11.3 Environmental and Social Considerations on the Priority Projects

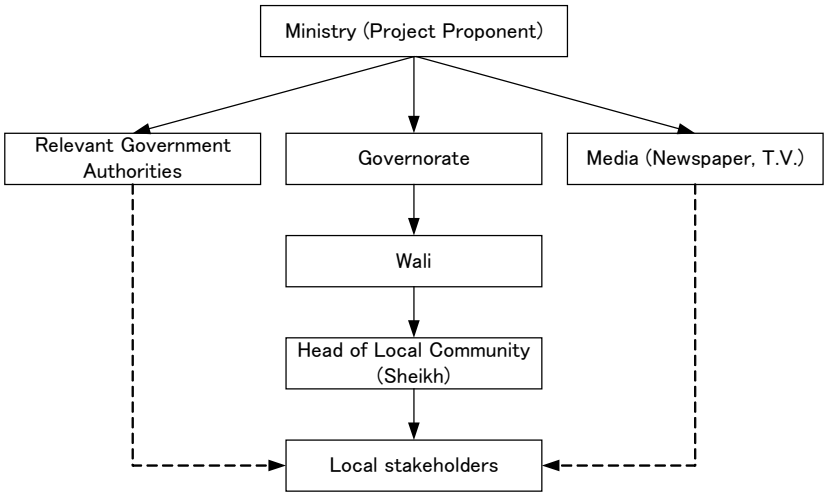
(1) Explanation to and Discussions with Stakeholders

In accordance to the MRMEWR, *"Guidelines For Obtaining Environmental Permits, Appendix B"*, the project proponent is requested to develop and implement an efficient public information program throughout the project.

Conventionally in Oman, information of any new government projects are initially disseminated by the Ministry (project proponent) at the conceptual stage of the project to the concerned Governorate (or Wali in case there are no Governorate), related government authorities and sometimes to the media. Upon provisional consent from the Governorate or Wali, the project proponent will commence with the F/S and D/D study.

After being informed by the Ministry of the project, the Governorate is responsible for disseminating the project information to the concerned Wali. The Wali will then hold a local committee meeting and inform the Sheikh (heads of the local community). The local community has strong ties with the Sheikh and information of any new projects are eventually disseminated to the local stakeholders through the Sheikh. Other than the above procedure, the local stakeholders often are informed of new projects through the media. The above procedure is summarized in the following flow chart (Figure 11.3-1).

Figure 11.3-1 Information Dissemination Procedure



Source: JICA Study Team

The local stakeholders can express their opinions or complaints to the Sheikh or Wali. The Sheikh or Wali will then inform the Governorate or the Ministry of the local stakeholder's views. In other words, the local people does not contact directly to the Ministry for complaints but indirectly via their local representatives. The views of the local stakeholders are also considered at the Steering Committee of the project, which is usually held for each project before the construction phase.

As an initial step of the information dissemination process, DGPMA organized stakeholder meetings to explain the possible environmental impacts of the proposed development plan of the JICA Study Team for the Sultan Qaboos Port and Duqm Port. The Wali and the concerned Sheikhs of the Wilayat Muttrah were invited for the Sultan Qaboos Port and the Wali of Duqm for the Duqm Port. Following are some of the main comments obtained through the meetings.

1) Comments regarding the Sultan Qaboos Port Development

- The stakeholders suggested that a new access road should be built before starting the port development construction. This will relieve the pressure on the existing access road during the construction period and reduce the frequency of traffic jams in the Muttrah area. This will also lead to the reduction in air and noise pollution from the project.
- JICA Study Team acknowledged the importance of the new access road and explained to the stakeholders that an in-depth study on the access road to Sultan Qaboos Port needs to be implemented by Ministries and Local Government concerned.
- The Sheikh of Aint district expressed his concern over the proposed breakwater, since its location overlaps with the gill net fishing ground of the Aint district fishermen.
- JICA Study Team explained to the stakeholders, that the new breakwater could potentially provide new habitats for various marine species including fishery resource species. JICA Study Team also explained that deployment of an eco-friendly breakwater would enhance coral settlement, provide excellent habitat for the various marine species and benefit the local fishermen as a consequence.
- The Wali acknowledged the importance of the proposed development plan and stated the importance of environmental consideration, and that any negative environmental impacts should be mitigated in an appropriate way through careful discussion with the MRMEWR.

2) Comments regarding the Duqm Port Development

- The Wali expressed that the establishment of the Duqm Port and the oil storage and exporting facilities will be an excellent way to promote the socioeconomic growth of the region. The local residents should appreciate such plan.
- Some of the major oil wells of Oman lie in the Al Wusta Region. Establishment of the oil storage and exporting facilities in the Duqm area should significantly reduce the present cost and work of transporting oil to the Mina Al Fahal.
- Together with the oil storage and exporting facilities, an oil reception facility should be considered as a measure to prevent illegal discharge of ballast water.
- Since the oil storage and exporting facilities have significant potential environmental impact, a detailed environment and socio-economic study should be implemented at the earliest possible stages.
- The planned fishery harbour inside the Duqm port may have to be reconsidered mainly due

to the proximity to the drydock facilities (i.e. hygienic reasons). An alternative fishery harbour may have to be considered outside the Duqm port.

- Although the current fish landing activities at the proposed Duqm port area may have to be relocated to another area during the construction phase, there are many alternative sites for fish landing in the Duqm area. For example in Ras Madraka.
- The current fish processing factory located in the proposed Duqm port area may have to be shifted depending on the layout of the port.
- In the Duqm area, fishing is not conducted during the SW monsoon season (June – September). Most of the local fishermen move to the inland areas during this season to pursue other income generating activities such as dates farming.

Various comments were obtained from both meetings. These comments should be referred and reflected into the JICA Study and the next stages of the port planning.

(2) Implementation of Environmental and Social Considerations on the Priority Projects

Based on the collected environmental information, the environmental impacts of the priority projects were assessed in terms of the environmental capacity of the project area (Table 11.3-1). The project area is separated into the hinterland, port and coastal area, and the environmental capacities of these areas are represented through the following environmental parameters.

- Air quality
- Noise / vibration
- Water quality
- Bottom sediment quality
- Groundwater quality
- Ecosystem

Impact assessment was conducted by referring to the national or international environmental quality standards of the above parameters (except ecosystem). If the environmental impact was predicted to exceed the environmental quality standards, lowest ratings were given (please refer to the foot note of Table 11.3-1 for the rating criteria). In addition to environmental quality standards, factors such as the location of the port, development scheme, the characteristics of the local ecosystem were also integrated into the assessment procedure.

Table 11.3-1 Preliminary Assessment of the Impacts of the Priority Projects in Terms of the Environmental Capacity of the Project Area

		Qaboos	Salalah	Sohar	Duqm
Hinterland area	Air quality	2	3	3	3
	Noise / vibration	2	3	3	3
	Water quality	-	-	-	-
	Bottom sediment quality	-	-	-	-
	Groundwater quality	3	3	2	3
	Ecosystem	3	3	3	2
Port area	Air quality	2	2	3	2
	Noise / vibration	1	2	2	2
	Water quality	2	2	2	2
	Bottom sediment quality	2	2	2	2
	Groundwater quality	-	-	-	-
	Ecosystem	2	3	3	2
Coastal area	Air quality	3	3	3	3
	Noise / vibration	3	3	3	3
	Water quality	2	3	3	2
	Bottom sediment quality	2	3	3	2
	Groundwater quality	-	-	-	-
	Ecosystem	2	3	3	2
Total		31	38	38	33

Rank 1: Likely to exceed environmental capacity, Rank 2: Likely to be within environmental capacity if appropriately controlled, Rank 3: Likely to be below environmental capacity or no impact factors

Source: JICA Study Team

The environmental capacity was more likely to be exceeded in proportion to the scale of the development and proximity to sensitive environments, which is reflected in the above results. Sohar and Salalah Port scored the highest ratings (38 out of maximum 42) mainly due to the relatively minor scale of development compared to the other ports. Sultan Qaboos Port scored the lowest rating (31 points), mainly due to the relatively large-scale development and its close proximity to sensitive environment (e.g. corals and residential area). Although the development scheme of Duqm Port is the largest within the four ports, the rating was only second lowest (33 points) because the port will be located at a relatively far distance from the residential area.

(3) Formulation of Frameworks for the Implementation of Environmental Impact Assessment (EIA)

In accordance to the MRMEWR, *"Guidelines For Obtaining Environmental Permits"*, all port development projects will require an detailed EIA to obtain an Environmental Permit from MRMEWR,

unless the project is considered by the MRMEWR to have a negligible impact on the environment. The following Table 11.3-2 identifies for each priority projects the environmental parameters that require an impact assessment, through the utilization of a ranking system.

Table 11.3-2 Environmental Parameters that Require an Environmental Impact Assessment

Environmental parameters		Qaboos	Salalah	Sohar	Duqm
Pollution	Air quality	1	1	1	1
	Noise / vibration	1	1	1	1
	Seawater quality	1	1	1	1
	Sediment quality	1	1	1	1
	Odor	2	2	2	2
Biophysical environment	Ecosystem	1	3	3	1
	Topography / Geology	2	3	3	2
	Groundwater	3	2	1	2
	Wadi flow	3	3	3	3
	Water circulation	1	3	3	1
	Coastal erosion / accretion	2	2	2	1
	Landscape	1	3	3	1
Social environment	Livelihood / Resettlement	1	1	1	1
	Fisheries	1	2	2	1
	Tourism	1	2	3	2
	Land / water use	1	3	3	1
	Cultural assets	1	3	3	3
	Infrastructure	2	2	2	2
	Waste	2	2	1	1
Total		28	40	39	28

Rank 1: Environmental impact assessment should be conducted, Rank 2: Environmental impact assessment should preferably be conducted, Rank 3: Environmental impact assessment not required

Source: JICA Study Team

According to the results of the above Table, Sultan Qaboos Port and Duqm Port will likely require a detailed and comprehensive EIA due to the low point scored. For Sohar and Salalah Port, a comprehensive EIA may not be required since the expected environmental impact is restricted to limited parameters. Still a minor EIA report may be required specifically for some parameters. However, the final decision lies with the MRMEWR.

According to the MRMEWR guideline, *"Guidelines For Obtaining Environmental Permits, Appendix B"* an EIA should include the following information.

- Background of the project

- Legislative framework
- Description of the project
- Description of the existing environment – baseline study
- Identification and assessment of potential impacts
- Mitigation measures and risk assessment
- Evaluation of alternatives
- Environmental Management Plan (EMP)
- Conclusion

In order to monitor the potential impacts identified in the EIA and the effectiveness of the mitigation measures, an Environmental Management Plan (EMP) should be incorporated into the EIA. The EMP should include an Environmental Monitoring Plan that covers the construction and operation phase.

Based on the results of Table 11.3-2, a draft TOR of the EIA has been prepared for each priority projects. The TOR provides methods for the baseline study, environmental impact assessment and necessary parameters of environmental monitoring.

1) Draft TOR of EIA of Sultan Qaboos Port Development

i. Baseline study method

Table 11.3-3 Proposed Survey Parameters and Method for the Baseline Study (Sultan Qaboos Port)

Environmental parameters		Survey method
Air quality	NOx, SOx, CO, PM10, TSP	Method: Field survey Location: Access road, residential and commercial area, port area
Noise		Method: Field survey Location: Same location as air quality survey
Seawater quality	Suspended Solids (SS)	Method: Field survey Location: Port basin, outside the port entrance, landfill outfall, adjacent coral habitat, reference site
	Temp., salinity, DO, pH, COD, HC, TN, TP, Fe, Mn, Cu, Hg, As, Cr, Al, Pb, Coliform, Chl-a	Method: Field survey Location: Port basin, approach channel, reference site
Sediment quality	Temp., colour, grain size, COD, HC, oxidation-reduction potential, TN, TP, Fe, Mn, Cu, Hg, As, Cr, Al, Pb	Method: Field survey Location: Same location as water quality survey
Water circulation		Method: Literature survey, Installation of 2 current meters for at least 15 days
Ecosystem	Inventory of marine species	Method: Literature survey, Interview survey of local fishermen
	Coral distribution	Method: Transect survey using divers Location: Adjacent coastline
	Benthic biota	Method: Quadrat survey Location: Adjacent coastline

Cultural asset	Archaeological and historical sites	Method: Location and the significance of archaeological and historical sites should be identified through field survey and interview survey
Traffic volume		Method: Traffic counts during weekday and weekends Location: Access road
Fisheries	Fishing ground, fishing method, target species, fish catch	Method: Interview survey of local fishermen that use the port.
Tourism	Tourism spots, diving spots	Method: Interview survey of tourism operators
Land / water use		Method: Interview survey, literature survey, field reconnaissance
Socio-economic	Population, no. of households, annual income, occupation, relocation	Method: Interview survey, literature survey Scope: Muttrah area

Source: JICA Study Team

ii. Environmental Impact Assessment method

Table 11.3-4 Proposed Methods for Environmental Impact Assessment (Sultan Qaboos Port)

Environmental parameters	Assessment method
Air quality	Impact of vehicle traffic on the adjacent areas (e.g. residential, commercial, port area) should be assessed based on the expected increase in traffic volume in the construction and operation phase. The results should then be compared with the national or international standards. Impact of quarrying activities on the adjacent areas (e.g. residential, commercial, port area) should be assessed. The results should then be compared with the national or international standards.
Noise	Impact of vehicle traffic on the adjacent areas (e.g. residential, commercial, port area) should be assessed based on the expected increase in traffic volume in the construction and operation phase. The results should then be compared with the national standards. Impact of quarrying activities on the adjacent areas (e.g. residential, commercial, port area) should be assessed. The results should then be compared with the national standards.
Seawater quality (SS)	The SS dispersion should be predicted based on the available oceanographic info., landfill outfall discharge volume and breakwater construction intensity. The impact on the adjacent corals and marine fauna should then be assessed.
Water circulation	The expected alteration of water circulation pattern should be predicted using a simulation model.
Ecosystem	The corals and benthic biota that will be directly lost through the construction of container terminal and breakwater should be quantified. Impact on the adjacent corals and benthic biota should be assessed based on the expected increase in SS concentration.
Traffic volume	The expected increase of traffic volume during the construction and operation phase should be predicted based on the construction schedule and cargo increase. The impact on the current access road should then be assessed.
Fisheries	The impact on the local fishermen should be assessed for the construction and operation phase.
Tourism	The impact on the local tourism operators should be assessed for the construction and operation phase.
Land / water use	The impact on fishery operation, PDO operation and land use plan should be assessed.
Socio-economic	The impact on the livelihood of the local residents should be assessed for the construction and operation phase.

Source: JICA Study Team

iii. Environmental monitoring parameter

The following parameters are recommended for environmental monitoring.

- Air quality
- Noise
- Water quality
- Sediment quality
- Corals
- Marine benthic species
- Local fishermen

2) Draft TOR of EIA of Salalah Port Development

i. Baseline study method

Table 11.3-5 Proposed Survey Parameters and Method for the Baseline Study (Salalah Port)

Environmental parameters		Survey method
Air quality	NOx, SOx, CO, PM10, TSP	Method: Field survey Location: Access road, residential and commercial area, port area
Noise		Method: Field survey Location: Same location as air quality survey
Seawater quality	Suspended Solids (SS)	Method: Field survey Location: Port basin, outside the port entrance, landfill outfall, reference site
	Temp., salinity, DO, pH, COD, HC, TN, TP, Fe, Mn, Cu, Hg, As, Cr, Al, Pb, Coliform, Chl-a	Method: Field survey Location: At least 5 stations
Sediment quality	Temp., colour, grain size, COD, HC, oxidation-reduction potential, TN, TP, Fe, Mn, Cu, Hg, As, Cr, Al, Pb	Method: Field survey Location: Dredging area and same location as water quality survey
Traffic volume		Method: Traffic counts during weekday and weekends Location: Access road
Socio-economic	Population, no. of households, annual income, occupation, relocation	Method: Interview survey, literature survey Scope: Salalah City

Source: JICA Study Team

ii. Environmental Impact Assessment method

Table 11.3-6 Proposed Methods for Environmental Impact Assessment (Salalah Port)

Environmental parameters	Assessment method
Air quality	Impact of vehicle traffic on the adjacent areas (e.g. residential, commercial, port area) should be assessed based on the expected increase in traffic volume in the construction and operation phase. The results should then be compared with the national or international standards.
Noise	Impact of vehicle traffic on the adjacent areas (e.g. residential, commercial, port area) should be assessed based on the expected increase in traffic volume in the construction and operation phase. The results should then be compared with the national standards.
Seawater quality (SS)	The SS dispersion should be predicted based on the available oceanographic info., landfill outfall discharge volume. The impact on the marine fauna should then be assessed.
Traffic volume	The expected increase of traffic volume during the construction and operation phase should be predicted based on the construction schedule and cargo increase. The impact on the access road should then be assessed.
Socio-economic	The impact on the livelihood of the local residents should be assessed for the construction and operation phase.

Source: JICA Study Team

iii. Environmental monitoring parameter

The following parameters are recommended for environmental monitoring.

- Air quality
- Noise
- Water quality
- Sediment quality
- Marine benthic species
- Mangrove forest
- Coastal erosion
- Local fishermen

3) Draft TOR of EIA of Sohar Port Development

i. Baseline study method

Table 11.3-7 Proposed Survey Parameters and Method for the Baseline Study (Sohar Port)

Environmental parameters		Survey method
Air quality	NOx, SOx, CO, PM10, TSP	Method: Field survey Location: Access road, residential and commercial area, port area, Sohar Port Industrial Area
Noise		Method: Field survey Location: Same location as air quality survey
Seawater quality	Suspended Solids (SS)	Method: Field survey Location: Port basin, outside the port entrance, landfill outfall, mangrove entrance, dumping site of excess dredge material
	Temp., salinity, DO, pH, COD, HC, TN, TP, Fe, Mn, Cu, Hg, As, Cr, Al, Pb, Coliform, Chl-a	Method: Field survey Location: At least 5 stations
Sediment quality	Temp., colour, grain size, COD, HC, oxidation-reduction potential, TN, TP, Fe, Mn, Cu, Hg, As, Cr, Al, Pb	Method: Field survey Location: Dredging area and same location as water quality survey
Groundwater	Temp., salinity, DO, pH, alkalinity, COD, HC, Fe, Mn, Cu, Hg, As, Cr, Al, Pb, Coliform, water level, flow direction	Method: Measurement of adjacent wells Location: Hinterland of port area, reference site
	Geological structure of the dredging and landfill area	Method: Literature survey of past boring survey
Traffic volume		Method: Traffic counts during weekday and weekends Location: Access road
Socio-economic	Population, no. of households, annual income, occupation, relocation	Method: Interview survey, literature survey Scope: Adjacent villages
Waste	Dumping site of excess dredged material	Method: Collection of existing data (bathymetry, current pattern, important ecological habitats), interview survey of local fishermen regarding fishing ground, review of London Convention

Source: JICA Study Team

ii. Environmental Impact Assessment method

Table 11.3-8 Proposed Methods for Environmental Impact Assessment (Sohar Port)

Environmental parameters	Assessment method
Air quality	Impact of vehicle traffic on the adjacent areas (e.g. residential, commercial, port area) should be assessed based on the expected increase in traffic volume in the construction and operation phase. The results should then be compared with the national or international standards.
Noise	Impact of vehicle traffic on the adjacent areas (e.g. residential, commercial, port area) should be assessed based on the expected increase in traffic volume in the construction and operation phase. The results should then be compared with the national standards.
Seawater quality (SS)	The SS dispersion should be predicted based on the available oceanographic info., landfill outfall discharge volume, dredging and dumping intensity. The impact on the mangrove forest, marine fauna and fisheries should then be assessed.
Groundwater	The impact of dredging and landfill on the local groundwater quality should be assessed based on the geological structure and past dredging and landfill cases of Sohar Port.
Traffic volume	The expected increase of traffic volume during the construction and operation phase should be predicted based on the construction schedule and cargo increase. The impact on the access road should then be assessed.
Socio-economic	The impact on the livelihood of the local residents should be assessed for the construction and operation phase.
Waste	The impact of the dumping of excess dredged material should be assessed.

Source: JICA Study Team

iii. Environmental monitoring parameter

The following parameters are recommended for environmental monitoring.

- Air quality
- Noise
- Water quality
- Sediment quality
- Groundwater quality

4) Draft TOR of EIA of Duqm Port Development

i. Baseline study method

Table 11.3-9 Proposed Survey Parameters and Method for the Baseline Study (Duqm Port)

Environmental parameters		Survey method
Air quality	NOx, SOx, CO, PM10, TSP	Method: Field survey Location: Access road, residential area, port area
Noise		Method: Field survey Location: Same location as air quality survey
Seawater quality	Temp., salinity, DO, pH, COD, SS, HC, TN, TP, Fe, Mn, Cu, Hg, As, Cr, Al, Pb, Coliform, Chl-a, TBT	Method: Field survey Location: At least 5 locations
Sediment quality	Temp., colour, grain size, COD, HC, oxidation-reduction potential, TN, TP, Fe, Mn, Cu, Hg, As, Cr, Al, Pb, TBT	Method: Field survey Location: Same location as water quality survey
Water circulation		Method: Literature survey, installation of 2 current meters for at least 15 days during the NE and SW monsoon season.
Coastal erosion / accretion		Method: Collection of meteorological data, installation of wave rider buoy during the NE and SW monsoon season, grain size analysis, cross-section survey
Ecosystem	Terrestrial and marine fauna	Method: Literature survey, interview survey of local fishermen and residents
	Birds	Method: Field observation during migration season, identification of nesting sites, interview survey of local resident
	Benthic biota	Method: Quadrat survey
Fisheries	Fishing ground, fishing method, target species, fish catch	Method: Interview survey of local fishermen
Socio-economic	Population, no. of households, annual income, occupation, relocation	Method: Interview survey, literature survey
Land / water use	Residential and commercial area, fishing ground	Method: Interview survey, literature survey, field reconnaissance
Infrastructure	Power and water supply facilities, waste treatment facilities in Duqm	Method: Interview survey, literature survey
Waste	Type of hazardous waste to be generated from port activities	Method: Interview survey, literature survey

Source: JICA Study Team

ii. Environmental Impact Assessment method

Table 11.3-10 Proposed Methods for Environmental Impact Assessment (Duqm Port)

Environmental parameters	Assessment method
Air quality	Impact of vehicle traffic on the adjacent areas (e.g. residential, commercial, port area) should be assessed based on the expected increase in traffic volume in the construction and operation phase. The results should then be compared with the national or international standards.
Noise	Impact of vehicle traffic on the adjacent areas (e.g. residential, commercial, port area) should be assessed based on the expected increase in traffic volume in the construction and operation phase. The results should then be compared with the national standards.
Seawater quality (SS)	The SS dispersion should be predicted based on the available oceanographic info., landfill outfall discharge volume and breakwater construction intensity. The impact on the marine fauna should then be assessed.
Water circulation	The expected alteration of water circulation pattern should be predicted using a simulation model.
Coastal erosion / accretion	The expected alteration of coastal morphology should be predicted using a simulation model.
Ecosystem (benthic biota)	The benthic biota that will be directly lost through the port construction should be quantified. Impact on the benthic biota should be assessed based on the expected increase in SS concentration.
(birds)	The impact of habitat loss on the migratory birds should be assessed.
Fisheries	The impact on the activities of the local fishermen should be assessed for the construction and operation phase.
Socio-economic	The impact on the livelihood of the local residents should be assessed for the construction and operation phase.
Land / water use	The impact on fishery operation, land use plan should be assessed.
Infrastructure	The impact on the local infrastructure should be assessed based on the expected demand for water, power and waste treatment in the construction and operation phase.

Source: JICA Study Team

iii. Environmental monitoring parameter

The following parameters are recommended for environmental monitoring.

- Air quality
- Noise
- Water quality
- Sediment quality
- Marine benthic species
- Migratory birds
- Coastal erosion
- Local fishermen
- Waste management

(4) Recommendation

In order to achieve sustainable development in the Sultanate of Oman, continued commitment must be taken to preserve the environmental quality. Together with current rise of environmental awareness in the world, demand to environmental consideration for development project has never been higher nationally and globally, and this trend is likely to continue.

In accordance with Law on the Conservation of Environment and Prevention of Pollution (Royal Decree 114/01) as the basic environment law of the Sultanate of Oman, any new development projects will require approval from MRENEWR, and for most large projects an EIA is required as the condition of the approval. Furthermore, in cases of newly established port like Sohar and Duqm, some parameters might be placed under occasional environmental monitoring by relevant agencies or entities in future.

To fulfill the above environmental requirements, as well as the demands to be envisaged in future, DGPMA should be aware of the sustainability of environment, and following steps may be taken in this respects:

- To take part positively of programs, which MRMEWR or other agencies convene to encourage consciousness and knowledge in terms of conservation of environmental quality.
- To manage environmental information (e.g. result of EIA, environmental permits and so on). It may be advisable that the utilization of proposed port IT system be served for this purpose.
- To observe regulations adequately to be stipulated by the MRMEWR, and to notify them to the relevant private entities where necessary.

Under the present and future circumstances of limited staff deployment in DGPMA, it is not practicable to designate a specific officer in charge of environmental issues. Instead, it is important that in each stage of planning, implementation and operation of port, responsible staffs be aware of environmental issue related to their task.

11.4 Preliminary Engineering and Cost Estimates of Priority Projects

As for priority projects, four projects have been selected, namely, the development of container berths at Sultan Qaboos Port, the development of a container yard, bulk berths and a passenger berth at Salalah Port, the development of container and bulk berths at Sohar Port, and the development of commercial, fishery and government berths and a ship yard at Duqm Port. In this section, the discussion on the above four projects has been carried out from the viewpoint of engineering and project costs. With respect to design standards, the following designs are based on the Technical Standards and Commentaries for Port and Harbour Facilities in Japan with supplemented by the British Standard.

11.4.1 Sultan Qaboos Port

(1) Preliminary Design

1) Design criteria

Design criteria for the new breakwater and quay wall at Sultan Qaboos Port have been determined as shown in Table 11.4-1.

Table 11.4-1 Design Criteria for Sultan Qaboos Port Development

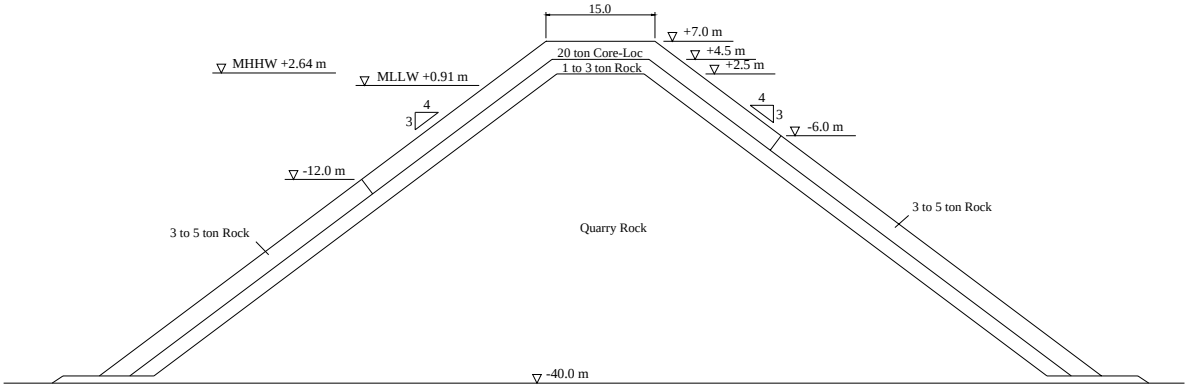
Item	Description
Design Wave	Wave height; 6.0 m, wave period; 12 s
Tidal Levels	MHHW +2.64 m CD MLHW +2.55 m CD MHLW +1.67 m CD MLLW +0.91 m CD LAT ±0.00m CD
Water Depth	-40.0m (breakwater) -16.0m (quay wall)
Depth of Channel & Basin	Turning basin; -16.0m Access channel; -16.5m
Soil Conditions	Sandy layer (within 3m beneath the seabed); N-value 20 Gravelly layer (below sandy layer); N-value 50
Design Vessels	Container ship 60,000DWT
Crest Elevations	Quay wall; +4.2m CD Breakwater; +7.0m CD
Seismic Condition	Not considered
Service Life Time	50 years

Source: JICA Study Team

2) Breakwater

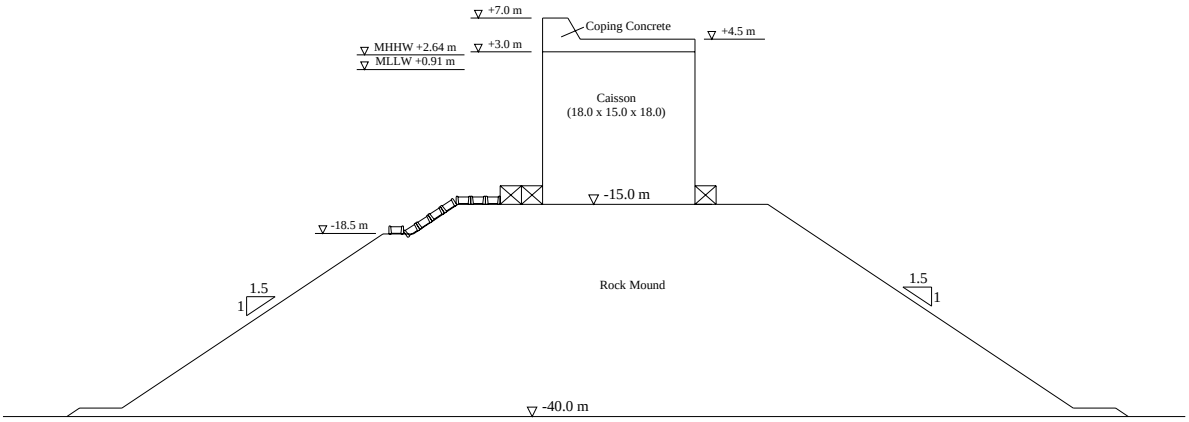
Comparative design between a rubble mound breakwater and a caisson breakwater has been conducted based on design criteria shown in Table 11.4-1. A typical cross section for a rubble mound breakwater is shown in Figure 11.4-1 and for a caisson breakwater in Figure 11.4-2.

Figure 11.4-1 Typical Cross Section of Rubble Mound Breakwater



Source: JICA Study Team

Figure 11.4-2 Typical Cross Section of Caisson Breakwater



Source: JICA Study Team

On the assumption that CORE-LOC will be applied for armour concrete blocks for the rubble mound breakwater, its weight has been calculated at 20 tons by using the Hudson Formula. Three- to five-ton rocks are placed below a depth equivalent to twice of the design wave height on the sea side and below a depth equivalent to the design wave height on the harbour side, because the weight of armour blocks can be reduced as armour blocks in the deep areas not affected by wave forces. Quarry rocks, which will be blasted from the rocky hill behind the port, will be transported by barges.

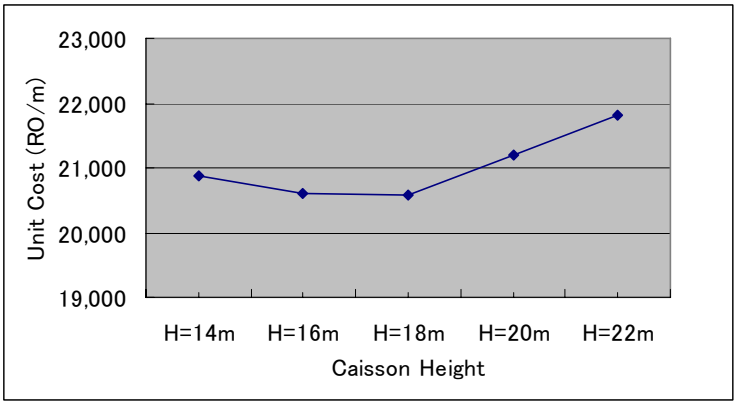
On the other hand, a caisson breakwater comprises a rock foundation made up of rock core protected with rock armour. This foundation supports a caisson box. The possibility of the caisson's sliding and overturning has been examined for a caisson breakwater, and its results are 1.5 against a safety factor

of 1.2 and 2.1 against a safety factor of 1.2, respectively. The bearing capacity of the rock mound is restricted to being within 60 tons / m^2 to prevent the collapse of the rubble mound. The weight of the caisson therefore needs to be approximately 2200 tons excluding the filling sand and cover concrete.

The unit cost of a caisson breakwater has been compared economically with changing its height by 2 m. According to the result shown in Figure 11.4-3, a caisson height of 18 m has been chosen for the representative of caisson breakwater. In selecting the size of the caisson box, it is assumed that four boxes can be manufactured at the same time on a floating dock of the 6,000, 8,000 or 10,000 ton class.

Concrete for the caisson box will be cast to a height of 3.0 m at a time using normal metal forms. It will take for approximately one and half months, which is one cycle, to manufacture four caisson boxes without preparatory works. If a sliding form is applied, caisson production will be done three times faster.

Figure 11.4-3 Comparison of Unit Cost of Caisson Breakwater



Source: JICA Study Team

The comparison between a rubble mound breakwater and a caisson breakwater is summarized in Table 11.4-2. The latter has a little advantage in unit cost, which is only 6% cheaper than that of the former. As a floating dock for caisson production will be set at the inside of the port and caissons will be placed temporarily inside the port as well, the port operation can be disturbed.

It is significant that the former can provide enough container yard space to operate efficient container handling. It would be necessary for provision of a wider container yard to blast the rocky hill behind the port, because the rubble mound type requires more rock materials than the caisson type. Local labourers are familiar with rubble mound breakwaters.

Therefore, a rubble mound type has been selected for the structure of the breakwater.

Table 11.4-2 Comparative Structure Analysis

	Rubble Mound Breakwater	Caisson Breakwater
Skill level	It is not necessary to require a large pool of skilled labour.	A more skilled pool of labour is required.
Influence on Port Operation	Though container yard near the sea will be used as a stacking yard for rock materials, there will be a little influence on the port operation.	Caissons will be anchored temporarily inside the port. Therefore, there will be a great influence on the port operation.
Area of New Container Yard*	24 ha	17 ha
Unit Cost	21,960 RO/m	20,580 RO/m
Construction Period	Approx. 3 years	Approx. 3.3 years

Note: New Container Yard will be developed by blasting the rocky hill behind the port.

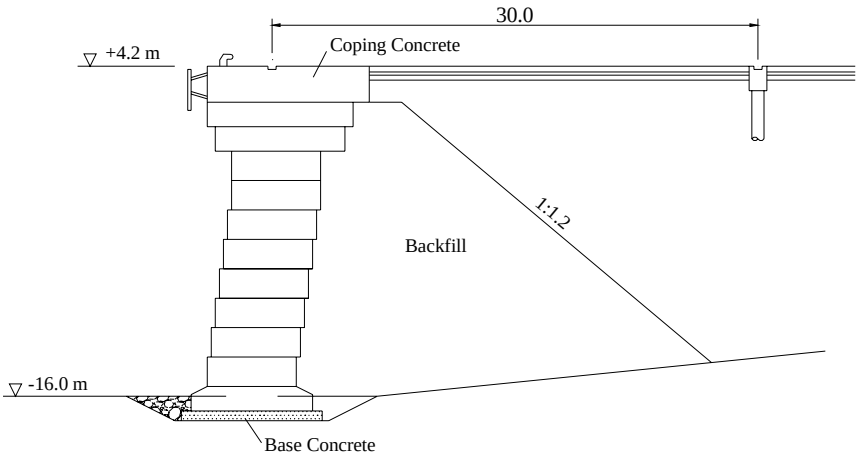
Source: JICA Study Team

3) Quay wall

Based on design criteria in the Progress Report, a pre-cast concrete block type has been selected for the structure of the quay wall. The depth in front of the quay wall has been assumed to be 16.0 m. An in-situ concrete type will be applied for base concrete and coping concrete, and pre-cast concrete will be applied for other concrete blocks. The average weight of pre-cast concrete blocks is 45 tons.

Steel pipe piles for the landside crane base should be driven up to the bearing soil layer. The diameter of steel pipe piles has been determined to be 800 mm. It is assumed that the wheel base of gantry crane is 30.0 m. A typical cross section is shown as follows.

Figure 11.4-4 Cross Section of Quay wall



Source: JICA Study Team

(2) Implementation Program

An implementation program has been examined with including the period for the design and tender stage. At first, the rocky hill behind the port will be blasted to provide a temporary container yard, and containers will be shifted from the existing container yard to the temporary container yard. The existing container yard near the sea will be used as a stacking yard of rocks, concrete blocks, etc. It is necessary to construct a breakwater in advance in order to ensure the calm conditions for vessels undertaking the quay wall construction. It is assumed that the tipping volume of core rocks is approximate 5,000 m^3 / day, namely, 1.5 m progress per day. After tipping the core, it is necessary to place armour concrete blocks soon, and 25 blocks have to be placed in a day to meet the planned schedule. Excavation of foundations for pre-cast concrete blocks will be conducted by grab dredger. Armour concrete blocks for the breakwater and pre-cast concrete blocks for the quay wall will be placed by using a floating crane.

With respect to working days, the following table was set up in the Master Plan Study (JICA, 1990). Windy days with an average wind speed of over 10 m/s were assessed as critical for offshore works.

Table 11.4-3 Annual Working Days

Description	Onshore Work (days)	Offshore Work (days)
Windy Days	-	15
Holidays	62*	6**
Annual Working Days	303	344
Monthly Average Working Days	25.3	28.7

Note: *Fridays and national holidays

**only national holidays

Source: Master Plan Study (JICA, 1990)

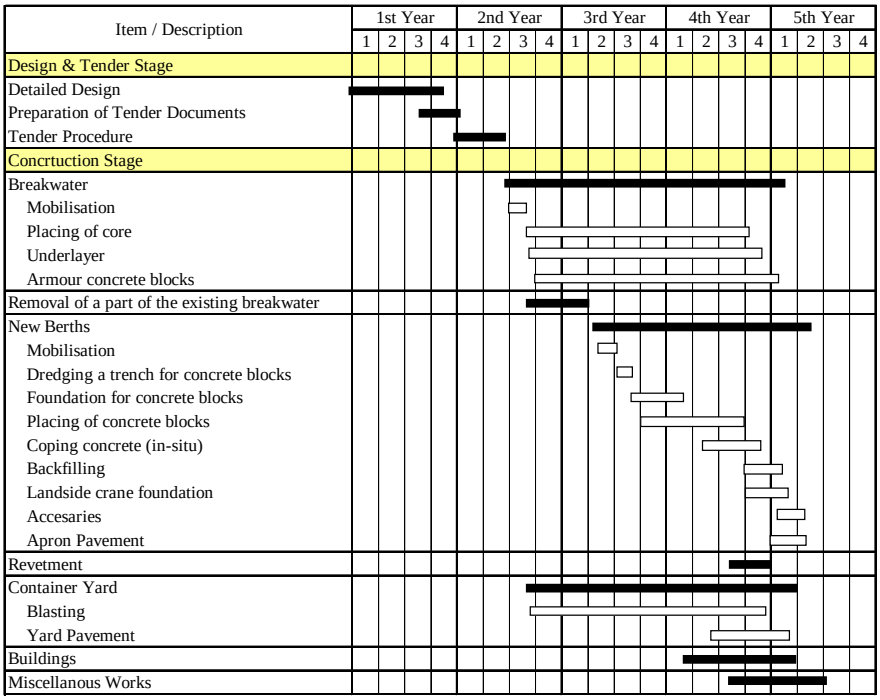
The main construction materials are described in Table 11.4-4. Quarry rock (5-1000 kg) and rock (1-5 tons) are assumed to be procured from the rocky hill behind the port. Based on the above information, the implementation program is shown in Figure 11.4-5.

Table 11.4-4 Main Construction Materials

Item	Unit	Quantity
Quarry rock (5-1000 kg)	m^3	4,000,000
Rock (1-5 tons)	m^3	710,000
Concrete	m^3	110,000
Armour concrete block	nos	13,000
Steel pipe pile	nos	140

Source: JICA Study Team

Figure 11.4-5 Preliminary Implementation Program for Sultan Qaboos Port Development



Source: JICA Study Team

(3) Preliminary Cost Estimate

1) Capital cost

The cost estimate has been carried out preliminarily based on the following conditions.

- Physical contingency is set at 10% for major works and 5% for equipment.
- Indirect cost for major works is set at 15%.
- Engineering services are set at 1-5% for major works, which varies in accordance with its amount, and 5% for equipment.
- Each unit cost of equipment is set up based on the actual purchase price by SPS and PSC.
- The exchange rate applied for the study is USD 1 = OR. 0.3845 = JPN 109.4 following the current rates on September 1, 2004.
- Inflation is not considered because the exchange rate of the USD against the OR.. in the Master Plan Study (JICA, 1990) was USD 1 = OR.. 0.385, which is almost the same as the current rate.
- Renovation cost is not considered.
- Construction of a cruise terminal at Sultan Qaboos Port is outside the scope of this project.
- Equipment is to be purchased by the private sector, and the construction works are to be financed by the government.

Unit costs of major works have been calculated as the sum of labour cost, fuel cost, material cost and equipment cost considering the unit costs in other projects such as Salalah Port, Sohar Port, etc. The cost data for the main items applied for the estimate are as follows.

Common labour	5.2 RO / day
Bar-bender	6.0 RO / day
Ready mixed concrete	25.0 RO / m^3
Reinforcement bar	250.0 RO / ton
Fuel (diesel)	0.0895 RO / litre
Fuel (bunker fuel)	0.13 RO / litre
Fuel (diesel)	0.0895 RO / litre

Based on the above conditions, the capital project cost has been estimated at OR. 87 million including the purchase cost of equipment. The result is shown in Table 11.4-5.

Table 11.4-5 Summary of Cost Estimate for Sultan Qaboos Port Development

Public Sector

Item of Major Works	Quantity	Unit	Unit Cost (RO)	Amount (M. RO)
Breakwater	1200	m	21,960	26.35
Replacement of a part of the existing breakwater	1	LS	840,000	0.84
Container berths	700	m	12,260	8.58
Pavement	320,000	m^2	24.60	7.88
Buildings	1	LS		1.40
Miscellanous works	1	LS		2.60
Total for all works				47.65
Physical contingency	10	%		4.77
Indirect cost	15	%		7.15
Engineering services (Design & Construction Supervision)	3	%		1.43
TOTAL				60.99

Private Sector

Item of Equipment	Quantity	Unit	Rate (RO)	Amount (M. RO)
Qantry crane (18 rows)	6	nos	2,300,000	13.80
RTG	12	nos	340,000	4.08
Tug (5000HP)	2	nos	2,300,000	4.60
Yard tractor	24	nos	34,000	0.82
Yard chassis	24	nos	7,300	0.18
Sub-total				23.48
Physical contingency	5	%		1.17
Engineering services	5	%		1.17
TOTAL				25.82

GRAND TOTAL				86.81

Source: JICA Study Team

2) Maintenance cost

Maintenance cost has been estimated preliminarily based on the following conditions.

- Estimated from 2010 to 2025.

- Equipment A (container gantry crane & RTG) has to be renewed in 20 years.
- Equipment B (trailer & chassis) has to be renewed in 10 years.
- Each rate of annual maintenance cost to capital cost has been determined by referring to similar projects in Oman and foreign countries.
- Those items in which the capital has been invested in the capital by the government will be maintained by the government, and the same approach applies to the items financed by the private sector.

The annual maintenance cost has been estimated at OR. 0.8 million, which is composed of OR. 0.1 million by the public sector and OR. 0.7 million by the private sector, except for renewal costs of equipment. The result is shown in Table 11.4-6.

Table 11.4-6 Maintenance Cost at Sultan Qaboos Port Unit: million R.O.

	Investment	Rate	2010	2011	2012	2013	2014	2015	2020	2025
Breakwater	33.7									
Terminal	27.3	0.2%	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Equipment-A	19.7	2.5%	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Equipment-B	6.2	2.5%	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Total annual maintenance cost			0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8

Source: JICA Study Team

(4) Engineering Aspects

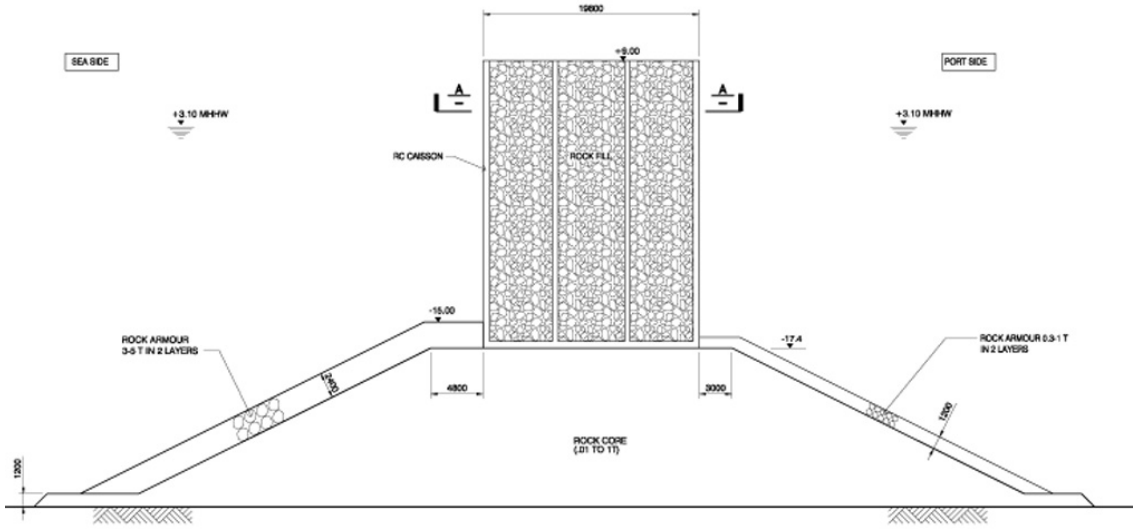
The occurrence of calm conditions in the port area, where wave height is below 0.5 m, has been calculated at about 95% based on the Master Plan Study (JICA, 1990). As there is very little wave data, waves have also been predicted by means of the SMB method by using wind data observed at Seeb Airport and the calmness has been confirmed to be about 95%.

Considering the scale of the port development, the base data is not adequate to finalize the layout of the breakwater. Wave observations at the proposed site of the breakwater should be carried out for at least one year. Based on observed data, the effectiveness of the proposed breakwater layout should be verified by model testing. It is desirable that the breakwater should be extended further, if necessary.

As a caisson breakwater has a thick rock mound, there is a possibility to cause the impulsive pressure acting to the caisson due to breaking waves. It should be verified by model testing as well.

Halcrow proposed a caisson breakwater as shown in Figure 11.4-6. Detailed information such as cost information is not available. If such information is available, it is possible that some examinations on his caisson breakwater will be carried out.

Figure 11.4-6 Cross Section of Breakwater proposed by Halcrow



Source: PSC

11.4.2. Salalah Port

(1) Preliminary Design

1) Design criteria

Design criteria for the quay wall at Salalah Port have been determined as shown in Table 11.4-7.

Table 11.4-7 Design Criteria for Salalah Port Development

Item	Description
Tidal Levels	MHHW +1.68 m CD MLHW +1.64 m CD MHLW +1.33 m CD MLLW +0.65 m CD LAT ±0.00 m CD
Water depth at Construction Site	varies
Water Depth of Berths	Container berth; -16.0m Bulk berth; - 16.0m Oil Jetty; -16.0m Passenger berth; -10.0m
Soil Conditions	Sand layer (within 3m beneath the seabed) Limestone layer (below sand layer); N-value over 50
Design Vessels	Container ship; 60,000DWT Bulk carrier; 60,000DWT Tanker; 35,000DWT Passenger ship; 70,000GT
Crest Elevation	Quay wall; +4.0m CD
Seismic Condition	Not considered
Service Life Time	50 years

Source: JICA Study Team

2) Berths 30 & 31

By referring to the structural design of the landside crane base at berths 1-4, the crane base at berths 30-31 is expected to use steel pipe piles with a diameter of 800 mm more or less. Though the existing cross section of berths 30-31 is not available, it is assumed that the seaside crane base can be provided on the top of the existing berth structure. Dimensions of steel pipe piles such as diameter, thickness, length and so on, depend on the soil condition.

At present, there is no pavement at the bulk yard behind berths No.30-31. It is necessary to carry out paving of the surface of the bulk yard in order to convert it to a container yard.

3) New bulk berths

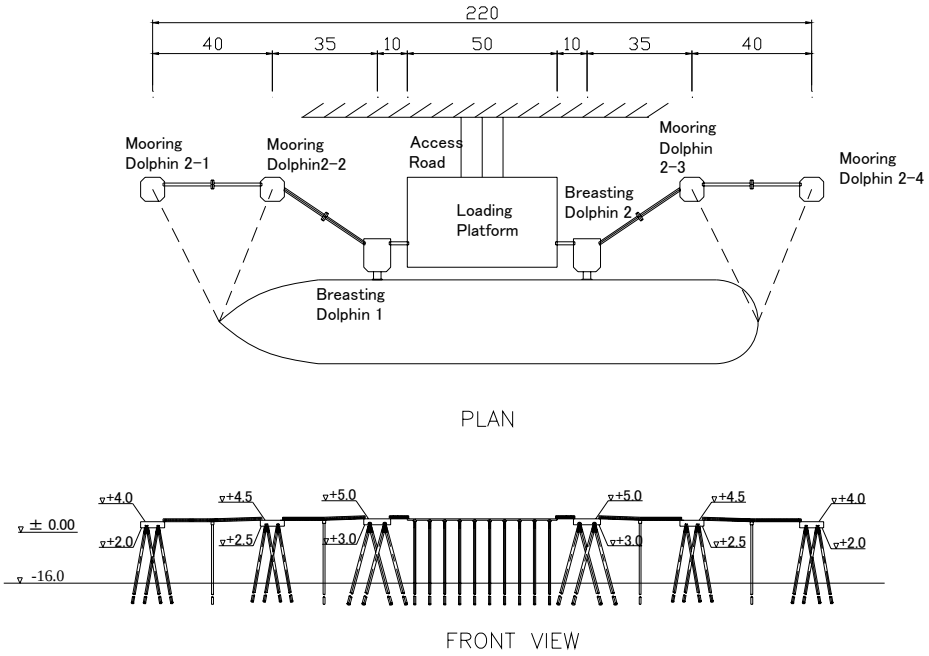
Considering the structural design at berths 1-6, pre-cast concrete block type has been selected for the structure of the quay wall. The depth in front of the quay wall has been determined to be 16.0 m. As it is assumed that mobile cranes will be engaged in handling bulk cargo, a crane base is not required.

4) Oil jetty

The existing oil jetty is located at the site of the future passenger berth, beside new bulk berths. It will be necessary to abandon the existing oil jetty and to construct the new oil jetty to the rear of the new breakwater with considering the safety of port operation. Drawings of the existing oil jetty are not available at the moment.

According to the Master Plan Study (JICA, 2000), the maximum capacity of the oil jetty is a 35,000 DWT of tanker. It is assumed that the oil jetty consists of one plat form, two breasting dolphins and four mooring dolphins. The diameter of batter piles is 1000 mm and that of vertical piles is 700 mm. Installation of oil pipe line is outside the scope of this study. Figure 11.4-7 shows the layout plan and front view of the oil jetty.

Figure 11.4-7 Plan and Front View of Oil Jetty



Source: JICA Study Team

5) Passenger berth

There will be a little opportunity, ten times in a year, for passenger vessels to make use of the passenger berth. Therefore, while passenger vessels are not using the berth, it is better to have flexibility not only for passenger vessels but also for other vessels such as government ships. That is the reason why pre-cast concrete block type has been selected for the passenger berth with a depth of 10.0 m. As for the passenger terminal building, it needs to express a sense of being a symbol as an "entrance". This work should be started as soon as possible, because it will take a long time to develop this image.

(2) Implementation Program

Considering the different design procedures, the implementation program can be separated into two, one for the container yard at berths 30&31 and the new bulk berths (Salalah Port Development (A)), and another for the oil jetty and the passenger berth (Salalah Port Development (B)). Though revetments will form a frame of the reclamation area and they will be constructed at the construction stage of berths 5&6, only excess dredged material will be dumped into the inside of the frame. Therefore, the dredging work will be required for the reclamation. That is the reason why a cutter suction dredger is recommended because of its discharge pipe line system.

The berth structure will be constructed in front of the revetments. It is expected that pre-cast concrete blocks will be placed by floating crane. Excavation of the foundation for pre-cast concrete blocks will be conducted by grab dredger.

A pile driving barge will be engaged in driving the steel pipe piles for the oil jetty. Its average driving

speed is expected to be two piles per day.

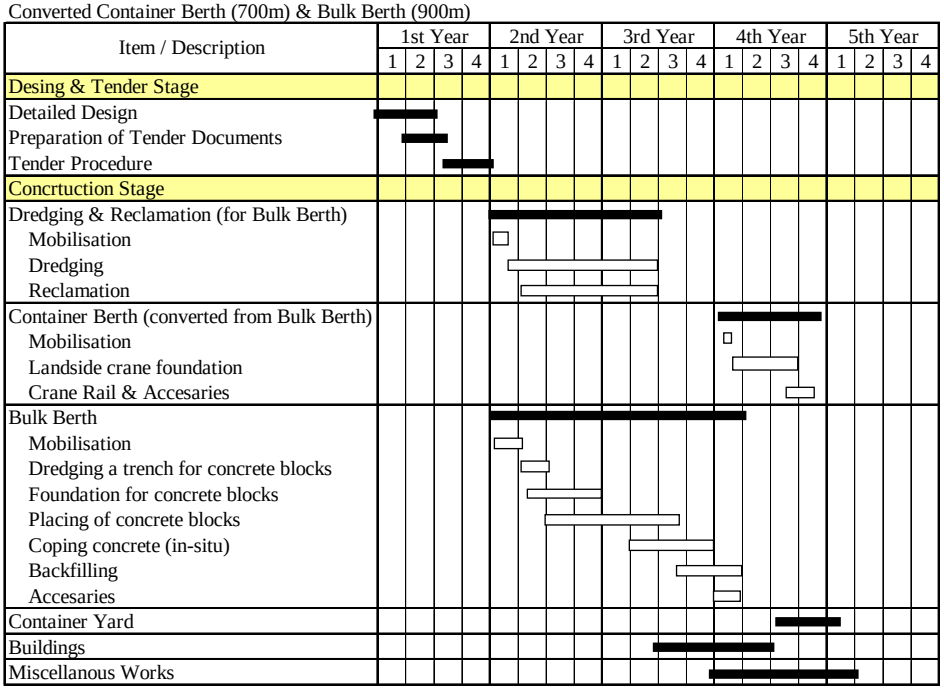
Offshore working conditions at Salalah Port are expected to be better than that at Sultan Qaboos Port, because the site is sheltered by a breakwater. However, as there is no other data available, the implementation program has been prepared in accordance with Table 11.4-3. The main construction materials are summarized in Table 11.4-8. Based on the above data, implementation programs are shown in Figure 11.4-8 and 11.4-9.

Table 11.4-8 Main Construction Materials

Item	Unit	Quantity
Dredged material	m^3	6,400,000
Concrete	m^3	200,000
Steel pipe pile	nos	96

Source: JICA Study Team

Figure 11.4-8 Preliminary Implementation Program for Salalah Port Development (A)



Source: JICA Study Team

Figure 11.4-9 Preliminary Implementation Program for Salalah Port Development (B)

Passenger Berth & Oil Jetty

Item / Description	1st Year				2nd Year				3rd Year				4th Year			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Desing & Tender Stage																
Detailed Design																
Preparation of Tender Documents																
Tender Procedure																
Concrtuction Stage																
Dredging & Reclamation (for Passenger Berth)																
Mobilisation																
Dredging																
Reclamation																
Passenger Berth																
Mobilisation																
Dredging a trench for concrete blocks																
Foundation for concrete blocks																
Placing of concrete blocks																
Coping concrete (in-situ)																
Backfilling																
Pavement																
Accesaries																
Oil Jetty																
Mobilisation																
Driving of Steel Pipe Pile																
Superstructures																
Accearies																
Paasenger Building																
Miscellanous Works																

Source: JICA Study Team

(3) Cost Estimate

1) Capital cost

The capital project cost has been estimated preliminarily based on the same conditions as in section 11.4.1 (3) 1), and its result is OR. 71 million including equipment cost. It is assumed that rock materials can be obtained at a quarry, which is 5 km far from Salalah Port. The result is shown in Table 11.4-9.

Table 11.4-9 Summary of Cost Estimate for Salalah Port Development

Public Sector: Converted Container Berth (700m) & Bulk Berth (900m)

Item of Major Works	Quantity	Unit	Unit Cost (RO)	Amount (M. RO)
Dredging & Reclamation	5,200,000	m3	1.09	5.67
Container Berth (converted from Bulk berth)	700	m	1,014	0.71
New Bulk Berths	900	m	9,000	8.10
Container Yard Pavement	230,000	m2	25	5.75
Buildings	1	LS		0.50
Miscellanous works	1	LS		3.90
Total for all works				24.63
Physical contingency	10	%		2.46
Indirect cost	15	%		3.69
Engineering services	4	%		0.99
TOTAL				31.77

Public Sector: Passenger Berth & Oil Jetty

Item of Major Works	Quantity	Unit	Unit Cost (RO)	Amount (M. RO)
Dredging & Reclamation	1,200,000	m3	1.29	1.55
Passenger Berth	340	m	10,353	3.52
Oil Jetty	1	LS		1.21
Passenger building	1	LS		0.40
Miscellanous works	1	LS		1.75
Total for all works				8.43
Physical contingency	10	%		0.84
Indirect cost	15	%		1.26
Engineering services	5	%		0.42
TOTAL				10.95

Private Sector

Item of Equipment	Quantity	Unit	Rate (RO)	Amount (M. RO)
Qantry crane (18 rows)	6	nos	2,300,000	13.80
RTG	12	nos	340,000	4.08
Mobile crane (60t)	3	nos	300,000	0.90
Tug (5000HP)	2	nos	2,300,000	4.60
Yard tractor	24	nos	34,000	0.82
Loader/Unloader	1	nos	1,200,000	1.20
Sub-total				25.40
Physical contingency	5	%		1.27
Engineering services	5	%		1.27
TOTAL				27.94

GRAND TOTAL				70.66

Source: JICA Study Team

2) Maintenance cost

The annual maintenance cost has been estimated at OR. 0.8 million, which is almost predominantly by the private sector, except for the renewal cost of equipment based on the same condition as section 11.4.1 (3) 2). The result is shown in Table 11.4-10.

Table 11.4-10 Maintenance Cost at Salalah Port Unit: million R.O.

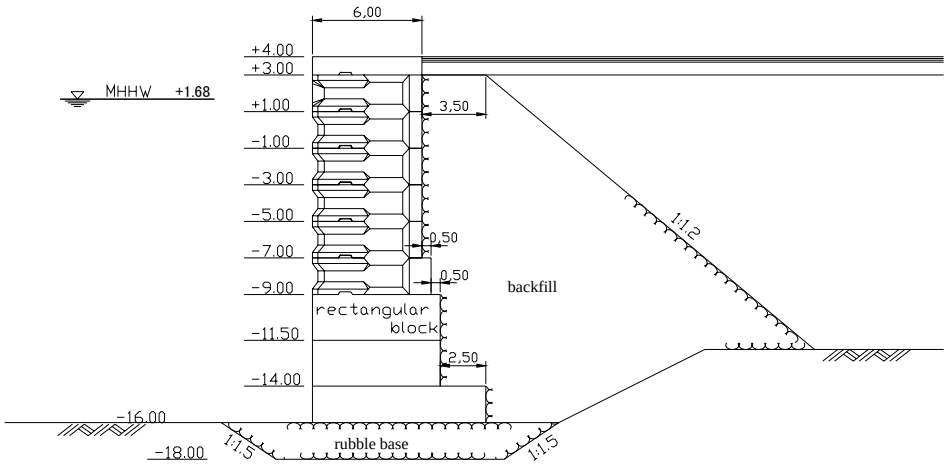
		(Rate)	2007	2008	2009	2010	2011	2015	2020	2025
Dredging	9.3					0.0	0.0	0.0	0.0	0.0
Terminal	32.2	0.2%				0.0	0.1	0.1	0.1	0.1
Building	1.2	0.5%				0.0	0.0	0.0	0.0	0.0
Equipment-A	19.7	2.5%				0.2	0.5	0.5	0.5	0.5
Equipment-B	8.3	2.5%				0.1	0.2	0.2	0.2	0.2
Total Maintenance cost (Mil RO/Yr)						0.4	0.8	0.8	0.8	0.8

Source: JICA Study Team

(4) Engineering Aspects

As mentioned above, pre-cast concrete block type has been selected for the structural design of the bulk berths. If it is important to restrain the surge problem, the structure of the bulk berths should have the function of dissipating the wave energy. As a sample of pre-cast concrete block that is dissipating wave energy, a quay wall applying “Warock” is shown in Figure 11.4-10. The construction cost of bulk berths with using Warock is increased by approximate 7%, namely, OR. 0.8 million. This block is used for the revetment at Kashima Port as well, and it has the advantage of providing not only dissipation of wave energy but wider channel or turning basin as it does not need armour concrete blocks in front of it.

Figure 11.4-10 Sample of Pre-cast Concrete Block Quay wall with Dissipating Wave Energy



Source: JICA Study Team

11.4.3. Sohar Port

(1) Preliminary Design

1) Design criteria

Design criteria for the quay wall at Sohar Port have been determined as shown in Table 11.4-11.

Table 11.4-11 Design Criteria for Sohar Port Development

Item	Description
Tidal Levels	MHHW +2.72 m CD MLHW +2.61 m CD MHLW +1.67 m CD MLLW +0.83 m CD LAT ±0.00 m CD
Water depth at Construction Site	±0.0 m (quay wall and temporary revetment)
Water Depth of Basin & Channel	Turning basin; -16.0 m (Access channel; -16.5 m)
Soil Conditions	Loose sediments (within 4m beneath the seabed) Sandy silt or silty sand layer (10m thick below loose sediments); N-value 10-30 Sandstone (below sandy silt or silty sand layer); N-value over 50
Design Vessels	Container ship 60,000DWT
Crest Elevation	Quay wall; +4.6m CD
Seismic Condition	Not considered
Service Life Time	50 years

Source: JICA Study Team

2) Bulk berths & container berth

Pre-cast concrete block type has been selected for the structure of the quay wall, because it was applied for the berth structures that have already been constructed. The depth in front of the quay wall is determined to be 16.0 m, the same as that of the existing berths. It is assumed that a belt conveyer will be equipped from the berth directly to the production plant in the bulk berths. It is necessary for the container berth to provide a container crane base. Steel pipe piles with a diameter of 800 mm are to be driven at intervals of 5.0 m.

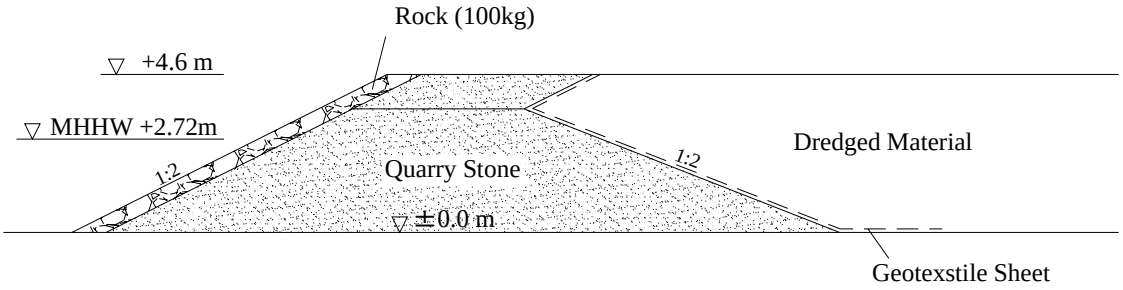
3) Temporary revetment

In order to mitigate the environmental impact on marine ecology around the dumping area by dumping

dredged materials, and to utilize dredged materials effectively, a temporary revetment will be constructed between the bulk berths and the container berth, and some dredged materials which are suitable for reclamation will be discharged into it.

As it is located at the inside of the port with a depth of around 0.0 m, armour stones are not required. However, the weight of the primary layer is determined to need to be over 100 kg with considering the stability of the slope. Of course, a berth structure in front of the temporary revetment will be constructed in the future. Figure 11.4-11 shows a typical cross section of the temporary revetment.

Figure 11.4-11 Typical Cross Section of Temporary Revetment



Source: JICA Study Team

(2) Implementation Program

As the original area is very shallow, a significant soil volume has to be dredged. It has been estimated at 18.0 million m^3. As there will be, however, no onshore dumping area except for the onshore dumping area framed by the temporary revetment with its capacity of 2.0 million m^3, dredged material of 16.0 million m^3 has to be dumped offshore. It is assumed that the dumping area is 20 km offshore in accordance with the EIA report (WS Atkins, 1999).

The soil condition to be dredged is expected to be medium sand with an N-value of 10-30. Though a trailer suction dredger is speedy, it can not dredge a sand layer with an N-value of more than 20 due to not having a cutter head. Therefore, the programme of dredging operation requires careful consideration. It is recommended that a trailer suction dredger and a cutter suction dredger should be engaged together.

The berth structure will be constructed in front of the existing revetment. It is expected that pre-cast concrete blocks will be placed by floating crane. Excavation of the foundation for pre-cast concrete blocks will be conducted by grab dredger in advance.

With respect to pile driving for the landside base of the container crane, this work will be carried out from the land because it is so shallow that the pile driving barge can not reach the site. Its average driving speed is expected to be three piles per day.

Considering the EIA report on Sohar Port (WS Atkins, 1999), it was assumed that rock (100 kg) can be obtained at Jabel Shaykh, which is approximately 20 km far from Sohar Port.

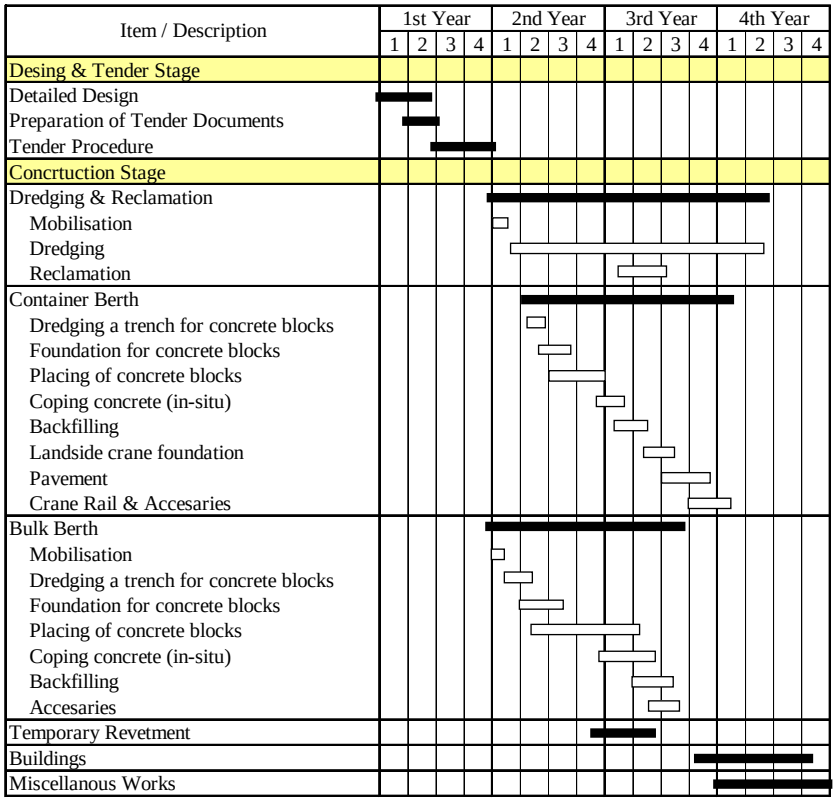
Offshore working conditions at Sohar Port are expected to be better than that at Sultan Qaboos Port, because the site is sheltered by breakwaters. However, as there is no other data available, the implementation program has been prepared in accordance with Table 11.4-3. The main construction materials are summarised in Table 11.4-12.

Table 11.4-12 Main Construction Materials

Item	Unit	Quantity
Dredged material	m^3	18,000,000
Concrete	m^3	140,000
Rock (1-3 tons)	m^3	12,000
Steel pipe pile	nos	70

Source: JICA Study Team

Figure 11.4-12 Preliminary Implementation Program for Sohar Port Development



Source: JICA Study Team

(3) Cost Estimate

1) Capital cost

The capital project cost has been estimated preliminarily based on the same conditions as section 11.4.1 (3) 1), and its result is OR. 58 million, which includes only container handling equipment as for equipment cost. A summary of the cost estimate is shown in Table 11.4-13.

Table 11.4-13 Summary of Cost Estimate for Sohar Port Development

Public Sector

Item of Major Works	Quantity	Unit	Unit Cost (RO)	Amount (M. RO)
Dredging (offhore dumping)	15,900,000	m^3	1.10	17.49
Dredging (onhore dumping) & Reclamation	2,100,000	m^3	1.60	3.36
Container Berth	350	m	8,771	3.07
Bulk Berth	600	m	7,667	4.60
Temporary Revetment	1,100	m	418	0.46
Container Yard Pavement	140,000	m2	25.0	3.50
Buildings	1	LS		0.80
Miscellanous works	1	LS		3.53
Total for all works				36.81
Physical contingency	10	%		3.68
Indirect cost	15	%		5.52
Engineering services	4	%		1.47
TOTAL				47.48

Private Sector

Item of Equipment	Quantity	Unit	Rate (RO)	Amount (M. RO)
Qantry crane (18 rows)	3	nos	2,300,000	6.90
RTG	6	nos	340,000	2.04
Yard tractor	12	nos	34,000	0.41
Yard chassis	12	nos	7,300	0.09
Sub-total				9.44
Physical contingency	5	%		0.47
Engineering services	5	%		0.47
TOTAL				10.38

GRAND TOTAL				57.86

Source: JICA Study Team

2) Maintenance cost

The annual maintenance cost has been estimated at OR. 0.4 million, which is composed of OR. 0.2 million each by the public and the private sectors, except for the renewal cost of equipment based on the same condition as section 11.4.1 (3) 2). The result is shown in Table 11.4-14.

Table 11.4-14 Maintenance Cost at Sohar Port Unit: million R.O.

	Investment	Rate	2010	2011	2012	2013	2014	2015	2020	2025
Dredging	26.9	0.5%	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Terminal	20.6	0.5%	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Equipment-A	9.8	2.5%	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Equipment-B	0.6	2.5%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total annual maintenance cost			0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4

Source: JICA Study Team

(4) Engineering Aspects

There is a problem of beach erosion in the northern part of Sohar Port. This problem may be caused mainly by the construction of breakwaters. Accordingly, the dredging of the inside of the basin will not have a great influence on beach erosion.

Sohar Port will start regular port operation in 2006. Therefore, it is important to programme the dredging operation so it will not disturb the port operation. The main characteristics of the three types of dredger are summarised as below. Of course, soil investigation is very significant for the programme.

1) Trailer suction dredger

- As a trailer suction dredger has a hopper in itself, assistant vessels are not required.
- A trailer suction dredger is a self-propelled vessel with suction pipes from one or from both sides. When the hopper is full, the vessel proceeds to the dumping area.
- It is often used at sites where vessel traffic is heavy because of its ability to manoeuvre as a ship.
- The speed is 13 knots during sailing and 2 knots during dredging.
- There are some large dredgers with hopper sizes of over 10,000m^3. In the case of dredgers in the hopper size of 10,000 m^3 class, monthly dredging productivity amounts to 1 million m^3.
- It is suitable for sand layers with an N-value of less than 20.

2) Cutter suction dredger

- It is particularly suited for reclaiming purposes because dredged material is discharged directly into the reclamation area.
- As a cutter head is equipped, it can dredge a soft rock layer as well.
- There are some powerful cutter suction dredgers with a power of over 10,000 PS.
- Though monthly dredging productivity and discharge distance depend on the site condition, large cutter suction dredgers can dredge loose sand at a rate of 800,000 m^3 monthly with discharge distance of 3 km.
- An anchor boat is required because a cutter suction dredger can not move by itself.

3) Grab dredger

- There are some grab dredgers with a large grab of over 25 m^3.
- A common group of ships consists of an anchor boat, a sand transportation barge and a tug boat in addition to the grab dredger.
- A simple composition of a grab dredger is just a crane on a pontoon.
- It is suitable for a small scale dredging such as trench excavation for gravity-type berth structure and so on.
- In the case of a grab dredger with a grab size of 23 m^3, the monthly productivity of dredging loose sand is calculated at 300,000 m^3.
- If a heavy grab is applied, it is possible to dredge any soft rock layer as well.

11.4.4. Duqm Port

(1) Preliminary Design

1) Design criteria

Design criteria for the quayside facilities at Duqm Port have been summarized as shown in Table 11.4-15.

Table 11.4-15 Design Criteria for Duqm Port Development

Item	Description
Design Wave	Wave height; 5.8m, wave period; 10s
Tidal Levels	MHHW +2.36 m CD MLHW +2.29 m CD MHLW +1.48 m CD MLLW +0.70 m CD LAT ±0.00 m CD
Water Depth at Construction Site	-1.0m (quay wall) 0.0-12.0m (breakwater)
Water Depth of Channel & Basin	Turning basin; -10.0m (Access channel; -12.0m)
Soil Conditions	Loose sediments (within 4m beneath the seabed) Mudstone or siltstone (below loose sediments)
Design Vessels	5,000DWT (shipyard)
Crest Elevation	Quay wall; +5.0m CD
Seismic Condition	Not considered
Service Life Time	50 years

Source: JICA Study Team

1) Breakwater

Rubble mound type has been selected for the structure of the breakwater with reference to the Feasibility Study (Haskoning, 2004). The weight of armour concrete blocks is calculated at 10.0 tons with using CORE-LOC and their slope is to be 1 to 1.5. Data on the natural condition at Duqm such as wind data, wave data, etc, was not available during the first study in Oman. As there is no sub-breakwater at Salalah Port, it should be confirmed what length of sub-breakwater at Duqm is really needed.

2) Quay wall

Pre-cast concrete block type has been selected for the structure of the commercial berth with reference to the Feasibility Study (Haskoning, 2004). The depth in front of the commercial berth has been determined to be 10.0 m.

(2) Implementation Program

The port development at Duqm will require significant dredging volume, which is estimated at 13.0 million m^3. Once the breakwaters provide the appropriate calmness, the dredging work will begin. Most of the dredged materials are expected to be unsuitable for reclamation because they are too fine. A consultant named Haskoning proposed not offshore but onshore dumping to minimize the project cost. A cutter suction dredger will be suitable for the dredging work.

From the site reconnaissance, there is only a narrow and dirt road connecting the main road and the port. It is necessary at the beginning of the construction to prepare a wide road with satisfactory bearing capacity in order to provide access for heavy construction machinery and materials. At the detailed design stage, additional soil investigations around the access road should be carried out.

From the interview with Haskoning, the nearest quarry site for rock material is located around the mouth of Wadi Darqast, 20km from Duqm Port. The implementation program will be influenced by the breakwater construction and its related quarrying operations. Therefore, it should be confirmed whether those quarries can provide enough volume and quality of rock materials to construct the breakwaters.

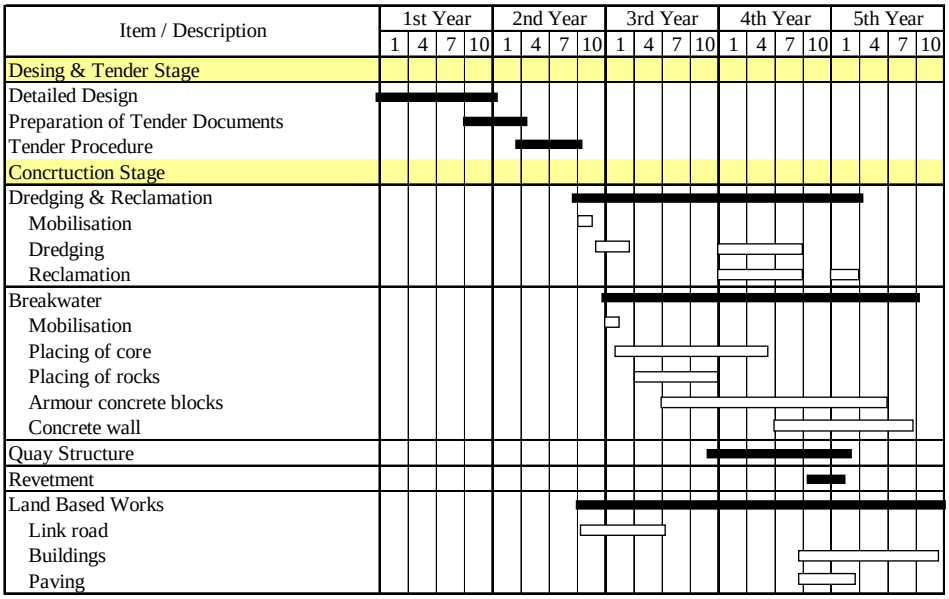
The offshore working conditions at Duqm Port are expected to be worse than that at Sultan Qaboos Port, especially during the SW monsoon season. Therefore, the implementation program is shown in Figure 11.4-13 allowing for the SW monsoon. The main construction materials are summarised in Table 11.4-16.

Table 11.4-16 Main Construction Materials

Item	Unit	Quantity
Dredged material	m^3	13,000,000
Armour concrete block	m^3	120,000
Rock (core)	m^3	1,300,000
Rock (armour)	m^3	340,000

Source: JICA Study Team

Figure 11.4-13 Preliminary Implementation Program for Duqm Port Development



Source: JICA Study Team

(3) Cost Estimate

1) Capital cost

Duqm Port is different from the other three ports on the point that a tugboat and guiding vessels will be provided by the public sector. Shipyard facilities for large vessels such as 50,000 DWT and 100,000 DWT has not been considered in the short term plan. The capital project cost has been estimated at a total of OR. 79 million, which is composed of OR. 76.5 million by the public sector and OR. 2.5 million by the private sector.

Table 11.4-17 Summary of Cost Estimate for Duqm Port Development

Public Sector

Item of Major Works	Quantity	Unit	Unit Cost (RO)	Amount (M. RO)
Dredging (onshore dumping)	12,600,000	m^3	1.30	16.38
Reclamation	3,000,000	m^3	1.40	4.20
Breakwater	3000	m	4,977	14.93
Commercial Jetty	380	m	6,526	2.48
Revetment	300	m	1,933	0.58
Buildings	1	LS		2.49
Government Facilities	1	LS		5.56
Shipyard - 5000t	1	LS		2.99
Port Support Infrastructure	1	LS		8.04
Total for all works				57.65
Physical contingency	10	%		5.77
Indirect cost	15	%		8.65
Engineering services	3	%		1.73
TOTAL				73.80

Item of Equipment	Quantity	Unit	Rate (RO)	Amount (M. RO)
Shipping Supporters	1	LS		0.20
Tug and Guiding vessels	1	LS		2.19
Sub-total				2.39
Physical contingency	5	%		0.12
Engineering services	5	%		0.12
TOTAL				2.63

SUB TOTAL				76.43

Private Sector

Item of Equipment	Quantity	Unit	Rate (RO)	Amount (M. RO)
Equipment for Commercial Jetty	1	LS		1.45
Equipment for Shipyard	1	LS		0.77
Sub-total				2.22
Physical contingency	5	%		0.11
Engineering services	5	%		0.11
TOTAL				2.44

GRAND TOTAL				78.87

Source: JICA Study Team

2) Maintenance cost

Based on the Feasibility Study (Haskoning, 2004), the annual maintenance cost is OR. 0.31 million, which is composed of OR. 0.14 million by the public sector and OR. 0.17 million by the private sector except for the renewal cost of equipment with applying the same conditions as in section 11.4.1 (3) 2).

(4) Engineering Aspects

The sub-breakwater is about 300 m shorter than that proposed by Haskoning because the capital cost would be minimized by the reduction. From the viewpoint of sedimentation, it is said that the critical water depth for sediment movement is usually -8.0 ～ -10.0m, which depends mainly on wave height and average grain size. However, the depth at the edge of the sub-breakwater is preliminary set at -6.0 m as shown in Figure 11.1-12 because waves coming to the port entrance will be refracted by the main breakwater.

Though physical analyses on the Trial Pit such as sieve analysis were recommended additionally in the Progress Report, no physical analysis results are available except for moisture content results. When additional data are available, the critical water depth for sediment movement should be checked.

On the assumption that d_{50}, the average grain size of sediment, is 50 μm, the critical water depth for sediment movement has been calculated at -6.0 ～ -8.0 m. Therefore, it may be reasonable that the sub breakwater can be shortened up to the depth of -6.0 m. If the sedimentation happens or the required calmness can not be obtained, the breakwater should be extended.

11.5 Management, Operation and Financing Scheme of Priority Projects

This Section deals with so-called 'Soft Issues', i.e. improvement or upgrading of management, operation, manning and some administrative issue of the priority ports. Present scheme of major port management is following the basic direction of the country's privatization policy, and the port authorities are the form of public joint stock company (SAOG). Within the limited period, change of the privatization policy is not envisaged, since the planning period is likely less than ten years. It is reasonable to assume that for the foreseeable future, the form and the management body of major port will continue as it is.

11.5.1 Sultan Qaboos Port

Present Concession Agreement shall terminate at the end of 2006. In the light of current record of financial account, and in order not to interrupt operation in the transition period of the contract, it will be justifiable that GSO rewards concession to PSC {see 10.11.4 (1) 1) }.

However, the performance is not entirely satisfactory to GSO as well as customers. Followings are the issues:

(1) Expediting Decision Making

1) Sultan Qaboos port trails competitors of the region in terms of certain cargo-handling equipment and computerization of container handling. This situation is partly due to the decision-making procedure.

i. Day to day management and operation are conducted by the executive branch of PSC, headed by the Executive President. The Executive President is also the Secretary to the Board of Directors, but he is not assigned to be neither the Chairman nor a Member of the Board, the supreme body of PSC.

ii. According to PSC's procurement rule, purchase of goods and services, and contracts above R.O.40,000 up to 150,000 R.O. are decided by the Board Audit Committee (BAC). Purchases and contracts above 150,000 R.O. by the Board of Directors based upon the recommendation of BAC.

iii. Decision process of the Board and the Committee is cumbersome and time-consuming, since each member's signature is required.

Above arrangements in terms of procurement of goods and services may be useful for protecting PSC from over-investment or excessive spending, however, delay of investment to catch up with neighbouring terminals' technological evolution make it difficult to respond the customers' requirements properly.

2) Balance between bold and cautious approach can enhance effective operations while still ensuring a financially sound port. It seems that PSC is tilting towards a cautious approach at this moment, but given that PSC has enjoyed good financial results in recent years it may be a good time to adjust the tilt.

Following arrangements are recommended to improve the decision-making process.

i. The number of Board members has recently been reduced from 12 to seven, three of whom are government officials (no representative from port background), and four come from private interests. There is no representation from the executive side. It is felt that timely management decision can only be made by the executive branch, and the president = CEO should be a member of the Board, or even the chairman like at many other organizations.

ii. In the decision-making procedure, signature of each member is a redundant requirement. A record of decision is sufficient for keeping corporate governance.

iii. Although the Auditing Committee is a compulsory organ, assessing each tender beyond a certain amount is going too far. The function is to evaluate the expense of the executive branch. It is desirable that the Auditing Committee abolishes the practice of intervening in the process of individual tenders.

(2) Proper Manning

The number of employee has been falling since 1999. At present, the staff size is 11% smaller than in 1999. In 2001, Moore Stephens/Hyder finalized a comprehensive study of human resources requirements, and main items of the recommendations are;

- Introduce a new IT network
- Improve working methods
- Develop staff skills, including multi-tasking
- Introduce flexibility in shift timings
- Outsource-possible candidates are security, computer maintenance and marine maintenance.

PSC accepted the main recommendations and is now in the process of implementation. While the Report recommended various measures to reduce manpower requirements such as introduction of new IT network, development of staffs' multi-task skills, out-sourcing and so on, in many areas of PSC works are, particularly in the operation and engineering field, suffered from staff shortage and elderly staffs. Apart from labour requirement for new infrastructures to be built during the planning period, a considerable number of workers (more than 100) are necessary for operation and maintenance.

(3) Customers' Satisfaction

Generally speaking, the potential of port is not being fully utilized. This is mainly due to insufficient maintenance of equipment, operationally inadequate space use, and lack of supporting facilities including EDI. For container (including reefer container) operation, space is limited not only due to rapid containerization, but also inadequate space utilization. Above operational deficiency results in prolonged berthing time.

Problems are observed in terms of business environment. Some of the clients have moved to UAE ports due to bureaucratic procedure of documentation, limited work time of CIQ and bureaucratic arrangement of work. PSC is aware that it has insufficient equipment, and allocated necessary funds in

the 2004 budget for some cargo handling equipment and introduction of IT system into container operations. It is urgently required to invest in the apparatus and equipment mentioned above to attract and maintain customers.

(4) Discipline of Investment

Since year 2000, PSC has accumulated a considerable amount of surplus without loan, and it has sufficient fund for investment of port services. Nevertheless, PSC invests the available fund to portfolios rather than port services. Furthermore, the rate of dividend has hiked to 30% in 2003. These performances may be well functioned to attract possible investors, however, considering operational efficiency of port and customers' appreciation being more important for the port's future, use of fund should be more customer oriented.

11.5.2 Salalah Port

Concession Agreement with SPS shall last until 2021. Issues on the investment sharing between GSO and private sector are shown in 10.11.4 (1), 2) iii. . Followings are other issues on SPS performance.

(1) Fair Sharing of Profit

According to the Concession Agreement 1996, revenues are distributed among contracting parties based upon the established formula. Conditions of profit sharing are analyzed in depth in the next section of this Chapter.

The Agreement provides that the Government exempts income tax from 1999 to 2003, and SPS can apply to the Government for a further 5 year exemption. The Government has in fact already granted a further five year exemption.

SPS first showed a profit in 2000, and it continues to be profitable. Although SPS, together with the Government, is about to invest a considerable amount for expansion of container facilities, SPS's financial performance is sound according to a series of financial indicators and this condition is expected to continue. In view of covering the Government's huge investment in infrastructure, the Government should try to levy income tax as soon as possible.

(2) Cultivating New Clients

SPS is obliged to carry out marketing activities to encourage calling by various shipping companies. In fact, according to the record in the summer of 2004, about 77% of container vessels calling the port were Maersk, 19 % were APL and only 3% were other shipping lines. Maersk line's vessels place berth reservation more than two weeks before scheduled arrival, however, frequent schedule change or cancellation making it difficult for other shipping lines to make a reservation. Under these circumstances, some shipping lines are hesitant to call Salalah. To attract other shipping lines, it will be necessary to provide evidence of fair berth assignment. A part of the berthing reservation record at Salalah in August to October 2004 is shown in the Appendix III.

Expanded clients will contribute to the activation of business in Salalah Municipality and Dofhar Region. The more vessels from multiple shipping lines call to the port, the more industries ancillary or related to shipping and port will take root in the area, such as shipping agent, forwarders, goods and services suppliers and financial institutions. At present, these industries are mainly located in Muscat, but when Salalah becomes a multi-client port, many such industries will move to Salalah or set up branch offices.

The headquarters of SPS is in Muscat, and neither the CEO nor his Deputy is at the port site, but when related commercial activities grow in the area, it may become inevitable that the headquarters be moved to Salalah.

(3) Protecting Regional Interest

Growing container operation causes a shortage of available space, consequently, multi-purpose berth and the bulk berths are in many times occupied by container feeder vessels. From the commercial point of view, giving priority of berth assignment to container feeders is justifiable. However, considering GSO spending huge investment in infrastructure of Salalah port, requests by local exporters should be accommodated in the port operation. While these steps may cause limiting container use for the moment, after the completion of on-going project, space for containers will become sufficient.

(4) Recruitment Needs

In line with the expansion of port infrastructure and superstructure, staff increase will become necessary, however, in view of the favourable labour market in the Dhofar Region and SPS's excellent training scheme, it would not be difficult to recruit the required workers.

11.5.3 Sohar Port

SIPC, the 'landlord' type managing body of the port is established a couple of years ago, and very recently start operations under the contracts of cargo handling and marine services with companies abroad. It is no reason to change the port managing body as well as operation scheme. Details are shown below:

1) Main responsibility for port management is taken by SIPC, which is established by the GSO and the Rotterdam Port Authority (RPA), which has a 50% share. While major port services such as cargo handling and marine services are contracting out to affiliates of experienced European companies, SIPC provides common and logistics services such as environment protection, safety, health, fire fighting, single window clearance facility and so on, and is responsible for maintenance. Moreover, it has overall responsibility concerning rules and regulations within the port, business plan, human resource plan, pilot and tug and marketing plan.In light of the above, SIPC can be called a 'landlord type port authority'.

The quality of operation is not yet known, since the port has just inaugurated operation. SIPC calls for management advice from RPA from time to time paying a management consulting fee.

It is important for GSO to ensure that newcomers be allowed to locate in the port where appropriate, and to secure fair competition in the port area. In this respect, the stevedoring company now working in the

port enjoys by contract 'first refusal' status, and an option to acquire 51% of the total share of new comers. Such clause may be useful attracting developers in its initial stage, but in future when the port becomes a multi-function/multi-terminal port, it may create a harmful monopolistic situation.

2) SIPC's financial result and accurate financial structure is not clear, however, as a 'land-lord type' port authority, SIPC's revenue comes from 1) 20% commission of quay land rental fees from tenants, 2) rentals of quaywall and land, 3) other miscellaneous income from land users and port servicers. There is no franchise fee variable to the vessel or cargo volume.

SIPC's operational activities are limited, and number of staffs is 20-30, and even in future, the staff may not increase substantially because of its work nature. Above revenue may cover the current expenditure.

3) It is said that according to the terms of existing concession agreement, after 2007, GSO will not bear the investment cost. In this case, it is envisaged that private sector would not be able to raise sufficient fund for the planned infrastructure. If GSO promotes the plan, it is required to find out an adequate financial resource other than the private sector.

4) Even though SIPC has established very recently and now about to start the business, there is very limited information in terms of its structure, financial account and activities available. More disclosure such as publishing annual report is necessary to attract attention of the interested organizations and of general public.

11.5.4 Duqm Port

Duqm port is a 'greenfield port', but unlike Sohar port, the hinterland is very sparsely inhabited and no industries are located. The development project is a far-reaching one. The preliminary schemes of management are shown in Section 9.5.5.

GSO intends to provide a port and other infrastructures, and to award a concession to attracted industries. While it is premature to demonstrate the concrete views in terms of the shape and characteristics of management at this very early stage, however if the partner(s) are rightly selected, SIPC type port authority may be the adequate solution.

Due to the nature of the area and tight situation of ship repairing market, it may take time to attract private sectors in a short run. GSO may operate the port for certain period after its inauguration.

11.5.5 MOTC

Section 10.8.3 identifies the issue on MOTC, particularly on DGPMA, main points of which are following:

1) Functions of the Directorate-General are divided into port sector and maritime sector.

2) Technical experts are short in DGPMA.

3) Transmission and compilation of data/statistics is not adequate.

4) Communications with other organizations within MOTC as well as relevant agencies are not sufficient.

Section 10.8.6 together with Section 10.11.2, show future direction of strengthening the capabilities of DGPMA for remedying the present problems and for meeting the future expansion of port business. Followings are the outline:

- Establishment of Directorate-Generals in terms of port and maritime affairs,
- Recruit of expertise of various fields, e.g. Legal matters, information technology, civil engineering,
- Participation of advanced training schemes, and
- Creation of port EDI center.

These are the organizational reform target, which may be materialized in a long period, say ten to twenty years time. Based upon the above direction, the Team draws a reform plan for the intermediate stage.

1) While the best solution would be the separation of port sector and maritime sector, administrative reorganization may require very long time. However, the recent development of international measures in terms of maritime safety, security and marine environment issues will require frequent attendance to international forum by high level officials in the Government. Therefore, as a short term measure, it is recommended that the position of an Assistant DG for Maritime Affairs be newly created.

2) Since the progress of information technology is very rapid, immediately after introduction the first generation system, an integrated IT network to connect agencies and major ports concerned by EDI should be established. MOTC/DGPMA should hire an IT expert and his assistants. The Team recommended the creation of Port IT Center as an ultimate target, however, at least small IT unit should be placed in DGPMA as the first step.

3) As has been stated, number of professionals engaging in port sector of DGPMA, in particular qualified expert in the Headquarters is extremely limited. Also, new technology development and coordination work require further staffs. Followings are the outline;

Port technical staff (including Head of Department and Division Chief) … 10-13, IT expert …2, Technical inspector…1, Statistics…1, Legal and Administrative Advisor…1, Total… 15-18.

4) To fill the above requirement, MOTC should hire a certain number of university graduates. At present, this is not easy because private firms are able to offer students better work conditions. Nevertheless, MOTC/DGPMA should strive to hire qualified personnel.

5) At present, DGPMA has no concrete scheme for on-the-job training, except JICA's port technology training. However, in view of strengthening the capability through DGPMA, it should participate in training schemes outside MOTC.

CHAPTER 12

PRELIMINARY ECONOMIC AND FINANCIAL ANALYSIS OF THE PRIORITY PROJECTS

12 PRELIMINARY ECONOMIC AND FINANCIAL ANALYSIS OF THE PRIORITY PROJECTS

12.1 Examination and Evaluation of Tariff and Concession System

(1) Current Tariff level in the International Market

There are two commercial ports currently operating in Oman, namely Sultan Qaboos Port at Muscat and Salalah Port. In addition to these, Sohar port is now at preparation stage to operate as industrial port. Tariff rates are published in these ports and possible to compare with other major international ports in the following table.

Table 12.1-1 Comparison of Container Handling Tariff (USD/Move/Box)

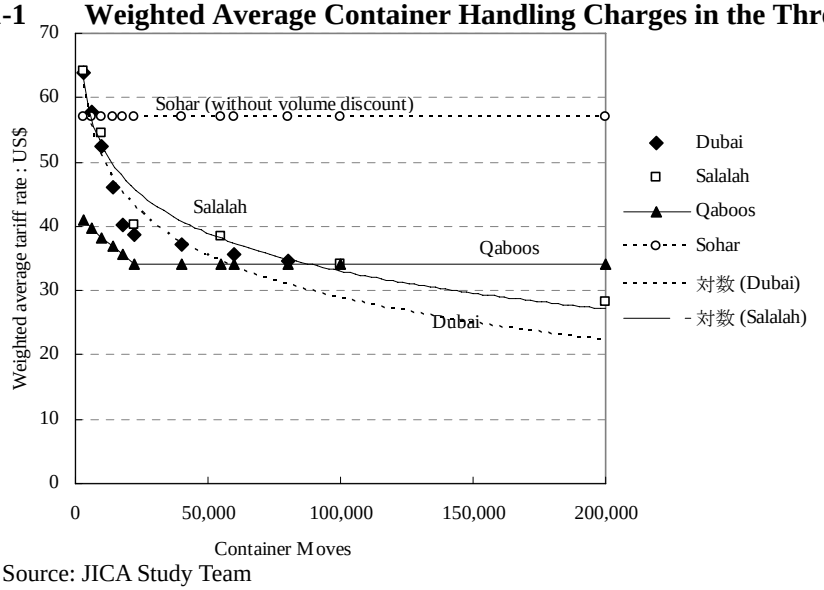
	PSC Qaboos (25,000TEUs)	SPS Salalah (60,000TEUs)	Steinweg Sohar	DPI Dubai (60,000 TEUs)	SLPA Colombo (JCT)	PSA Singapore	PTP Tanjung Pelepes
Import/Export 20' laden	83.2	66.0	104.0	64.0	140.0	82.9	60.5
Transhipment 20' laden	46.8	87.1	78.0	74.6	71.3	63.6	52.6
Import/Export 20' Empty	43.7	46.5	44.2	42.2	118	44.2	47.4
Transhipment 20' Empty	NA	71.5	78.0	59.9	NA	NA	NA
Import/Export 40' laden	114.4	90.5	143.0	89.8	212	118.9	90.8
Transhipment 40' laden	70.2	116.2	78.0	107.3	109.5	65.2	79.0
Import/Export 40' Empty	58.2	60.0	57.2	58.5	179	96.7	71.1
Transhipment 40' Empty	NA	100.7	78.0	92.6	NA	NA	NA

Note: Transhipment charge is set by two moves in the tariff book of every port.
Rates at PSC, SPS, and DPI are discounted according to the volume discount schedule.

Source: JICA Study Team

In order to compare at effective level of rate, discounted rate at the maximum of 25,000 TEUs/year is listed at Sultan Qaboos Port, and those at volume level of 60,000 TEUs/year are listed at Salalah and DPI(Dubai). Salalah indicates largest discount at the volume of nearly 200,000 TEUs/year. These ports listed here are functioning as International transshipment hub except Qaboos and Sohar ports. Dubai does not disclose any individual rate with the cargo amount more than 60,000 TEUs/year.

Figure 12.1-1 Weighted Average Container Handling Charges in the Three Ports



Source: JICA Study Team

As is seen in the table above, transshipment tariff at Sultan Qaboos Port is very low even at the level of small volume. This is a strong attractive aspect of the PSC Qaboos and the port of Sohar seems to break into the market with competitive tariff level in the near future.

Calculating the weighted average cargo handling charges at discounted rate, it is recognized that the Salalah and Dubai is in the similar level of charges whereas Qaboos is low in small volume but high at large volume. There must be a possibility Qaboos port also apply similar tariff structure in order to compete with other ports and yet making reasonable profit from small cargo suppliers.

Another aspect to attract cargo is free storage period. It is a message how quickly the port expects the cargos to move. Salalah, Qaboos and Dubai have similar profile of free period given to the containers. Qaboos has a shorter free period for empty box which guides shipping agents to move empty boxes out of the yard quicker than other ports.

Table 12.1-2 Free Storage Days

	Transhipment	Laden box	Empty box	Charges after the days of Free Period
Salalah	20	10	20	Charge counts after the free period
Qaboos	21	10	10	Charge counts after the free period
Sohar	20	10	20	Charge counts after the free period
Dubai	20	10	20	Charge counts after the free period
Colombo	21	7	3	Charge accrues during the days of free period

Source: JICA Study Team

In Comparison, Colombo port gives much shorter free staying days for laden and empty boxes with 7 and 3 days respectively. In addition, significant difference exists after the free period. When the charges begin at Colombo port, days are counted retroactive from the first day of storage. For example, transshipment cargo on the 22nd day, it is charged for the entire 22 days, whereas in other ports in the table, charges are made by counting after the free period. If the PSC Qaboos expects the cargoes to move more quickly, measures similar to Colombo would work to increase the efficiency of yard area.

(2) Tariff Level of the Sultan Qaboos Port

1) Background

The tariff at Qaboos was revised in November 2003, and the average level has been raised. The question is whether the revised level of tariff is competitive against other ports. An underlying fact behind this question is that there are more than half of cargos imported from neighboring countries such as UAE through the land gates rather than ports. The table below indicates that the cargo imported through Omani ports is 2.1 million tons which corresponds to 44% of total import. On the other hand, cargo from Dubai or through Khor Fakkan amounts to 2.7 million tons and corresponds to 56% of total import.

Table 12.1-3 Import Cargo by Each Point of Entry

	Volume (,000 ton)	Value (mil. RO)	% (ton Base)
Sultan Qaboos Port	1,438	1,040	
Salalah Port	704	113	
Airports & Other Seaports	32	304	
Subtotal (from Omani Ports)	**2,174**	1,456	44%
From Dubai (through Al Wajaja border)	1,315	544	
From Khor Fakkan & Fujayrah (Khatmat Milaha Border)	1,117	49	
Other Land Gates	295	260	
Subtotal (From UAE mainly**)**	**2,727**	853	56%
Total	4,901	2,309	

Source: Foreign Trade Statistics (2002) summarized by JICA Study Team

2) Comparison of tariff rates and transportation cost

Even after the tariff rates being increased, port charges agreed by agents are cheaper in Sultan Qaboos Port than that of Dubai. However, private ports such as Khor Fakkan and Fujaira make special volume discount by individual negotiation, so the effective rates are assumed to be lower than published rates.

Table 12.1-4 Port Charges as Agent Fee (US$)

	20' Container	40' Container
Sultan Qaboos Port	108	**149**
Dubai Port	114	**168**

Note: Agent fee is based on the port tariff and kept as the same by all agent in the Gulf area

Source: Interview survey by the JICA Study Team

In addition to port charges, land transportation cost is necessary to bring cargo to the city of Muscat. Tracking charge of 40' container from Sultan Qaboos Port is US$ 130 whereas from Dubai US$ 350. As is compared in the table below, port charge and trucking cost together, the one way cost from Sultan Qaboos Port is cheaper by US$ 239, which is approximately $120 per TEUs. However if the return cargo is arranged with large volume of cargo booking in regular basis between Dubai and Muscat, the price will be negotiated for large discount because competition is very severe among track operators in UAE.

Table 12.1-5 Land Transportation Charges of a 40-foot Container to Muscat City

(US$)	Through Dubai	Through Port S Qaboos	Difference for 40 footer
Port Charges	168	149	
Trucking cost	350	130	
Total	**518**	**279**	**239 (120 $/TEU)**

Note: Above rates are based on the condition of one-way load, spot contract basis. Term contract and volume discount will be applied to transportation between Dubai-Muscat cargos but not included in this table.
Source: Interview survey by the JICA Study Team

Agent and consignee hope to have total transportation cost as low as possible including freight charges. Current freight rate of containers from Asia to Sultan Qaboos Port is higher by US$100/TEU than that to Dubai as exhibited in the table below. This is because Sultan Qaboos Port accommodates only feeder vessels from Dubai, thereby additional cost is incurred.

Table 12.1-6 Freight Charges (West Bound)

From	Size	To Dubai (in US$)	to Muscat (in US$)	Difference M – D
Singapore	20'	800	900	100
	40'	1,500	1,700	200 (100 /TEU)
Hong Kong	20'	1,000	1,100	100
	40'	2,000	2,200	200 (100 /TEU)
Europe	20'	650	750	100
	40'	900	1,000	100 (50 /TEU)

Note 1. In addition to the above rates, cargo from Asia is subject to surcharges of 82 USD/TEU as Fuel Adjustment Factor and 100 USD/TEU as Peak Season Surcharge during 4 months from September to December.
Note 2. For cargo from Europe, in addition to the above rates, 50 USD/TEU as Bunkerage Adjustment Factor and 6% as Currency Adjustment Factor are charged.
Note 3. East Bound Freight from Europe to China is basically empty positioning, and the rates are very low. In those cases freight rates are higher from Muscat than from Dubai by 50 USD/TEU, such that freight for 20' from Dubai to Singapore is 25$ whereas 75$ for 40'.
Source: Interview survey by the JICA Study Team

As a result of combination of freight charges and land transportation cost, importation through Sultan Qaboos Port has some advantage. Under the delicate balance, having certain traders who reserves cargo through Sultan Qaboos Port as the regular port user, the Sultan Qaboos Port survives as local gate port to the city of Muscat. But considering the frequency of delivery and possibility of discount, there are many cases to use Dubai which resulted in larger volume in regular schedule of import through UAE.

3) Views from port user

In addition to freight charges, following factors need to be included in the determination of entry port to use.

- Business magnitude of hinterland
- Size and frequency of calling vessel

Business size of the hinterland is measured by the cargo volume. Dubai has 5.1 million TEUss as container throughput in 2003 in which import/export container is 2.5 million. Cargo in Sultan Qaboos Port is 5 million tons in total including bulk cargo, which can be translated into containers only 0.5 million TEUss, in which import/export cargo is 0.1 million TEUs.

Judging from this fact the size of economy is 10 times larger in Dubai than that in Muscat. In some area of business, considering import/export cargo, more than 20 times of difference is assumed. Traders in Muscat expressed that demand for consumer goods is 7 times larger, and construction demand is 15 times larger in Dubai. Economic growth is somewhere over 7 % as against 3.3 % in Muscat.

Concerning the calling vessel, Dubai is equipped with large post-panamax quay-side cranes and enough depth for main-liners, but the Port of Sultan Qaboos accepts only feeders from Dubai because of limited outreach of cranes and low efficiency of cargo handling. As a result, when importing through Sultan Qaboos Port from abroad, cargo arrives at Dubai on schedule but the feeder service

takes another week, sometimes 2 weeks when congested, to arrive at Muscat.

Sohar is located almost in the middle of Muscat and Dubai, and cargo delivered to Sohar finds it more advantageous to use Dubai port because the land transportation cost being the same and freight charge is cheaper at Dubai.

Nizwa industrial park is located 45 km from Sultan Qaboos Port and the current ratio of using Sultan Qaboos Port is 50%. Import rout of using Qaboos is less costly, but convenience in terms of frequency and flexibility is much better through Dubai.

4) Strategy of port development from marketing point of view

Development strategy is related not only to tariff issue but also how to market port service to international trade. When the government decide the development strategy of the Sultan Qaboos Port to grow out of local port to International Gateway, following factors are important from the marketing point of view.

a. Liner Vessel call – Immediate improvement of equipment in order to accommodate mainliners and improve the level of service, sufficient cargo volume will follow because the freight rate gets lower, which stimulates local entrepreneur with constant demand of cargo from industry.

b. Efficient service and good infrastructure including land transportation - total logistics to be quick response and free from bottle neck, which includes upgrading of cranes, training of operators and engineers, morale enhancement with shift re-scheduling, renewal of equipment and proper maintenance, expansion of yard, etc.

c. Competitive tariff level and volume discount – enough incentive to use port.

d. Sufficient space for cargo stay –for transhipment ease.

e. Electronic and IT development for Location control, Port EDI and Customs declaration – Several systems should be quickly developed and implemented including Cargo handling system and Electronic customs declaration enabling on-line payment within the framework of single window system.

It is important for Sultan Qaboos Port to apply volume discount for major port users according to negotiation individually. The published tariff does not provide sufficient information because most of international ports have special terms with major port users on volume discount in confidential basis, thereby attract large volume of cargo.

(3) Examination of Concession System and Profit Sharing

Under the current concession agreement, the Government constructs the infrastructure such as breakwater and quay-wall, then terminal operator, as concessionaire, prepares equipments such as cranes and RTGs. Revenues are distributed to each party according to the agreement in various forms such as rent and dividend. In this section, condition of concession is examined by the comparison of

revenues as a result of profit sharing between the Government and terminal operators.

At Salalah, the GSO constructed container terminal at the cost of total US$ 120 million, which is equivalent to RO 46 million, and receiving returns in the following four items.

- Rent: US$ 1 million (RO 384,615)with annual increase by 3 %
- Income tax: 12% of annual net profit but not paid by SPS during the first 5 plus some years which is under negotiation.
- Dividend for the share capital: the government holds 22.61% of share
- Payment to the Government as profit sharing: 50% of net profit in excess of 15% of issued capital and 5.5% of fund reserves and retained earning. This item is accounted for as "Franchise fee" in the financial report.

Based on the financial statements, above items are singled out, and the government revenue and the share of AP Moller are calculated shown in the following table.

Table 12.1-7 Profit Sharing of Salalah

year	2000	2001	2002	2003
Dividends Paid (from net profit)	0	0	0	180,557
Profit sharing (franchise fee)	0	0	246,002	935,351
Rent	397,520	409,446	421,729	434,381
Tax	0	0	0	0
Government Revenue	**397,520**	**409,446**	**667,731**	**1,550,289**
	17%	18%	22%	28%
Operation Cost Before Rent payment	16,219,213	14,699,677	13,817,166	12,504,231
Profit of SPS before rent and royalty payment	-2,385,839	527,238	2,020,005	5,451,774
Dividend + Management Fees to AP Moller	**0**	**608,780**	**732,523**	**1,642,617**
	0%	27%	24%	30%
MSL Payment to SPS	12,134,498	12,405,981	13,366,439	16,735,778
Maersk line savings by discount (Estimated)	0	155,558	450,857	2,343,009
Benefit of the AP Moller - Maersk Group	**0**	764,338	1,183,380	**3,985,626**

Source: JICA Study Team

The calculation indicates that the share of the government has started from 17% from the early stage of the operation and reached to the level of 28% in 2003. On the other hand the share of AP Moller started 0% and has reached 30% in 2003. In other words, AP Moller-Maersk Group took high risk for the development of Salalah and now getting the return and realizing benefit. Therefore it is natural that they begin to take larger share as a group. Admitting this fact it is important to discuss the future development burdens and shares of the benefit.

In order to measure the impact of tariff discount to the financial statement at Salalah Port, hypothetical assumption was made to the account in 2003 by applying the average rate of 2000 in the amount of 11.6 RO/TEU. This is approximately 15% increase in revenue rate as against actual 10.1 RO/TEU in 2003. Keeping other conditions the same, only the change of this revenue rate could bring big differences as are seen in the table below.

Table 12.1-8 Comparative Income Statement by the Tariff Rate, Actual and Hypothetical

(RO)	2003 Actual	2003-hypothetical	Rate increase
Revenue	22,018,842	24,860,686	113%
Operating costs	10,494,309	10,494,310	
Gross Profit	11,524,533	14,366,376	125%
Profit From Operations	**6,355,644**	**9,197,487**	**145%**
Net profit for the year before royalty fees	5,017,393	7,859,236	157%
Income tax (12%)	0	943,108	
Royalty fees to the Government	**935,351**	**1,749,982**	**187%**
Net Profit/Loss for the year	4,082,042	5,166,146	127%
Cash at the end of the year	4,649,245	5,733,353	123%

Note: 2003-hypothetical use the same revenue rate applied in the year 2000.
Source: JICA Study Team

The increase of container related revenue by 15% brings increase of net operating profit by 45%, making tax payment possible and share of profit by the name of royalty fees to the government increases by 87%. Based on this comparative data, profit sharing by hypothetical assumption gives idea of frame to measure the range of negotiation.

Table 12.1-9 Cost and Profit Share (R.O per one TEU)

	2003 Actual		2003-hypothetical	
Government revenue (rent, dividend, royalty fee)	0.8	8%	1.7	14%
Profit of SPS	3.1	31%	3.6	32%
AP. Moller Rev (dividend & franchise fee)	0.8	8%	0.8	7%
Operating Cost	5.4	54%	5.4	47%
Revenue (RO/TEU)	10.1	100%	11.6	100%

Source: JICA Study Team

As a result, the profit sharing to the government in the hypothetical case become more than double with a large increase of tax and royalty fee after the surplus of net profit. Even after these increase in the payment to the government, the share of SPS increases and the share of AP Moller does not change. Considering these facts, the current discounted tariff rate may result in the sacrifice of the government.

The current situation of profit sharing is measured in the aspect of return on investment. Based on the activity in 2003, government revenue from the operation was RO 1.57 million, whereas SPS made net profit RO 6.2 million. Investment for the 1 to 4 container terminal construction by the Government was RO 46.2 million, whereas SPS invested on cargo handling equipment in the amount RO 52.2 million. Based on these figures return on investment for the government is 3.4% whereas for SPS it is 11.9%.

Table 12.1-10 Return on Investment in 2003: Government and SPS

	2003 Actual	2003-hypothetical	2003 (if tax paid)
Government Revenue (Thous. RO)	1,573	3,331	1,962
Net Profit of SPS (Thous. RO)	6,202	7,286	6,897
Gov. Investment for Terminal 1-4 (Thous. RO)	46,200	46,200	46,200
SPS. Investment for Equipment 1-4 (Thous. RO)	52,200	52,200	52,200
Gov Return on Investment	3.4%	7.2%	4.2%
SPS Return on Investment	11.9%	14.0%	13.2%

Note-1: 2003-hypothetical is calculated on the condition that volume discount is the same level as that of year 2000 which is approximately 15% increase in revenue rate of 2003. Tax payment is also assumed.
Naote-2: 2003 Tax payment assumes that tax is paid to the government with other conditions being the same as the revenue rate of 2003.
Source: JICA Study Team

The return for the government is expected to reach the level of interest rate being approximately 5% in the current international fund procurement situation. Based on the calculation of hypothetical assumptions these return on investments are 7.2% and 14%. Therefore the some amendment measures considered to recover the loss of return on the side of the government by either reducing the degree of volume discount to half, and enforce the due tax payment to the government.

The increase of payment to SPS should be made by the Maersk Sealand, of which AP Moller is a holding company and major shareholder of SPS, and the additional payment by 1.5 RO/TEU would offset the revenue of AP Moller being only 0.8 RO/TEU. Although the increase of share to the government seems to become possible only at the cost of AP Moller- Maersk Sealand line, the level of 11.6 RO/TEU, 30 USD/TEU inclusive of all vessel-related charges and all cargo handling charges should be maintained on the following reasons.

Reason one is based on the concept to secure the minimum return for the repayment of loan for the breakwater construction. Investment on the breakwater is approximately $100 million, which is R.O 38 million. In order to cover the repayment of loan, total of 7% will be needed as return on the break water. Current average interest rate for the project is 5.5 % and 1.5% will be added as risk premium. If this amount should be charged as surcharge to all the containers as flat rate, the amount will be $2.3 on the assumption that the cargo volume will be 3 million TEUs after the completion of berth 5 and 6.

100 Mil $ * 7% / 3 Mil TEUs = 2.33 US$/TEU = 0.9 RO/TEU

Reason two is based on the fact that the profit share at the Sultan Qaboos Port is much larger than that of Salalah port. PSC at Sultan Qaboos Port is providing 24% to the government, which is three times larger than that from SPS being 8%. Cargo composition and the role of port is very different, simple comparison is not appropriate, but the intention of PSC is clearly indicated here as large share to the government and not much discount. The ratio of share should be larger with the government

Table 12.1-11 Cost and Profit Share of One Container at Sultan Qaboos Port

	Year 2003	
Government share of profit (RO/TEU)	49.6	24%
PSC Share: retained earnings and dividend to shareholders other than Government (Profit / TEUs)	33.7	16%
Operating cost (RO/TEU)	122.4	59%
Revenue per TEUs (RO/TEU)	205.7	100%

Source: JICA Study Team

Even though the government appreciates the performance of the SPS and its quick development as international container hub, the study result by hypothetical calculations and comparison of tariff rates indicate following points as suggestions to the policy of the government.

- Tax payment should be made by the SPS to make the government to receive a due share on the investment. If the tax is paid by SPS to the government, the government share of profit increases and the ratio to the gross profit will increase from 29% to 36%. This is the first step to secure the fair share of the government even though this is not enough to cover the return on the investment of the government.
- Volume discount should be made to balance the fair share of the government. The current level of discount is evaluated to be excessive to sacrifice the share of the government and benefit the AP Moller-Maersk group even at the stage of expansion. Any further volume discount should be granted after the government secured its faire share of the profit.

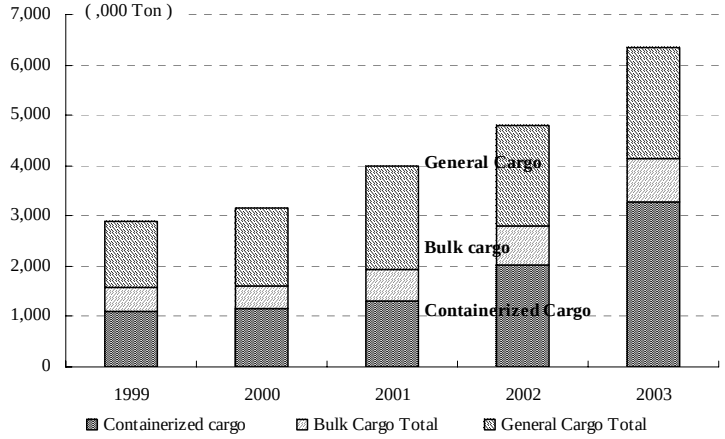
12.2 Overview of Financial Situation of Project Implementation Bodies

(1) Port Services Corporation SAOG (PSC) at Sultan Qaboos Port

1) Business structure in recent years

Sultan Qaboos Port handles various types of cargo including bulk, general and containers. Recent increase of containerized cargo contributes to the increase of revenue. Containerized cargo does not look like increasing much in tonnage basis, but in TEUs basis it makes a rapid increase especially in transshipment containers.

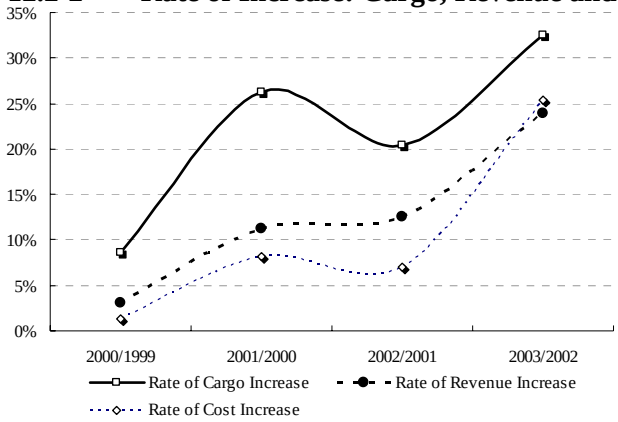
Figure 12.2-1 Cargo Composition at Sultan Qaboos Port (FRTon)



Source: PSC Annual Reports arranged by JICA Study Team

The increase of cargo results in the increase of revenue, but the rate of increase is not as high as that of cargo, because the type of cargo such as transhipmant is charged less and volume discount is applied to major traders. As you see in the figure here, the rate of increase is fairly high in recent years and surprisingly the rate is in the increasing trend.

Figure 12.2-2 Rate of Increase: Cargo, Revenue and Cost

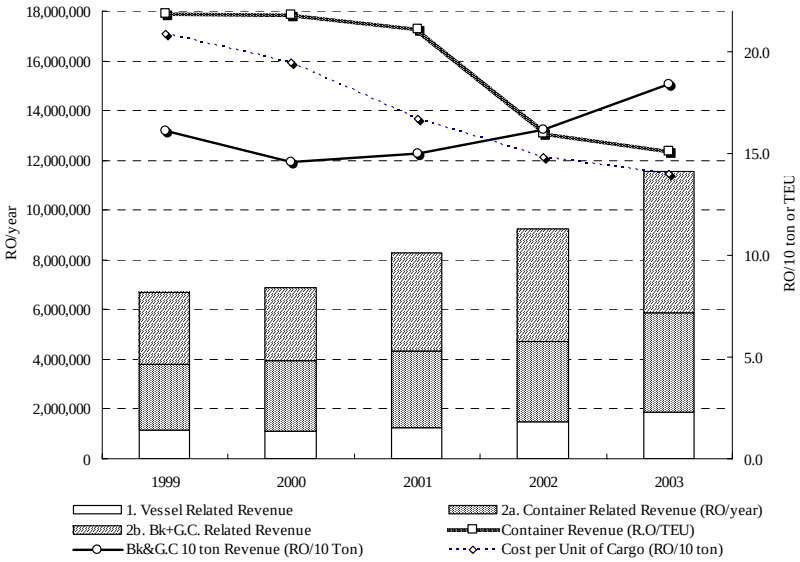


Source: PSC Annual Reports arranged by JICA Study Team

Another thing to be noticed is that the rate of revenue increase is always lower that that of cargo, and the rate of cost increase is generally lower than that of revenue except one in most recent year because of increase in salary. Therefore during the time of increase in the cargo volume, it is important to make good controle over the cost increase because revenue per unit of cargo generally decline as cargo volume increases.

Next figure indicate the declining trend of unit revenue of container handling and unit cost of total caargo by tonnage. The revenue per TEUs declined from R.O 21 in 2000 to R.O 15 in 2003, which is approximately 30% decline. Concurrently the unit cost by 10 tons of cargo, including containerized cargo, declined from R.O 20 to 14 These trends are shown in the thick line and broken line in the graph.

Figure 12.2-3 Revenue by Type of Cargo and Unit Revenue



Source: PSC Annual Reports arranged by JICA Study Team

But on the other hand, unit revenue of general cargo and bulk cargo is in the increasing trend, as is shown in the thin line in the graph. As a result of compounded effect of this increasing trend of unit

revenue of general & bulk cargo and quick increase of container cargo volume, total revenue and profit has steadily increased in the past 5 years.

2) Break even analysis of Sultan Qaboos Port in 2003

Unit revenues and costs are calculated from the financial statement and confirmed that these unit revenues and costs are constant during the past four years. Based on the analysis, following unit rates are determined as component of business structure of the port of Sultan Qaboos, and will be applied to the calculation of revenue and cost for the future activities.

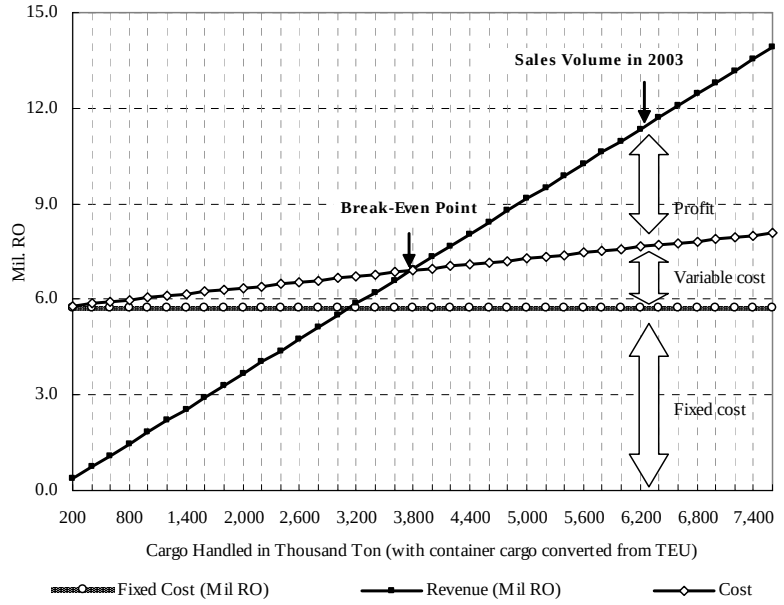
Table 12.2-1 Unit Revenue and Cost of Sultan Qaboos Port in 2003

Non container cargo: Revenue (including vessel charges & stevedoring)	2.20	RO/Ton
: Variable Cost	0.22	RO/Ton
Container cargo: Revenue (Import/Export container)	26.4	RO/TEU
Revenue (Transhipment container)	7.5	RO/TEU
Variable Cost (RO/TEU)	4.82	RO/TEU
Fixed Cost (Including Personnel cost, rent etc)	5.74	Mil RO

Source: JICA Study Team

Using the numbers in the unit revenue and cost, Break-even analysis is exhibited in the following graph. The cost in the graph does not include payment of profit sharing to the government by the name of “franchise fee” because it is paid from operating profit.

Figure 12.2-4 Break-Even Analysis of Sultan Qaboos Port (RO) in 2003



Source: JICA Study Team

As shown in the graph, break-even sales amount is 3.8 million ton/year. Sales in 2003 being 6.3 million ton gives break-even ratio as 60% which is very good for making profit by operation.

3) Fund availability of PSC

Sultan Qaboos Port is operated with sufficient fund and generating good amount of surplus without loan as is seen in the next table. The operating cashflow is steadily growing, but the Asset amount of "property, plant and equipment" is declining. The content of investment is not on the operational facilities but on stock market. Profit earned from operation is not properly invested for the expansion of facility to prepare to handle the growing cargo toward the future.

Even after investing money on securities, fund available for new investment is plenty. Generally the type of fund available for new investment is measured by the amount of Free Cashflow which is calculated by Operating cashflow minus investing cashflow. This free cashflow is mostly paid to shareholders as dividend and the rest is held as reserves and deposits. The rate of dividend is high being 25% in 2002 and 30% in 2003 on the stated value of the share.

As a result of high financial performance, the share price of PSC increased from 2.5 to 4.4 during the year 2003.

With this financial background, it is possible to procure fund from stock market for expansion of terminal together with cargo handling facilities so that the future growth will be ensured. In order to make successful development, it is necessary to reduce dividend payment and increase the retained earnings in relation to the future fund requirements.

Table 12.2-2 Cashflow Composition and Related Information

	1,999	2,000	2,001	2,002	2,003
Operating Cashflow	837,217	456,984	3,022,027	2,921,022	3,369,699
Investing Cashflow	313,358	447,396	326,800	-1,674,727	-1,232,569
Free Cashflow	**1,150,575**	**904,380**	**3,348,827**	**1,246,295**	**2,137,130**
Financing Cashflow (mostly Dividend & Pension fund payment)	-1,097,500	-917,500	-2,998,228	-1,296,000	-1,800,000
Dividend rate for stockholders equity	10.0%	10.0%	18.0%	25.0%	30.0%
Addition to Cash deposit	53,075	-13,120	350,599	-49,705	337,130
Cash at year-end (incl. S.T.Deposits)	**4,437,837**	**4,424,717**	**4,775,316**	**4,725,611**	**5,062,741**
Property, plant and equipment(asset value)	**9,763,230**	**8,981,990**	**8,239,469**	**7,771,143**	**7,420,879**

Source: PSC Annual Reports modified by JICA Study Team

(2) Salalah Port Service Co. SAOG at Salalah Port

1) Business structure and comparison of terminals in recent years

Based on the financial Report of the SPS, financial performance is studied terminal-wise. The container terminal is the main operating part of the Salalah port and the sales volume has almost doubled in the past 4 years. Net profit increased more than double as a result of the cost control of direct operation.

Table 12.2-3 Financial Performance of the Container Terminal at Salalah Port

(Unit RO)	2000	2001	2002	2003
Sales	**11,932,941**	**13,552,715**	**14,066,792**	**20,279,614**
Direct Operation Cost	6,806,785	7,435,452	7,009,469	9,433,347
Segment gross profit	**5,126,156**	**6,117,263**	**7,057,323**	**10,846,267**
Common costs (*1)	1,691,664	3,329,722	3,729,093	5,622,077
Profit from operations	**3,434,492**	**2,787,541**	**3,328,230**	**5,224,190**
Finance costs (net) (*2)	2,157,530	1,513,576	1,583,161	2,099,243
Other income - insurance claim received (*2)	306,711	21,792	30,491	700,883
Net Profit of the year	**1,583,673**	**1,295,757**	**1,775,560**	**3,825,829**
Segment total assets	41,170,222	53,546,939	49,066,128	52,787,559
Inter-division Balances eliminated (*3)	1,342,788	1,309,905	789,493	839,279
Total assets of the container terminal	39,827,434	52,237,034	48,276,635	51,948,280

(*1) Apportioned to container terminal by Sales size
(*2) Apportioned by investment size
(*3) Apportioned by asset size
Source: SPS Annual Report modified by JICA Study Team

General Cargo terminal, unlike the container terminal, is small in size and handles approximately 1.7 million tons with nearly 1 million tons of import. After the vehicle import moved out in 2002, cargo volume decreased. When the industrial park in the hinterland begins to invite direct investment, cargo will be expected to increase again.

Table 12.2-4 Financial Performance of General Cargo Terminal at Salalah Port

(Unit RO)	2000	2001	2002	2003
Sales	**2,623,109**	**2,083,646**	**2,514,100**	**1,739,228**
Direct Operation Cost	2,019,028	1,050,609	1,203,213	1,060,962
Segment gross profit	**604,081**	**1,033,037**	**1,310,887**	**678,266**
Common costs (*1)	371,863	511,924	666,486	482,163
Profit from operations	**232,218**	**521,113**	**644,401**	**196,103**
Other income - insurance claim received (*2)	67,422	3,350	5,450	60,109
Net Profit for the year	**299,640**	**524,463**	**649,851**	**256,213**
Segment total assets	1,677,017	1,793,359	1,606,204	1,294,227
Inter-division Balances eliminated (*3)	54,697	43,870	25,844	20,577
Total assets	1,622,320	1,749,489	1,580,360	1,273,650

(*1) Apportioned by Sales size
(*2) Apportioned by investment size
(*3) Apportioned by asset size
Source: SPS Annual Reports modified by JICA Study Team

After the beginning of operation in 1998, SPS continued to expand its operation to the management of the General Cargo Terminal in 2000. As a result, management and operation of the Salalah port by a single operator is expected to provide significant synergies even though the size of activities are very different. In the year 2000, Asset ratios of both the container terminal and the general cargo terminal are 96% and 4%.The ratio of the container terminal increased to 98% in 2003.

Table 12.2-5 Activity Ratio of Container Terminal and General Cargo Terminal at Salalah Port

	Container terminal				General cargo terminal			
	2000	2001	2002	2003	2000	2001	2002	2003
Asset Ratio	96%	97%	97%	98%	4%	3%	3%	2%
Sales ratio	82%	87%	85%	92%	18%	13%	15%	8%
Operational Profit	94%	84%	84%	96%	6%	16%	16%	4%
Net Profit for the year	84%	71%	73%	94%	16%	29%	27%	6%

Source: SPS Annual Reports arranged by JICA Study Team

Sales ratios over the years indicate 82% for container operation as opposed to 18 % for general cargo handling in 2000. But again the ratio of container revenue increased over the years and reached to 92% in 2003

Table 12.2-6 Financial Indicator by Terminal

	Container terminal				General cargo terminal			
	2000	2001	2002	2003	2000	2001	2002	2003
Return on asset	4%	2%	4%	7%	18%	29%	40%	20%
Return on sales	13%	10%	13%	19%	11%	25%	26%	15%

Source: JICA Study Team

Operational profit and net profit also shows large ratio to the container handling activity, even though there were times when investment cost for terminal development reduced the ratio to as low as 71% in 2001.

Financial indicator shows higher return on the general cargo terminal, however the figure for the container terminal is not bad considering the size of investment for 4 container terminals. Return on sales is higher than that on asset in the container terminal, and this is natural because of the size of investment. The container terminal shows steady growth whereas the general cargo terminal shows large fluctuation according to the amount of cargo each year. Unit revenue and cost are calculated and shown in the table below.

Table 12.2-7 Unit Revenue, Cost and Profit by Cargo Type (unit R.O.)

		2000	2001	2002	2003
Container Cargo	Total TEUs	1,032,846	1,187,753	1,258,608	2,001,259
	Revenue (RO/TEU)	11.6	11.4	11.2	10.1
	Cost (RO/TEU)	8.2	9.1	8.5	7.5
	Profit (RO/TEU)	3.3	2.3	2.6	2.6
General Cargo	Total tonnage (Bulk & General)	1,049,322	1,401,573	1,677,916	1,342,577
	Revenue (RO/Ton)	2.5	1.5	1.5	1.3
	Cost (RO/Ton)	2.3	1.1	1.1	1.1
	Profit (RO/Ton)	0.22	0.37	0.38	0.15

Source: SPS Annual Reports arranged by JICA Study Team

In the Salalah port, 95% of activity is container cargo handling and the rest of non-container cargo is largely fuel import and cement export.

2) Break even analysis of Salalah Port in 2003

Unit revenues and costs are calculated from the financial statement and confirmed that these unit revenues and costs are constant during the past four years. Based on these analyses, following unit rates are determined as component of container handling business structure of the Salalah port, and will be applied to the calculation of revenue and cost for the future activities.

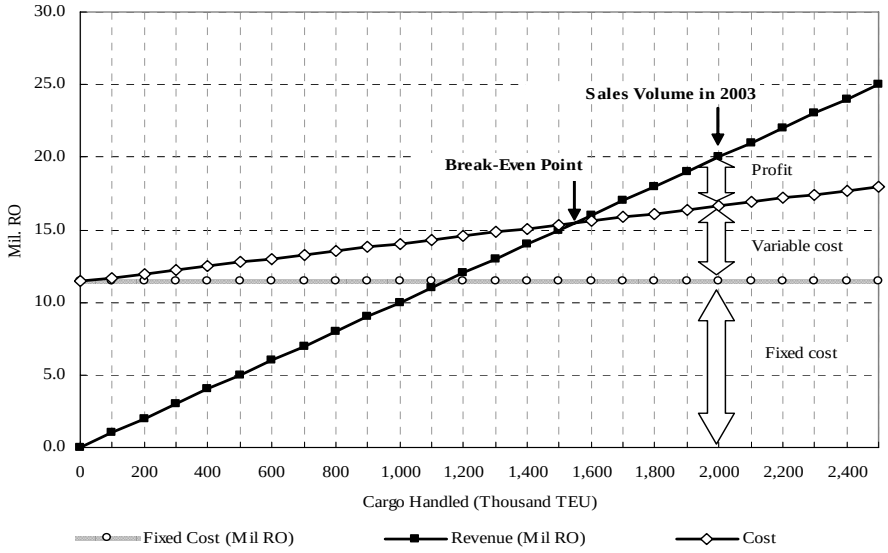
Table 12.2-8 Unit Revenue and cost of Salalah Port Container Handling in 2003

Unit Revenue by Container (including vessel charges & stevedoring)	10.0	RO/TEU
Unit Variable Cost of Container Handling (RO/TEU)	2.6	RO/TEU
Fixed Cost (Including Personnel cost, rent etc)	11.45	Mil RO (5.7RO/TEU)

Source: JICA Study Team

Using the numbers in the unit revenue and cost, Break-even analysis is made in the following graph. Salalah Port Service (SPS) has already invested substantial amount to the Cargo Handling Equipments, and the fixed cost consisting of depreciations and maintenance costs, is much higher than those of Sultan Qaboos Port. But the cargo volume is constantly increasing with the profit ratio of approximately 15% in 2003.

Figure 12.2-5 Break-Even Analysis of Containers at Salalah Port (2003)



Source: JICA Study Team

Break-Even sales amount being 1.55 million TEUs and sales amount of 2 million gives the break-even ratio as 77%, which is good indication that the profit earning structure is sound and strong enough to produce cashflow for the continuing investment.

3) Fund availability of SPS

Reviewing the cashflow since the beginning of operation, the growth of SPS is reflected in the growing number of operating cashflow. It is negative in the first two years and it turned positive after the years 2000. Free cashflow also turned from negative to positive after the first four years of operation.

The SPS procured fund from capital market and from bank every year for four years, and invested on the container terminal. The repayment capacity is large enough to procure fund because of the sufficient level of the Debt Service Coverage Ratio which is calculated by dividing cashflow generated from operation by total debt repayment including interest and principal repayments. SPS turned this indicator at the level of more than 1.5 in 2000, and reached the level of 3.0 in 2003. The concept of this indicator is to check the repayment ability by the operation of business, and 1.5 is regarded as minimum requirement.

Table 12.2-9 Cashflow Summary at Salalah Port

	1998	1999	2000	2001	2002	2003
Operating Cashflow	-780,540	-541,221	6,381,941	6,393,453	7,043,210	10,197,936
Investing Cashflow	-17,964,397	-13,799,120	-8,010,503	-14,734,808	5,976,798	-7,100,807
Free Cashflow	**-18,744,937**	**-14,340,341**	**-1,628,562**	**-8,341,355**	**13,020,008**	**3,097,129**
Financing Cashflow (share capital + Loan – repayment)	14,443,777 (Loan+Capital)	12,471,963 (Loan)	1,068,088 (Loan – int)	10,105,847 (Loan+Capital)	-8,853,152 (Repayment)	-4,294,997
Addition to Cash deposit	**-4,301,160**	**-1,868,378**	**-560,474**	**1,764,492**	**4,166,856**	**-1,197,868**
Cash at the end of the year	2,344,617	476,239	-84,235	1,680,257	5,847,113	4,649,245
Property and equipment	18,198,367	27,180,926	32,484,069	39,178,353	37,063,796	36,686,035
Total debt service (Intst & Repayment)	-1,777,132	-1,887,147	-3,846,449	-4,156,592	-9,491,422	-3,395,810
Debt Service Coverage Ratio	-0.44	-0.29	1.66	1.54	0.74	3.00

Source: SPS Annual Reports arranged by JICA Study Team

SPS is in the quick growing stage in order to compete with international container transshipment market, capital investment is important in the coming several years as well as annual financial performance. Stage by stage development and skillful strategy to attract transshipment cargo secures the development of SPS, and future is in the capability of management rather than the past performance of financial record.

4) Financial structures compared

Following table shows financial situation of Qaboos and Salalah in a comparative format. There are several characteristics to be conspicuous.

Fixed asset amount of Salalah including property and equipments is 36 million RO which is nearly 5 times as much as that of Qaboos. These assets have built up by long term loans which in total amounts to 18 million RO. On the other hand, Qaboos has no long term loan and a lot of investment in the stock market and other real estates. But the size of total asset is nearly 3 times larger in Salalah which is reflected in the size of revenue being twice the size of Qaboos.

Salalah has high ratio of operating cost, depreciation and amortization, administration cost, all of which are more than twice as those of Qaboos. But as for salaries and employee related cost, Qaboos has very high ratio being 50% of total cost as against 31% at Salalah. The average salary per person is 6,600 RO in Qaboos and 4,500 RO in Salalah. As a result, ratio of total operating cost is almost the same in both Qaboos and Salalah at the level of 75%.

Table 12.2-10 Comparison of PSC-Qaboos and SPS-Salalah (1/2)

Balance Sheet (Unit: RO)	**Qaboos 2003**		**Salalah 2003**	
ASSETS				
Property, plant and equipment	7,420,879	36%	36,686,035	69%
Intangible assets	0		358,516	1%
Investment on stock market and others in real estate	5,337,222	27%	0	
Non-current assets Total	**12,758,101**	63%	**37,044,551**	70%
Held for trading investments	827600	4%	0	
Inventories	258,475	1%	921,306	2%
Receivable and prepayments	1,045,235	5%	2,947,249	6%
Short term deposits	4,500,000	22%	10,813,162	20%
Bank balances and cash	968,373	5%	1,495,662	3%
Total current assets	**7,599,683**	37%	**16,177,379**	30%
Total assets	**20,357,784**	100%	**53,221,930**	100%
Capital and Reserve				
Share capital	7,200,000	35%	17,983,740	34%
Legal reserve & General reserve	4,900,000	24%	3,967,867	8%
Proposed dividend	2,160,000	11%	0	
Retained earnings	667,194	3%	3,937,600	7%
Fair value reserve	1,455,069	7%	0	
Total shareholders' equity	**16,382,263**	80%	**25,889,207**	49%
Liabilities				
Non current liabilities	0		18,667,225	35%
Employee terminal benefits deferred tax liability	1,476,493	8%	317,003	1%
Total non current liabilities	**1,476,493**	8%	**18,984,228**	36%
Accounts payable and accruals	2,230,074	11%	5,911,753	11%
Current taxation and other liabilities	268,954	1%	2436742	5%
Total current liabilities	**2,499,028**	12%	**8,348,495**	16%
Total liabilities	**3,975,521**	20%	**27,332,723**	51%
Total shareholders' funds and liabilities	**20,357,784**	100%	**53,221,930**	100%

Income Statement (Unit: RO)	**PSC-2003**		**SPS-2003**		
Operating Revenue	11,551,394		22,018,842		
Other operating Income	164,635		124,390		
Total Operating Revenue	11,716,029		22,143,232		
Direct Expenses					
Salaries and employee related costs	4,487,620	50%	5,101,299	31%	of op cost
Operating costs (including Rent & Insurance)	1,351,139	15%	5,596,519	33%	of op cost
Depreciation and amortization	653,061	8%	2,634,344	16%	of op cost
Total Operating Costs	6,491,820	73%	13,885,086	83%	of op cost
Administration and general expenses	525,815	6%	2,455,426	16%	of op cost
Profit Share to Gov (Franchise, Royalty Fee)	**1,892,617**	**21%**	**935,351**	**6%**	of op cost
Total Admin & Indirect Cost	2,418,432	27%	6,228,630	17%	of op cost
Total Operating Cost	8,910,252	76.1%	16,722,939	75.5%	of op rev
Profit from operations	**2,805,777**	**23.9%**	**5,420,293**	**24.5%**	of op rev
Other income (or loss)	526,295		-1,338,251		
Profit before tax	**3,332,072**	**28%**	**4,082,042**	**18%**	of total rev
Taxation	359,455	11%	0	0%	of profit bef. tax
Net profit for the year	**2,972,617**	**25%**	**4,082,042**	**18%**	of total rev

Source: Compiled by JICA Study Team based on the financial report of PSC and SPS 2003

12.3 Financial and Economic Analysis of the Priority Projects

(1) Outline of Financial and Economic Analysis

The Internal Rate of Return (IRR) is used as a guide to judge whether a project is feasible as against the hurdle rate of weighted average cost of capital which is in recent years 4.5 to 5.5%. For the government investment in this study, the hurdle rate is assumed to be 5%.

For private sector such as PSC or SPS, hurdle rate is identified as opportunity cost of capital in the stock market, which is approximately 15% in Oman. If the IRR on private investment exceeds this hurdle rate, the project is feasible enough to attract private company.

The IRR is calculated by finding an appropriate value of "r" which satisfies the following formula in either economic or financial return:

$$\sum_{i=i}^{n} \frac{Bi - Ci}{(1+r)^{i-1}} = 0$$

Where; n = Period of analysis
Bi = Benefit or Cash in-flow in i-th year,
Ci = Cost of investment and operation or Cash outflow in i-th year
r = Discount Rate (IRR)

The result of calculation is indicated as IRR in each project by each implementation body. The calculation of IRR by each implementation body helps understand the balance in the scheme of Public Private Partnership.

In some cases Net Present value (NPV) is calculated in order to understand the impact and magnitude of investment in relation to project risk by each component. NPV calculate the present value of future income and deduct the investment amount. When the balance of value is positive, implication is that the project is viable and sustainable. In the process of calculating present value of future income, several discount rates are employed according to the risk rating of each income and expenditure item.

Although IRR (Internal Rate of Return) is commonly used, it can be used only when initial investment is once and for all followed by years of expected returns of investment. In the case of staged development, IRR cannot correctly be calculated. Therefore it is suggested to consider the NPV as supplementary tool to measure the feasibility.

(2) Assumptions for financial models of major ports

1) Structure of financial models

Based on the break-even analysis in the previous section, unit revenue, unit operation cost and itemized fixed costs are calculated at each port. Results of calculation in the past 5 years proved to be fairly constant for unit revenue/cost, hence it is reasonable to use these information for the future projections. The unit revenue includes vessel charge, container handling charge, storage charge and

other miscelaneous charges. Unit operation cost includes diesel for trailers, oil and lubricant, electricity and water, and wages for on-call stevedores. The future estimation of revenue and operation cost is calculated by multiplying the unit values with future cargo throughput.

Fixed cost is calculated by each cost item such as maintenance cost, depreciation, administration cost including personnel cost, rent payment to the government and interest payment of loan. These costs are based on the contract or calculated by their own rules or heuristic relation to initial investment. Rules for these calculatins are explained in the following sections.

2) Assumption of unit revenue and unit operation cost

For the Sultan Qaboos Port, priority porject is an expansion of container terminal, so that container related revenues and costs are prepared. The actual financial record shows unit revenues for transhipment container as RO.7.5 /TEU/move and that for import-export container as RO.26.4 /TEU. Operation cost is also calculated on the basis of actual record, and reached a recognition that unit cost is RO.4.8/TEU.

Priority project at Salalah port deals with both container and conventional cargo. Based on the actual record, unit revenue for container cargo is RO.11.6 /TEU/move, and that for bulk and general cargo is RO.1.5 /ton. Operation cost for containers is RO 2.6 /TEU and for conventional cargo RO.0.8 /ton.

For the estimation of other ports, unit data for the calculation of future account is prepared based on the assumption similar to those of Sultan Qaboos Port considering the similarity of situation in each case.

3) Preliminary estimation of fixed cost by item

Depreciation is calculated according to the expected life of each facility in the following table, and assumed straight line rule with no salvage value at the end of life. Maintenance cost is calculated by the ratio to initial investment based on the following rates in the table. Estimated amount calculated as maintenance cost is exhibited in Chapter 11.4 Preliminary Engineering and Cost Estimates of Priority Projects.

Table 12.3-1 Expected Life of Facilities and Maintenance Cost

	Expected Life	Rate of Maintenance cost
Breakwater	100	0%
Quay wall	50	0.2%
Pavement	20	0.2%
Architecture, and facilities	25	0.5%
Equipment	15	2.5%
Tractors,	10	2.5%

Source: JICA Study Team

Administration cost is assumed as additional portion of cost in proportion with the increase of facilities and cargo. The amount includes personnel cost such as PSC assumes 0.5 million RO every year as fixed portion of administration cost. Rent is considered to be set by the negotiation between the Government and each port authority. There is no simple criterion for either of the party because the

government hopes to recover the risk of investments in addition to economic benefit to the nation, whereas each port authority hopes to reduce the burden of payment as low as possible. PSC at Sultan Qaboos port is assumed to pay rent to the government as fixed payment for the newly developed terminal 3.0 mil RO, calculated as 5.5% of 54 Mil RO of total government investment. Similarly other ports are set in relation with investment amounts and economic effects of the projects.

(3) Feasibility of Sultan Qaboos Port

The development of Sultan Qaboos Port should be evaluated by the financial feasibility because it has been operating as the major entry port to the country and has to respond to the growing demand of capacity enhancement. The priority project for the coming 5-year-plan deals with the new container terminal on the outer rim of the existing port with new breakwater.

The result of feasibility study is indicated in the following table which indicates sufficient financial return on the project as a whole and favorable return on the PSC. Return on the government is just enough to pay back the loan. As a public project and the expansion of the port outside of the existing water area, it tends to be costly and public side cannot usually afford to enjoy the direct financial benefit. Often the development induce quick increase of cargo demand and high case will be realized after the completion of construction, and in such a case financial return is more favorable to both of the body, as is shown in the high case below.

Table 12.3-2 Result of Financial Feasibility of the Qaboos Priority Project

IRR of Each investment body	
Base Case	
IRR of Government Investment	5.6%
IRR of PSC Investment	15.5%
High Case	
IRR of Government Investment	6.2%
IRR of PSC Investment	21.1%
Low Case	
IRR of Government Investment	5.1%
IRR of PSC Investment	10.4%
Economic Return	
Economic Return on Investment of Sultan Qaboos Port : 16.8%	

Source: JICA Study Team

The development of new container terminal allows reallocation of conventional cargo terminal including bulk cargo such as grains and cement, the improvement of handling capacity of such cargo will improve the business structure of the Sultan Qaboos Port. Therefore the comparison between "With and Without the priority project" will clear the condition of underlying situation.

The opportunity loss is calculated and measured in relation with potential benefit from minor improvements of existing facilities. In the case of "without the prior project", it is assumed that there will be no major investment on the infrastructure but upgrade and improvements will be made to the cargo handling equipment so that the efficiency and capacity enhancement will be achieved.

In the case of "Without the Priority Project", the opportunity loss is estimated as large as 105 million RO in the net present value, as against the net benefit of 52 million RO by the continued profit from gradual increase of cargo handling equipment at the existing terminals.

Table 12.3-3 Summary of Net Present Value in the case of "Without the Priority Project"

Government Position		
Investment amount	0	Mil RO.
Government Net Benefit from the project in the Present Value	25	
PSC Position		
PSC investment on Terminal and Equipment for improvement	30	Mil RO.
PSC Benefit from the project (NPV discounted by risk factor)	26	
Total value of port in the future		
Project As a whole Investment amount		
Project Benefit as a whole (NPV discounted by risk factor)	**52**	Mil RO.
Opportunity Loss up to 2025	**105**	Mil RO.

Source: JICA Study Team

Table 12.3-4 Feasibility Analysis of the Priority Project at the Sultan Qaboos Port

Financial Feasibility of PSC

Revenue	UnitRO/TEU	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2020	2025
Container (Transhipment)	7.5						1.28	1.37	1.46	1.55	1.64	1.73	2.27	2.07
Container (Imp/Exp)	26.4						6.12	6.55	6.97	7.39	7.81	8.24	11.04	13.83
Total							7.40	7.91	8.42	8.94	9.45	9.96	13.31	15.90
Expenditure														
Op. cost (RO/TEU)	4.8						1.94	2.07	2.21	2.34	2.48	2.61	3.48	3.86
Rent	3.00						3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Maintenance (Terminal)							0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Maintenance(Equipment)							0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66
Depreciation							3.78	3.78	3.78	3.78	3.78	3.78	3.78	3.78
Admin & Personnel	0.46						0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46
Interest of Loan (Equipmt)							1.33	1.19	1.05	0.91	0.77	0.64	0.00	0.00
Total							9.89	10.02	10.16	10.29	10.43	10.56	11.42	11.80
Profit Before Tax							(2.49)	(2.11)	(1.73)	(1.35)	(0.98)	(0.60)	1.88	4.10
Income Tax	12%						0.00	0.00	0.00	0.00	0.00	0.00	0.23	0.49
Net Profit After Tax							(2.49)	(2.11)	(1.73)	(1.35)	(0.98)	(0.60)	1.66	3.61
Franchise Fee							0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Net Profit After Tax,F-Fee							(2.49)	(2.11)	(1.73)	(1.35)	(0.98)	(0.60)	1.66	3.61

Cash Flow of PSC Mil $

Cash In-flow	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2020	2025
Profit Before Tax						-2.5	-2.1	-1.7	-1.4	-1.0	-0.6	1.9	4.1
Depreciation						3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8
Total						1.3	1.7	2.0	2.4	2.8	3.2	5.7	7.9
Cash Out-flow													
Income Tax						0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.5
Dividend						0.0	0.0	0.0	0.0	0.0	0.0	1.4	1.8
Franchise Fee						0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Outflow						0.0	0.0	0.0	0.0	0.0	0.0	1.6	2.3
Operating Cash Balance of the year						1.3	1.7	2.0	2.4	2.8	3.2	4.1	5.5
Loan Repay(Equipment)						2.8	2.8	2.8	2.8	2.8	2.5	0.0	0.0
Interest of Loan (Equipmt)						1.3	1.2	1.1	0.9	0.8	0.6	0.0	0.0
Total amount of repayment					0	-4	-4	-4	-4	-4	-3	0	0

Cash flow of Priority Project

IRR of Investment Total	9.1%
IRR of Government Investment	5.6%
IRR of PSC Investment	15.5%

Source: JICA Study Team

Table 12.3-5 Investment Schedule by the Government and the PSC

Investment Schedule	Mil US$	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Breakwater		0.0	0.0	28.7	0.0	0.0						
Container Terminal		0.0	0.0	0.0	25.2	0.0						
Equipment		0.0	0.0	0.0	0.0	25.4						
Total	79.4	0.0	0.0	28.7	25.2	25.4						

Source: JICA Study Team

Breakwater construction cost is prorated to two berths out of three in the calculation of financial feasibility and the amount is different from that of the priority project. As a result the total amount used for financial feasibility is slightly different from the cost estimation of priority project, but the long term project cost with three berths is the same.

For the economic return on the investment of the development of Sultan Qaboos Port, initial investment for the priority project consists of port expansion and new access road, which are estimated at 87 million RO and 10 million RO respectively.

For the benefit of development, in addition to the direct operational profit from the new terminal, following items are considered as additional economic benefit.

1. Increase of conventional cargo by the rearrangement of terminal after moving containers to new terminal.
2. Additional employment of local people starting the number of 200 which support the local consumption by the multiplier factor of 1.5
3. Additional conventional cargos are assumed to realize the transportation cost savings by sifting the rout from Dubai and other UAE ports to Sultan Qaboos Port.

As a result of calculating these economic effects, the Economic return (EIRR) on the development of Sultan Qaboos Port is 16.8%. As is shown in the table below, total accumulated benefit amounts to approximately 208 million RO in 10 years of operation as against the initial investment being 97 million RO in total. The benefit is more than twice as much as the initial investment.

Without this project, the economic development of this country will be seriously hampered not only by the limited capacity of port but also by hesitation of direct investment from abroad because business environment remains much worse than neighboring countries. The calculation reveals that net benefit is more than 100 million RO with project case. This is an indication that without this project, the loss is much larger and the capital city will eventually fall far behind the international development trend.

Table 12.3-6 Economic Return of the Priority Project at Sultan Qaboos Port (,000 RO)

Year	Employment	Trans-portation Cost Saving	Profit from Port activity: Non-Container Cargo	Profit from Port activity: Container Cargo	Benefit total	Initial Investment: (Port) 87mil RO	Initial Investment: (Road) 10 mil RO	Maintenance cost (Port)	Maintenance cost (Road)	Base Case (investment from 2007) Cash-Flow	Acumulated amount of Investment & Benefit	
2005										0		
2006										0	**Initial Investmt Total 97,000**	
2007						28,000	2,500			-30500		
2008						32,000	3,500			-35500		Accumulated
2009						27,000	4,000			-31000		Benefit
2010	1,144	6,512	23	5,002	12,681			714	20	11,947	11,947	1 year
2011	1,159	7,980	44	5,380	14,562			714	20	13,829	25,776	2 years
2012	1,174	9,448	65	5,757	16,444			714	20	15,710	41,486	3 years
2013	1,189	10,916	86	6,134	18,325			714	20	17,592	59,078	4 years
2014	1,203	12,385	107	6,512	20,207			714	20	19,473	78,551	5 years
2015	1,218	13,853	128	6,889	22,089			714	20	21,355	99,906	6 years
2016	1,236	15,571	136	7,386	24,329			714	20	23,595	123,501	7 years
2017	1,253	17,290	144	7,883	26,570			714	20	25,836	149,337	8 years
2018	1,270	19,009	152	8,379	28,810			714	20	28,076	177,414	9 years
2019	1,288	20,727	160	8,876	31,051			714	20	30,317	**207,731**	**10 years of Accumulated Benefit**
2020	1,305	22,446	168	9,372	33,291			714	20	32,557	240,288	
2021	1,322	24,164	176	9,869	35,532			714	20	34,798	275,086	
2022	1,340	25,883	184	10,366	37,772			714	20	37,039	312,125	
2023	1,357	27,602	192	10,786	39,937			714	20	39,203	351,328	
2024	1,374	29,320	200	11,187	42,081			714	20	41,348	392,675	
2025	1,392	31,039	208	11,588	44,226			714	20	43,492	436,167	
Economic Return on Investment of the Priority Project including Access Road										**16.8%**		

Notes on assumptions
Additional cargos are assumed to realize the transportation cost savings.
Containers are possible to realize cost saving of 120($/TEU).
Non-container cargos are possible to realize cost saveings of 9.6 $/ton.
Non-container cargos are bulk cargo & project cargo. General cargo is not included. (transferred)
Employment of Expatriates is 12 people of 1000 RO/month with multiplier effect 1.5
Employment at Port Operator is 200 people of 250 RO/month average with multiplier effect 1.5
Employment of Port Operators increases by the ratio of 0.2 to the rate of cargo increase.
Maintenance cost is assumed to be 2.5% of initial investment for equipment and 0.2% for civil works.

Source: JICA Study Team

(4) Feasibility of Salalah Port

The development of Salalah Port should be evaluated by the financial feasibility because it has made a successful start with significant investment by the Maersk-Moller group. The priority project encompasses conversion of No.30 and 31 berths to container terminals and shift of general cargo terminal and improvement of passenger terminal and oil berth.

Based on the cargo demand forecast and the investment schedule set by the engineering section, financial benefit on investment is calculated according to the rule of internal rate of return. As is shown in the table below, each implementation body shows modest but reasonable return on the project. The return on government investment is generally lower than that of SPS, and the project as a whole has intermediate level of return. In the base case and the high case shows the rate higher than the hurdle rate of fund procurement from international funding institutions of 5% as average. The case of low demand shows some difficulty to pay the financial responsibility by the cargo handling activity solely.

In addition to these cargoes handling activity, passenger berth is a development by the government for

the sake of cultural and economic benefit including tourism development. Therefore it is considered as a national project which disregards the sufficient monetary return in the limited timeframe to the future.

Table 12.3-7 Result of Feasibility of the Priority Project

Economic Return	
Return on Investment at Salalah Port	8.6%
IRR of Each investment body	
Base Case	
IRR on Government investment	7.6%
IRR on SPS investment	10.7%
Hurdle Rate	5%
High Case	
IRR on Government investment	9.3%
IRR on SPS investment	12.4%
Low Case	
IRR on Government investment	3.8%
IRR on SPS investment	7.6%

Source: JICA Study Team

Table 12.3-8 Financial Feasibility of the Government and the SPS

Revenue	Unit	RO/TEU	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2020	2025
Container (Vessel+Stevedoring)	11.6	RO/TEU				4	6	8	10	12	15	17	20	22	24	24	24
Bulk and general Cargo	1.5	RO/ton								3	2	2	2	2	3	3	3
Total						4	6	8	10	15	17	19	22	25	27	27	27
Expenditure																	
Op. cost of Containers	2.6					0.9	1.3	1.8	2.2	2.7	3.3	3.8	4.4	5.0	5.5	5.5	5.5
Op. cost of Bulk & General Cargo	0.8									1.5	1.6	1.7	1.7	1.8	1.9	2.0	2.0
Rent	2.70	3%				3.4	3.5	3.6	3.7	3.8	4.0	4.1	4.2	4.3	4.5	5.2	6.0
Maintenance (Terminal)						0.0	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Maintenance(Equipment)						0.1	0.7	0.7	0.7	1.1	1.4	1.4	1.4	1.4	1.4	1.4	1.4
Depreciation						1.6	2.9	2.9	3.3	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9
Admin & Personnel	1.1					1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Total						7.1	9.6	10.2	11.1	16.2	17.4	18.1	18.9	19.7	20.4	21.2	22.0
Profit Before Tax & interest						-3.1	-3.7	-2.2	-1.1	-1.2	-0.7	1.2	3.1	5.0	6.5	5.9	5
Interest of Loan (Equipmt)						1.4	2.5	2.2	1.9	2.8	2.4	2.0	1.6	1.2	0.8	0.3	2.5
Income Tax	12%					0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.4	0.6	0.8	0.7	1
Net Profit After Tax						-3.1	-3.7	-2.2	-1.1	-1.2	-0.7	1.1	2.8	4.4	5.7	5.2	4.4
Franchise Fee						0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.5	0.8	1.1	1.0	0.8
Net Profit After Tax & F Fee						-3.1	-3.7	-2.2	-1.1	-1.2	-0.7	0.9	2.2	3.6	4.7	4.2	3.6

Cash Flow of SPS Mil $

Cash In-flow		2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2020	2025
Profit Before Tax					-3.1	-3.7	-2.2	-1.1	-1.2	-0.7	1.2	3.1	5.0	6.5	5.9	5.0
Depreciation					1.6	2.9	2.9	3.3	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9
Total					-1.5	-0.8	0.7	2.2	4.8	5.3	7.2	9.1	10.9	12.4	11.8	11.0
Cash Out-flow																
Income Tax					0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.4	0.6	0.8	0.7	0.6
Dividend					0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.7	1.1	1.4	1.3	1.1
Franchise Fee					0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.5	0.8	1.1	1.0	0.8
Total Outflow					0.0	0.0	0.0	0.0	0.0	0.0	0.6	1.6	2.5	3.3	3.0	2.5
Operating Cash Balance of the year					-1.5	-0.8	0.7	2.2	4.8	5.3	6.5	7.5	8.4	9.1	8.8	8.4
Loan Repay(Equipment)					3.0	6.0	6.0	6.0	8.8	7.9	7.9	7.9	7.9	7.3	1.1	5.8
Interest of Loan (Equipmt)					1.4	2.5	2.2	1.9	2.8	2.4	2.0	1.6	1.2	0.8	0.3	2.5
Total Repayment(Equipment)					4.4	8.4	8.1	7.8	11.6	10.3	9.9	9.5	9.1	8.1	1.4	8.3

Profitability of Priority Project Case-1: Base case of Priority Project: (A = Breakwater and Terminal 5 & 6) + (B = conversion of GC to C, Passenger & Oil)

IRR of investment Total	**8.6%**
IRR on Government investment	**7.6%**
IRR on SPS investment	**10.7%**

Source: JICA Study Team

Table 12.3-9 Investment Schedule by the Government and the SPS

Investment Schedule	Mil RO			2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2020	2025
Breakwater	26.6			26.6	0.0	0.0	0.0	0.0							0.0	0.0
Container Terminal	68.5	95.1		13.0	13.0	0.0	17.4	25.1							0.0	0.0
Equipment	55.0			14.9	14.9	0.0	0.0	25.3							0.6	7.0
Total	150			54.5	27.9	0.0	17.4	50.3							0.6	7.0

Source: JICA Study Team

(5) Feasibility Analysis of Sohar Port

Sohar port is a national project coupled with development of an industrial park which will be a new center of industrial area. Therefore the economic impact is very large including cost savings by a new transportation rout directly from the port. The location is competitive against Dubai and other UAE ports.

Financial feasibility is assumed to be sufficient considering the SIPC (Sohar Industrial Port Corporation) as a management body and the Steinweg Oman as an operator of port operation. The SIPC is free from significant investment and works as a landlord to collect rent and do the maintenance of facilities. The Steinweg Oman is nominated as a port operator with investment on cargo handling equipment.

The result of calculation in the following table is based on the assumptions that development and tenant operations would start as early as possible so that the economic effect will take shape as initially planned by the government. Therefore any economic turbulence in the future might change the forecast of return on investment, and in most cases it is very likely that the economic return might be reduced to the level of nearly two thirds of the expected return here.

Table 12.3-10 Result of Economic and Financial Feasibility of the Sohar Priority Project

Return on Investment of the Government		
Economic Return on The priority Project	30.7%	
Economic Return on the whole investment	17.0%	Economic Benefit includes transportation cost savings and employment effiect

Return on Investment of Each management bodies		Base Case
Financial Return of SIPC		
IRR of Investment on terminal	16.5%	Investment amount assumed as 20 % of government investment
Net Present Value of the Investment (SIPC)	13.2	Mil RO
Financial Return of Steinweg Oman		
IRR of Investment on Terminal Equipment and M	27.9%	Investment on Equipments and facilities for terminal operation
Net Present Value of the Investment (Steinweg)	30.8	Mil RO

Source: JICA Study Team

Table 12.3-11 Economic Return on Investment of Sohar Port Development (,000 RO)

Year	Employment	Transportation Cost Saving		Benefit total	Initial Investment	Maintenance & Admin. Cost	Base Case (investment from 2006) 58,100	Dumping Case 14,533
		Non-Container Cargo	Container Cargo					
2002								
2003					23,191		-23,191	-23,191
2004					9,939		-9,939	-9,939
2005							0	0
2006					28,599		-28,599	-7266.6667
2007					29,466		-29,466	-7266.6667
2008	991	20,559	3,549	25,099		8,026	17,073	17,073
2009	1,059	22,211	3,708	26,978		8,590	18,388	18,388
2010	1,095	23,863	3,867	28,824		9,143	19,681	19,681
2011	1,116	25,514	4,026	30,656		9,693	20,963	20,963
2012	1,138	27,166	4,185	32,489		10,243	22,246	22,246
2013	1,160	28,818	4,344	34,322		10,793	23,529	23,529
2014	1,182	30,469	4,503	36,154		11,342	24,812	24,812
2015	1,204	32,121	4,662	37,987		11,892	26,095	26,095
2016	1,207	32,121	4,952	38,280		11,980	26,300	26,300
2017	1,211	32,121	5,242	38,574		12,068	26,506	26,506
2018	1,214	32,121	5,533	38,868		12,157	26,711	26,711
2019	1,217	32,121	5,823	39,161		12,245	26,917	26,917
2020	1,221	32,121	6,113	39,455		12,333	27,122	27,122
2021	1,226	32,121	6,404	39,751		12,422	27,330	27,330
2022	1,232	32,121	6,694	40,047		12,510	27,537	27,537
2023	1,237	32,121	6,984	40,343		12,599	27,744	27,744
2024	1,243	32,121	7,275	40,639		12,688	27,951	27,951
2025	1,248	32,121	7,565	40,935		12,777	28,158	28,158
Economic Return on Investment in the Priority Project (Base Case)								31%
Economic Return on Investment of the whole project (including the past investment)								17%
Economic Return on Investment in the Priority Project with dumping area								88%
Economic Return on Investment in the project as a whole with dumping area								23%

Notes on assumptions

50% of container and non-container cargos are assumed to realize the transportation cost savings.
Containers are possible to reach cost saving of 150$/FEU (= 75$/TEU.)
Non-container cargos are possible to reach cost saveings of 10 $/ton.
Employment at administration office is 12 people of 250 RO/month with multiplier effect 1.5
Employment at Port Operator is 200 people of 250 RO/month average with multiplier effect 1.5
Employment of Port Operators increases by the rate of 0.2 of cargo increase
60% of initial investment is made in 2006, and the rest of 40% with equipment is invested in 2007.
Maintenancecost is assumed to be 2.5% of initial investment for equipment and 0.5% for civil works.

Source: JICA Study Team

Table 12.3-12 Financial Feasibility of the Sohar Priority Project by Each Operating Body

Financial Feasibility of Sohar Port Mil R.O

Revenue	Unit Revenue		2008	2009	2010	2011	2012	2013	2014	2015	2020	2025
Cargo Handling -General Cargo	2.5	R.O/ton			2.1	2.2	2.3	2.4	2.4	2.5	2.5	2.5
Cargo Handling -Liquid Bulk	0.6	R.O/ton			4.6	4.8	5.0	5.2	5.4	5.6	5.6	5.6
Cargo Handling -Dry Bulk	1.0	R.O/ton			3.8	4.3	4.8	5.3	5.9	6.4	6.4	6.4
Container handling -Imp/Exp	26.4	R.O/TEU			8.2	8.8	9.4	10.0	10.6	11.1	14.4	17.7
Container handling -Empty	15.8	R.O/TEU			3.3	3.5	3.8	4.0	4.2	4.5	5.8	7.1
Other Revenue on cargo handling	3	R.O/TEU			1.6	1.7	1.8	1.9	2.0	2.1	2.7	3.4
Total Revenue (individual tenant)					7.6	8.2	8.9	9.5	10.1	10.7	10.7	10.7
Total Revenue (Steinweg)					16.0	17.1	18.2	19.3	20.4	21.5	26.8	32.0
Expenditure	Unit cost											
Maintenance cost (Quay strudture)	0.04	,001 R.O			0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Maintenance cost (Equipment)	0.26	,000 R.O			0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26
Op. cost (Cargo Handling)	0.7	,000 R.O			8.6	9.2	9.8	10.5	11.1	11.7	11.7	11.7
Op. cost (Container Handling)	4.8	,000 R.O			2.5	2.7	2.8	3.0	3.2	3.4	4.4	5.4
Admin Cost	0.33	,001 R.O			0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.4
Depreciation (Equipment)	0.52	Mil R.O			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Rent Payment to Port Authority	2.73	Mil R.O			2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7
Interest of Loan (Total)		Mil R.O			0.5	0.5	0.4	0.4	0.3	0.3	0.0	0.0
Total					15.5	16.2	17.0	17.7	18.5	19.2	20.0	21.0
Profit Before Tax					0.5	0.9	1.2	1.6	2.0	2.3	6.8	11
Income Tax	12%				0.1	0.1	0.1	0.2	0.2	0.3	0.8	1
Net Profit After Tax					0.5	0.8	1.1	1.4	1.7	2.0	6.0	9.7
Rent Revenue												
Rate Rent to Initial Investment	8.0%											
Discount Rate with Operational Risk	8.0%											
Discount Rate with Financial Risk	5.0%											

A. Cash Flow of SIPC (Sohar Industrial Port Corporation) Mil.RO

Cash In-flow from Operation	NPV-25		2008	2009	2010	2011	2012	2013	2014	2015	2020	2025
Rent Revenue	13	8%			1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Cash Out-flow from Operation												
Maintenance of Infrastructure	0.4	5%			0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Admin Cost	1.2	5%			0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Operating Cash Balance of the year	13				1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
Cash Flow from Financial Activity												
Cash Inflow	35	5%	37.2									
Loan Repay (Infrastructure)	21.0	5%		1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9
Interest of Loan (Infrastructure)	13.8	5%		1.9	1.8	1.7	1.6	1.5	1.4	1.3	0.8	0.4
Financial Cash Balance	1		37	-4	-4	-4	-3	-3	-3	-3	-3	-2
A. Feasibility of Investment and Return												
IRR of Port Authrity (Infrastructure)	**16.5%**											
NPV of Sohar Port Authority Investmen	**13.2**											
Hurdle Rate	**5.0%**											

B. Cash Flow of Steinweg Oman as Terminal Operator Mil.RO

Cash In-flow from Operation	NPV-25			2009	2010	2011	2012	2013	2014	2015	2020	2025
Cargo Handling Service	198.1	8%			16.0	17.1	18.2	19.3	20.4	21.5	26.8	32.0
Cash Out-flow from Operation												
Operation Cost (Cargo Handling)	133.1	8%			11.7	12.5	13.3	14.1	14.9	15.7	16.7	17.8
Rent Payment to Port Authority	29.6	5%			2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7
Tax payment duty	4.1	8%			0.1	0.1	0.1	0.2	0.2	0.3	0.8	1.3
Operating Cash Balance of the year	31.3				1.5	1.8	2.0	2.3	2.5	2.8	6.5	10.2
Cash Flow from Financial Activity												
Cash Inflow	9.9	5%		10.4								
Loan Repay (Equipment)	8.0	5%			1.0	1.0	1.0	1.0	1.0	1.0	0.0	
Interest of Loan (Equipment)	2.4	5%			0.5	0.5	0.4	0.4	0.3	0.3	0.0	
Financial Cash Balance	-0.5			10.4	-1.6	-1.5	-1.5	-1.4	-1.3	-1.3	0.0	0.0
B. Feasibility of Investment and Return												
IRR of Terminal Operator	**28%**											
NPV of Port Service Investment	30.8											
Hurdle Rate	5.0%											

Source: JICA Study Team

(6) Feasibility Analysis of Duqm Port

Duqm Port development is planned to create a place of regional industrial center helping local fishery folks and supply center of consumable cargo and new industry of dockyard. Economic impact is assumed to be marginal but the strategic location would provide an important key to future development of the area.

Financial feasibility by each operating body indicates that the port authority for the support of fishery folks is low return. Private companies such as terminal operators and dockyard company are expected to receive reasonable returns which make their business feasible. In order to secure the success of investment, reasonable speed and size would be required together with hinterland development.

Table 12.3-13 Economic and Financial Feasibility of the Duqm Priority Project

Economic Return on Government Investment		
Economic Return on the priority project	10.9%	Economic Benefit includes transportation cost savings and employment effiect
Return on Investment of each management body		Base Case
Financial Return of Duqm Port Authority		
IRR of Investment on port infrastructure	2.7%	Investment includes breakwater, fishery wharfs and terminals
Net Present Value of the Investment (Duqm Port	27.4	Mil RO
Financial Return of Marine and Cargo handling company		
IRR of Investment on Terminal Equipment and M	20.1%	Investment on equipments and facilities for navigationa and terminal operation
Net Present Value of the Investment	5.1	Mil RO
Financial Return of Dockyard		
IRR of Investment on Dockyard	12.8%	Investment on equipments and facilities for dockyard business
Net Present Value of the Investment	22.3	Mil RO

Source: JICA Study Team

Table 12.3-14 Economic Return on Investment at Duqm Port (,000 RO)

Year	Benfit to Employment	Benefit from Transportation Cost Saving		Benefit total	Initial Investment	Maintenance Cost (,000 RO)	Admin. And Operation Cost (,000 RO)	Base Case (investment from 2006)
		General Cargo	Liquid Cargo					
2005								0
2006					3,160			-3,160
2007					2,210			-2,210
2008					18,433			-18,433
2009					32,699			-32,699
2010					22,375			-22,375
2011	1,050	7,157	4,636	12,843		212.1	2,359	10,484
2012	1,260	7,372	4,775	13,407		212.1	2,429	10,977
2013	1,268	7,593	4,918	13,779		212.1	2,502	11,277
2014	1,275	7,821	5,066	14,162		212.1	2,577	11,584
2015	1,283	8,056	5,218	14,556		212.1	2,655	11,901
2016	1,291	8,297	5,374	14,962		212.1	2,734	12,228
2017	1,298	8,546	5,535	15,380		212.1	2,816	12,563
2018	1,306	8,803	5,701	15,810		212.1	2,901	12,909
2019	1,314	9,067	5,872	16,253		212.1	2,988	13,265
2020	1,322	9,339	6,049	16,709		212.1	3,077	13,632
2021	1,330	9,619	6,230	17,179		212.1	3,170	14,009
2022	1,338	9,907	6,417	17,662		212.1	3,265	14,397
2023	1,346	10,205	6,609	18,160		212.1	3,363	14,797
2024	1,354	10,511	6,808	18,672		212.1	3,464	15,209
2025	1,362	10,826	7,012	19,200		212.1	3,568	15,632
Economic Return on Investment in the Priority Project (Base Case)								**10.9%**
Economic Return on Investment of the whole project (including the past investment)								**10.9%**

Notes on assumptions

All cargos are assumed to realize the transportation cost savings.
General and Dry-bulk cargos are expected to encourage export and reach cost saveings of 100 $/ton.
Total employment at Duqm port is estimated to be 350 people with average salary of 3,000 RO/month.
From the second year multiplier effect of 1.2 is expected to the benefit of employment
Employment at Port increases by the rate of 0.2 of cargo increase
Maintenancecost is assumed to be 2.5% of initial investment for equipment and 0.2% for civil works.
Operation and Administration cost is assumed to be 20% of benefit from transportation benefit.

Source: JICA Study Team

Table 12.3-15 Cash Flow of Duqm Port by each operating body

A. Cash Flow of Duqm Port Authority (including Fishery Port maintenance) Mil.RO

Cash In-flow from Operation	NPV-25		2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2020	2025
Rent Revenue	35	8%			3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8
Cash Out-flow from Operation														
Maintenance of Infrastructure	3	5%			0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.8
Operating Cash Balance of the year	32				3.4	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.2	2.9
Cash Flow from Financial Activity														
Cash Inflow	72	5%	51.0	25.5										
Loan Repay (Infrastructure)	59	5%			7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	0.0	0.0
Interest of Loan (Infrastructure)	17	5%			3.8	3.4	3.1	2.7	2.3	1.9	1.5	1.1	0.0	0.0
Financial Cash Balance	-5		51	25	-11	-11	-11	-10	-10	-10	-9	-9	0	0

A. Feasibility of Investment and Return	
IRR of Port Authrity (Infrastructure)	**2.7%**
NPV of Duqm Port Authority Investment	**27**
Hurdle Rate	**5.0%**

B. Cash Flow of Marine Service & Cargo Handling Mil.RO

Cash In-flow from Operation	NPV-25		2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2020	2025
Marine Service	27.3	8%			1.0	1.1	1.3	1.5	1.8	2.0	2.4	2.7	5.3	6.8
Cargo Handling Service	5.6	8%			0.5	0.5	0.5	0.5	0.6	0.6	0.6	0.6	0.7	0.8
Cash Out-flow from Operation														
Operation Cost (Marine + Cargo)	13.2	8%			1.2	1.2	1.3	1.3	1.3	1.4	1.4	1.4	1.6	1.8
Rent Payment to Port Authority	14.6	5%			1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Operating Cash Balance of the year	5.2				-1.0	-0.8	-0.7	-0.5	-0.3	0.0	0.3	0.7	3.2	4.6
Cash Flow from Financial Activity														
Cash Inflow	1.5	5%		1.6										
Loan Repay (Infrastructure)	1.2	5%			0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.0	0.0
Interest of Loan (Infrastructure)	0.4	5%			0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Financial Cash Balance	-0.1		0.0	1.6	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	0.0	0.0

B. Feasibility of Investment and Return	
IRR of Marine + Cargo Service	**20.1%**
NPV of Port Service Investment	**5.1**
Hurdle Rate	**5.0%**

D. Cash Flow of Dockyard Mil.RO

Cash In-flow from Operation	NPV-25		2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2020	2025
Dockyard Service Revenue	25.9	8%			0.5	0.6	0.7	0.8	0.9	1.1	1.2	1.4	2.8	3.5
Cash Out-flow from Operation														
Operation Cost of Dockyard	3.6	8%			0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Rent Payment to Port Authority	22.0	5%			1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Operating Cash Balance of the year	0.4				-1.0	-0.9	-0.8	-0.7	-0.6	-0.5	-0.3	-0.1	1.2	2.0
Cash Flow from Financial Activity														
Cash Inflow	0.8	5%		0.9										
Loan Repay (Infrastructure)	0.6	5%			0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0
Interest of Loan (Infrastructure)	0.2	5%			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Financial Cash Balance	0.0		0.0	0.9	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	0.0	0.0

D. Feasibility of Investment and Return	
IRR of Port Authrity (Infrastructure)	**12.8%**
NPV of Dockyard Service Investment	**22.3**
Hurdle Rate	**5.0%**

Source: JICA Study Team

12.4 Overall Preliminary Evaluation of Priority Projects from Economic and Financial Perspectives

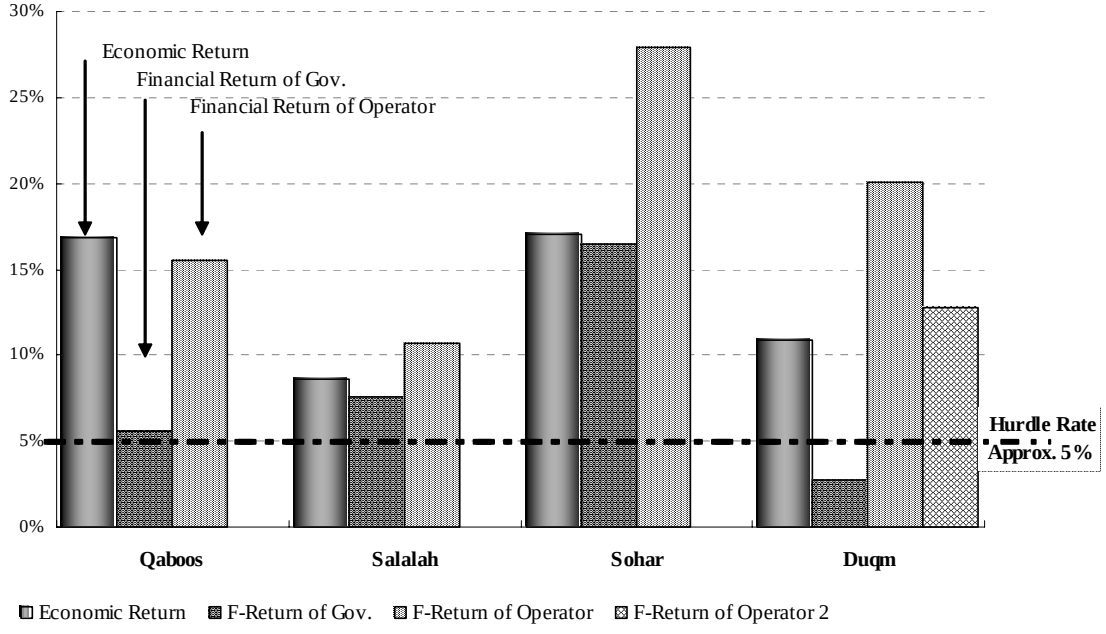
As a result of the feasibility study for priority projects, returns on investments are exhibited in the following graph in which IRR on government investments should be compared with the hurdle rate of 5%, and the IRR on operator should be compared with the hurdle rate of 15%.

In most projects such as Qaboos, Salalah and Sohar, government will receive the return more than the hurdle rate but Duqm does not have sufficient return. Sultan Qaboos port is only slightly over the hurdle rate because of the investment on the breakwater. Duqm port is new and lack in economic and financial background, thereby need continuous support of the government for maintenance.

Economic returns are also important to check whether it is in the reasonable level of 10%. Duqm port has sufficient economic return and the level of economic return is generally reasonable in most of the projects.

Financial returns on the investment of private sectors in priority projects are in the level above the hurdle rate of 15% except Salalah. It is, therefore in short, Qaboos and Sohar is feasible, and Salalah depends on the risk taking effort of SPS, and Duqm depend on the government support after the opening of the port.

Figure12.4-1 Summary of Return on Investment at Priority Projects



Source: JICA Study Team

Besides economic and financial feasibility study, integrated analysis including socio-political viewpoints might be important. Sultan Qaboos Port needs to be developed as gate port to the nation and the development of container terminal is a must for the future of the port. Salalah port already established its reputation as an international container transshipment hub and its development is

ardently wished by users as international economy grows.

Sohar and Duqm Ports are strategically planned and their success is hoped for the regional and industrial development. These ports are particularly expected to grow even during the time of political instability in the Gulf region.

Table 12.4-1 Evaluation and Strategic Portfolio of Priority Projects (1/2)

	Sultan Qaboos Port	Salalah Port	Sohar Port	Duqm Port
Overall Evaluation	The project is feasible from both financial and economic aspects. Demand from the hinterland is large and the development is indispensable for the development of capital area of Muscat.	The project is feasible from both financial and economic aspects, especially with strong tie-up with Maersk-Sealand group.	The project is indispensable and feasible from both financial and economic aspects.	The project from the government side requires continuous support. Private sector needs to make a lot of effort to make their business feasible.
Strategic implications of development	Port activity corresponds to the development of the nation. The success will take advantage of insurgence in the gulf region.	Quick and successful development relates to the international economy.	Port is a must for the hinterland development. The success will take advantage of insurgence in the gulf region.	Proactive development will be supported by the international economy.
Socio-Economic Aspect				
Needs of the nation, compliance to the policy including effect on employment	The development of new terminal is supported by the strong needs of both industry and consumers in the capital region.	The port functions as transhipment hub and created positive impact on employment opportunity. Success of development depends on the international economy between east and west and shipping line.	This is a national project already started with development of industrial park. Oil and gas related industries are showing interest and signed to locate here. Contribution to employment is large.	This is a National Top-down project creating new employment opportunity. Oil reserve as national strategic project will be realized here in the long run.
Relation to industry	Various industry depend on the Port including distribution processing and Rusayl Industrial Park	Industrial park such as Raysut Industrial Park is planned but not strongly moving yet.	Port will be developed together with the industrial hinterland	New industry such as dockyard service and related engineering will be nurtured.
Relation to society and consumer	Steady consumption demand from Muscat City	limited growth of the consumption in the hinterland	Local consumer demand is considered as subordinate.	Increase habitation of port related workers.
Management Body	Management company PSC is a locally owned corporation operated by Omani people.	Maersk-Moller Group leads the development and management of the port.	Port of Rotterdam and terminal operator Steinweg seems to lead the development and operation of the port.	Private participation is considered for the operation of cargo handling and dockyard operation.

Source: JICA Study Team

Table 12.4-2 Evaluation and Strategic Portfolio of Priority Projects (2/2)

	Sultan Qaboos Port	Salalah Port	Sohar Port	Duqm Port
Financial Aspect				
Project Size (Investment Amount)	86 Mil R.O (220 Mil USD)	82 (5&6 on-going) + 68 (BB, Oil, Passenger, Others) = 150 Mil R.O (210 + 170 = 390 Mil USD)	33 (sunk cost) + 58 (new investment) = 91 Mil R.O (85 + 150 = 236 Mil. USD)	80 Mil RO (210 Mil USD)
Financial Feasibility (Revenue Outlook & Cost controllability)	Because of breakwater construction, return on investment is not very high, just above the hurdle rate (bank payment rate.)	Transhipment business is marginally profitable in the world competitive market. As a result, return on investment is not easy to improve.	Economic impact is great but financial return is limited. The government must be happy to have private industries prosper.	New industry to be developed, which is risky and not certain to attract private investors.
Risk Identification				
Engineering Risk for construction and Management risk for port service.	Omanization in employee and management may undermine the quality of service among international competition.	Strong management body will ensure the steady and quick development of facilities and realization of quality service.	Experienced management body of Rotterdam will support the development of the port, but may not comply with the policy of the nation.	There is not enough identification of management and engineering body.
Marketing risk (cargo fluctuation) and business risk	Majority of cargo is import-export and supported by the hinterland demands.	Majority of cargo is international transhipment containers. They are quick to move to other ports unless the service satisfies the expectation.	Majority of cargo is assumed to be import and export of hinterland industries, thereby stable as long as those industries are in good operation.	Substantial amount of investment is necessary to induce cargo. Therefore it is not easy to attract cargo.
Financial risk (Interest rate fluctuation)	Equity fund has to be sufficient for the operation, but not for the development investment. Based on the high dividend rate, equity finance might be possible.	AP Moller as a management support will ensure the success of development. Debt ratio is higher than Sultan Qaboos Port.	SIPC as a management body may not receive the sufficient return. Financial support from government needs to be continued.	Financial support from government is the only reliable source as a guarantor.
Country Risk of the neighboring countries	Susceptible to the instability of neighboring Arab countries	Susceptible to the international economy.	Insurgence in the neighboring country helps to develop Sohar.	Relatively independent, but a function of oil reserve has somewhat reverse relationship with instability of Arab countries.

Source: JICA Study Team

CHAPTER 13

DRAFT GUIDELINE FOR SEVENTH FIVE-YEAR DEVELOPMENT PLAN OF PORT SECTOR

13 FORMULATION OF DRAFT GUIDELINE FOR SEVENTH FIVE-YEAR DEVELOPMENT PLAN OF PORT SECTOR

13.1 Review of the Port Sector Plans in the Previous Five-Year Development Plans (4th - 6th Plans)

In order to examine the past record of annual budget of port sector, the budget of previous Five-Year Plans (4th – 6th Plans) are summarized below.

Table 13.1-1 Summary of Previous Five-Year Plans of Port Sector

Qaboos Port; 18mRO

Unit: m R.O.

Plan	4th Plan (1991-1995)	5th Plan (1996-2000)	6th Plan (2001-2005)
Allocated Budget	23.2	2.6	5.2
Transferred from Previous Plan	3.1	0.9	93.8
Supplementary Budget for Additional Projects	-	166.7	96.6
Total Budget	-	170.2	195.6
Actual Expenditure	-	76.5	39.0

Sohar Port; 81mRO

Salalah Port; 77mRO

Salalah Port; 52mRO
Sohar Port; 96mRO

Source: previous Five-Year Plan
data sheets from MOTC
JICA Study 2000

During the period of the 4th Development Plan (1991 – 1995), a total of OR. 26.3 million was allocated to the Port Sector as development expenditure including for ongoing projects from the 3rd plan. Majority of the budget was spent for projects to expand the capacity of Sultan Qaboos Port, and construction of Royal Yacht berth at the Port was accomplished in the 4th Plan. All of the approved development expenditure was originated from the public sector.

Port Sector set up the following goals to be achieved during the period of 4th Five Year Plan;

- Expand the capacity of Sultan Qaboos Port by improving facilities and equipment.
- Improve the managerial efficiency of ports.
- Study the need to build a new port and a suitable operation system

At the beginning of the 5th Five Year Plan (1996 – 2000), OR. 3.5 million including the budget for the ongoing projects was allocated to the Port Sector as development expenditure. Main new projects were civil works for maintenance and renovation of jetties in Khasab Port (OR. 1.5 million) and Raysut Port (OR. 1.0 million). At later stage of the Five Year Plan period, however, budget of OR. 52 million for construction of container berths (No.1 – 4) at Salalah Port, which was commissioned in November 1998, was appropriated in 5th Plan. Industrial Port Development Project at Sohar was also approved officially later in 1999, and amount of OR. 96 million was capitalized for this project in the 5th plan although most of the budget for the implementation of Sohar Industrial Port was carried over to the 6th Plan. Supplementary budget for these new projects reached OR. 166.7 million.

In the 5th Five Year Plan, Port Sector put the emphasis on private sector's roles in port construction and operation, and following policies were adopted in the port sector;

1) Upgrading the ports and the services they provide through:
   - Expanding the capacity of existing ports through the improvement and development of equipment, construction and increasing the depth of quays.
   - Improving the management efficiency of ports and that of loading and unloading operations.
2) Furthering the role of the private sector in financing additional investments required for the development and modernization of the existing and proposed sea ports.

In the 6th Five Year Plan (2001 – 2005), about OR. 5.2 million are approbations for new projects which include establishment of free trade estate in Salalah at a cost of OR. 2.5 million. Most of the approved budget for Sohar Industrial Port is transferred from the previous plan. In addition to these projects, establishment of Ad Duqm Port at a cost of OR. 20 million was approved supplementary, and a project to extend the container berths by 900m at Salalah Port was also approved recently. It is planned to announce the tender for construction works early in 2005 though its design on detailed design is still under way. By summing up, approved development expenditure for the port sector totals nearly OR. 200 million in the 6th plan.

In the 6th plan, the port sector adopts the following objectives;

- Privatization of Sohar and Khasab Ports through long term concession agreement.
- Reorganizing the administrative framework for ports authority
- Broadening the established sea ports capacity through development and amelioration
- Establishment of duty free and industrial estates in port areas.
- Furthering private sector role in financing through long term concession agreements
- Development of different systems to serve the sea navigation safety in the Sultanate.
- Expansion in employing qualified citizens to replace expatriates.
- Raising the efficiency of territorial and Private Economic Water Management

13.2 Preliminary Evaluation of the Sixth Five-Year Development of the Port Sector

13.2.1 Administration, Port management and Operation

(1) General Evaluation

During the Sixth-Five Year Development Plan, port management system in the major port, namely Sultan Qaboos Port, Salalah Port and Sohar Port witnessed remarkable development. Sultan Qaboos Port increased the ratio of private sector holding share. Salalah port has been earning the net profit since 2000 consecutively. Sohar Industrial Port Company (SIPC) is established at the time of the completion of the first phase construction. The private participation to the port operation has achieved certain progress.

(2) Objectives of Sixth-Five Year Development Plan – Evaluation

1) Privatization of Sohar port and Khasab port.

As shown in above, Sohar port is managed by SIPC jointly established by GSO and Rotterdam Port Authority sharing 50% each. As far as Khasab port, a study has recommended trust port scheme, however, no appropriate formula is created. In view of the area being not developed, private operator may be hesitant to apply.

2) Reorganization of the administrative framework for port authority to achieve the links between planning, marketing and development matters encouragement and support of private investment.

Many projects in Sultan Qaboos and Salalah port based on the private sector initiative but being included in the five-year development plan are delayed due to lengthy procedure among the government. The procedure should be expedited, as well as the line ministries' persuasiveness should be strengthened.

3) Establishment of duty free and industrial estates.

Not established except Sohar Industrial Area. Salalah Free-zone was created, but not function well.

4) Furthering private sector role in financing additional investments.

Gate and workshop of Sultan Qaboos port, and extension of breakwater, expansion of quays and other works of Salalah port will be commenced within the sixth five year term. Second phase of Sohar port construction is now under way.
Khasab port and Ad Duqm port should continue marketing to get qualified concessionaire.

5) Omanization

While major three ports have cleared the Omanization target, GSO should try to support the port authorities hiring the qualified workers, considering in particular that modern port works require much technology and skills.

6) Raising the efficiency of territorial and private economic water management

No significant scheme has observed. GSO should make effort to create adequate scheme in this regard.

(3) Approved policy and mechanisms to achieve sector objectives in the Sixth Five-year Plan - Evaluation

1) Linking management of Sultan Qaboos port with Sohar port

From management point of view, no necessity to link both ports exists. While Sultan Qaboos port is a service port catering for common users, Sohar port is a landlord type port serving for industries. It is not appropriate for the management of both ports to unify into one management.

2) Preparation of strategic plan for development of ports to escort with openness and new directives in foreign trade and regional cooperation agreements.

Not created yet. While GSO is observing international conventions (Law of the Sea, IMO Conventions) as well as regional agreement, there is no strategy for port development escorting with above international instruments. It is doubtful that this kind of strategy is really necessary for future port development.

3) Imposing duty free incentives to Salalah and Khasab port.

See 2-2 4.

13.2.2 Infrastructure Development

(1) Port Traffic

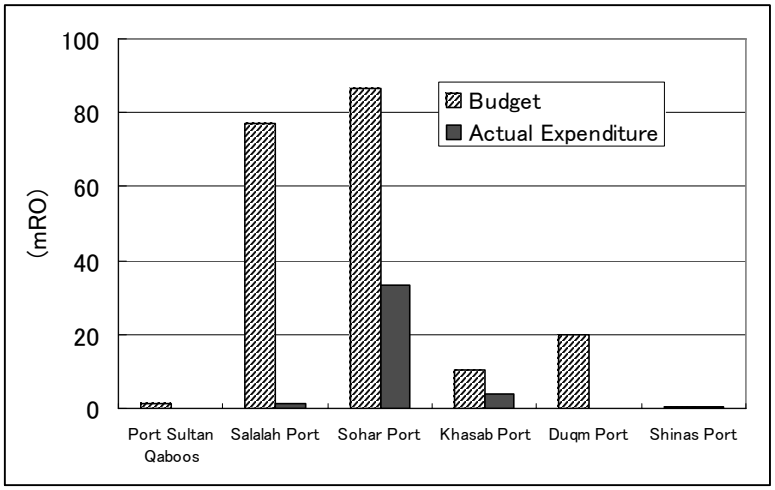
Sea transportation in the Sultanate has been concentrated on the two major commercial ports i.e. Sultan Qaboos Port and Salalah Port. The former is the national gateway of the Sultanate and the latter is one of the busiest international container transhipment ports. As shown in Chapter 7, Omani ports registered a total of 1.9 million tons of export/import cargo in 1995, 2.9 million tons in 2000, and 3.6 million tons in 2003, yielding an annual growth rate of 7.9 percent during the period from 1995 to 2000 and 8.3 percent during the period from 2000 to 2003. Regarding the transhipment container throughput at Salalah Port, 2.001 million TEUs was registered in 2003 while 1.033 million TEUs was recorded in 2000. Resulting annual growth rate is 24.7 percent. From these observations, it can be safely said that volume of port throughput at Omani ports has been remarkably increasingly in recent years.

(2) Overall Contracted Ratio

Analysis was made on the relationship between the allocated budget and real expenditure to the port sector in order to review the past performance. Comparison of the budget in the 6th Five-Year Plan for each port and the percentage of expenditure to budget are shown in Figure 13.2-1 and 13.2-2, respectively. It is obvious from these Figures that majority of the port budget is allocated for Salalah Port and Sohar Port in the 6th Plan, and the ratio of the total actual expenditure to the budget is around

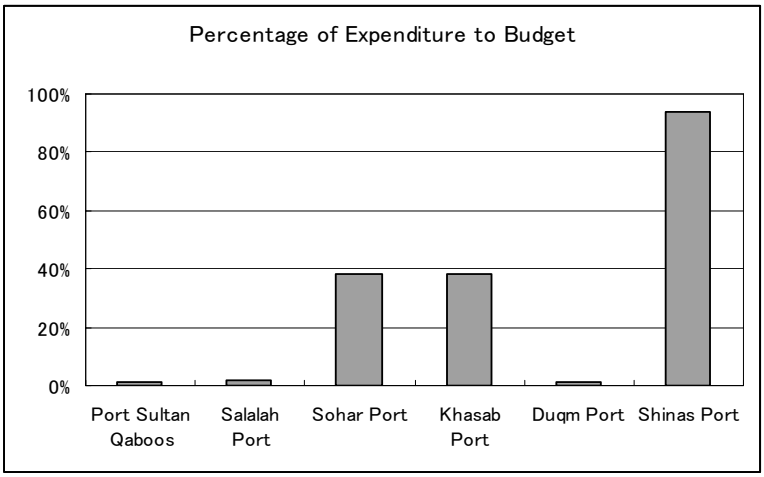
20% in January 2005. The actual contracted ratio to the budget is still low in each port except for Shinas Port where more than 90% of the allocated budget has been implemented. However, taking into account the fact that the construction of Sohar Port is on-going, the phase 1 of Khasab Port Project has been completed in October 2004, the phase 2 of Khasab Port Project including the establishment of buildings for commercial berth will be completed within 2005 and Salalah Expansion Project will start in May 2005, the execution ratio will increase gradually. Concerning Duqm Port Project, it is still at the stage of study and coordination of the integrated master plan. Although early implementation has been expected to promote regional economic development, the project is likely to be carried over into the next Seventh Five-Year Plan.

Figure 13.2-1 Comparison of Budget & Expenditure of Each Port



Source: Five-Year Plan & MOTC

Figure 13.2-2 Percentage of Expenditure to Budget



Source: Five-Year Plan & MOTC

(3) Achievement of Major Infrastructure Development

In the 6th Plan, the amended approbations for Sohar Industrial Port Development Project and Salalah Port Expansion Project total about OR. 160 million and account for about 80 percent of the sector's investment programme.

Regarding the Sohar Port Project, construction of two bulk berths at the foot of the southern breakwater will be completed by the end of April 2005, and liquid berth C1 will be built by August 2005. Construction of new steel and aluminium berth for 600m to the north side of the small boat mooring is also planned. More than OR. 30 million will be needed for the projects during the rest period of the 6th Plan.

Salalah Port Expansion Project (978m long quay wall, breakwater and dredging) has been approved in 2004 as container volume handled at Salalah Port has increased suddenly since the port operation started in 1998 because of cargo movement related Iraqi and Afghan rehabilitation and partly its relative security versus to inside Gulf ports and Yemeni ports. Construction works will take place from 2005 to 2007. Salalah Free Zone Company was established with 100% government equity to manage the Salalah Free Trade Zone where duty free will be exercised to industries. The government has decided to allocate natural gas to industries in the Salalah Free Trade Zone. Infrastructure development in the free zone has been preparing.

The phase 1 development of Khasab Port has been completed in 2004, which includes the construction of breakwaters, the dredging of turning basin, 75 ha land reclamation, 300 m commercial berth, 3 floating jetties for Iranian vessels, 2 floating jetties for government vessels, 2 floating jetties for fishing boats and 100 m quay for fishery harbour. The phase 2 development is on-going and will be completed within 2005. Deepening of Shinas Port has been finalized. Regarding Duqm Port, the Ship repair facilities and port development project is at the preparation stage before the implementation, and the project is likely to be carried over into the next Seventh Five-Year Plan. Based on the above analysis, the actual expenditure in 6th Five-Year Plan is estimated at around OR. 80 million although OR. 39 million has been actually spent so far till January 2005.

As explained above, expansion of port capacity has been realized through development and improvement of port infrastructure and cargo handling equipment although Sultan Qaboos Port has been suffering from shortage of the port capacity.

13.3 Cargo Demand for 2010 and Existing Capacity

Cargo demand forecast was made for each major commercial port to evaluate the necessity of expansion of port facilities at the target year of the 7th Five Year Plan. Resultant demands are shown in Table 13.3-1 by package type.

For Sultan Qaboos Port, container traffic, both import/export containers and transhipment containers, is expected to continuously increase and will reach more than 400,000 TEUs in 2010, which is 52%

larger than that in 2003. As existing capacity to handle containers at Sultan Qaboos Port is estimated at around 300,000 TEUs, the forecast container traffic cannot be accommodated at the Port unless additional facilities are constructed by 2010. Regarding the conventional cargo, no major problems are foreseen because cargo demand of this type is rather stable or moderate in the coming years.

For Salalah Port, container traffic is likely to exceed 3 million TEUs in 2010 while this port handled 2 million TEUs in 2003. In order to catch up with the expected volume of container traffic through this port, the government has approved the expansion project and the 900m long new berths will be commissioned in 2007. After the expansion project is completed, the Salalah Port will have an annual container handling capacity of 3 million plus and agree with the demand forecast. Regarding the conventional cargo, there is a possibility that capacity for dry bulk cargo is in short if No30 and No.31 berths are utilized for container handling. Provision both for container and conventional traffic are necessary.

Industries at Sohar Port will start operation in 2006 at earliest and 312,000 TEUs of containers are expected to pass through Sohar Port in 2010. In addition, nearly one million tons of break-bulk cargo and about 4 million tons of dry bulk cargo are also forecast to be handled at the port in the same year. As existing multi-purpose berths with 700m in length will accommodate only about one million tons of break-bulk cargo, construction of new bulk and container berths are to be practiced at the early stage.

Table 13.3-1 Cargo Demand Forecast for 2010

		Qaboos		Salalah		Sohar	
Base Case		2003	2010	2003	2010	2003	2010
Break-Bulk	(1,000 ton)		766		131	0	854
Dry Bulk	(1,000 ton)	2,472	1,498	1347	2,123	0	3,775
Liquid Bulk	(1,000 ton)		458		214	0	7,679
Im/Ex Cntr	(1,000 teu)	151	232		64	0	312
Transship Cntr	(1,000 teu)	114	170	2,001	2,972	0	0

Remarks: Teu of container includes both laden and empty.
Source: JICA Study Team

13.4 Draft Objectives of the Port Sector in the 7th Five-Year Plan

After evaluating the past performances of the port sector and foreseeing the future expectations toward this sector, following draft objectives can be proposed;

1. Creating within MOTC the Port Planning Committee consisting of the representative from government agencies and relevant port authorities and private sector, for the purpose of establishing the administrative framework of ports adequate for planning and coordinating with a view to achieving long-term/short-term port development.
2. Establishing information and data collection/processing system of port and maritime

sector in the administration as well as in the related private sector, with extensively utilizing the Information Technology.

3. Streamlining decision-making procedures in the administration, as well as in the port authorities, so as to respond the challenge of global maritime market.

4. Reviewing the demarcation of investment between the government and the private sector for future development of major ports, and establishing adequate scheme of investment for each port.

5. Reviewing the terms of the Agreement of Sultan Qaboos port, which shall expire at the end of 2006, and deciding the management of the port as soon as possible with the view to maintaining continuous operation during transition period.

6. In view of low profitability of the ports and reducing the operational burden of the government, entrusting the management of the Shinas and Khasab ports to a private operator with operational subsidy.

7. Privatizing of Duqm port after qualifying a company that can manage entire port and its attached industry area through long term concession agreement

8. Expansion of port capacities so as to meet the ever-increasing cargo demand which will be necessarily generated in correspondence with not only the government economic development policies but also global economic development scheme.

9. Promotion of the economic diversification policy. Diversification of the national economic structure will affect the port activities by realizing the variety of port traffic. For example, tourism development policy will require a cruise terminal at the prospective ports.

10. Realization of portside industrial zones. Port areas are ideal positions for industrial activities because they are transition points between land and maritime transportation. Industrial activities are expected to commission at Sohar and Salalah during the 7^{th} Plan.

11. Balanced development and reduction of discrepancy among regions are important government targets to be achieved. Duqm is on of the places in this category and a port should be developed as a basic infrastructure through which everyone can benefit. .

12. Exploration of Future Potential of the Port Sector
    Exploration of the future need of the sector is a must of its sector in every Plan. Evaluation and selection of the best location for new port should be studies from social, economic and environment aspects. Future potentials of Duqm and Musandam be evaluated deeply.

13.5 Ports Sector Investment Programme in the 7th Five-Year Development Plan (2006-2010)

The important projects expected to be implemented in the 7th Five-Year development Plan are summarized in Table 13.5-1, by categorizing into three groups: construction works, information system, and studies. Required investments by the private sector are also listed for reference in the Table.

Promotion of export oriented non-oil industries will be achieved by continuous effort of industrial port development at Sohar, activation of EPZ at Salalah through expansion of its container terminal as well as general cargo facilities. Promotion of tourism development through building cruise terminals at Sultan Qaboos Port and Salalah Port is another effective way for the promotion of non-oil sector economy.

Duqm port development will be one of the key projects to achieve the balanced development of the nation and also effectively promote non-oil sector industry by creating a dock-yard for ship repair as the core plant in the area. The ship yard will require not only physical docks and yard facilities but also need miscellaneous supporting industries and people in the vicinity of the plant.

Expansion and improvement of Sultan Qaboos Port is contemplated as one of the most effective projects to improve accessibility to the foreign market. By this project, a part of trade now relying on UAE ports will be switched to Sultan Qaboos Port and the project will effectively enhance local commercial activities as well as promotion of local employment. This project will also reduce overall transportation cost for export and import cargo and will be useful for stabilizing consumer price in the country.

In order to activate private sector in the port related industries and business, improvement of business environment in Oman is required. In this respect, introduction of IT system throughout the country will effectively improve efficiency of business transactions by port users and business circles.

Future need of the port sector should be explored and studied from the view points of long term development and perspectives. Selection of the best location for the development of a new port to promote and enhance the national policies should be implemented. Future potentials of dispersed populated regions such as Al Wusta and Musandam be evaluated and studied deeply.

Within the Seventh Five-Year Plan, the private sector is expected to invest a large amount of port super-structures as shown in Table 13.5-1. With regards to the port infra-structures, however, direct investment by the private sector is not expected because almost all the port infrastructures in the competing ports in the region are developed by the public sector.

Table 13.5-1 Investment Plan for Port Sector Development in the Seventh 5-Year Plan (Draft)

(Unit: RO. Million)

Type	Port	Project	Sector	1st Year	2nd Year	3rd Year	4th Year	5th Year	Total
Construction Works	**Sultan Qaboos**	**Cruise Terminal**	Public	0.55					0.55
			Private						0.00
			Sub Total	0.55	0.00	0.00	0.00	0.00	0.55
	Sultan Qaboos	**Outer Harbor (Phase I)**	Public	0.31	8.60	20.82	25.33	5.93	60.99
			Private	0.59	0.29	0.00	0.00	24.94	25.82
			Sub Total	0.90	8.89	20.82	25.33	30.87	86.81
	Salalah	**No.5 and 6 Berths**	Public	49.31	5.08				54.39
			Private	0.00	20.06				20.06
			Sub Total	49.31	25.14	0.00	0.00	0.00	74.46
	Salalah	**2nd Phase**	Public	0.34	12.60	14.22	13.62	1.93	42.72
			Private	0.84	0.02	0.00	1.28	25.81	27.94
			Sub Total	1.18	12.62	14.22	14.89	27.75	70.66
	Sohar	**Container and Bulk Berths**	Public	0.37	16.39	20.43	10.29		47.48
			Private	0.31	0.00	0.00	10.07		10.38
			Sub Total	0.68	16.39	20.43	20.36	0.00	57.86
	Duqm	**1st Phase (Berths & Dock)**	Public	3.12	2.17	18.43	32.70	20.01	76.43
			Private	0.04	0.04	0.00	0.00	2.37	2.44
			Sub Total	3.16	2.21	18.43	32.70	22.38	78.88
	Shinas	**Channel and Berths**	Public	0.08	3.82				3.90
			Private						0.00
			Sub Total	0.08	3.82	0.00	0.00	0.00	3.90
Information System (EDI)	**Nationwide**	**EDI**	Public	1.00	0.46				1.46
			Private						0.00
			Sub Total	1.00	0.46	0.00	0.00	0.00	1.46
Studies	**Khasab**	**Canal (Feasibility /S)**	Public	0.08					0.08
			Private						0.00
			Sub Total	0.08	0.00	0.00	0.00	0.00	0.08
	Duqm	**2nd Phase (Feasibility/S)**	Public	0.15					0.15
			Private						0.00
			Sub Total	0.15	0.00	0.00	0.00	0.00	0.15
	New Port	**Feasibility Study**	Public	0.20					0.20
			Private						0.00
			Sub Total	0.20	0.00	0.00	0.00	0.00	0.20
	TOTAL	**All Projects Above**	Public	55.52	49.12	73.91	81.94	27.87	288.35
			Private	1.77	20.41	0.00	11.35	53.13	86.65
			Total	57.29	69.53	73.91	93.28	80.99	375.00

Source: JICA Study Team

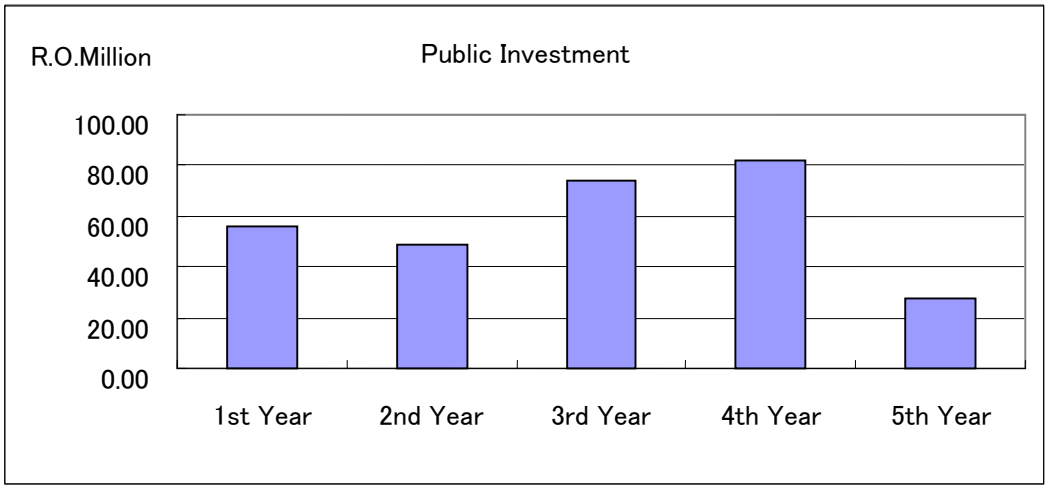
Table 13.5-2 Port Sector Investment in Each 5-Year Plan

(Unit: R.O. Million)

Plan	4th Plan (1991-1995)	5th Plan (1996-2000)	6th Plan (2001-2005)	7th Plan (Draft) (2006-2010)
Allocated Budget	23.2	2.6	5.2	
Transferred from Previous Plan	3.1	0.9	93.8	
Supplementary Budget for Additional Projects		166.7	96.6	
Total Budget		170.2	195.6	288.3
Actual Expenditure		76.5	39.0	

Source: JICA Study Team

Figure 13.5-1 Yearly Variance of Public Investment of Major Projects



Source: JICA Study Team

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Present Environmental Conditions

Appendix I.1 Present Environmental Conditions of the Sultan Qaboos Port Area

1 Pysico-chemical Environment

1.1 Meteorology

The meteorological observation data of Seeb Airport is presented below.

(1) Temperature

Muscat is one of the hottest capital in the world. Extremely hot temperatures persist from May to September, often exceeding 40℃. Temperatures become relatively cool from October to March, but can still exceed 30℃.

AIT.1-1 Monthly Mean Temperature in Seeb from 1998 – 2002

Unit: ℃

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Ave.
1998	21.2	21.7	25.0	30.1	34.8	34.5	32.9	32.6	31.1	29.3	25.2	23.3	28.5
1999	21.2	23.5	24.1	30.2	33.1	34.1	33.1	31.6	28.8	28.9	26.5	22.0	28.1
2000	22.0	21.7	24.2	31.8	33.3	34.3	32.3	32.3	30.2	29.9	25.5	21.9	28.3
2001	20.0	21.3	25.2	29.1	35.1	34.1	32.6	30.5	30.6	29.2	25.5	23.8	28.1
2002	21.4	21.3	25.3	29.5	35.0	35.0	33.6	30.7	29.6	29.5	24.5	22.4	28.2
Ave.	21.2	21.9	24.8	30.1	34.3	34.4	32.9	31.5	30.1	29.4	25.4	22.7	28.2

Source: MOTC, Directorate General Civil Aviation and Meteorology

(2) Relative Humidity

Humidity is low during most of the year. Highest humidity are experienced during the peak summer season.

AIT.1-2 Monthly Mean Relative Humidity in Seeb from 1998 – 2002

Unit: %

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Ave.
1998	65	66	60	44	36	54	65	65	70	53	58	69	59
1999	63	69	58	44	46	57	62	72	79	57	61	60	61
2000	62	54	50	37	49	55	66	66	68	52	63	65	57
2001	64	65	58	45	36	60	67	70	66	55	57	70	59
2002	55	61	57	43	36	50	64	75	77	62	66	62	59
Ave.	62	63	57	43	41	55	65	70	72	56	61	65	59

Source: MOTC, Directorate General Civil Aviation and Meteorology

(3) Rainfall

Rainfall is scarce in the Muscat area. The annual rainfall is usually below 100 mm, which classifies Muscat as a hyper-arid region.

AIT.1-3 Monthly Mean Rainfall in Seeb from 1999 – 2003

Unit: mm

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1999	34.8	4.0	22.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	61.1
2000	4.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	2.6	0.0	6.9
2001	17.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.2
2002	0.0	0.4	7.6	14.8	0.0	0.0	0.0	0.3	0.0	0.0	5.8	3.2	32.1
2003	1.2	0.0	0.6	74.6	0.0	0.0	9.0	0.0	0.0	0.0	0.6	0.0	88.4
Ave.	11.4	0.9	6.1	17.9	0.0	0.0	1.8	0.1	0.0	0.0	1.8	0.6	41.1

Source: MOTC, Directorate General Civil Aviation and Meteorology

(4) Wind

Wind is generally calm throughout the year. The wind direction fluctuates between northeast to southwest during most of the year, except during the peak summer season when the wind is predominantly from the northeast.

AIT.1-4 Monthly Prevailing Wind Direction and Mean Wind Speed in Seeb from 1998 – 2002

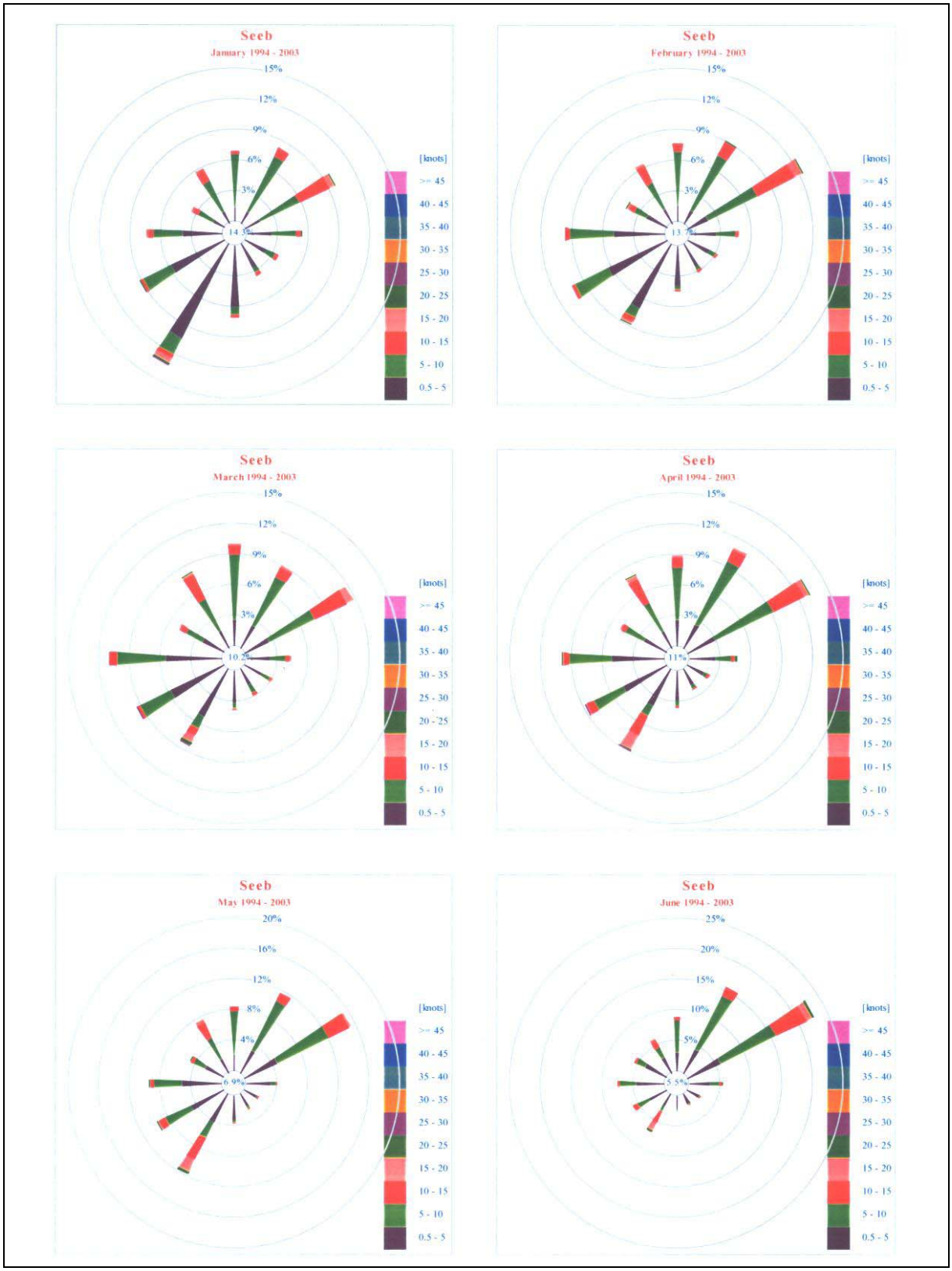
Unit: knots

		Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1998	Dir.	060	060	060	210	210	060	060	060	060	210	210	210
	Vel.	05	06	06	06	07	05	05	05	05	05	04	04
1999	Dir.	210	060	360	030	030	060	060	080	060	240	060	210
	Vel.	05	06	05	05	05	05	06	05	05	05	05	04
2000	Dir.	210	240	240	210	030	060	060	060	090	060	240	240
	Vel.	05	05	05	06	05	06	05	06	05	05	06	05
2001	Dir.	210	240	240	360	210	060	060	060	060	360	210	210
	Vel.	05	04	05	05	05	05	05	04	05	04	04	04
2002	Dir.	210	060	360	330	210	030	060	060	030	030	210	210
	Vel.	05	05	05	06	06	06	06	06	05	04	04	04

Source: MOTC, Directorate General Civil Aviation and Meteorology

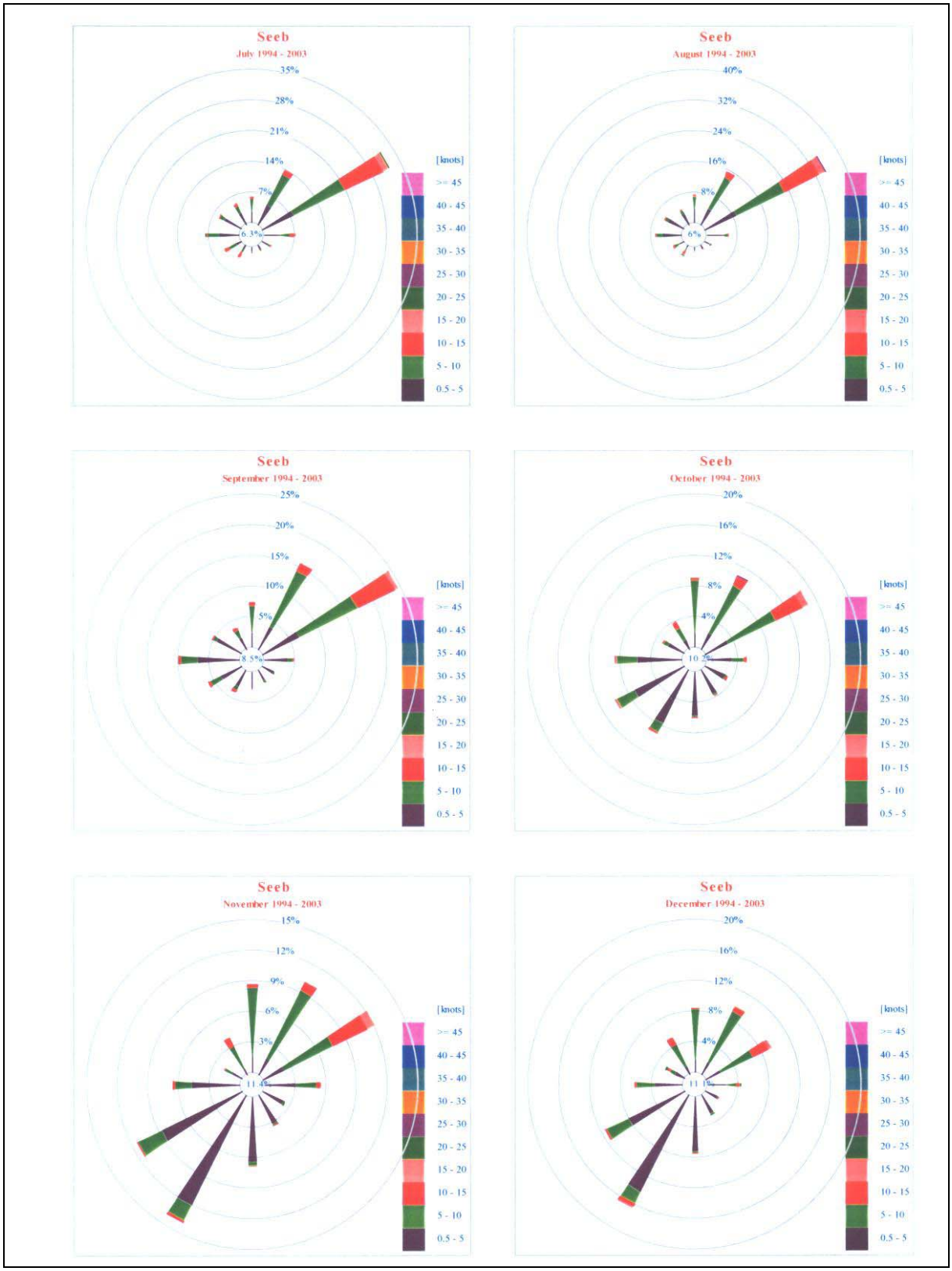
AIF.1-1 shows the monthly wind direction and speed averaged over the 1994 - 2003 period.

AIF.1-1 Wind Rose of Seeb from January – June (1994 – 2003)



Source: MOTC, Directorate General Civil Aviation and Meteorology

AIF.1-2 Wind Rose of Seeb from July – December (1994 – 2003)



Source: MOTC, Directorate General Civil Aviation and Meteorology

1.2 Oceanography

(1) Tide

In the Gulf of Oman, spring tides tend to be semi-diurnal and diurnal during neap tides.

AIT.1-5 Mean Tide Levels in Sultan Qaboos Port

Unit: meters

Lat. N	Long. E	Mean range	Mean Sea Level	MHHW	MLHW	MHLW	MLLW
23° 38′	58° 34′	1.73	1.93	2.64	2.55	1.67	0.91

Source: Oman Maritime Handbook 2004, Royal Navy of Oman

(2) Wave

Despite being located in the inner part of the Gulf of Oman, the Muscat area receives long period swell waves from the Indian Ocean. However, the height of these waves is significantly reduced by the time it reaches Muscat. According to the past wave rider buoy observations, the wave height in the Muscat area is generally between 0.3 – 0.5m.

(3) Current

Currents in the Gulf of Oman is complex and variable. The current flow is assumed to be governed by large-scale flow regimes rather than from tidal and wind factors. Currents generally alternate between east – west direction. The current speed is partly determined by the tidal factor (Wimpol 1986).

(4) Littoral Drift

Coastal erosion is prevalent in the beach area around Azaiba (approximately 20km west of the port) and Seeb (approximately 40km west of the port), which is probably due to the recent restriction in the sediment supply from wadis (James Dobbin 1992). Coastal erosion is insignificant in the vicinity of the port area due to the rocky substrate.

1.3 Topography

The Sultan Qaboos Port is constructed inside a rocky embayment in Wilayat Mutrah. The shore is rocky and steep, quickly reaching to depth over 20m outside the port. The port is surrounded by small rocky hills with heights ranging between 100 – 150m. Residential and commercial areas are established between these rocky hills. The adjacent coastlines are mainly comprised of steep cliffs, although occasional small sandy beaches are interspersed between the cliffs. Small fishing villages are often established in these beach areas.

1.4 Geology

According to the Geological Map Sheet NF40-4A, 1986 Masqat (scale, 1:100,000), the port lies over a Quaternary origin wadi alluvium substrate. The small rocky hills behind the port are ophiolite rocks, composed of harzburgite and dunite layers.

1.5 Hydrology

(1) Wadi flow

Although there is no major wadi outflow near the port, the residential area is prone to flooding that originate from the adjacent small hills. However, the scales of the floods are minor due to the small catchment area.

(2) Groundwater

Approximately 20% of the water supply of the capital area is supplied through the local groundwater.

1.6 Seawater Quality

(1) General Conditions

The sea surface temperature generally follows the ambient air temperature pattern. Highest temperatures are recorded in May – October, ranging between 28 – 32℃. However, sea surface temperature does on occasion dramatically drop over a day, after an upwelling event. Sea surface temperature in the winter months are generally between 23 – 25℃. Salinity is generally between 36 – 38.

(2) Status of Water Pollution

Water quality data within the Sultan Qaboos Port area is not available. However, Petroleum Development Oman (PDO) has conducted several seawater quality surveys in Mina Al Fahal area, which is a bay located west of the Sultan Qaboos Port. PDO oil refinery operates in Mina Al Fahal, and the bay supports three single bouy moorings for oil export. Following are the summary of the 2001 survey.

Heavy metal concentrations (Al, Cd, Cu, Hg, Ni, Pb, TBT, V) were measured at 10 stations around the bay. The results did not indicate any elevated levels of heavy metal, with all the measurements being below the detection limits and EC/UK Environmental Quality Standards.

Furthermore, heavy metal and petroleum concentration were measured from rock oysters collected in the Mina Al Fahal waters. Oysters were collected from the East and West headland and the offshore Fahal Island. Values are compared with similar surveys conducted in 1997 (AIT.1-6 and 7).

AIT.1-6 Concentration of Heavy Metals in the Oysters of Mina Al Fahal

Unit: mg/kg dry wt.

		Cd	Cu	Cr	Ni	Pb	V
1997	E. headland	5.10	102.0	0.89	1.10	0.17	<0.04
	Fahal Island	7.53	157.8	1.51	0.96	<0.02	0.34
	W. headland	6.99	196.8	1.52	1.30	<0.02	0.09
2001	E. headland	5.46	71.3	0.40	12.10	0.39	<0.05
	Fahal Island	5.50	125.5	0.87	4.72	0.50	0.67
	W. headland	4.84	207.7	0.80	9.66	0.27	0.44
Reference value*		11.68	110.5	0.63	1.16	-	1.8

*: Data from IAEA surveys of the Omani waters from 1983-91

Source: The Mina Al Fahal Marine Environment, PDO, 2001

Heavy metal concentrations in the oyster tissues were high for copper, nickel and chromium. The high copper concentration could be attributed to the antifouling paints of the tankers, anchored at the single buoy moorings offshore of Mina Al Fahal. High nickel and chromium levels are attributed to leaching from the adjacent ophiolite rocks.

AIT.1-7 Concentration of Petroleum Hydrocarbon in the Oysters of Mina Al Fahal

Unit: mg/kg dry wt.

		Total Aliphatics	Total Aromatics	Total HCs
1996		100	35	135
1997	E. headland	25	41	66
	Fahal Island	35	68	103
	W. headland	267	100	367
2001	E. headland	14	-	14
	Fahal Island	5	-	5
	W. headland	8	-	8
Ras Al Hadd*[1]		7.57 – 492.40	16.45 – 246.30	24.02 – 738.70
IAEA 1991 (KSA)*[2]		143 – 475	27 – 240	170 – 715

*1: Results of Ras Al Hadd during the 1996/97 survey

*2: Data from IAEA surveys of the KSA in 1991

Source 1: Monitoring Pollutants in the Marine Environment, Auscon, 1998

Source 2: The Mina Al Fahal Marine Environment, PDO, 2001

Concentration of petroleum hydrocarbon has decreased dramatically from the high 1996 / 1997 levels.

1.7 Bottom Sediment Quality

Sediment quality data within the Sultan Qaboos Port area is not available. However, an extensive sediment quality survey of heavy metal, oil residue and petroleum hydrocarbon has been conducted in

Mina Al Fahal by MRMEWR and PDO. The results of the survey are shown in the following AIT.1- 8 – 10.

AIT.1-8 Concentration of Heavy Metal in the Intertidal and Subtidal Sediments of Mina Al Fahal

Unit: mg/kg dry wt.

	Grain size (μ m)	Pb	Cd	Cu	Cr	Ni	V	Fe	Mn	Co	Zn
PDO 2001 intertidal*[1]	<125	10.27	0.32	4.11	92.5	130.5	34.3	-	-	-	185
PDO 2001 subtidal*[2]	-	6.48	0.69	15.92	-	233.02	26.39	-	171.54	-	-
2002	<125	2.34	0.33	3.99	285	129	23.9	7,710	86.0	3.28	45.30
2003	<125	6.57	0.63	10.84	73.3	258	16.55	-	169	-	77.78
MAFF Action Level*[3]	-	40	2	40	100	100	-	-	-	-	200

*1: The values are the average of east and west end of Mina Al Fahal beach.

*2: The values are the average of 10 sampling stations around Mina Al Fahal

*3: Threshold values proposed by the UK Ministry of Agriculture, Fisheries and Food

Source 1: MPMP, MRMEWR, 2002/03

Source 2: The Mina Al Fahal Marine Environment, PDO, 2001

Most of the heavy metals in the Mina Al Fahal area did not exceed the U.K. standard, except for nickel. High nickel concentration is attributed to leaching from ophiolite rocks.

AIT.1-9 Concentration of Petroleum Hydrocarbon in the Intertidal Sediments of Mina Al Fahal

Unit: mg/kg dry wt.

	Grain size (μ m)	Total Aliphatics	Total Aromatics	Total HCs
1996	<250	24.76	0.70	25.46
2001*[1]	<125	34.5	-	34.5
2002	<125	-	-	6.02
IAEA 1991 (KSA)*[2]	-	13 – 496	6 – 175	19 – 671

*1: The values are the average of east and west end of Mina Al Fahal beach.

*2: Data of IAEA survey in KSA in 1991

Source 1: MPMP, MRMEWR 1996/97, 2001/02

Source 2: The Mina Al Fahal Marine Environment, PDO, 2001

AIT.1-10 Concentration of Tar Ball in Mina Al Fahal Beach

Unit: g/m

	Range	Mean
1996	317 - 577	422
2002	7.6 – 41.1	17.7

Source: MPMP, MRMEWR 1996, 2002

Before 2002, the petroleum hydrocarbon levels in the intertidal sediments were one of the highest in the 6 candidate port areas, which could be attributed to the oil exporting activities (AIT.1-9). The tar ball surveys also indicated high levels oil pollution in the Mina Al Fahal beach area (AIT.1-10). However, by 2002 the oil pollution levels in both the intertidal sediment and the beach has decreased dramatically to more acceptable levels.

1.8 Noise and Air Quality

There are no major air pollution sources in the vicinity of the port area except for perhaps exhaust gas emission from large vessels, heavy vehicles and operating machines.

No air quality data exist for the port area. However, MRMEWR has conducted some air quality measurements in Ruwi District (approximately 3 – 4km south of the port), a major commercial area in Muscat. Vehicle traffic is heavy in Ruwi and probably heavier than in the port area. Therefore, the values of Ruwi should give a conservative estimate of the port air quality (AIT.1-11).

AIT.1-11 Concentration of Air Pollutants Measured in Ruwi District

	TSP (μ g/m^3)	PM_{10} (μ g/m^3)	HC (μ g/m^3)	Pb (μ g/m^3)
1993	314	-	0.087	1.185
1998	92.05	-	0.08	0.611
1999	92.194	-	0.403	0.267
2000	286.86	-	0.148	0.694
2001	103.61	88.26	3.162	0.373
Standard	340	150	160	1.5

Source: MRMEWR

Air quality in the Ruwi area is relatively good according to the above results. No values exceeded international air quality standards, although TSP concentration was relatively high. High TSP values can partly be attributed to naturally high background concentrations rather than from an anthropogenic input (i.e. Muscat area is naturally arid and dusty). Concentration of lead (Pb) is on a decreasing trend since the ban on the use of leaded fuel.

1.9 Odor

During the field reconnaissance in August 2004, smells of petroleum were detected at the coastal

village of Darsayt, which is located approximately 2km west from the Sultan Qaboos Port, and 2km south of the PDO offshore oil export terminal. The smell of petroleum probably reached the village from the PDO oil export terminal through the onshore winds.

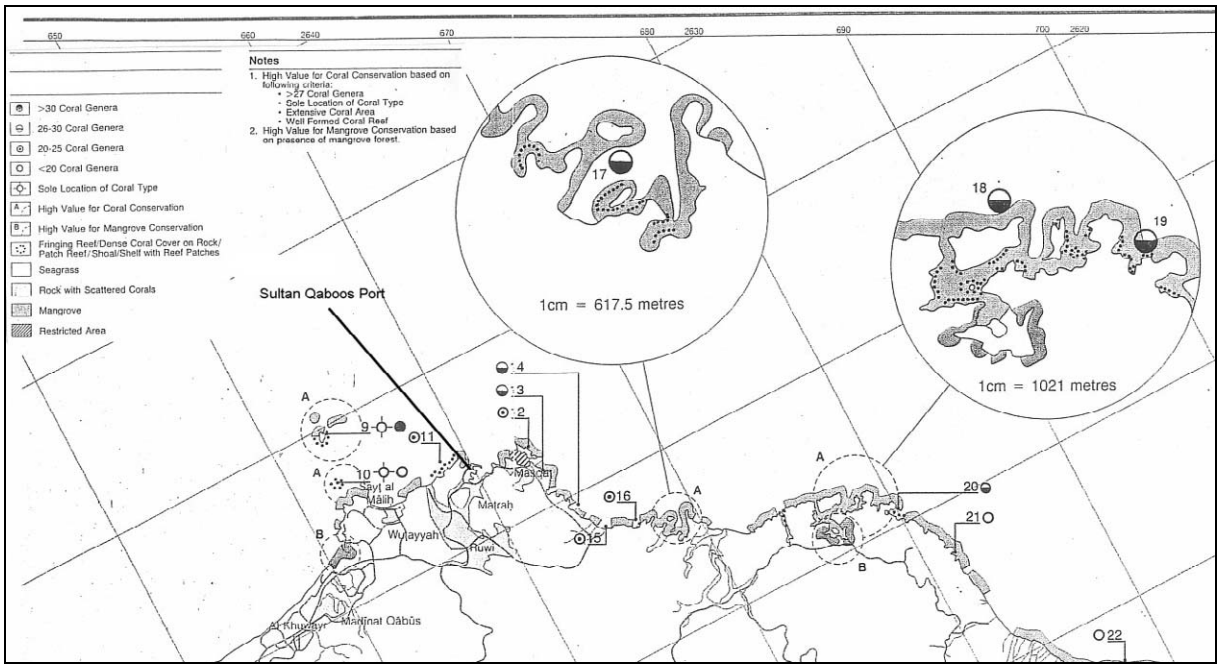
2 Biological Environment

2.1 Marine Ecosystem

Sparse beds of seagrass (*Halodule uninervis*) are found in the east cove at Bandar Jissah (approximately 12km southeast from the port). Although the area of seagrass bed may be relatively limited, it could be an important habitat for juvenile fishes, crustaceans and mollusks. Also sea turtles are known to feed in the seagrass bed.

Numerous corals and coral reefs occur along the coast, supporting and providing protection for various marine fauna and resource species. Near the port, coral reefs are found along the coast between Darsayt (2-3km west of the port) and the port, offshore of Ras al Hamra (approximately 10km west of the port) and around the Fahal Island (approximately 5km offshore of Ras al Hamra). Fahal Island also supports the highest coral diversity (>30 coral genera) around this area. AIF.1-3 shows the coral distribution near Sultan Qaboos Port.

AIF.1-3 Distribution of Corals Near the Sultan Qaboos Port



Source: CZMP Greater Capital Area, IUCN, 1986

The green and hawksbill turtles are often seen in the area. They are also known to nest in the beaches east of the port (e.g. Bandar Jissah).

2.2 Terrestrial Ecosystem

Although there is very limited vegetation around the port area, a mangrove forest of approximately 74 ha is found approximately 10km west of the port at the mouth of Wadi Aday. The mangrove forest is designated as a nature reserve by the Royal Decree 38/75, entitled as "Qurm Nature Reserve". As with all mangrove forest in Oman, the mangrove in Qurm Nature Reserve is composed solely from *Avicennia marina*. The mangrove forest supports various fauna. The study by Fouda and Al-Muharrami (1996) reported, 194 birds, 27 crustaceans, 48 molluscs and 40 fish species.

3 Social Environment

3.1 Demography

According to the Statistical Year Book 2003, the total population in Wilayat Mutrah in year 2002 was 223,284, which represents approximately 30% of the total population of Muscat Governorate. Wilayat Mutrah is a cosmopolitan city with approximately 64% of the population being expatriates and the remaining 36% Omanis.

3.2 Infrastructure

(1) Access Road

The transportation of cargo to and from ports involves considerable vehicular movement. Currently Sultan Qaboos Port is only accessible through Al Mina Street (dual carriageway), which is connected to the main road through the Al Mina roundabout. Due to the limited access option, traffic jams are common near the port entrance, especially during the morning hours (around 7 am).

(2) Waste Management

Solid waste from the incoming vessels and port activities are dumped at the Muscat Municipality waste disposal site (Amirat waste disposal or Sunub waste disposal site). Sewage from the port is temporarily stored in a holding tank, then transported to Muscat Municipality Al Ansab sewage treatment plant.

There are no sewage and waste oil reception facility in the port for incoming vessels. Waste oil can be discharged in Fujayrah waste oil reception facility.

(3) Power and Water Supply

Water and power to the port is supplied through the Al Ghubrah power / desalination plant.

3.3 Livelihood

Although the economic activities of the capital area have diversified over the past decades, primary industry such as fishing is still an important component for the local people.

(1) Fisheries

Fishery in the Muscat region is based around the traditional artisanal fishery, which is mainly conducted by traps, gill net, hand line and trolling. Gill nets and trap nets are often seen set along the coast, even in areas near the port. Hand line and trolling are conducted by small motorboats and are often seen in the offshore waters of the port.

Many small fishing villages are scattered around the adjacent coastline of the port, and fishermen from these villages come to the port to land their daily catch, which is equipped with ice plant, fish market and fish processing factory. These fishing villages are located in Wilayat Mutrah and Muscat. The following AIT.1-12 shows the fishing villages near the port, and the number of fishermen and fishing boats in the Muscat Governorate and in the Wilayat Mutrah and Muscat for year 2003.

AIT.1-12 Outline of the Artisanal Fishery in Muscat Governorate, Wilayat Mutrah and Muscat

	Muscat Governate	Wilayat Muttrah	Wilayat Muscat
Fishing villages near the port[1]	-	Mutrah, Darsayt, Al Qurm, Aint	Sidab, Haramel, Al Bustan, Qantab
No. of fishermen (2003)[2]	3,961	516	1,179
No. of fishing boats (2003)[2]	1,835	234	554

Source 1: MOAF
Source 2: Fisheries Statistics Book 2003, MOAF

Various large and small pelagic fish species, demersal fish species, sharks / rays and others are caught in the Muscat region. AIT.1-13 shows the annual total landing in the Muscat Governorate from 1999 to 2003 and the major caught species. Species that fetch relatively high prices are groupers, seabream, emperors, kingfish, yellowfin and longtail tuna.

AIT.1-13 Annual Total Landing in the Muscat Governorate from 1999 to 2003

Unit: Metric tons

	1999	2000	2001	2002	2003	Major species
Large pelagic	7,064	3,566	3,528	3,080	5,970	Yellowfin & longtail tuna, kawakawa, barracuda, kingfish
Small pelagic	8,514	19,319	20,726	18,964	12,998	Sardine, Indian mackerel, small jacks
Demersal	2,597	2,117	1,546	2,188	5,417	Seabream, emperor, grouper
Sharks & rays	504	202	379	488	257	-
Crustaceans	2	33	0	9	0	Lobster
Molluscs	1,135	369	150	727	879	Cuttlefish
Others	0	58	60	266	31	-
Total	19,817	25,664	26,388	25,721 (1,522)	25,552	

*: The parenthesis shows the total landing in Wilayat Mutrah

Source: Fisheries Statistics Book 2003, MOAF

(2) Tourism

Muscat is a popular destination for tourists, especially during the cooler winter months. Tourists are attracted to the beautiful landscape, ancient buildings, clear waters, beautiful beaches, etc. Based on the statistics of Ministry of Tourism, 633,938 people made overnight stays in Muscat in year 2003.

There are various tourist attractions near the Sultan Qaboos Port such as the Mutrah souq (market), Mutrah fort and Riyam park.

Attracted by the rich corals, scuba diving has become a popular marine activity for tourists, with many diving spots scattered along the Muscat coast. Popular diving spots near the port include Fahal Island (approximately 10km northwest from the port), Bandar Jissah (approximately 12km southeast from the port) and Bandar Khayran (approximately 20km southeast from the port).

3.4 Cultural Assets

Various forts and watchtowers exist near the port. One watchtower is located immediately behind the rocky hills of the port area, although its cultural significance is uncertain.

3.5 Land Use

A lively commercial and residential area lies adjacent to the port. Small fishing villages are also scattered along the coast near the port. Then approximately 5 km west of the port lies the PDO oil refinery, which has 3 single buoy moorings located offshore. Large oil tankers are often anchored next to the single buoy moorings.

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Appendix I.2 Present Environmental Conditions of the Salalah Port Area

1 Pysico-chemical Environment

1.1 Meteorology

(1) Temperature

The air temperature in Salalah does not follow a conventional seasonal pattern due to the effects of the SW monsoon. Although temperature gradually increases from April, it drops back to near winter levels from July to September. This is due to the upwelling of deep cool water offshore of the Arabian Sea, which is triggered by the intensification of the SW monsoon winds in July – September.

AIT.2-1 Monthly Mean Temperature in Salalah from 1998 – 2002

Unit: ℃

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Ave.
1998	23.7	25.7	26.9	29.0	30.6	30.3	27.6	26.3	26.0	27.1	26.5	26.0	27.1
1999	24.1	24.9	25.7	28	28.9	27.8	25.3	24.7	26.4	27.3	26.4	25.2	26.2
2000	23.3	24.1	25.4	28.1	29.4	29.3	25.6	25	25.5	27.2	27.0	24.5	26.2
2001	22.52	23.26	25.84	27.7	30.1	29.2	26.0	25.26	26.7	27.44	26.64	25.23	26.3
2002	23.8	23.7	26.3	28.4	29.0	28.4	25.5	24.1	27.0	27.2	27.0	25.0	26.3
Ave.	23.5	24.3	26.0	28.2	29.6	29.0	26.0	25.1	26.3	27.2	26.7	25.2	26.4

Source: MOTC, Directorate General Civil Aviation and Meteorology

(2) Relative Humidity

Relative humidity increases during the SW monsoon season due to the inflow of moist cold air from the Arabian Sea. Maximum relative humidity can reach to or near 100% during the SW monsoon.

AIT.2-2 Monthly Mean Relative Humidity in Salalah from 1998 – 2002

Unit: %

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Ave.
1998	58	63	60	70	72	81	88	89	85	73	51	50	70
1999	54	67	61	67	79	85	91	90	84	72	62	44	71
2000	50	50	50	70	73	77	84	88	81	67	59	52	67
2001	39	50	60	63	73	77	85	87	75	65	47	61	65
2002	48	47	61	63	73	79	85	89	77	61	47	58	66
Ave.	49.8	55.4	58.4	66.6	74	79.8	86.6	88.6	80.4	67.6	53.2	53	67.8

Source: MOTC, Directorate General Civil Aviation and Meteorology

(3) Rainfall

Most of the rainfall occurs during the peak SW monsoon season in July and August in the form of monsoonal drizzle or fog. Other sources of rainfall are from the occasional cyclones and low pressure systems, which greatly enhances the annual rainfall.

AIT.2-3 Monthly Mean Rainfall in Salalah from 1998 – 2002

Unit: mm

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1998	0.0	1.5	0.0	4.6	0.0	2.0	20.4	27.2	10.0	0.9	0.0	0.0	66.6
1999	0.0	0.0	0.0	0.0	0.0	0.0	24.7	22.8	0.7	70.7	0.0	0.0	118.9
2000	0.0	0.0	0.0	0.0	0.0	6.0	8.0	16.6	10.4	0.0	0.0	0.0	41.0
2001	0.0	0.0	0.0	0.0	0.0	4.8	10.4	17.2	0.0	0.0	0.0	0.0	32.4
2002	0.0	0.0	0.0	30.4	61.6	3.0	13.4	25.8	0.8	0.0	0.0	0.6	135.6
Ave.	0.0	0.3	0.0	7.0	15.4	3.2	15.4	21.9	4.4	14.3	0.0	0.1	78.9

Source: MOTC, Directorate General Civil Aviation and Meteorology

(4) Wind

From March to October the prevalent wind direction is from the south to southwest. Wind direction is more variable during winter, fluctuating between northwest to southeast.

AIT.2-4 Monthly Prevailing Wind Direction and Mean Wind Speed in Salalah from 1998 – 2002

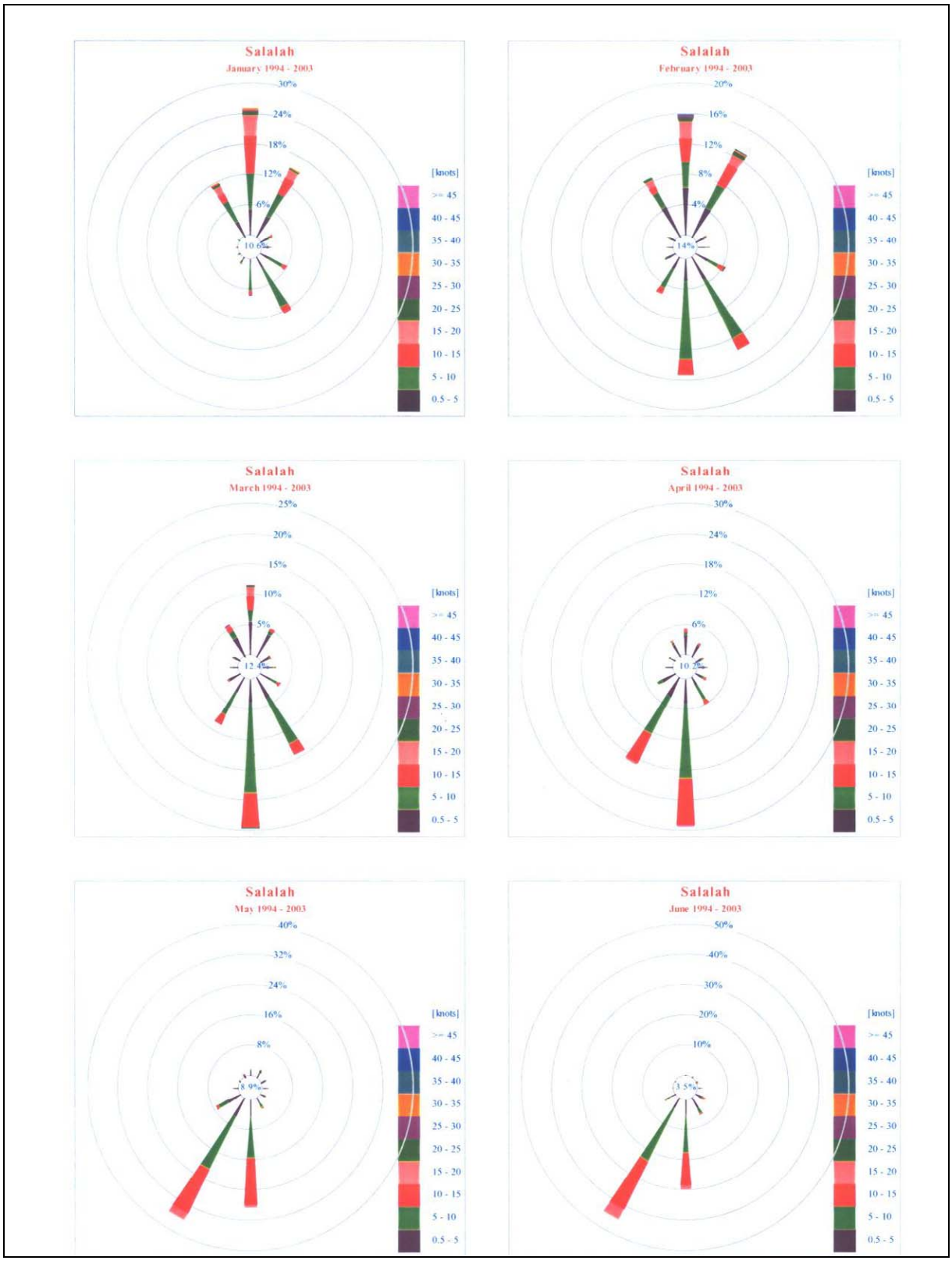
Unit: knots

		Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1998	Dir.	150	180	180	180	180	180	180	180	180	180	330	360
	Vel.	07	06	05	06	06	09	07	06	06	05	04	07
1999	Dir.	360	150	180	180	180	180	180	150	180	180	360	360
	Vel.	06	04	06	05	06	07	05	05	06	05	05	08
2000	Dir.	360	360	360	210	210	210	180	150	210	180	150	360
	Vel.	11	11	06	06	07	09	06	06	05	05	06	07
2001	Dir.	360	360	180	210	210	210	210	180	210	180	360	150
	Vel.	09	06	05	06	08	08	06	05	06	05	06	05
2002	Dir.	360	180	180	180	210	210	180	180	210	180	360	360
	Vel.	07	07	05	06	07	07	07	05	06	04	06	06

Source: MOTC, Directorate General Civil Aviation and Meteorology

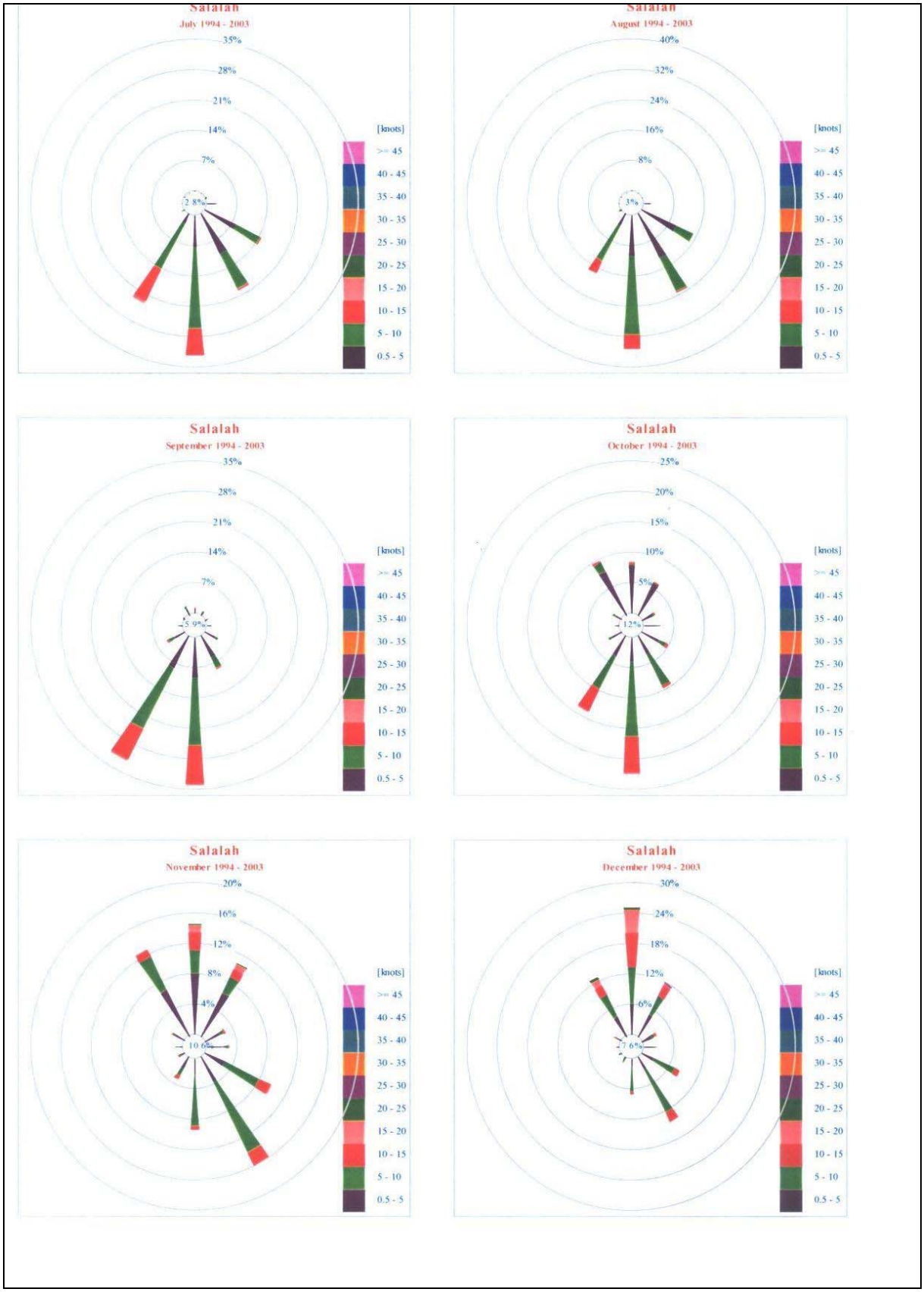
AIF.2-1 shows the monthly wind direction and speed averaged over 1994 - 2003 period.

AIF.2-1 Wind Rose of Salalah Area from January – June (1994 – 2003)



Source: MOTC, Directorate General Civil Aviation and Meteorology

AIF.2-2 Wind Rose of Salalah Area from July – December (1994 – 2003)



Source: MOTC, Directorate General Civil Aviation and Meteorology

(5) Tropical Cyclones

On average, there is approximately one cyclone every 5 year in the Dhofar region. The last time Salalah had a cyclone was in May 2002.

1.2 Oceanography

(1) Tide

In Salalah, spring tides tend to be semi-diurnal and diurnal during neap tides. The mean tidal range in Salalah is small compared to the Gulf of Oman.

AIT.2-5 Mean Tide Levels in Salalah

Unit: meters

Lat. N	Long. E	Mean range	Mean Sea Level	MHHW	MLHW	MHLW	MLLW
16° 56′	54° 00′	1.03	1.30	1.68	1.64	1.33	0.65

Source: Oman Maritime Handbook 2004, Royal Navy of Oman

(2) Wave

Wave conditions in the Salalah area is closely linked to the two monsoon seasons. During the SW monsoon season, strong SW winds in the Arabian Sea generate large waves that have a typical yearly maximum significant wave heights in the order of 6.5 m (Dobbins 1992). These large swells penetrate into the Salalah coast from the south to southwest direction.

Winds in the Arabian Sea are much weaker during the NE monsoon season, thus waves are generally much smaller. However, long period swells from the northeast direction do refract into the south facing Salalah coast.

(3) Current

Currents of the Salalah coastal area is mainly influenced by the monsoon-driven current patterns. During the SW monsoon season, currents run northeast along the coastline with velocities reaching up to 0.5 m/s. During the NE monsoon season the current direction reverses and run towards the southwest. Currents are weaker during this season (Dobbin 1992).

(4) Littoral Drift

A sandy beach coastline extends along the Salalah plain, from east of the Salalah port to the coastal town of Taqah, located approximately 40km east from the port. This coastline is prone to heavy erosion during the rough SW monsoon season, which could retreat up to 60 – 80m (James Dobbin 1992). The coastline is then rebuilt during the NE monsoon season. Figure 4 shows significant erosion along the beach near Al Haffa (probably in year 2000). The coastal road is close to being washed away from the wave force.

Erosion problems seem to have increased over recent years, which could partly be due to the construction of coastal structures such as Salalah Port. The breakwaters of the port could be hindering the sediment supply from the western coast. However, further studies (e.g. beach profiling, aero photo) will be required for a better understanding of the seasonal sediment transportation and erosion pattern of the Salalah coast.

AIF.2-3 Beach Erosion Along the Salalah Coast

Source: MOH

1.3 Topography

Salalah Port is located in the western edge of the Salalah plain, separated from the residential and commercial areas. The hinterland of the Port is generally barren and flat, and is reserved for future industrial development such as the Salalah FTZ. The coast west of the port is rugged and is lined with steep cliffs and occasional small beaches that receive the full force of the Arabian Sea during the SW monsoon season. A shallow rocky sandy shoreline extends north of the port, which gradually shifts to a long sandy beach after passing the Raysut Fishery Harbour. The mouth of Wadi Adawnib runs next

to the container terminal.

1.4 Geology

According to the Geological Map Sheet NF39-16C, 1992 Raysut (scale, 1:100,000), the current port area lies over Tertiary origin limestone bed. North of the current port is mainly composed of Quaternary beach sand, backed by alluvial deposits.

1.5 Hydrology

(1) Wadi flow

There are over 10 major wadis within the Salalah Plain. These wadis are generally dry during most of the time, except during extreme weather events such as cyclones. The mouth of Wadi Adwnab is located immediately next to the current container berth.

(2) Groundwater

Groundwater is the main source of fresh water supply in Salalah. The groundwater is mainly recharged through the SW monsoon season rains and occasional cyclones. Groundwater is fresh in the central area of the Salalah Plain, but gradually becomes saline outside the central area. Salalah Port lies over a brackish groundwater zone.

The recent overuse of the groundwater primary through agricultural activities has resulted in the reduction of the freshwater zone and increase in the brackish zone. The groundwater is also under increasing pressure from seawater intrusion. To counter seawater intrusion, treated wastewater is currently injected back to the boundary of fresh groundwater and seawater, which functions as barrier to seawater intrusion.

1.6 Seawater Quality

(1) General Conditions

Due to the upwelling of deep cold water in the SW monsoon season, sea surface temperature is lowest during July – September at around 21 – 23℃. Highest sea surface temperature occur prior to the onset of the SW monsoon in April – May, which is around 28 – 29℃, and can occasionally exceed 30℃ (DGCAM data). Salinity is generally between 35 – 36 throughout the year (Wimpol, 1986).

(2) Status of Water Pollution

In year 2000, JICA has conducted water quality surveys in and around the port area. The results showed extremely high levels of various heavy metals (Cu, Cd, Pb, Cr, Ni, Zn and Total Hg) in the water column. Most metals greatly exceeded the EEC Environmental Quality Standards.

In year 2002, MRMEWR conducted heavy metal analysis of rock oysters that were collected near the port. The results are summarized in the following AIT.2-6.

AIT.2-6 Concentration of Heavy Metals in Rock Oysters Collected Near Salalah Port

Unit: mg/kg dry wt.

	Pb	Cd	Cu	Cr	Ni	V
2002*[1]	0.30	3.97	27.5	0.46	<0.02	0.2
Reference value*[2]	-	11.68	110.5	0.63	1.16	1.80

*1: The values are the mean of several samples

*2: Data from IAEA surveys of the Omani waters from 1983-91

Source: MPMP, MRMEWR, 2002

The collected rock oyster tissues did not show any significant elevated heavy metal concentration, which contradicts with the extremely high concentrations recorded in the water column in the 2000 JICA study. Since there are no major land based input of pollutants in the Salalah area, the high levels could be attributed to natural elevated levels, or perhaps there were some errors in either the JICA study or MRMEWR study. A carefully controlled water quality survey should be conducted in the future to clarify the above results, which will provide baseline data prior to any future expansion of the port.

As an indicator of oil pollution, the concentrations of petroleum hydrocarbon in rock oyster tissues were also measured. The results are summarized in the following AIT.2-7.

AIT.2-7 Concentration of Petroleum Hydrocarbon in Rock Oysters Collected Near Salalah Port

Unit: mg/kg dry wt.

	Range of total Aliphatics	Range of total Aromatics	Range of total HCs	Mean total HCs
2002 Phase 1	-	-	-	24.7
2002 Phase 2	-	-	-	80.7
Ras Al Hadd*[1]	7.57 – 492.40	16.45 – 246.30	24.02 – 738.70	355.82
IAEA 1991 (KSA)*[2]	143 – 475	27 – 240	170 – 715	-

*1: Results of Ras Al Hadd during the 1996/97 survey

*2: Survey results of IAEA in KSA in 1991

Source: MPMP, MRMEWR, 2002

Although the results showed slightly elevated levels of petroleum hydrocarbon, it was significantly

less compared to highly polluted Ras Al Hadd area.

1.7 Sediment Quality

In year 2000, JICA has conducted sediment quality surveys in and around the Salalah port area. The results did not show any elevated levels of pollutants and significant variation between sites.

In 2002 and 2003, the MRMEWR has conducted sediment quality surveys of heavy metals in the intertidal area near the port (AIT.2-8). The concentration did not differ much with the results of the above JICA study, except for chromium (Cr), copper (Cu), Zinc (Zn) and Manganese (Mn). The concentrations of these metals were significantly higher compared to the JICA study, though still under the U.K. standards.

AIT.2-8 Concentration of Heavy Metals in the Intertidal Sediments near Salalah Port

Unit: mg/kg dry wt.

	Grain size (μ m)	Pb	Cd	Cu	Cr	Ni	V	Zn	Mn
2002	<150	3.97	0.323	2.10	24.6	6.90	1.01	-	-
2003	<125	3.90	0.53	3.00	15.75	4.10	5.88	16.28	19.92
MAFF Action Level*		40	2	40	100	100	-	200	-

Note: The values are the mean of several samples

*: Threshold values proposed by the UK Ministry of Agriculture, Fisheries and Food

Source: MPMP, MRMEWR, 2002/03

The MRMEWR has also analyzed the petroleum hydrocarbon concentration in the intertidal sediments near Salalah port. The results are summarized in the following AIT.2-9.

AIT.2-9 Concentration of Petroleum Hydrocarbon in the Intertidal Sediments near Salalah Port

Unit: mg/kg dry wt.

	Grain size (μ m)	Total HCs
2002 Phase I	<250	11.6
2002 Phase II	<125	10.4
IAEA 1991 (KSA)*	-	19 – 671

*: Data from IAEA surveys of the KSA in 1991

Source: MPMP, MRMEWR, 2002

The intertidal petroleum hydrocarbon levels in Salalah are comparable to the other sites in Oman, and are significantly lower than oil contaminated beaches in KSA.

As an alternative indicator of oil pollution MRMEWR has also conducted oil residues surveys along the beach near Salalah port in 2002. The average amount of oil residues were approximately 3.8 g/m,

which is significantly low compared to the other polluted sites in Oman.

1.8 Noise and Air Quality

An air quality survey (CO, NO_2, SO_2) was conducted along the access roads behind the port by JICA in January 2000. Not surprisingly, the results did not show any high levels of pollutants, mainly due to relatively low traffic volume and limited industrial activities.

1.9 Odor

There was no odor felt during the field reconnaissance in August 2004. However, odor from the Raysut waste disposal site (located approximately 3km inland from the Port) could potentially reach the port area depending on the wind directions.

2 Biological Environment

2.1 Marine Ecosystem

(1) Flora

Seasonal algal beds (*Ulva* sp., *Sargassum* sp., *Sargassopsis* sp.) are distributed along the rocky coastline west of the port. No marine flora seems to be distributed along the sandy coastline east of the port (IUCN, 1989).

(2) Fauna

Due to the upwelling of nutrient rich deep water, the Arabian Sea is highly productive, supporting a diverse range of marine fauna. It is consequently one of the most productive and important fishing ground in Oman.

The Dhofar coastline is generally unsuitable for coral growth due to the turbid and rough conditions during the SW monsoon season. However, dense coral communities are still found in the sheltered coves west of the port (IUCN 1989).

Substantial numbers of sea turtles are known to feed and nest along the Dhofar coastline. The most common species are green and loggerhead turtles, which are both classified as endangered in the IUCN Red List. The small coves scattered between the western coast of the port are important nesting grounds for these turtles. The closest nesting beach from the port is Ras Hamar (approximately 5km west of the port), which has approximately 100 – 250 nesting / year. The sandy beach between Salalah and Taqah are also important nesting grounds (<100 nesting / year) (IUCN 1989). The peak nesting

period of green turtles in this area is July – August, and May – June for loggerheads.

Several dolphin and whale species are known to occur around the Dhofar coastline, which are listed in the following AIT.2-10.

AIT.2-10 Dolphins and Whales that Commonly Occur Along the Dhofar Coast

	Common name	Species name	Status in IUCN Red List
Dolphins	Humpback dolphin	*Sousa chinensis*	-
	Bottle-nosed dolphin	*Tursiops truncatus*	-
	Common dolphin	*Delphinus delphis*	-
Whales	Sperm whale	*Physeter macrocephalus*	Vulnerable
	Humpback whale	*Megaptera novaeangliae*	Vulnerable
	Minke whale	*Balaenoptera acutorostrata*	-
	Sei whale	*Balaenoptera borealis*	Endangered

Source: Oman CZMP Dhofar, IUCN, 1989

2.2 Terrestrial Ecosystem

(1) Flora

The hinterland of Salalah Port is generally barren and arid, having limited vegetation cover and conservation value. Also many of the hinterland land area have been cleared for industrial development. However, approximately 4 km northeast from the Salalah port, the mangrove species *Avicennia marina* are found growing along the edge of two small khwars (coastal lagoon). These two khwars (Khawr Qurm as Sagheer and Khawr Qurm al Kabeer) are proclaimed as nature reserve along with 7 other khwars in the Dhofar coast by Royal Decree 49/97. The total area of the two khawrs is only 0.175km^2, but the grazing pressure of camels on the precious mangrove led to its proclamation (MRMEWR brochure). Although the khawrs are usually physically separated from the sea by a sand barrier, seawater occasionally intrudes or infiltrates into the khawrs over the sand barriers during high tides, which is important for water exchange (JICA 2000). Significant erosion or accretion of the adjacent beach could have significant impact on these mangroves.

(2) Fauna

The Dhofar region is located under the major migratory pathway of various migrant birds that travel to and from Africa and Europe. Many of these migrant birds utilize the khawrs and tidal flats of the Dhofar coastline for roosting and feeding, including the khawrs located east of the port.

3 Socio-economic Environment

3.1 Demography

According to the Statistical Year Book 2003, the total population in Wilayat Salalah in year 2002 was 165,396, which is approximately 70% of the total population of Dhofar Governorate. Approximately 40% are expatriate and the remaining 60% Omanis.

3.2 Infrastructure

(1) Access Road

According to the traffic volume survey conducted by JICA in year 2000, relatively high traffic volume were observed at the road opposite the Raysut Fishery Harbour. This road is busy because it connects the city center to the Salalah Port or the Raysut Industrial Estate. Traffic was insignificant in the other roads near the port.

(2) Waste Management

Solid waste generated from Salalah port is dumped at the Dhofar municipality Raysut main waste disposal site. Sewage is treated locally at the sewage treatment plant inside the port area.
There is no waste oil reception facility in the port for incoming vessels. Waste oil can be discharged in Fujayrah waste oil reception facility.

(3) Water and Power Supply

Water is supplied through the local groundwater, which is extracted from the Municipality wellfield located behind the airport. Power is supplied through the local gas / diesel power plant.

3.3 Livelihood

Fishing, agriculture and tourism is the main source of income for the local residents. Employment rate is high, although statistical figures could not be obtained.

(1) Fisheries

Fishing activity has been and still is an important industry in the Dohfar region, which is blessed with abundant fishery resources mainly due to the upwelling of nutrients in the offshore waters. Fishery in the Dohfar region is based on traditional artisanal fishery, using mainly small fiberglass motorboats and small dhows. Fishing methods include, hand line, cast net, beach seine, trap net, gill net and so on.

The following AIT.2-11 shows the fishing villages near the port, and the number of fishermen and fishing boats in the Dhofar Governorate and in the Wilayat Salalah for year 2003.

AIT.2-11 Outline of the Artisanal Fishery in Dohfar Governorate and Wilayat Salalah

	Dhofar	Salalah
Fishing villages near the port[1]	-	Raysut, Salalah, Al Haffah, Mughsayl, Ad Dahariz, Awqad
No. of fishermen (2003)[2]	3,583	1,530
No. of fishing boats (2003)[2]	1,640	702

Source 1: MOAF
Source 2: Fisheries statistics 2003 (MOAF)

Currently, fish landing in the Salalah area is mainly conducted at the Raysut Fishery Harbour located approximately 2km north of Salalah Port. However, since the harbour is too shallow for dhows, some dhows vessels use Salalah Port for fish landing, though entrance to Salalah Port will be prohibited in the near future. Most of the fish are transported directly to the wholesale or fish market in the Salalah city center and then exported. There have been several plans to improve the facilities of the Raysut Fishery Harbour, such as construction of wholesale market or fish processing factory. However, these plans are currently on hold due to the expansion plans of Salalah Port.

At present, there are no fishing restriction zones established outside the port area, thus the adjacent coastline of Salalah Port is utilized as a convenient fishing ground for local fishermen, especially during the calm winter season. Hand line and lobster trap is conducted in the rocky western coast. Beach seine, cast net and trap fishery is conducted in the sandy eastern coast, mainly targeting small pelagic fishes. During the field reconnaissance in August 2004, several fish traps were observed just outside the container terminal.

AIT.2-12 shows the annual total landing in the Dhofar Governorate from 1999 to 2003 and the major caught species.

AIT.2-12 Annual Total Landing in the Dhofar Governorate from 1999 to 2003

Unit: Metric tons

	1999	2000	2001	2002	2003	Major species
Large pelagic	2,142	2,477	1,791	2,928	3,608	Yellowfin & longtail tuna, kawakawa, large jacks, kingfish
Small pelagic	4,312	8,555	7,212	2,391	2,734	Sardines
Demersal	4,323	6,584	6,181	7,178	5,975	Seabream, emperor, grouper
Sharks & rays	381	548	395	170	1,023	-
Crustaceans	152	116	291	178	198	Lobster
Cuttlefish	54	378	516	524	1340	-
Abalone	29	45	51	50	56	-
Others	1	35	0	1	1,108	-
Total	11,393	18,738	16,437	13,420 (3,719)	16,042	

*: The parenthesis shows the total landing in Wilayat Salalah

Source: Fisheries Statistics Book 2003, MOAF

In Oman, lobsters are mostly caught in the Arabian Sea and can fetch high value. Lobster fishing in Dohfar is permitted only for 2 months during the winter season. Abalone is also highly valued and is only caught in Dhofar. Abalones are concentrated in the eastern coast of Dhofar were dense kelps grow and are caught by local divers for a permitted 2 month period.

(2) Tourism

The main tourist season in Salalah is during the khareef season (June to September). The tourists are attracted by the cool weather, greenery and fantastic scenery. According to the survey conducted by the MONE, an approximate 179,000 tourists visited Salalah during June 21st to August 18th, 2004. Although, the area around the Salalah Port is not a major tourist destination, Hotel Hilton is located approximately 4km northeast of the port.

3.4 Cultural Assets

The most important archeological site in the Salalah area is located near the coast of the Al Balid area (Al Balid Archeological Site), which is relatively far from the port area. Behind the port area near the south facing cliffs, some archeological remains were found by the IUCN coastal zone survey but its significance are unknown.

3.5 Land Use

A comprehensive land use plan (Salalah Structure Plan) has been developed for the Salalah region until 2015. According to this plan, the major part of the port hinterland is designated as an industrial area. Several heavy industries and the Raysut Industrial Estate are found in this area. The coast south of the port is partly designated as a nature conservation area. The Raysut Fishery Harbour is located approximately 2 km north of the port, and a military camp is located between this fishery harbour and the Salalah Port.

Appendix I.3 Present Environmental Conditions of Sohar Port Area

1 Physic-chemical Environment

1.1 Meteorology

(1) Temperature

Temperatures are extremely high during May to September, which often exceeds 40℃. Temperatures are relatively cool from October to April but can still exceed 30℃.

AIT.3-1 Monthly Mean Temperature in Sohar Area from 1999 – 2003

Unit: ℃

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Ave.
1999	20.6	22.2	22.7	27.6	31.4	32.8	33.1	32.2	29.8	27.9	25.7	21.0	27.3
2000	21.0	20.6	22.9	28.7	31.4	32.6	32.4	32.1	30.1	28.1	24.6	20.6	27.1
2001	18.7	19.8	23.4	26.9	32.0	33.2	33.1	31.3	30.5	28.0	24.2	22.7	27.0
2002	21.5	20.0	23.6	26.9	31.7	33.3	33.2	31.6	29.9	28.1	24.1	21.3	27.0
2003	19.2	21.5	23.1	27.0	31.0	33.3	31.6	31.2	30.2	27.7	24.3	20.7	26.7
Ave.	20.2	20.8	23.1	27.4	31.5	33.0	32.7	31.7	30.1	28.0	24.6	21.3	27.0

Source: MOTC, Directorate General Civil Aviation and Meteorology

(2) Relative Humidity

Humidity is low during most of the year, with a slight increase during the peak summer season (July – September).

AIT.3-2 Monthly Mean Relative Humidity in Sohar Area from 1999 – 2003

Unit: %

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Ave.
1999	73	82	71	66	66	78	77	83	85	78	72	68	75
2000	73	66	62	52	63	65	72	74	73	65	64	66	66
2001	65	67	68	62	53	67	73	71	70	61	60	74	66
2002	59	63	65	59	55	63	68	73	76	68	65	63	65
2003	66	70	67	65	55	63	75	77	73	69	62	66	67
Ave.	67	70	67	61	58	67	73	76	75	68	65	67	68

Source: MOTC, Directorate General Civil Aviation and Meteorology

(3) Rainfall

The Sohar area experiences very little rainfall during summer, with most rainfall occurring in winter. The annual rainfall generally fluctuates between 100 mm. The occasional rainfall is produced either by the migratory low pressure system from the west or from convective rainstorms.

AIT.3-3 Monthly Mean Rainfall in Sohar Area from 1999 – 2003

Unit: mm

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1999	23.3	25.5	47.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	96.3
2000	8.2	0.0	0.0	0.0	0.0	0.4	0.0	0.0	2.2	2.0	6.8	0.0	19.6
2001	17.6	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.2	0.0	23.4
2002	0.0	0.0	7.6	15.2	0.4	0.0	0.0	0.0	0.0	0.0	30.0	0.0	53.2
2003	3.8	1.0	3.4	22.2	0.0	0.0	6.6	0.0	0.0	0.6	0.4	0.0	38.0
Ave.	10.6	5.3	11.8	7.5	0.1	0.1	1.3	0.0	0.4	0.5	8.5	0.0	46.1

Source: MOTC, Directorate General Civil Aviation and Meteorology

(4) Wind

Wind is relatively calm throughout the year. The mean wind speed is between 4 – 6 knots. The prevailing wind direction is NW during the winter months (Nov. – Feb.) and SE to E during the rest of the year. The wind direction is partly influenced by the daily cycle of offshore and onshore thermic winds.

AIT.3-4 Monthly Prevailing Wind Direction and Mean Wind Speed in Sohar Area from 1998 – 2002

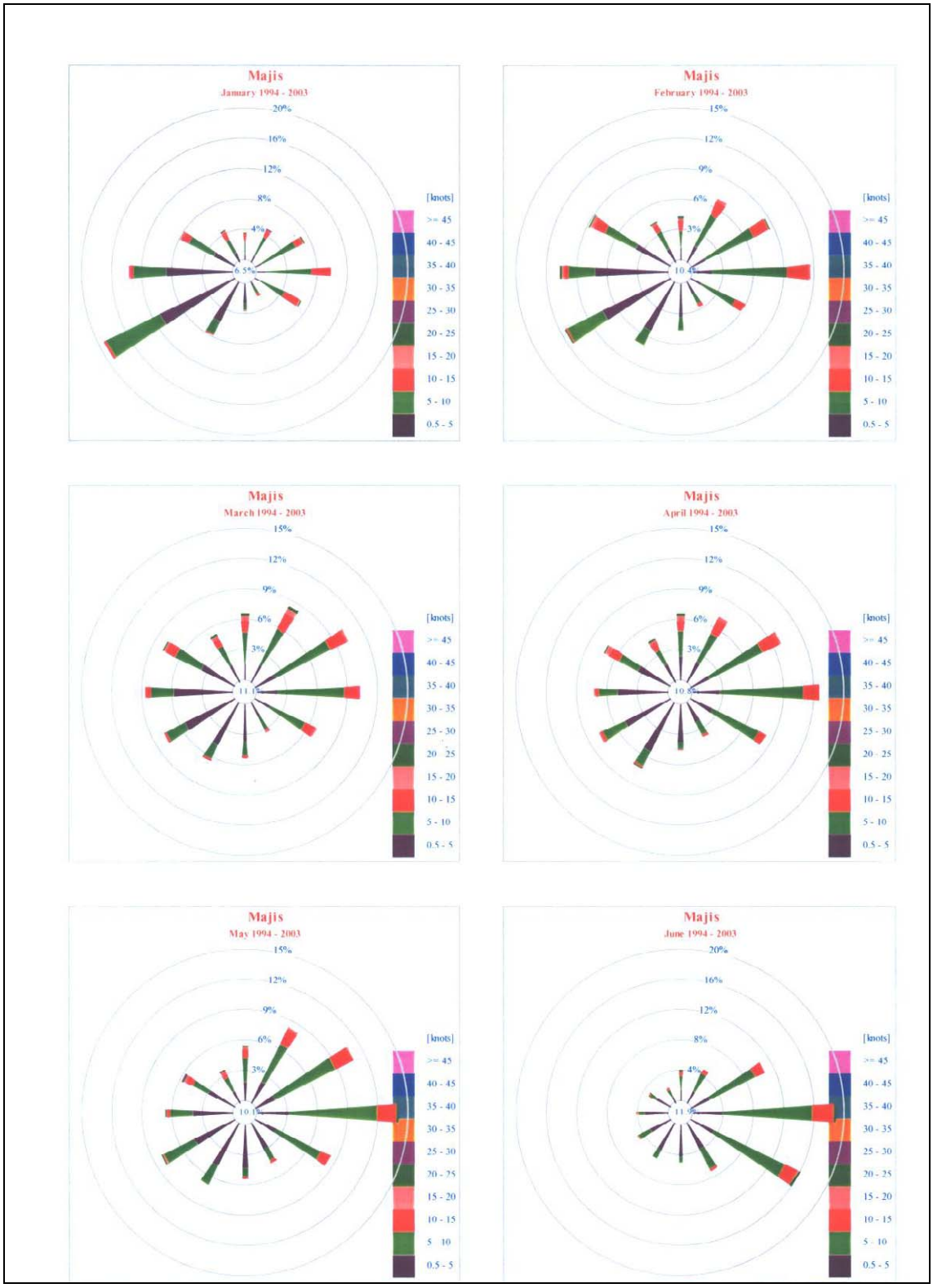
Unit: knots

		Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1998	Dir.	270	300	090	060	090	120	120	120	120	090	240	240
	Vel.	05	05	04	05	04	04	05	05	04	04	04	04
1999	Dir.	270	090	080	120	090	120	120	120	120	090	240	270
	Vel.	05	04	05	05	04	04	05	05	04	04	05	04
2000	Dir.	270	270	300	090	090	090	090	090	090	060	240	240
	Vel.	06	04	06	05	05	05	06	06	05	05	06	05
2001	Dir.	240	240	090	090	090	090	090	090	090	090	240	240
	Vel.	06	06	06	05	05	05	06	06	05	05	05	05
2002	Dir.	240	210	060	050	090	060	090	090	090	060	090	240
	Vel.	06	05	05	05	05	05	06	06	05	04	05	05

Source: MOTC, Directorate General Civil Aviation and Meteorology

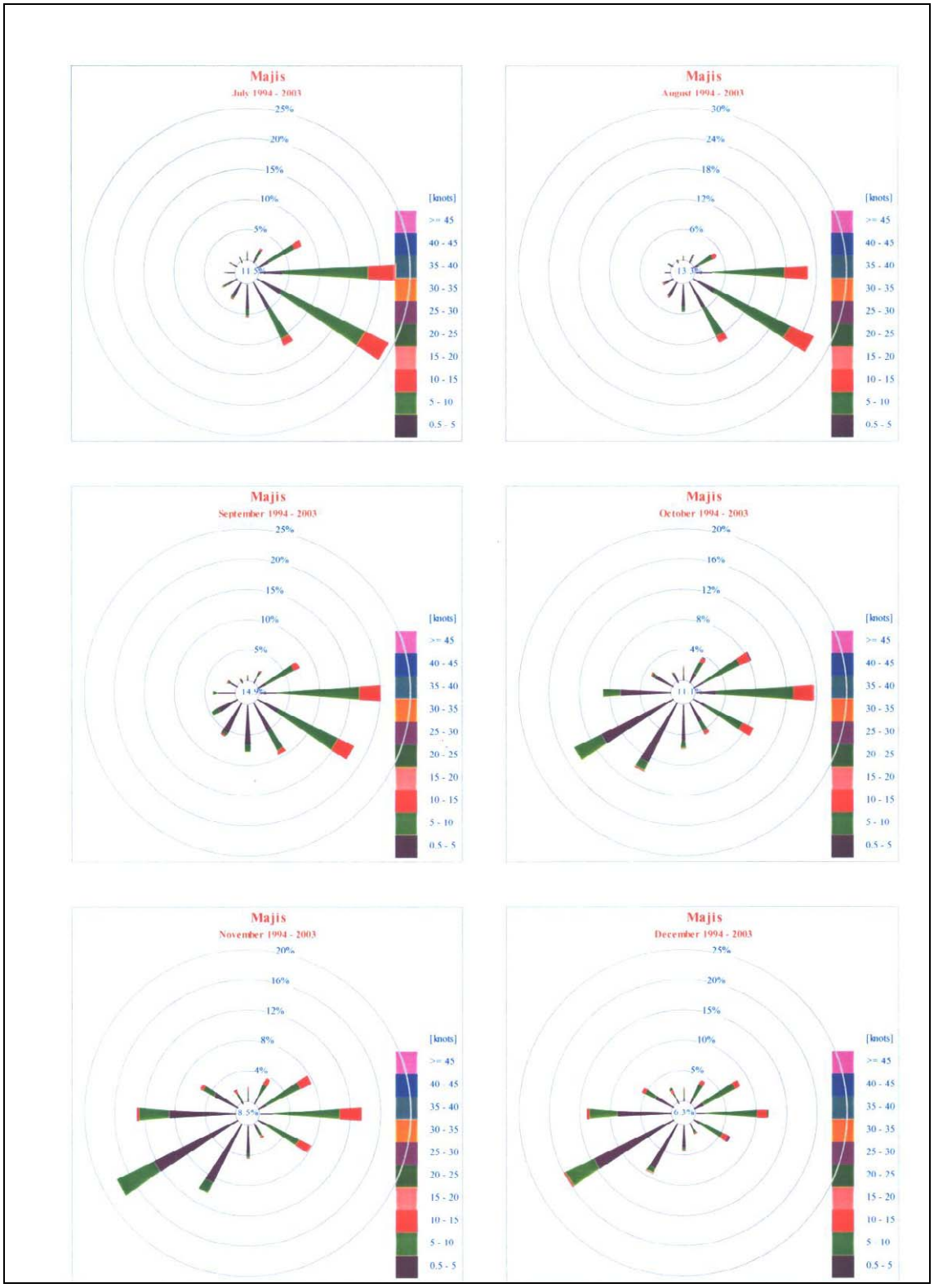
AIF.3-1 shows the monthly wind direction and speed averaged over 1994 - 2003 period.

AIF.3-1 Wind Rose of Sohar Area from January – June (1994 – 2003)



Source: MOTC, Directorate General Civil Aviation and Meteorology

AIF.3-2 Wind Rose of Sohar Area from July – December (1994 – 2003)



Source: MOTC, Directorate General Civil Aviation and Meteorology

1.2 Oceanography

(1) Tide

In the Gulf of Oman, spring tides tend to be semi-diurnal and diurnal during neap tides.

AIT.3-5 Mean Tide Levels in Sohar

Unit: meters

Lat. N	Long. E	Mean range	Mean Sea Level	MHHW	MLHW	MHLW	MLLW
24° 09′	56° 54′	1.82	1.90	2.72	2.61	1.67	0.83

Note: The levels are of Saham, approximately 40km SE of Sohar

Source: Oman Maritime Handbook 2004

(2) Wave

Despite being located in the inner part of the Gulf of Oman, Sohar receives long period SE swell waves (up to 20 second) from the Indian Ocean. However, the height of these waves is significantly reduced by the time it reaches Sohar. The sea is reported to be calm (waves of 0.5 m or less) for 85% of the time (WS Atkins 2002).

(3) Currents

Currents in the Gulf of Oman is complex and variable. Current flow is assumed to be determined by large-scale flow regimes rather than from tidal and wind factors. Such large features may include eddies and circulation of the North Arabian Sea (Wimpol, 1986).

Current velocities along the Batinah coast are generally very low at around 0.1 m/s (WS Atkins, 1999). Deducing from the available but limited information, the net current direction in the Batinah coast is towards the NW.

(4) Littoral Drift

The sandy coastline along the Batinah region, including the Sohar area is known to be mobile with a net northwest drift of sediment along the coastline. The net sediment transport rate in the Sohar coastline is estimated at 88,000 m^3 per year (Dobbin, 1992). The main sediment supply to the Batinah coastline is assumed to be from the occasional discharges of wadis (WS Atkins 2002).

Since the commencement of the port construction, significant sediment accretion has occurred along the southern breakwater of Sohar Port, and sediment erosion and accretion north of the northern breakwater. Beach erosion in the north of the northern breakwater, is a major concern for the villagers

of Harmul, which is located approximately 200 m from the northern boundary of the port. Significant sediment accretion has also being observed in the inlet of the mangrove forest (approximately 2.5km north of the northern breakwater) since the construction of the port.

1.3 Topography

The Sohar Port is located along a shallow sandy coastline running from the southeast to northwest direction over the border of Wilayat Sohar and Liwa. The seabed is generally featureless and gently sloping.

The hinterland of the port is flat and has been cleared and partly landfilled for the development of the Sohar Industrial Port Area, which is approximately 24 km^2. The landfill area in the northern section of the port requires renovation due to unstable ground conditions. Agriculture and residential area lies behind the industrial area and the Batinah Highway.

1.4 Geology

The coastal plain of Al Batinah region is mainly composed of alluvial deposits. According to the Geological Map Sheet NE40-14, 1992 Buraymi (scale, 1:250,000), Sohar port is located over Quaternary, recent coastal deposits, beach sand (Q*mz*). Behind this area and up to the Batinah Highway, the substrate is composed of a narrow band of Quaternary, Khabra deposits (Q*ky-z*), interspersed with Quaternary, sabkhah deposits (Q*by-z*).

1.5 Hydrology

(1) Wadi flow

The Sohar Port is located in a high risk flood zone from two major wadis (Wadi Suq and Wadi Bani Umar), which flows along the northern and southern boundaries. However, discharge events are rare and only occur during intense rainfalls.

(2) Groundwater

The availability of groundwater resources has played a vital role in the settlement and development of the northern Batinah region. Currently, the majority of the groundwater is used for agriculture. However, due to overexploitation over the last decade the water levels near the coast are now below sea level in many areas and saline intrusion is active. This has raised the groundwater salinity level in many areas, making it unsuitable for agriculture.

Sine December 2000, as part of the monitoring program of Sohar port construction, regular salinity

measurements of groundwater have been conducted in the agriculture / residential area just outside the Sohar Industrial Port Area. According to the monitoring results, salinity levels showed significant increases in most monitoring stations during this period, and the rate of increase of these monitoring stations were greater compared with the groundwater monitoring wells located outside the port construction area. These results implies that the port construction have enhanced the salinity levels in the already high saline content local groundwater. Although, the major construction works of the port is near completion, further construction works in the Sohar Industrial Port Area may also have significant impact on the groundwater quality.

1.6 Seawater Quality

(1) General Conditions

Seawater surface temperatures are relatively high, ranging from 24℃ in the winter months to 33℃ in August and September. Surface salinity in the Batinah coast varies between 36.5 and 39 from January to May, and 37 to 39 from June to December (WS Atkins, 1999).

(2) Status of Water Pollution

Prior to the construction of the Sohar Port, water quality surveys were conducted in October 1998 in the adjacent waters of the port area. AIT.3-6 shows the analysis results.

AIT.3-6 Water Quality Prior to the Construction of the Sohar Port

	Station 1	Station 2	Water quality standard*
BOD (mg/l)	10	10	
pH	8.3	8.2	8.2 – 8.3
TSS (mg/l)	0.10	0.10	
TN (mg/l)	0.3	0.34	
TP (mg/l)	0.002	0.002	
Potassium (mg/l)	490	480	
Total iron (mg/l)	0.02	0.02	1
Manganese (mg/l)	0.005	0.006	
Copper (mg/l)	0.02	0.02	0.005
Mercury (mg/l)	<0.001	<0.001	0.000003
Arsenic (mg/l)	0.004	0.004	0.025
Total Chromium (mg/l)	<0.001	<0.001	0.015
Lead (mg/l)	0.004	0.004	0.025
DO (mg/l)	15.3	14.2	
Total Bacteria counts/100ml	500	520	
Total Coliforms counts/100ml	12	16	500
Faecal Coliforms counts/100ml	0	0	100

*: UK Water Quality Objectives (EC Directive 76/464/EEC)

Source: WS Atkins, 1999

According to the above results the water quality in the Sohar area was relatively good prior to the construction. However, high level of copper was detected, which could be due to the inland copper mining and smelting plant activities in the Falaj Al Qabail area.

1.7 Sediment Quality

As part of the MPMP, the intertidal sediments of the Sohar area have been surveyed in 2002 and 2003, which is after the main marine construction works of Sohar Port. The following AIT.3-7 shows the results of the heavy metal analysis. AIT.3-8 shows the result of petroleum hydrocarbon analysis.

AIT.3-7 Concentration of Heavy Metals in the Intertidal Sediments of Sohar

Unit: mg/kg dry wt.

	Pb	Cd	Cu	Cr	Ni	Mn	V	Zn
2002	2.70	0.115	22.37	737	1,167	-	63.7	-
2003	4.82	0.769	8.16	70.35	828	355	16.07	142
MAFF Action Level*	40	2	40	100	100	-	-	200

*: Threshold values proposed by the UK Ministry of Agriculture, Fisheries and Food (MAFF)

Source: MPMP, MRMEWR 2002/03

Concentration of chromium and nickel were particularly high in Sohar area. Although the high level of chromium and nickel may partly be attributed to anthropogenic sources (e.g. oil pollution), the natural mineralogy of the intertidal sediment must be a major contributor to the high levels.

AIT.3-8 Concentration of Petroleum Hydrocarbon in the Intertidal Sediments of Sohar

Unit: mg/kg dry wt.

	Grain size (μ m)	Total Aliphatics	Total Aromatics	Total HCs
2002	<125	-	-	1.7
IAEA 1991 (KSA)*[1]	-	13 - 496	6 - 175	19 - 671

*1: Data from IAEA surveys of the KSA in 1991

Source: MPMP, MRMEWR, 2002

The petroleum hydrocarbon level in Sohar was one of the lowest within Oman, despite heavy oil tanker traffic in the offshore areas.

1.8 Noise and Air Quality

Prior to the construction of the Sohar Port and the hinterland industrial area, the major pollution sources in the Sohar area were the small-scale heavy industries in the Sohar Industrial Estate and the Batinah Highway. However, due to the limited scale, air pollution was not a major problem.

The port construction activities has temporally elevated the local dust level, especially during the hot summer season when the soils were especially dry. The ongoing development activities in the Sohar Port Industrial Area may enhance dust problems for nearby villages such as Harmul, Majis and Ghadajan.

The villages near the Batinah Highway experience constantly high levels of noise and this problem could be enhanced by the construction and operation of the Sohar Port Industrial Area (i.e. increase in vehicle traffic and industrial activities).

1.9 Odor

No significant odor was detected during the field reconnaissance in July 2004. Odor problems could become noticeable with the operation of the hinterland industries and increased shipping.

2 Biological Environment

2.1 Marine Ecosystem

(1) Flora

According to the Sohar Port EIA, two seagrass species (*Halodule uninervis* and *Halophila ovalis*) were recorded in the shallow waters of Sohar. These species generally grew in low densities with maximum of 10 plants / m^2 (WS Atkins, 1999).

(2) Fauna

According to the transect survey conducted by the Sohar Port EIA, the most common subtidal epibenthic fauna (fauna which lives on the seabed) were gastropod (*Strombus persicus*) and starfish (*Astropecten* sp.). These species are very common in subtidal sandy environment. Other species observed but with less frequency were hermit crab (*Pagurus* sp.), anemones and bivalves, which are also usual residents in subtidal sandy environment. As for subtidal benthic infauna (fauna which lives under the seabed), a total of 29 species were recorded, which were composed of polychaetes, crustaceans, mollusks and echinoderms. Polychaetes were the most abundant and had the highest diversity (16 species).

Fish species commonly observed during the Sohar Port EIA were, sweetlips, sardines, scad, guitarfish, goatfish, gobies and jacks.

The carcasses of the endangered green turtle (*Chelonia mydas*) were also found during the survey.

According to the Oman Cetacean Database, several cetacean species such as Humpback whale, sperm whale, Dwarf sperm whale, false killer whale, bottlenose dolphin, Risso's dolphin and spinner dolphin occur in the offshore areas.

2.2 Terrestrial Ecosystem

(1) Flora

A mangrove forest with an area of about 35 ha, lies approximately 2.5 km northwest of the Sohar Port in Khawr Harmul. The mangrove forest is solely composed from *Avicennia marina* species, which grows along the creeks and small tributary channels inside the inlet.

The mangrove of Khawr Harmul is one of only four notable mangrove sites along the Batinah coast and has high conservation values due to its high ecological role and recreational value. Its roles include nursery ground for various resource fish species, habitat for various mollusks and crustaceans, and feeding grounds for various bird species. The mangrove has also high cultural and recreational value for the local people.

Prior to the construction of the Sohar Port (in 1998), the entrance of the inlet was further south. However, by May 2002 the entrance has moved approximately 300m north along the coast due to the accretion of sediments, and has narrowed the entrance of the inlet in the consequence. With the present accretion rate, the entrance of the inlet could be blocked in the near future, and should have significant adverse impacts on the ecosystem. It will for example, prevent the entrance of juvenile fish and also enhance water quality deterioration due to the hindrance of seawater exchange.

(2) Fauna

The Batinah coastline, including the port area is a region of national and international significance for migrating birds between Africa and West Asia. The greatest numbers of birds occur between August and April, with gulls and terns being most abundant. Other migrating birds include herons and waders.

3 Social Environment

3.1 Demography

According to the Statistical Year Book 2003, the total population in Wilayat Sohar and Liwa in year 2002 was 112,405 and 28,080, respectively. In Wilayat Sohar approximately 79% are Omanis and 21% Expatriates. In Wilayat Liwa, approximately 86% are Omanis and 14% Expatriates.

3.2 Infrastructure

(1) Access Road

Access to the Sohar port is possible from the Majis Jetty (south of the port) or Harmul village (north of the port) side. The road from Majis Jetty and Harmul village is currently unpaved. Both Majis Jetty and Harmul village is connected to the Batinah Highway via a 7m wide single carriageway. Construction of a new highway (Batinah Expressway), interchanges and flyovers are planned to serve the expected increase in traffic volume.

(2) Waste Management

Since the port and the adjacent industrial area are still in its construction stage, waste management policies for the operation phase are still in its development stage. Following are some of the planned waste management policies of Sohar Industrial Port Area that are relevant to the port activities.

- Non-hazardous solid waste will be dumped at a MRMEWR owned dumping site (Al Khadhra or Al Dhiyan waste disposal site).
- Construction of a sewage treatment plant is scheduled in the industrial area to treat all the sewage generated from the port and industrial area.
- A reception facility for waste oil and oily bilge water may be installed in the industrial area. If not, the waste oil can be transported to the reception facility in Fujayrah, UAE.

(3) Water and Power Supply

To serve the needs of the new port and factories, a desalination / power plant is planned to be constructed in the southern area of the Sohar Port Industrial Area.

3.3 Livelihood

The majority of the local people depend on artisanal fishing or agriculture (date palm cultivation) for their livelihood. Over the past decade, through the establishment of the Sohar Industrial Estate, secondary industries have been established in the Sohar area. Employment opportunities for the local residents will be further enhanced through the establishment of the Sohar Industrial Port Area.

(1) Fisheries

Fishing is traditionally and still is one of the principal economic activity of the northern Batinah coast, and is an important income source for the local population of the Sohar port area. The following AIT.3-9 shows the fishing villages that are located near the port, and the number of fishermen and

fishing boats in the Al Batinah Region and in the Wilayat Sohar and Liwa for year 2003.

AIT.3-9 Outline of the Artisanal Fishery in Al Batinah Region, Wilayat Sohar and Liwa

	Al Batinah Region	Wilayat Sohar	Wilayat Liwa
Fishing villages near the port[1]	-	Majis	Al Hadd, Ghadfan, Harmul
No. of fishermen (2003)[2]	10,298	1,608	405
No. of fishing boats (2003)[2]	4,753	740	184

Source 1: MOAF
Source 2: Fisheries Statistics Book 2003, MOAF

The main fishing methods employed in the Sohar coastal area are beach seine, fish traps, handline and gillnet. Artificial reefs are placed along the coast to enhance fish catch of demersal species. An estimated 40 – 50 artificial reefs are located offshore (up to 30m depth) between Majis Jetty and Harmul, with some reefs placed only 400m to 1,600m from shore. Offshore trolling is conducted approximately 20km offshore, which mainly target large pelagic fishes such as longtail and yellowfin tuna, barracuda and jacks. AIT.3-10 shows the annual total landing in the Al Batinah Region from 1999 to 2003 and the major caught species. Species that fetch relatively high prices are kingfish, large jacks, seabream, groupers and emperors.

AIT.3-10 Annual Total Landing in the Al Batinah Region from 1999 to 2003 Unit: Metric tons

	1999	2000	2001	2002	2003	Major species
Large pelagic	8,160	5,387	4,392	5,803	5,090	Longtail tuna, yellowfin tuna, barracuda, kingfish, kawakawa, large jacks
Small pelagic	9,217	16,113	20,303	12,549	11,444	Sardine, Indian mackerel, anchovy
Demersal	2,230	1,485	1,284	1,353	1,774	Emperor, grouper, seabream, ribbonfish
Sharks & rays	780	513	472	565	486	-
Crustaceans	3	3	0	0	0	Lobster, shrimp
Molluscs	291	245	251	195	581	Cuttlefish
Others	0	3	0	148	507	-
Total	20,681	23,749	26,702	20,613 (4,217)	19,882	

*: The parenthesis shows the combined total landing in Wilayat Sohar and Liwa
Source: Fisheries Statistics Book 2003, MOAF

During the site reconnaissance in July 2004, only one or two fishing vessels were observed in the new fishery harbour next to the Sohar Port, and most of the fishing vessels were observed outside of the harbour. The local fishermen do not seem to be utilizing the new fishing harbour as yet, which could be partly due to the lack of any facilities for fishermen, such as ice plant, fish market and so on. Also the local fishermen usually land their fish catch in the fishery harbour in Sohar Town.

3.4 Cultural Assets

Forts and mosque of cultural significance exist in the adjacent villages near the port area and could be

affected from road building and road traffic associated with the future increase in port activities.

3.5 Land Use

The Ministry of Housing, Electricity & Water (MHEW) has developed the Sohar Industrial Area Master Plan (SIAMP) in year 2000, which covers the area from the Sohar's northern most point to the Wilayat Liwa (approximately 250 km^2). The land has been divided into three major uses: port, industry and farm and residence. The existing residential and farm areas are located close to the planned industrial areas and are susceptible to impacts from industrial activities and possible expansion of road network.