loggerhead Caretta caretta, olive Ridley Lepidochelys olivacea and leatherback Dermochelys coriacea (Frazier, 1975). All five are found in Zanzibar waters though the last three are not so common, but they exist in Menai Bay Conservation Area.

The hawksbill is classified by IUCN as critically endangered and their population is decline over 80% in the past 50 years, while others are categorized as endangered, of these only the green and hawksbill turtles are known to nest (Khatib et al., 2002). Turtles nest can be seen around Unguja Ukuu and Muungoni. Clark and Khatib (1993) reported that nesting of between 10 and 40 nests per year occur in Kizimkazi peninsula and between 10 and 20 at Fumba beach.

In common with other marine turtles, the Green Turtle Chelonia mydas are commonly found in the MBCA and their nesting sites are scattered along the beaches of MBCA.

Marine mammals

Cetaceans, whales, dolphins and porpoises are among marine mammals which frequent the coastal waters of Tanzania. Some dugongs can also be found, particularly near Kilwa and Mafia. The dugong was once a common species in Tanzania, but is now almost decimated. They are killed for their flesh and oil. Further threats to dugong populations include habitat degradation (e.g. pollution and siltation) which might affect its food supply and dynamite fishing, which kills individuals and destroys the habitat.

Several species of dolphins have been reported in the waters of Tanzania and these include rough-toothed dolphin (*Steno bredanensis*), bottlenose and spinner dolphins (*Stenella longirostris*) and Indo-Pacific humpback. They have been observed in different places.

Humpback whales (*Megaptera novaeanglia*) have also been sighted in Tanzanian waters, particularly near the coast of Zanzibar and Tanga.

FUMBA, landing Point - Menai Bay Conservation Area MBCA

Six cetacean (whales and dolphins) species have been recorded in Menai Bay Conservation Area. Of these, the most abundant species are *Tursiops aduncus* (Indo-Pacific bottlenose dolphins)and *Sousa chinensis*) Indo-Pacific humpback dolphins (Todesco, 1999; Amir *et al*., 2002). Stensland (2004) showed that there were about 161 Indo-Pacific bottlenose dolphins and 71 humpback dolphins in Menai Bay. The results also showed that these two species are resident to the area.

Other cetaceans that have been sighted in the area include spinner dolphins *Stenella longirostris*, risso's dolphins *Grampus griseus,* common bottlenose dolphins *Tursiops truncatus* and humpback whales *Megaptera novaeangliae* (Amir *et al., 2005*). Humpback whales migrate seasonally from temperate water where they eat to warm tropical waters where they breed and calve. They come to the area between July and November (Amir and Berggren, 2001). Dolphins in MBCA are used as an attraction to tourists.

Migratory and other birds

Mangroves, intertidal flats and rocky cliffs provide habitats for a wide variety of birds. At low tide migrant birds are attracted to the intertidal flats to feed.

Fairy tern, frigate birds and gannets are commonly found along the coast. The mangrove swamps and the coastal wetlands are a home to many birds such as egrets, fish eagle and plovers. The non-native Indian house crow, which was introduced in Zanzibar at the turn of the century, has expanded its range to the mainland and has had severe effects on local bird species. It is an aggressive predator of birds, their eggs and young and also a potential carrier of diseases to poultry and native species.

FUMBA, landing Point - Menai Bay Conservation Area MBCA

MBCA is among the important birds area (IBA) in Tanzania. . The Islands found within MBCA also serve as major roosting and breeding sites for birds such as Egrets and Herons. The area is accommodating both migratory and resident. Most of the migratory are the Palearctic coming from Eurasia via Middle East down to South coast of East Africa to South Africa. The area meets Ramsar criteria to be conserved (1%) , The principal areas for birds include: the sand banks, beaches, intertidal areas and even the deep sea. The common migratory birds found include: Plover's, Sandpiper's, Tern's, Noddy, Whimbrel, Curlew's, etc. However, more studies are needed to understand bird's distribution, breeding, roosting and feeding grounds as well as high concentration bird's spots.

Species at risk

Dugongs and turtles are considered endangered in Tanzania. The dugong species *Dugong dugon* (status unknown) and the turtle species *Caretta caretta* are considered vulnerable while the sea turtles *Chelonia mydas*, *Eretmochelys imbricata*, *Lepidochelys olivacea* and *Demochelys coriacea* are all endangered. Dugong populations used to inhabit the seagrass beds surrounding Kilwa and Mafia and off the Tanga region coast. However, there have been no recent sightings by local populations who enjoyed their meat as a delicacy, or by researchers. The nesting populations of turtles have also been declining rapidly. This is due to increase in incidental catches of these species, hunting as well as degradation of their environment-feeding grounds for the dugongs (seagrass beds) and nesting beaches for the turtles. The huge decline in populations of sea turtles may result in their extinction unless effective protective measures are taken.

Several shore birds depend upon small undisturbed islands for their nesting.

The following table 15 contains the main rare, vulnerable and threatened species:

Table 15: Rare, vUlnerable and Threatened Species

TYPE	COMMON NAME	SPECIES NAME
Plants		*Encephalartos hildebrandtii*
Mammals	African elephant	*Loxodonta africana*
	Leopard	*Panthera pardus*
	Black-and-rufous elephant shrew	*Rhynchocyon petersi petersi*
	Black-and-rufous elephant shrew	*Rhynchocyon petersi adersi*
	Zanzibar galago	*Galagoides zanzibaricus*
	Lesser pouched rat	*Beamys hindei*
	Mongoose	*Bdeogale crassicauda*
	Cyclops leaf-nosed bat	*Hipposideros cyclops*
Reptiles	Nile crocodile	*Crocodylus niloticus*
Birds	Purple-throated cuckoo shrike	
	Sokoke scops owl	*Otus sokokensis*
	Clarke's weaver	*Ploceus golandi*
	Reichenow's batis	*Batis reichenowi*
	Sokoke pipit	*Anthus sokokensis*
	Little yellow flycatcher	*Erthrocercus holochlorus*

6.1.10 - Protected area

Tanzania mainland

- Mafia Island Marine Park
- mainland Mnazi Bay – Ruvuma Estuary Marine Park
- **Dar es Salaam Marine Reserves** (Bongoyo, Fungu, Yasini, Mbudya, Pangavini) (**Figure 36**).
- Tanga Collaborative Management Areas (Boma-Mahandakini, Deepsea-Boma, Mwarongo-Sahare, Mtanga'ata, Boza-Sange &Mkwaja-Sange)
- Maziwe Island Marine Reserve

Zanzibar

- Chumbe Reef Sanctuary
- Misali Island Conservation Area
- **Menai Bay Conservation Area** (**Figure 34 or 37**)
- Mnemba Island Conservation Area

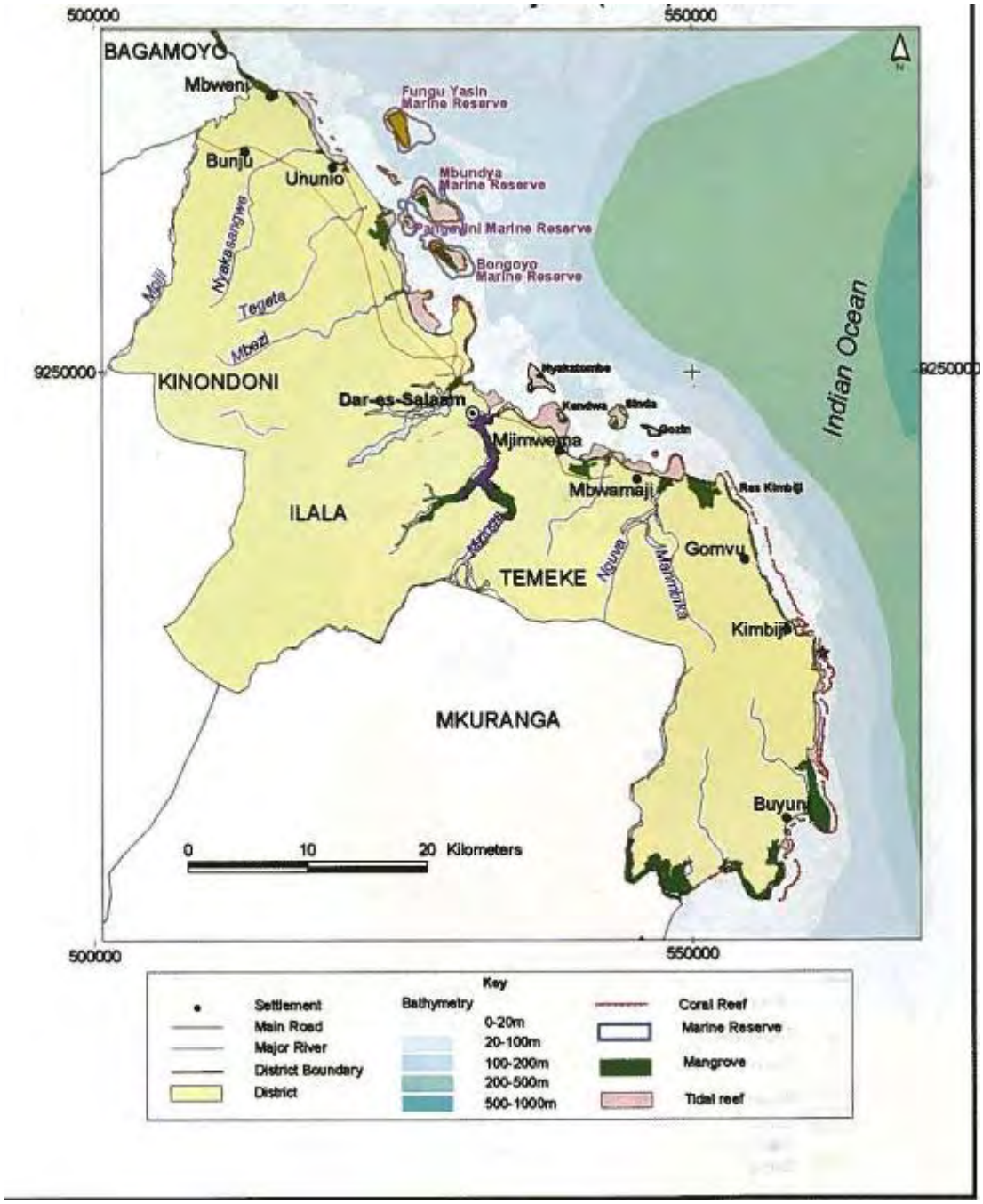


Figure 36. Map of Dar es Salaam Region showing the location of the Dar es Salaam Marine Reserve System

Figure 37. Map of Dar es Salaam Region showing the location of the Dar es Salaam Marine Reserve System

6.1.11 - Ramsar site

Tanzania presently has 4 sites (3 terrestrial and 1 marine) designated as Wetlands of International Importance, with a surface area of about 4,868,424 hectares (**Figure 68**).

- Kilombero Valley Floodplain, Morogoro Region; 796,735 ha; 08°40'S 036°10'E.
- Lake Natron Basin, Arusha Region. 224,781 ha. 02°21’S 036°00’E
- Malagarasi-Muyovozi Wetlands, Kigoma, Shinyanga, & Tabora. 3,250,000 ha. 05°00’S 0031°00’E
- Rufiji-Mafia-Kilwa Marine Ramsar site, Coast, Lindi Regions; 596,908 ha; 08°08'S 039°38'E

Figure 38. Ramsar site in Kenya - Copyright 2005 Wetlands International

All Ramsar sites are very far from the BMH

6.2 - SOCIO-ECONOMIC AND CULTURAL ENVIRONMENT

6.2.1 - Population

The population of Tanzania has tripled between the 1950's and the 1990's (from about 7.7 million to 23.1 million). In the year 2000, the percentage of coastal population to the country population is estimated at 24.2%.

An estimation of the population living in Dar es Salaam by the year 2000, is about 7.7% of the Tanzanian. It is around 2,430,500 persons. The population growth rate of Dar es Salaam is very high.

By the year 2000, the population density for the country is estimated at 36 persons/km2 (based on land area of 883,749 km2), whereas in Dar es Salaam, the density would reach 1745 persons/km2.

By the year 2000, the Zanzibar population is estimated at 867,473 persons. The Zanzibar Island covers an area of 2460 km2. The population density for Zanzibar is estimated to be 353 persons/km2. The following figure 39 shows estimating of the population in the Zanzibar district by the year 2000.

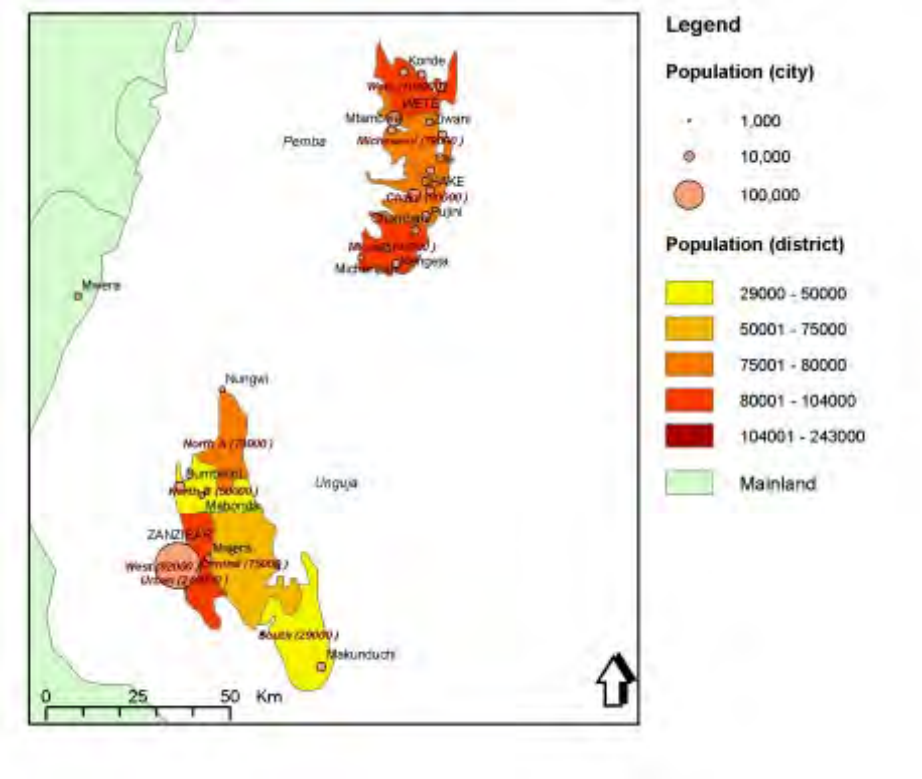


Figure 39. Population projections (estimates) for settlements and districts in Zanzibar for the year 2000 (Source: UNEP, 2001)

The explosive urban growth in Tanzania, especially in Dar es Salaam, has not matched the level of surveyed plots for construction of homes and extension of sanitation services. The trend has therefore led to an increase in squatter settlements and environmental degradation.

6.2.2 - Coastal economy

The main features of the coastal economy in Tanzania are summarized in UNEP report (2001):

The economy is heavily dependent on agriculture (primarily coffee, cotton, tea, cashewnuts, sisal and tobacco), which accounts for 50% of the gross domestic product (GDP). Agriculture thus provides 85% of the country's exports and employs 90% of the work force. Industry accounts for some 15% of the GDP and is mainly limited to processing agricultural products and light consumer goods. Tourism is one of Tanzania's dynamic sectors and has shown significant growth in recent years.

Economic activities in coastal areas include fishing, subsistence farming, trade and tourism. Smallscale trading occupation involves selling fish, mangrove poles, coconut, salt, lime, charcoal, firewood and retail trade. Although farming is the nation's most common occupation, agricultural activities are less important economically than fisheries to the coastal communities. In coastal communities, coconut is the most important cash crop in terms of land area in production and number of farms. The other major cash crops are cotton, sisal and cashews.

Activities such as coastal tourism, mariculture and natural gas exploitation are seen as potential resources for national economic development. There is also a substantial potential for agriculture, fisheries, shipping, urban development, smallscale mining and manufacturing, which have been tapped.

6.2.3 - Fishing

This description is issued from UNEP report (2008)

The contribution of fishery to Tanzania's GDP varies between 2.1–5% in Tanzania mainland and 2.2–10.4% in Zanzibar, mostly from export of fishery products. Tanzania exports marine fishery products to the tune of around US$ 7,652,700 for the mainland part and US$ 598,203 for Zanzibar. These products are shrimp, beche-de-mer, shells, lobster, crabs, squid, octopus, sardines, fish offal and aquarium fish. In Tanzania marine fisheries are still mainly artisanal. Marine fish output contributes about 15% of the total fish production in the country with the rest coming from freshwater fisheries.

In Tanzania Mainland, marine fish catches fluctuated between 35,000–60,000 metric tonnes annually between 1990 and 1996 (Table 14) of which more than 95% was contributed by smallscale fisheries. From 1992 to 1997, the artisanal fishery production in Zanzibar remained steady at around 10 metric tonnes. The number of artisanal fishermen in Tanzania Mainland in 1996 was estimated to be 13,822 and the number of fishing vessels were 3768.

Artisanal fishermen use traditional crafts (mostly non-motorised) and simple fishing gear. Most of the fishing vessels in Tanzania Mainland and Zanzibar are locally made and range in size from 4–10 m. The most common fishing vessels are dugout canoes. Dugout canoes with outriggers are known locally as 'ngalawa' and those without are known as 'mitumbwi'.

The most common means of propulsion is by oar, pole or sail. The larger dhow and 'mashua' are usually wooden planked and sometimes motorised. The most common vessel used in Tanzania is the 'ngalawa' because it is cheaper than the 'mashua' and

relatively more efficient than the dhow or 'mtumbwi'. The fishing gears commonly used are lines (troll line, handline and longline), traps (fixed and moveable), nets (purse seine, scoop, drift gillnets, demersal gillnets with small and large mesh, shark nets and surrounding gill nets), spear guns and iron harpoons.

The main groups of fish caught by artisanal fishermen in Tanzania are the demersal fish (i.e. bream, parrotfish, snappers, mullet, emperors, groupers, etc.), which are caught with lines, traps and nets. The small pelagic fish (sardines, mackerel, anchovies, etc.) are caught with purse seine nets, surrounding nets and scoop nets, while the large pelagic fish (tuna, kingfish, sailfish, marlin, shark and ray) are caught with lines, drift gillnets, demersal gillnets and shark nets. Other species caught include octopus, squid, prawn and lobster. Fishing communities (with the exception of urban centres) exist in many small villages scattered along the entire Tanzania Mainland coastline. Fishing takes place almost entirely within the nearshore waters to depths of 40 m, although sometimes there is handlining to 60 m depth on the upper edge of the continental shelf. The area along the Tanzania Mainland coast available to the artisanal fishery is estimated to be around 12,000 km2, regionally divided into

Tanga (2200 km2), Coast including Dar es Salaam (8100 km2), Lindi (1550 km2) and Mtwara (310 km2).

6.2.4 - Shipping and anchorages

The major ports are Dar es Salaam, Tanga, Mtwara, and Zanzibar. It also has smaller ports in Kilwa, Lindi and Mafia. Both Dar es Salaam and Zanzibar have witnessed significant expansions and improvements to their port facilities, in part resulting from the increased tourismrelated trade between the two destinations and recent economic development.

The Port of Dar es Salaam is Tanzania's major port, center for industry, largest city, and seat of government. Located on the shores of eastern Africa off the Indian Ocean, the Port of Dar es Salaam is about 41 nautical miles south-southeast of the Port of Zanzibar and some 170 nautical miles south of Kenya's Port of Mombasa. The Port of Dar es Salaam has a beautiful harbor, wonderful beaches, and an exciting nightlife that have made it a popular tourist destination as well.

Port location	Dar es Salaam
Port name	Port of Dar es Salaam
Port Authority	Tanzania Ports Authority
Address	Main Quay Number 1 P.O. Box 1130 Dar es Salaam Tanzania
Phone	255 22-2113642
Fax	255 22-2113646 pmdsm@tanzaniaports.com
Web site	www.tanzaniaports.com
Latitude	6° 50' 4" S
Longitude	39° 17' 57" E
Port type	Seaport
Port size	large
Admiralty charts	693, Approaches 674
Airport	International is about 13Km from the port

Port location	Zanzibar
Port name	Port of Zanzibar
Port Authority	Zanzibar Harbours Department
Address	P.O. Box 263 Tanzania
Phone	255 24 32858
Fax	255 24 32578
Web site	
Latitude	6° 9' 20" S
Longitude	6° 9' 20" S
Port type	Harbor
Port size	Small
Admiralty charts	693, Approaches 674
Airport	

A recreational anchorage area exits near Dar es Salaam (**Figure 40**).

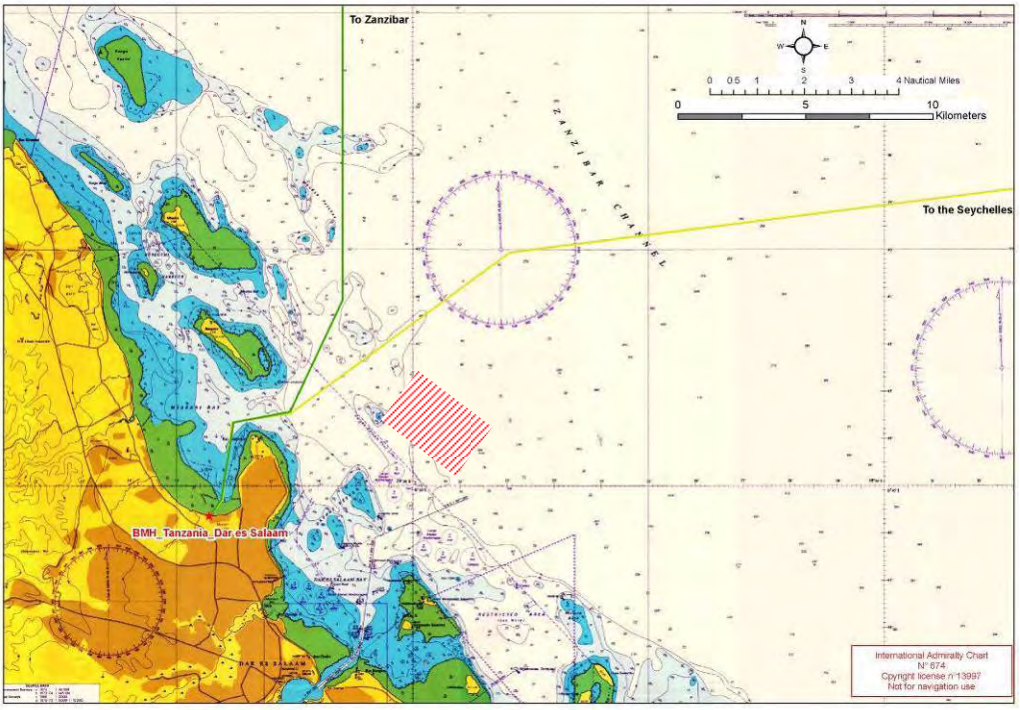


Figure 40. Recreational anchorage in the vicinity of Dar es Salaam

6.2.5 - Hydrocarbon exploitation

Oil and gas exploration has been conducted for the last 50 years, more recently promoted by the Tanzania Petroleum Development Corporation (TPDC). Significant gas discoveries have so far be made at Songo Songo, Mkuranga and Mnazi Bay with explorations continuing along much of the coast and 35 exploration and development wells drilled to date (http://www.tpdc-tz.com/exploration.htm). The aim of the Songo Songo gas to electricity project is to develop natural gas from the Songo Songo gas field in Kilwa District, supply gas to a power station in Dar es Salaam and local industries, providing a reliable source of low cost electricity. The project was completed in 2006 and is since expanding. The Mnazi Bay block, allocated to the Artumas Group (Canada), includes a gas field with about 500 billion cubic feet of proven gas reserves and a single drilled well, but plans are underway to conduct additional exploratory drilling. The estimated Mnazi Bay gas field may have more gas reserves than that of Songo Songo field and generating facilities are now in place, supplying electricity to the city of Mtwara and surroundings. In addition, the Mafia Deep Offshore Basin in southern Tanzania has a high potential for exploration. Other areas with high potential for exploration include sedimentary basins onshore and offshore with open acreage at Rufiji Basin, inland rift basins of Lakes Rukwa, Tanganyika and Nyasa, and the Ruhhu Karoo Basin (http://www.tpdctz.com/exploration.htm) (**Figure 41**).

From 2005, the Government of Tanzania, through the TPDC, has put up invitations to several international petroleum industry partners and other specialized investors to participate in exploration of hydrocarbons in Tanzania and production sharing agreements (PSAs) have been signed with Ophir Energy (Austria), StatoilHydro (Norway), Petrobras (Brazil), Maurel et Prom (France), Petrodel and Dominion (both UK). Shell has yet to finalize an agreement for four blocks near Unguja and Pemba Islands (Zanzibar), which it successfully negotiated over two years ago.

Figure 41. Status of exploration wells drilled in Mineral extraction

6.2.6 - Mining

Mineral resources are found in many of the coastal sediments of southern and eastern Africa where rich mineral deposits exist.

In Tanzania, mining activities in the coastal zone mainly take place near Tanga in the north or Mtwara in the south. Other coastal mining activities take place in Kisarawe, Miono, Mkonge and Mandera, Dar es Salaam, Bagamoyo and Lindi. Mining of gravel, sand, limestone and rutile goes on throughout the coast of Tanzania.

6.2.7 - Dumping, dredging and reclamation

There is a dumping zone near Dar es Salaam (**Figure 73**).

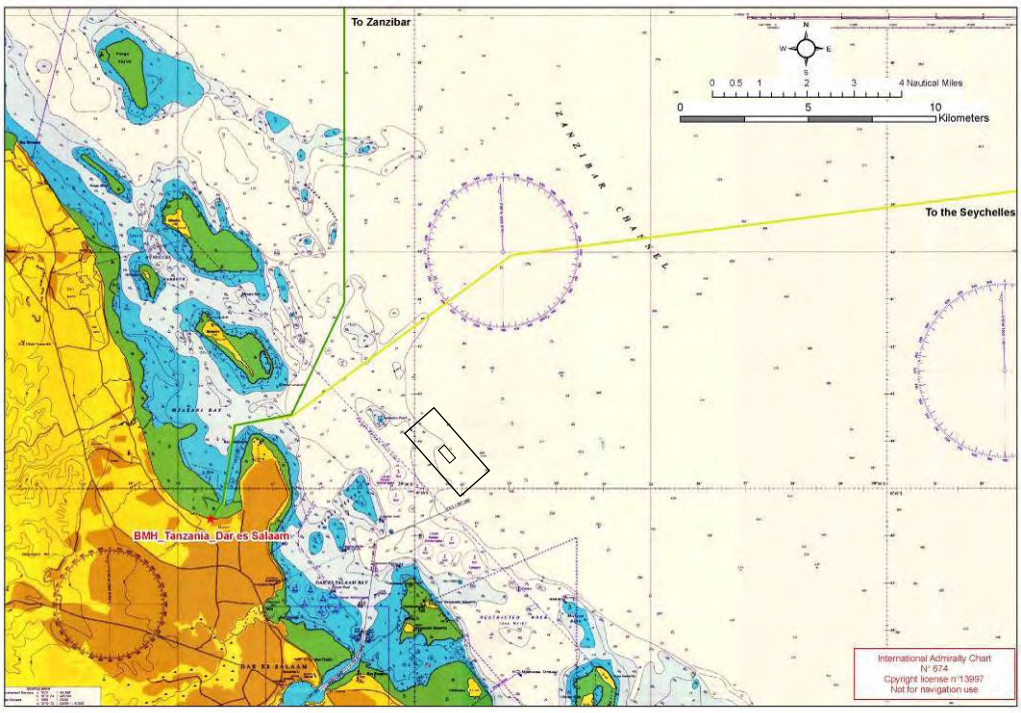


Figure 42. Location of dumping zone

6.2.8 - Submarine pipeline/cables

There is a power cable between Dar-es Salaam and Zanzibar. A crossing will be considered if landfall BDWEI selected.

6.2.9 - Military activities

Exercise areas are not marked on the charts, and it is difficult if not possible to obtain detailed information about existing or planned areas military operations.

6.2.10 - Charted obstructions and wrecks

No obstructions have been reported in the area of the proposed landfall(s).

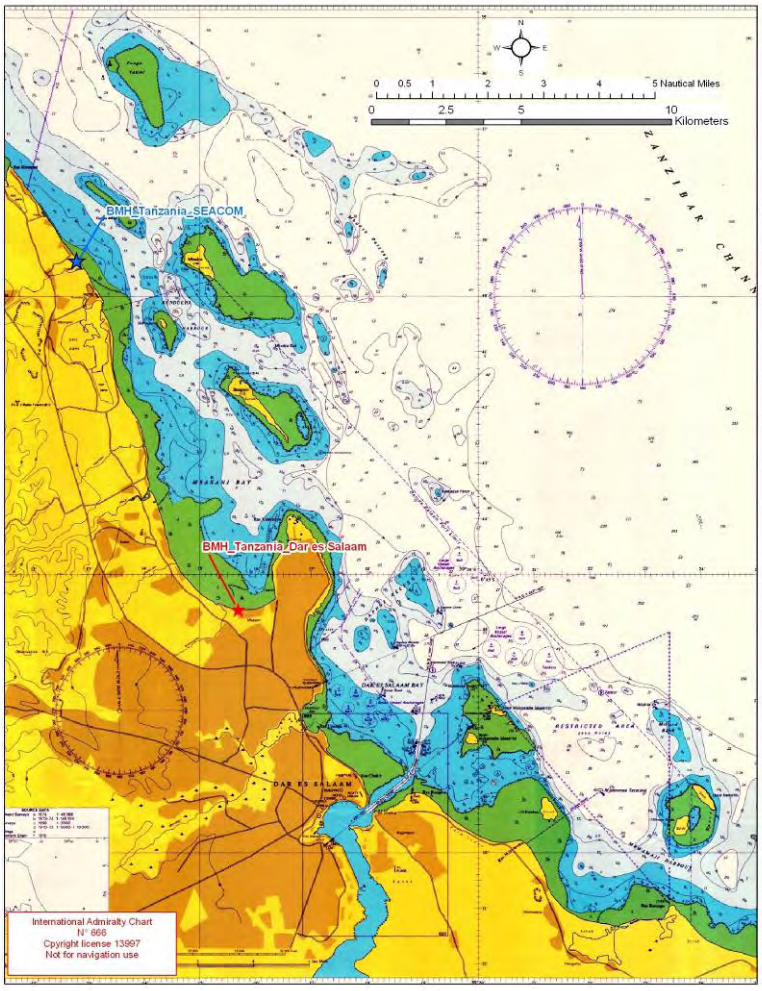
6.2.11 - Telecommunication cables

There are two submarine telecommunication cables (**Figure 43**) in Tanzania (Eassy and Seacom).

Figure 43. Map of the Eassy and SEACOM Fibre optic cable systems

In Tanzania the SEACOM marine cable will land approximately 20km north of Dar Es Salaam adjacent to the Silver Sands Resort Hotel Complex in a sandy area adjacent to an area of mangroves. Silver Sands is adjacent to a designated marine conservation area (Dar es Salaam Marine Reserves System or DMRS). The BMH will be positioned within the boundary of the hotel's western edge near the boundary fence on an unpaved access road.

A crossing (between SEACOM and project cable) will be consider for Dar es salaam landfall and Zanzibar landfalls (Fumba or BDWEI).



7 - IDENTIFICATION OF IMPACTS

7.1 - INTRODUCTION

This chapter discusses the environmental and social impacts that may results from the proposed development. Potential impacts are identified, mitigation measures listed and residuals impacts, taking these measures into account, are described.

Supporting baseline environmental and social information is contained in chapter 6 of this report. Cross references to other sections of this report are made where impacts are likely to be either directly or indirectly interlinked. A full description of the proposed project activities is provided in chapter 2.

Potential impacts on environmental and social resources arising from the proposed development include direct and indirect (both permanent and temporary) impacts within the development area and surrounds. There is also potential for impacts relating to cumulative impacts of the proposed cable system and other developments.

The following sections outline these impacts, giving detailed explanations and assessment with regard to the predicted significance of the impacts. Where appropriate mitigation, management and enhance measures are identified to avoid, reduce or remove the predicted impact.

7.2 - DEFINITION AND TYPES OF IMPACTS

An impact it any change to a receptor brought about by the presence of a project component or by the execution of a project related activity. Evaluation of baseline data provides important information for the process of evaluating and describing how the project could affect the environment (physic, biologic and socio-economic). Impact nature and type are:

- **Positive**

  An impact is considerate to represent an improvement on the baseline or introduces a positive change. For example, section 7.4 describes this aspect

- **Negative**

  Introduces a new undesirable factor

  - **Direct**

    Direct interaction between the project planned activity and the environment (occupation of a site and the pre-existing habitats, other activities...)

  - **Indirect**

    Impact that result from other activities that are encouraged to happen as a consequence of the project

  - **Cumulative**

    Impacts that act together with other impact, affect the same resource/receptor

Impacts are described in terms of significance. Significance is a function of the magnitude and function of the extent, duration and intensity of the impact. The degree of change brought about in the environment:

- **Extent**
  - ***On site*** (limited to the site area only)
  - ***Local affect*** (an area in a radius of 30 km around the area)
  - ***Regional*** (affect regionally the important environment resources, ecosystems)
  - ***National*** (affect nationally important environment resources, have a macro-economic consequences)
  - ***International*** (affect internationally important resources such as protected areas – international conventions)
- **Duration**
  - ***Temporary*** (short duration and intermittent/occasional
  - ***Short-term*** (during construction period)
  - ***Long-term*** (during the life of the project, but ceases when the project stop operating)
  - ***Permanent*** (cause a permanent change in the affected receptor, resource (destruction of an habitat such as coral reef..) and edurs substantially beyond the project lifetime
- **Intensity**

	Environment	
	Biophysical	**Socio-economic**
Negligible	No detectable	No perceptible change people's away life
Low	No affectt/No changes the natural functions	People are able to adapt with relative ease and maintain pre-impact livelihoods
Medium	affect the natural functions	Able to adapt with some difficulty and maintain pe-impact livelihoods but only with a degree of support
High	Alterations Temporarily or Permanently cease	Those affected will not be able to adapt to chnage and continue to maintain pre-impact livelihoods

7.3 - GENERIC IMPACTS

Modern submarine telecommunication systems are fiber optic cables using pulses of light to transport information. Coaxial cables, as the former standard, use electric current to carry information and are sporadically still in service. However, long-distance optical cables require repeaters and thus also need a constant power supply. Whereas coaxial cables have a diameter of up to 10 cm, fiber optic cables are only 2 – 5 cm thick.

Submarine cables are usually buried to minimize the risk of damage by, for example, anchors and fishing gears.

Submarine cables have a wide range of potential impacts on the marine environment due to their placement (i.e. cable-laying) as well as due to their operation. The various potential impacts of submarine cables differ considerably in terms of their spatial extent, duration, frequency and reversibility. A general overview is given in Table 16.

Table 16. Main environmental impacts associated with submarine cables

Phase	Installation, maintenance, repair work and removal	Operational phase
Submarine Telecommunication cable	Seabed disturbance	Introdution of artificial hard surbstrate
	Damage/disturbance of organisms	
	Re-suspension of contaminants	
	Visual disturbance	
	Noise (Vessels, laying machinery…)	
	Emissions and wastes from vessels	

The various impacts act on different components of the ecosystem in different ways. Seabed disturbance may impact benthic organisms, underwater noise is most relevant for marine mammals, electromagnetic fields may have effects on sensitive fish and marine mammals and visual disturbance (including visual and aerial noise) has the potential to displace sensitive sea birds and seals. The extent of such impacts is determined by the technical design of the cables, the laying equipment. Some environmental impacts are mainly linked to the installation phase and/or maintenance, repair activities and removal. Others are only relevant during operation.

7.4 - POSITIVE IMPACTS OF THE PROJECT

A number of positive benefits are predicted to be associated with the proposed development. Many of the positive aspects of the project relate to macro and micro-economic opportunities and benefits resulting from increased Information and communication technology connectivity, but many other secondary benefits including, social, employment and educational impacts will also be realized. T he positive aspects of the project are discussed in chapter 4, section 4.3.

7.5 - NEGATIVE IMPACTS AND MITIGATION MEASURES

Potential impacts are described for the pre-construction, construction, operational and decommissioning phases of the project.

For activities with significant impact, the project would be required to identify suitable and practical mitigation measures and fully implement them. The implementation of the mitigations is ensured through the Environmental Management Plan (EMP) (Chapter X).

7.5.1 - Pre-construction

The phase refers to initial route selection work including the desk top study (DTS) which delineated the cable route, and subsequent onshore/offshore route selection survey work, the marine survey. It therefore includes a number of onshore surveys and the use of vessels and survey equipment. There are no impacts resulting from DTS phase work (selection of the cable route).

7.5.1.1 - Environmental impacts

Several techniques are used during route selection studies that include geophysical and geotechnical survey equipment, such as:

<u>Geophysical and geotechnical equipment</u>

- Side scan sonar
- Sub-bottom profiler
- Multibeam/Singlebeam
- Magnetometer
- Corer (gravity or vibrocorer)
- Grabber
- Cone penetrometer

These equipments use non intrusive techniques to record sea bed bathymetry. Coring, grabbing or penetration tests involve minimal ground disturbance at location.

Impacts from these survey techniques are all considerate to be low.

Impacts that may results from the operation of survey vessels are described in section.

7.5.1.2 - Social impact

There no discernible social impact associated with the pre construction phase.

Indeed, cable survey could cause temporary disruption o the flow of shipping traffic or other activities (scuba diving, swimming...). This is particularly the case if the survey vessels have to maintain station for some time (during core penetration for example). However, these operations are limited to short periods of time and other marine traffic/activities can generally avoid working area without significant diversion.

The project will notify the Ports Authority and main activities, so that vessels in the area would be warned in advance of the ongoing operations through a “Notice to Mariners or to marine users (divers...)’ report transmitted daily. The cables routes avoid the major ports but the contractors will heighten awareness for potential danger posed by and to other vessels/activities (diving, snorkelling...) when working in areas.

7.5.2 - Construction

For obvious reasons of scale proportions the project does not impact the following environmental conditions:

- Local and regional meteorological conditions
- offshore metocean conditions
- local tide cycles

  Regarding these conditions, because their causes are global / at large-scale, they are very few impacted by a local disruption

- Local geology or hydrogeology

  For example, installation of the BMH will not involve the construction of any new access roads or large impermeable surfaces that may impact the current surface or ground water flow. The impacts on hydrology are therefore predicted to be negligible.

-

  The project does not imply a disturbance of the substratum, works will only concern shallow/superficial sedimentary layers

- Regional coastal geomorphology

  The geomorphologic effects (bathymetric and sedimentary changes) of the project are very much localized to the work site.

7.5.2.1 - Environmental impacts

Construction activities will result in some negative environmental impacts during route clearance and cable laying, particularly to benthic biota along the survey route.

However, at any one location the disturbance will occur over a very short duration, natural recovery will readily occur and impacts will therefore tend to be minor in nature.

Construction activities will result in some negative environmental impacts during route clearance and cable laying, particularly to benthic biota along the survey route.

However, at any one location the disturbance will occur over a very short duration, natural recovery will readily occur and impacts will therefore tend to be minor in nature.

7.5.2.1.1 - Offshore

The pre-laying grapple run

The grapnel will penetrate the seabed to a depth of up to 0.8 meters. Due to the intrusive nature of this operation some negative impact is unavoidable. Impacts include the generation of:

- a small amount of turbidity
- through physical contact mortality or injury to marine organisms, particularly plants and other organisms that have low mobility.

The pre-laying grapple run and cable installation will have some minor physical impact on sea bed geology. This impact will be limited to the area where the cable will be installed only and will vary in intensity depending on the installation method (cable burial in a trench or laying on the seabed).

Cable laying

The laying of cables leads to seabed disturbance and associated impacts of damage, displacement or disturbance of flora and fauna,

- increased turbidity
- release of contaminants
- alteration of sediments.

These effects are mainly restricted to the installation, repair works and/or removal phase and are generally temporary. In addition, their spatial extent is limited to the cable corridor (in the order of 5 m width if the cable has been ploughed into the seabed).

Some mobile benthos are able to avoid disturbance and though sessile species (bivalves, tubeworms etc.) will be impacted.

The cable installation process will only result in short term direct impacts to the subtidal bottom habitats and assemblage present on intertidal area. The short term loss of benthic organisms directly along the cable routes is not considerate to represent an unacceptable ecological impact. The rapid natural reinstatement of the seabed will result in the area being available or rapid recolonisation and hence, no permanent impacts are anticipated from cable project.

Raised turbidity and suspended sediment levels can have a number of adverse effects on marine organisms, particularly in areas that would normally have clear waters.

Where suspended sediment concentrations are present for prolonged periods, or are particularly high and widespread, visibility can be reduced affecting the ability of some fish to feed.

Raised turbidity can also reduce light penetration in the water column and reduce photosynthesis/productivity in sea grasses and affecting the coral reef presents in the area.

However the duration, spatial extent and level of suspended sediment associated with route clearance and cable installation in this project are unlikely to cause such problems.

Nevertheless, turbidity levels should be minimized during cable lay operations by minimizing the duration and extent of physical seabed disturbance.

Substrate of the cable route considerate in thus study includes hard substrate and sediments.

Air quality – Vessels operations

Cable laying will require use of dedicated cable lay vessels resulting in a number of general environmental impacts and risks. During normal operational activities vessels emit exhaust gases.

Assuming that the vessels are well maintained, emissions of pollutants will be minimal and within allowable limits.

Solid waste -Vessels operations

A variety of non hazardous (packaging…) and hazardous (oil wastes, paints…) wastes are typically generated during vessels operations.

Hazardous wastes can clearly have a toxic effect on organisms and can in some circumstances lead to bioaccumulation and ultimately lethal or sub lethal affects if badly managed. In addition, some non hazardous waste types can be equally harmful, particularly non degradable plastics that can remain at sea for many years posing an entanglement risk to sea birds and marine life.

Annex V of MARPOL prohibits the disposal to sea of any plastics whilst restricting the discharge of other non hazardous waste in coastal waters and in designated "Special Areas".

Hazardous waste should be stored on board the vessel until it can be disposed at a suitably equipped port, respecting the requirements of the Basel Convention on Transboundary Shipment of Hazardous Wastes.

Aqueous Discharges - Vessels operations

Planned aqueous discharges can include sewage water, grey waters (discharge from showers and sinks) and potentially contaminated drainage from the ship deck. Sewage and grey waters can have high bacteria levels, surfactants and a high Biological Oxygen Demand (BOD5), all which can result in potential human health issues and harm to marine organisms, particularly in sensitive areas or locations with poor mixing and dilution potential.

These wastewaters should therefore be managed in accordance with applicable international regulations and guidance, including the requirements of MARPOL 73/78, Annex IV (sewage).

MARPOL, Annex 1 also addresses discharge of oily waters, for example bilge waters. For ships of 400 gross tonnage and above, for control of oil from machinery spaces, waste water must have an oil concentration below 15ppm without any prior dilution. More specifically:

- Within special areas – discharges are prohibited, except when the ship is proceeding en route, and the oil content of the effluent without dilution does not exceed 15 ppm, and the ship has in operation oil filtering equipment with automatic 15 ppm stopping device.

- Outside special areas - discharges are prohibited, except when the ship is proceeding en route, the oil content of the processed bilge water (from machinery spaces) effluent is less than 15 ppm, and the ship has in operation an oil discharge monitoring and control systems, oily-water separating or filtering equipment

Ballast water management - Vessels operations

It is possible that invasive (predominantly non-native) species may be unintentionally introduced. This has a potential impact habitats and fauna and flora if invasive species become highly aggressive, outcompeting native species and altering the structure and community composition of marine ecosystems.

Conservation Areas

The cable would enter the suggested beach landing site located to the west of the Msasani Peninsula via inshore waters between the marine reserve island of Bongoyo and Msasani Slipway. The three islands of Bongoyo, Pangavini and Mbudya together with Fungu Yasini constitute the Dar es Salaam Marine Reserves (DMRs) system in which the Ministry of Natural Resources and Tourism has designated all areas within a 5 fathom (about 10 metres) contour depth as Marine Reserves. Bongoyo which has about 80.5 ha of land is the nearest island to the proposed Dar es Salaam Submarine Cable system and may be considered to lie within the direct impact zone of the Cable Project.

The selected cable route from the landing point in international waters to the shore at Msasani Bay is outside the buffer zone of Bongoyo Marine Reserve thus it does not traverse a conservation area. The 800-meter buffer zone boundary acts as a cushion against activities outside the marine reserve.

The Menai Bay Conservation Area (MBCA), gazetted in 1995, is located in the south western tip of Unguja Island, of the Zanzibar Archipelago. It covers an area of 470 square km extending into two regions, of three districts which take in 17 villages. The area is rich in marine resources and one of the most famous fishing grounds. A rush of fishermen and use of none friendly fishing gears resulted in the degradation of marine resources.

Menai Bay is one of the Ecoreginal Priority sites in Eastern African Marine Ecoregion. WWF support, with funding from WWF-Switzerland, of Menai Bay has been utilised to establish the first ever Marine Protected Areas in Zanzibar. It paved the way for more MPAs in Zanzibar and lots of lessons and experience have been learned on marine resource management in the area. The purpose of gazetting the area was to protect marine resources and improve the fishery.

The cable crosses directly in the Menai Bay Conservation Area; the impact is direct.

The greatest risk to sensitive habitats from the cable project is during the installation period, when the seabed may be disturbed by vessels and/or equipment. Severe abrasion and sediment plumes can disrupt the natural functioning of the ecosystem in the area. However, as any potential disturbance to the seabed is likely to be minimal, localised and of a short duration, no unacceptable impacts have been predicted to occur to fisheries resources, including spawning grounds, or fishing operations, as a result of the proposed cable deployment and installation.

7.5.2.1.2 - Onshore

Dar es Salaam landfall, the existing terminal station, BMH and ducts are owned by Zantel. Cable installation within the existing ducts is considerate to have no significant impact.

For Fumba, BMH and ducts have to be build from BMH to Zantel park office

Waste

Construction wastes will be generated during onshore construction. Overall these are expected to be relatively small quantities although they may include some hazardous waste (oily rags, spent fuel cans, batteries etc.).

If a good waste management plan is planned, the impact of onshore waste is as being of low significance.

Air quality

The local air quality in the close proximity of onshore construction activities will be affected by emissions from mobile (construction vehicles) and stationary machinery (portable generators).

Dust

There is potential some dust generation during the construction at the shore crossing BMH and ducts. Dust is most likely to be generated during the transportation of materials on unpaved roads and during trench digging and soil movement.

Increased levels of dust in the air have the potential to impact environment (flora, communities) and social resources. However, the construction (BMH and ducts) period will be very short (approximately 3 weeks); any dust would be limited to the construction area, access route and very near surrounds only. Dust related impacts largely reversible within a short timescale. Therefore, no impacts are predicted to occur as a result of increased dust.

Noise

Construction trafic typically consists of large, heavy vehicles which will generate noise and vibration during the transportation of materials for construction of the landing site (BMH and ducts). Impact to local residences, restaurants, hotel are not predicted to occur as the increase in noise levels associated with the construction of the landing site will only be small, will be limited to short construction period, and because construction will be take place during day-light hours only.

Contractors will be required to implement best driving practices when approaching and leaving the site to minimize noise emissions

7.5.2.1.3 - Ramsar site

There are no Ramsar sites near the proposed project site.

7.5.2.2 - Social impact

7.5.2.2.1 - Human health and safety

There is potential for impacts on human health and safety to occur as a result of accidents and unplanned events that may occur during the Project installation activities.

The project activities have the potential to results in a direct and indirect negative impact on human health and safety within the development area and near surrounds.

Extend of the impact is limited to on-site and local. The duration will range from temporary to permanent as some impacts will last only a short while (minor injury) and some may cause a permanent change (mortality related to vehicle or vessel strike).

At particular risk are artisanal fishermen and other vessels (divers, jet ski…) that may move at night-time or in reduced visibility conditions when the Project activities are taking place. Collision of Project vessels with fishing boat and nets or other vessels could results in damage of vessels and equipment, injury or loss of life.

Collision of Project vessels with fishing boats and nets or other vessels could result in damage of vessels and equipment, injury or loss of life. In the terrestrial environment, human health and safety could be impacted through road traffic accidents involving construction vehicles.

In onshore environment, human health and safety could be impacted through road traffic accidents involving construction vehicles. The risk of other injury associated with the construction activities at the landing site will be limited to the work force only (as the site will be secured to avoid public incursion into the active development area), but there is some risk of public injury associated with the installation of the cable between the landing site and CLS as this construction will not be fenced.

Cable survey and installation could cause temporary disruption to the flow of sea use.

However, these operations are limited to short periods of time and other activities can generally avoid the work area without significant diversion.

The project will notify the ports authority and others activities, so that vessels in the area would be warned in advance of the ongoing operations through a “Notice to recreational sea users” report transmitted daily

No impacts to marine activities are thus predicted to occur a result of the project activities.

7.5.2.2.2 - Visual – landscape

The onshore facilities will either be buried in the case of beach man holes and therefore little visual impact is envisaged.

7.5.2.2.3 - Odor, Heat and Radiation.

The project will not result in any significant increases in odor, heat or radiation conditions.

7.5.2.2.4 - Transport Infrastructure

There are no formal or regularly used transport networks (eg roads, ferries) within the site area and no major shipping routes will be impacted by the development. No impacts to transport networks and their function are predicted to occur as a result of the development.

7.5.2.2.5 - Education

No negative impacts on education levels or educational facilities are predicted to occur as a result of the proposed development.

7.5.2.2.6 - Fishing

Minor interruptions to fishing operations and fish auctioning are expected to occur only during the cables deployment phase. This disturbance is predicted to be localized to the area in which the activities occur and near surrounds only, and will be short term and progressive in its nature as the activities move along the cable route corridor. Any disturbance to fisheries will be temporary.

7.5.2.2.7 - Landscape and Visual Receptors

There will be small amounts of increased light pollution during the construction period at the BMH as a result of security lighting. There will be no permanent lighting at the beach area.

7.5.3 - Operational Impacts

During operation it is expected that the cable will have no significant negative environmental or social impacts. During the operational phase there will be no routine maintenance of the cable and the cable will have a passive influence on the environment.

7.5.3.1 - Electromagnetic fields

Electromagnetic fields are generated by operational transmission cables. Electric fields increase in strength as voltage increases.

In addition, induced electric fields are generated by the interaction between the magnetic field around a submarine cable and the ambient saltwater.

Magnetic fields are generated by the flow of current and increase in strength as current increases. The strength may reach the multiple of the natural terrestrial magnetic field. In general, HVDC cables produce stronger electromagnetic fields than AC cables.

The World Health Organization has considered the effects on EMF on marine life. It concludes that although all organisms are exposed to the geomagnetic field, marine animals are also exposed to natural electric fields caused by sea currents moving through the geomagnetic field. Electrosensitive fish, such as sharks and rays in oceans, can orient themselves in response to very low electric fields by means of electroreceptive organs.

It acknowledges that some investigators have suggested that human-made Electromagnetic fields from undersea power cables could interfere with the prey sensing or navigational abilities of these animals in the immediate vicinity of the sea cables. However, none of the studies performed, to assess the impact of undersea cables on migratory fish or pelagos and all the relatively immobile fauna inhabiting the sea floor (benthos), have found any substantial behavioural or biological impact.

The potential impact to marine life from electromagnetic fields is considered to be low.

7.5.3.2 - Exposed cables

Cables can become exposed on beaches and in other areas prone to erosion. In addition to the unsightly nature of an exposed cable at low tide, it represents a safety risk to beach users and also substantially increases the risk of cable failure.

For beach crossings the cable is typically installed in flexible steel pipe with an outside diameter in the order of 20 cm and buried in a trench 2 m deep dug previously by equipment such as a backhoe. In the unlikely event of severe erosion resulting in the pipe becoming exposed it will be reburied.

The cable during operations is considered to be minimal and therefore the impact of exposed cables is assessed to be low.

7.5.4 - Decommissioning

It is expected that the cable will be abandoned in place at the end of the Project's lifetime. No impacts are predicted to occur in association with the cable during this stage of the Project.

The cable will continue to have a passive influence on the environment and will be benign, so will not degrade or pollute the environment.

A full decommissioning plan will be developed at the end of the cable's useful life and it will consider best practice at that time. The plan will consider the potential for environmental and social impacts for the decommissioning alternatives.

7.6 - CONCLUSION

The potentials impacts from the project are limited in scope and are mainly associated with the pre-installation and installation phases. Potential impacts during operations and decommissioning are negligible.

This study indicates that there will be no impacts or negligible impacts on the following resources:

- Soils and geology
- Oceanography characteristics
- Hydrology
- Water quality
- Air quality
- Marine biology and fisheries
- Landscape and visual receptors
- Noise and vibration receptors
- Traffic
- Social and cultural structure

Detailed impact assessment was carried out for three potential impact areas

- Habitats, fauna and flora
- Human health and safety
- Menai Bay Conservation Area

Potential impacts were determined to be moderate or minor (localized short time scale...). Following application or mitigation measures the impacts for these areas was determinate to be negligible.

Table 17. Summary of impacts without mitigation 0 : No impact, 1 : minimal impact, no need for specific mitigation ; 2: low to medium impact, need basic mitigation ; 3 medium to high, need specific mitigation measures and careful monitoring programme to ensure no adverse effects

Potential impact without mitigation			Project stage															
			Onshore				Shallow water						Offshore					
Area of impact	Description	Degree of impact	Construction (BMH)	Cable installation	Operation/Maintenance	Decommisioning	Marine Route Survey (e1cl. vessels)	Route Clearance (e1cl. Vessels)	Submarine cable installation	Vessels (All operations)	Operation/Repairs	Decommissionning	Marine Route Survey (e1cl. vessels)	Route Clearance (e1cl. Vessels)	Submarine cable installation	Vessels (All operations)	Operation/Repairs	Decommissionning
Environment																		
Geology and soils		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydrology		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Meteorology	Winds, rainfall…	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oceanography	Swell, currents…	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ecology	Terrestrial	Temporary, reversible,direct	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	Coral reef	Temporary, reversible,indirect	0	0	0	0	0	1	1	1	1	0	0	1	1	1	1	0
	Seagrass bed	Temporary, reversible,indirect	0	0	0	0	0	1	1	1	1	0	0	1	1	1	1	0
	Marine fauna/flora	Temporary, reversible,direct	0	0	0	0	0	1	1	1	1	0	0	1	1	1	1	0
	Marine habitats	Temporary, reversible,direct	0	0	0	0	0	1	1	1	1	0	0	1	1	1	1	0
Conservation Area	Menai Bay Conservation Area	Temporary, reversible,direct	0	0	0	0	1	1	2	2	1	0	1	1	2	2	1	0
Water quality	Sediment disturbance causing turbidity discharges	Temporary, reversible,indirect	0	0	0	0	0	1	2	1	1	0	0	1	2	1	1	0
	Discharges	Temporary, reversible,indirect	1	1	0	0	0	1	2	1	1	0	0	1	2	1	1	0
	Accidents which cause spills	Temporary, reversible,indirect	0	0	0	0	0	1	2	1	1	0	0	1	2	1	1	0
Waste	Generation of wastes	Temporary, reversible,indirect	1	1	1	0	0	1	1	1	0	0	0	1	1	1	0	0
Air quality (Local)	Dust	Temporary, reversible,indirect	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	Gazeous emissions	Temporary, reversible,direct	1	1	1	0	0	1	1	1	1	0	0	1	1	1	1	0
	Odour	Temporary, reversible,direct	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Heat/radiation		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Social																		
Traffic	Impacts on traffic in area	Temporary, reversible,direct	1	1	1	0	1	1	1	1	1	0	1	1	1	1	1	0
Noise		Temporary, reversible,direct	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Visual Pollution	creation of new building, landsacpe	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cultural and heritage	Impacts to sites of cultural or archeological interest	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Human activities	Impacts on fisheries activities	Temporary, reversible,indirect	0	0	0	0	1	1	2	2	1	0	1	1	2	2	1	0
	On tourism - diving sites, recreational activities	Temporary, reversible,indirect	1	1	1	0	1	1	2	2	1	0	1	1	2	2	1	0
	Impact on shipping and anchorage	Temporary, reversible,indirect	0	0	0	0	1	1	2	2	1	0	1	1	2	2	1	0
	Impact on mining activities	Temporary, reversible,indirect	0	0	0	0	1	1	1	1	1	0	1	1	1	1	1	0
	Impact on dredging/submarine cable/hydrocarbon activities	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Impact on employment	Positive																

8 - ANALYSIS OF ALTERNATIVES

The analysis of alternatives is a component of the ESIA process. Its purpose is to improve project design, construction and operation decisions based on feasible project alternatives. Early consideration of alternatives during the design phase of a project can result in the avoidance/minimization of impacts without the need for expensive or time consuming mitigation measures at a later stage.

The cable has a small diameter and is designed to be benign in the marine environment. Nevertheless some impacts are likely including:

- Impact to flora and fauna, ecosystems
- Disruption to recreational activities
- Disruption/loss of income to fishing communities
- Construction related nuisance (noise, dust, exclusion areas)
- Environmental and health risks

The impact of others, most notably exclusion areas where fishing and anchoring activity is prohibited, can be minimised if existing corridors (with existing exclusion areas) are used.

During the early stages of Project design an extensive desk top study (DTS) was undertaken to identify a preferred route. Throughout this study environmental issues were considered and potential impacts minimised through selection of the best route. The general philosophy included:

- Use of existing onshore facilities where possible;
- Avoidance of environmental sensitivities (protected areas, sensitive species...);
- Installation of pre fabricated facilities where exiting facilities were unavailable;
- Use of existing corridors (and existing exclusion areas)

For those potential impacts that remain following selection of an optimal route, appropriate mitigation measures are readily available. Where warranted, further consideration of route selection is provided in the country specific EIAs.

9 - ENVIRONMENTAL ENVIRONMENT PLAN AND MONOTORING

In the project impact assessment studies, mitigation measures and best practice have been designed in order to avoid, minimize and reduce negative environmental and social impacts. These measures are reflected in this Environmental Management Plan (EMP) as a set of mitigations measures.

To ensure that the actions are managed fully and that unforeseen or unidentified impacts of the project are detected and resolved, an integral part of the EIS is the development of the EMP.

9.1 - PRE-CONSTRUCTION

The phase refers to initial route selection work including the desk top study (DTS) which delineated the cable route, and subsequent onshore/offshore route selection survey work, the marine survey. It therefore includes a number of onshore surveys and the use of vessels and survey equipment. There are no impacts resulting from DTS phase work (selection of the cable route).

9.1.1 - Environmental impacts

Impacts from these survey techniques are all considerate to be low. Impacts and mitigation measures that may results from the operation of survey vessels are described in section.

9.1.2 - Social impact

There no discernible social impact associated with the pre construction phase.

Construction activities will result in some negative environmental impacts during route clearance and cable laying, particularly to benthic biota along the survey route.

However, at any one location the disturbance will occur over a very short duration, natural recovery will readily occur and impacts will therefore tend to be minor in nature.

9.1.2.1.1 - Offshore

The pre-laying grapple run

The grapnel will penetrate the seabed to a depth of up to 0.8 meters. Due to the intrusive nature of this operation some negative impact is unavoidable. Impacts include the generation of:

- a small amount of turbidity
- through physical contact mortality or injury to marine organisms, particularly plants and other organisms that have low mobility.

The pre-laying grapple run and cable installation will have some minor physical impact on sea bed geology. This impact will be limited to the area where the cable will be installed only and will vary in intensity depending on the installation method (cable burial in a trench or laying on the seabed).

Cable laying

The laying of cables leads to seabed disturbance and associated impacts of damage, displacement or disturbance of flora and fauna,

- increased turbidity
- release of contaminants
- alteration of sediments.

These effects are mainly restricted to the installation, repair works and/or removal phase and are generally temporary. In addition, their spatial extent is limited to the cable corridor (in the order of 5 m width if the cable has been ploughed into the seabed).

Some mobile benthos are able to avoid disturbance and though sessile species (bivalves, tubeworms etc.) will be impacted.

The cable installation process will only result in short term direct impacts to the subtidal bottom habitats and assemblage present on intertidal area. The short term loss of benthic organisms directly along the cable routes is not considerate to represent an unacceptable ecological impact. The rapid natural reinstatement of the seabed will result in the area being available or rapid recolonisation and hence, no permanent impacts are anticipated from cable project.

Raised turbidity and suspended sediment levels can have a number of adverse effects on marine organisms, particularly in areas that would normally have clear waters.

Where suspended sediment concentrations are present for prolonged periods, or are particularly high and widespread, visibility can be reduced affecting the ability of some fish to feed.

Raised turbidity can also reduce light penetration in the water column and reduce photosynthesis/productivity in sea grasses and affecting the coral reef presents in the area.

However the duration, spatial extent and level of suspended sediment associated with route clearance and cable installation in this project are unlikely to cause such problems.

Nevertheless, turbidity levels should be minimized during cable lay operations by minimizing the duration and extent of physical seabed disturbance.

Substrate of the cable route considerate in thus study includes hard substrate and sediments.

Mitigation

No immediate mitigation known due to temporal nature of impact less than 24h) would be selected. But this can be achieved using the sea plough burial method in preference to jetting wherever possible. The impact of turbidity generation is assessed as being of low significance.

The Project will implement mitigation measures to reduce the risks of impacts on fauna with particular attention is paid to sensitive marine species including marine mammals and turtles. This will include:

- monitoring for the presence of marine mammals and turtles during marine activities;
- working with an appropriate environmental organization to develop a notification process;
- conduct a detailed cable route study to minimize passage of cable over hard substrates to optimize burial of the cable;
- Minimizing the impact of lighting at the beach areas.
- Assure prescribed specifications for cable type
- Use the same EASSy cable route (Msasani Bay)
- Work during calmer condition to minimize resuspension and spread of sediment.

With appropriate mitigation the significance of impacts on fauna are predicted to be negligible.

Air quality – Vessels operations

Cable laying will require use of dedicated cable lay vessels resulting in a number of general environmental impacts and risks. During normal operational activities vessels emit exhaust gases.

Assuming that the vessels are well maintained, emissions of pollutants will be minimal and within allowable limits.

Mitigation

- To minimize air emissions the Project's cable laying vessels will operate in line with the requirements specified under MARPOL 73/78 Annex VI, Prevention of air pollution from ships.
- When mitigated by compliance with MARPOL requirements, the impact of vessel operations on air quality is assessed as being of low significance.
- The project should require that construction contractors operate only well maintained engines.

Solid waste -Vessels operations

A variety of non hazardous (packaging…) and hazardous (oil wastes, paints…) wastes are typically generated during vessels operations.

Hazardous wastes can clearly have a toxic effect on organisms and can in some circumstances lead to bioaccumulation and ultimately lethal or sub lethal affects if badly managed. In addition, some non hazardous waste types can be equally harmful, particularly non degradable plastics that can remain at sea for many years posing an entanglement risk to sea birds and marine life.

Annex V of MARPOL prohibits the disposal to sea of any plastics whilst restricting the discharge of other non hazardous waste in coastal waters and in designated "Special Areas".

Hazardous waste should be stored on board the vessel until it can be disposed at a suitably equipped port, respecting the requirements of the Basel Convention on Transboundary Shipment of Hazardous Wastes.

Mitigation

- When mitigated by compliance with MARPOL requirements, the impact of solid waste in vessel operations is assessed as being of low significance.

Aqueous Discharges - Vessels operations

Planned aqueous discharges can include sewage water, grey waters (discharge from showers and sinks) and potentially contaminated drainage from the ship deck. Sewage and grey waters can have high bacteria levels, surfactants and a high Biological Oxygen Demand (BOD5), all which can result in potential human health issues and harm to marine organisms, particularly in sensitive areas or locations with poor mixing and dilution potential.

These wastewaters should therefore be managed in accordance with applicable international regulations and guidance, including the requirements of MARPOL 73/78, Annex IV (sewage).

MARPOL, Annex 1 also addresses discharge of oily waters, for example bilge waters. For ships of 400 gross tonnage and above, for control of oil from machinery spaces, waste water must have an oil concentration below 15ppm without any prior dilution. More specifically:

- Within special areas – discharges are prohibited, except when the ship is proceeding en route, and the oil content of the effluent without dilution does not exceed 15 ppm, and the ship has in operation oil filtering equipment with automatic 15 ppm stopping device.

- Outside special areas - discharges are prohibited, except when the ship is proceeding en route, the oil content of the processed bilge water (from machinery spaces) effluent is less than 15 ppm, and the ship has in operation an oil discharge monitoring and control systems, oily-water separating or filtering equipment

Mitigation

- When mitigated by compliance with MARPOL requirements and the impact of aqueous discharges (excluding ballast waters)in vessel operations is assessed as being of low significance.

Ballast water management - Vessels operations

It is possible that invasive (predominantly non-native) species may be unintentionally introduced. This has a potential impact habitats and fauna and flora if invasive species become highly aggressive, outcompeting native species and altering the structure and community composition of marine ecosystems.

Mitigation

- Marine vessels will be required to adhere to International Maritime organization (IMO) regulations on bilge and ballast water discharge in order to avoid unintentional introduction of non-native species to the marine environment.

9.1.2.1.2 - Conservation area

This site will not be affected directly by cable construction, but might be affected by sediment plumes, pollutants, oil and discharges from vessels operations.

Mitigation

- monitoring for the presence of marine mammals and turtles during marine activities;
- working with an appropriate environmental organization to develop a notification process;
- conduct a detailed cable route study to minimize passage of cable over hard substrates to optimize burial of the cable
- set depth for cable laying to ensure coral reef
- adopted a good practices procedures to minimize the resuspension of sediment to these habitats
- Prepare a notice for community and fishers with full description of construction activities (construction/renovation at the manhole) and its consequence from the landing point to explain the benefits of the project.

9.1.2.1.3 - Onshore

Waste

Construction wastes will be generated during onshore construction. Overall these are expected to be relatively small quantities although they may include some hazardous waste (oily rags, spent fuel cans, batteries etc.).

If a good waste management plan is planned, the impact of onshore waste is as being of low significance.

Mitigation

- Waste management is required to avoid the risk of harm to the environment and human health

Air quality

The local air quality in the close proximity of onshore construction activities will be affected by emissions from mobile (construction vehicles) and stationary machinery (portable generators).

Mitigation

- Assuming that the engines are well maintained, emissions of pollutants will be minimal and within allowable limits.

Dust

There is potential some dust generation during the construction at the shore crossing BMH and ducts. Dust is most likely to be generated during the transportation of materials on unpaved roads and during trench digging and soil movement.

Increased levels of dust in the air have the potential to impact environment (flora, communities) and social resources. However, the construction (BMH and ducts) period will be very short (approximately 3 weeks); any dust would be limited to the construction area, access route and very near surrounds only. Dust related impacts largely reversible within a short timescale. Therefore, no impacts are predicted to occur as a result of increased dust.

Mitigation

- Dust suppression techniques, such as increasing the moisture content of excavated materials and roadways by applying water or non toxic chemicals, can be used to reduce the amount of dust in the air, particularly where construction activities are taking place in close proximity to dust sensitive receptors e.g. residential/commercial areas. Other dust management measures include speed restrictions on dust generating vehicles.

Noise

Construction trafic typically consists of large, heavy vehicles which will generate noise and vibration during the transportation of materials for construction of the landing site (BMH and ducts).

Impact to local residences, restaurants, hotel are not predicted to occur as the increase in noise levels associated with the construction of the landing site will only be small, will be limited to short construction period, and because construction will be take place during day-light hours only.

Mitigation

- The project will require contractors to use equipment and vehicles that are in good working order, well maintained, and that have all noise suppression equipment intact and in working order
- Contractors will be required to implement best driving practices when approaching and leaving the site to minimize noise emissions

9.1.2.1.4 - Ramsar site

There are no Ramsar sites near the proposed project site.

9.1.2.2 - Social impact

9.1.2.2.1 - Human health and safety

There is potential for impacts on human health and safety to occur as a result of accidents and unplanned events that may occur during the Project installation activities.

The project activities have the potential to results in a direct and indirect negative impact on human health and safety within the development area and near surrounds.

Extend of the impact is limited to on-site and local. The duration will range from temporary to permanent as some impacts will last only a short while (minor injury) and some may cause a permanent change (mortality related to vehicle or vessel strike).

At particular risk are artisanal fishermen and other vessels (divers, jet ski…) that may move at night-time or in reduced visibility conditions when the Project activities are taking place. Collision of Project vessels with fishing boat and nets or other vessels could results in damage of vessels and equipment, injury or loss of life.

Collision of Project vessels with fishing boats and nets or other vessels could result in damage of vessels and equipment, injury or loss of life. In the terrestrial environment, human health and safety could be impacted through road traffic accidents involving construction vehicles.

In onshore environment, human health and safety could be impacted through road traffic accidents involving construction vehicles. The risk of other injury associated with the construction activities at the landing site will be limited to the work force only (as the site will be secured to avoid public incursion into the active development area), but there is some risk of public injury associated with the installation of the cable between the landing site and CLS as this construction will not be fenced.

Mitigation

- All active construction areas will be marked with high-visibility tape to reduce the risk accidents
- All open trenches and excavated areas will be backfilled as soon as possible after the construction has been completed. Access to open tranches and excavated areas will be secured to prevent pedestrians or vehicle from failing in.
- The project will require all contractors to implement an Environmental, Health and safety plan which will outline procedures for avoiding health and safety incidents and for emergency medical treatment.
- Contractors will be required to wear suitable personnel protective equipment (hard hats, high-visibility vests, safety boots and gloves and life vests)

- All construction and cable repair workers will sufficiently trained in the safe methods of working with fiber optic cables to avoid injury associated with laser lights and fibers.

- While a ship is laying its manoeuvrability is restricted, as such it will display the day signals and lights of a hampered vessel to avoid collision with other vessels at sea.

- Vessels will increase watch when navigating in areas that are kwon to be used by fishermen and other vessels. If other vessels are observed within the near vicinity, the project vessel will stop moving, make contact with the other vessel if possible, and wait until it has been confirmed that the course of both vessels will not result in collision or damage to equipment.

- works have to take place outside of periods of festival (Mombasa triathlon) periods as much as possible,

- Prepare a notice for community and fishers with full description of construction activities (construction/renovation at the manhole) and its consequence from the landing point to explain the benefits of the project.

Cable survey and installation could cause temporary disruption to the flow of recreational sea use.

However, these operations are limited to short periods of time and other activities can generally avoid the work area without significant diversion.

The project will notify the Dar es Salaam and Zanzibar Ports Authority and others activities, so that vessels in the area would be warned in advance of the ongoing operations through a “Notice to recreational sea users” report transmitted daily

No impacts to marine activities are thus predicted to occur a result of the project activities.

9.1.2.2.2 - Visual – landscape

The onshore facilities will either be buried in the case of beach man holes and therefore little visual impact is envisaged.

Mitigation

Efforts will be made to minimize visual impacts; land disturbed by cable laying will be contoured to its original form as part of overall reinstatement

9.1.2.2.3 - Odor, Heat and Radiation.

The project will not result in any significant increases in odor, heat or radiation conditions.

9.1.2.2.4 - Transport Infrastructure/port activities

Minor interruptions to port operations and shipping are expected to occur only during the cables deployment phase. This disturbance is predicted to be localized to the area in which the activities occur and near surrounds only, and will be short term and progressive in its nature as the activities move along the cable route corridor. Any disturbance to shipping operations will be temporary.

Mitigation

- While a ship is laying its maneuverability is restricted, as such it will display the day signals and lights of a hampered vessel to avoid collision with other vessels at sea.
- Raise awareness in the fishing activity of the project and its benefits (precise details and impacts of the cable project)
- Vessels will increase watch when navigating in areas that are kwon to be used by fishermen and other vessels. If other vessels are observed within the near vicinity, the project vessel will stop moving, make contact with the other vessel if possible, and wait until it has been confirmed that the course of both vessels will not result in collision or damage to equipment
- The project will notify the Dar es Salaam and Zanzibar Ports Authority and others activities, so that vessels in the area would be warned in advance of the ongoing operations through a “Notice to recreational sea users” report transmitted daily

9.1.2.2.5 - Education

No negative impacts on education levels or educational facilities are predicted to occur as a result of the proposed development.

9.1.2.2.6 - Fishing

Minor interruptions to fishing operations and fish auctioning are expected to occur only during the cables deployment phase. This disturbance is predicted to be localized to the area in which the activities occur and near surrounds only, and will be short term and progressive in its nature as the activities move along the cable route corridor. Any disturbance to fisheries will be temporary.

Mitigation

- While a ship is laying its maneuverability is restricted, as such it will display the day signals and lights of a hampered vessel to avoid collision with other vessels at sea.
- Raise awareness in the fishing activity of the project and its benefits (precise details and impacts of the cable project)
- Vessels will increase watch when navigating in areas that are kwon to be used by fishermen and other vessels. If other vessels are observed within the near vicinity, the project vessel will stop moving, make contact with the other vessel if possible, and wait until it has been confirmed that the course of both vessels will not result in collision or damage to equipment

9.1.2.2.7 - Landscape and Visual Receptors

There will be small amounts of increased light pollution during the construction period at the BMH as a result of security lighting. There will be no permanent lighting at the beach area.

9.2 - SYNTHESIS

Potential impacts were determined to be moderate or minor (localized short time scale...). Following application or mitigation measures the impacts for these areas was determinate to be negligible (**Tables 18 and 19**).

Table 18. Environnement management plan actions

Impact	Scope for Mitigation	Monitoring/ Implementation	Responsability
Environment			
Geology, soils, Hydrology, Meterology, Oceanography	not specific mitigation require		Contractors
Terrestrial	Limiting clearing and restoring areas of disturbance Controls to prevent incursion into adjacent areas Top soil will be segregated and laced on other back fill material to promote regeneration of vegetation. All soil that is disturbed during trench digging will be restored to approximate original depths as the trenches are backfilled	Hazardous materials management plan Construction site management plan	Contractors
Marine fauna/flora, Habitats	Marine vessels will be required to adhere to IMO regulations on bilge and ballast water discharge in order to avoid tensional introduction of non-native species to the marine environment Areas of habitat that are temporarily disturbed during cable installation will be restored upon the completion of the installation phase. Areas are disturbed during installation activities will be rehabilitated ASAP after the cable has been installed. The Project will ensure that measures are adopted to avoid incursion into areas adjacent to the work site or any secondary affects from pollution, sedimentation, or accidental spills The Project will also require that marine vessels have a similarly comprehensive plan for storage and handling of hazardous materials as well as a plan for containment and cleanup of accidental spills into the marine environment Contractors will implement a suitable system for spotting marine mammals and turtle whilst pre-installation and installation vessels are at sea. Should these species be observed in the vicinity of the work area, the vessels will execute measures to avoid collision or disturbance. Vessel operators will maintain a distance of 100 m or greater and will travel at 10 knots or less when safety permits until animals are more than 500 m away. Abrupt changes in direction will be avoided Vessel crews must report sightings of any injured or dead marine mammals and sea turtles immediately, regardless of whether the injury or death is caused by a Project vessel. The report should include the date and location latitude/longitude) of the animal/strike, the name of the vessel involved, and the species identification or a description of the animal. The report should be made to a designated ecology organisation Security lighting will be aimed on the area it is required at an adequate level of illumination only to avoid impacts on sensitive fauna. Spillage of illumination outside the direct work area will be avoided.	Construction site management plan Hazardous Materials Management Plan Marine Logistics Plan Waste Management Plan Marine Fauna Protection Procedure Daily fauna observation report Lighting plan	Contractors
Protected area/Ramsar	not specific mitigation require	Construction site management plan	
Water quality	Marine vessels will be required to comply fully with the requirements of the MARPOL Protocol (1978) at all times Marine vessel anchors will not be dragged along the seabed and they will be retrieved vertically to avoid unnecessary sediment disturbance The maximum speed of the cable laying will not exceed 5 knots per hour so that the amount of seabed sediment disturbed anddispersed during the cable laying process can be kept to a minimum	Marine logistic plan	
Waste	Waste management is required to avoid the risk of harm to the environment and human health.	Waste mangement plan	
Air quality (Local)	The Project should require that construction contractors operateonly well maintained engines Should considerable dust generation occur during construction, causing plumes of dust in the vicinity of the works and behind construction vehicles, a routine wetting program of all unpaved surfaces including roads and construction areas will be undertaken to ensure sufficient moisture content is maintained to suppress dust generation. Construction traffic speed control measures will be enforced on unpaved roads (reduced dust generation levels are often consistent with reduced traffic speeds). Operation in line with the requirements specified under MARPOL 73/78 Annex VI	Dust management measures Vehicle maintenance records Placement of traffic signs indicating the speed limit along the route used by construction vehicles Construction Site Management Plan	Contractors
Menai Bay Conservation Area	Minimize the resuspension of sediments. Special care has been taken to avoid projetc exposure of sensitives areas to prolonged high turbidity Schedule cable-laying activities have to coincide with projected periods of lower wave action	Marine Logistics Plan	Contractors
Heat/radiation	not specific mitigation require		

Table 19. Environmental and Social management plan actions

Social			
Traffic	Make contact with the other vessel to avoid collision or damage to equipment Vessels will increase watch when navigating in areas that are kwon to be used by fishermen and other vessels Make contact with the other vessel	Construction Site Management Plan	Contractors
Noise	Use equipment and vehicles in good working order, well maintained The Project will require contractors to use equipment and vehicles that are in good working order, well maintained, and that have all noise suppression equipment (mufflers, noise baffles) intact and in working order	Best driving practices Vehicle maintenance records	Contractors
Visual Pollution	Efforts will be made to minimize visual impacts; land disturbed by cable laying will be contoured to its original form as part of overall reinstatement		
Human activities (fisheries activities, On tourism - diving sites, recreational activities...)	Contractors will be required to wear suitable Personal Protective Equipment including hard hats, high-visibility vests, safety boots and gloves and life vests as appropriate in accordance with theEHS plan All construction and cable repair workers will be sufficiently trained in the safe methods of working with fiber optic cables to avoid injury associated with laser lights and fibers All open trenches and excavated areas will be backfilled as soon as possible after the construction has been completed. Access to open trenches and excavated areas will be secured to prevent pedestrians or vehicles from falling in Vessels will increase watch when navigating in areas that are known to be used by fishermen and other vessels. If other vessels are observed within the near vicinity, the Project vessel will stop moving, make contact with the other vessel if possible, and wait until it has been confirmed that the course of both vessels will not result in collision or damage to equipment While a ship is laying cable its manoeuvrability is restricted, as such it will display the day signals and lights of a hampered vessel to avoid collision with other vessels at sea. Trenches and excavated areas will be backfilled ASAP Require to wear suitable personnel protective equipment Require day signals and lights of a hampered vessel to avoid collision with other vessels at sea	Environmental, Health and Safety Plan Health and safety training and training records Health and safety incident register Marine Logistics Plan	Contractors

Globally, project activities are expected to have no effect on the environmental or social environment. This is mainly a result of the benign nature of the Project and the associated activities as well as the result of the integration of preventative measures into the project design.

The environmental assessment does indicate some potential for limited environmental and social impacts to habitats and flora; fauna; water quality; and human health and safety. The potential is reduced through the implementation of standard mitigation measures and industry best practices, none of which are excessive in cost.

Given the low potential for negative impacts and the high potential for significant positive benefits (both direct and indirect), the Project would be deemed to have a high level of environmental and social acceptability.

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