9.2 Alternative Development Plans

9.2.1 Sultan Qaboos Port

1) General observation about capacity

Sultan Qaboos Port handled about one million ton of conventional cargo and 265 thousand TEUs of containers in 2003. It seems that the Port is operating at its full capacity. Yard is packed with containers and vehicles, and almost all of the quays are occupied by loading/unloading oceangoing vessels and Dhows.

Understandings about the Sultan Qaboos Port's capacity mentioned above can be supported by the following observation. Facilities of the Sultan Qaboos Port has been developed based on the recommendations of the JICA Study 1990 including reclamation of Shutaify Bay. The said JICA Study recommended the government that Sultan Qaboos Port should have the capacity to accommodate 820 thousand tons of conventional cargo and 246 thousand TEUs of containers with the target year of 2000.

Berth Occupancy Rates (BOR) of the Sultan Qaboos Port during selected months in 2003 are shown in Table 9.2-1 and Figure 9.2-1. Containers are handled at No1,2,4,5 Berths at Sultan Qaboos Port, and BORs of these berths vary in the range of 50% to 70%, which look below the optimum level. However, cargo handling capacity of this port is decided by the landside capacity, not quayside capacity. Port land at Sultan Qaboos is almost saturated with containers.

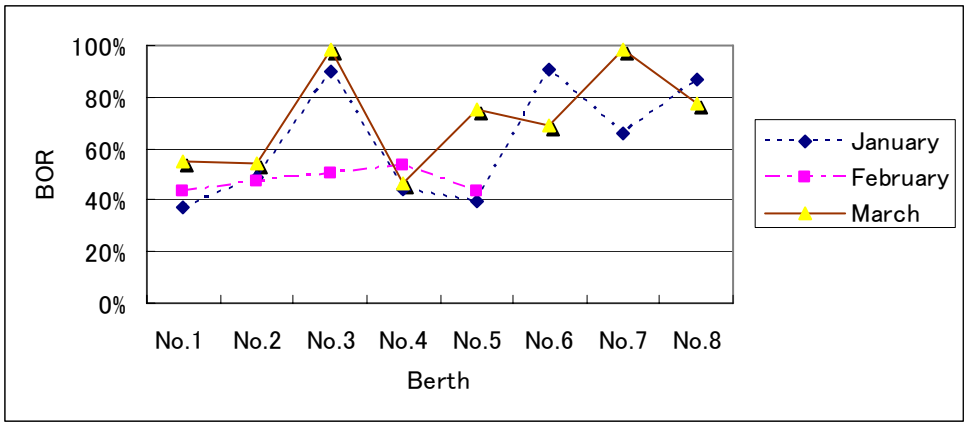
Breakbulk and Dry bulk cargoes are handled at No. 3, 6, 7, 8 berths, and their BOR exceed 70% and some of them are close to 100%. It can be safely said that Sultan Qaboos Port cannot accommodate additional conventional cargoes without forcing vessels to wait off the port under the present operational efficiency level.

Table 9.2-1 Berth Occupancy Rates of Sultan Qaboos Port (January~March 2003)

Berth	No.1	No.2	No.3	No.4	No.5	No.6	No.7	No.8
January	37.09%	48.90%	90.27%	44.04%	39.29%	90.43%	66.20%	86.87%
February	43.18%	47.28%	50.46%	53.75%	43.37%			
March	55.00%	54.29%	98.48%	46.43%	75.25%	68.81%	98.35%	77.67%

(Source: PSC)

Figure 9.2-1 BOR of Sultan Qaboos Port



Source: PSC, Compiled by JICA Study Team

2) Container handling capacity at each berth

i. Container dedicated berths (No4 – No5)

Berths No 4 & 5, which are 366m long all together and 10.9m deep at chart datum, are designed to accommodate the second generation container vessels. As required berth length of this class of vessels is about 250m, it is impossible for two vessels of this class land at the quay simultaneously. The marshalling yard is located immediately behind the berth and has 192 reefer-equipped ground slots plus 1,044 slots for dry storage.

Judging from storage capacity of the marshalling yard, container handling capacity par annum of this terminal is estimated as follows;

- Ground slots at container marshalling yard 1,044 TEUs
- Tier 4
- Working coefficient 0.75
- Peak ratio 1.3 assumed
- Average dwelling 12 days assumed
  (1,044 * 4*0.75)*365/12/1.3 = 73 thousand TEUs/year

ii. Multi purpose berth (No 1 & 2)

Berths No 1 & 2, having 458m in total length and a depth alongside of 13m, are designed to accommodate the third generation container vessels of loading capacity of 2,000 – 3,000 TEUs. As required berth length of this class of vessels is more than 300m, it is impossible for two vessels of this class land at the quay simultaneously. These berths have multi-purposes, hence are utilized for bulk carriers loaded with grains and clinker as well as container vessels. From the quayside, containers are

transported to the Shutaify Bay Container Yard, which boasts a total of 1,104 ground slots, 120 of them reefer equipped. Although these No.1 and No.2 berths accommodate grain carriers as well, quayside capacity is larger than the yard capacity, and container handling capacity of these berths is decided by the yard capacity.

Judging from storage capacity of the marshalling yard, container handling capacity par annum of these berths is estimated as follows;

- Shutaify Bay 150,000 m2 (Yard 112,500 m2 is assumed)
- Tier 4
- Working coefficient 0.75
- Peak ratio 1.3 assumed
- Average dwelling 12 days assumed

  Annual capacity is estimated at 211 thousand TEUs

Therefore, existing capacity of Sultan Qaboos Port as a container port is estimated at around 300 thousand TEUs per annum.

iii. Grain unloading capacity

Grain discharging capacity at the port allows Oman Flour Mills to handle an average of 6,000 tonnes a day. Underground grain conveyor system is used to transport shipments from the quayside to the port's silos with capacity of 120,000 tonnes. Two sets of pneumatic unloader are capable of discharging up to 250 tonnes per hour each. Judging from the capacity of the unloading equipment, annual grain handling capacity is estimated as follows;

- Pneumatic unloader 250 ton/hour/set * 2 sets
- Efficiency coefficient 0.7
- Working coefficient 0.8
- Resting hour during berthing 12 hours assumed
- Unloading volume per ship 30,000 tonnes
- Berth occupancy rate 60%

  Annual cargo handling capacity = 1,323 thousand ton

Considering the situation that container vessels are given priority, the grain handling capacity of the port would be around 1,000,000 tonnes per annum. As import volume of grain is estimated at 770,000 tons in 2025, Sultan Qaboos Port will not suffer from shortage of grain handling capacity after

expansion for container handling takes place in Shutaify Bay and Berth No. 2 is solely utilized by grain vessels. However, if Berth No. 2 is utilized by not only grain vessels but also feeder container vessels, then improvement of unloading capacity of grain is highly recommended in order to avoid queuing of vessels wishing to use this berth.

iv. Bulk cement unloading/loading capacity

A total of 39 bulk carriers unloaded 157 thousand tons of cement at Sultan Qaboos port in 2003, and these vessels berthed either No. 7 or No.8 berth for unloading operations. They stayed at Sultan Qaboos Port about 35 hours per ship.

Bulk cement unloading capacity based on ship crane capacity is calculated as follows;

Grab capacity	5.0 ton/crane
Working ratio	0.8
Cycle time	3.0 minutes
Efficiency ratio	0.6
Nr. of Gang	3.0
Non-working time	4.0 hours
Unloading volume per ship	4,000 ton
Optimum BOR	0.60
Net Unloading per hour	144 ton/hour
Net working hour	27.8 hour
Gross Unloading hour	31.8 hour
Optimum capacity	660,000 ton/berth/year

v. General cargo handling capacity

General cargoes can be handled at berths such as No.3 and No6, and a total of their quay length reaches about 500 m. Assuming general cargo handling productivity per unit quay length to be 1,000 ton/m, about half million can be handled at Sultan Qaboos Port annually.

3) Potential cargo demand by package type

Cargo demand for Sultan Qaboos Port with the target year of 2025 is summarized in Table 9.2-2. In this forecast, an assumption is made that cargoes generated from Sohar Industrial Area be handled at Sohar Industrial Port. According to the forecast, over three times larger tonnage of cargo than the present traffic level, or nearly existing port capacity, is potentially expected to come to the capital port in 2025.

Table 9.2-2 Cargo Demand Forecast of Sultan Qaboos Port for 2025

(1,000 Ton)

		2002 (Actual)	2025	2025/2002
Import	Container	968.2	2,956.0	3.05
	General/Bulk	915.6	2,761.0	3.02
	Total	1,883.8	5,717.0	3.03
Export	Container	280.8	528.0	1.88
	General/Bulk	152.5	678.0	4.45
	Total	433.3	1,206.0	2.78
Total	Container	1,249.0	3,484.0	2.79
	General/Bulk	1,068.1	3,439.0	3.22
	Total	2,317.1	6,923.0	2.99
Transship	(TEU)	29,325.0	376,000.0	12.82

4) Planning policy

It is obvious that existing facilities of Qaboos Port are nearly saturated with cargoes, and cannot accommodate all of the potential cargoes even after some expansion project is materialized because social and natural constraints exist.

Following development policy and strategies on expansion of Sultan Qaboos Port can be proposed:

i. Considering the natures and characteristics of Sultan Qaboos Port being the sole gateway of the country, the port will not accommodate all the cargo but selected cargo.

ii. Sultan Qaboos Port should play a key role to promote diversification of national economy, especially tourism development.

iii. Container handling function shall remain here because majority of container cargoes are imported consumer goods.

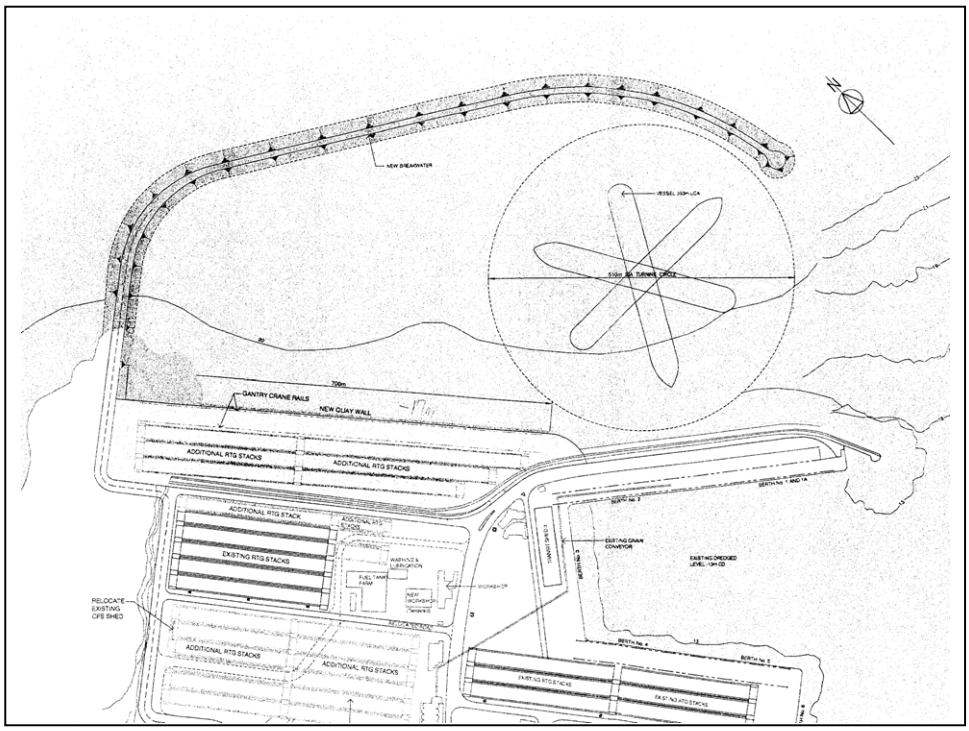
iv. Grain and cement are difficult to move because costs to relocate facilities for manufacturing and storage would be very high.

v. Project cargoes and bulk cargoes need not to be handled at the capital port.

5) Development concept

PSC entrusted a series of expansion study to Halcrow Group Ltd., and Final Report of Physical Planning Study was delivered to PSC in October 2004. According to the Final Report, there are three principal options for developing a new outer basin at PSQ. One of the options are "an outer basin created by a new breakwater extending from the end of Ras Shutaify in an easterly direction", which is shown in Figure 9.2-2.

Figure 9.2-2 Extension Plan of Sultan Qaboos Port (by Halcrow)



Source: PSC

JICA Study Team agrees in principle that the option shown above is superior than the other options such as a new basin created on the northern side of Ras Shutaify. Based on this option, JICA Study Team proposes following development concept which are in line with the planning policy of the Sultan Qaboos Port discussed previously.

Containers will be handled at the new deep-sea container terminal with three berths, and grain vessels will be accommodated at Berth No. 2 as is done presently while the multi purpose berths are basically utilized for container feeder vessels. Warehouse of Berth No. 3 will be converted as a part of container marshalling yard. Berth 4 and 5 will be converted to cement bulk cargo berths.

Multifunctional commercial complex including cruise terminal will be built at around No. 6, 7, 8 berths for tourists and citizens in general. Priority is given to cruise vessels, which are basically to stay at No. 7 berth.

Some portion of landside plots shall be allocated and developed for the promotion of tourism at the waterfront. A land which is currently utilized for cargo storage and fishery related activities can be converted to a place where a viewpoint of portscape will be arranged. People gather to see world class cruise vessels and enjoy eating and shopping amid waterfront atmosphere.

Cargoes which cannot find space to be handled at Sultan Qaboos Port shall be handled at a new port. Regarding the new port, discussion should be made at the coming part of this report. Cargo allocation between Sultan Qaboos Port and the new port for 2025 is forecast as shown in Table 9.2-3.

Table 9.2-3 Cargo Allocation between Sultan Qaboos Port and New Port

(1,000 Ton)

		Sultan Qaboos	New Port	Total
Import	Container	2,956	0	2,956
	General/Bulk	1,330	1,431	2,761
	Total	4,286	1,431	5,717
Export	Container	528	0	528
	General/Bulk	386	292	678
	Total	914	292	1,206
Total	Container	3,484	0	3,484
	General/Bulk	1,716	1,723	3,439
	Total	5,200	1,723	6,923
Transship	(1,000TEU)	376	0	376

Source: JICA Study Team

6) Alternative facility layout plans

Two alternative facility layout plans of Sultan Qaboos Port for 2025 are shown in Figure 9.2-3 (Alternative A) and Figure 9.2-4 (Alternative B). Both layout plans provide a total of 1,050 linear meter quaywall to handle containers in front of the present Shutaify Bay storage area. A new breakwater provides sheltered water at the berths.

As waterdepth at the site of the breakwater is in the range of 35m to 40m, large quantities of rocks and fill are required for construction. The construction materials for breakwater, quaywalls and reclaimed area can be obtained by the excavation of hills near Shutaify Bay storage area. Reclaimed area behind the quaywalls and leveled space after excavation of hills for rocks can be utilized as container stocking area.

The difference between the two alternative plans is length and configuration of the breakwater. The breakwater in Alternative A is connected to the end of Ras Shutaify and has 2,000 m in length, while that in Alternative B is planned without connection and is shorter by 500m than Alternative A. Alternative B is proposed to reduce construction cost and potential environmental impacts, and advantages and disadvantages of the both alternatives are discussed in detail in Ch 9.3 through Ch 9.6.

Figure 9.2-3 Alternative A of Sultan Qaboos Port Development Plan for 2025

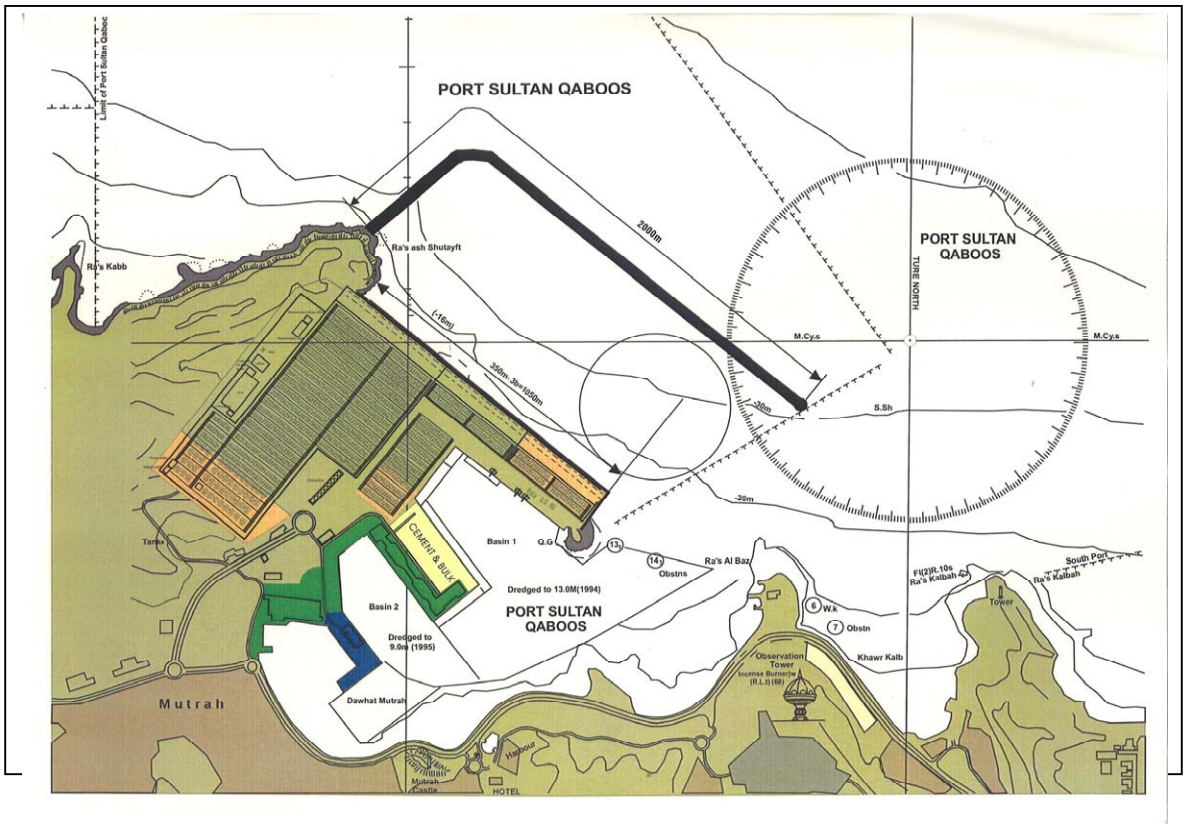
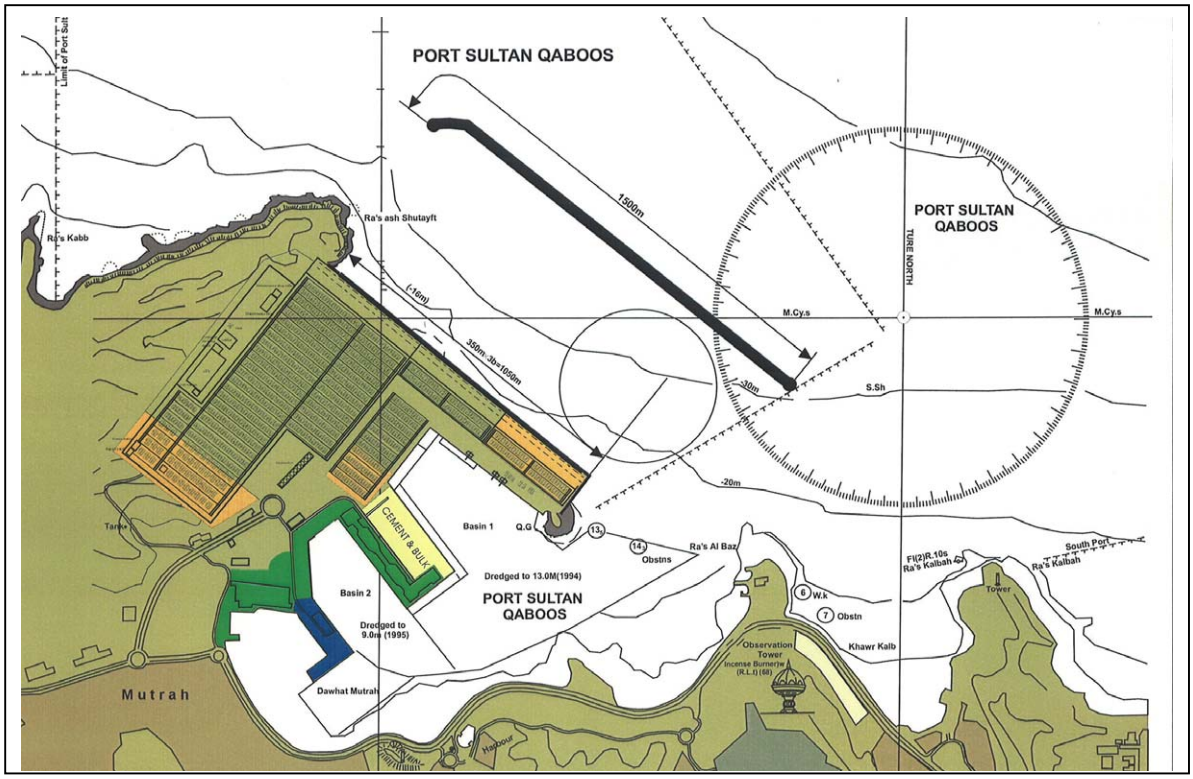


Figure 9.2-4 Alternative B of Sultan Qaboos Port Development Plan for 2025



Source: JICA Study Team

7) Necessity of coordinated planning for waterfront development

Sultan Qaboos Port has to cope with increasing volume of maritime traffic as the nation seeks sustainable economic growth. Generally speaking, goals of port development should be in line with goals of the national economic development policy, and the present policy is to shift from oil-led industries to diversified structures. Another aspect which this port has to deal with is the fact that this port adjoins commercial and residential districts as well as tourist destinations. It is also important to mention that this port is topographically restricted by both steep hills at land side and deep water at sea side. Taking these aspects into consideration, well coordinated planning is required especially in the following three fields: functional allocation between Sultan Qaboos Port and a New Port, coordination between port planning and city planning, and that between land use planning and water area planning.

Construction of a cruise terminal at Sultan Qaboos Port can be regarded as one of the policy statement how this port fulfills the public expectation as the capital port. Because of this nature, every kind of users' demands has been pressing Sultan Qaboos Port. Unfortunately, however, even after expansion works are realized, port area is physically limited, and Sultan Qaboos Port cannot meet all the needs of the clients. Therefore, functional allocation between Sultan Qaboos Port and A New Port is necessary. JICA Study Team preliminarily proposes in the following way that general cargos and project cargos as well as a part of bulk cargos be shifted to a New Port.

Well coordinated planning is required to effectively promote tourism at Muttrah district and near the port area. Cruise terminal will be situated in the port area and safety and security for the pedestrians and tourists are required both in and out side of the port area. Tourist attractions scatter over the wide area not only on the land side but also on the sea side. Calling and mooring vessels of different types in the bay, especially at night, are one of the most attractive tourism resources in Muscat. Viewing platforms and waterfront parks should be arranged after fully evaluating portscape.

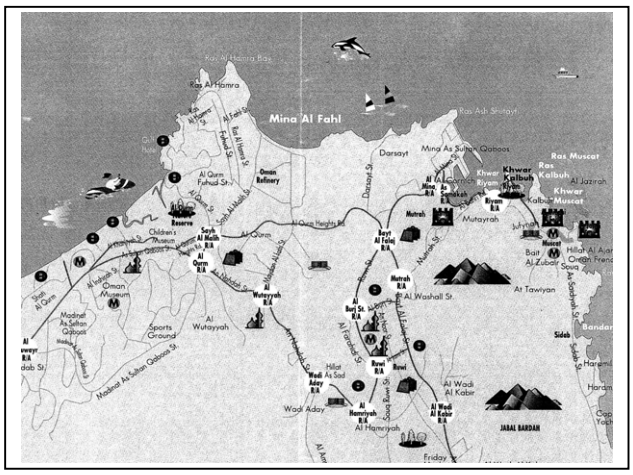
Photo 9.2-1 Muttrah Waterfront

In 1990 JICA submitted the Final Report on "The Study on the Port Development for Northern Oman", which states the importance of the land use plan and admires attractive panorama of the waterfront, citing that " the shallow water area and landscapes in the southern part of Mina Qaboos should be strictly preserved for the sake of amenity aspect activities." JICA Study Team 2005 basically agrees this view, and water area use plan for the southern part of the port be studied and established in collaboration with Ministries concerned, port and municipality. Promotion of tourism be given priority in the southern part of the water area, and tourist amenities such as waterfront promenade and mooring facilities for tourist boats and Dhows could be proposed.

8) Access road

Port operators and users are not satisfied with the existing road system, and in particular they are concerned with restrictions on heavy trucks. They propose trimming and smoothening the hump between Jibroo and Darsei roundabouts, and allowing heavy trucks up to 30 tons to use flyovers. On the other hand, residents near the port claim that road is congested partly because of port traffic.

Figure 9.2-5 Road Networks around Port



Road system in the Sultanate is characterized by roundabout at intersection with small diameter. This intersection system is suited for relatively small traffic volume. In the Muscat Governorate, traffic congestions are observed certain times a day at the intersections because of limited capacity of intersections.

Although road system has sufficient traffic capacity and is not congested in general, congestions and delays are sometimes observed at roundabouts near Sultan Qaboos Port because of the above mentioned reason. Almost all of the port related traffic pass through Bayt Al Falaj roundabout and Al Mina roundabout, and traffic congestions occur certain times a day at these intersections.

Expected increase of port cargo through Sultan Qaboos will increase port related traffic, and frequency of traffic congestion occurrences at the roundabouts near the port will also increase. Export and import container traffic excluding transshipment is expected to nearly triple the present level while conventional type of cargo will be less than twice of the present due to development of a new port somewhere. A new access road to Sultan Qaboos Port has been proposed in order both to reduce the burdens of the residents nearby and to reduce land transportation cost for shippers and consignees of the port cargos.

Planning for access corridor has been under discussion among ministries and a municipality concerned, and one option for new access corridor may start from Ras Ash Shutaifi of the proposed outer harbor, passing along the coast to the north, and get into the hilly area of eastern side of Mina Al Fahal, and finally will be connected with the proposed Southern Highway. Tunnels can be constructed where necessary.

JICA Study Team acknowledges the importance of the new access road, and an in-depth study on the access road to Sultan Qaboos Port needs to be implemented by Ministries and Local Government concerned. It is recommended that the in-depth access road study should include actual traffic survey at the main intersections and port gate as well as at the middle point of the corridor between Bait Al Falaj Roundabout and Al Mina Roundabout.

9.2.2 Salalah Port

1) Cargo demand by type

Cargo demand of Base Case at Salalah Port for 2025 is summarized in the Table 9.2-4. By package type, about 0.1 million tons of general cargo, about 3 million tons of dry bulk cargo, about half million tons of liquid bulk cargo and about 6.5 million TEUs of container cargoes are expected to pass through Salalah Port in 2025.

Table 9.2-4 Cargo Throughput at Salalah Port in 2025

	(1,000 ton)			(1,000 TEU)
	General C.	Dry Bulk	Liquid Bulk	Container
Import	77	104	416	215
Export	43	2,651		215
Total	120	2,755	416	Transship 6,571

Source: JICA Study Team

2) Cargo handling capacity by type

i. Container cargo

As mentioned earlier, volume of containers in 2025 has been estimated as follows;

High case: 9,073,000 TEUs
Base case: 6,571,000 TEUs
Low case: 6,027,000 TEUs

Salalah Port handled at its full capacity 2,001,000 TEUs in 2003, out of which 99% were international transshipment containers. Container throughput at Salalah Port sharply increased in 2003 from about 1.4 million TEUs in 2002. This surge of container movement to this port continues in 2004, three vessels were waiting off the port for berthing.

The JICA Study on Salalah Port Development for 2020 analyzed both the quay-side capacity and yard-side capacity of the existing 4-berth terminal, and concluded that the existing terminal can handle up to 2 millions TEUs per year. It can be roughly estimated that container handling capacity per berth at Salalah Port is about half million TEUs per annum if portion of the transshipment remains same as present.

The said JICA Study proposed additional container berths of 1,050m with 18m draft and 1,750m with 16m draft, and additional terminal area of 112 ha. Each container berth will be equipped with 3 gantry cranes and total container handling capacity including existing facilities will be 6 million TEUs per year.

Since the expected container volume is about 7 million TEUs in 2025, required number of berths is estimated at around 13 berths. Presently part of No. 30 and 31 berth of Bulk terminal are utilized for container handling and storage even though this practice is done temporarily, these berths can be converted to dedicated container berths if other suitable space is provided for bulk cargo handling. Hence, the expected volume of containers for the base case can be accommodated within the basic framework of the JICA study 2000.

ii. Bulk cargo

The annual throughput of bulk cargo in 2025 is estimated to be in the neighborhood of three million tons excluding fuel. The main cargo items are cement (1.7 million tons) and minerals (1.0 million tons). In order to increase its productivity, quay side grabbing cranes will be required. This type of cargo handling equipment can handle a variety of commodities with different sets of attachments.

If grabbing crane of 800-t/h capacity is installed at one of the bulk berths, it can handle up to 1.7 million tons of dry bulk cargo by 24 hour a day service with the berth occupancy of 50%.

> Handling capacity= 800 t/h x 0.6 (efficiency) x 0.8 (operation ratio) x 365 days x 24 hours x 0.5 (berth occupancy) = 1,682,000 ton/year

On the other hand, exporting cement can be loaded to a ship at the rate of 500ton/hour with the berth occupancy of 50%. That is equivalent to 0.9 million tons a year. As it is estimated that about 1.7 million tons of cement will be exported from Salalah Port, 2 berths with 600m quay length are required for loading this type of bulk cargo in 2025.

As explained above, three berths with a total length of 900m are needed to handle three million bulk cargo in 2025. Currently Salalah Port has two bulk berths with total length of 600m. One more bulk berth will be eventually needed when the estimated volume of cargo actually come to the port.

iii. Break bulk cargo

No. 21 through No. 24 berths have water depth of less than 10m alongside, and total quay length of these berths is 719m. General Cargo vessels with moderate or small size are usually mooring along these berths. About one million tons general cargo can be handled at these berths annually.

Others berths have alongside water depth of less than 5m, and Dhows are berthed along these quays for cargo loading/unloading and for resting. Cargo handling capacity of these small berths is minimal.

Aforementioned earlier, as the estimated volume of break bulk cargo is less than 100,000 tons annually in 2025, it is unlikely that the realized break bulk cargo volume exceeds the maximum capacity of the existing facilities. On the contrary, the break bulk terminal will have excess capacity, and this type of cargo has diminishing tendency as containerization spreads out into less developed nations and regions.

3) Planning policy

- Maintain and strengthen international container hub function

Salalah Port is recognized as a leading container hub port in the world shipping, and container throughput at Salalah Port has been remarkably increasing since commissioning in 1998. Successful hub port operation has generated employment opportunities, and enhanced business competitiveness in the region. Future port traffic is expected to continuously grow if sufficient facilities are provided. To maintain and strengthen the international hub function should be given the highest priority to Salalah Port.

- Promote and Support Tourism Development

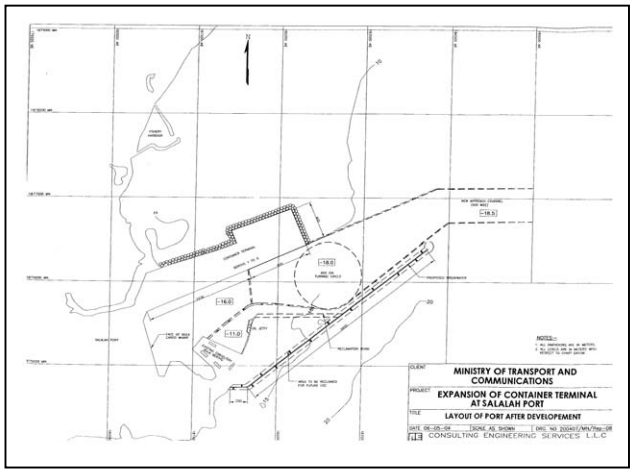
The government officially called for economic diversification, i.e. deviation from oil-led industries. Salalah has been one of the tourist destinations in the Middle East because of unique geographical and meteorological characteristics. Consequently, Salalah Port has been visited by worldwide cruise vessels. Through providing cruise passenger oriented facilities and space, Salalah port should support the Government's led tourism development policy.

- Expand Bulk Terminal Function

Salalah Port handles bulk cargo as well as containerized cargo, and tonnage of the former cargo is expected to increase as the expansion of business opportunities in the hinterland. To support economic growth in Dhofar Region including Free Trade Zone near the port, Salalh Port is expected to strengthen bulk terminal function.

4) Development concept

Figure 9.2-6 No.5, 6 Berths Extension Project



JICA conducted a development study in 2000 and formulated a master plan for Salalah Port with the target year of 2020, which is shown in Figure 3.2-1.

To cope with the steep increase in the volume of container transshipment and technological advancement of container shipping circle, the government of the Sultanate decided to expand the existing facilities. The plan is basically consistent with the master plan formulated by JICA study team (2000), but slight modification is made as shown in Figure 9.2-6.

The plan includes an extension of the existing container berths by 900 (2 berths x 450m, original plan was 3 berths x 350m) with a depth of 18m, the dredging of the navigation channel to the depth of 18.5m and the extension of the breakwaters by 2,400m (original plan was 2,550m). Reclaimed area in the new plan which is located between the existing breakwater and new breakwater is larger than that in the original plan. The plan has already been approved by the GSO, and the construction works are scheduled to be completed by 2007.

5) Alternative facility layout plans

Taking the government decision on the two berths extension by 900m as a given factor, JICA Study Team can suggest alternative development plans with the target year of 2025. Modification from the original plan drafted by JICA in 2000 is locations of bulk terminal, passenger terminal, oil jetty, and container berths.

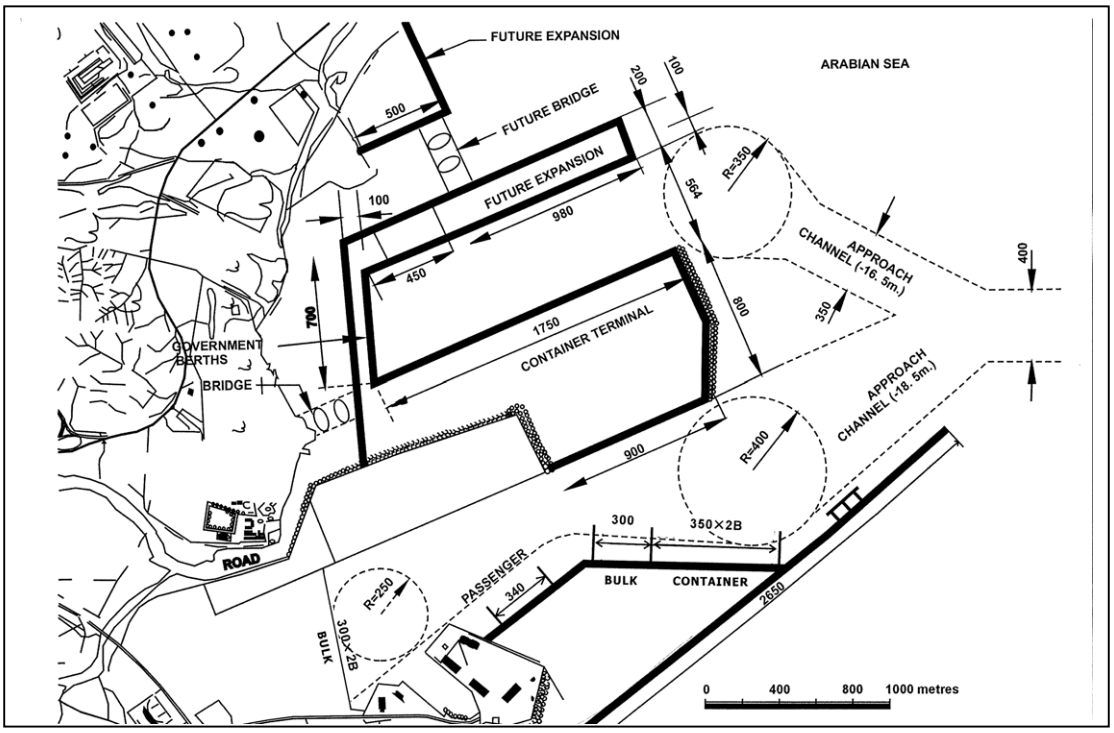
Location of passenger terminal is recommended to shift to the proposed reclamation area from future extension area near the fishery port because the government set the economic diversification policy and tourism is seen as one of the prosperous fields for business expansion. Realization of passenger terminal seems to come earlier than the supposition in order to promote the government policy.

Oil jetty has to be shifted to the back of the new breakwater because existing location is both hindrance and dangerous to the maneuvering of a cruise vessel. Regarding the bulk cargo berths, three berths will be required to meet the forecast demand for 2025. Therefore, at least one more berth has to be constructed somewhere outside the container terminal.

According to demand forecast, Salalah Port will be required to equip capacity to handle about 6 million TEUs for low case and 9 million TEUs for high case in 2025. Therefore 12 to 18 berths will be required if it is assumed that one container berth can handle about half million TEUs per year. More container berths will be required in the both base case and high case.

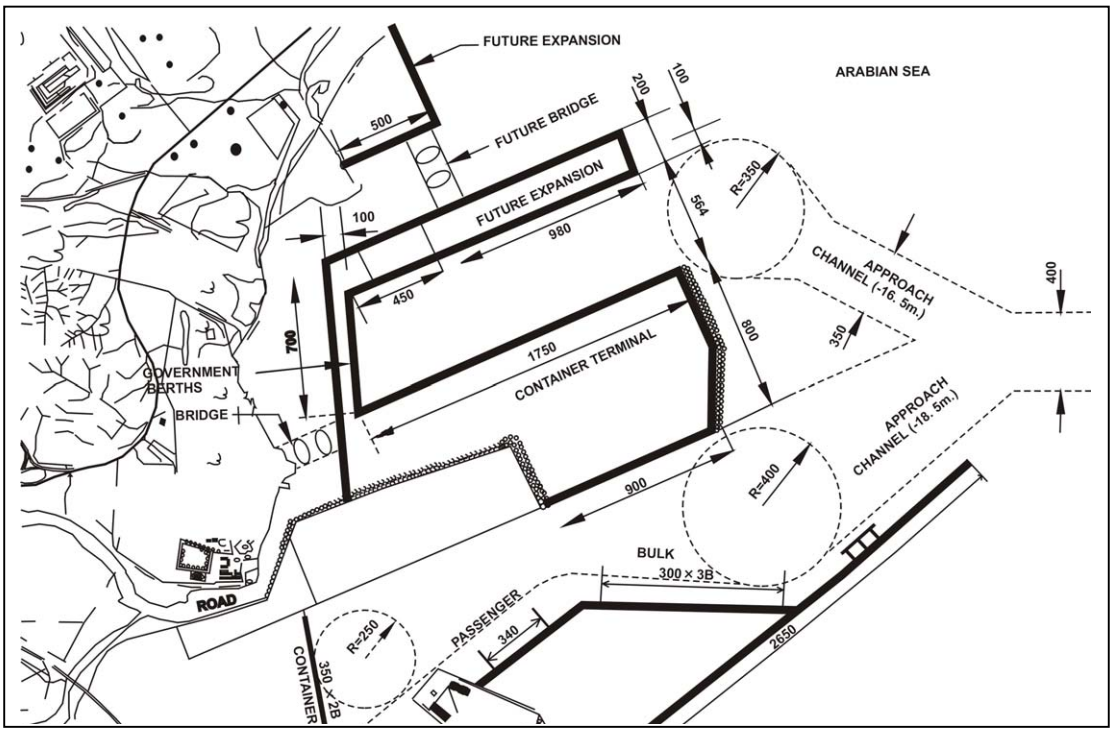
Two alternative plans are drafted, and they are shown in Figure 9.2-7 for Alternative A and Figure 9.2-8 for Alternative B. Differences between the two alternatives are locations of bulk terminal and container terminal. In Alternative A, an additional bulk berth and container berths are located at the reclaimed area. On the contrary, in Alternative B, existing bulk berths No.30 and No.31 are converted to container berths because currently a part of these bulk berths is utilized as a container stock yard in order to cope with rapidly increasing container traffic. Cruise terminal and oil jetty are set at same locations in both cases.

Figure 9.2-7 Alternative A of Salalah Port Development Plan for 2025



Source: JICA Study Team

Figure 9.2-8 Alternative B of Salalah Port Development Plan for 2025



Source: JICA Study Team

9.2.3 Sohar Port

1) Outline of Sohar industrial development project

Sohar Port project aims at providing necessary infrastructures mainly to the industries which rely on gas for power, hydrocarbon industries and their down stream industries. Encouraging investment and creating employment opportunities by value added projects, a number of industrial projects were identified in the port area where infrastructure were provided including port facilities. Industrial projects in the first phased development include establishment of Aluminum factory, the refinery projects, the chemical feasibility projects, and the methanol projects.

Followings are main components of the Sohar Industrial Development Projects;

- Oil refinery project, production is expected to start in 2006.
- Polypropylene project, production is expected to start in 2006.
- Methanol project, production is expected to start in 2006.
- Urea project, project start in 2006.
- Energy generation plant, production I expected in 2009.
- Seawater desalination project, the project is expected to start in 2005.
- Seawater cooling project, the project is expected to start in 2005.
- Sewerage water treatment project. The project is expected to start in 2005.
- Aluminum project. Production is expected to start in 2009.
- Ferrochrome and Ferrosilicon project. Expected to start operation in 2009.

2) Port construction works

Completed works of the Sohar Port Project

- Construction of Breakwater with a length of 6 km in addition to 900 meter of breakwater of the fishery port.
- Dredging and reclamation work mounted to about 19 million cubic meters. Deepening the port up to 16 meters below the sea level.
- Construction works of quays and jetties (phase 1), which include multipurpose berths with 700m in length and mooring facilities for government boats.

Under Construction

- Works for the phase II development are under construction such as dry bulk berths at the foot of the South Breakwater.
- Construction of additional jetties for liquid cargo are planned, and under preparation for tendering.

Under Preparation for next stage

There are 3 other projects that are about to be let and design work will start soon;

- Development of the Fishery Harbour at SIP Area
- Interchange at Al-Batinah Highway as an entrance to SIP Area
- New Steel and Aluminum Berth for 600m to the north side of the small boat mooring

3) Cargo demand

As aforementioned earlier, cargoes, which will be moved in to and out of Sohar Industrial Port as raw material and/or manufactured products in 2025 can be summarized as follows;

General Cargo	Import	97,950	ton
	Export	912,000	ton
Dry Bulk	Import	3,935,000	ton
	Export	2,450,000	ton
Liquid Bulk	Import	208,000	ton
	Export	9,100,000	ton
Container	Import	1,088,876	ton
	Export	4,156,227	ton

4) Capacity evaluation

Multi purpose berths of No. 3 and No. 4 with a total length of 700m have constructed and being operational since April 2004, and can handle expected volume of general cargo shown above.

Liquid bulk can be handled at the jetties which already exist and another jetty will be constructed by August 2005 at least.

Dry Bulk berths with a total length of 810m are under construction and additional berths for steel and aluminum with a length of 600m to the north side of the small boat mooring are under planning. These berths can accommodate the expected level of bulk cargo traffic in the target year of 2025 provided that suitable and efficient dedicated cargo handling equipment is installed at the quayside.

Container berths are crucial part of this port because a considerable portion of both raw materials and manufactured products will be transported in containers. It is forecast that container volume will reach 780,000 TEUs in 2025, which is three times larger than the container volume at Sultan Qaboos Port in 2003.

Required number of the dedicated container berths and terminals is calculated in the following manners. Maximum size of the calling container vessels to Sohar Port is assumed to be same as that in Sultan Qaboos Port, and width of the terminal is set at 400m including apron, which is in line with the dimension of major container terminals in the world.

Container terminal capacity per berth is assessed based on container yard area on the following premises. Regarding the dwelling time, 7 days are set a side because Sohar Port Container Terminal is export-dominated; hence short dwelling time is anticipated;

Capacity estimation based on yard area	
Quay Length (m)	350
Terminal Width (m: without apron)	350
Area of Container Terminal (m2)	122,500
Container Yard Ratio	0.75
Container Yard Area (m2)	91,875
Average stocking area (m2/TEU)	37.5
Ground slots (TEU)	2,450
Tier	4
Working coefficient	0.75
Peak ratio	1.3
Average dwelling (days)	7
Working Day Ratio	1
Annual Capacity (TEU/Year)	294,808

Container terminal capacity restricted by quayside crane capacity is also calculated and compared with the previous result as follow;

Capacity estimation based on crane	
Number of Crane per Ship	3
Crane move/hour	25
TEU/Box (1997 Actual)	1.35
Non-working hour	3
Loading & Unloading TEU/ship	300
BOR	0.7
Net Loading & Discharging Hour per Ship	3.0
Gross Berthing Hour per Ship	6.0
Gross Hour per Ship	8.5
Number of Ship Call	1,028
Maximum Quayside Capacity (TEU/Year)	308,504

The container terminal capacities at Sohar Port derived from both the yard capacity and the quayside crane capacity happen to be almost identical and about 300,000 TEUs per berth per annum. As nearly 700,000 TEUs of containers including empty ones are estimated to pass through Sohar Port in 2025, three berths need to be developed.

5) Planning policy

- Develop as a full scale industrial port in the Sultanate

Sohar Port should be developed as a full scale industrial port with a vast extent of industrial area to promote industrialization and diversification of economy in the nation, rather than a multiple functional new port to supplement other ports.

- Well coordination with industrial operation plan

Main role of Sohar Port is to support industrial activities in the adjacent area by unloading raw materials and loading manufactured goods to the markets. In this sense, well coordination is necessary between implementation schedule of port facility construction and operation plans of industries.

- Prepare flexibility for future expansion

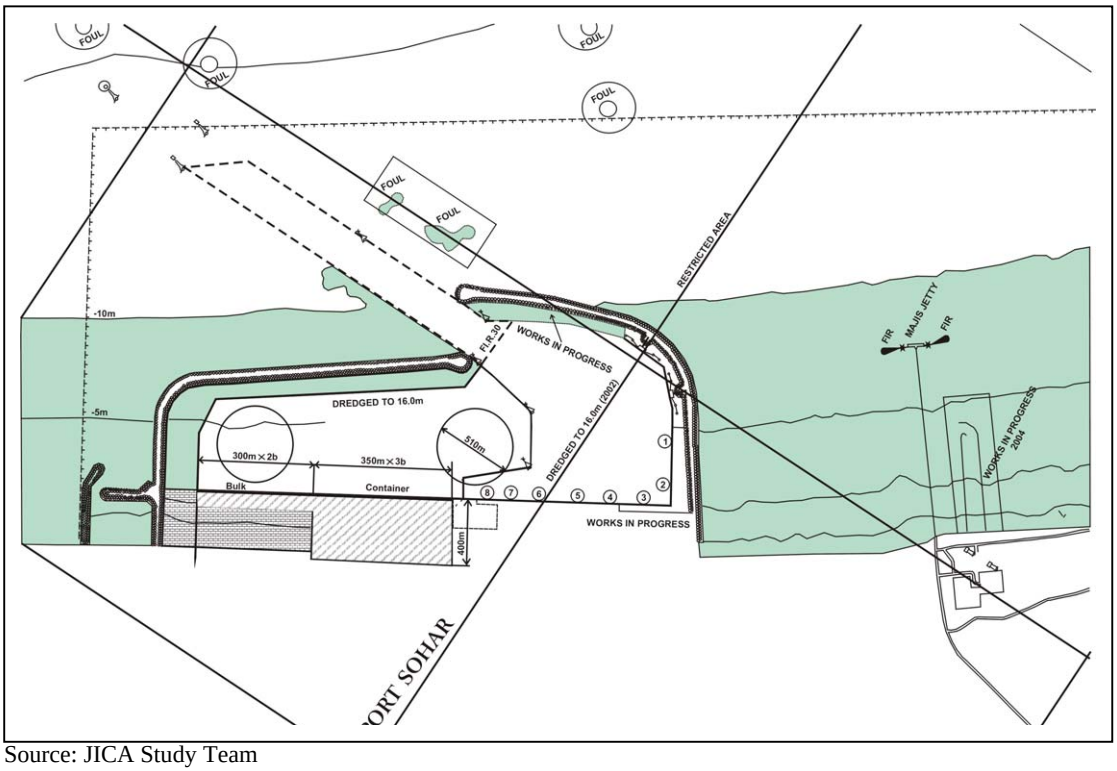
Sohar Port is situated in the industrial area with 2,000 ha along the coast, and more than 6,000 ha of inland plots can be further developed for industrial use. Therefore, layout plan of major port facilities should be set up based on future expansion potential and planning flexibility.

6) Alternative facility layout plans

As explained earlier, east side of the protected basin by the breakwaters has almost been developed for liquid bulk berths, dry bulk berths, multipurpose berths and small crafts use. Further requirements for berthing facilities can only be realized at the northern side of the protected basin and its space is also physically limited.

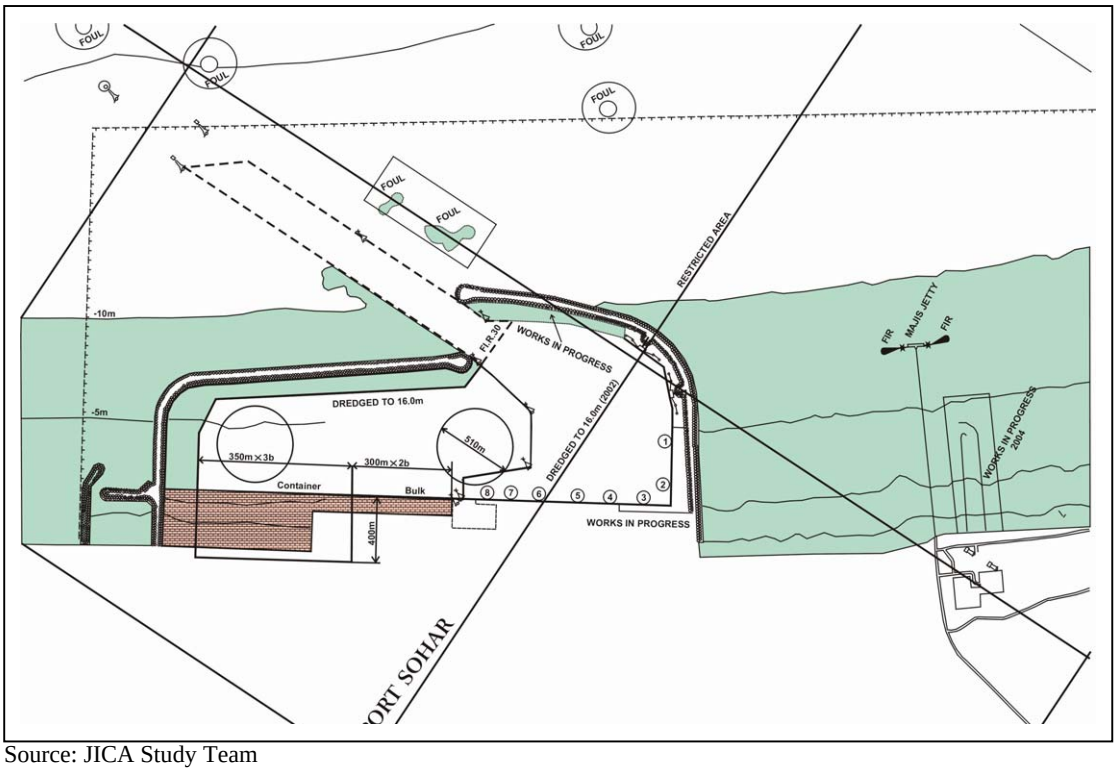
To meet the future demand for 2025, two bulk berths and three container berths will be required. Regarding the layout of these berthing facilities for the long term development, two alternatives can be proposed. In the Alternative A, container terminal with 1,050m in length is centrally located while in Alternative B, dry bulk berths with 600m in length is located centrally. Alternative A and Alternative B are displayed in Figure 9.2-9 and Figure 9.2-10, respectively.

Figure 9.2-9 Alternative A of Sohar Port Development Plan for 2025



Source: JICA Study Team

Figure 9.2-10 Alternative B of Sohar Port Development Plan for 2025



Source: JICA Study Team

7) General observation on required quay length

i. General

JICA Study Team visited Sohar Industrial Port several times to understand outline and present situation of the on-going project. What the Team realized was a huge waterfront industrial area with about 2,000ha and an inland reserved area with about 6,000ha for further expansion.

On the other hand, it seemed that waterfront for port use was limited in length and had several constraints for expansion because port basin was surrounded by two breakwaters. Expansion to south is difficult because of existence of Majees Jetty and intake facilities, and construction of new port facilities at north side of northern breakwater is under constraint of a fishery harbor.

A question arises whether port facilities, especially berthing facilities, can be provided sufficiently to support operations of industries which will be located in the Sohar Industrial Area including inland future development area. In this subsection, a comparative analysis is made regarding required quaywall length among Dubai Port, Kashima Port, and Sohar Port.

ii. Jebel Ali Port

Photo 9.2-2 Jebeli Ali Port

The Port of Jebel Ali is situated 35 km SW of the city of Dubai, and this port is composed of and backed up by the huge area of free trade zone. There are a total of 67 berths in Jebel Ali Terminal.

Water depths of the main berths at this terminal are summarized below;

Tanker Berth 1,3,5 & 7 15 m
East Wharf 5.5 m
Alongside Quay 1,2 & 3 (From 1-15) 14 m
Berth 16 & 17 16m
Along Quay 4,5,6,7,8,9,10 (berth 18 through 66) 11.5 m

iii. Kashima Port

Photo 9.2-3 Kashima Port

Kashima Port, which is located less than one hour away from Tokyo Metropolitan Area, is an excavated man-made port. This port was developed in 1960s to play a key function for coastal industrial zone in transporting raw materials and products.

Although Kashima Port was initially developed as an industrial port servicing for the Kashima heavy and chemical industrial complex, this port is functioning as a commercial port as well while providing regular container services to Fuzhou and Ningbo in China.

Kashima Port has a total of 97 berths stretching 15.452 km in length, and currently handles more than 50 million tons of cargo annually.

iv. Comparative analysis

Comparative analysis was made among aforementioned three ports, namely Sohar, Jebel Ali, and Kashima Port, on the linear quay length per surrounding industrial area. The aim of this analysis is to evaluate whether quay side capacity of Sohar Port is adequate to accommodate anticipated cargo volume associated with industrial activities.

Sohar Port has or will have a total of about 2,000m linear quay length by developing southern part of the sheltered area by the two breakwaters. After this area is saturated, the Port can be expanded to the northern part of the sheltered area to obtain necessary berthing capacity. Linear length of the quay length of the northern part of the existing port is roughly estimated at about 2,000 m again. Thus, potential linear length of the quay of the Port is estimated at 4,000m at most.

Waterfront industrial area of Sohar Port covers about 2,000ha, and the Port is also supported by larger potential industrial area with about 6,000ha including existing Sohar Industrial Estate. This inland industrial area is located several kilo meters away from the waterfront industrial area, and Sohar Aluminum Smelter factory will be located in this back yard.

Therefore, all of the sheltered waterfronts suitable for berths are developed, and waterfront industrial area is fully developed for industrial activities, the quay length per industrial area is calculated at 2

m/ha. When all of the potential industrial areas are fully developed, then the index will drop to 0.5m/ha only while the index of both Jebel Ali Port and Kashima Port are around 5 m/ha.

As information obtained so far is limited, the result should be considered indicated only. Nevertheless the result clearly indicates the high possibility that the linear length of shoreline protected by the two breakwaters is not adequate to accommodate anticipated volume of cargoes generated from industrial activities when industrial area is fully developed and commercial entities are fully operated. Therefore, it is strongly recommended that the Government should closely monitor the port demand after the port is commissioned, and that a study on future expansion of the port be implemented so that shortage of the port infrastructure will not be a hindrance to industrial development in this region.

Table 9.2-5 Unit Quaywall Length Per Industrial Land Area

	Industrial Area	Quay Length	Nr. of Berth	Quay Length/Area
Sohar	2,000 ~ 8,000 ha	4,000m	10~12	0.5~2.0 m/ha
Jebel Ali	4,500 ha	21,900m	71	5 m/ha
Kashima	3,200 ha	15,452m	97	5 m/ha

(Remarks: Figures are indicative only)

9.2.4 Khasab Port

1) Trade with Iran

Photo 9.2-4 Speed Boat Trade with Iran

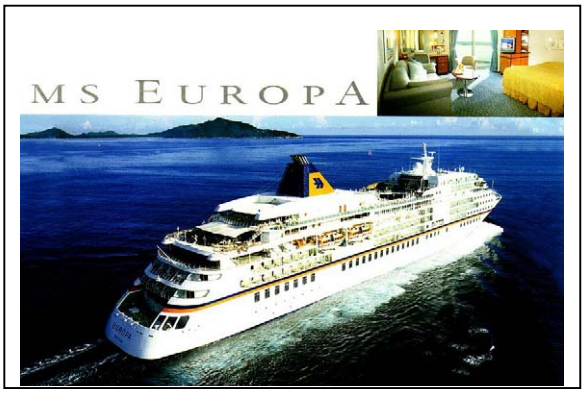
Port activities at Khasab are characterized by small boats which come from and go to Iranian territory. The local economy and employment opportunities have greatly been depending on this type of trade activities as a whole. It is anticipated that the unregulated trade with Iran by speedboats is likely to continue for a while at a present level while holding twin high-powered outboard engines is banned by Omani authority. It is considered appropriate to allocate a reasonable length of beach to cater for this trade activity.

In future it is likely that unregulated type of trades will be ceased and replaced for example by short-sea roll-on/roll off vessels as the economic growth in both countries continues. It is, however, uncertain that the same level of trade will be maintained between Iran and Khasab. It is important, therefore, to monitor the trend of trade connecting directly Iran with Dubai.

2) Calls of cruise vessels

Tourism is the other pillar for the Port and the local economy to be prosperous in their activities. It is likely that several cruise vessels will call on Khasab Port, and one of the cruise vessels whose calling schedule to Khasab Port is fixed so far is Vs ERUOPA. She has 408 lower berths and is scheduled to come to Khasab Port on 15 November 2005, and going to visit several other ports as follows;

Photo 9.2-5 Ms Europa



Salalah	04 November 2005
Sur	06 November 2005
Khasab	15 November 2005
Muscat	16 November 2005

Although her calling schedule is fixed, it is not

certain whether she will get through the channel and berth at the newly developed quay with sufficient alongside water depth because large cruise vessels sometime anchor at outside of breakwaters and disembark passengers by small launch. It is worth mentioning that before construction of the new breakwaters, almost all cruise vessels calling to Khasab Port practiced this type of disembarkation and embarkation.

3) Export of aggregate and minerals

Ministry of Commerce and Industry claims that 3 to 4 million tons of aggregate, limestone, Shale/clay, and dolomite can be exploited and exported annually from Musandam port. Exact locations of the quarries, however, are not revealed so far. According to some information sources, two companies with Government permit are exploiting rocks at remote areas deep inside a bay and exporting them as aggregate for UAE from jetties, which were constructed by themselves.

Many aggregates are exploited and exported for markets in GCC countries from Ras al khaymah where well-systematized loading practice by private firms has been observed. Omani quarry business has to compete with UAE counterparts because they have advantages regarding close proximity to markets and having systematized production and logistic skills.

4) Capacity evaluation

Khasab Port has a berth with a length of 300m and a water depth of 10m equipped with a landing ramp for Ro/Ro vessels. Three floating jetties with a length of 35m to accommodate Dhows are included in the 1st phase of the expansion project. Total capacity of the port after completion of the 1st phase plan is estimated at around 400,000 tons per year. In the case when Ro/Ro vessels are plied between Khasab Port and Iranian Ports, the capacity of Khasab Port could be double because of high efficiency of cargo handling by Ro/Ro system.

5) Planning policy

- Improve Traffic Access to Khasab

Khasab is the central city of Musandam Governorate and is expected to play key roles to supply social services and daily necessities to surrounding and isolated hamlets in the Governorate. Khasab Port should improve and expand maritime traffic access for the hinterland.

- Promote Tourism Development

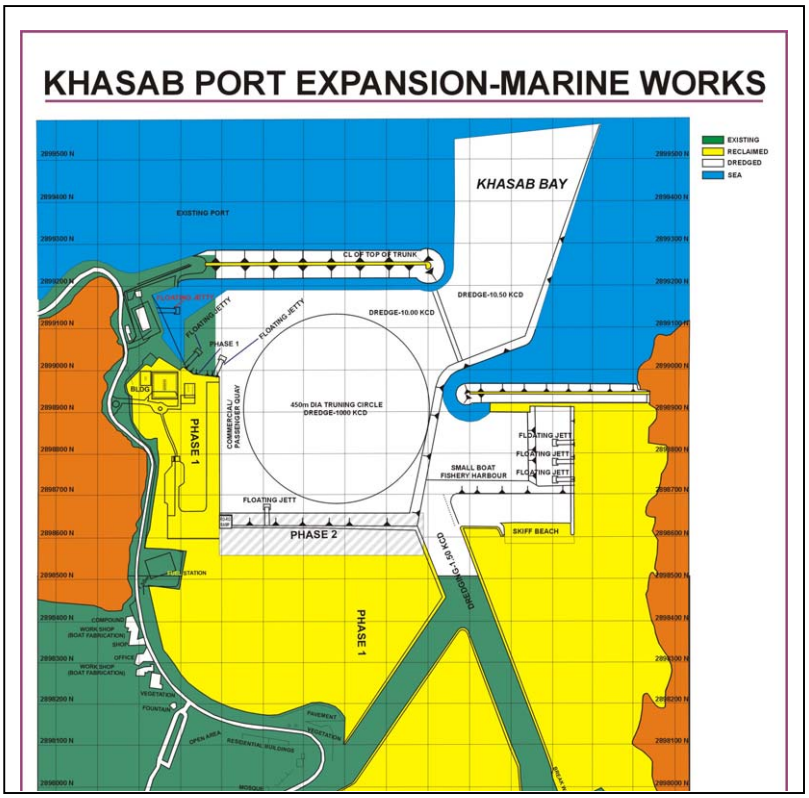
One of the most prospective industries in the Musandam Governorate is tourism. Khasab Port should strengthen tourism promotion function by constructing cruise passengers and tourists oriented facilities in the port area.

- Land Use of the Reclamation Area

75 ha of reclaimed land have been created by the 1st phase port expansion project. Utilization of waterfront land for port and tourism related activities will constitute a key component for realization of economic and social growth in Khasab and Musandam Governorate.

6) Facility layout plan

Figure 9.2-11 Khasab Port Development Plan for 2025



Source: MOTC/DGPMA

Phase I port expansion works of Khasab Port were initiated in 2002, and completed in around September 2004. Two breakwaters, quaywall with 10m water depth, reclamation area of 75ha as well as fishing harbor have been created in this construction phase.

After the 1st phase expansion works were completed, the Government proceeded to the 2nd phase project, which included construction of storage shed, custom building, and administration building. The 2nd phase construction project was contracted in October 2004, and total contracted amount is R.O.2.4 million.

The government has already approved the Khasab Port Expansion Plan, which is shown in Figure 9.2-11, and construction works have been progressing based on the approved development plan. Areas left for expanding berthing and related facilities within the planned harbor are an area along the seaward end of the reclaimed land (about 400 long) on the southern side of the bay including the

mouth of the inside channel (about 200m long) and an area behind the north breakwater (about 500m long). These areas are considered to be enough to cope with unpredictable port activities in future.

Taking into consideration the planning elements discussed above, JICA Study Team suggests that the further expansion of Khasab Port should be based on the careful and continuous monitoring on the trend of the port activities.

7) Central function and canal project

Khasab is the central city of Musandam Governorate and is expected to play key roles to supply social services and daily necessities to surrounding and isolated hamlets in the Governorate. Vessels of the Ministry of Electricity and Water are based at Khasab Port to supply water and other support requirements to the outlying villages. One of the fields which Khasab Port should strengthen for the future is to support the Khasab City to improve social service supply function.

There are several villages and hamlets, which are scattered along coastal plots in remote peninsula and islands. Because Khasab Port is located at the foot of Kumzar Ras Qabr Hindi (Peninsula), it takes long time to deliver services such as water supply to the villages and hamlets which are located at the eastern side of the peninsula, it is desirable to cut short the distance between Khasab Port and outlying villages to improve service frequencies and cost for social services.

Construction of a canal or a tunnel can be proposed to achieve this goal. As the port expansion plan prepares to provide berthing facilities for government vessels with a length of 35m and the water depth of 4.5m, the proposed canal shall have the water depth of 5.0m and width of 50m. Collaborated study shall be done after consultation with counterparts and local authorities. Project evolution from social, economic and environmental evaluation is surely needed in due course of the study of the project.

Construction of small-scale canal or tunnel can be attractive for tourists and induce more maritime traffic of small size boats. Khasab Port will be required to supply berthing facilities for small boats including sightseeing ships.

Khasab Port has acquired sufficient port infrastructure for the development of Musandam Governorate. One of the most important tasks for the region is to develop economically and financially viable plans on the use of the reclamation area. Involvement of private circles is essential in this task. To support this task and encourage investors, quays at the reclamation area may be required. With additional berthing facility of 10m alongside water depth, the reclamation area is more attractive for investors. Perspective of Khasab Port depends largely on land use plan of the reclamation area.

Figure 9.2-12 Proposed Canal Project in Musandam

Source: JICA Study Team

Photo 9.2-6 Typical Tourist Port in Southern Japan

Source: Japan Ports and Harbours Association

9.2.5 Duqm Port

1) Outline of the new port project

The GSO entrusted consulting firm the study for a new port and dry dock complex of Duqm in 2002. The consulting firm submitted Final Report in August 2004. The consulting firm estimated a total of 175,514 ton of commercial cargo in addition to 2 million tone of mineral export at Duqm in 2020. Regarding the ship repair yard, the Study estimated IRR of 9.6% for small shipyard and –2.6% for large shipyard.

To the Draft Final Report, Ministries concerned expressed their views, which can be outlined below, and requested the consultant that the report be revised in reflection of their views and comments into the Final Report.

- Export potential both for the minerals to India and for aggregates to Gulf countries has to be confirmed by discussions with the importers.
- Geologists should visit Duqm to confirm the quantities of the minerals and aggregates.
- Most of the loading and unloading ports are located at quite a distance from Duqm. Comparative advantages for docking at Duqm should be identified.
- It is too optimistic to consider that public/private investment will come to regions where basic social service facilities, financial institutions, communication centers are lacking.
- Fishing port be separated from the commercial port.

2) Field survey and meeting

Five experts of the JICA Study Team made a port visit to Duqm on 01 August 2004 to review and confirm the socioeconomic, natural and environmental conditions of Al Wuster Region as well as assessing the industrial development potential at Duqm.

The Study Team made a series of meetings with Government officials and technical staffs in the relevant ministries to exchange views on port and industry development in the Region as well as to get necessary information to look for possible socioeconomic development at Duqm. Meetings were extended to private circles including shipping and quarry business.

3) Preliminary evaluation on ship repair facility

Government of Sultanate of Oman would like to strengthen the national shipping fleet, and as a measure to pursue this goal, GOS ordered to build four LNG vessels, two in Japanese dock yard, and two in Korean counterpart. A prospective vessel operator pointed out that one of the important aspects to select a repair yard is whether the dock is situated in business environment to acquire sophisticated spare parts for the vessel as quickly as possible.

Photo 9.2-7 Dubai Dry Dock

When experts of the JICA Study Team visited a ship repair dock in Dubai in September 2004, they were informed that within 24 hours including custom clearance the requested spare parts be delivered to their dry dock in Dubai since the spare parts were aboard the airplane in Tokyo.

Dismantlement of vessel usually causes environmental problems because it requires strict treatment of PCB, asbestos, and plastic for wire coating. This business puts importance on low labour cost, existence of electric furnace for scrap treatment as well as basic infrastructure such as electricity and water. Competition with neighboring yard is indispensable. Ship inspectors, who play vital role in operating dock yard, are residing at Dubai.

Premium of ship insurance would be an advantageous factor for Duqm Port if that at Duqm is lower than the counterpart at the ports in the Gulf. What the study team has found is that premium of ship insurance is same both at Duqm and in gulf region currently while it was higher in gulf region during the time of Iraqi War.

4) Preliminary evaluation on export of mineral

The JICA Study team held meetings with business circles on export possibilities of minerals and aggregates from Duqm Port. According to provided information, India has been importing lime stones for manufacturing steel, and its volume is about 2 million tons annually. Steel industries located along east coast of Indian sub-continent need imported lime stones because domestically produced lime stones are more expensive than imported one due to high overland transportation cost. Considerable portion of the imported lime stones is currently shipped from UAE.

Lime stones which are utilized for the manufacturing steel should not contain silica. It is widely believed that lime stones produced near Duqm contains silica although geological examination has not conducted at the pin point of Duqm. Therefore, according to the businessman's opinion, lime stones produced near Duqm do not satisfy export quality for steel manufacturing in India. Alternatively, lime stones produced near Salalah do not contain silica, therefore holding export quality for steel industry.

Regarding the aggregates, huge demand exists in nations in the Gulf such as Qatar and Kuwait. These countries are importing aggregates for civil works and construction of buildings. Some Omani companies are exporting aggregates through Fujayra Port in UAE while majority of them are shipped from Ras al Khaymah in UAE where modernized and systematic excavating and loading work is realized. As Duqm is located far from the market in the Gulf, it cannot be competitive with UAE firms as far as aggregates are concerned. Only possible site which is competitive with UAE port for exporting aggregates from the Sultanate is loading sites in the Musandam Governorate. There seems no demand in neighboring countries for importing aggregates from Duqm.

5) Views of Ministry of Commerce and Industry

On the other hand, Ministry of Commerce and Industry has optimistic views about potential of Duqm Port as an export port of minerals and aggregates. According to the Ministry, Duqm Port has potential as an export base of aggregates and stones as follows;

A. Classification of stones
   i. Aggregate
   ii. Limestone for steel industry and limestone fillers for other industries as well
   iii. Silica sand/quartzite
B. Expected Quantity
   3 to 4 million tons/annum

6) Planning policy

- Utilization of Natural Resources at Duqm

Strength of Duqm as a site for new port is an abundance of natural resources such as crude oil, and existence of vast vacant land along the coast. Development of a new port should me realized by utilizing the region's strong points.

- National Redundancy

It seems that initiatives of development of Duqm Port were generated from national policy to pursue the balanced development in the nation. Benefits and costs associated with the project should be shared between locals and nationals.

- Port as a key social infrastructure

There are many uncertainties in the Duqm Port project on economic and financial viability. Therefore, careful and in-depth study is recommended before the project goes on site. In the mean time, basic port facilities should be developed as a key social infrastructure to sustain regional economic growth.

7) Oil export and storage complex at Duqm

i. Necessity of input of other planning elements

As mentioned before in an earlier part of this Report, Duqm Port development was studied and proposed by a UK based consultant, and dry dock complex with capacity of 100,000 DWT has been placed as a core project in the said study. It was assumed in demand forecast that 5% of vessels passing near Duqm will utilize the dry dock facilities at Duqm for repairing and maintenance. Some of the government officials are skeptical about both results of the demand forecast and financial viability of the dry dock project.

It is anticipated in the aforementioned feasibility study report that export of minerals and aggregates to GCC and ISC countries will exceed 3 million tons in 2020. It is not certain, however, whether minerals produced at Duqm such as lime stones can hold export quality, and aggregates are sufficiently competitive in the international markets. Therefore, in order to materialize the dry dock complex project at Duqm, it is necessary to put other planning elements into the originally proposed project. It is highly desirous if some mechanism can be proposed in the plan to attract more vessels for ship repairing at Duqm.

ii. Characteristics of Duqm

Duqm area is characterized as follows;

- Sparsely populated area with approximately 3,200 people.
- Situated at the coast over looking the Arabian Sea.
- Al Wusta Region is distinguished for having a great number of oil wells.
- Huge vacant area lies along the coast.

Taking the Duqm's characteristics mentioned above into considerations, one of the possible industries which may take place in Duqm seems to be a space-oriented industry such as oil refinery and storage. Currently oil refinery and export activities in the Sultanate are solely taken place at Mina Al Fahl, Muscat.

iii. Mina Al Fahl

Port of Al Fahl, situated in Capital area, is the sole exporting port of crude oil in the Sultanate of Oman. Oil refinery is also located at the landside close to the marine facilities. Petroleum Development of Oman (PDO) owns both SMBI (set in 1981) and SMB2 (set in 1976) while Shell owns SMB3 (set in 1976). Operation and management of all of these marine facilities including SMB4 for reserve have been conducted by PDO. Table 9.2.2-5 shows the outline of the berthing facilities in the Port of Al Fahl.

Table 9.2-6 Berthing Facilities of Port Al Fahl

Berth	Type	Max. Draft (m)	Design Vessel (DWT)	Cargo	Max. Loading Capacity (m3/h)
SMB1	SMB	21.0	350,000	Crude oil	9,500
				Heavy oil	3,500
SMB2	SMB	N/A	554,000	Crude oil	8,700
				Heavy oil	500
SMB3	SMB	14.0	100,000	Gas oil, Gasoline, Jet Fuel	530
Coaster		4.5	Coaster		

Source: PDO

Production of crude oil reached 328 million barrel in 2002, and 306 million barrel out of which was exported. Deposits of crude oil have been steadily expanding, and reached 5.71 billion barrel in 2002, which was 139 million barrel larger than that in 2001. Some 500 tankers a year are loaded with 'Oman blend' crude', then taken to many parts of the world, but particularly Japan and Far East.

Mina Al Fahl can be summarized as follows;

- Situated in the capital of the Sultanate
- Surrounded by populated area, especially for housing, and administration.
- Offshore area is also busy for commercial shipping activities.
- Oil fields are far away, and oil is transported over the mountains
- Environmental problems arising from refine work and marine operations are addressed.

Taking these factors mentioned above into consideration, further expansion of Mina Al Fahl for oil refinery and exporting activities does not meet the public expectation and welfare. It is also true that oil industry is essence of the Sultanate's economy and indispensable for improvement of public welfare even in the future. To pursue the stable and sustainable economic growth, redundancy of the national industry is desirable, and necessary from the viewpoint of national security.

Gradual shifting of oil refinery and export function from Mina Al Fahl to Duqm is a possible option.

iv. Oil Storage for the Gulf Region

Japanese prominent newspaper NIKKEI on 15 January 2003 reported as follows;

"An ambitious plan of Gulf's crude oil export from an Omani port is disclosed recently. Outline of the plan is to export crude oil, which was produced in the Gulf region and transported through pipeline to Omani port. One of the advantages of this project is the fact that tankers. GCC, which is composed of 6 nations, will discuss the possibility of this project at under-secretary level meeting due to be held at Qatar at the end of this month. This project aims to reduce the possible risk generated from wars and terrorism of crud oil produced in the Gulf region.

His Excellency Rumuhi, Minister of Oil and Gas, Government of Sultanate of Oman, revealed this plan at a press meeting with NIKKEI, which was held on 13 January 2003 in Muscat. He stressed the importance of this project to prepare the renewed risk of terrorism.

His Excellency showed the estimated cost of this project being several billion US Dollars, and said that pipeline transportation can be competitive with tanker transportation in terms of cost. After completion of feasibility study, this project is scheduled to be one of the official agenda at the Summit of GCC at the end this year, his Excellency said.

At the Holms Strait, which is situated at the mouse of the Persian Gulf, tankers loaded with 16 million barrel, which is equivalent to one quarter of the world consumption, are passing every day. As it takes about 4 days to Holms from Kuwait, which is innermost located in the Gulf. It is pointed that tankers can be easily targeted by terrorists. Last year, crude oil price jumped up after information was circulated throughout the world that terrorist may attack oil tankers.

Taking these factors into consideration, the JICA Study Team suggests the oil refinery and storage function can be added function to the original dry dock complex, and this option should be studied deeply and sincerely including in-depth environmental and social consideration study.

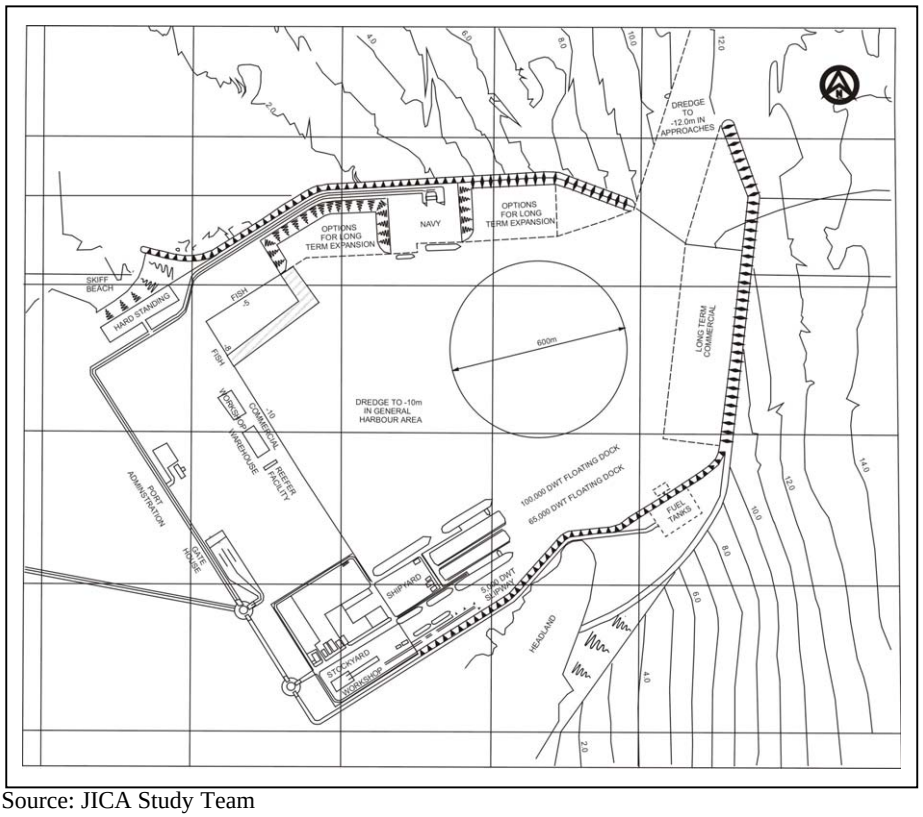
8) Alternative facility layout plans

UK consultant's proposed facility layout plan of dry dock complex at Duqm is shown in Figure 9.2-7. JICA Study Team proposes an alternative development plan which incorporates the oil refinery and storage function to the dry dock complex as shown in Figure 9.2-8.

Analysis of ship call data of Salalah Port reveals that several vessels called at Salalah Port for repairing although they were not container vessels but general cargo ships and trawlers. This fact indicates the existence of need for some sort of ship repair facilities at the southern part of the Sultanate. However, it is not clear whether 100,000 DWT class Dry Dock is necessary at the commencement of the project. Rather it is recommended to begin the project with small size ship repair facility.

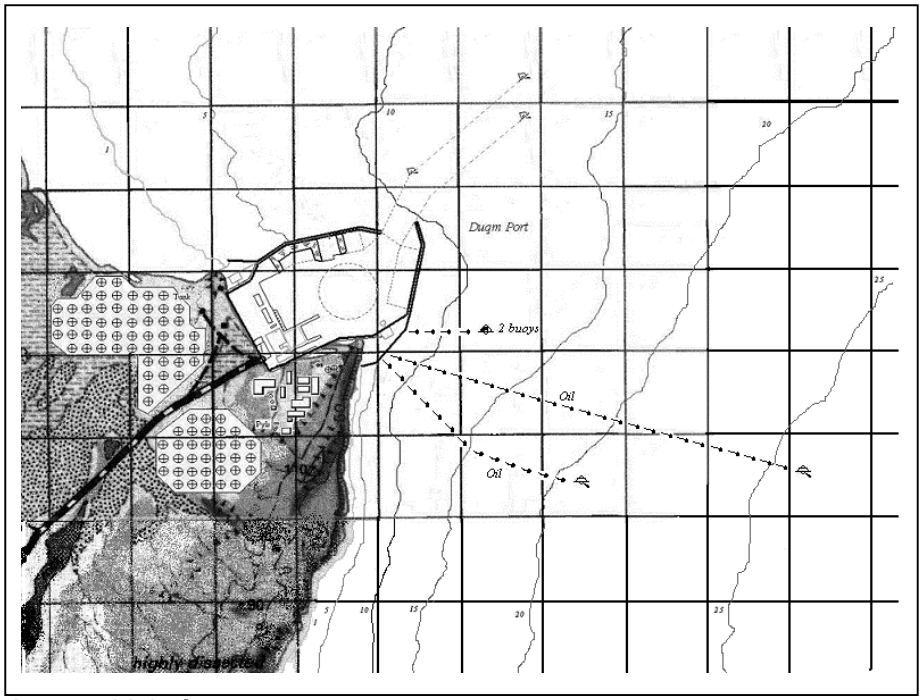
Regarding the layout of the port facility, modification may be required for the initial stage of the development after conducting detailed studies on natural and environmental conditions. It is worth mentioning some aspects on natural conditions at site. Soil to be dredged will be certainly a fine material. This type of soil is not suitable for reclamation and needs to be dumped offshore. It is difficult to deal with mudstone after dredged and mixed with sea water. In such respects, the site investigation is of great significance and prerequisite for the structural design and estimate of project cost as well.

Figure 9.2-13 Alternative A of Duqm Port Development Plan for 2025



Source: JICA Study Team

Figure 9.2-14 Alternative B of Duqm Port Development Plan for 2025



Source: JICA Study Team