5.2 Port of Lobito

5.2.1 Overview

Port of Lobito is located at 30km north of Benguela, in middle area of Angolan coast and physical distribution base in Middle West area utilizing Benguela Railway connecting to inland areas. City of Lobito has about 800 thousand population and the main industries are Benguela Railway, Petroleum, Cement, Brewery, Water and Sewer Company including Lobito Port Authority. The port has been constructed in 1903 by landfill of everglade. The port has the same location pattern as port of Luanda and good natural port. Main handling cargos are daily commodity and restoration related material such as construction material, oil, flour, sugar, grain and general cargo. At this moment, the restoration works of Benguela railways is underway and the port is expected to be important as international hub port for the countries like Zambia, Botswana and Zimbabwe who have no coast and Congo. Figure 5-5 shows the layout of the Port of Lobito and Photo 5-14 shows a panoramic view of the Port of Lobito.

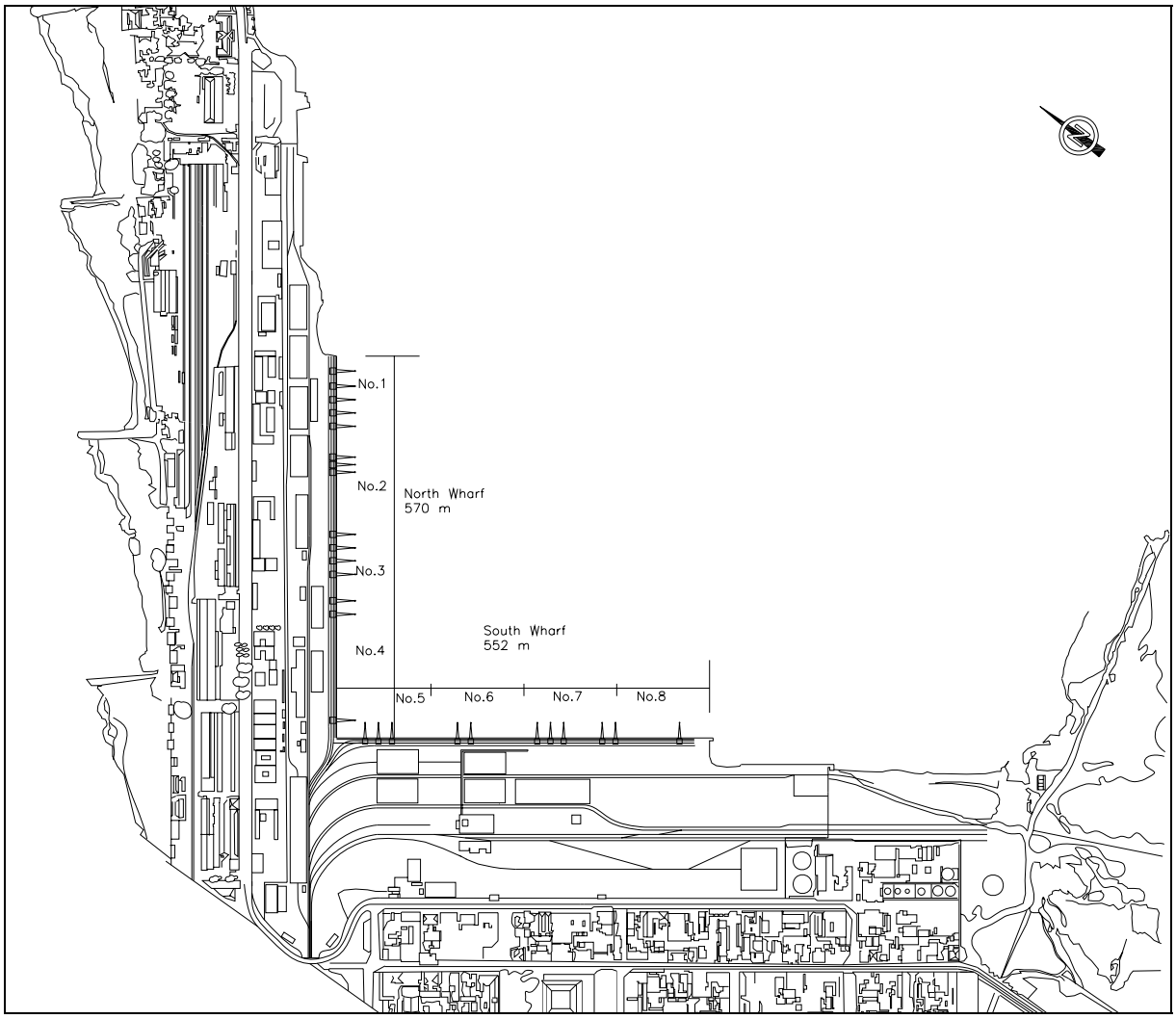


Figure 5-5 Present Layout of the Port of Lobito

Photo 5-14 Panoramic View of the Port of Lobito (2005)

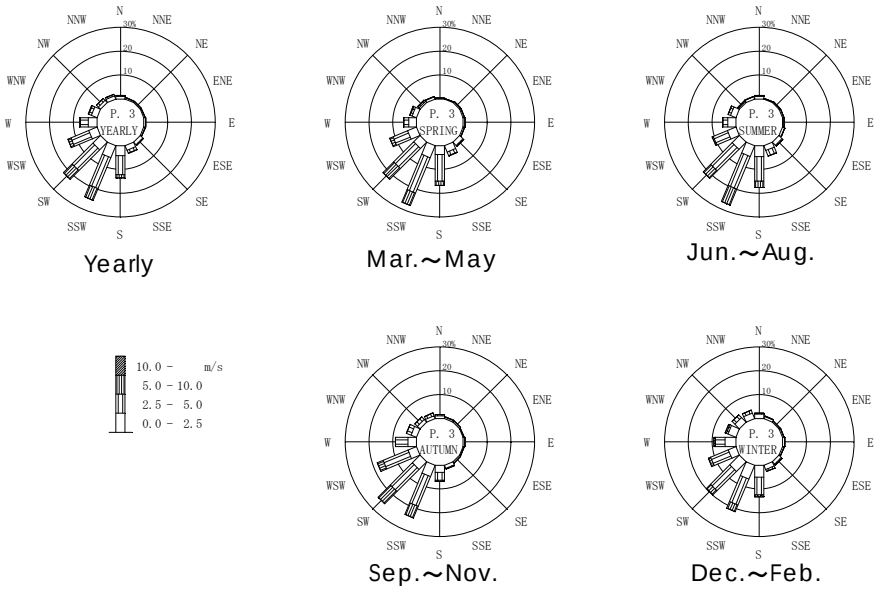
5.2.2 Natural Condition

1) Meteorological Conditions

Meteorological information such as temperature, humidity and precipitation for the period from 1991 to 2004 were obtained through the National Institute of Meteorology and Geophysics (INAMET) in Angola. Wind data was obtained through the Meteorological Agency in Japan. There exists a dry tropical climate in Lobito area.

i) Wind Direction and Wind Speed

Figure 5-6 shows wind rose and wind direction. Lobito is in the low latitude of southeastern trade wind zone, and annual mean wind speed is approximately from 2.5m/s～5.0m/s. Wind direction is predominantly from SSE to SW.



Source : Meteorological Agency in Japan (2001～2004)

Figure 5-6 Wind Rose

ii) Temperature

The difference between the annual mean high and mean low in air temperature is approximately from 6 degrees to 7 degrees as shown in Table 5-11, and mean high is over 30 degrees

in March and April. It becomes around 20 degrees as mean low temperature in July and August.

Table 5-11 Monthly Mean Temperature (Centigrade)

Month / Temperature	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Maximum	29.1	29.9	30.8	30.3	28.3	25.8	24.3	24.3	25.5	27.5	28.7	28.5
Minimum	22.7	23.4	24.7	24.0	21.3	18.7	17.6	18.0	19.3	22.0	22.9	22.8
Average	25.9	26.7	27.8	27.2	24.8	22.2	20.9	21.2	22.4	24.8	25.8	25.7

Source : the National Meteorology and Geophysics Institute in Angola (1991～2004)

iii) Humidity

The mean humidity level through a year is very high with the figure of 75% to 81% as shown in Table 5-12. Humidity of this area is high in July and August. Data mentioned below was observed by Lobito Meteorological Station in 2003.

Table 5-12 Monthly Mean humidity (%)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Humidity	77.0	75.0	77.0	79.0	78.0	79.0	80.0	81.0	80.0	80.0	78.0	77.0

Source: Port of Lobito (Lobito Meteorological Station 2003)

iv) Precipitation

Table 5-13 and Table 5-14 show the monthly precipitation and number of rainy days in 2003 sourced from Port of Lobito (Lobito Meteorological Station). It had no precipitation from May to September. It had the maximum precipitation which is 110 mm in March in 2003, and the maximum precipitation per day was October. Precipitation per year in 2003 was 320 mm, however number of rainy days were 25 days which is small in numbers. Table 5-15 shows the monthly precipitation from 1991 to 2003 at Benguela Meteorological Station. Benguela is located about 30 km south from Lobito, however characteristics of rainfall is almost same as Lobito.

Table 5-13 Monthly precipitation in 2003 (mm)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rainfall	20.0	30.0	110.0	50.0	0.0	0.0	0.0	0.0	0.0	30.0	20.0	60.0

Source: Port of Lobito (Lobito Meteorological Station)

Table 5-14 Number of days with rain in 2003

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	3	8	4	-	-	-	-	-	2	2	5

Source: Port of Lobito (Lobito Meteorological Station)

Table 5-15 Monthly Mean Precipitation at Benguela (mm)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rainfall	11.7	12.0	72.7	32.7	4.9	0.0	0.0	8.6	2.5	8.6	19.2	20.9

Source : the Institute of National Meteorology and Geophysics in Angola (1991～2003)

2) Hydrographic Conditions

i) Tide

The Port of Lobito does not observe the tide in the port, however the Port prepares tide table based on Admiralty Tide Table issued by the UK Hydrographic Office. Mean high water spring level of the Port of Lobito is 10 cm lower than the tide of the Port of Luanda, and mean low water spring is 10 cm higher than that of Luanda. The time of mean high water is 10 minutes behind the Port of Luanda and mean low water is 15 minutes behind the Port of Luanda. Tide condition at Port of Lobito is shown in Figure 5-7.

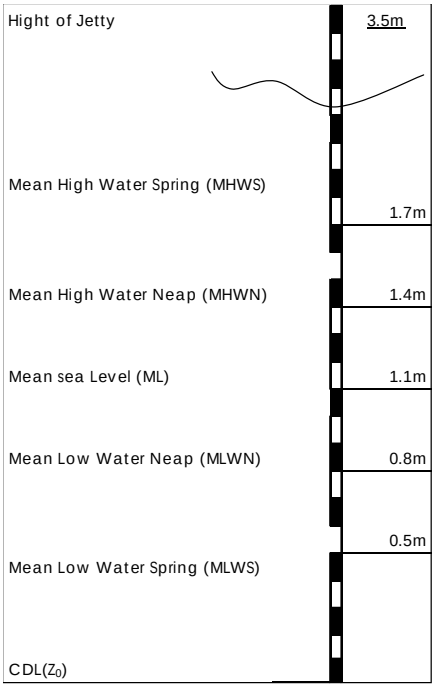


Figure 5-7 Tide Condition of Port of Lobito

ii) Tidal Current

Tidal current observed at entrance of Lobito Bay has a speed of 20 - 60 cm/s. Waves from 5.5 to 17.5 second period are observed at offshore in front of Lobito sand bank. Most frequent wave period observed was 12 seconds and the wave height was 50 cm.

3) Topography and Bathymetry

i) Topography

Topographic survey was carried out at port of Lobito during 6 to 17 June, 2005 in order to verify ground surface bump. Survey area was 55,000m2 in North and South wharf. Location map of cross section and each cross section are sown in Figure 5-8 to Figure 5-12.

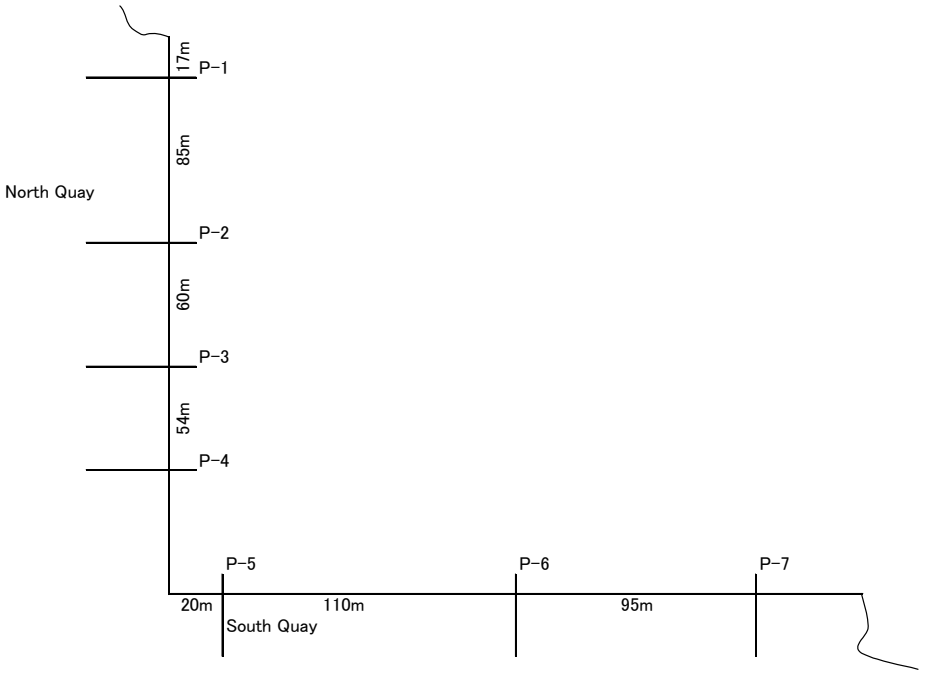


Figure 5-8 Location Map of Cross Section at Port of Lobito

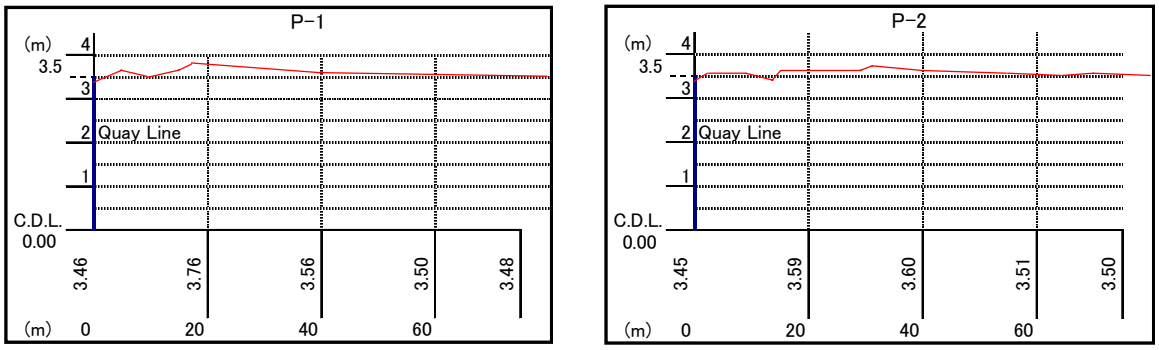


Figure 5-9 Cross Section of P-1 & P-2 at North Quay

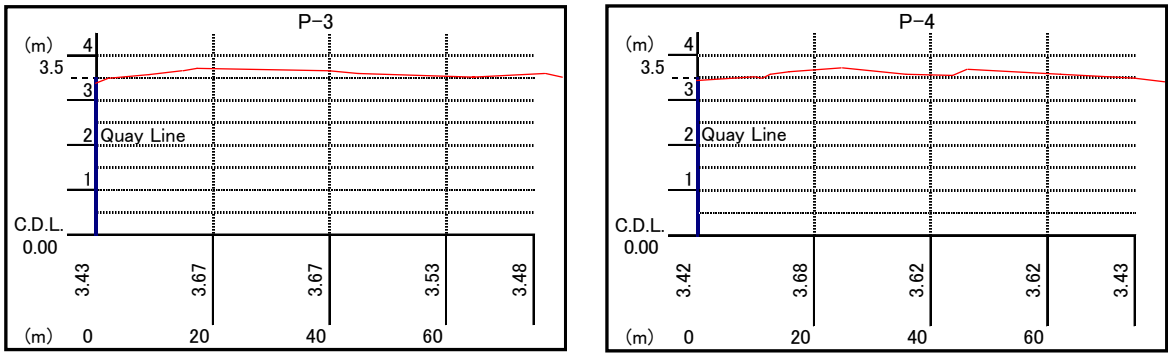


Figure 5-10 Cross Section of P-3 & P-4 at North Quay

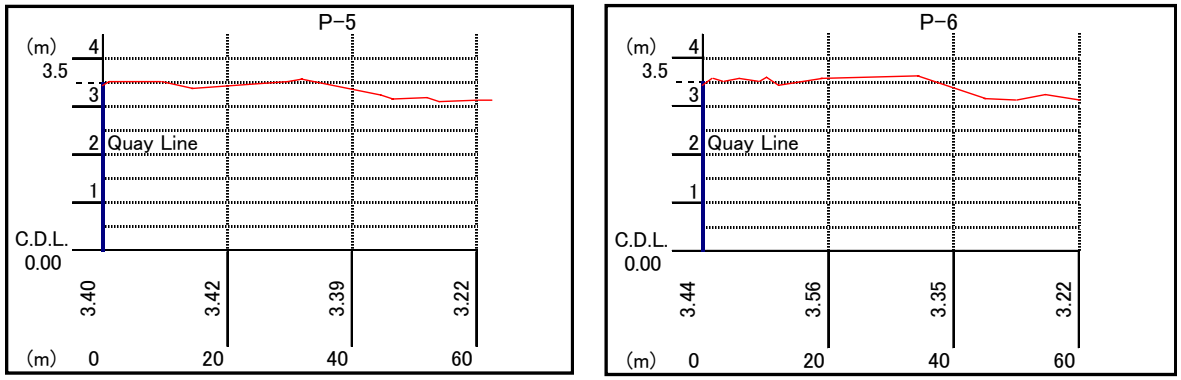


Figure 5-11 Cross Section of P-5 & P-6 at South Quay

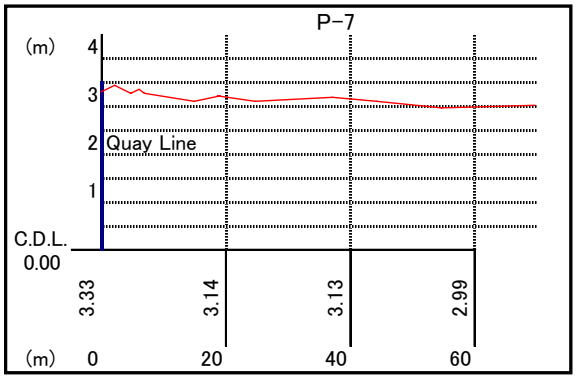


Figure 5-12 Cross Section of P-7 at South Quay

Height of North quay wall line shown in P-1 to P-4 is 4 cm to 8 cm lower than planned height. It is considered that some tolerable errors could be happened when quay wall was constructed. Most level of apron is over 3.5 m with the setting up transversal gradient due consideration to the rainfall intensity. Height of South quay wall line from P-5 to P-7 is 6 cm to 17 cm lower than planned height; it appears at P-7 apparently. Apron height is about 3.5m at west side area of South quay; however ground level where is located at backside of apron in west side of South quay is lower than 3.5 m. Lower ground level is not paved. East side of South quay is lower than planned level because, no pavement was done and earth retaining wall was collapsed.

The actual depth of entrance channel is regarded different from announcement due to deposition of sand by long shore drift. It is known that the length of the Restinga grew by about 900 m between 1891 and 1962 and that a series of groins was then built to reduce the impact of sedimentation on the entrance channel. Also, the hydraulic regime in the Catumbela River is influenced by man-made effects such as the construction of a dam on the lower reaches of the river which may affect the rate of sediment transport down the river and into the sea. There is a lagoon and salt field behind the port of Lobito. Cliff runs out to north in north-east side of Lobito bay.

ii) Bathymetry

There is continental shelf, which is 200 meter depth, extended to 50 km offshore around Lobito area. Lobito stands on a bay facing north which is protected by natural sand bar extending downstream from the town. This encloses a wide and deep anchorage well sheltered from Atlantic waves. They were constructed groin along sand bar and dam in the Catumbela River have little influence on littoral drift. Entrance of the Lobito bay is 400 m in width, from 10 to 20 m in depth and central part of bay is 30 m in depth. Average depth of North quay is 8.4 m and it has range between 7.5 m and 9 m. Average depth of South quay is 9.0 m and it has range between 8.2 m and 10.0 m. There were 4m depth offshore of east side of South quay, SONAMET carried out dredging this area.

iii) Soil Conditions

Geological condition of Lobito area consists of recent costal terrace and beach deposits comprising of sand, silt, clay and minor gravel. Block sand stone and alternate layers of sand stone and shale are observed at cliff around the Lobito bay. There is a sandy soil around port area. Soil investigation survey is carried out at Port of Lobito during from 13th to 19th May. Figure 5-13 shows location of bore hole. Figure 5-14 and Figure 5-15 show boring logs. According to soil investigation survey, soil condition consisted predominantly of medium to fine grained sand and occasional thin layers of clay. The only significant clay layer was encountered in borehole L1 below 27 m depths. A summary of the results of the logging is given in Table 5-16.

Table 5-16 Summary of Soil Profile and Consistencies

BH No.	Loose sand (N Values)	Medium Dense sand (N Values)	Dense to very Dense sand (N Values)	Stiff clay (N Values)
L1	1.60 – 9.00m (N=8)	9.00 – 22.00m (N=22) & 25.00 – 27.00m (N=12)	22.00 – 25.00m (N=33)	27.00 – 30.45m (N=12)
L2	3.00 – 4.00 (N=9) & 6.00 – 8.00m (N=7)	4.00 – 6.00m (N=21) & 8.00 – 10.00m (N=20)	0.00 – 3.00 (N=40) & 10.00 – 20.45m (N=56)	
L3	2.45 – 6.00m (N=5)	0.00 – 2.45m (N=12) & 6.00 – 20.45m (N=20)		

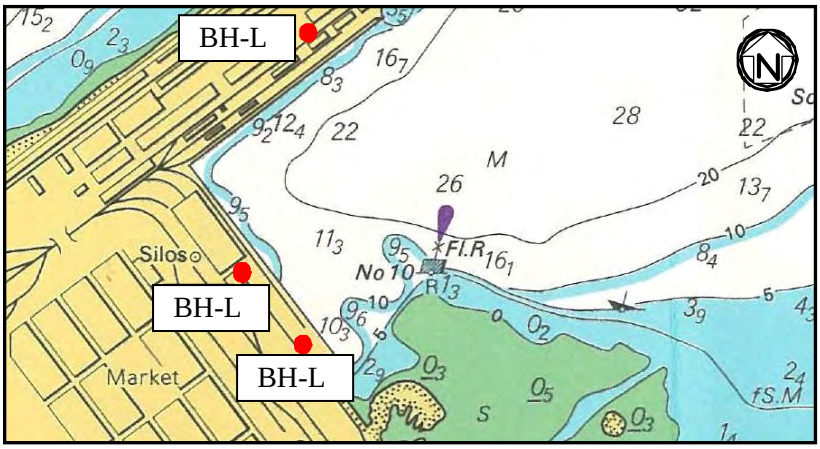


Figure 5-13 Location of Bore Hole

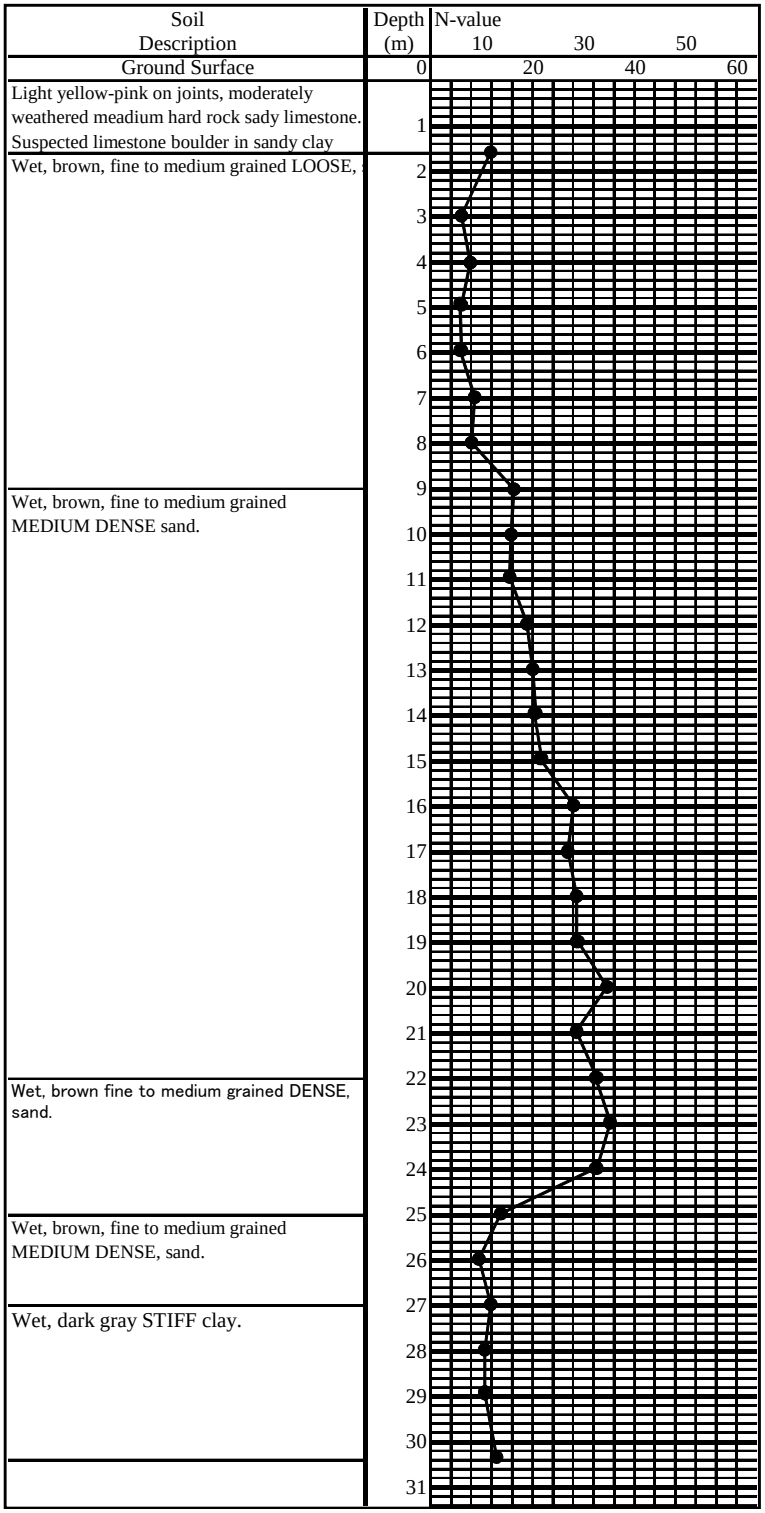


Figure 5-14 Boring Log of BH-L1

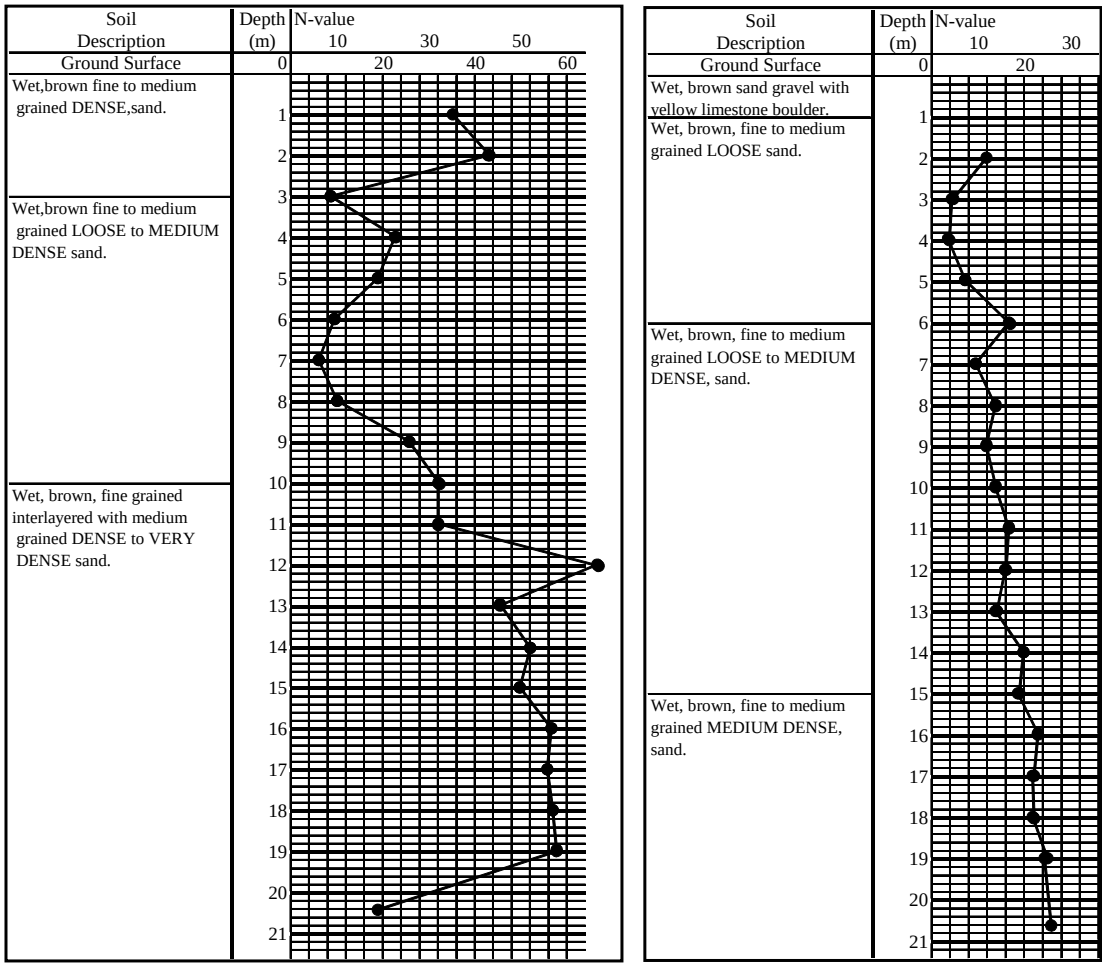


Figure 5-15 Boring Log of BH-L2 & BH-L3

5.2.3 Port Facilities

According to the "Directório Mar e Portos 2004", the Port of Lobito has the following aspects;

Latitude: 12° 20' S – Longitude: 13° 34' E – Time Zone: GMT +1h

Approach Channel: The harbor is formed by natural sandpit of 4.8 km in length and about 740 meters in width. There are no inner or outer bars and no currents in the harbor area. Depth of approach channel is over 18 meters. Vessels may enter or leave at any time of the year, day or night, but normally berthing takes place during daylight.

Berths: There are two quays in "L" – shaped arrangement with maximum depth of 10.5 meters providing six berths. Quay No.1 is running from NE to SW with 570 m in length. Quay No.2 is running from NW to SE with 552 m in length. There is a railway on both quays.

Storage: The port of Lobito has a covered area of about 24,500 m^2 with 13 warehouses and two sheds for 100,000 tons of goods. There are ten refrigerators and freezer each with a volume of 120 m^3. There is an open area of 72,000 m^2. There are silos adjacent to quay No.2 with capacity of 20,000 tons, and loading equipment and mechanical devices which allow a loading rate of 400 tons per hour.

Cranes: There are 28 various electric cranes with lifting capacity of between 3 and 22tons. There is one floating crane with capacity up to 120 tons and there are two mobile cranes and 35 forklifts with capacity of 3 to 44 tons.

Container Facilities: Containers are handled at the general cargo quay. There is a container yard

covering 8,000 m^2 and a reefer container area for 64 containers.

Ore and Bulk Cargo Facilities: There is equipment for loading bulk cargo on berth of quay No.2 with loading capacity of 450 tons per hour.

Railway: The port is connected to the national railway network. The port has 4 locomotives with 360 horse power.

The findings obtained in the course of the survey are described below.

1) Navigational Aids

The port of Lobito has two light houses and seven floating buoys as the navigational aids. Three of these floating buoys were landed due to the dredging works at the other side of the port. The floating buoys, which were secondhand American-manufactured, were purchased from Spain in 1993. The port of Lobito wants to replace these old floating buoys with new ones. As for the maintenance of the navigational aids, the port of Lobito checks the blinking light once a week and replaces the anodes of floating buoys biennially. The anchor chains of floating buoy were supposed to be replaced once in six to eight years, but the last replacement reportedly took place in 1991.

All navigational aids are solar-powered and they have not been equipped with synchronous flashing system. Some of the surfaces of their solar panels were tainted by bird droppings. While the color of starboard side buoy was green, the portside is red. During night-time observation, both of the lighthouses and both of the buoys located inside the harbor were confirmed to be effective, but the portside buoy located at the port entrance was found to be nonfunctional. This nonfunctional buoy was reported to be waiting for repair parts of battery.

The body of the floating buoy was made by fiber-reinforced plastic (FRP). Because the port of Lobito lacked sufficient enough technical know-how for repairing FRP, when the upper part of the buoy was damaged, they replaced it by steel member. Some of the steel members were found to be corroded. In addition, some man-guard rings made of steel at the upper part of the buoy were found to be deformed and biofoulings were observed on the floaters.

2) Entrance Channel

The depth of the entrance channel is approximately -35 meters and becomes shallow abruptly near the wharf. The maximum width of the entrance channel is 1,000 meters. Sedimentation stretched from the sandpit is going on at the starboard side of the port entrance, which is a serious problem of the Port of Lobito (see Photo 5-15).

Sedimentation at port entrance (encircled)

Full view of entrance channel (seen from the port entrance)

Photo 5-15 Present Conditions of Entrance Channel

3) Quay Wall

The quay wall survey was conducted from the sea side by use of a small craft and managed by the location No. of the mooring bollards. The northernmost mooring bollard on the north quay was numbered as No.1, and then the west end mooring bollard on the south quay was No. 38. According to the site measurement, North quay measures 571.70m in length and South quay 555.20m in length.

i) North Quay

Although some damage and repair traces of coping concrete and quay wall were observed in the north quay, structural condition was largely good. Chipping failure was found in the coping concrete throughout the length of the north quay and some section losses due to ship's impact were observed in the quay wall between bollard No. 8 and No.9. Neither floating of the cover concrete nor cracks was found on the quay wall.

Seventeen power sockets for quay cranes and 14 water supply bulbs for vessels installed on the coping concrete seem to be kept in good condition and are operational.

ii) South Quay

Along with the north quay, damage and repair traces of coping concrete and quay wall were observed in the south north quay, but the repair works were far from sufficient. Cracks with oozing of efflorescence and floating of cover concrete were found in several part of the quay wall. Moreover, spalling of cover concrete was observed in three places: two were between bollard No.29 and No.30 and one was between No.33 and No.34. Reinforcing bars were exposed and severely deteriorated there. Many cracks and floating of cover concrete were observed adjacent to the collapsed area, and the cover concrete might well come off. The mechanism of collapse is considered to be as follows: Despite the lack of sufficient rubber fenders, a lot of ships come to the south quay, therefore, ships' impact on the quay wall occurs very often. Then, the repeating ship's impacts initiate a crack on the side wall through which sea water and salty air penetrate inside the concrete. As a result, reinforcing bars inside the concrete corroded and became distended, and this distending force makes the cover concrete come off.

The retaining wall located at the tip of the south quay was found to be collapsed. The main causes of this problem are considered to be sliding and overturning due to soil pressure, lack of bearing capacity of the ground and unevenness of the base mound. In concrete terms, inadequate weight of the retaining wall, overestimation of the soil conditions and/or underestimation of loads acting on the wall during the design stage and defective compaction of the base mound during the construction stage can be pointed out as the reasons for the collapse.

Seventeen power sockets for quay cranes and 12 water supply bulbs for vessels installed on the coping concrete seem to be kept in good condition and are operational.

4) Apron Pavement

i) North Quay

Unevenness and cracks were observed on the apron pavement. Bumps stretching more than 20 cm on the apron pavement constitute a serious obstacle to safe operation of the cargo handling equipment.

ii) South Quay

Along with the north quay, unevenness and cracks were found on the apron pavement. In

addition, lack of cover on the utility duct was also observed.

5) Railway

Eighteen railway tracks placed in the 1950's were found on the port premises; 6 lines in North quay and 12 lines in South quay. Unevenness and distortion were observed in many places on the railways. Some railways were buried under containers or cargoes and others were found to be buried in subgrade. As for the railway yard, while the four tracks near the Maintenance shop side are used by the port of Lobito, the rest of the tracks are used by Benguela Railway. Generally, railways were covered by grass and littered with decayed railway wagons.

6) Berthing and Mooring Facility

The port of Lobito had purchased and installed rubber fenders manufactured by Bridge Stone on the quay walls, however, all of them were stolen during the civil war. Therefore, used truck tires hanging from the coping concrete were substituted as a stopgap measure. In addition, there were two wooden fenders installed on the quay wall, but both of them seemed to be out of service due to severe deterioration

The total number of mooring bollards is 38. A mooring bollard of No.12 is missing. Two of them were assessed to be disabled due to severe damage: one was No.17 of the north quay and the other one was No.24 of the south quay. The load capacity of 50 tons seems to be insufficient considering the maximum size of incoming vessel. Traces of pulling out failure of mooring bollard with its base concrete were observed in many places. Since only mooring bollard was not pulled out, the length of its anchor bolts are thought to be sufficient. Many mooring ropes were linked to one mooring bollard and every rope was tightly tensed.

7) Warehouse

The chillroom and freezing compartment on the second floor of the warehouse No.1 were found to be seriously deteriorated. As for the other warehouses, although some small holes on the roof were found, the general conditions were good. In addition, during the second site survey, some rehabilitation works were in progress. Every warehouse could easily be distinguished by its No. painted on the side wall. As for inside the warehouses, goods were well-organized. Behind warehouse No.9, some goods were loaded to wagons at the time of the survey.

8) Maintenance Shop

Generally, maintenance shops were well-organized. At the wood processing factory, a very old cutting machine, which reportedly seldom went broke down because of its simple mechanism, was still in operation. However, since it was not equipped with a safety cover on the disk saw, it seemed very dangerous. At the locomotive maintenance shop, three of the four locomotives were being overhauled. The port of Lobito wants to purchase new locomotives. As for the crane maintenance shop, working surroundings were found poorer than the other maintenance shops because it does not have enough walls to keep out wind and rain and has very old machines. Moreover, since it is located far away from the other maintenance shops, the working efficiency is reportedly quite bad (see Photo 5-16). Forklifts and mobile cranes were kept tidily in the store house (see Photo 5-16).


Storage for parts


Metal processing factory


Locomotive maintenance shop


Motor maintenance shop


Wood processing factory


Maintenance shop of electrical machinery


Crane maintenance shop


Storage for cargo handling equipment

Photo 5-16 Maintenance Shop

9) Cargo Handling Equipment

The port of Lobito has 26 quay cranes, which were sequentially installed beginning more than over 50 years ago. Only two cranes have load capacity of 22 tons and others have less than 10

tons capacity. Because of the insufficient load capacity of quay cranes, container handling is exclusively conducted by ship's gear. The quay cranes are only available for discharge of bagged or palletized cargo and loading of empty containers. All of them were overhauled in 2004, but two of them were out of commission at the time of survey. The port of Lobito plans to replace old cranes sequentially in the five years ahead.

The port of Lobito has a floating crane of 120 tons capacity, which is reported to be used for handling heavy cargos. Since its jib can not circle, the working efficiency seems not so good. The formerly-utilized grain ship loader, which is equipped with belt conveyor system, was used for exporting cereals produced in hinterland. The port of Lobito wants to change the equipment to accommodate imports of cereals. Although it has been a long time since the port of Lobito ceased operations, the facility was found to be well-organized.

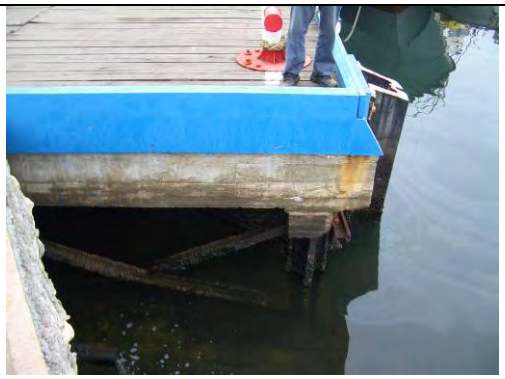
Other cargo handling equipment such as reach stackers and forklifts, etc. were well maintained. The port of Lobito introduced the latest model of reach stacker with a unique shape of boom in 2005.

10) Others

Almost all ladders fixed on the quay wall were found to be severely deteriorated or missing. Although the port of Lobito has spare ladders, ladders are not replaced because the use of them is far less frequent. On the same score, corroded mooring rings for small crafts were also found in many places, but they are not replaced.

The Cabotage jetty, which was constructed recently, was well maintained. The condition of its wooden deck was found quite well because there is little traffic on the deck unlike in the port of Cabinda. Rubber fenders manufactured by Bridge Stone, which escaped theft during the civil war, were installed on the jetty (see Photo 5-17). Repair works were implemented at several places during the survey

Wooden deck



Substructure

Photo 5-17 Present Status of the Cabotage Jetty

5.2.4 Volume of Traffic

Total cargo and container volume trends at Lobito port are shown in Table 5-17 and Table 5-18. Since 2000, both total cargo and container volumes have been increasing at a fast pace. Cargo volume by major bulk commodities is shown in Table 5-20. More than 140,000 tons of cargo is imported bulk food. There is small one cement factory in Lobito, so 9,000 tons of cement was imported through Lobito port to satisfy its demand in the central part of Angola. The ratio of the bulk cargo to the total cargo is 30% in Lobito Port. Fertilizer is one of the major commodities in Lobito port. Many part of the cargo of Lobito port is used for the survival of Angolan people and for the rehabilitation of Angolan country. The composition of 20ft and 40 ft container of Lobito port is shown

in Table 5-19. The ratio of 20ft container is 85%. The ratio of TEU to Unit of Lobito port is 1.151 in 2004.

Table 5-17 Cargo Throughput of Lobito Port

year	International (ton)			Domestic (ton)			G. Total (ton)	Rate of Increase (%)
	Import	Export	Total	Inbound	Outbound	Total		
1995	52.4	0.0	52.4	38.9	30.6	69.5	121.9	
1996	94.8	0.0	94.8	18.7	14.9	33.6	128.4	5.3%
1997	259.4	0.0	259.4	94.4	57.2	151.6	411.0	220.1%
1998	242.5	0.0	242.5	137.8	81.0	218.8	461.3	12.2%
1999	199.4	0.0	199.4	117.5	68.1	185.6	385.0	-16.5%
2000	300.3	0.0	300.3	152.3	83.3	235.6	535.9	39.2%
2001	349.8	0.0	349.8	248.7	103.7	352.4	702.2	31.0%
2002	405.2	0.0	405.2	195.0	72.8	267.8	673.0	-4.2%
2003	610.8	0.0	610.8	156.4	75.4	231.8	842.6	25.2%
2004	575.6	91.0	666.6	13.0	70.2	83.2	749.8	-11.0%

Table 5-18 Container Throughput of Lobito Port

Year	Unloading (Unit)	Loading (unit)	Handover (unit)	Total (unit)	Rate of Increase (%)
2000	7,410	7,675		15,085	
2001	9,099	8,314		17,413	15.4%
2002	11,228	19,696		30,924	77.6%
2003	12,413	11,496	7,855	31,764	2.7%
2004	14,404	14,546	9,100	38,050	19.8%

Table 5-19 Composition of 20ft & 40ft Container of Lobito Port

	Year	2000	2001	2002	2003	2004
Unloaded	20ft	6,826	8,123	10,032	10,793	12,088
	40ft	584	976	1,196	1,898	2,316
	Unit	7,410	9,099	11,228	12,691	14,404
	TEU	7,994	10,075	12,424	14,589	16,720
Loaded	20ft	7,168	7,428	9,722	10,044	12,343
	40ft	507	886	974	1,639	2,203
	Unit	7,675	8,314	10,696	11,683	14,546
	TEU	8,182	9,200	11,670	13,322	16,749
Total	20ft	13,994	15,551	19,754	20,837	24,431
	40ft	1,091	1,862	2,170	3,537	4,519
	Unit	15,085	17,413	21,924	24,374	28,950
	TEU	16,176	19,275	24,094	27,911	33,469

Table 5-20 Cargo Throughput of Major Dry Bulk in 2004

(Ton)

Cargo type		Throughput
Bags	**182,081**	
Rice		44,297
Wheat		45,684
Sugar		19,039
Corn		32,637
Fertilizer		12,259
Cement		9,000
Others		19,165
Pallets, Various Materials	**90,917**	
Clinker		46,424
Others		44,493
Total	**272,998**	
Break Bulk/ All Cargo		31.3%

5.2.5 Cargo Handling and Security Issues

1) Cargo handling at quay side

Cargo handling operation in Lobito Port is similar to that at the port of Luanda. However, ship waiting is seldom observed since the cargo volume is smaller than Luanda Port.

The quay cranes at the port do not have enough power to lift the heavy cargo, and thus ship's gear is mostly used for loading and unloading of containers. The ships have heavy-duty cranes that are capable of lifting up to 35~40 tons cargo. Quay cranes are capable of handling empty containers and handling many boxes in a short time. Quay cranes are also used for general cargo such as bagged commodities.


Ship cargo handling with a quay crane
(near warehouse No.11 in north wharf, near warehouse No.20 in south wharf)

2) Cargo handling at yard

The reach stackers are mostly used for the container handling. The stack height of the loaded containers is three high. The reach stacker can move forward holding a container laterally or 45 degrees tangentially. Since the movement of a reach stacker needs space, the number of containers which can be stored in the container yard is less than the case of transfer crane. The available yard space is barely sufficient to cope with the increasing container volume. The port enterprise has demolished some of the warehouses to increase the space for the containers. The pavement is excessively deteriorated. This results in inefficient container handling and damage to the machines in

the form of flat tires, bursts, torsion of frames, bending of the wheel axes, etc.

All the documentation is carried out manually by pen and paper. Electronic documentation is not seen in the yard. This is not only time-consuming but also errors involving container location often occur. All warehouses are used by some uses (partly used for offices). There is only a distance of about 17m from the quay front to this warehouse, and this has a negative impact on the cargo handling efficiency.

There were two silos in the past, but one of them is being transformed into an office space and the other is inoperative. The port administrator is responsible for procuring cargo handling equipment such as reach stacker if necessary. In addition, the port administrator depends in a list of repair demands of every year, and they repair an approved institution about an existing institution such as a key crane and a warehouse. At present, No. 25 quay crane and No. 10 warehouse are undergoing repair works.

Cargo handling by a top lifter

Inside of warehouse No. 20

Warehouse closed to the quay front

A silo, the belt conveyor which do not operate anymore for dozens of years

Repair of No. 10 warehouse in the north wharf

New Reach Stacker

Cargo handling Equipments and warehouses of the port of Lobito is shown in the following table.

Table 5-21 Cargo handling equipment of the port of Lobito

Type of Facility	Numbers	Lifting Capacity
Quay Crane	25*	3t～22t
Mobile Crane	3	16t～150t
Floating Crane	1	120t
Grain Ship Loader	2	200t/h
Reach Stacker	2	40t～45t
Top lifter	2	40t
Forklift	24	2.5t～40t

* of which one was under repair, two were broken

Table 5-22 Warehouse and Silo of the Port of Lobito

Type of Facility	Numbers	Capacity
Warehouses	14*	Total Floor: 22,710 m^2
Silo	1	Capacity: 20,000t

* Under Repair x1

3) Security Issues

Security issues in the port of Lobito are almost the same as at the port of Luanda: In accordance with the new ISPS Code (International Ship and Port Facility Security Code) which became effective in July 2004, the ports in Angola drafted security and took necessary measures to comply with the Code. The walls and fences surrounding the port were improved. The information system, firefighting system, electrical system and cranes were also implemented or repaired. The port of Lobito is capable of making a quick response in the event of emergency involving combustibles. Access control is conducted to prohibit the entry of suspicious persons. The uniforms of employees are different in shape and color according to the category of the job. At the port gates, the guard men inspect passports or ID.

The port is not as busy as the airport and thus can easily fulfill its security obligations. Security systems are also in place outside of the port. Therefore, the chance of a terrorist attack in Lobito is very small. The gate at the port of Lobito is in better condition than in Luanda as fewer people complain of tripping.

The port administrator installed a fence and a gate by July 2005 and is now installing lights in the yard. They installed one CCD camera in the roof of an office. They have a plan to introduce an identification card with magnetic reading in the future. In addition, they plan to install a wide- raging camera that can monitor the arrival of ships as well as the port area.

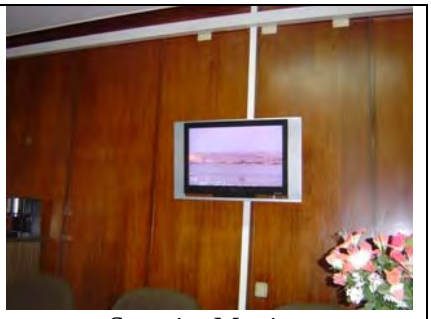
		
Gate No.0	Gate No.4	Security Monitor

Table 5-23 The IMO Registration Situation of the Port of Lobito

Port Tag	Lobito Angola
Facility Name	Commercial Port of Lobito
Port Facility Description	General Cargo, Container, Liquid and Bulk Terminal
Port Facility Has Alternative Arrangement	No
Port Facility Has Approved Port Facility Security Plan	Yes
Date Of Approval	29/06/2004
Port Facility Security Plan Has Been Withdrawn	No
Withdrawn date	

5.2.6 Summary of Findings

Through the review of present status and issues of the port of Lobito, following 7 points are summarized as findings of this study.

- At South Quay, some part of the upper structure is lacking along all berths. Some look to have been repaired but more work is required.
- At the front edge of South Quay, retaining wall has collapsed.
- Yards of the North Quay and the South Quay have many cracks and uneven sections. Pavement is peeled.
- Railways have some unevenness and deviance like yard.
- Old tires are used as a substitute for fender.
- Quay cranes are old and capacity is low. Container loading/ unloading depends on ship gears.
- Area of container yard is rather narrow to handle the current volume of containers.

5.3 Port of Namibe

5.3.1 Overview

The Port of Namibe is located at 230km north from neighboring country, Namibia boarder and physical distribution base to southern areas connecting to inland areas through Mocamedes Railway. The port was constructed in 1958 and dispersed with Saco Mar port in north putting Namibe mortar shaped bay. Main handling cargos in the port are food, construction materials, fish, agricultural product, marble, granite and so forth and Saco Mar port has been functioned as

exclusive terminal of iron ore but now changed to the terminal for oil and natural gas. Port of Namibe is expected to bear the strategic role as resources export of not only Angola but also southern African countries in the future since potentiality of mineral resources and agricultural products are rich in surrounding areas of port of Namibe. Figure 5-16 shows the layout of the Port of Namibe and Photo 5-18 shows a panoramic view of the Port of Namibe.

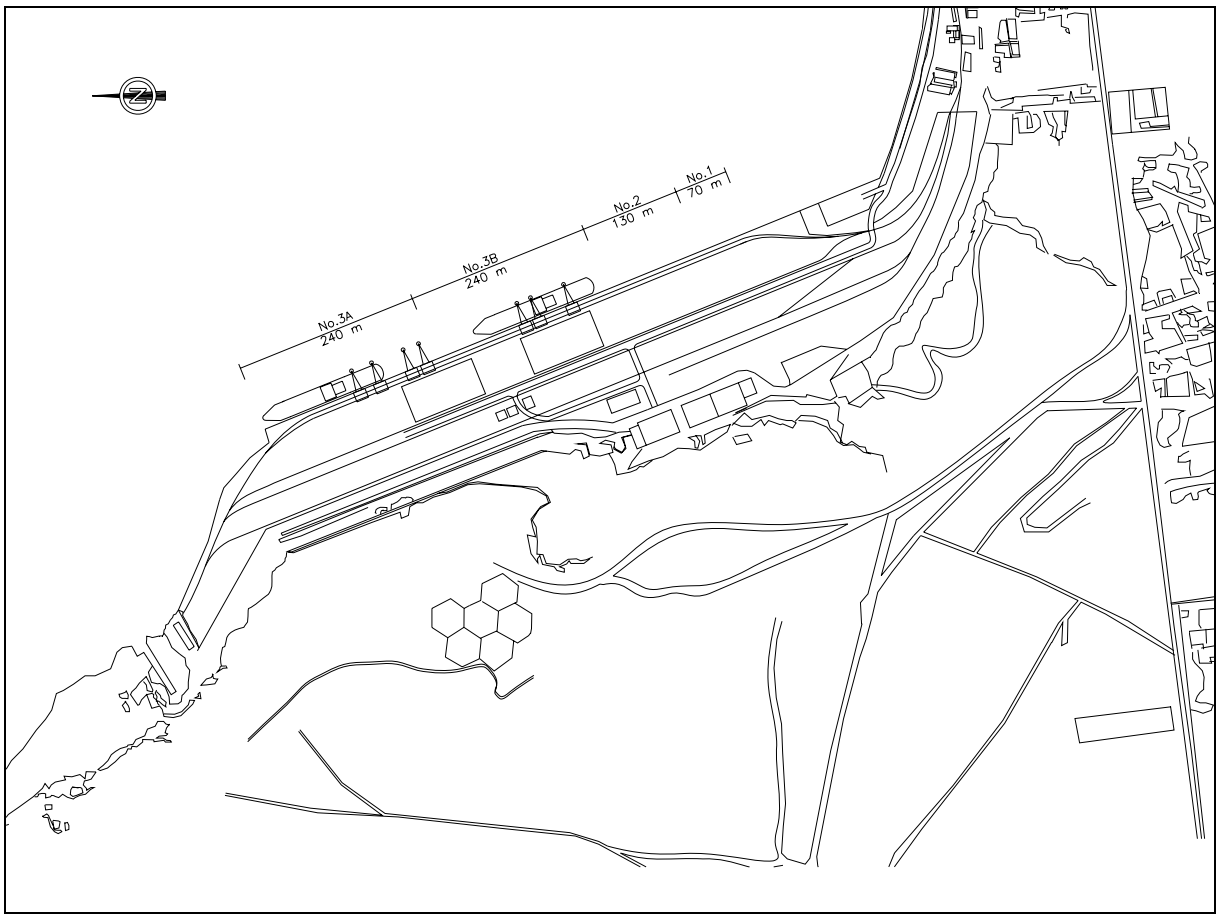


Figure 5-16 Present Layout of the Port of Namibe

Photo 5-18 Panoramic View of Port of Namibe (2005)

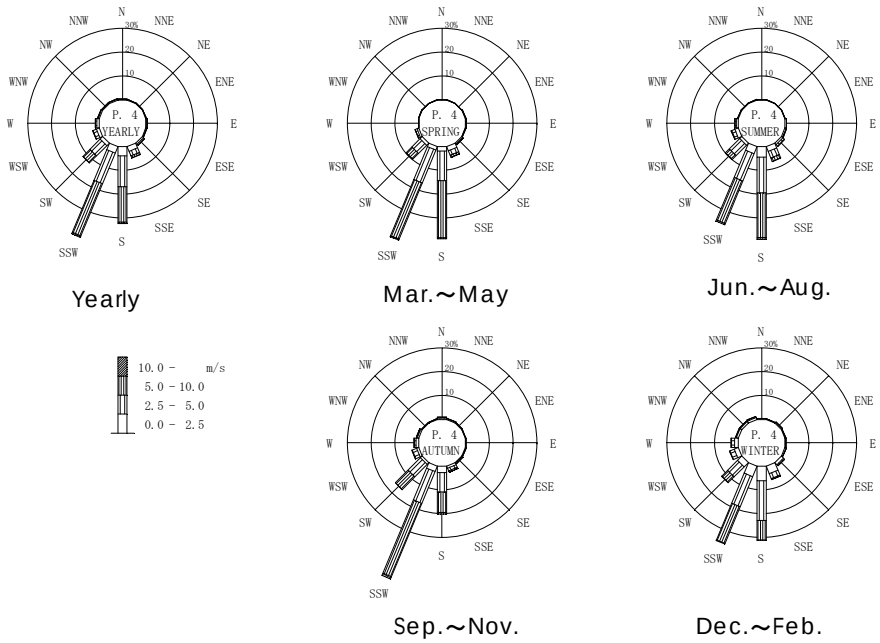
5.3.2 Natural Condition

1) Meteorological Conditions

Meteorological Information such as temperature, humidity and precipitation for the period from 1991 to 2004 was obtained through the National Institute of Meteorology and Geophysics (INAMET) in Angola. Wind data was obtained through the Meteorological Agency in Japan. There is a tropical desert climate in Namibe area.

i) Wind Direction and Wind Speed

Figure 5-17 shows wind rose and wind direction. Namibe is in the low latitude of southeastern trade wind zone, and annual mean wind speed is approximately 2.5m/s～7.5m/s. Wind direction is predominantly SSW with 7.5m/s and 18.8% frequency.



Source : Meteorological Agency in Japan (2001～2004)

Figure 5-17 Wind Rose

ii) Temperature

The difference between the annual mean high and mean low in air temperature is approximately 8 degrees as shown in Table 5-24, however it is over 10 degrees in May and June. Mean high is about 28 degrees and over 29 degrees in March.

Table 5-24 Monthly Mean Temperature (Centigrade)

Temperature \ Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Maximum	27.6	28.7	29.1	28.8	26.3	24.4	22.7	21.8	23.2	25.2	26.6	27.0
Minimum	19.2	20.1	20.9	19.4	15.5	13.9	13.8	14.1	15.2	16.9	18.3	18.6
Average	23.4	24.4	25.0	24.1	20.9	19.1	18.2	17.9	19.2	21.0	22.4	22.8

Source : the Institute of National Meteorology and Geophysics in Angola (1991～2004)

iii) Humidity

The mean humidity through a year is constantly high at 70s % as shown in Table 5-25.

Table 5-25 Monthly Mean Humidity (%)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Humidity	71.1	72.9	73.6	73.4	76.7	78.5	79.8	79.8	78.5	73.0	71.2	71.2

Source : the Institute of National Meteorology and Geophysics in Angola (1991～2004)

iv) Precipitation

Table 5-26 shows the monthly precipitation from 1991 to 2004. They have a small precipitation caused by tropical desert climate in Namibe. The monthly mean precipitation is 42 mm for the past 14 years. The Bero River which flows into the Namibe Bay is a dried-up river in dry season, however it has strong current from upriver such as Lubango in rainy season. Strong current causes flood near its mouth sometimes in rainy season.

Table 5-26 Monthly Mean Precipitation (mm)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rainfall	2.4	11.2	17.5	2.7	0.3	0.0	0.0	0.1	0.5	1.1	3.7	2.3

Source : the Institute of National Meteorology and Geophysics in Angola (1991～2004)

2) Hydrographic Conditions

i) Tide

Port of Namibe does not observe tide level, however the value of their tide table is very similar value with Admiralty Tide Table which issued by The UK Hydrographic Office. Mean high water spring level of Port of Namibe is 10 cm lower and mean low water spring is 10 cm higher than tide of Port of Luanda, also time differences of mean high water behind 14 minutes and mean low water behind 18 minutes in comparison to Port of Luanda. Tide level at Port of Namibe is shown in Figure 5-18.

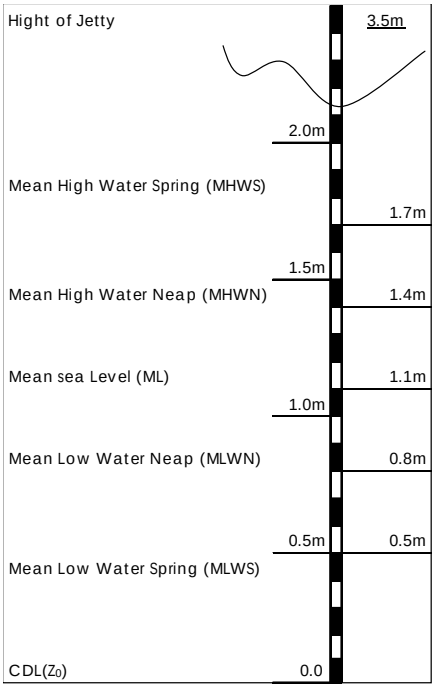


Figure 5-18 Tide Condition of Port of Namibe

ii) Ocean Waves

Port of Namibe stretched out from north to south is located at south side of Namibe bay and is protected from big wave from ocean by Point of Noronha. In the interview, it is also confirmed that Port of Namibe is not affected by ocean waves. According to the observation from Point of Noronha wave direction is predominantly from west. Wave of less than 50 cm wave height is frequently seen by getting the south-west wind in the after noon around the Saco mar pier where is

located at north of Namibe bay.

3) Topography and Bathymetry

i) Topography

Topographic survey is carried out in Port of Namibe from 27th April to 11th May, 2005 in order to verify ground surface bump. Survey area was 88,000m^2 on the wharf. Location maps of cross section and each section are shown in Figure 5-19 to Figure 5-22. Red line indicates level which survey was conducted in April, 2005. Black line indicates level which survey was conducted in March, 1996. Blue line indicates designed phase level.

According to the survey in 1996 by Port of Namibe, sea side rail sank in around 10 cm at maximum on the other hand, all land side rail is elevated.

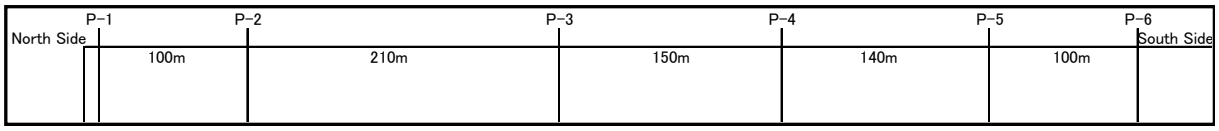


Figure 5-19 Location Map of Cross Section at Port of Namibe

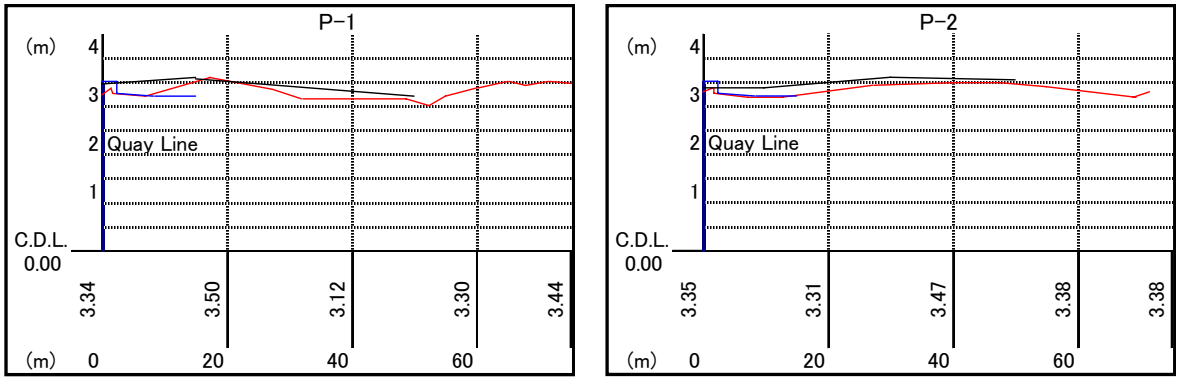


Figure 5-20 Cross Section of P-1 & P-2

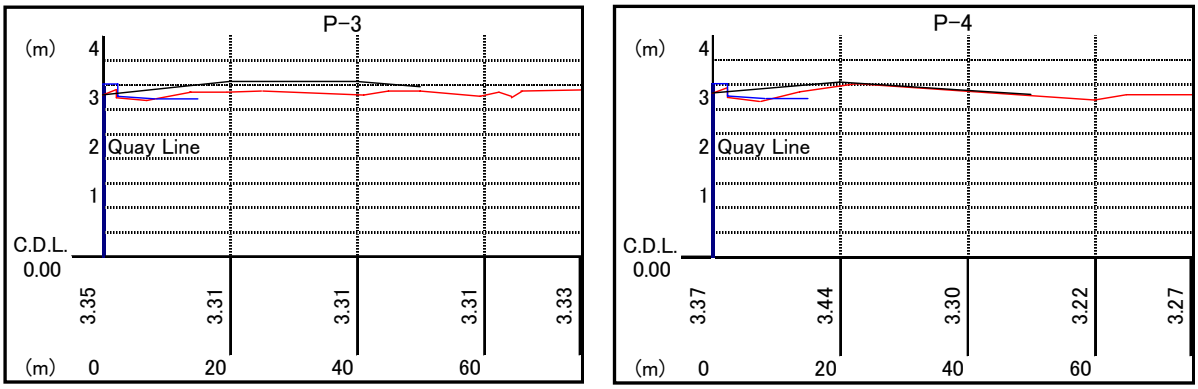


Figure 5-21 Cross Section of P-3 & P-4

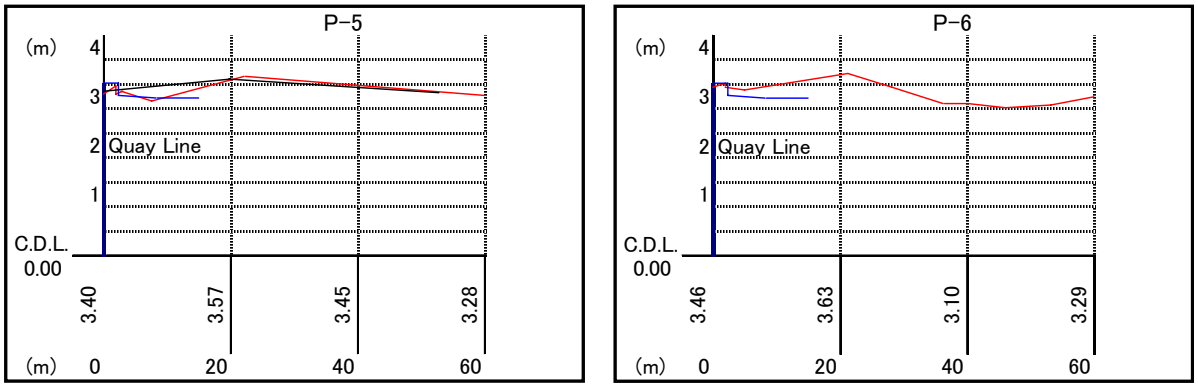


Figure 5-22 Cross Section of P-5 & P-6

According to the survey result, wharf front is depressed than original design since the coping concrete is lost here and there. Red and black lines in the above are elevated than planned height except wharf front. It is considered that wharf became uneven due to possible heavy cargo transportation like container and granite.

Port of Namibe was constructed with the reclamation of foreshore by leveling sand stone terrace behind the port. There is about 40m difference of height between top of cliff and port area. Therefore, they say that concrete fence sometime is broken by landslide when it is heavy rain.

ii) Bathymetry

Map of Namibe area (updated in 1980) issued by Institute of Geodetic and Cartography of Angola is shown in Figure 5-23. The present depth of the bay is 100m to 500m from the Bero river mouth to offshore. Submarine topography is very similar to land topography. Variation of bathymetry is supposed to be affected by rain since 200 m isobathic line moved to land side as compared with bathymetric map made by the Port of Namibe in 1996. Ships are not able to approach from west side since there is Amelia rock located at about 3 km west from Point of Noronha.

As the result of survey of water depth, average depth from north end to 460 m point is 9.3 m with the range between 8.5 m and 10m. Average depth from 460m point to 580 m point is 6.2 m with the range between 5.8 m and 6.8 m. Average depth from 580 m point to 660 m point is 4.3 m with the range between 3.7 m and 5.5 m. These results nearly met with the results of survey made in March, 1996 by Port of Namibe. Thus, depth in front of quay wall has not been changed for 9 years.

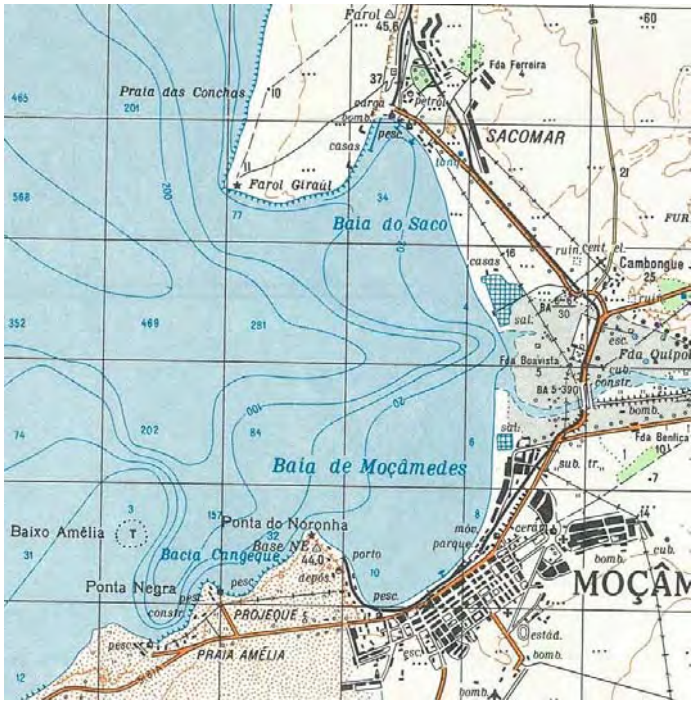


Figure 5-23 Bathymetry at Namibe bay (Institute of Geodetic and Cartography in Angola)

4) Soil Conditions

Geological condition of Namibe area consists of recent coastal terrace and beach deposits comprising of sand, silt, clay and minor gravel. This was confirmed during the logging of the samples retrieved from the three boreholes, which consisted predominantly of fine grained sand and occasional layers of very soft to soft rock sandstone and marl. Thin layers of fine grained black sand were encountered in all three boreholes. This could be the result of pollution in the water or could be decomposed organic material. Very soft sand layers were encountered above 5 meters in all three boreholes. Composition of cliff behind the Port of Namibe is sandstone and sand. Soil investigation survey is carried out at Port of Namibe during from 31st May to 10th July. A summary of the results of the logging is given in Table 5-27. Figure 5-24 shows location of boreholes. Figure 5-25 to Figure 5-27 show boring logs.

Table 5-27 Summary of the Results of the Logging

BH No.	Location	Remarks
N1	Center	High SPT values and refusal occurred on marl and sandstone
N2	North	High SPT values and refusal occurred on marl and sandstone
N3	South	High SPT values and refusal occurred on marl and sandstone

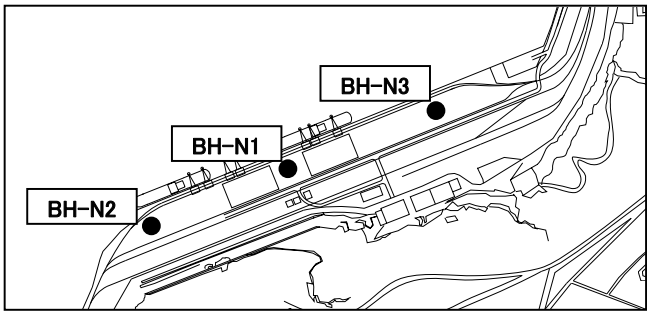


Figure 5-24 Location of Boreholes at Port of Namibe

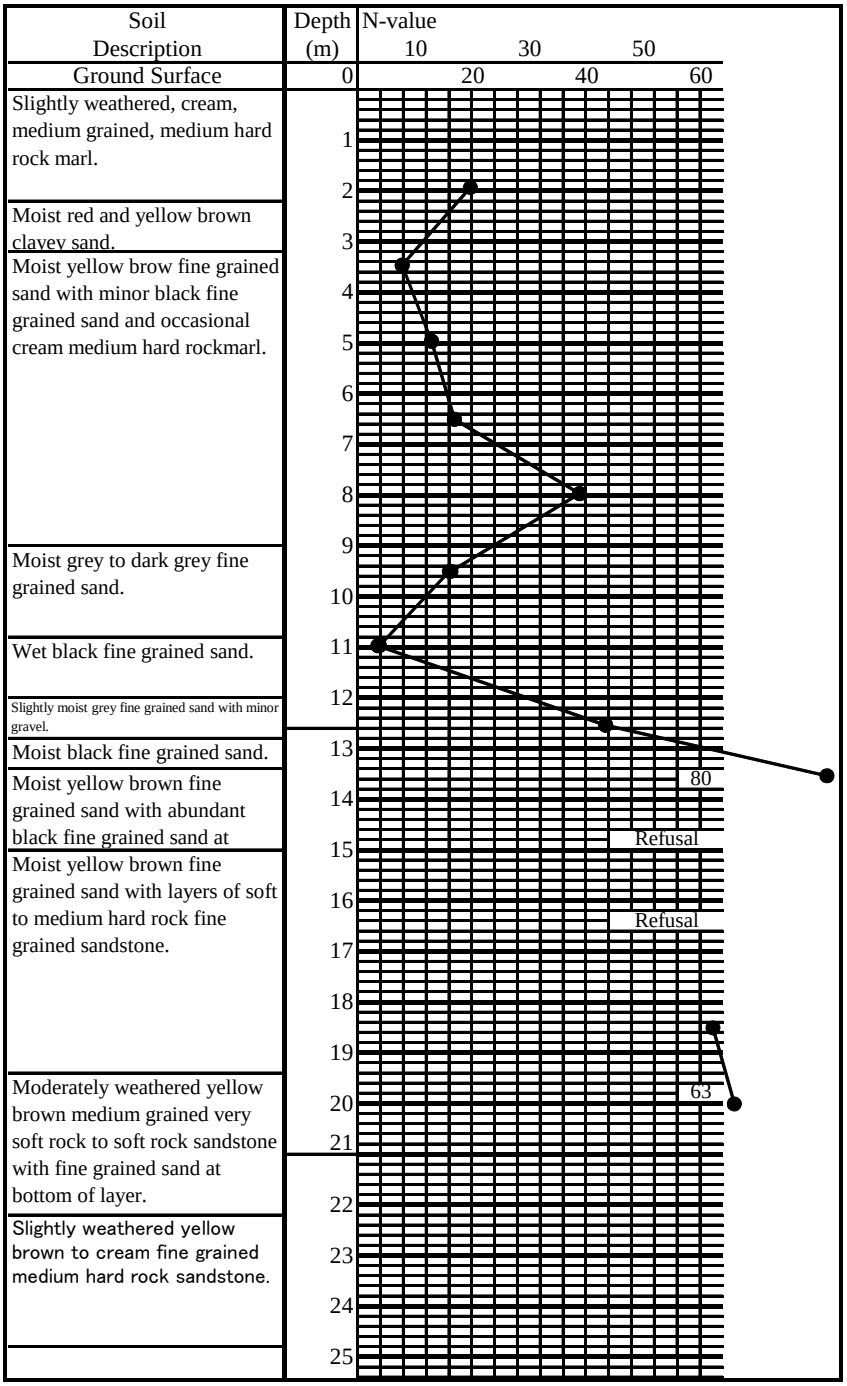


Figure 5-25 Boring Log of BH-N1

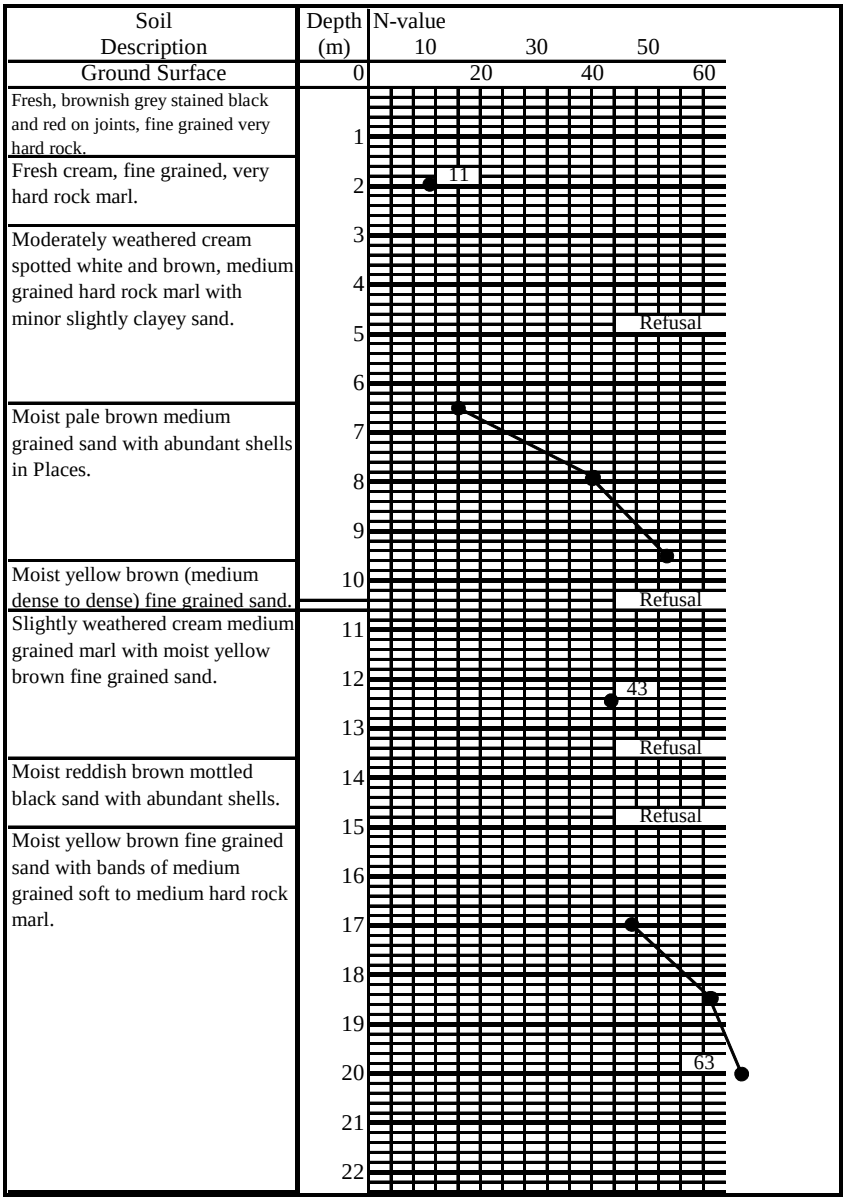


Figure 5-26 Boring Log of BH-N2

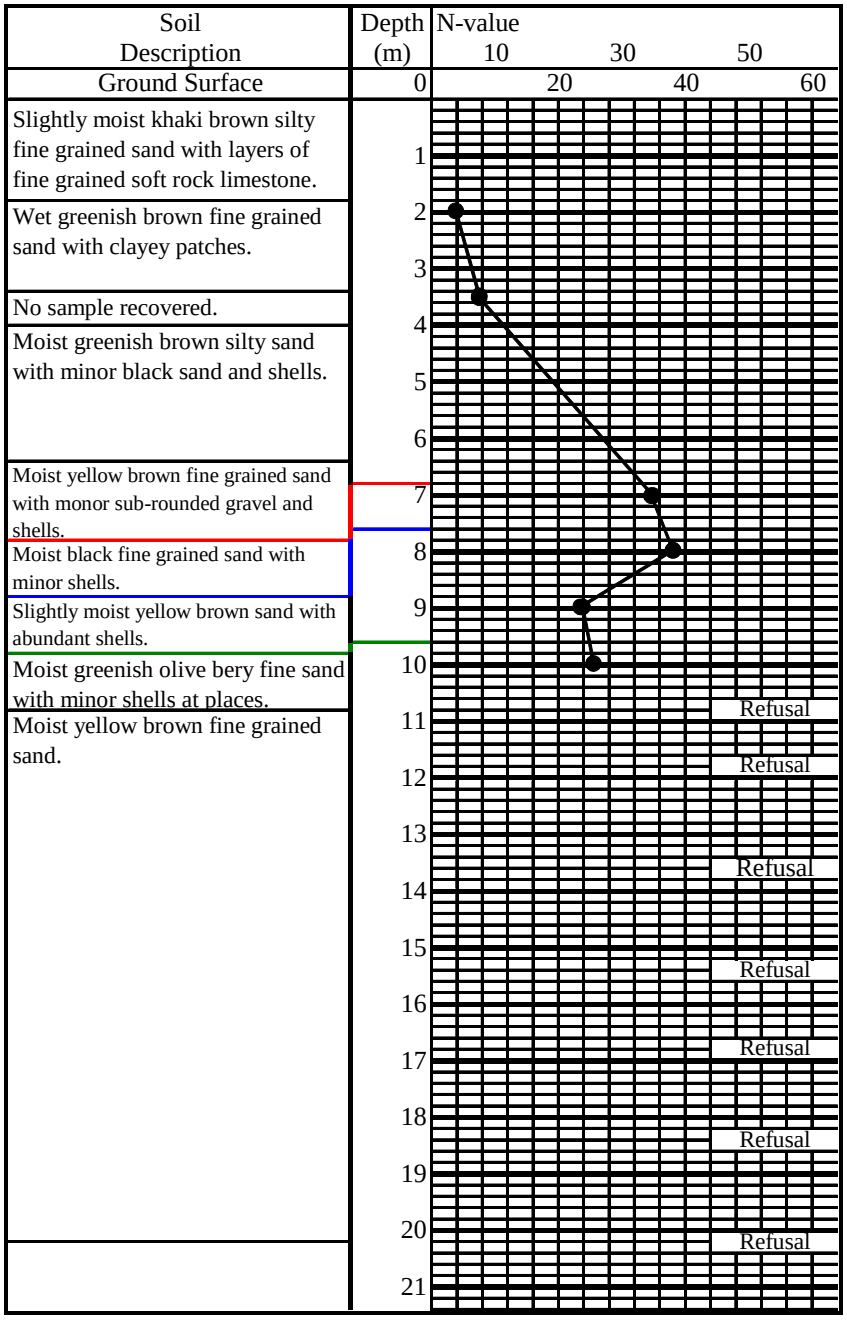


Figure 5-27 Boring Log of BH-N3

5.3.3 Port Facilities

According to the "Directório Mar e Portos 2004" and "Breve Informação (prepared by the port of Namibe), the Port of Namibe has the following aspects;

Latitude: 15^{o} 11' S – Longitude: 12^{o} 08' E – Time Zone: GMT +1h

Approach Channel: The bay is easily accessed, particularly from the northern calls; from the southern calls attention must be paid to "Banco Amélia", a sand bank which is not indicated by buoy. Minimum depth in approach channel is 10.5 meters. There are no inner or outer bars in the harbor area. Depth of approach channel is over 18 meters. Vessels may enter or leave at any time of the year, day or night.

Berths: The port of Namibe has three types of quay: 480 meters in length with 10.5 meters in depth, 130 meters in length with 6.1 meters in depth and 70 meters in length with 3 meters in depth.

Storage: There are two warehouses with an area of approximately 3,000m2 each. There are two cold storages, one is privately owned and the other is state-owned. All warehouses are in a poor state of repair and cargo is stored at the owner's own risk.

Cranes: There are 7 various electric cranes with lifting capacity of between 3 and 22 tons. The port of Namibe also has diesel locomotives, forklifts and trucks.

Quay Equipment: In the southern part of the quay, there is a yard of 100 meters in length equipped with three small bollards, three electrical switches and a switchboard. The other part of the quay is 575 meters in length, and is equipped with 21 bollards, 9 water taps and 23 electrical switches for quay cranes. Alongside the quay which stretches 875 meters in length, there is a concrete service duct on which there are 12 manholes.

Ore and Bulk Cargo Facilities: The port of Saco Mar, located 10 km from the general cargo port, started its operation in 1967. The port was used to export iron ore. It was operated for 8 years and the exported iron ore reached a maximum of 6.2 million tons in 1973. The port of Saco Mar has the following facilities: a quay of 525 meters in length (325 meters for iron ore and 200 meters for oil) with 19 meters in depth allowing up to 200,000 DWT vessels, a railway terminal, two areas for stock yard with an area of 35,000 m^2 each, allowing 1,500,000 m^3 of ore to be stored, loading equipment with a capacity of up to 5,000 tons per hour.

The findings obtained in the course of the survey are described below.

1) Navigational Aids

The port of Namibe has three lighthouses and no floating buoy. "Farol Giraul" lighthouse located on the portside hill of the port entrance is out of service due to severe deterioration. The port of Namibe is planning to demolish it and construct a new lighthouse. The other two lighthouses located on the starboard side of the port entrance were confirmed to be effective during night-time observation.

2) Berthing Basin

As for the berthing basin, the water depth was measured by use of a portable echo sounding machine and recorded at -9.5 to -10.0 meters.

3) Quay Wall

The quay wall survey was conducted from the sea side by use of a small craft and managed by the location No. of the mooring bollards. The northernmost mooring bollard on the quay was numbered as No.1, and then the south end mooring bollard was No.35. According to the site measurement, the quay measures 694.65m in total length.

Some damage and chipping failure were observed in the coping concrete throughout the length of the quay. Damage of concrete cover for the utility valves was found in many places in the quay. There are two concrete steps on the quay wall, but both of them did not have hand rail and were deteriorated.

As for the underwater part of concrete block, the joint between blocks was checked by visual survey throughout the length of the quay. Markedly wide joint was not found during the survey. Some large cracks and section loss were observed in places. One of the main reasons for this damage is considered to be explosions which reportedly occurred during the civil war.

The beating test of concrete was also conducted for the quay wall above water level. The sound heard during the survey was good and indicated that the concrete was well compacted.

Twenty-three power sockets for quay crane and 10 water supply bulbs for vessels are

installed on the coping concrete. While some parts of the power sockets are operational, no water supply bulb is workable. Rehabilitation works for the water distribution facility are planned.

4) Yard and Apron Pavement

Most stacked containers were 20 feet containers, though some were 40 feet. Electricity supply point for reefer containers were not found in the yard. Containers were found to be located even on the railway.

As for the apron pavement, large unevenness and stripping were observed in many places. While the pavement seemed to be inclining and sagging uniformly throughout the length of the quay, local settlement was not observed. The maximum settlement was recorded as 20 cm.

Granite stones were being stowed for export at the north part of the quay. They were temporarily placed on the apron in a bad manner, that is, they were placed on a few timber sleepers put underneath. Because of the insufficient number of the sleepers, the apron pavement has to carry too much concentrated load. That is deemed to be one of the main reasons for unevenness of the apron pavement at the north part of the quay.

The yard behind the north end of the quay was used as a stacking yard for scrap of demolished cranes etc. The scrap was being cut to the proper size for selling off. The yard will be fairly organized if the process of clearing the scrap progresses favorably (see Photo 5-19).

Stacked scrap

Cutting scrap

Photo 5-19 Scrap Stacking Yard

5) Railway

Ten railway tracks placed in the 1960's were found on the port premises. Unevenness and distortion were observed in many places on the railways. The point with large horizontal distortion was deemed to be virtually out of service. Some timber sleepers for the granite stone were placed on the railway at the north side of the quay. That is considered to be one of the main reasons for deformation of the railway.

As for the railway located behind the warehouses, some repair traces of filling with crushed stones ballast were found in place. In addition, a switch was observed behind the warehouses, but it was unclear if it was functional. As for the sleepers, some steel sleepers were observed besides timber ones. At the north side of the quay, the railway was partially demolished allowing forklifts to pass easily. As for the railways in the landside yard, no railway is in service except for the one located near the granite stock yard.

6) Berthing and Mooring Facility

Eleven of the 35 mooring bollards were found missing. The place where the mooring bollard had been pulled out with its base concrete was installed a new bollard with its new base concrete nearby. The port of Namibe does not have appropriate rubber fenders on its quay. Used truck tires hanging from the coping concrete were substituted.

7) Warehouse

The south warehouse was disabled due to severe damage. The roof of the south warehouse was found to have collapsed. As for the north warehouse, some broken window glass and cracks on the wall were observed. In addition, because of the deterioration of the original column, additional column is installed to support the roof.

8) Cargo Handling Equipment

The port of Namibe has 7 quay cranes. All of them are degraded, and three of them are out of service. Because of the insufficient load capacity of quay cranes, container handling is exclusively conducted by ship's gear. Granite stone handling is also done by ship's gear. The quay cranes are only available for discharge of bagged or palletized cargo and loading of empty containers.

Unevenness and distortion were found in many places in crane rails. At the south part of the quay, some part of crane rail seems to have been removed. Other cargo handling equipment such as reach stacker and forklifts, etc. were kept at the yard behind warehouses, and were exposed to the weather. Every machine was operating with some troubles such as engine failure, brake trouble and electrical system defect.

9) Iron Ore Export Jetty (Saco Mar)

The port of Saco Mar is now used for import of oil which is used in the southern three provinces of Angola. Since the facility for exporting iron ore ceased operation in early 1980's, all equipment was found terribly degraded. The upper part of the jetty was surveyed by walking around and the lower part by use of a small craft.

The structure of the jetty was found to be a concrete slab supported by concrete filled steel piles. There were both vertical and battered piles. Piles were heavily corroded at inter tidal zone. Beating test on the steel pile was conducted, and the sound heard during the survey was good and indicated that the concrete inside the pile was generally filled well. As for the top surface of the jetty concrete slab, some cracks and chipping were found in places. The concrete curb had been scraped by mooring ropes and many mooring cleats were deteriorated.

The bottom surface of the jetty concrete deck slab was investigated by use of a small craft. While no cracks were found on the bottom surface seaward from the iron ore ship loader, some cracks with oozing efflorescence were observed in places of the bottom surface landward from the iron ore ship loader. However, considering the elapsed years since the jetty was constructed, the deterioration of the concrete seems to be in a less advanced stage. This is because the structure of the jetty is less subject to chloride attack, that is, the bottom surface of the deck slab is located 8 meters above the water level, and therefore it is difficult for seawater and salty air to penetrate into the concrete. Concrete cover of the deck slab was recorded as 60 up to 70 mm by use of nondestructive test equipment.

As for the side surface of the deck slab, some spalling of cover concrete and exposure of reinforcing bars were observed in places. In addition, the concrete steps stretched from the deck slab were found to be terribly deteriorated. Compressive strength of the concrete was recorded at more than 30 N/mm2 by use of nondestructive test equipment, "Schmitt Hammer".

As for the berthing facility, the port of Saco Mar has a very unique system comprised of a cylindrical rubber fender, timber beam shock absorber and plumb bob-shaped concrete beam. However, no berthing facility remains in its original design any more: a cylindrical fender has been replaced by truck tire, timber beam has become eroded and neither a cylindrical fender nor timber beam is installed. In addition, deterioration of the concrete due to chloride attack and corrosion of lifting chain were observed. Some potion of the plumb bob-shaped concrete beam was found to have dropped because the lifting chain broke due to the corrosion.

At a section of the access road, soil loss due to erosion was observed. Sagging was observed at the connection point between the iron ore jetty and oil jetty. There is a ship mooring and/or breasting dolphin at the tip of the jetty which is no longer in use. Spalling of cover concrete and exposure of reinforcing bars were found in many places of the side wall. The port of Namibe wants to remove this dolphin.

As for the rails for iron ore ship loader, some part of the rail seems to have been removed and bent intentionally. Along with the rails for iron ore ship loader, unnatural curve was observed in the railway. In addition, equipment such as ship loader, belt conveyor and control tower, was found disabled due to terrible deterioration.

10) Others

Since the port of Namibe was reportedly constructed by cutting the cliff and filling, there is a steep cliff close behind the port. Because the cliff consists of brittle sandstone and sandy soil, stone falls occur very frequently and threaten the safety of the port facility (see Photo 5-20).

Almost all ladders and mooring rings for small crafts fixed on the quay wall were found to be severely deteriorated or missing. At the iron ore stacking yard, there are abandoned railway wagons, bucket wheel excavators and belt conveyor system. All equipment was terribly degraded and disabled.

Cliff behind the port

Falling rocks

Photo 5-20 resent Status of the Cliff behind the Port of Namibe

5.3.4 Volume of Traffic

Total cargo volume and container volume trends at Luanda port are shown in Table 5-28 and Table 5-29. Since 2000, containers have been increasing at a fast pace. The proportion of container cargo to total cargo in Namibe port is nearly 20-30%. This rather low ratio is due to the Import of principle commodities such as rice and wheat and exported granite stone as bulk cargo. In 2004, the ratio of imported bulk food to total cargo is 42%, and more than 100,000 tons of food was imported to southern part of Angola through the Namibe Port. In addition, some of containers were used for food import. There is no cement factories in southern Angola so all cement used in southern Angola are imported through Namibe port. In a few years, the rehabilitation of Angola will be

accelerated and the volume of imported construction materials like cement or steel bar will increase rapidly. In 2005, the number of the company handling granite increased from 2 to 5 and they would plan to increase their export. Namibe port supports people's life, rehabilitation of the infrastructure and promotes local industry like Lobito port. The ratio of 40ft and 20ft container is shown in Table 5-30.

The usage data of Berth 3 from August to December 2004 is shown in Table 5-31. 40 ships used berth 3 and average length of berthing is 5.2 days. 15 ships did not use the berth 3 on the arrival day and totally waited for 32 days. According to those ships' length, two or three ships can use berth 3 at a time. If the berth 3 can be used by 3 ships at a time, berth occupancy rate is 45.1% during that period. The highest rate in one month is 63.4% and three of five months are over 50%. In November and December, some ships waited their turns of the berthing for more than one day.

Table 5-28 Cargo Throughput of Namibe Port

Years	Unloaded									Loaded					Annual Increase
	Rice	Sugar	Beans	Flour	Corn	Cargo Container	Vehicles	Cement	Others	Cargo Container	Dry fish frozen	Granite Blocks	Others	Total tons	
1997	5,050	3,264	1,700	7,509	8,984	20,747	333	1.548	10,963	722	756	2,437	3,226	67,239	
1998	2,597	7,931	680	6,246	11,894	23,427	275	1,493	4,964	3,303	310	5,586	2,242	70,948	5.5%
1999	528	5,825	496	4,852	14,262	22,911	268	1,164	7,100	1,744	406	10,334	12,595	82,485	16.3%
2000	6,911	9,490	1,756	11,717	19,705	18,052	477	6,203	6,708	4,508	780	33,664	30,349	150,320	82.2%
2001	613	8,972	1,756	10,651	13,262	30,271	788	11,724	6,887	21,003	1,766	29,767	13,963	151,423	0.7%
2002	15,088	14,699	50	15,524	15,610	35,157	307	15,187	4,812	10,518	573	40,268	6,174	173,967	14.9%
2003	13,669	42,181		16,577	6,785	46,040	273	27,162	2,780	8,812	568	39,092	3,134	207,073	19.0%
2004	29,723	37,216		31,826	11,081	54,206	321	11,672	9,761	9,952	64	64,359	884	261,065	26.1%
Total tons	74,179	129,578	6,438	104,902	101,583	250,811	3,042	74,607	53,975	60,562	5,223	225,507	72,567	1,164,520	

Table 5-29 Container Throughput of Namibe Port

Years	Unloading (unit)	Loading (unit)	Total (unit)	Annually Increase	Unloading (t)	Loading (t)	Total (t)	Annually Increase	Ratio to Total Cargo
2000	1,121	1,053	2,174		20,921	3,738	24,659		16.4%
2001	2,637	1,671	4,308	98.2%	30,925	11,669	42,594	72.7%	28.1%
2002	2,673	1,811	4,484	4.1%	34,021	5,862	39,883	-6.4%	22.9%
2003	2,344	1,929	4,273	-4.7%	43,400	8,373	51,773	29.8%	25.0%
2004	2,760	2,398	5,158	20.7%	50,479	8,654	59,133	14.2%	22.7%

Table 5-30 Composition of 40ft and 20ft Container in Namibe Port

40ft	20ft	Unit	TEU	TEU/Unit
72Unit	90Unit	162	234	1.44

Surveyed on Nov.11,2005

Table 5-31 Usage of the Berth No.3 of Namibe Port in 2004

Month	Number of Calling Ships	Number of Waiting Ships	Total days of Waiting for berth	Total days of Berthing	Average use of Berth (Day)	Berth Occupancy Ratio 2Berths	Berth Occupancy Ratio 3Berths
Aug.	6	2	2	18	3.0	29.0%	19.4%
Sep.	9	4	4	46	5.1	76.7%	51.1%
Oct.	12	3	3	36	3.0	58.1%	38.7%
Nov.	5	2	8	48	9.6	80.0%	53.3%
Dec.	8	4	15	59	7.4	95.2%	63.4%
Aug. -Dec.	40	15	32	207	5.2	67.6%	45.1%

5.3.5 Cargo Handling and Security Issues

The port of Namibe handles 5,000TEUs of containers and 200,000 tons of general cargo per year. Cargo handling at the port of Namibe has the following characteristics:

1) Cargo handling at quay side

Cargo handling operation in Namibe Port is similar to that at the port of Lobito. However, ship waiting is sometimes observed in Namibe Port, since the cargo handling is slow. The quay cranes do not have enough power to lift heavy cargo, and thus ship's gear is mostly used for loading and unloading of heavy material such as containers and granite stones. The ships have heavy-duty cranes that are capable of lifting up to 35~40 tons cargo. Quay cranes are capable of handling empty containers, but they are scarcely used because they are not movable to and fro.

Handling of an empty container with a quay crane(Quay No.2)


Cargo handling with a ship gear(Quay No.2)

2) Cargo handling at the container yard

Similar to the Lobito Port, the reach stackers are mostly used for the container handling in Namibe Port. However, the number of reach stackers is very limited. The stack height of the loaded

containers is three high. The reach stacker can move forward holding a container laterally or 45 degrees tangentially. Since the movement of a reach stacker needs space, the number of containers which can be stored in the container yard is less than the case of transfer crane.

The yard space is becoming tight because the containers are increasing rapidly. However there is a lot of unused space in the port area. The pavement is excessively deteriorated. This results in inefficient container handling and damage to the machines in the form of flat tires, bursts, torsion of frames, bending of the wheel axes, etc. All the documentation is carried out manually by pen and paper. Electrical documentation is not seen in the yard. This is not only time-consuming but also errors involving container location often occur.

Warehouse No.2 is closed because it has no roof and the structure is in a dangerous condition. Warehouse No.1 is partly used for office space and partly for storage. But the space between the quay and the warehouse is only 15m. This leads to inefficient cargo handling as the trucks do not have sufficient room to maneuver. The port authority faces a difficulty in repairing cargo handling equipment and warehouse, despite their poor condition.

Landside cargo handling with a forklift(Quay No.1)

Reach Stacker

Top lifter in poor condition

Warehouse-No.1

Warehouse-No.2

Cargo handling equipment and warehouses of the port of Namibe is shown in the following table.

Table 5-32 Cargo handling equipment of the port of Namibe

Type of Facility	Numbers	Capacity
Quay Crane	7*	1.5t～10t
Reach Stacker	1	40t～45t
Top lifter	2	40t
Forklift	6	2.5t～40t

* of which three were broken

Table 5-33 Warehouses of the Port of Namibe

Type of Facility	Number	Capacity
Warehouses	2	Floor 7,200 m^2

3) Security Issues

Security issues in the port of Namibe are almost the same as at the port of Lobito. In accordance with the new ISPS Code (International Ship and Port Facility Security Code) which became effective in July 2004, the ports in Angola drafted security and took necessary measures to comply with the Code. The walls and fences surrounding the port were improved. The information system, firefighting system, electrical system and cranes were also implemented or repaired. The port of Namibe is capable of making a quick response in the event of emergency involving combustibles. Access control is conducted to prohibit the entry of suspicious persons. The uniforms of employees are different in shape and color according to the category of the job. At the port gates, guard men inspect passports or ID.

The port is not as busy as the airport and thus can easily fulfill its security obligations. Security systems are also in place outside of the port. Therefore, the chance of a terrorist attack in Namibe is very small. The gate at the port of Namibe is in satisfactory condition as few people complain of tripping. The port plans to increase the height of the wall to 4m, and to install a metal detector and gate facility. The Table 5-34 shows the IMO registration of the Namibe Port.

Main Gate

Outer Wall

Table 5-34 The IMO registration situation of Namibe port

Port Tag	Namibe Angola	
Facility Name	Saco Mar	Commercial Port of Namibe
Port Facility Description	Liquid Gas and Oil Terminal	General Cargo and Container Terminal
Port Facility Has Alternative Arrangement	No	No
Port Facility Has Approved Port Facility Security Plan	Yes	Yes
Date Of Approval	29/06/2004	29/06/2004
Port Facility Security Plan Has Been Withdrawn	No	No

5.3.6 Summary of Findings

Through the review of present status and issues of the port of Namibe, following 8 points are summarized as findings of this study.

- Farol Giraul lighthouse is too old and does not work.

(Commercial Port)

- Berth is damaged and incomplete.
- There are cracks on the concrete blocks under water.
- Yard pavement has many cracks and uneven sections. Heavy cargoes like containers and granite are handled in Namibe port. The pavement needs to be repaired urgently to secure safety and increase efficiency.
- Railway has some unevenness and deviance and some areas are not functioning.
- Warehouse has been badly damaged and abandoned.

(Saco Mar Port)

- Pier structure is steel pile and concrete. Erosion of Steel pile is heavy in splash zone. On the other hand, concrete inside looks well packed.
- At the side of the slave of the pier, concrete is lacking and steel bars are exposed.

5.4 Port of Cabinda

5.4.1 Overview

Port of Cabinda is physical distribution base located in Cabinda Bay where is northern isolated enclave. Cabinda has about 200 thousand population. The port was constructed in 1956 and is functioned as the base facility of offshore oil which occupies most of Angolan crude oil and export terminal of lumber. The jetty of the port has been constructed using steel pile and truss and upper deck was made by wood. It was constructed in 1974 but because of no maintenance and no rehabilitation from its berth the accident has occurred during cargo handling operations in January 2004. Therefore, the jetty is now under rehabilitation. The port is too shallow because of deposit of sand and the loading and unloading works are done offshore not on the jetty. Figure 5-28 shows the layout of the Port of Cabinda and Photo 5-21 shows a panoramic view of the Port of Cabinda.

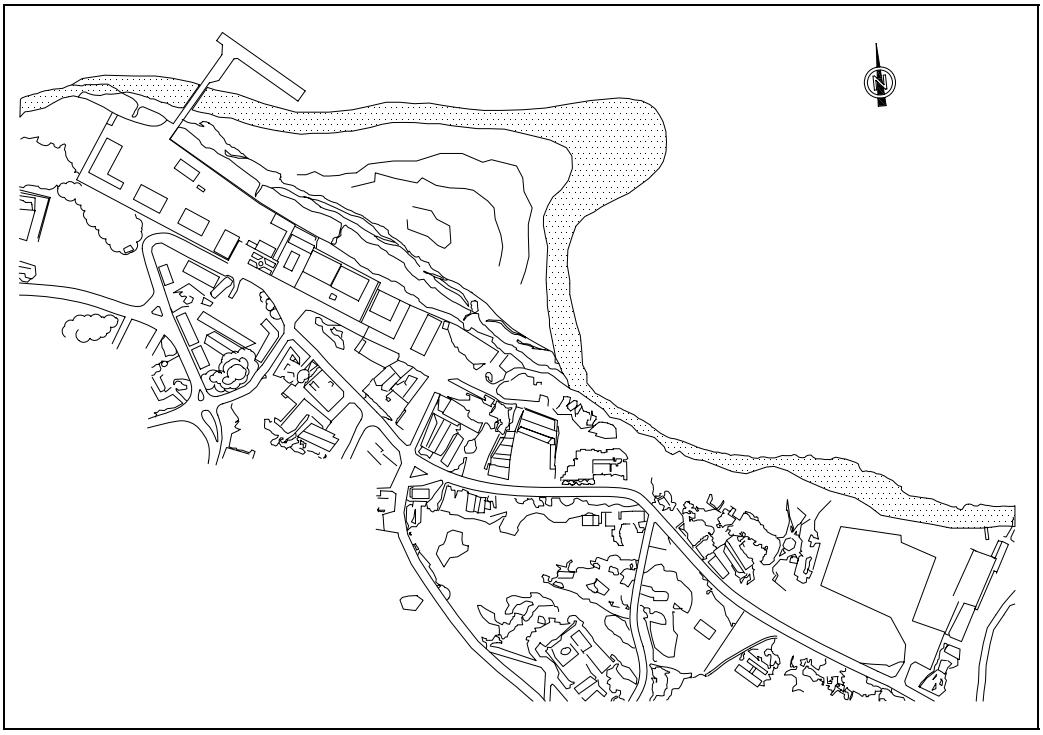


Figure 5-28 Present Layout of the Port of Cabinda

Photo 5-21 Panoramic View of Port of Cabinda (2005)

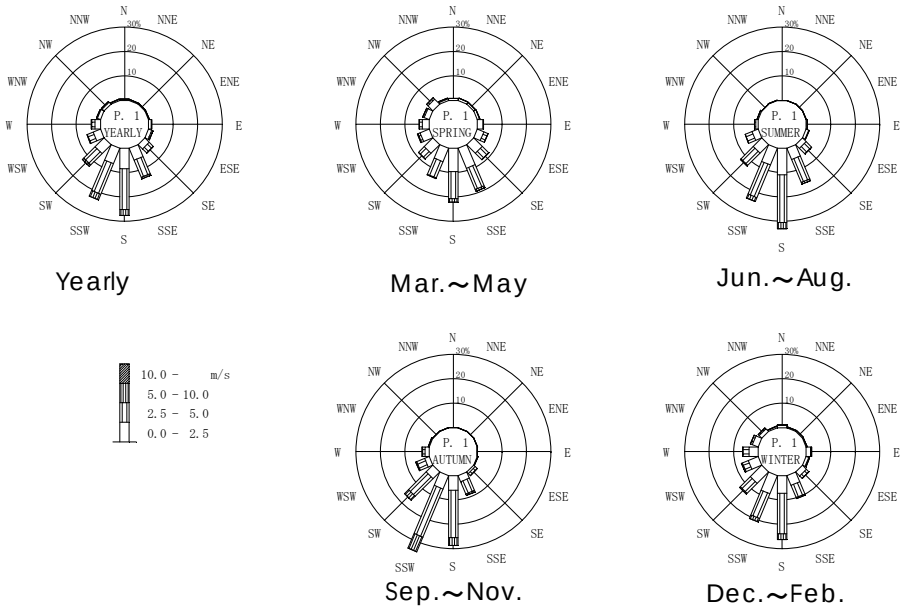
5.4.2 Natural Condition

1) Meteorological Conditions

Meteorological information such as temperature, humidity and precipitation period from 1940 to 1970 was obtained through the National Institute of Meteorology and Geophysics in Angola. Wind data was obtained through the Meteorological Agency in Japan. They have a tropical humid climate in Cabinda.

i) Wind Direction and Wind Speed

Figure 5-29 shows wind rose and wind direction. Cabinda belongs to the low latitude of southeastern trade wind zone, and annual mean wind speed is approximate from 2.5m/s～5.0m/s. Wind direction is predominantly south.



Source : Meteorological Agency in Japan (2001～2004)

Figure 5-29 Wind Rose

ii) Humidity

The mean humidity level through a year is constantly high at 80's % as shown in Table 5-35.

Table 5-35 Monthly Mean Humidity (%)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Humidity	83.0	83.0	83.0	85.0	85.0	83.0	82.0	81.0	81.0	83.0	83.0	84.0

Source : the Institute of National Meteorological and Geophysics in Angola (1940～1970)

iii) Precipitation

Table 5-36 shows the monthly precipitation in Cabinda. They have 800 mm precipitation in Cabinda where belongs to tropical rain forest climate and this is more than double comparing to Luanda and Lobito where have around 300 mm precipitation.

Table 5-36 Monthly Precipitation (mm)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rainfall	122.0	109.8	128.9	135.1	45.1	0.2	0.1	1.0	5.7	39.8	129.3	92.9

Source : the Institute of National Meteorological and Geophysics in Angola (1940～1970)

2) Hydrographic Conditions

i) Tide

Port of Cabinda dose not observe tide level, however the value of their tide table is very similar with Admiralty Tide Table which issued by The UK Hydrographic Office. Mean high and low water spring level in Port of Cabinda is the same as Port of Luanda, however time difference of mean high and low water is generated 15 minutes earlier than Port of Luanda. Tide level at Port of Namibe is shown in Figure 5-30.

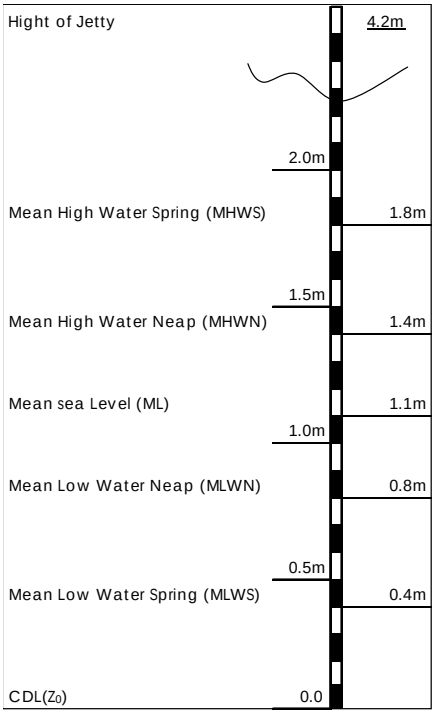


Figure 5-30 Tide Condition of Port of Cabinda

ii) Tidal Current

According to the Port of Cabinda, tidal current offshore is predominantly SSE, and speed is from 0.26 to 1 m per second. The speed of West and East tidal current is less than 0.2m/s around jetty.

iii) Ocean Waves

Wave direction is from West to West-South-West around shore line in Cabinda. Also, wave direction is from South-West to West-South-West in front of the Port of Cabinda. 60% of wave heights are less than 1 m, 30% of them are from 1 m to 1.5 m and the10% is over 1.5m. Wave height in Cabinda bay become low because of offshore shoal existence.

3) Topography and Bathymetry

i) Topography

Flat land less than 200 meters ASL stretches out in Cabinda province except north-east area. Pictures given below are Port of Cabinda in 1998 and 2005. There was a boat mooring behind the jetty in1998 (see Photo 5-22). However, the depth around here is now CDL 0.4 meters only, and no boat is able to moor behind the jetty (see Photo 5-23). Bottom of flat barge is touched to sea bed because, it is very shallow at east end of jetty.

Photo 5-22 Port of Cabinda in 1998

Photo 5-23 Port of Cabinda in May, 2005

ii) Bathymetry

Red allow indicates -2.5 meters contour line in sounding chart of 1988 as shown in Figure 5-31, also it became shallower at east end of jetty. Therefore, Port of Cabinda carried out dredging in this area. We found that it keeps in certain depth at middle part of the jetty, however sand had accumulated behind the jetty and east end of the jetty. According to the findings of sounding survey carried out together with staff of Port of Cabinda, this time, +0.5 meters contour line which is indicated by black arrow had moved 20 meters to offshore (see Figure 5-32).

It is conceivable that there is typical littoral drift around shore of Cabinda because tidal current direction is south-east and Port of Cabinda is located north of the Congo River.

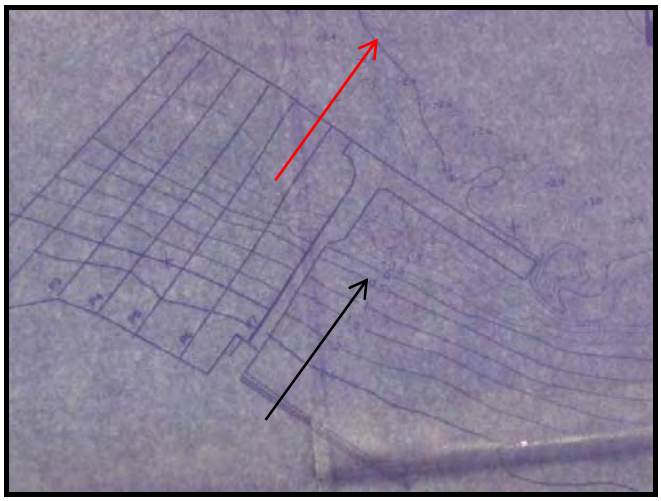


Figure 5-31 Sounding Chart at Port of Cabinda in 1998

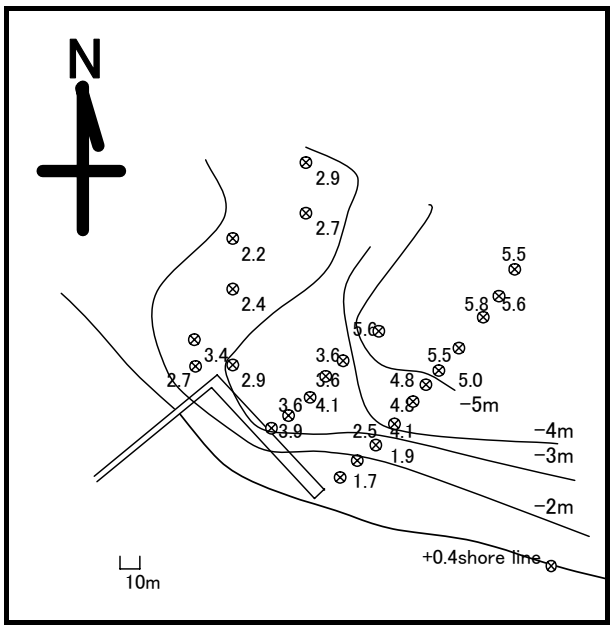


Figure 5-32 Sounding Chart at Port of Cabinda in May, 2005

4) Soil Condition

The ground soil is silt and clay at Port of Cabinda area as the results of observation. According to soil investigation survey by Port of Cabinda, there are rocks from -0.5 m to -2 m in accesses channel and jetty area. Also, clay of high plasticity is distributed in accesses channel and east side shore of Cabinda bay. There is a loose sand layer, which thickness is from o.2 to 18 m and it has been accumulated by littoral drift in Cabinda bay.

5.4.3 Port Facilities

According to the "Directório Mar e Portos 2004", the Port of Cabinda has the following aspects;

Latitude: 5^{o} 33' S – Longitude: 12^{o} 12' E – Time Zone: GMT +1h

Approach Channel: The bay of Cabinda can be entered directly from the sea, but due to the insufficient water depth, navigation is difficult. A bar extends along the coast between Massabi and Congo River at a width of 5 miles.

Anchorage Area: Ocean going vessels can only anchor at some distance from the coast. The official anchorage area is sandy seabed. The security line near the port can be found in Portuguese Maritime Charts. Depth at the official anchorage is between 9 and 10.7 meters.

Berths: The old wooden quay is 100 meters in length with only 3.4 meters in depth. It is possible to work on each side of the jetty, but the land side is restricted to light cargo handling. The port of Cabinda operates barges with capacity ranging 100 to 200 tons and some launches for towing barges.

The findings obtained in the course of the survey are described below.

1) Berthing Basin

The port of Cabinda is located at the river mouth of the Congo River. The water depth of the port becomes shallower and shallower year by year because of sedimentation. The port of Cabinda wants to conduct its maintenance dredging, however, there is no dredger in the port of Cabinda, and thus maintenance dredging work is outsourced to the foreign companies. The last maintenance dredging was conducted in 2003.

The water depth of berthing basin was measured by use of a portable echo sounding machine and recorded at -3.8 meters. Vessels can not come to the land side berth at low tide due to the insufficient water depth. In addition, a sand bank which has reportedly been formed in the past few years is located near the jetty. The port of Cabinda introduced dredging equipment for its maintenance dredging around the jetty.

2) Jetty

The repair works of the jetty are being conducted by the Dutch company Damen Shipyards funded by the National Ship owners Council.

The structure of the jetty was found to be a wooden deck slab placed on the timber beams supported by steel beams and piles. As for the main steel members, some rust was observed in places but neither holes nor concentrate corrosion was found, and the repainting works seemed to have been conducted sequentially. After the rehabilitation work for the wooden deck was completed, dredging works at landside of the jetty and installation works of rubber fenders were being conducted.

3) Yard

The yard was found to be unpaved and uneven. A maintenance shop is located in the yard. According to the port of Cabinda, 7,000m^2 out of 9,000m^2 of unpaved yard will be paved by May 2006.

4) Berthing and Mooring Facility

Rehabilitation works for the fendering system were completed. Timber beams which come into contact with the vessel's hull were replaced by large rubber tires. In addition, deteriorated steel piles driven at the landside of the jetty were repaired. Mooring bitts are welded on the steel deck beam. The condition of paint was found to be good. The capacity of the mooring bollard is 35 t. There are 35 mooring bollards on the jetty.

5) Cargo Handling Equipment

The crane rails left on the wooden deck indicate that formerly a quay crane or some kind of cargo handling equipment was operated. Today, a mobile crane with a load capacity of 65 tons is used for the cargo handling. Although no protection measure was applied to the base of the outrigger, some measure to transmit the reaction force of the outrigger to the steel beams was found. The port of Cabinda introduced latest models of top lifter and tractor recently. The rotative driver seat of the tractor contributes to the safe running and turnaround on the narrow jetty

6) Others

There is a large building for the passengers of the ferry between Cabinda and Soyo and for the people who are working at the offshore oil-drilling platform.

7) Cacongo Jetty

Surveys of the present conditions of the Cacongo jetty, which is located in the northern area of Cabinda Province, are being conducted by two companies. One is the company which has formulated the development plan with a target year of 2010, the other is Damen Shipyards which is conducting the rehabilitation work in the port of Cabinda. Based on the survey results, the port of Cabinda will determine whether the Cacongo jetty is rehabilitated or reconstructed.

The wave height observed during the survey was not so high, but the wave period was rather long. At the access to the jetty, concrete blocks for shore protection were found to be scattered

and soil loss below the access road due to erosion was also observed. The structure of the jetty is approximately the same as the jetty of the port of Cabinda. The width of the jetty is narrow at landside, and is wide at seaside. Some concrete filled steel piles were found beside the land side of the jetty.

Because many years have past since the jetty was in use, wooden deck, timber beam and steel members were terribly deteriorated. Some wooden deck was found to have collapsed in places. The crane rails left on the wooden deck indicate that formerly a quay crane or some kind of cargo handling equipment was operated.

5.4.4 Volume of Traffic

Total volume and container volume trends at Cabinda port are shown in Table 5-37 and Table 5-38. Cargo has been increasing since 2000.

Table 5-37 Cargo Volume of Cabinda Port

Year	Volume (ton	Annual Increase (%)
2000	29,500	
2001	37,900	28.5%
2002	40,400	6.6%
2003	50,100	24.0%
2004	81,600	62.9%

Table 5-38 Container volume of Cabinda Port (2004)

(ton)

Year	Unloaded			Loaded			G. total
	Domestic	International	Total	Domestic	International	Total	
2004	15,900	37,600	53,500	2,800	25,300	28,100	81,600

5.4.5 Cargo Handling and Security Issues

The port of Cabinda handles 2,500TEUs of containers. Cargo handling of the port of Cabinda has the following characteristics:

1) Cargo handling at quay side

The quay has a very shallow draft (-3.5m), necessitating the transshipment of containers to barge 10 km offshore where handling works are exposed to long swell waves. The cargo handling operation is thus dangerous. The barge with the containers is towed to the quay. Containers are unloaded by mobile crane.

Cargo handling by Mobile Crane

2) Cargo handling at the container yard

Similar to Namibe Port, reach stackers are mostly used for the container handling. However, the number of reach stackers is very limited. The stack height of the loaded containers is three high. The reach stacker can move forward holding a container laterally or 45 degrees tangentially. The yard space is very limited. However the port plans to expand the container yard. The pavement is in poor condition. Wheels sink in the mud, machines break down and operation is occasionally interrupted.

All the documentation is carried out manually by pen and paper. Electrical documentation is not seen in the yard. However, this has not had a large impact yet because the volume of containers is not large. A chassis and top lifter have been introduced recently.

Transport by chassis

Congestion in the yard

Top lifter

Chassis and Head

Cargo handling equipment of the port of Cabinda is shown in Table 5-39. All warehouses are used for office and waiting room. The number of warehouse of the port of Cabinda is shown in Table 5-40.

Table 5-39 Cargo Handling Equipment of the Port of Cabinda

Type of Facility	Number	Capacity
Mobile Crane	4	25t～65t
Reach Stacker	1	40t～45t
Top lifter	2	40t
Forklift	5	2.5t～5t

Table 5-40 Warehouse of the port of Cabinda

Type of Facility	Number	Capacity
Warehouses	4	

3) Security Issues

Security issues in the port of Cabinda are almost the same as the port of Namibe: In accordance with the new ISPS Code (International Ship and Port Facility Security Code) which became effective in July 2004, the ports in Angola drafted security and took necessary measures to comply with the Code. The walls and fences surrounding the port were improved. The information system, firefighting system, electrical system and cranes were also implemented or repaired. The port of Cabinda is capable of making a quick response in the event of emergency involving combustibles. Access control is conducted to prohibit the entry of suspicious persons. The uniforms of employees are different in shape and color according to the category of the job. At the port gates, guard men inspect passports or ID. The IMO registration situation of the port of Cabinda is shown in Table 5-41.


Main Gate


Gate of pier


Gate for vehicles

Table 5-41 The IMO registration situation of the port of Cabinda

Port Tag	Cabinda Angola
Facility Name	Commercial Port of Cabinda
Port Facility Description	General Largo Jetty
Port Facility Has Alternative Arrangement	No
Port Facility Has Approved Port Facility Security Plan	Yes
Date Of Approval	29/06/2004
Port Facility Security Plan Has Been Withdrawn	No

5.4.6 Summary of Findings

Through the review of present status and issues of the port of Cabinda, following 5 points are summarized as findings of this study.

- Center part of mooring basin has enough depth. But due to the sand settlement around the east end and land side of the pier, ships cannot be laid up there at low tide.
- Because of shallow water, cargo is loaded onto barge 12km offshore. Loading / unloading work offshore is very dangerous and not effective.
- Wooden deck, wooden pier and steel pier of Cacongo pier are heavily damaged.
- Due to the narrow and unpaved yard, cargo handling work is not effective and machines are often broken down.

5.5 Port of Soyo

5.5.1 Overview

Port of Soyo is located on the south bank of the Congo River, close to its mouth. Soyo Port authority was established in 1980. Soyo belongs to Zaire province and is 400km from Luanda. Soyo port is a main port of northern Angola and the gateway to Cabinda province, Angolan enclave. Panoramic view of Soyo port is shown in Photo 5-24. The bottom of photo is the Congo River and top of it is the Atlantic Ocean.

According to the Soyo Port Authority, tidal change at Soyo port is about 1.5m. Huge volume of earth and sand flowing from Congo River creates problems for the Soyo Port Authority.

Through the review of present status and issues of the port of Soyo, following 2 points are summarized as findings of this study. Due to the settlement of sand from the Congo River, maintenance dredging is needed continuously. Due to lack of loading equipment like quay crane, shippers cannot use public berth when they want.

Photo 5-24 The Port of Soyo (in red circle)

5.5.2 Port Facilities

In 1980, when the port authority was established, there were no facilities in the port. When the Kwanda oil company constructed their private facilities, they constructed berth and provided it to the port authority. The length of the berth is 200 m and its depth is 6.5 m. There is an old jetty on the Congo River. There is no superstructure, so it is not in use. Due to the earth and sand flowing from the Congo River, continual dredging is required to keep the depth of waterways and mooring basin. (see Photo 5-25, Photo 5-26 and Photo 5-27).

Photo 5-25 Public Berth (left) and Kwanda's Berth

Photo 5-26 Berth

Photo 5-27 Yard

5.5.3 Volume of Traffic

Number of ships calling Soyo port is shown in Table 5-42. Cargo volume and container volume are shown in Table 5-43 and Table 5-44. In 2004, 2,279ships, including 81 international ships called Soyo port. Only three of the international ships used the public berth owned by Soyo Port Authority and the other 78 ships used Kwanda's private berth. Total volume of cargo reached 1.4 million tons. As only 19 thousand tons of cargo were handled in 2002, cargo volume increase more than seventy times in last two years. Most of the cargo is international cargo. The largest ship size is 1,300 gross tons. Dominant commodities are equipment and material for oil exploration coming from the US and EU. There is a ferry service connecting with Cabinda three times a week, using ferryboat which can carry four or six cars at a time. There are no ships calling from the Congo River. Boma and Matadi, river ports on the Congo River, in DRC connect ocean transport with inland-water transport using the Congo River.

Table 5-42 Number of Ships

Number of Ships	2002	2003	2004	'04/'03
International	29	72	81	12.5%
Domestic	69	55	25	-54.5%
Tugboat	382	922	2,173	135.7%
Total	480	1,049	2,279	117.3%

Table 5-43 Volume of Cargo (t)

Year	Unloading			Loading			Total
	International	Domestic	Total	International	Domestic	Total	
2002	14,378	2,421	16,799	1,564	836	2,400	19,199
2003	77,157	9,625	86,782	657	314	971	87,753
2004	1,181,408	226,406	1,407,814	15,495	1,607	17,102	1,424,916

Table 5-44 Container Throughput

Year	Unit			Tons		
	Unloading	Loading	Total	Unloading	Loading	Total
2002	203	78	281	2,000	231	2,231
2003	342	54	396	5,025	352	5,377
2004	683	77	760	9,845	230	10,075

6. Deterioration Assessment of the Port Facilities

6.1 General

The present status of the port facilities was surveyed during the first visit to Angola in order to grasp the physical deterioration degree and cause of the degradation which are necessary for formulating the port rehabilitation plan. Checked facilities were classified into three categories depending on their deterioration level. Facilities, which had been classified as "Deterioration Degree 1", were the focus of the detailed survey during the second visit to Angola in order to judge the necessity of their rehabilitation.

In the course of the second visit to Angola, the port facilities which had been assessed as having "Deterioration Degree 1" and had not been investigated sufficiently during the first visit to Angola were the focus of the detailed visual inspection. Focusing on the necessity of their rehabilitation, the deterioration degrees of the target port facilities, which serve as a basis for formulating the port rehabilitation plan, were assessed. The final results of the deterioration assessment are to be divided into two categories, namely, "rehabilitation is necessary" and "rehabilitation is unnecessary". Figure 6-1 shows the flow chart from checking facility to formulation of rehabilitation plan.

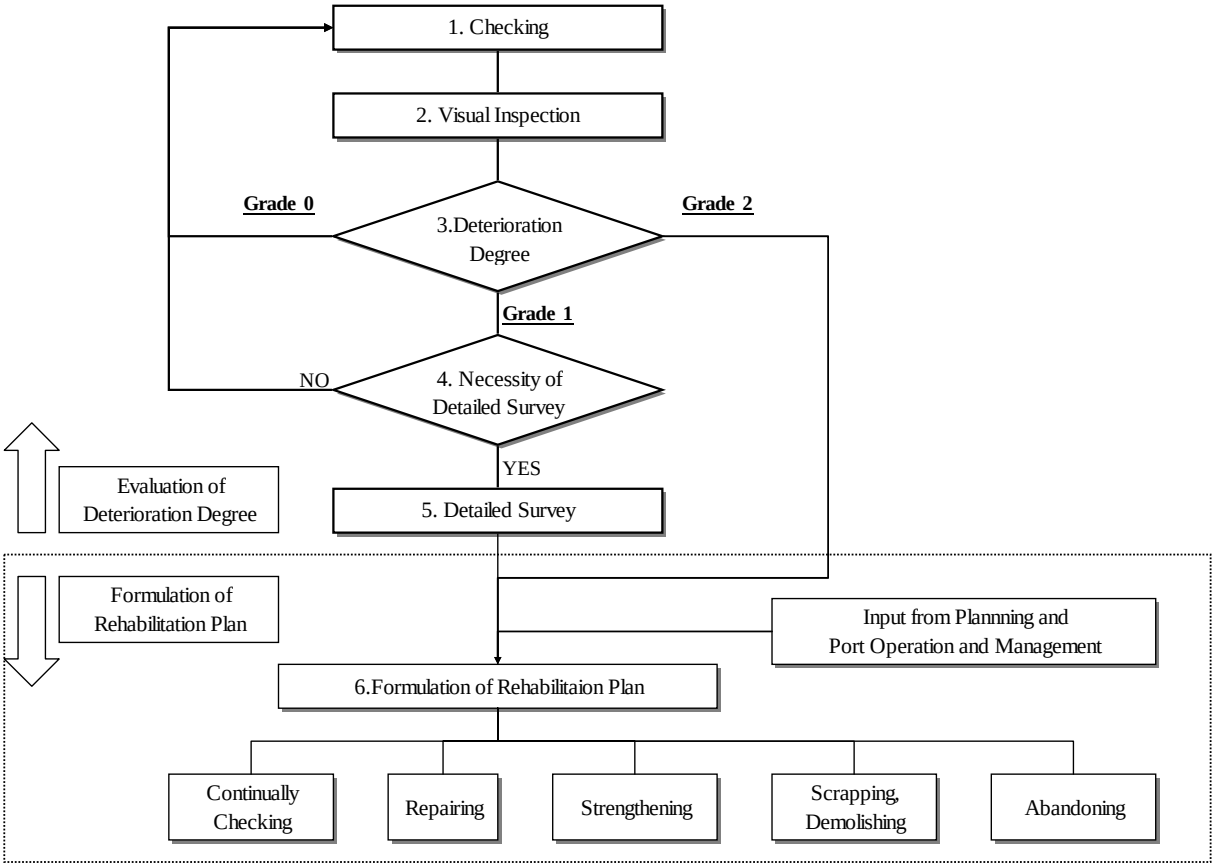


Figure 6-1 Flow chart from checking facility to formulation of rehabilitation plan

Basically, the criteria for the deterioration assessment are derived from the "Maintenance Manual of Port Facilities" (Coastal Development Institute of Technology, Japan). As for the items which are not mentioned in the manual, the deterioration assessment is based on uniquely established criteria (see tables in 6.2.2). In addition, the deterioration grades are defined as follows;

Deterioration Degree 0: The facility is structurally in sound condition. Detailed survey is not required but periodical check is needed.

Deterioration Degree 1: The facility is structurally in bad condition, but the necessity of repair and/or reinforcement can not be decided. Therefore, detailed survey and/or supplemental analysis are required.

Deterioration Degree 2: The facility is structurally in bad condition and repair and/or reinforcement are needed. It is considered to be the object of the rehabilitation plan.

In addition, according to the discussion with the port authorities and the result of the field survey during the first visit to Angola, the following items are excluded from the object of deterioration assessment of the port facilities;

Landside facilities in the port of Luanda

Reason: Full-scale privatization is currently ongoing in the port of Luanda, and it has been stipulated that the maintenance and rehabilitation of existing port facilities on “land areas” to be the responsibilities of concessionaires. Taking this fact into consideration, Luanda Port Corporation and the Study Team have agreed to exclude the formulation of rehabilitation plan of port facilities on land areas from the scope of the Study for the port of Luanda.

Substructure of the Jetty in the port of Cabinda

Reason: The rehabilitation work of the jetty is in progress. The rehabilitation plan of the port of Cabinda could exclude it.

Cacongo jetty located in the northern area of Cabinda Province

Reason: There exists a fatally deteriorated and unusable pier which used to be actively utilized for exporting a large amount of timber to other countries. While the Cabinda Port Corporation has requested the Study Team to include a rehabilitation plan of the facility in the scope of the Study, the Team conducted a field survey on the current physical condition of the pier and concluded that the partial rehabilitation works would be inadequate; reconstruction is necessary. Thus, this issue is out of the scope of the Study. Both sides have agreed to this conclusion.

6.2 Method of Facility Survey and Deterioration Assessment

6.2.1 Method of Survey

Facility survey was carried out in accordance with the methods shown in Table 6-1. The portable equipment used in the course of the survey is as follows (see Photo 6-1).

Nondestructive reinforcing bar detector/ measurement of thickness of concrete cover and pitch of reinforcing bar

Ultrasonic thickness meter/ measurement of wall thickness of steel material

Schmitt hammer/ for measurement of compressive strength of concrete

Phenolphthalein solution/ for measurement of carbonation depth of concrete

Table 6-1 Method of Survey on Port Facility

Survey Object	Survey Unit	Method of Survey	Survey Item
Navigational aids	Each facility	Visual inspection by use of a small craft Night-time observation	Lighting condition, Existence of damage
Superstructure (both gravity and jetty type)	Each block	Visual inspection on foot and by use of a small craft Measurement by use of portable equipment	Existence of damage
Quay wall and substructure of jetty	Each block	Visual inspection by use of a small craft Beating test of concrete Measurement by use of portable equipment	Existence of damage
Apron pavement	Each block	Visual inspection on foot	Existence of damage
Rail track (crane rail, railway)	Each block	Visual inspection on foot	Existence of damage
Miscellaneous Accessories (Rubber fender, mooring bollard)	Each facility	Visual inspection on foot and by use of a small craft	Existence of damage
Warehouse	Each facility	Visual inspection by walk	Existence of damage
Cargo handling equipment, work vessel	Each facility	Visual inspection	Existence of damage

Nondestructive reinforcing bar detector

Ultrasonic thickness meter


Schmitt hammer


Phenolphthalein solution

Photo 6-1 Portable Equipment

6.2.2 Method of Deterioration Assessment

Each facility is categorized according to the name of port and the type of the facility and has a unique "Facility ID". For example, the Facility ID of Ca-06-001 means that the facility is located at the port of Cabinda, the type of facility is wooden deck and its sequential serial number is 1. The classification method is shown as follows;

The name of port

Location Code.	Port Name
Lu	The Port of Luanda
Lo	The Port of Lobito
Na	The Port of Namibe
Sa	The Port of Saco Mar (Namibe)
Ca	The Port of Cabinda

The type of facility

Facility Type No.	Type of the Facility	Facility Type No.	Type of the Facility
01	Navigational aid	11	Mooring system
02	Coping concrete	12	Warehouse
03	Quay wall	13	Workshop
04	Concrete deck slab	14	Miscellaneous Accessories
05	Steel pipe pile	15	Cargo Handling Equipment
06	Wooden deck	16	Work Vessel
07	Apron pavement	17	Other Equipment
08	Crane rail	18	Steel Pile
09	Railway	19	Yard Pavement
10	Fendering system		

According to the visual inspection of the port facility, the deterioration assessment was conducted based on the criteria shown in Table 6-2 to Table 6-11. The deterioration assessment sheets for each facility including facility name, survey date, location, result of visual inspection, deterioration grade, photo and etc., are attached in Appendix.

Table 6-2 Criteria for the Deterioration Assessment (Navigational aid)

Deterioration Degree / Checking Item	0	1	2
Lighting condition	Blinking	—	Not blinking
Corrosion	No	Partially	Wholly corroded
Deterioration	No	Partially	Widespread
Fouling	No	Partially	Great amount

Table 6-3 Criteria for the Deterioration Assessment (Coping concrete)

Checking Item \ Deterioration Degree	0	1	2
Settlement	0 - 10 cm	10 - 20 cm	More than 20 cm
Inclination	0 – 3 degrees	3 – 5 degrees	More than 5 degrees
Damage	No	Partially	Widespread

Table 6-4 Criteria for the Deterioration Assessment (Quay wall)

Checking Item \ Deterioration Degree	0	1	2
Damage	No	Partially	Widespread
Corrosion of reinforcing bar	No	Rust stain on concrete surface corrosion of exposed reinforcing bar	Large amount of rust stain on concrete surface and notable corrosion of exposed reinforcing bar
Spalling and floating of cover concrete	No	Partially	Widespread
Crack	No, or crack width less than 1mm	Many cracks and some net-like crack	Wide spread net-like crack
Efflorescence	No	Oozing partially	Oozing widespread

Table 6-5 Criteria for the Deterioration Assessment (Concrete deck slab)

Checking Item \ Deterioration Degree	0	1	2
Corrosion of reinforcing bar	No	Rust stain on concrete surface corrosion of exposed reinforcing bar	Large amount of rust stain on concrete surface and notable corrosion of exposed reinforcing bar
Spalling and floating of cover concrete	No	Partially	Widespread
Crack	No, or crack width less than 1mm	Many cracks and some net-like crack	Wide spread net-like crack
Efflorescence	No	Oozing partially	Oozing widespread

Table 6-6 Criteria for the Deterioration Assessment (Steel pipe pile and steel pile)

Checking Item \ Deterioration Degree	0	1	2
Damage	No	Partial corrosion	Widespread corrosion

Table 6-7 Criteria for the Deterioration Assessment (Apron pavement)

Checking Item \ Deterioration Degree	0	1	2
Settlement	0 - 10 cm	10 - 20 cm	More than 20 cm
Inclination	0 – 3 degrees	3 – 5 degrees	More than 5 degrees
Damage	No	Partially	Widespread

Table 6-8 Criteria for the Deterioration Assessment (Rail track)

Checking Item \ Deterioration Degree	0	1	2
Unevenness	No	Minor	Widespread
Alignment deviation	No	Minor	Widespread
Mounting condition	No damage	Minor damage	Widespread damage

Table 6-9 Criteria for the Deterioration Assessment (Warehouse)

Checking Item \ Deterioration Degree	0	1	2
Damage	No	Partially	Widespread

Table 6-10 Criteria for the Deterioration Assessment (Miscellaneous accessories)

Checking Item \ Deterioration Degree	0	1	2
Damage	No	Partially	Widespread

Table 6-11 Criteria for the Deterioration Assessment (Machinery)

Checking Item \ Deterioration Degree	0	1	2
Damage	No	Partially	Widespread

6.3 Summary of Deterioration Assessment

Table 6-12 shows the comprehensive deterioration assessment of the port facility based on the criteria shown in Table 6-2 to Table 6-11.

In the first visit to Angola, of the 412 surveyed facilities, 108 were assessed to have deterioration degree 0, 140 had degree 1, and 164 had degree 2.

In the course of the second visit to Angola, the port facilities which had been assessed as having “Deterioration Degree 1” and had not been investigated sufficiently during the first visit to Angola were surveyed by detailed visual inspection to judge the necessity of their rehabilitation. Out of a total of 528 surveyed facilities, 154 were judged as “rehabilitation is unnecessary (grade 0)” and 374 as “rehabilitation is necessary (grade 2)”.

Summaries of individual target ports are also shown from Table 6-13 to Table 6-16. The summary of the port of Namibe includes the data of port of Saco Mar. According to Table 6-12, at least 374 facilities are candidates for the port rehabilitation plan. Almost all coping concrete, concrete deck slab, steel pipe pile, apron pavement, crane rail, railway, fendering system, mooring system and miscellaneous accessories need rehabilitation. And some of navigational aids, quay wall, warehouses and cargo handling equipment also need rehabilitation. By port, the port of Luanda is assessed to have the severest degree of deterioration followed by the port of Namibe, the port of Lobito and the port of Cabinda (see Table 6-13 to Table 6-16).

Table 6-12 Comprehensive Deterioration Assessment

Type of Facility	Total Number of Checked Items	Number of Facilities Deterioration Degree	
		0	2
Navigational aid	**12**	**7**	**5**
Coping concrete	**75**	**0**	**75**
Quay wall	**75**	**56**	**19**
Concrete deck slab	**7**	**2**	**5**
Steel pipe pile	**1**	**0**	**1**
Wooden deck	**4**	**3**	**1**
Apron pavement	**75**	**0**	**75**
Crane rail	**4**	**0**	**4**
Railway	**27**	**0**	**27**
Fendering system	**9**	**3**	**6**
Mooring system	**75**	**1**	**74**
Warehouse	**23**	**19**	**4**
Miscellaneous accessories	**41**	**1**	**40**
Cargo Handling Equipment	**69**	**34**	**35**
Work Vessel	**6**	**6**	**0**
Other Equipment	**20**	**19**	**1**
Steel Pile	**4**	**3**	**1**
Yard Pavement	**1**	**0**	**1**
Total	**528**	**154**	**374**

Table 6-13 Summary of Deterioration Assessment of Port of Luanda

Type of Facility	Total Number of Checked Items	Number of Facilities Deterioration Degree	
		0	2
Navigational aid	**3**	**0**	**3**
Total	**3**	**0**	**3**

Table 6-14 Summary of Deterioration Assessment of Port of Lobito

Type of Facility	Total Number of Checked Items	Number of Facilities Deterioration Degree	
		0	2
Navigational aid	**6**	**5**	**1**
Coping concrete	**40**	**0**	**40**
Quay wall	**40**	**27**	**13**
Apron pavement	**40**	**0**	**40**
Crane rail	**2**	**0**	**2**
Railway	**16**	**0**	**16**
Fendering System	**2**	**0**	**2**
Mooring system	**38**	**0**	**38**
Warehouse	**21**	**19**	**2**
Miscellaneous accessories	**24**	**1**	**24**
Cargo Handling Equipment	**40**	**18**	**22**
Work Vessel	**4**	**4**	**0**
Other Equipment	**10**	**9**	**1**
Total	**283**	**83**	**200**

Table 6-15 Summary of Deterioration Assessment of Port of Namibe

Type of Facility	Total Number of Checked Items	Number of Facilities Deterioration Degree	
		0	2
Navigational aid	**3**	**2**	**1**
Coping concrete	**35**	**0**	**35**
Quay wall	**35**	**29**	**6**
Concrete deck slab	**7**	**2**	**5**
Steel pipe pile	**1**	**0**	**1**
Apron pavement	**35**	**0**	**35**
Crane rail	**2**	**0**	**2**
Railway	**11**	**0**	**11**
Fendering system	**4**	**0**	**4**
Mooring system	**36**	**0**	**36**
Warehouse	**2**	**0**	**2**
Miscellaneous accessories	**16**	**0**	**16**
Cargo Handling Equipment	**19**	**6**	**13**
Work Vessel	**2**	**2**	**0**
Other Equipment	**2**	**2**	**0**
Total	**210**	**43**	**167**

Table 6-16 Summary of Deterioration Assessment of Port of Cabinda

Type of Facility	Total Number of Checked Items	Number of Facilities Deterioration Degree	
		0	2
Wooden deck	**4**	**3**	**1**
Fendering system	**3**	**3**	**0**
Mooring system	**1**	**1**	**0**
Miscellaneous accessories	**1**	**0**	**1**
Cargo Handling Equipment	**10**	**10**	**0**
Steel Pile	**4**	**3**	**1**
Yard Pavement	**1**	**0**	**1**
Other Equipment	**8**	**8**	**0**
Total	**32**	**28**	**4**

7. Environmental and Social Consideration

7.1 Natural and Social Environment of Angola

7.1.1 Natural Environment

1) Sensitive and Protected area of the country

Most of the 1,600 km Angolan coastline consists of soft marine sediments and supports large areas of mangroves (70,000ha) at the mouths of several rivers, and extensive salt marshes/tidal flats. A study in 1995 by International Union for the Conservation of Nature and Natural Resources (IUCN) reported that there are several protected areas on the coast of Angola, namely the Congo River Delta Marine protected Area in ZAIRE, Liheu dos Passaros Nature Reserve in LUANDA, Kissama National Park in BENGO, Chimalaverera Regional Nature Park in BENGUELA and Iona National Park in NAMIBE (as shown in Figure 7-1).

Figure 7-1 Protected and Sensitive Coastal Areas (Source: IUCN)

2) Water Quality

Water quality survey has not been conducted so far in the ports nor is there any existing data. A request for a water quality survey in the ports was made at the stakeholders meeting which is described in 7.4. Surveys of Transparency, COD and Coliform Count were conducted by simple pack test to obtain the water quality of each port. Two surveys were conducted at the time of flood tide and ebb tide during September and October, 2005. Water samples from outside of the bay were also taken for comparison.

Since COD levels were not high as a whole, the water does not seem to be organically polluted. However, the water quality behind the Port of Luanda and at the east side of the Port of Lobito has COD levels over 4mg/l due to untreated effluent. Number of Coliform levels in these two water areas is also too high, exceeding 5,000MPN/100mg. According to the local hearing it is said that this is due to the discharge of untreated effluent of domestic wastewater. Cabinda Bay and Namibe Bay are regarded comparatively normal judging from COD test although transparency is low because of turbidity of sedimentation inflowing from the Congo River.

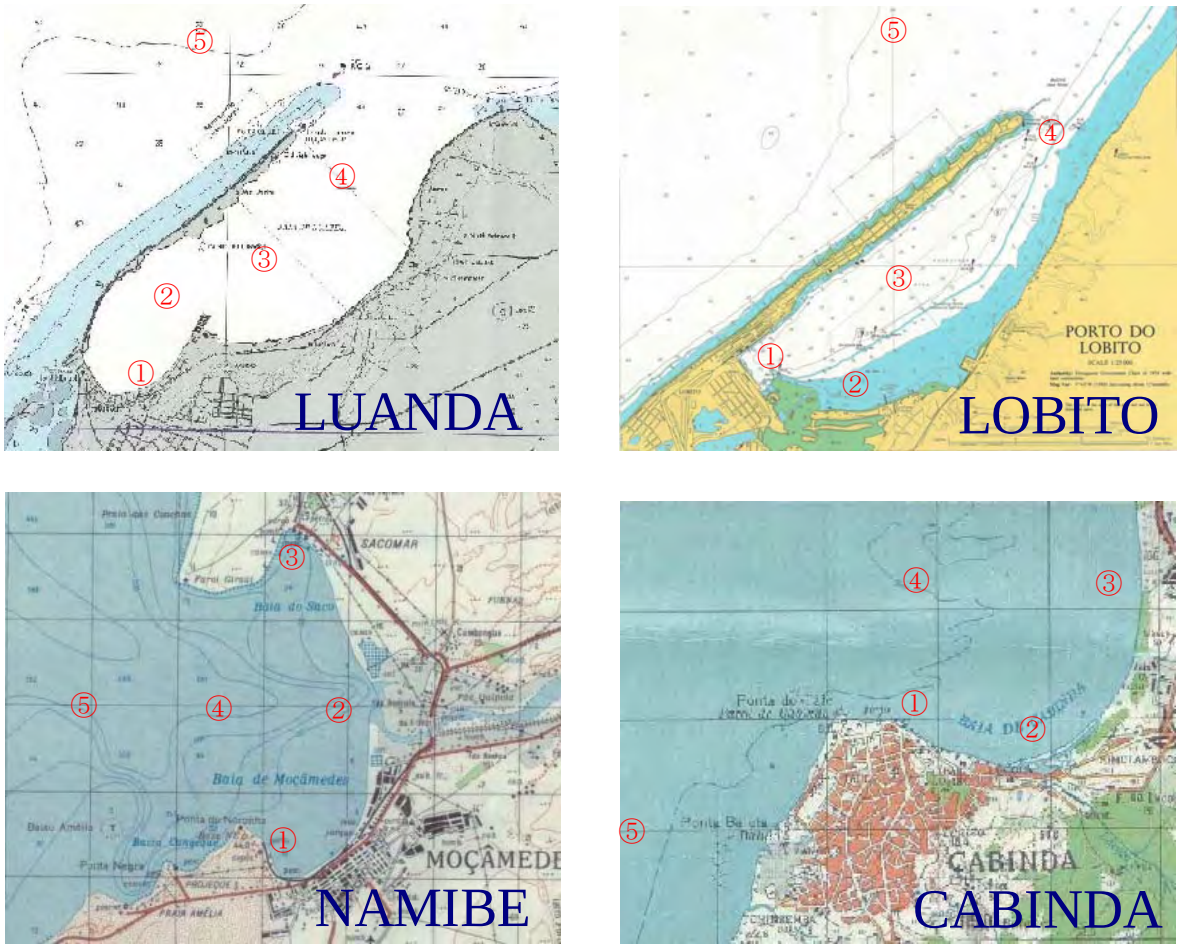


Figure 7-2 Location of Water Quality Survey

Table 7-1 Finding of Water Quality test on Port of Luanda

No.	Date & Time	Tide	Temperature	Transparency	COD(mg/l)	Coliform (MPN/100ml)
①	10/4, 14:50	Flood	34.0℃	0.9m	4.0	5,000
	10/4, 17:00	Ebb	29.3℃	1.5m	4.0	6,600
②	10/4, 15:03	Flood	33.2℃	2.5m	4.0	2,900
	10/4, 16:55	Ebb	29.2℃	2.0m	4.5	7,200
③	10/4, 15:15	Flood	31.9℃	4.0m	4.0	2,000
	10/4, 16:30	Ebb	30.9℃	4.0m	4.5	1,600
④	10/4, 15:35	Flood	31.1℃	4.5m	4.0	2,000
	10/4, 16:20	Ebb	30.0℃	5.5m	2.0	2,900
⑤	10/4, 15:50	Flood	30.9℃	4.5m	1.0	1,500
	10/4, 16:10	Ebb	30.3℃	4.5m	1.5	4,900

Table 7-2 Finding of Water Quality test on Port of Lobito

No.	Date & Time	Tide	Temperature	Transparency	COD(mg/l)	Coliform (MPN/100ml)
①	9/27, 10:00	Flood	28.5℃	2.1m	1.5	2,100
	9/27, 14:10	Ebb	30.9℃	-	1.5	5,400
②	9/27, 10:10	Flood	28.5℃	1.3m	8.5	4,200
	9/27, 14:25	Ebb	19.2℃	-	6.0	7,300
③	9/27, 10:17	Flood	28.6℃	2.1m	2.0	8,300
	9/27, 14:58	Ebb	29.2℃	-	1.5	1,400
④	9/27, 10:40	Flood	29.0℃	2.3m	6.0	2,900
	9/27, 15:00	Ebb	29.2℃	-	1.5	5,100
⑤	9/27, 10:50	Flood	29.3℃	3.5m	2.0	1,500
	9/27, 15:10	Ebb	29.2℃	-	1.5	2,700

Table 7-3 Finding of Water Quality test on Port of Namibe

No.	Date & Time	Tide	Temperature	Transparency	COD(mg/l)	Coliform (MPN/100ml)
①	10/7, 16:50	Flood	23.2℃	3.5m	1.0	2,800
	10/7, 09:15	Ebb	27.3℃	4.5m	1.0	5,400
②	10/7, 16:15	Flood	24.1℃	2.6m	1.0	3,400
	10/7, 09:50	Ebb	27.5℃	3.5m	1.0	4,300
③	10/7, 15:55	Flood	25.7℃	4.0m	1.0	4,700
	10/7, 10:10	Ebb	27.0℃	5.5m	1.0	8,400
④	10/7, 15:30	Flood	27.1℃	13.6m	1.0	3,900
	10/7, 10:30	Ebb	25.2℃	5.5m	1.0	5,900
⑤	10/7, 15:20	Flood	28.1℃	16.0m	1.0	900
	10/7, 10:45	Ebb	24.0℃	10.0m	1.0	7,000

Table 7-4 Finding of Water Quality test on Port of Cabinda

No.	Date & Time	Tide	Temperature	Transparency	COD(mg/l)	Coliform (MPN/100ml)
①	10/11, 16:25	Flood	30.0℃	1.0m	1.0	800
	10/25, 10:45	Ebb	-	-	2.5	2,400
②	10/11, 15:45	Flood	29.1℃	1.1m	1.0	1,500
	10/25, 10:55	Ebb	-	-	1.0	4,200
③	10/11, 16:00	Flood	29.1℃	1.1m	1.0	1,300
	10/25, 11:05	Ebb	-	-	1.0	3,000
④	10/11, 16:15	Flood	30.0℃	1.8m	1.0	2,300
	10/25, 11:20	Ebb	-	-	1.0	3,000
⑤	10/11, 15:25	Flood	30.0℃	0.5m	1.0	1,800
	10/25, 11:35	Ebb	-	-	1.0	1,000

7.1.2 Social Environment

1) Displaced People

Angola's nearly 27 years of civil conflict has had devastating effects on the country's economy, infrastructure, and citizen's quality of life. While accurate data are lacking, it is estimated that over 1.5 million people have been killed since the armed conflict began between rival groups following independence in 1975. The conflict also displaced about 3.6 million people, about one-third of the country's 13 million citizens (UN estimates as of April 2003). Most of the displaced fled to Luanda, Lobito, and other costal cities. They live in squalid conditions in overcrowded urban and semi-urban areas without functioning health and water and sanitation infrastructure and without adequate social service.

2) Agricultural resources and food shortages

Poverty is still deeper and more widespread in rural areas. In many areas, people live under the poverty line. Although Angola has substantial potential to develop an agricultural economy, the lack of roads and other transportation infrastructure, displacement of farmers and loss of livestock, and collapse of commercial agriculture and rural marketing have prevented this potential from being realized.

3) Water and sanitation systems

Water and sanitation systems have totally collapsed in the areas most affected by the war. According the WHO-UNICEF only 40 percent of rural inhabitants in Angola have access to safe water and 30 percent have access to improved sanitation. In provincial cities the water utilities serve only about 30 percent of the population. About 61 percent of the urban population has access to some sanitation service, with18 percent connected to a sewer and the remainder relying on septic tanks, latrines, and leaching pits.

4) Human Development Index (HDI)

Angola ranks 166th out of 177 countries on UNDP's HDI for 2004. Per capita income totaled about US$1,304 per year in 2004. Angola's social indicators are among the worst in the world. Access to education at all levels of the system is severely constrained and educational quality is very poor. As a result, Angola has one of the lowest rates of literacy in Sub-Saharan Africa.

7.1.3 Highlights of environmental issues

The following environmental issues were pointed out by the Government of Angola, Emergency Multisector Recovery Project (EMRP) and the site hearings.

A myriad of land mine removal spread over the inland;

Separation of urban and rural areas by destruction of transportation infrastructure such as roads, bridges and railways;

Food Security for all;

Price increase by import dependency;

House shortage, shortage of Water and Sewage, Electricity, Health Facility, Sanitary Facility, Inadequate garbage control;

Lost fauna and flora;

Loss of habitat for animals by deforestation;

Concentration of population to urban area and high unemployment;

Thoroughness of environmental conservation management; and

Internal human training.

7.2 Legal Framework of Environmental and Social Consideration

7.2.1 Environmental Laws

Angola has 1) Environmental Basis Law; 2) Environmental Impact Assessment Law; and 3) Water Resource Law as major Environmental Laws which are opened to the public at present. Environmental Impact Statement Law (July, 2004) and Water Resource Law (February, 2002) are opened to the public through approval by Council of Ministers based on Environmental Basic Law passed in June 1999. These laws have been passed recently, just after the civil conflict, therefore, the detailed implementation procedure, guidelines and standards on environmental markers are not yet established.

MINUA is organized by two bureaus, the Environmental Bureau and Natural Resource Bureau. Garbage problem in urban areas, deforestation and air and water pollution are handled by the Environmental Bureau while problems related to natural resources other than in urban areas are handled by the Natural Resource Bureau. However, management system is developing caused by lack of found, not enough equipment and shortage of staff. An outline of the above (1) - (3) environmental laws is giving below.

1) Environmental Basis Law

Environmental Basis Law serves as the basis for forming environmental standards and related organizations for future betterment of the environment. It defines the concept of environmental protection and conservation, better quality of life, rational utilization of national resources and the rights to receive the benefit. The law consists of 1. Environmental management organization 2. Environmental protection management 3. People's rights and duties 4. Responsibility, violation and permission 5. Environment inspection 6. Final treatment. "People's involvement" (Article8), "NGO" (Article9), "Public consultation"(Artcle10), "Improvement of Infrastructure"(Article15), "Environmental impact assessment"(Article16) are constituted in the articles of the law.

<Basic policies of Environmental Basis Law>

Attain in full, a sustainable development in every aspect of national living.

Maintain equilibrium between the satisfaction of the citizens' basic needs and nature's capacity to respond.

Guarantee the least possible impact of the actions needed for the country's development by implementing a correct territorial order and the application of adequate techniques and technologies.

Pay more attention to the quality of urban environment through an efficient application of local and municipal administration.

Constitute, consolidate and strengthen a network of environment protected areas in order to ensure the maintenance of biodiversity, using those areas for environmental education and recreation.

Promote initiatives of research and scientific study in all domains of ecology, using national capacity mainly from University and Research Institutes.

Promote the application of environment quality norms in every productive and service sector, based on international norms adapted to the current situation in Angola.

Ensure the participation of the citizens in all decision making that implicates environmental and social disequilibrium.

Promote a defense for consumer in accordance to other sectors of national living.

Establish clear and applicable rules in defense of our country's natural, cultural and social patrimony.

Proceed with the recovery of degraded areas in the national territory.

Articulate actions of environmental protection and ways to improve the quality of life in areas adjacent to neighboring countries.

2) Environmental Impact Assessment (EIA)

This is regulation indicates the method of environmental management and aims to accurately assess environmental impacts of a project. This regulation constitutes implementation of assessment (EIA), submission of the report to MINUA and related legal procedures. According to MINUA, EIA has not been implemented so far in Angola due to the civil war. In fact, EIA has only recently come into effect. However, for future projects, even if the project is to expand and improve existing facilities approval and a license must be obtained from MINUA at the initial stage or the project. Impact assessment is depended on the project content and the scale, however, current law does not regulate assessment standard therefore, public consultation and information disclosure are must conditions in EIA procedure.

i) Environmental Procedure

MINUA does not have an official flow chart of the EIA procedure of MINUA. The following flow chart (see Figure 7-3) was made after clarifying the legal procedure with the Environmental Bureau.

Main articles of EIA regulations are as follows.

Presentation of Environmental Impact Study: Article 5

The owner of the works shall present the Environmental Impact Study to the public entity authorized to approve it at the commencement of the administrative approval or licensing phase of the project. The public entity referred to in the preceding number shall, within 5 days of receipt of the study, forward the following elements to the member of Government in charge of the environment:

a) The Project to be approved or licensed;
b) The Environmental Impact Study;
c) Other elements deemed convenient for the correct analysis of the project.

Entity Responsible for Environmental Impact Assessment: Article 11

The process of Environmental Impact Assessment is the competency of the Minister responsible for the environment area, who shall appoint the entity in charge of the process start-up. The competency referred to in the preceding paragraph shall be exercised jointly by the Minister in charge of the project under analysis and by the Minister in charge of public works and territorial planning, in case of projects situated with urban perimeters or those passing through populated areas.

Deadlines: Article 12

Within a maximum period of 30 days commencing on the date of receipt of documentation referred to in paragraph 2 of Article 5, MINUA shall send the respective opinion to the entity authorized to license or approve the project, together with the relevant public consultation report and analysis relating thereto. If, within the period stipulated in the preceding paragraph, no communication had been made to the entity authorized to approve or license the project, the opinion shall be deemed favorable.

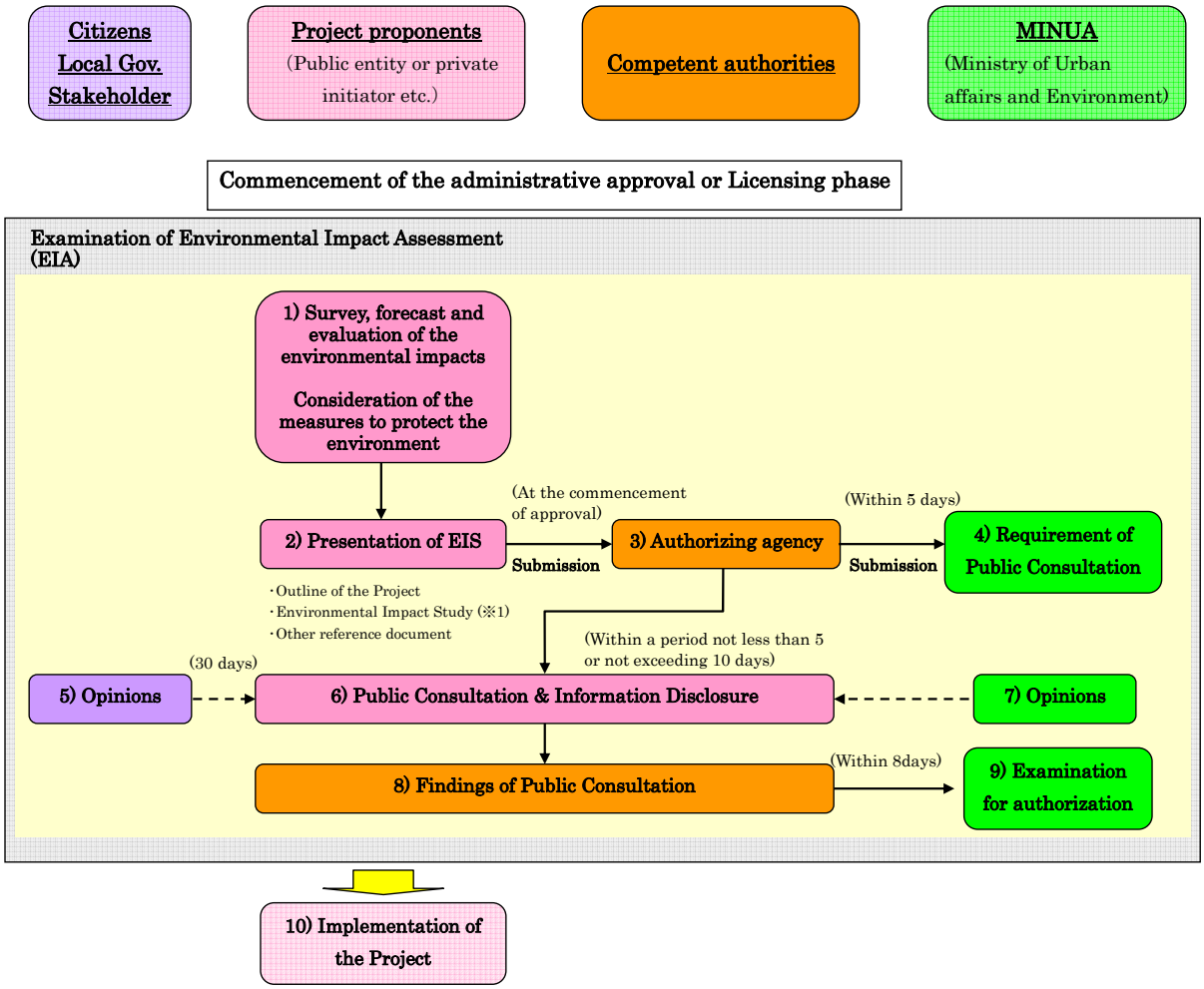


Figure 7-3 EIA Procedure

ii) Contents of Environmental Impact Study: Article 6

Description of Project;

Report on the Environmental Impact Study;

All technological alternatives and location of the project, bearing in mind the probability of non-execution of the project;

Systematic identification and evaluation of environmental impact occurring in the initial and operational phases of projected activities;

Definition of the limits of geographic area to be affected directly or indirectly by the impact, denominated the area of influences of the project, taking into account in all cases human population, other living things and the hydro-graphic basins in which they are located;

Taking into consideration government plans and programs and those being implemented in the area of influence of the project and their compatibility;

Other elements deemed relevant either for their particularity or nature of the project.

iii) Public Consultations: Article 10

Projects subject to environmental impact assessment shall be obligatorily subject to public consultations promoted by the Minister responsible for the environmental.

The public consultations shall commence with a prior publication of a non-technical summary of the environmental impact study outlining the most important effects that the project could have on the environment, especially the utilization of natural resources, pollution, creation of disturbances (lighting and temperature intensity, noise and odors) or removal waste matter, identifying preventive measures to assess and reduce the effects on the environment, as well as the socioeconomic impact of the project.

The publication of matters referred to in the preceding number shall comply with industrial secrecy and observance of the legal instruments in force for the protection of technical knowledge not having a patent.

Within the scope of public consultation, opinions and complaints presented and relating to the project shall be taken into consideration and reviewed.

The public consultation shall be held within a period not less than 5 or not exceeding 10 days in projects.

Upon expiry of the deadline set for public consultation, a written report is drawn up within the subsequent eight days, specifying the work undertaken, the participation registered and the conclusions thereof.

The cost arising from the carrying out of the public consultation shall be included in the expenses of the owner of the works.

iv) Publication of the Decision: Article 14

The final decision taken on projects analyzed under the term of this act and the respective processes shall be subject to publication, without prejudice to limitations established by the law.

3) Water law

Water law based on "the Water Management Principles" in Angola aims stipulates the follows management policy by related Ministries.

a) guaranteeing access to water
b) ensuring balance between available water resources and demand
c) guaranteeing use of available water
d) supplying water in continuous and sufficient manner in order to meet their health needs of citizens
e) promoting and regulating utilization of water for agricultural, livestock raising, industrial and hydroelectric purposes
f) promoting research activities and efficient use of existing water resources
g) regulating discharge of effluents
h) safeguarding navigation, fishing activities and water recreational activities

Articles related to port activities and port developments are as follows.

i) Article 25 (Conditions and Purposes Permitted in Private Use):

Waters of the public domain can, by concession or license, be used for supply of potable water for human consumption, for irrigation and livestock raising, for energy production, for treatment of ores, for ore extraction from crushed rock, for treatment of vegetable fibers, as a raw material for industry and for any other purposes permitted by law.

ii) Article 26 (Use Arising From Right to Exploit Land):

Those holding the right to use and exploit land in order to meet their domestic needs and the normal and foreseeable needs of agriculture can, without licensing and free of charge, use the following in accordance with the stipulations of the regulations:

a) the waters of lakes, lagoons and marshes existing inside the piece of land in question, except for cases in which, on account of its volume or importance, such utilization requires a license or concession;
b) the waters of springs, freely flowing, that do not cross over the limits of the piece of land in question or that do not turn into a course of water;
c) the groundwater not included in protection zones, provided that its system is not disturbed and its quality is not deteriorated;
d) Rainwater.

The uses referred to in 1. above cannot affect preexisting common uses that have been traditionally established or the rights of others.

iii) Article 28 (Areas Contiguous to Protection Zones):

On sloped lands near springs and water courses or where there is prevention or fighting of erosion outside zones subject to a protection system the carrying out of any activities is subject to the prior authorization of the institution responsible for management of the water resources of the basin and other competent entities.

Such authorization is granted necessarily after hearing of the opinions of the interested entities, specifically those that oversee agricultural and forestry activities, the parceling and development of land and mining and environmental resources.

iv) Article 32 (Drainage of Rain waters and Treatment of Liquid Wastes):

Drainage of rain waters and treatment of liquid wastes are subject to specific regulation.

v) Article 41 (Purpose):

Private use of water is subject to licensing when utilization thereof does not significantly alter the quality and quantity of the water or the environmental balance in accordance with the provisions established in the regulations. Also subject to licensing are:

a) prospecting for, tapping and use of groundwater, except for what is stipulated in c) of 1. of Article 26 of the present law;
   installation of dumps, planting of crops or plantations and the felling of trees in the beds or on the banks of continuous or discontinuous natural courses of water or of lakes, lagoons or marshes;
b) installation of dumps, planting of crops or plantations and the felling of trees in the beds or on the banks of continuous or discontinuous natural courses of water or of lakes, lagoons or marshes;
c) extraction of inert materials, particularly sand and gravel, of beds and banks of continuous or discontinuous natural courses of water or of lakes, lagoons and marshes.

vi) Article 67 (Prohibited Activities):

Engaging in direct or indirect discharges that surpass the self-cleansing capacity of the bodies of water;

Accumulating solid residues, wastes or any substances at places and in conditions that will contaminate or create risk of contamination of the waters;

Exercising any activities that entail or could entail risk of pollution or degradation of the public water domain;

7.2.2 International Environmental Conventions affiliated with Angola

Main International Environmental Conventions which are affiliated with Angola are shown in Table 7-5 and they are related to air pollution, marine pollution, natural culture protection, fauna and flora protection and biodiversity. There are many sunken and abandoned vessels in Luanda bay that used to be removed to promote safe navigation and improve water quality.

Table 7-5 Main International Environmental Conventions Ratified by Angola

Convention	Brief summary
Air Population	
Vienna Convention for the Protection of Ozone Layer	Convention to protect human health and environment from harmful effects due to the depletion of the Ozone layer
Montreal Protocol on Substances that Deplete the Ozone Layer	Protocol to promote international cooperation in restricting discharge of substances responsible for depleting the Ozone layer.
United Nations Framework Convention on Climate Change (UNFCCC)	Convention to stabilize the density of greenhouse gases in the atmosphere.
Marine Pollution	
Oil Pollution Incident Convention on International Waters	International convention to treat the case of oil pollution incident on international waters
International Convention on Civil Liability for Oil Pollution Damage (CLC)	Convention related to civil liability for oil pollution damage
MAROPOL 73/78 International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Prot	Protocol in 1978 and international convention to protect pollution by ships in 1973
United Nations Convention on the Law of the Sea (UNCLOS)	UN Convention related to laws of the sea
International convention on oil pollution preparedness, response and co-operation, 1990(OPRC)	International Convention to prepare, respond and cooperate against oil pollution in 1990
Convention on the Prevention and of Marine Pollution by Dumping of Wastes and other Matter (LDC / LC)	Convention to prevent marine pollution by waste material and dumping of others
Conservation of nature and cultural resource	
United Nations Convention to Combat Desertification in Those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa (UNCCD)	UN Convention to respond to desertification in the countries (especially African countries) suffering serious drought or desertification
Convention Concerning the Protection of the World Cultural and Natural Heritage (WHC)	Convention Concerning the Protection of the World Cultural and Natural Heritage
Biodiversity	
Convention on Biological Diversity (CBD)	Convention to fairly and evenly share profit from sustainable use and used of genetic resource of protection of biodiversity and the component

7.3 Environmental Social Conditions around Ports

The environmental control system in the four ports is not well prepared and there is a concern of environmental deterioration in the port areas. Each port has no record on environmental indicators, however, it is obvious that the following problems continue to get worse.

Oil leakage from ships through usual port operation

Untreated human sewage from hinterland of port area

Deterioration of water quality and sediment environment due to exhaust gas from increasing vehicles.

Most of them acknowledge the necessity to improve bay area environment urgently. However, what they can do is very limited since they do not have sufficient knowledge or the means to cope with these problems.

Four ports are Angolan main ports located at same intervals in north, central and south of west coast of Angola and they serve as important distribution bases. Hinterland area has main rail ways connecting to inland area. In the past, natural resources like Oil, Diamond, Iron ore, Phosphate, Cupper, Feldspar, Bauxite and etc. as well as agricultural resources were exported through these ports. Production volume of coffee used to be world No.2 and cotton was No.4. However, the roles of these ports after the conflict have changed to terminal for groceries and food supply as well as oil terminal base for economic recovery. More than 90% of imported containers are handled at the port of Luanda and port of Lobito/Namibe handles imported rice and corn as bulk cargo. Between 2002 and 2003, just after the civil war, about 4 million refugees returned to their original homes. At that time, WFP assumed that there would be a shortage of food for 1.4million people. Food was supplied at the rate of 75% in Lobito, 15% in Luanda and 10% in Namibe on the FOOD FOR WORK principal. Due to the destroyed road infrastructures, the food was transported by air to inland areas. At this moment, food is shortage for 0.9million people, but it is not in a severe state. According to the plan of WFP, the food supply will be decreased to 130,000 tons by December 2008, and 80 – 85% of the food will be transported through the port of Lobito.

As imports far outnumber exports at present, empty container boxes have increased in the port and it is necessary to secure the land to store them. Inefficient cargo handling and the complications in the yard area have to be improved. On the other hand, rehabilitation of main railways and roads connecting to inland areas for development of domestic industries are now going on. Future port activities will include handling export cargoes. In this sense, it is expected that port improvement needs to be conducted together with other infrastructures for the betterment of the Angolan economy. These ports have important roles as gateways to landlocked inland countries like Zambia, Congo, Zimbabwe, and Botswana.

7.3.1 Environmental and Social Conditions of the Port of Luanda

1) Natural Environmental Condition

Luanda bay is a closed water area by sand bar with the length about 8km. Wharf has been constructed at the west side of the bar for the prevention of accretion. There is a shallow water area of about 400ha (2km x 2km) at the back side of southern part of the bay and at the time of low water level grey herons, sea swallows, wagtails, sea gulls and other birds can be seen there. Luanda bay has sufficient water depth (20-30m) for vessel navigation. However, near the domestic trade wharf adjoining to the shallow area the water depth is 0.5-1m shallower than planned (-3.5m). The cause seems to be sedimentation of sand discharged from backside of the port together with rain water during the rainy season.

Water quality of Luanda bay is allegedly getting worse year by year due to human sewage from the hinter land, oil leakage from ships, gas emission from increasing vehicles and so on. Water pollution in the vicinity of shallow area is a special concern. Catching and eating of fish has been prohibited from December 2005 due to water pollution in Luanda Bay.

2) Social Environmental Condition

Luanda bay forms a dynamic natural landscape amenity located at the center of a big urban area. Fishery and marine activities other than port activity are conducted within the bay area. There is a foot path along the coastal road used by citizens for recreation.

About 36 sunken and or abandoned ships are observed all over the bay. These ships have remained untouched for a long time and pose environmental as well as navigational problems, especially at night. And these ships will be big obstacles for the future expansion of the access channel now being reclaimed for the oil related terminal at east side of the port. There are some broken navigation aids which do not function at night time.

Traffic jams centering around Port of Luanda during rush hour has become a big social issue for Luanda. In addition, Luanda has no garbage disposal facility and people dispose garbage along roads, river beds and drainage channels.

There are no rubber fenders on the domestic trade wharf which results in damage to ships' hull and the wharf itself. The port area is managed by a private company under a concession contract but most of the yard is not paved and fugitive dust is dispersed by port vehicles. The port has many unusable wharf cranes in the port concession area that are kept as remembrances of the civil war.

Since the civil war, the container yard has been very busy with increasing cargoes. The road in the yard is not wide enough and is becoming an obstacle not only to cargo handling works but also taking long time to take cargoes as well as administration and it leads to the hike of cargo handling fee. There is a suggestion that long kept empty container become corrupt and lead to soil pollution.

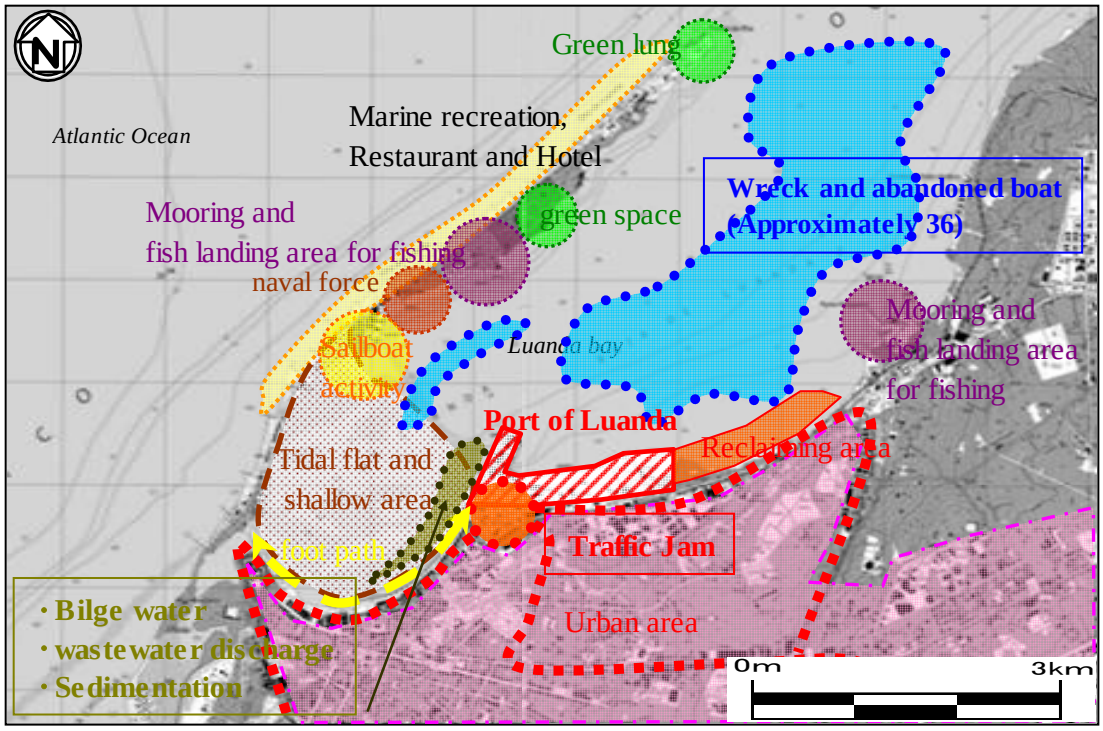


Figure 7-4 Environmental characteristics around Luanda Port

Photo 7-1 Sedimentation in front of Cabotage wharf

Photo 7-2 Foot path along with coastal road

Photo 7-3 Situation of Bilge Water

Photo 7-4 Traffic jam around port of Luanda

Photo 7-5 Issue of waste in large city, Luanda

Photo 7-6 Wreck and abandoned boat in Luanda bay

Photo 7-7 Overcrowding problem on Container yard in Port of Luanda

3) Current environmental issue in the vicinity of Port of Luanda

Table 7-6 Desirable Environmental Consideration for the Port of Luanda

Environmental Issue	Desirable environmental consideration
Securing navigation safety	Removal of sunken and abandoned ships Installation of rubber fenders Repair of unworkable navigation aids Revision of chart
Improvement of water quality	Management for prevention of marine pollution against ships based on International Treaty Recovery of floating oil and garbage Periodical monitoring of water quality in the bay
Solving traffic congestion around the Port	Construction of bypass road Rehabilitation of parking area
Treatment of garbage generated around the port	Construction of garbage disposal facility and sewage facility coupled with the other local area Construction of scrap yard
Prevention of dust in port area	Pavement of port yard and roads
Reduction of port charge	Efficient handling of container cargo