PORT AND HARBOR FACILITIES

Maritime transport (shipping) conveys over 82 percent of world trade; therefore, port and harbor development projects (e.g., terminals, berthing facilities, turning basins) are usually associated with longterm economic benefit for developing nations. Technological advancement in marine transport and the integration of transport by land, sea, and air have increased the complexity of port and harbor development. The dynamic character and importance of maritime transport can lead to projects such as development of approach channels, canals, waterways, and turning basins; construction of quays, breakwaters, jetties, and groins; and possibly the building of deepwater ports, prefabricated ports, offshore and relocatable terminals. Nearly all of the Bank's lending in recent years has been for rehabilitation or expansion of existing facilities.:

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The West African countries whose economies depend on the maritime transport for a significant portion of their exchanges need to be based on maritime transport and a harbour sector effective to ensure their competitiveness on the international market. It is accordingly that the African Western Bank of Development grants loans these last years, for the repair or the enlarging of existing installations. The success of the maritime trade, of the naval defense and fishing industries is dependent on the harbour development. It is essential thus that the design, the construction and the maintenance of this equipment are compatible with the marine and coastal stock management.

Potential Environmental Impacts

Maritime development usually generates local environmental problems; however, development associated with sensitive estuaries or inland on freshwater rivers may yield regional-scale problems. The impacts of maritime development will differ by location because of variations in features such as geography,

hydrology, geology, ecology, industrialization, urbanization and type of shipping.
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The alteration of natural waters and the construction of man-made structures can lead to direct impacts on the water body being developed as well as direct and indirect impacts on related ecosystems and communities in the project environs.:
Dredging operations, materials disposal, shorezone development, increased maritime traffic and vehicle traffic in the port can result in the release of natural and anthropogenic contaminants to the environment. Since numerous dredging, materials disposal, and construction methods exist for developing port and harbor facilities, the combinations of physical, chemical, and biologic effects on the medium of interest will vary. Potential aquatic impacts include oil spills and discharges; contaminant release from sediment resuspension, surface runoff, and point source discharges; habitat destruction; changes in water chemistry and circulation; occupational and public health concerns; and transportation safety. Terrestrial impacts may include contamination due to dredged materials disposal; erosion and sedimentation due to hydrologic changes caused by channel deepening and widening and shorezone development (construction of breakwaters, etc.); loss of sensitive habitat (e.g., wetlands, mangroves) due to shoreline and port-related development; and loss of existing and future land use. Air impacts can include degradation of air quality due to emissions from industrial stacks and vehicular traffic, and the generation of fugitive dusts. (A summary of all potential environmental impacts is provided in Table1. at the end of the document.)

1.1 Natural Resource Issues

1.1.1. marine environment

Dredging and dredge spoil disposal activities for port development and maintenance can induce shortand long-term impacts on aquatic systems as follows: degradation of marine resources such as beaches, estuaries, coral reefs, and fisheries; resuspension and settlement of sediments; partitioning of toxic contaminants and reintroduction to the water column; contaminant uptake by and accumulation in fish and shellfish; increased turbidity causing decrease in light penetration and associated photo synthetic activity; short-term depletions of dissolved oxygen levels; modified bathymetry causing changes in circulation, possible saltwater intrusion to groundwater and inland surface water; altered species diversity and structure of benthic communities, and fluctuations in water chemistry; changes in shoreline structure; and loss of
habitat and fisheries resources. : Similar impacts can also result from increased maritime traffic and facility development along the shorezone.

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Improved navigability and development of port facilities will increase maritime traffic and with it, the risk of spills and the discharge of oily bilge, ballast, anti-fouling materials and sewage. The increase in shorezone development will also contribute stress to the receiving aquatic system through point discharges of sewage, process and cooling waters, and accidental releases.:

1.1.2 Land

The waterfront region in the port and harbor area will be altered to suit new industry. These new industries can lead to relocation of villages, increased vehicular traffic, dust and airborne emissions from traffic and raw materials stockpiles, and contamination of surface runoff. Numerous port and harbor facilities are proximal to sensitive saltwater marshes, mangroves, and estuaries which can act as sinks for the collection of contaminated stormwater and sediment from the waterfront area.

Land disposal of dredge materials in confined and unconfined systems can also affect underlying groundwater, contaminate surface runoff, and alter future

land-use options. Increasing concern about the loss of wetlands and the effects of this loss on the hydrologic and biologic structure and function of biomes, will most likely preclude the use of wetlands as reclamation sites for dredged materials. :

1.2 Social and Cultural Issues

For the most part, new or expanded port and harbor facilities in a developing nation are welcomed since these projects provide new jobs and bring an influx of commerce to the region. However, improvements, expansion, and industrialization may upset the local cultural, ethnic, historical and religious traditions. In some cases, project acceptance and success may be hampered by local concern for the potential destruction of historical places, parks, reserves and valuable coastal zone recreational and fisheries resources. Community involvement in project planning is essential.
During the planning and implementation phases, projections should be made of the possible impacts of increased demands on the local technical and labor resources to prevent excess pressure on limited resources. Care must be taken to limit and/or prevent impacts on scarce local commodities. For example, the destruction of a valuable local fishery or recreational beach for the development of port and harbor facilities could result in undesirable economic and cultural impacts.:

2 Special Issues

2.1. Hazardous Materials/Cargoes

The shipping and handling of hazardous materials such as pesticides, explosives

or pressurized gases at port facilities in developing nations could pose an unacceptable risk to human health and the environment. To protect workers and the surrounding communities, authorities should ensure that effective measures are enforced for monitoring the transport and handling of hazardous materials at the port

2.2 Maintenance Dredging

Maintenance dredging is performed in approach channels and harbor basins to maintain depth and width and ensure safe access for large vessels. The dredged materials from maintenance dredging typically present a greater disposal problem than deeper sediments removed during construction dredging, since surficial sediments are composed of recently deposited materials that are usually contaminated. These younger sediments usually contain natural and anthropogenic contaminants and can arrive from atmospheric fallout, erosion of local land surface and channel banks, fallout from biological activity in the water column, sediment transport from inland waters, point source dischargers, and surface runoff from the surrounding area. To mitigate potential contaminant release from the port area, the following should be addressed: proper design of stormwater handling and treatment facilities; sewage and wastewater outfalls; local land use (e.g., proximity of agricultural fields or mining operations); procedures for handling hazardous materials; and types of industries permitted to operate in the port area

2.3. Port and Harbor Location

Internationally, greater attention is being given to the importance of maintaining and protecting the structural and functional integrity of marine and coastal zone resources; therefore, any port and harbor development which may affect these resources must comply with local and/or regional restrictions Open-ocean disposal of wastes, including contaminated dredge materials, has received considerable scrutiny in recent years. Applicable local and international

regulations, such as the Oslo Convention of 1974, the Paris Convention of 1978, and the London Dumping Convention of 1972 should be followed. Also, the International Maritime Organization (IMO) is responsible for establishing guidelines for ports to prevent and control releases and discharges from ships.

2.4 Port and Harbor Location

Coastal countries of West Africa, in the image of Many developing countries are characterized by dense human populations, inadequate potable water and sanitary waste disposal systems, intensive land use, and increasing levels of environmental degradation. Developing a port and harbor for increasing maritime commerce and port-related industry in an area currently experiencing environmental stress may be ill-advised, unless adequate mitigative measures are planned to ensure the proper handling of wastes from development-related activities. The decision to improve or develop port or harbor facilities is usually based on economic, geographic and political parameters rather than on those of an ecologic nature. In choosing location, the assimilative capacity of the prevailing natural systems should be considered along with accessibility, employment needs and local commerce.

3. Project Alternatives

Often several project planning, design and implementation alternatives exist for development of a port and harbor facility. Before starting the project, an analysis of the options must be finial in the process of developing an environmental and social impacts, As the project progresses, by consultants and staff of the Bank for financial and technical partners involved in the project, can make specific alternatives to consider when d. e its evaluationAlternatives and considerations described below can provide a framework for analysis of a particular project for the persons responsible for the assessment of environmental impacts and its validation.

3.1. Site Selection

Selection of a site for the development of new port or harbor facilities depends on many physical characteristics of the local surroundings as well as on socioeconomic concerns. Good locations typically satisfy the following criteria.

. Physical characteristics including, wind, tides, currents, weather and siltation do not require excessive maintenance or preclude maritime traffic.

. Alterations in circulation do not position the port where maximum sedimentation will occur, leading to increased frequency of maintenance dredging.

. Shorezone land area is adequate for the processing and waste management needs of any new waterfront industries.

. Scheduling considerations such as the spawning and migration periods for indigenous biota are
not violated.

. Need for resettlement is minimal.

. Project does not compete with or displace other highly valued land uses such as fishing beaches, agricultural fields or villages.

. Project activities do not adversely affect the value of an existing marine or coastal resource, such as dunes or a shellfishery.

. Construction materials, skilled labor, support industries, energy and freshwater supply, waste disposal facilities and transportation are accessible.

. Construction, operation and maintenance of the port or harbor does not damage sensitive habitats (e.g., estuaries, mangroves) or rare, threatened or endangered species.: . Port access by road/rail can be established easily without excessive disturbance to communities.:

3.2. Dredged Material Disposal

The initial screening for evaluating disposal options is a physical and chemical analysis for geotechnical character and the presence of contaminants in the sediments. Depending on the physical and chemical character of the dredged material, disposal may be confined, unconfined, or treated prior to release in

open water, along the shoreline, or on land. Disposal must be in accordance with applicable regulations. Also, long-term monitoring of the dredging process and disposal may be required

3.3 Dredging Process

The primary categories of dredges include mechanical, hydraulic and innovative technologies. When selecting the appropriate dredging technology or combination of technologies, the project engineer should consider the following site-specific factors: (a) environmental constraints associated with the physical and chemical character of the sediments; (b) cost and availability of equipment; disposal site location and limitations; (c) proximity of sensitive systems such as mangroves, estuaries, regional groundwater and freshwater bodies; (d) physical conditions affecting the dredge, transit and disposal locations; and (e) interference with other users at the dredge, transit and disposal locations.:

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4. Management and Training

A comprehensive dredging and dredged-materials management plan should be considered for the port and harbor facilities to ensure that maintenance projects can be carried out on schedule with minimum environmental effects. Port authorities and engineers should develop a plan using data from a characterization of the materials to be dredged; a vertical and horizontal profile of contaminant distribution in the channel sediments -to define homogeneity and locate prominent "hot spots"; an evaluation of sediment behavior using different dredging equipment and disposal options; and an analysis of potential long-term effects of maintenance on human and nvironmental health.

Support for efficient pollution control and waste reduction strategies may be important for dredging and construction activities, equipment operation,

materials disposal and waterfront industries. Port and industrial engineers should be familiar with state-of-the-art equipment and disposal technologies to ensure environmentally sound waste and spoils management.
All project staff and laborers should receive training under "standards of practice" for occupational health and safety and emergency response. The training should include procedures to be followed in the
event of accidents, spills, explosions or fires.

Training for government officials charged with supervision of an environmental management and monitoring plan may be required. To assess training needs, the capacity of local institutions to assume responsibility for environmental review should be evaluated, as well as the record of legal and regulatory agencies to monitor and enforce standards.

5. Monitoring

A site-specific environmental monitoring plan that enables West African Development Bank and Partners to manage a project and ensure compliance with environmental standards should be prepared for each individual project. Generic parameters that may require monitoring during project planning, start-up and operation are as follows: geotechnical and chemical characterization of sediments; water quality of project area and proposed disposal area; long-term chemical/physical testing of project area; disposal location sediments and water quality; longterm monitoring of biota for the possible accumulation of contaminants; long-term monitoring of sediment transport, accretion (shoaling), erosion, and the impacts and effectiveness of any manmade structures (e.g., groins, jetties); maintenance programs to keep a high level of employee environmental awareness; and monitoring of effects of project on populations and systems in the environs of the port and harbor facilities.:

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Table Potential impacts of construction projects - Ports and port facilities and their mitigation

Negative potential Impacts	Mitigation Measures
Direct Impacts	
Choosing a location (eg. Improvement or development of a waterway) may affect sensitive habitats or valuable fisheries resources or even seriously damage the quality of the environment	Undertake, on the one hand, a preliminary analysis of the surroundings and the ecology of the site and secondly, choose a place that is far enough away from sensitive habitats and not likely to move fish important resources
2. Displacement of the "no zone" close to the port	Conduct studies to determine the effective depth of the channel, corresponding to a balance between sediment transport and sedimentation
3 . Disturbance and removal of fauna and flora in the area of dredging .	Provide a mitigation plan for the local fauna and flora and identify the presence of rare, threatened or endangered and are native to the area of the project
4 . Hindrance caused to marine traffic due to the presence of dredging equipment	Develop in advance a program that coordinates and reduce obstructions faced by other users of the waterways.
5. Disruption or damage to any fixed installations such as underwater cables , pipes and outfalls .	☒ • Specify and highlight the location of facilities. • Change the evacuation to take account of the presence of structures plans dredging /.
6 . Noise pollution suffered by the residents of the area , especially at night.	Reduce the intensity of the noise by reducing the level of operations during the rest periods of the local community.
7 . Temporary increase in turbidity at the point of dredging reducing the penetration of light rays and thus the phenomena of photosynthesis.	To appeal to the more efficient dredging equipment use less destructive and screens sediment and carry out operations during low flow periods.

8 . Alteration of the surface of the funds can be detrimental to the survival of wildlife and native benthic fauna.	Ecological research when planning the project in order to reduce impacts on important or sensitive species of benthic fauna and flora.
9 . Separation of natural and anthropogenic sediment contaminants and reintroduction into the water column	• Perform a physical and chemical analysis of sediment before starting activities • Identify "points of focus" potential and develop a plan to reduce the resuspension of sediments in these areas.
10 . Changes in bathymetry causing changes in the tidal currents, the flow of the water , species diversity and salinity.	Undertake a review of the project area, a sample, determine the set of features and design, on this basis, a project that reduces the impact of the work.
11 . Diffusion phenomena turbidity.	To use technical means such as: temporary dams or barriers to absorb the transport of suspended solids outside the vicinity of the project
12 . Destruction / modification of the original shoreline	Review prior to project design, geology and hydrology of the shore, ensuring that the deepening of the channel does not cause changes such as subsidence or increased erosion. Provide erosion control devices
13. Risk of changes in terrestrial habitats caused by the deposition of dredged soil surface .	• Examine options for the disposal of materials and choose the one that will be less harmful to important habitats. • Require plans development of terrestrial environments. Identify, create or enhance if possible similar to those habitats will be destroyed
14. Temporary degradation of air quality	Control air quality and reduce operations

due to dredging activities	if it proves to be unacceptable.
15 . Projects can lead to pressure on local cultures.	• Review the local socio-cultural environment before implementing the project. • Develop specific mitigation measures with the participation of the community.
16. Burial of potential archaeological sites in the dredged material	• Inspect the disposal area for the presence of valuable art objects. • Make changes to the project design or recover or protect artwork.
17. Burial valuable benthic species such as mussels or clams, by sediment	• monitoring the degree of turbidity and maintain a concentration level of less than 2 grams / liter. • Limit dredging activities during the breeding season and fixing shells.
. Infiltration of sea water in the surface and underground	• Consider intrusion phenomena in the case of significant changes in channel depth and cross section. • It will be useful to analyze the effects of currents and the flow of the water.
Indirect impacts of dredging and disposal	
19. Absorption and accumulation by living species of contaminated sediment separated and resuspended	• Undertake physical and chemical analyzes necessary for proper planning before the implementation of the project planning, through an appropriate choice of equipment will reduce the resuspension of sediments. • Implement a monitoring program over the long term tissue of living species.
20 . • Occupational hazards to the health of workers engaged in handling operations sediments. • Effect of higher than normal accidents due to insufficient technical competence	Provide training to the workers who make them aware of the occupational hazards involved and establish a program of health and safety including the following: • Specificity and site analysis

or a lack of manpower.	• Monitoring sites • Training • Medical Surveillance • Control engineering structures, work practices and personal protective equipment • Program monitoring and information • Handling of raw materials and processed products • Decontamination • Emergency • Lighting • temporary and permanent sanitary facilities
21. Possible impacts of waste disposal in the ground on groundwater, surface water and / or land use	• If the choice falls to the floor drain, it should contain contaminated waste in a structure that minimizes the formation of leachate and their release into the surrounding groundwater. • Although non-contaminated sediments have their utility, the fact remains that the value of wetlands can not be considered an environmentally sound option.
22. Disruption of transport modes , noise , congestion and aggravation of pedestrian accidents due to up-and-coming heavyweight transporting construction materials	• If a suitable site location may help alleviate many of these problems, it should, however, undertake studies on transportation issues to select at the feasibility of the project, the more trips able to reduce new facilities / industries on the shores. • Initiate consultations on transport regulations, if they are lacking. Strengthen if necessary the state of access

	roads to the project site