社会開発協力部報告書

No. 8

THE DEMOCRATIC SOCIALIST REPUBLIC
OF
SRI LANKA

# REPORT ON
# THE DEVELOPMENT PROJECT
# OF
# THE PORT OF COLOMBO

MARCH 1980

JAPAN INTERNATIONAL COOPERATION AGENCY

THE DEMOCRATIC SOCIALIST REPUBLIC
OF
SRI LANKA

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# THE DEVELOPMENT PROJECT
# OF
# THE PORT OF COLOMBO

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JAPAN INTERNATIONAL COOPERATION AGENCY

## PREFACE

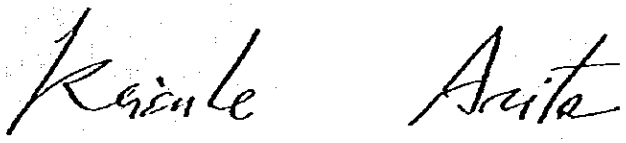
At the request of the Government of the Democratic Socialist Republic of Sri Lanka, the Government of Japan has decided to conduct a study on the Development Project of the Port of Colombo, and the Japan International Cooperation Agency (JICA) carried out the study.

JICA dispatched to Sri Lanka several times, a Survey Team headed by Mr. Masao Ohno, Executive Director of the Overseas Coastal Area Development Institute of Japan. The Survey Team consulted with Government officials of Sri Lanka, collected reference material and made field surveys. After returning to Japan, the Survey Team has complied this report on the basis of data and information collected.

I hope this report will prove to be useful for the Development of the Port of Colombo, thereby contributing to the promotion of friendly relations between on two countries.

I would like to express my heartfelt appreciation to all the officals concerned of the Government of Sri Lanka for their cooperation extended to the Survey Team.

March, 1980



Keisuke Arita
President
Japan International Cooperation Agency
Tokyo, Japan

# LETTER OF TRANSMITTAL

March 25, 1980

Mr. Keisuke Arita
President
Japan International Cooperation Agency

Dear Mr. Arita:

It is my great pleasure to submit herewith a report on the Development Project of the Port of Colombo, the Democratic Socialist Republic of Sri Lanka.

The Japanese study team, headed by myself, conducted a survey on the Project mainly in Colombo for 26 days from June 11, 1979, at the request of the Japan International Cooperation Agency. The findings of the feasibility study and our proposition on the port development are included in this report. The study shows that the importance and priority of the Project is very high so that I hope the Project be executed in the earliest opportunity.

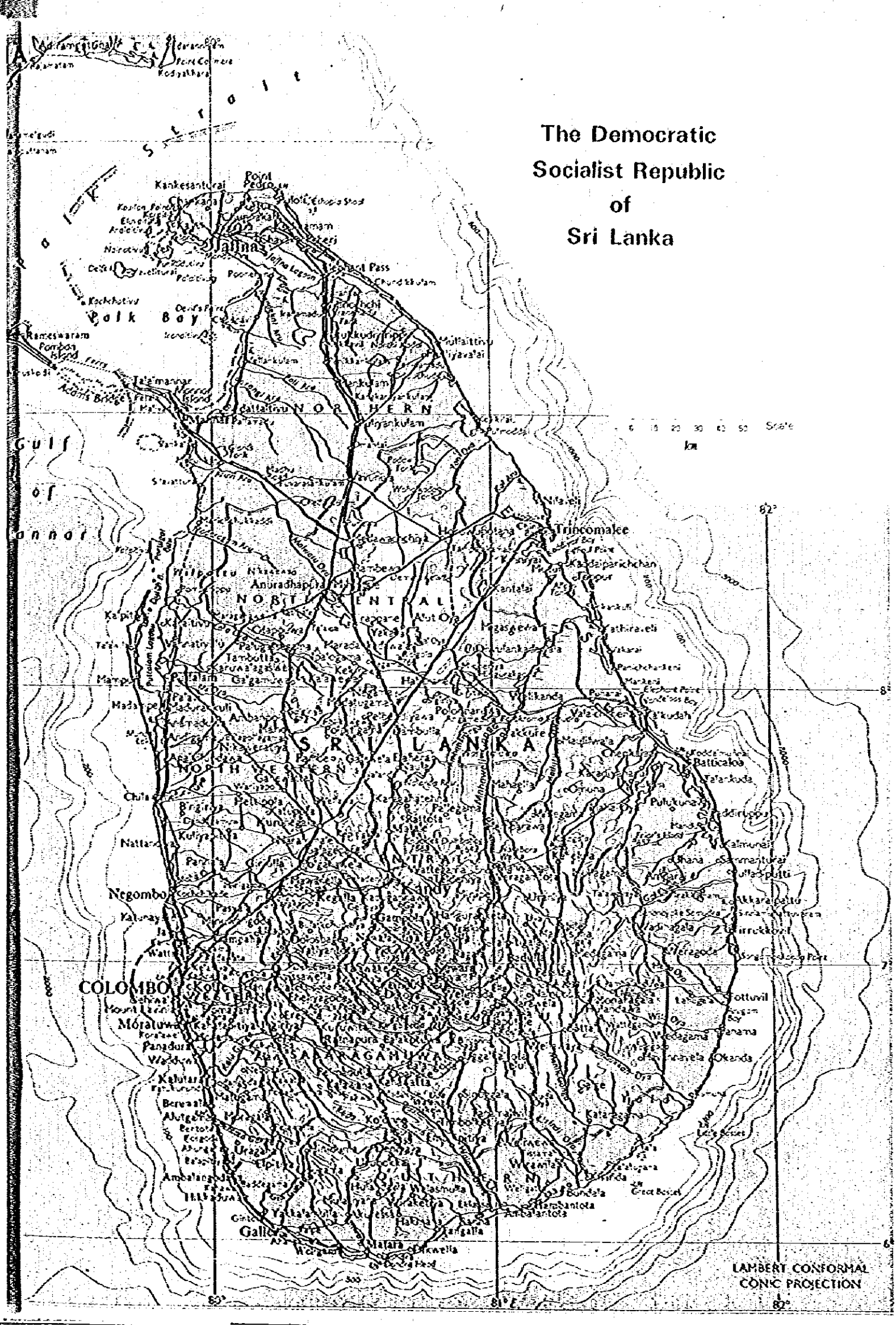
On behalf of the Japanese study team and myself, I would like to express my deepest appriciation to the Government of the Democratic Socialist Republic of Sri Lanka, the Sri Lanka Ports Authority and various organizations concerned the Project for their unlimited cooperation, assistance and warm hospitality extended to the team during our stay in Sri Lanka.

My indebtedness also is great to the Japan International Cooperation Agency, the Ministry of Transport, the Ministry of Foreign Affaires and the Japanese Embassy in Sri Lanka for giving us valuable suggestions and assistance in the field study and in preparation of this report.

Sincerely yours,

Masao Ohno

Masao Ohno
Head
Japanese Study Team for the Development of the Port of Colombo
(Executive Director, the Overseas Coastal Area Development Institute of Japan)


The Democratic
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of
Sri Lanka
Palk Strait
Palk Bay
Gulf of Mannar
Jaffna
Trincomalee
Batticaloa
Negombo
Kandy
Galle
COLOMBO
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NORTHERN
NORTH WESTERN
NORTH CENTRAL
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SOUTHERN
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Puttalam
Chilaw
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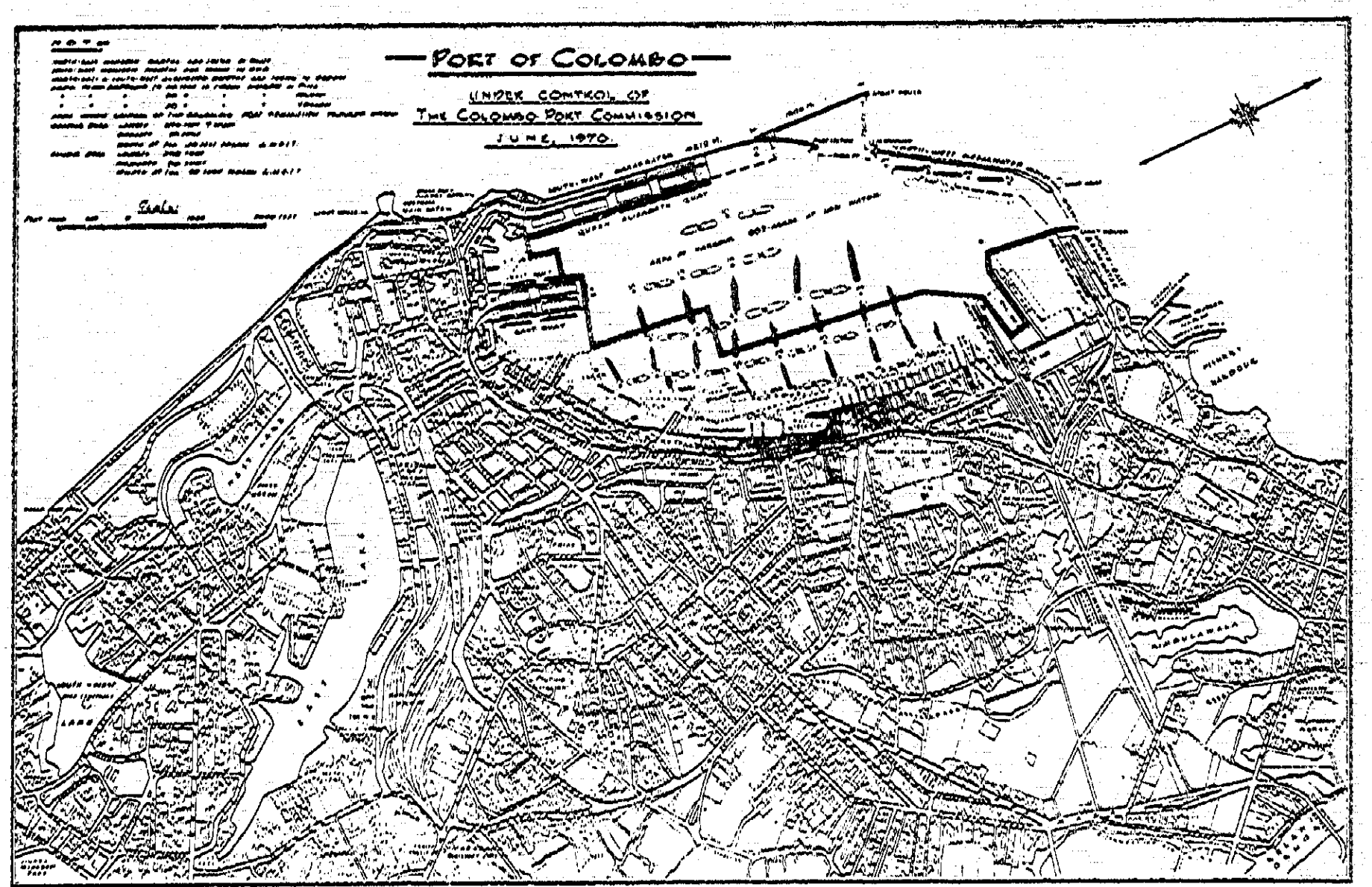
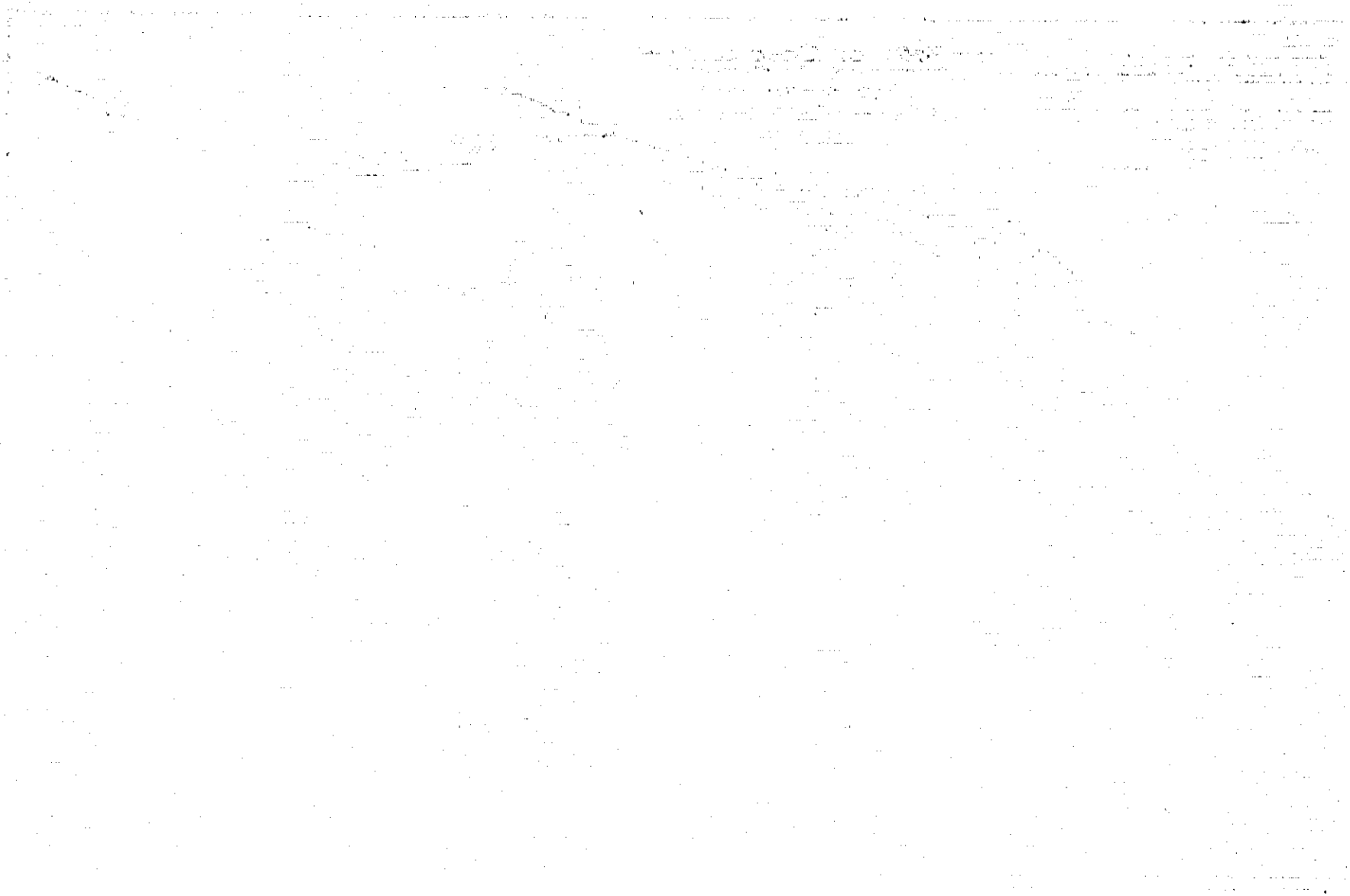
Batticaloa
Kalmunai
Pottuvil
Polonnaruwa
Vavuniya
Mullaittivu
Kilinochchi
Jaffna Lagoon
Palk Strait
Polk Bay
Gulf of Mannar
LAMBERT CONFORMAL
CONIC PROJECTION




COLOMBO PORT COMMISSION - CHIEF ENGINEER'S DEPARTMENT JUNE, 1970.



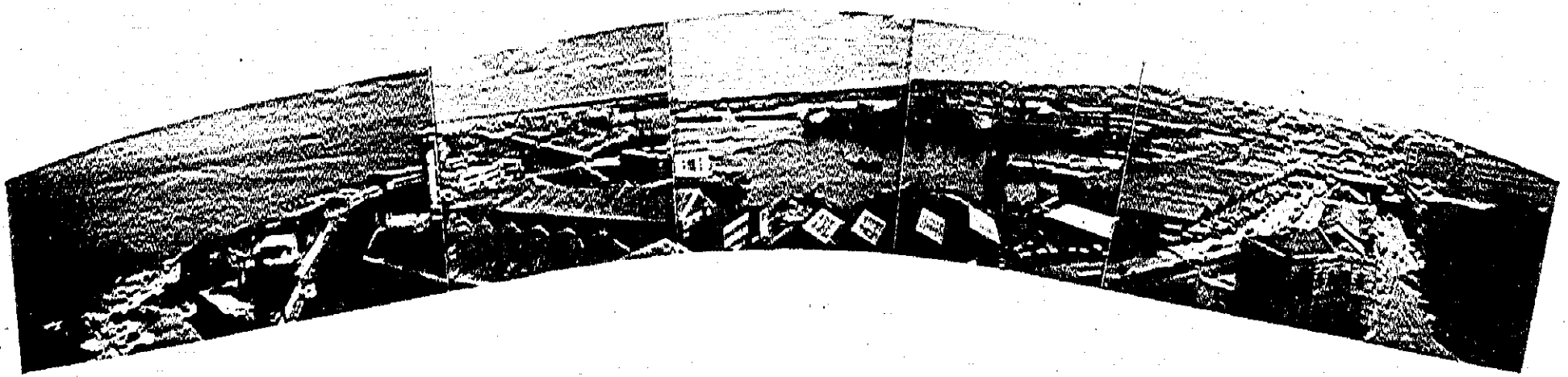


Photo-1 A General View of the Port of Colombo

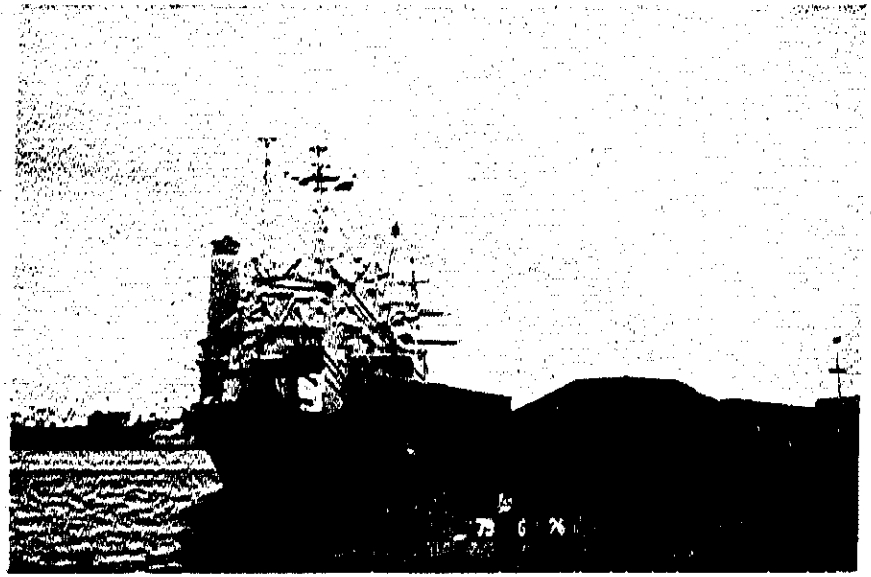


Photo-2 Container Rolling-off at the Queen Elizabeth Quay No. 4

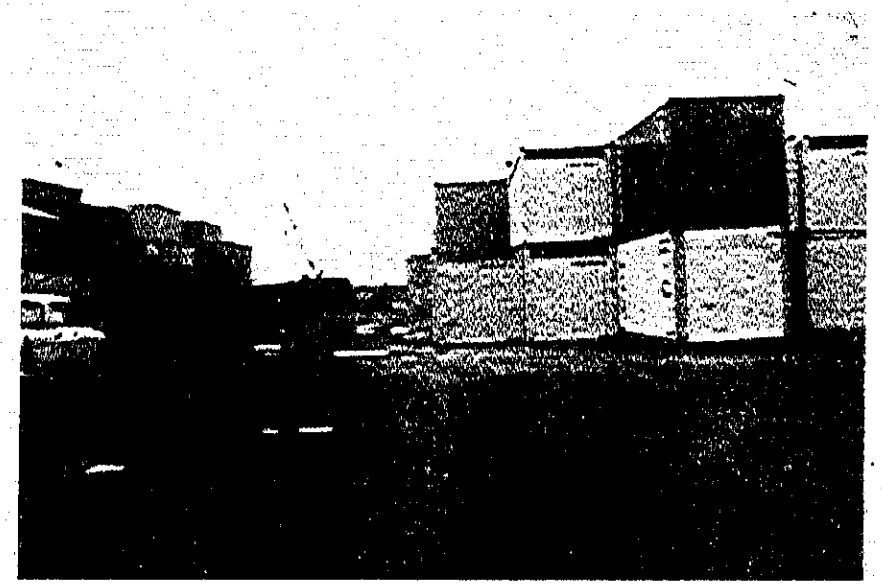


Photo-3 Container Yard at the Queen Elizabeth Quay No. 4

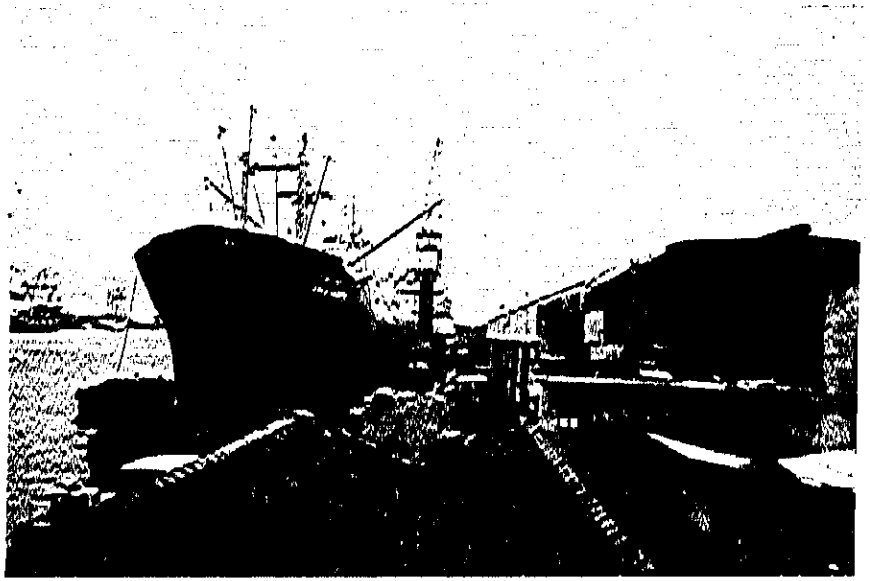


Photo-4 Bandaranaike Quay

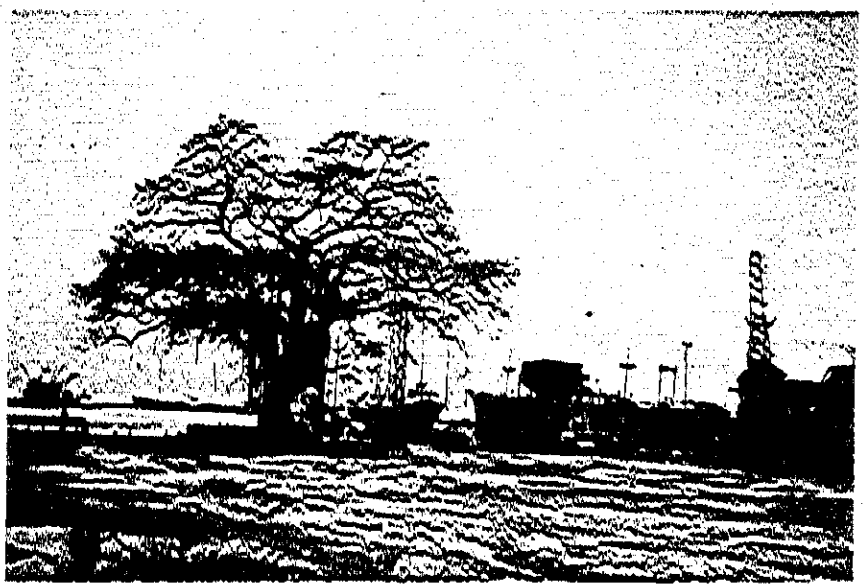


Photo-5 Backyard for Coaling Jetties

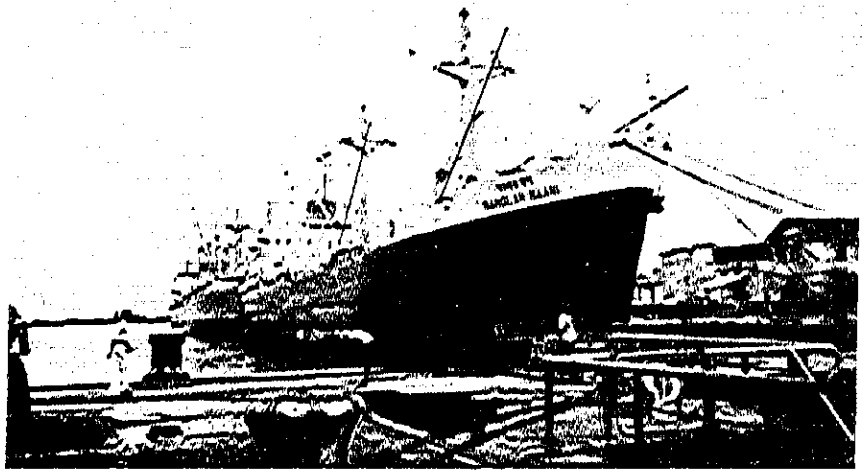


Photo-6 North Guid Pier

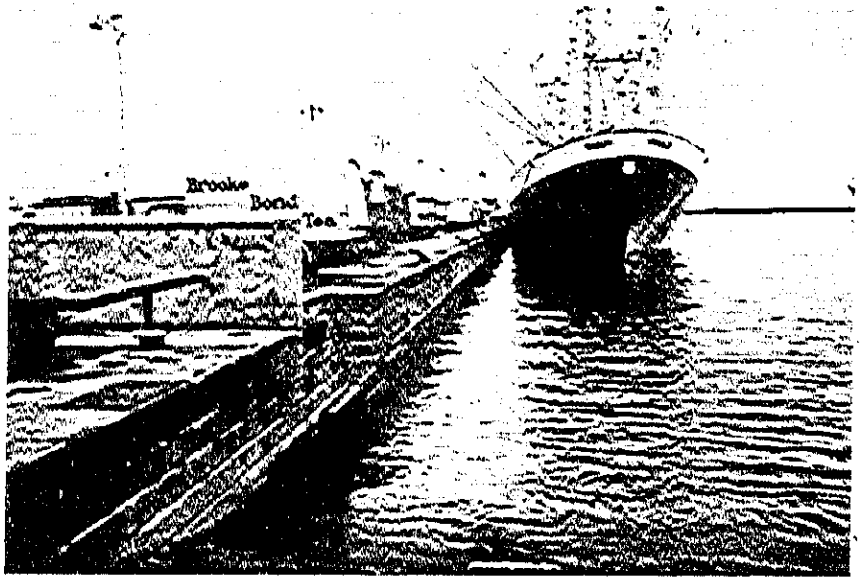



Photo-7 South Pier

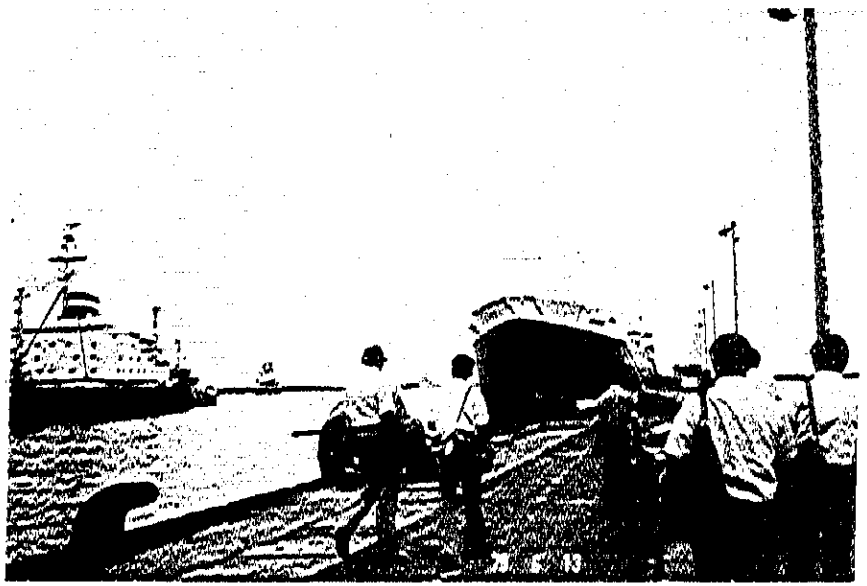


Photo-8 North Pier

Photo-9 Bunkering Facilities

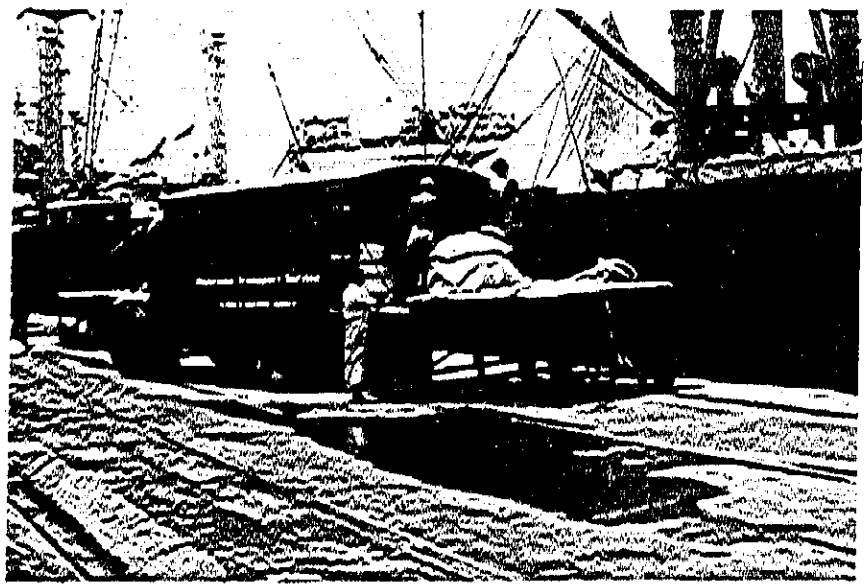


Photo-10 Cargo Handling at the Prince Vijaya Quay

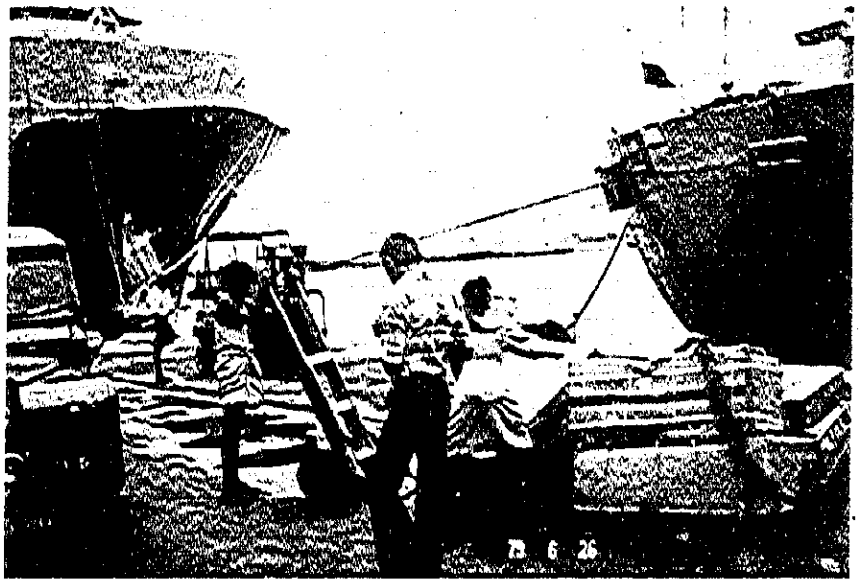


Photo-11 Cargo Handling at the Queen Elizabeth Quay

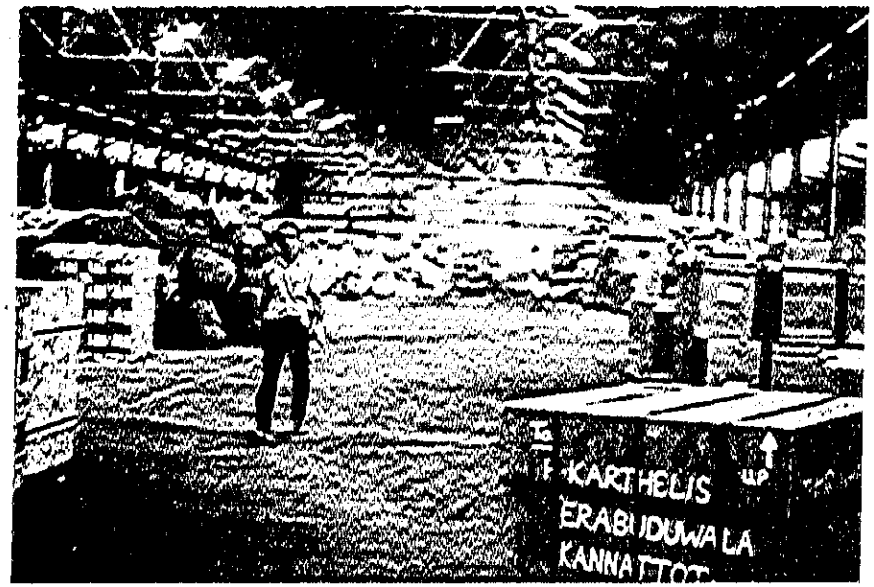



Photo-12 Inside of a Transit Shed

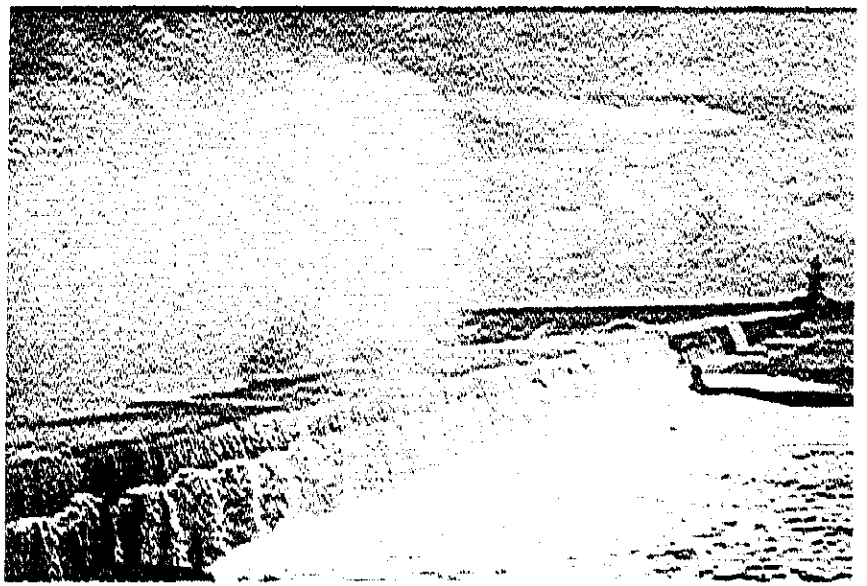


Photo-13 South-West Breakwater . .

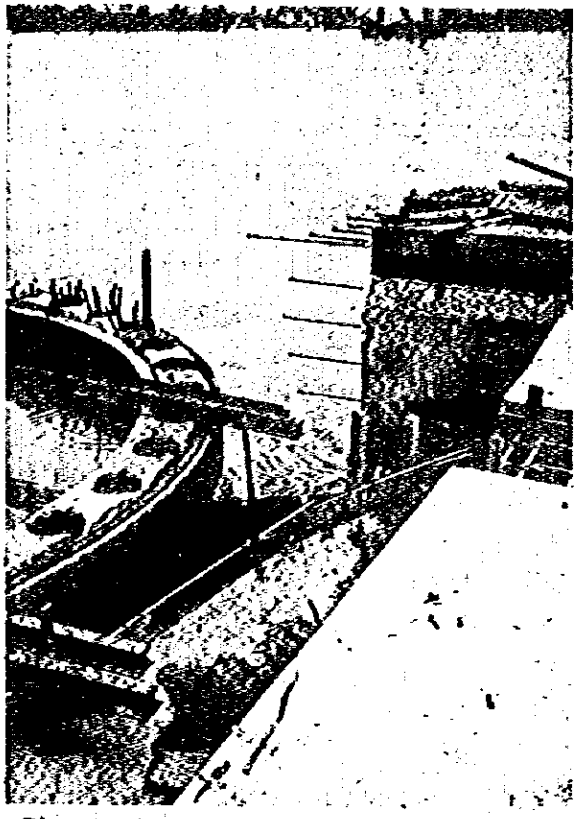


Photo-14 Quaywall of the Queen Elizabeth Quay No. 5

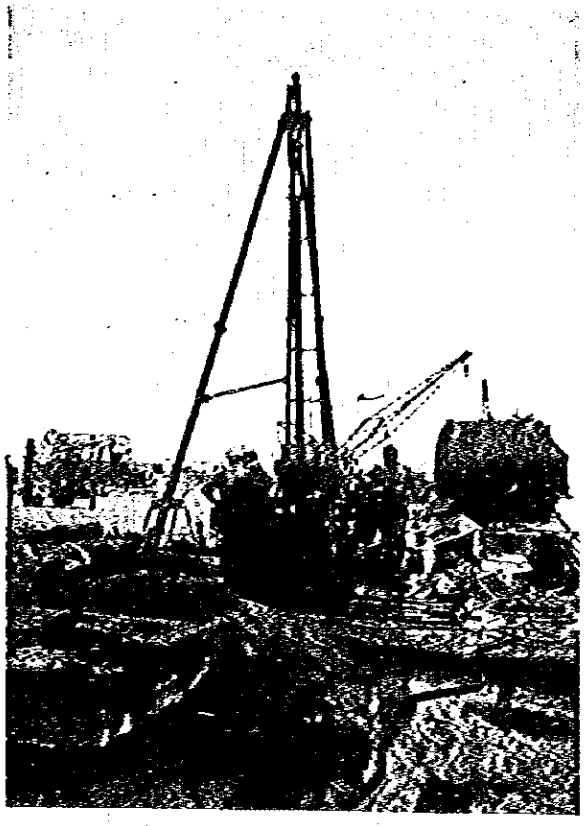


Photo-15 Soil Investigation at the Queen Elizabeth Quay

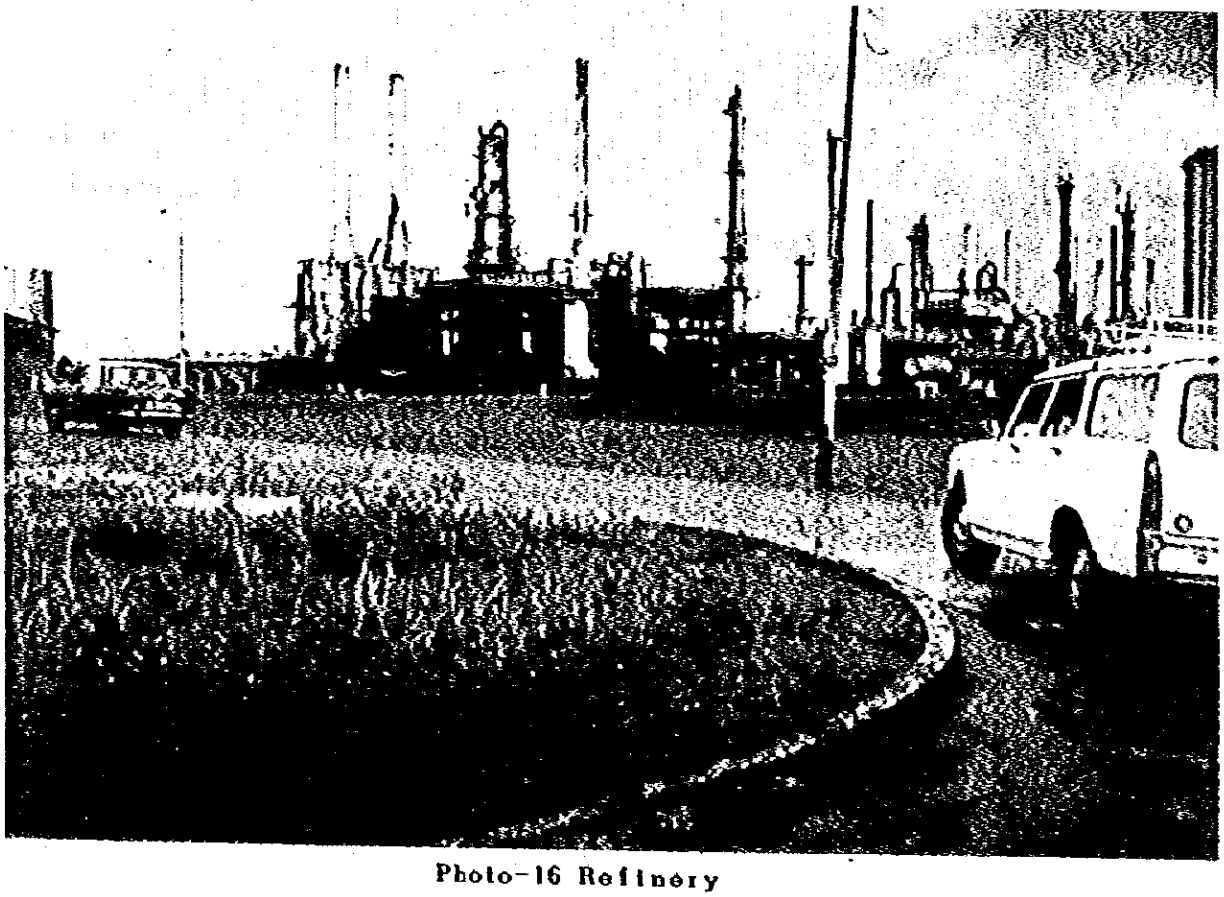


Photo-16 Refinery

## ABBREVIATIONS

| | | |
|---|---|---|
| QEQ No. 5 | : | Queen Elizabeth Quay No. 5 |
| QEQ No. 4 | : | Queen Elizabeth Quay No. 4 |
| BQ | : | Bandaranaike Quay |
| KQ | : | Korteboam Quay |
| NGP | : | North Guide Pier |
| NP | : | North Pier |
| SP | : | South Pier |
| CB | : | Coaster Berth |
| NE Breakwater | : | North-East Breakwater |
| SW Breakwater | : | South-West Breakwater |
| NW Breakwater | : | North-West Breakwater |
| W/H | : | Warehouse |
| SLPA | : | Sri Lanka Ports Authority |
| CPC | : | Colombo Port Commission |
| P(C)C | : | Port (Cargo) Corporation |
| PTPSC | : | Port Tally and Protective Services Corporation |
| CSC | : | Ceylon Shipping Corporation |
| FEECs | : | Foreign Exchange Entitlement Certificates |
| ADB | : | Asian Development Bank |
| CDL | : | Colombo Dockyard Ltd. |
| UNCTAD | : | United Nations Conference on Trade and Development |
| FAO | : | Food and Agriculture Organization |
| ILO | : | International Labour Organization |
| NEDECO | : | Netherlands Engineering Consultants |
| CIF | : | Cost Insurance and Freight |
| FOB | : | Free on Board |
| FCL | : | Full Container Load Cargo |
| LCL | : | Less than Container Load Cargo |
| TEU | : | Twenty Equivalent of Units |
| IRR | : | Internal Rate of Return |
| FRR | : | Financial Rate of Return |
| CFS | : | Container Freight Station |
| GDP | : | Gross Domestic Product |
| GNP | : | Gross National Product |
| ¥ | : | Yen |
| US$ | : | U. S. Dollar |
| Rs. | : | Rupees |

**Exchange Rate**

**US$ 1.00 = Rupees 15.625 = Yen 218.89**

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**Part III Cargo Traffic Forecast**



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Part I Location of the Port of Colombo

Part II Present Situation of the Port of Colombo



Part III Cargo Traffic Forecast

## Part IV Master Plan

## Part V Urgent Plan

# CONCLUSIONS AND RECOMMENDATIONS

# CONCLUSIONS AND RECOMMENDATIONS

## I. Master Plan

### 1. Conclusions

1) In response to the requirements for the Port of Colombo listed in Table-C.1, the Master Plan with a target year of 1988 has been formulated as shown in Table-C.2.

The schedule of implementation of the Plan is shown in Table-C.3. The investments for civil engineering works, conventional cargo handling equipment and container equipment are shown in Table-C.4 (a), (b) and (c) respectively.

The total investment of the Project is 130 million US$.

2) The feasibility of the proposed oil berth location, immediately behind the North-West Breakwater, depends largely on the depth of the sea bedrock in the approach channel. For this reason, the removal of the existing Oil Dock after the construction of new oil berths is not included in the Urgent Plan but rather in the Master Plan, though it is urgently required.

### 2. Recommendations

1) Master Plan – The Master Plan described above is recommended as a long term development plan of the Port of Colombo.

The Plan, however, should be reviewed after the completion of the Urgent Plan, because the current Sri Lankan National Economy is in a state of flux and long term plans must be periodically revised to meet the changing national potential.

2) Oil Berths – The prompt implementation of a feasibility study for new oil berths, including a sounding of the depth of the bedrock surface in the approach channel, is recommended.

## II. Urgent Plan

### 1. Conclusions

1) The Urgent Plan with a target year of 1983 is shown in Table-C.5. The schedule of the implementation of the Plan is shown in Table-C.3, and the details of the construction schedule of the civil engineering work is given in Table-C.6. The annual investment plan by currency is shown in Table- C.7.

The total investment is 70,458 thousand US$ of which 54,040 thousand US$ (76.7%) is foreign currency and the remaining 16,418 thousand US$ (23.3%) is local currency.

2) The Urgent Plan is concluded to be feasible both physically and economically.
The bore hole data so far available, including those from the in situ surveys carried out during the study period, are insufficient in number for the detailed structural design. Hence, the soil properties assumed in the study must be confirmed before commencement of the Plan.
Economically, the internal rates of return are obtained as 17.1% with shadow pricing and 19.5% with market pricing.

3) At present (October 1979), the financial formalities of the Sri Lanka Ports Authority, which was established on the 1st of August 1979, have not been totally prepared. A 25% average raise in the existing port tariff, excluding the container tariff, is concluded to be necessary to ensure the sound finance of the Ports Authority. This assumes that the Port of Colombo separately employs a self-supporting accounting system, that both the interest rates of foreign loans from the international aid organizations and local loans from the Consolidated Fund are 8%, and that the dividend for the capital investment by the Government is 4%.

2. Recommendations

1) Urgent Plan – The Urgent Plan described above is recommended as a short term development plan of the Port of Colombo.

2) Finance – Corresponding to the interest rates of local/foreign loans for the Project, a port tariff level and a rate of dividend on the capital investment by the Government are recommended to be determined reasonably and adequately to ensure the sound finance of the Ports Authority after every financial matter is fixed.

## III. Other

1. Conclusions

1) The rise in cargo handling productivity expected in the Master Plan and the Urgent Plan can not be achieved without an adequate and effective use of the land and sea area within the Port and a reliable maintenance/repair system for the equipment.

2) To meet unexpected but urgent needs, the purchase of a boring machine is strongly suggested.

2. Recommendations

1) Land use – Since the port area is not large, an adequate and effective use of land within the Port by removing facilities unrelated to the port function, by integrating redundant or idle facilities, and by reserving spaces for future use is recommended.

2) Use of protected sea area -- Since the protected sea area of the Port is not large, abolishing the cargo handling at midstream berths, which greatly contributes to the existing port congestion, is recommended at least in the final stage of the Master Plan.

3) The Plans include a large degree of mechanization in cargo handling. It is recommended that a reliable operation and management system, including retaining/training of equipment repair staff, parts supply/storage, maintenance and repair facilities for equipment be promptly established to ensure the smooth operation of the equipment.

4) Purchase of a boring machine is recommended. The cost of a boring machine, for use mainly in the standard penetration test, is about 25 thousand US$, and is included in the engineering cost for the Plan.

Table-C.1 Requirements for the Port of Colombo

| Requirement | Details |
|---|---|
| 1. Increase in cargo handling capacity | a. To meet expected demand in cargo traffic forecast |
| 2. Improvement of service level/coverage | a. To relieve port congestion<br>b. To prepare container facilities |
| 3. Effective use of land | a. Removal of facilities/functions unrelated to the Port<br>b. Effective use of idle spaces<br>c. Unification/integration of boat/barge repairing shops |
| 4. Improvement of road network | a. Improvement/widening of the existing road<br>b. To insure proper interfacing of port and city road plans |
| 5. Improvement of safety | a. Improvement of approach channel and turning/mooring basin<br>b. Removal of the existing Oil Dock |
| 6. Increase in large ship repairing capacity | a. Construction of a 65,000 DWT dry dock.<br>b. Modification of existing cargo handling berths to ship repair berths |

## Table – C.2 Summary – Master Plan

| Item | Unit | Q'ty | Cost | | Target Year | Note |
|---|---|---|---|---|---|---|
| | | | Value (1,000 US$) | Share (%) | | |
| Conventional Berths | | | | | | |
| KQ #2 (New Berth, Temporary) | Berth | 1 | – | | 1983 | Modified to CTNR Berth after 1988 |
| NP (Widening, 1 Berth → 2 Berths) | Berth | 2 | 3,538 | 2.7 | After Removal of Oil Dock | Widening of 50m, Two –9m Berths |
| NGP/SP (Cargo Berth → Ship Repair Berth) | Berth | 3 | – | | 1983 (1B) After Completion of NP (2B) | |
| QEQ #5 (Container → Conventional) | Berth | 1 | – | | 1988 | |
| Cargo Handling Equipment | Set | 1 | 7,537 | 5.8 | 1980 | |
| Sub Total | | | 11,075 | 8.5 | | |
| Container Berths | | | | | | |
| QEQ #5 (Crane Foundation, etc.) | Set | 1 | 1,628 | 1.2 | 1981 | |
| KQ #1/#2/#3 | Berth | 3 | 47,736 | 36.6 | 1983 (#1) 1988 (#2/#3) | #2 (Conventional → Container) |
| Dredging | M.m³ | 1.5 | 2,880 | 2.2 | 1983, 1988 | |
| Container Equipment | Set | 1 | 31,092 | 23.9 | 1981,1983, 1988 | |
| Sub Total | | | 83,336 | 63.9 | | |
| Oil Berth* | | | | | | *A feasibility study including an in situ survey of the bed-rock depth along the approch channel should be carried out. |
| Dolphines | Set | 1 | 937 | 0.7 | Set by F/S* | |
| Pipelines, etc. | Set | 1 | 11,515 | 8.8 | " | |
| Bunkering Facilities | Set | 1 | 686 | 0.5 | " | |
| Improvement of Port Entrance | Set | 1 | 12,011 | 9.2 | " | |
| Extension of SW Breakwater | (m) | (150) | (6,171) | | | |
| Removal of the Southwest End of NW Breakwater | (m) | (75) | (514) | | | |
| Seawall/Wave Dissipation Work along NW Breakwater | (m) | (700) | (5,326) | | | |
| Dredging | M.m³ | 3.24 | 6,900 | 5.4 | " | |
| Tug Boat | No. | 1 | 1,919 | 1.5 | " | |
| Sub Total | | | 33,968 | 26.1 | | |
| Road | km | 5.7 | 1,981 | 1.5 | 1982 (2 Lanes) 1988 (4 Lanes) | |
| Grand Total | | | 130,360 | 100.0 | | |

Note: Engineering fee and physical contingency are not included in the Table.

Table – C.3 Construction Schedule for Master Plan

| Item | | | Quantity | | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | Target year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Civil Engineering Works | QEQ #5 | Containerization | 200 | m | | | | | | | | | 1981 |
| | KQ | Quaywall & Revetment | 1,910 | m | | | | | | | | | Quaywall 550m 1983 350m 1987 |
| | | Reclamation | 2,600,000 | $m^3$ | | | | | | | | | |
| | | CFS and Others | 1 | Set | | | | | | | | | |
| | NP | Revetment | 410 | m | | | | | | | | | 1985 |
| | | Reclamation | 198,000 | $m^3$ | | | | | | | | | |
| | Road | | 5,700 | m | | | | | | | | | 1982 2-Lanes 1986 4-Lanes |
| | Dredigng | | 1,500,000 | $m^3$ | | | | | | | | | |
| Equipment | Conventional | | 1 | Set | | | | | | | | | 1980 |
| | QEQ #5 | | 1 | Set | | | | | | | | | 1981 |
| | KQ | | 1 | Set | | | | | | | | | 1 Berth 1983 2 Berths 1987 |
| Oil Berth | Feasibility Study | | 1 | Set | | | | | | | | | |
| | Berth | Dolphines | 1 | Set | | | | | | | | | |
| | | Pipelines | 1 | Set | | | | | | | | | |
| | Dredging (Turning Basin) | | 2,000,000 | $m^3$ | | | | | | | | | |
| | Dredging (Waterway) | | 1,240,000 | $m^3$ | | | | | | | | | |
| | Improvement of Port Entrance | SW Breakwater Extension | 150 | m | | | | | | | | | |
| | | NW Breakwater Removal | 75 | m | | | | | | | | | |
| | | NW Breakwater Seawall/ Wave Dissipating Work | 700 | m | | | | | | | | | |

## Table – C.4(a) Rough Estimate of Construction Costs

| | No. | Facility | Main item | Quantity | | Unit Price | Rough Cost Estimate |
|---|---|---|---|---|---|---|---|
| | | | | | | (US$) | (Thousand US$) |
| Container & Conventional Berths | 1 | QEQ #5 | Crane foundation | 200 | m | 6,540 | 1,308 |
| | | | Heavy Pavement | 40,000 | m² | 8 | 320 |
| | | | (Sub Total) | | | | (1,628) |
| | 2 | KQ Container Terminal | -12.0m Quaywall | 900 | m | 20,750 | 18,675 |
| | | | -7.5m Revetment | 610 | m | 9,960 | 6,076 |
| | | | -10.0m Revetment | 400 | m | 14,200 | 5,680 |
| | | | Reclamation | 2,600,000 | m³ | 2.5 | 6,500 |
| | | | Heavy Pavement | 235,000 | m² | 31 | 7,285 |
| | | | C.F.S | 16,000 | m² | 220 | 3,520 |
| | | | (Sub Total) | | | | (47,736) |
| | 3 | North Pier | -4.0 ~ -10.0m Revetment | 360 | m | 5,680 | 2,045 |
| | | | -10.0m Revetment | 50 | m | 14,200 | 710 |
| | | | Reclamation | 198,000 | m³ | 2.5 | 495 |
| | | | Pavement | 18,000 | m² | 16 | 288 |
| | | | (Sub Total) | | | | (3,538) |
| | 4 | Road | | 5,700 | m | | 1,981 |
| | 5 | Dredging | -12.0m Dreding | 1,500,000 | m³ | 1.92 | 2,880 |
| | Total | | | | | | 57,763 |
| Oil Berth | 6 | Oil Berth | Main dolphins | 1 | Set | | 937 |
| | | | Bunkering dolphins | 1 | Set | | 686 |
| | | | Piplines | 1 | Set | | 11,515 |
| | | | (Sub Total) | | | | (13,138) |
| | 7 | Dredging (Turning Basin) | -14m Dredging | 2,000,000 | m³ | 1.9 | 3,800 |
| | 8 | Dredging (Waterway) | -15.5m Dredging | 1,240,000 | m³ | 2.5 | 3,100 |
| | 9 | SW Breakwater | 150m Extension | 150 | m | 41,142 | 6,171 |
| | 10 | NW Breakwater | 75m Removal | 75 | m | 6,857 | 514 |
| | | | Seawall/Wave Dissipating Work | 1 | Set | | 5,326 |
| | 11 | Tug boat | | 1 | No. | | 1,919 |
| | Total | | | | | | 33,968 |
| Grand Total | | | | | | | 91,731 |

Table – C.4 (b) Conventional Cargo Handling Equipment and Cost Estimates for Master Plan

(Unit: Thouthand US$)

| Equipment | Nos. to be purchased | Cost per Unit | Total Cost |
|---|---|---|---|
| Forklift Trucks | 38 (3T) | 12.2 | 464 |
| | 47 (5T) | 22.1 | 1,039 |
| | | (Sub Total) | 1,503 |
| Mobil Cranes | 8 (30T) | 182.8 | 1,462 |
| | | | 1,462 |
| Floating Cranes | 1 (100T) | 4,572.0 | 4,572 |
| Total Cost | | | 7,537 |

Table – C.4 (c) Container Equipment and Cost Estimates for Master Plan

(Unit: 1,000 US$)

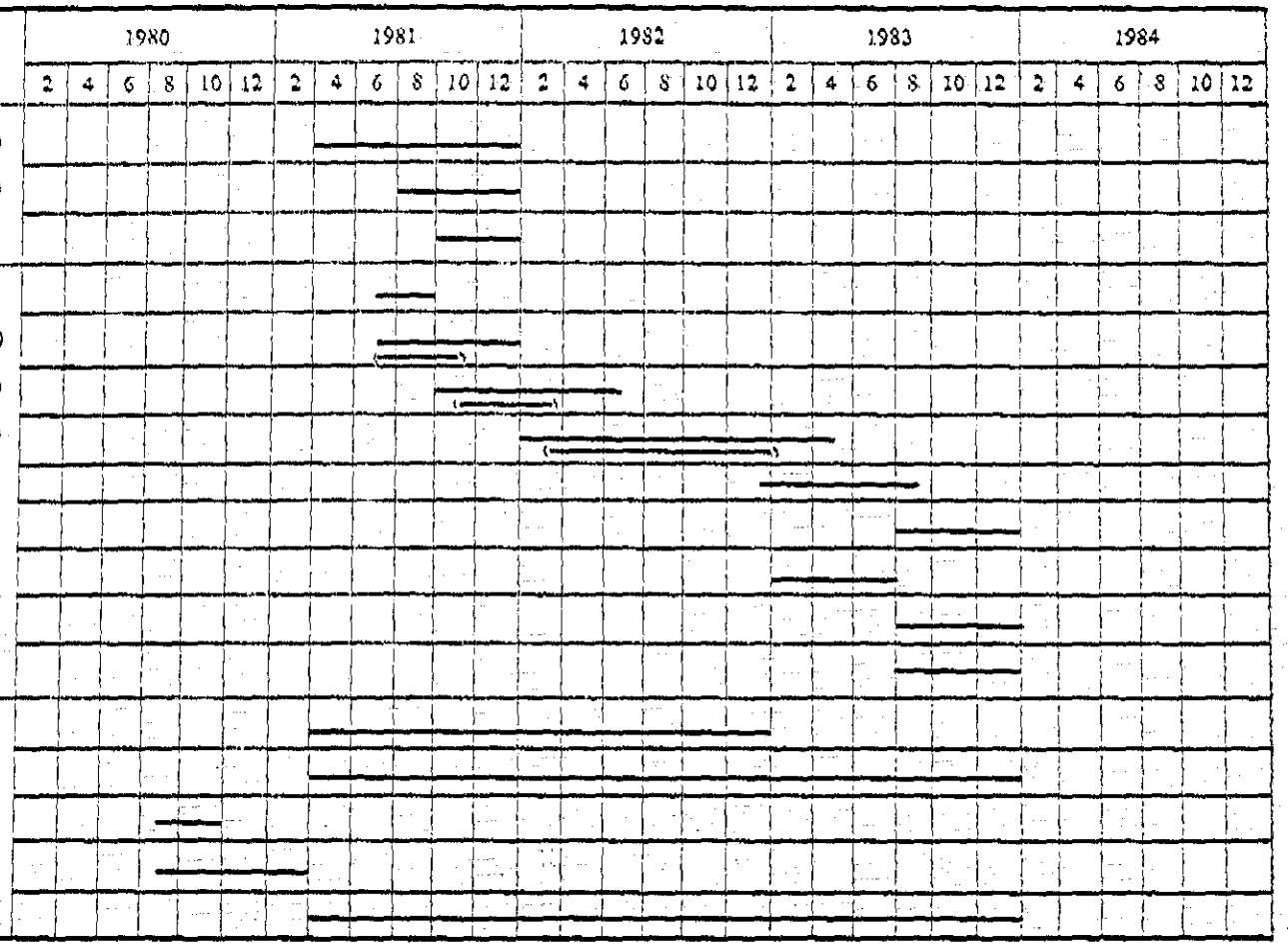
| Equipment | QEQ | | Korteboam | | Total | |
|---|---|---|---|---|---|---|
| | Quantity | Cost | Quantity | Cost | Quantity | Cost |
| Container Crane | 1 | 3,017 | 6 | 18,102 | 7 | 21,119 |
| Straddle Carrier | 3 | 960 | 22 | 7,040 | 25 | 8,000 |
| Yard-use Tractor | 2 | 52 | 15 | 390 | 17 | 442 |
| Yard-use Trailer Chassis 40' | 2 | 18 | 20 | 180 | 22 | 198 |
| " 20' | 8 | 56 | 30 | 210 | 38 | 266 |
| Forklift Truck 15 ton | 2 | 274 | – | – | 2 | 274 |
| " 1.5 ton | 6 | 84 | 36 | 504 | 42 | 588 |
| Weighing Scale | – | – | 5 | 205 | 5 | 205 |
| Total | | 4,461 | | 26,631 | | 31,092 |

## Table – C.5 Summary – Urgent Plant

| Item | Unit | Q'ty | Cost | | Target Year | Note |
|---|---|---|---|---|---|---|
| | | | Value (1,000 US$) | Share (%) | | |
| Conventional Berths | | | | | | |
| KQ #2 (New Berth, Temporary) | Berth | 1 | – | | 1983 | Modified to CTNR Berth after 1988 |
| NGP #1 (Cargo Berth -> Ship Repair Berth) | Berth | 1 | – | | 1983 | Transferred to CDL |
| Cargo Handling Equipment | Set | 1 | 7,537 | 10.7 | 1980 | |
| Forklift (3t) | (No.) | (38) | (464) | | | |
| Forklift (5t) | (No.) | (47) | (1,039) | | | |
| Mobile Crane (30t) | (No.) | ( 8) | (1,462) | | | |
| Floating Crane (100t) | (No.) | ( 1) | (4,572) | | | |
| Sub Total | | | 7,537 | 10.7 | | |
| Container Berth | | | | | | |
| QEQ #5 (Crane Foundation, etc.) | Set | 1 | 2,293 | 3.2 | 1981 | |
| KQ #1 (Bulkhead, etc.) | Set | 1 | 33,912 | 48.1 | 1983 | Includes Construction Cost for 250m of #2 |
| Dredging | | | 2,880 | 4.1 | 1983 | |
| Container Equipment | Set | 1 | 13,794 | 19.6 | 1981, 1983 | |
| (Container Crane) | (No.) | 3 | (9,051) | | | |
| (Straddle Carrier) | (No.) | 11 | (3,520) | | | |
| (Others) | (Set) | 1 | (1,223) | | | |
| Sub Total | | | 52,879 | 75.0 | | |
| Road (2 Lanes) | km | 5.7 | 1,524 | 2.2 | 1982 | 2 Lanes, Ditchs and Sidewalks |
| Engineering | Set | 1 | 2,111 | 3.0 | | |
| Physical Contingency | Set | 1 | 6,407 | 9.1 | | |
| Grand Total | | | 70,458 | 100.0 | | |

## Table – C.6 Construction Schedule for Urgent Plan

| No. | Item | | Unit | Quantity |
|---|---|---|---|---|
| 1 | | Crane foundation | m | 200 |
| 2 | OEQ | Paving | $m^2$ | 40,000 |
| 3 | | Offices & Others | $m^2$ | 1,135 |
| 4 | | Access road | m | 150 |
| 5 | | South revetment | m (caisson) | 310 (16) |
| 6 | | North revetment | m (caisson) | 350 (20) |
| 7 | | Quaywall | m (caisson) | 550 (39) |
| 8 | KQ | Reclamation | $m^3$ | 1,830,000 |
| 9 | | Yard paving | $m^2$ | 165,000 |
| 10 | | C.F.S | $m^2$ | 6,000 |
| 11 | | Electric & Others | Set | 1 |
| 12 | | Offices & Others | $m^3$ | 3,450 |
| 13 | Road | | m | 5,700 |
| 14 | Dredging | | $m^3$ | 1,500,000 |
| 15 | Survey | | Set | 1 |
| 16 | Design | | Set | 1 |
| 17 | Construction Supervision | | Set | 1 |




Note: Shown in ( ) is caisson production

## Table – C.7 Yearly Investment Plan

(Unit: Thousand US$)

| Construction year | | | Quantity | | 1980 | | | 1981 | | | 1982 | | | 1983 | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Foreign | Local | Total | Foreign | Local | Total | Foreign | Local | Total | Foreign | Local | Total | Foreign | Local | Total |
| Civil engineering facilities | QEQ | Crane foundation | 200 | m | | | | 1,248 | 60 | 1,308 | | | | | | | 1,248 | 60 | 1,308 |
| | | Heavy paving | 40,000 | m² | | | | | 320 | 320 | | | | | | | | 320 | 320 |
| | | Offices & Others | 1,135 | m² | | | | 226 | 146 | 372 | | | | | | | 226 | 146 | 372 |
| | | Power, lighting and water supply | 1 | Set | | | | 251 | 42 | 293 | | | | | | | 251 | 42 | 293 |
| | | Sub total | | | | | | 1,725 | 568 | 2,293 | | | | | | | 1,725 | 568 | 2,293 |
| | KQ | Access road | 150 | m | | | | 378 | 62 | 440 | | | | | | | 378 | 62 | 440 |
| | | South revetment | 310 | m | | | | 4,055 | 521 | 4,576 | 51 | 39 | 90 | | | | 4,106 | 560 | 4,666 |
| | | North revetment | 350 | m | | | | 1,856 | 251 | 2,107 | 1,190 | 168 | 1,358 | | | | 3,046 | 419 | 3,465 |
| | | Quaywall | 550 | m | | | | | | | 7,913 | 1,004 | 8,917 | 2,118 | 340 | 2,458 | 10,031 | 1,344 | 11,375 |
| | | Reclamation | 1,830,000 | m³ | | | | | | | 525 | 50 | 575 | 3,672 | 351 | 4,023 | 4,197 | 401 | 4,598 |
| | | Paving of yard | 165,000 | m² | | | | | | | | | | | 5,050 | 5,050 | | 5,050 | 5,050 |
| | | CFS | 6,000 | m² | | | | | | | | | | 792 | 516 | 1,308 | 792 | 516 | 1,308 |
| | | Offices and Others | 3,450 | m² | | | | | | | | | | 589 | 382 | 971 | 589 | 382 | 971 |
| | | Power, lighting and water supply | 1 | Set | | | | | | | | | | 1,913 | 126 | 2,039 | 1,913 | 126 | 2,039 |
| | | Sub total | | | | | | 6,289 | 834 | 7,123 | 9,679 | 1,261 | 10,940 | 9,084 | 6,765 | 15,849 | 25,052 | 8,860 | 33,912 |
| | Dreding | | 1,500,000 | m³ | | | | | 960 | 960 | | 960 | 960 | | 960 | 960 | | 2,880 | 2,880 |
| | Roads | | 5,700 | m | | | | | 762 | 762 | | 762 | 762 | | | | | 1,524 | 1,524 |
| | Sub total (1) | | | | | | | 8,014 | 3,124 | 11,138 | 9,679 | 2,983 | 12,662 | 9,084 | 7,725 | 16,809 | 26,777 | 13,832 | 40,609 |
| Equipment | QEQ (Container) | | 1 | Set | | | | 4,461 | | 4,461 | | | | | | | 4,461 | | 4,461 |
| | KQ (Container) | | 1 | Set | | | | | | | | | | 9,333 | | 9,333 | 9,333 | | 9,333 |
| | Conventional berth | | 1 | Set | 7,537 | | 7,537 | | | | | | | | | | 7,537 | | 7,537 |
| | Sub total (2) | | | | 7,537 | | 7,537 | 4,461 | | 4,461 | | | | 9,333 | | 9,333 | 21,331 | | 21,331 |
| Engineering | Survey and design | | 1 | Set | 594 | 169 | 763 | 238 | 69 | 307 | | | | | | | 832 | 238 | 1,070 |
| | Construction supervision | | 1 | Set | | | | 278 | 69 | 347 | 278 | 69 | 347 | 278 | 69 | 347 | 834 | 207 | 1,041 |
| | Sub-total (3) | | | | 594 | 169 | 763 | 516 | 138 | 654 | 278 | 69 | 347 | 278 | 69 | 347 | 1,666 | 445 | 2,111 |
| Physical contingency [15% of (1) + (3)] | | | | | 89 | 25 | 114 | 1,280 | 489 | 1,769 | 1,493 | 458 | 1,951 | 1,404 | 1,169 | 2,573 | 4,266 | 2,141 | 6,407 |
| Total | | | | | 8,220 | 194 | 8,414 | 14,271 | 3,751 | 18,022 | 11,450 | 3,510 | 14,960 | 20,099 | 8,963 | 29,062 | 54,040 | 16,418 | 70,458 |

# SUMMARY

# SUMMARY

## 1. General

The present Government, since it took office in July 1977, has been vigorously implementing the nation's economic development with special emphasis on such policies as the Mahaweli Development scheme the purpose of which is the irrigation for paddy cultivation together with hydroelectric power generation, the Free Trade Zone and the Investment Promotion Zone to induce export-oriented industries and to increase employment opportunities, the Urban Development and Housing scheme to shift the municipal functions and to construct housing units, and the import liberalization together with the unification of the dual exchange rate system. In particular, the import liberalization has had an immense impact on the Port of Colombo.

According to the port statistics, the dry cargo handled in the Port recorded a sharp drop of about 25% from 3 million freight tons or more in late sixties to 2,245 thousafreight tons in 1976, the year previous to the change of government. Particularly, the decrease of imports is remarkable, that is the import decreased by nearly 50% from the unprecedented level of 2,366 thousand freight tons in 1966 to 1,245 thousand freight tons in 1976. After the present Government came to power in 1977, however, the dry cargo handled in the Port has been greatly recovered. The total export and import recorded 2,945 thousand freight tons and the import recorded 1,895 thousand freight tons in 1978.

The waves of containerization that have swept over the developed countries are now washing the shore of the country. It is encouraging for the containerization of the Port that the share of containerizable cargo such as tea, rubber and a part of coconut products is very high in the total export. In addition, regional container feeder services (tranship containers) is likely to increase because of the advantageous location of the Port in relation to international shipping routes.

From the above discussion, it could be concluded that the biggest problem for the Port to solve promptly is how to meet the expected increase of port cargo and the urgent need for containerization.

The Port of Colombo, together with the other outports, is now under the control of the Sri Lanka Ports Authority which was established on the 1st of August 1979 by amalgamating the following three organizations: the Colombo Port Commission (CPC) which was a division of the Ministry of Trade and Shipping and was in charge of the administration/operation of the Port, the Port (Cargo) Corporation (P(C)C) which was a public body corporate and was in charge of the cargo handling in the Port, and the Port Tally and Protective Services Corporation which was in charge of the tally and protective services in the Port.

## 2. Sea and Soil Conditions of the Port of Colombo

Sri Lanka belongs to the Indian monsoon area and consequently has two main seasons, the southwest monsoon season from May to September and the northeast monsoon season from November to March. Being on the west coast, the Port of Colombo is affected by the southwest monsoon.

The wave hindcasting, based on the wind records observed at the Port over 13 years, gives, as a deepwater wave with a return period of 25 years, a significant wave height of 6.1 m, a significant wave period of 9.1 sec, and a predominant wave direction of WSW. There are, on the average, 56 days annually in which the significant wave height of deepwater waves exceeds 2 m. The tidal current seldom exceeds 0.5 kt in the vicinity of the Port. The tidal range is not so great, for example, the mean higher high water springs (MHHWS) is +72 cm.

The underlying bedrock of the Port of Colombo is very hard gneiss with the standard penetration value (N-value) of far more than 50. The bedrock surface generally lies −10 to −15 m except a few places, such as the area ajoining the North Pier or the starting point of the Queen Elizabeth Quay, where it is very shallow. The bedrock itself inclines with gentle slope toward the sea. On this hard gneiss there exists a weathered gneiss layer with the N-value of 27 to 50. The uppermost layer consists of loose and soft sediments, such as sand, silt and clay, with the N-value less than 14.

## 3. Current Situation of the Port of Colombo

The Port of Colombo, facing the Indian Ocean, is located on the west coast of Sri Lanka. It is the biggest port in the country and covers almost all part of the country as its service area. 96% of the nation's port cargo which amounts to 4,991 thousand freight tons was handled in the Port in 1978. Leading commodities in export are tea, rubber and coconut products, while those in import are rice, flour, sugar, fertilizer, general cargo and crude oil. The cargo handled in the Port in 1978 were 2,945 thousand freight tons of dry cargo and 1,852 thousand metric tons of wet cargo.

The Port is accommodated with 14 large alongside berths, 3 small alongside berths and about 20 midstream berths. The length of alongside berths totals about 3 km.

The shares in cargo handling were about 90% for alongside berths and about 10% for midstream berths in 1978.

The existing land use within the port area could be modified to a more effective and adequate one by, for example, integrating the small boat repair shops which are currently under dual operation by CPC and P(C)C.

Little cargo handling equipment is in commission mainly due to the age of the existing equipment and the difficulty in parts acquisition. The unavailability of cargo handling equipment results in the low productivity in cargo handling and the ineffective use of transit sheds. In addition to the shortage of alongside berths, this ineffectiveness leads, in turn, to the exsisting port congestion. Thus, the amount of dry cargo handled in 1978 is likely to be the nearly full capacity of the Port under the existing situation.

About 5,000 TEU of containers were handled at the #4 berth of the Queen Elizabeth Quay in 1978. At present, the Port has no container cranes and containers are loaded/unloaded by RO/RO or ship's gears. The backup yard of the Queen Elizabeth Quay is so narrow that the marshalling yard is always full of containers, thus further aggravating the traffic jam inside the Port.

The total wet cargo handled in the Port in 1978, excluding coconut oil in drums, amounts to 1,852 thousand metric tons, most part of which is crude oil imported from the Middle East. Almost all imported crude oil is unloaded at the North Pier. This pier involves safety problems

because of its adjacency to the dry dock belonging to the Colombo Dockyard Ltd.

The port has three dry docks (one 30,000 DWT dry dock and two 6,000 DWT dry docks) used mainly for the repair of large vessels. Further, there is a plan to construct a 65,000 DWT dry dock.

Both road and railway transports are available as the means to link the port and the hinterland. The roads transport almost all the port cargo. The railway is mainly used to haul foods, and its share in cargo transport is only about 3%.

## 4. Cargo Traffic Forecast

Since Sri Lanka is now in the stage of reforming its economic policy, the nation's economic plan has not been available yet. It is likely to be very hard at this time to forecast cargo traffic without some ambiguity. At present, "Public Investment 1979--1983" has been published by the Ministry of Finance and Planning.

The present forecast employs the "Public Investment 1979–1983" as its basis, together with the following premises:

1) A macro estimate utilizing the correlation between the port cargo traffic and the relevant economic indicators is impossible. Therefore,

2) a micro estimate, or a commodity-wise cargo traffic forecast based on the individual demand/supply plan is done. Further, the forecasted cargo is allotted to each port.

3) In doing so, the existing shares of each port are not changed except for imported wheat to the Port of Trincomalee.

4) The following figures in the "Public Investment 1979–1983" are employed in the forecast:

| | | |
|---|---|---|
| a. | GDP growth rate | 5.5% per annum |
| b. | Growth rate in industry including construction | 8.6% per annum |
| | Manufacturing industry | 8.0% per annum |
| | Construction | 12.0% per annum |
| c. | Growth rate in Agriculture | 4.5% per annum |
| d. | Rate of population growth | 1.5% per annum |
| | Population projection | 1978: 14,400,000 |
| | | 1983: 15,500,000 |

5) Mainly from the viewpoint of the reliability of the forecast, the year of 1983, the final year foreseen in the "Public Investment 1979–1983" is employed as the target year in the forecast for the Urgent Plan, and 1988, 10 years after 1978, the starting year of almost all informations on which the present study is based, is employed as the target year in the forecast for the Master Plan.

The results of the forecast are shown in Table-S.1.

## 5. Master Plan

### 5-1 Requirements for the Master Plan

Requirements for the Port are listed in Table-S.2.

### 5-2 Basic Lines of the Master Plan

With these requirements in view, the basic guidelines of the Plan are selected as follows:

1) The future increases in the cargo traffic, together with a reduction of existing and anticipated Port congestion, shall be met by raising the cargo handling productivity through mechanization and by constructing additional berthing facilities.
For crude oil import, the necessary expansion of the facilities shall be considered corresponding to the expansion of the existing oil refinery.

2) An urgent demand for containerization shall be met by providing container berths through the modification of existing berths and through the construction of new container terminals.

3) A more effective and adequate land use shall be considered.

4) The existing road network shall be improved, to increase road transport capacity and to insure proper interfacing of Port and city road plans.

5) The existing safety problem, involving the existing Oil Dock and midstream berths, shall be reduced.

6) An urgent need for the expansion of large vessel repair facilities shall be considered. The need consists of two proposals, to construct a dry dock, and to modify existing cargo handling berths to ship repair berths.

### 5-3 Master Plan

The proposed layout of the Master Plan is shown in Fig.-S.1. The summary of the Plan is listed in Table-S.3. Table-S.4 shows the breakdown of the number of alongside berths.

#### (1) Conventional Berths

1) As a substitution for one berth in the North Guide Pier, which has been requested to be transferred to the Colombo Dockyard Ltd., one alongside berth, for conventional cargo handling with the water depth of −12m and the length of 250m, is planned in the Korteboam Quay which will be constructed by the end of 1983.

2) After the removal of the Oil Dock, two alongside berths, for bulk cargo handling with

the water depth of −9m and the length of 165m each, are planned in the North Pier.

3) The whole Guide Pier including the South Pier is to be modified to ship repair berths by 1988.

4) The #5 berth of the Queen Elizabeth Quay is planned to be modified to a conventional cargo handling berth from a container handling berth after 1988. The container equipment of the berth, however, is assumed to be retained there in the cost estimate of the Master Plan. The above mentioend modification of the #5 berth of the Queen Elizabeth Quay and the retention of the container equipment must be judged at the final stage of the Plan taking into consideration the movement of the resultant containeriza-tion.

(2) Container Berth

1) In response to the urgent need, the 200m extended part of the Queen Elizabeth Quay is planned for a container berth. The crane foundations and other civil engineering works will be completed by the end of 1981.

2) As for full scale container berths, a new quay (Korteboam Quay) with 3 full size container berths is planned in front of the existing Coaling Jetties.
The expansion of the whole Queen Elizabeth Quay to provide sufficient backup yard has been revealed to be unfeasible, as the results of the subsoil tests carried out during the present study.

3) The Korteboam Quay is accommodated with 3 full size berths with the water depth of −12m and the length of 300m and will be completed by the end of 1987.
The northernmost (#1) berth will be completed by the end of 1983 together with 250m of the #2 berth, which shall be a temporary berth for conventional cargo handling.

(3) Oil Berth

1) Dolphine berths for a 60,000 DWT tanker and bunkering vessel, located immediately behind the North-West Breakwater, are employed in the Master Plan after comparing, under the assumption that the dredging of the approach channel does not involve rock blasting, with an off-shore buoy berth for a 100,000 DWT tanker.

2) Besides the existing pipelines, a pipeline with 20" diameter is necessary for the quick unloading of crude oil. All the pipelines will be submerged under the sea bottom at the North Entrance of the Port.

3) Widening of the approach channel to 200m (>5.8B) by removing 75m of the southern end of the North-West Breakwater and by extending the South-West Breakwater by 150m along the channel is planned. To prevent overtopping waves and to keep the approach channel calm, a seawall on the North-West Breakwater and a wave dissipating work in front of the Breakwater are proposed in the Plan.

4) The result of the comparison of a dolphine berth with an off-shore buoy berth largely depends on the depth of the sea bottom rock surface in the approach channel. For this and some other reasons, the construction of a new oil berth is not included in the Urgent Plan, though it is urgently needed.
A feasibility study on an oil berth including in situ verfication of the depth of the bed-rock surface in the channel must be commenced immediately.

(4) Land Use Plan

1) Boat/barge repair shops under dual operations are to be integrated to the Barge Repairing Basin.

2) Other workshops are integrated, and will replace the site where the Walker Sons & Co., Ltd. has been located.

3) The area between the Block Jetty and the Baghdad is reserved for the demands from beyond the scope of the Master Plan. The area could be temporarily used for various construction work shops/stores during the implementation of the Plan.

4) The construction of the new 65,000 DWT dry dock is accepted at the northern part of the existing Coaling Jetties as is planned in its feasibility study.

5) The Beira Lake (East Lake) is considered to be an environmental reservation at least in the long run.

(5) Road

1) The road inside the Port is widened to 4 lanes from the existing 2 lanes.

2) The main entrance to/from the Port is to be set up near the existing Blomendahl Railway Gate.

(6) Cargo Handling Equipment

1) Conventional Cargo Handling Equipment is listed in Table-S.5.

2) Container Equipment is listed in Table-S.6. A full size container berth is equipped with two container cranes, and straddle carriers are selected as the main equipment for the marshalling yard.

5-4 Structural Design

(1) Korteboam Quay

A reinforced concrete caisson quaywall is selected for the Korteboam Quay taking into account the soil condition, the construction cost/period, and the relative difficulty in construction work. The revetment of the Quay shall be constructed of the same type.

(2) Widening of the North Pier

For the revetment facing the Prince Vijaya Quay, a sloping rubble type is selected to dissipate the wave energy coming through the North Entrance.

(3) Extension of the South West Breakwater

A reinforced concrete caisson, the most favourable type on hard base, is used.

(4) Oil Berth

Since the bedrock surface is not deep, a reinforced concrete caisson type is chosen as the working platform and for the breasting dolphines.

(5) Soft surface layer

Soft surface layers, if any, are to be dredged and replaced by engineered fill.

5-5 Construction Method

(1) Construction of Korteboam Quay

The construction procedures of the Korteboam Quay are as follows:

1) First of all, caissons for the south side of the Quay in the Urgent Plan are to be made by floating docks in front of the Coaling Jetties. Concrete and other construction materials must be supplied by barges. The number of cassions to be made at this stage is 16 for 300m.

2) After placing every caisson at the prescribed position along the face line of the Quay and casting the backfill rubble, the south side revetment of the Quay itself can be used as mooring berths for the floating docks as well as the road for supply of construction materials. Thus, the remaining caissons are made there.

3) For the expansion of the Korteboam Quay in the Master Plan, the south side of the Quay after the completion of the Urgent Plan can be utilized as mooring berths for the floating docks. Thus the caissons necessary for the expansion in the Master Plan, except the southernmost side of the Quay, can be built there.

4) After placing all the caissons along the west/east face line of the Quay, the caissons of the south side of the Quay can be transfered to the southernmost side.

(2) Reclamation Fill for Kortebeam Quay

The sea bottom sand to the north of the North-West Breakwater or in front of the Kelani Ganga is to be used as a reclamation fill.

(3) Cement

For cement, there are likely to be some problems both in quantity and quality, hence the import of cement is proposed in the Plan.

5-6 Construction Schedule

The construction schedule is shown in Table-S.7.

5-7 Rough Cost Estimates

(1) Exchange Rate

The foreign exchange rate used in the study is the average of June 1979.

1 US$ = 15.625 Rupees = 218.89 Yen

From this, the exchange rate between Rupee and Yen is as follows:

1 Rupee = 14 Yen

(2) Rough Costs Estimates

The overall cost amounts to 130,360 thousand US$ and is shown in Table-S.3. The construction cost, which excludes the purchase of equipment, totals 91,731 thousand US$ (70.4%) and is shown in Table-S.8. The cost of purchasing conventional/container equipment amounts to 38,629 thousand US$ (29.6%) and is shown in Table-S.5 and Table-S.6.

6. Urgent Plan

6-1 Coverage of the Urgent Plan

The Urgent Plan covers all the urgent items in the Master Plan, excluding the new oil berth. The target year of the Urgent Plan is 1983. The proposed layout of the Urgent Plan is shown in Fig.-S.2. Table-S.9 shows the summary of the Plan.

(1) Container Berths

Two container berths are planned, one in the Queen Elizabeth Quay and the other in the Korteboam Quay.

The extended part of the Queen Elizabeth Quay, with the length of 200m, is equipped with a container crane and can be opened at the beginning of 1982. The northernmost (#1) berth of the Korteboam Quay, with the length of 300m and the water depth of −12m, is equipped with two container cranes and its construction work can be completed by the end of 1983.

(2) Conventional Berth

One berth in the North Guide Pier is transferred to the Colombo Dockyard Ltd. by the end of 1983. As a temporary substitution for this, one conventional berth in the Korteboam Quay is planned with the length of 250m.

(3) Road

2 lanes out of 4 lanes proposed in the Master Plan are improved in the Urgent Plan.

(4) Conventional Cargo Handling Equipment

All the conventional cargo handling equipment proposed in the Master Plan is purchased within the scope of the Urgent Plan. They are listed in Table-S.5.

(5) Container Equipment

The container equipment proposed in the Urgent Plan are shown in Table-S.10. Three container cranes, one for the Queen Elizabeth Quay and remaining two for the Korteboam Quay, are included in the Plan.

6-2 Construction Schedule

The construction schedule is shown in Table-S.7 and Table-S.11.

6-3 Cost Estimates and Investment Schedule

The cost and the investment schedule of the Urgent Plan are shown in Table-S.12. The total cost is 70,458 thousand US$ of which 54,040 thousand US$ (76.7%) is foreign currency and 16,418 thousand US$ (23.3%) is local currency.

6-4 Economic Analysis

(1) Method of Economic Analysis

The method of the economic analysis for the Urgent Plan is as follows:

1) Both the shadow pricing and the market pricing are employed to evaluate all the costs and the benefits.

2) The alternative to which the Plan is compared is called the "WITHOUT" Case, that is, the case without any investment.

3) The economic returns are evaluated through an internal rate of return (IRR).

4) Calculation of IRR is carried out over 25 years from 1980, the first year of the investment, to 2004.
The average service life of the facilities/equipments included in the Plan is 27.9 years.

(2) Benefits

The benefits of the Urgent Plan are as follows:

1) Contribution to the economic development – Strengthening the basis for the nation's economic development through modernization of the Port

2) Entrepot trade center – Providing the function of a center for an entrepot trade handling tranship cargo and providing container feeder services to the neighbouring countries.

3) Reduction in cargo handling costs – Reduction in cargo handling costs by raising cargo handling productivity through mechanization and containerization.

4) Reduction in damage to cargo – Reduction in damage to cargo through containerization and mechanization.

5) Reduction in ships' staying cost – Reduction in ship costs for awaiting berth and loading/unloading cargo through upgrading the port services.

6) Reduction in transit time – Reduction in transit time through upgrading the port services.

7) Safety – Improvement in the safety of navigation by extending the waterway and expanding the turning basin.

8) Value added earned by ship repair – Increase in the value added earned by the Colombo Dockyard Ltd., through the modification of a cargo handling berth in the North Guide Pier to a ship repair berth.

Among the above mentioned benefits, 3), 5) and 8) are measurable and are taken into account in the economic analysis.

All of the reduction of ships' staying cost, however, is not necessarily attributed to Sri Lanka. As the "feedback ratio", the ratio of what is attributed, irrespective of directly or indirectly, to Sri Lanka to all of the benefit, 10% is employed in consideration of the recent shares of the Ceylon Shipping Corporation in cargo traffic. Further, the feedback ratio of 50% is analyzed as well, considering the likely increase of the ratio in the next 25 years. At the same time, this serves as a sensitivity analysis.

(3) Costs

Costs of the Urgent Plan are as follows:

1) Construction cost – Cost of constructing civil engineering facilities.

2) Equipment cost – Cost of purchasing cargo handling equipment.

3) Operation/maintenance cost – Cost of operation and maintenance of equipment and other various facilities.

(4) Evaluation of Economic Returns

The internal rates of return (IRRs), with the feedback ratio of 10%, are as follows:

| | |
|---|---|
| Shadow pricing: | IRR = 17.1% |
| Market pricing: | IRR = 19.5% |

The IRRs in port investment projects usually range from 10% to 20% and it is commonly considered that a port project with an IRR of more than 10% is economically feasible.

Thus, the present Plan can be concluded to be economically feasible.

The IRRs with the feedback ratio of 50% are 40.8% for shadow pricing and 43.1% for market pricing.

6-5 Financial Analysis

(1) Premises

1) The Port of Colombo is separately operated under a self-supporting system.

2) Taking into consideration the scale of the Urgent Plan, the analysis covers the whole Port, including the Plan itself, rather than the Plan only. The internal rates of return (FRR) of the Plan itself are calculated, as well.

(2) Investigations on the Financial Statements and the Tariff Level

1) The Sri Lanka Ports Authority is now carrying out the revaluation of the fixed assets, which were under the control of the former Colombo Port Commission. Thus, the value of those fixed assets is not available yet, and only the cost of the extension of the Queen Elizabeth Quay and the estimated value of the land previously owned by the Port Commission are included in the analysis, besides the fixed assets previously owned by the Port (cargo) Corporation and the Tally and Protective Services Corproation.

2) It is concluded, by investigating the revenue/expenditure and the source/application of funds, that the self-supporting system of the Port can not be maintained under the current port tariff.

It is also concluded, under the following assumptions, that an average 25% raise in the port tariff, excluding the container tariff, is necessary to maintain the self-supporting system of the Port:

a. A foreign currency portion of the investment to the Plan is financed by a long-term loan (interest rate: 8%, term: 20 years) from foreign countries.
b. A local currency portion is financed by a loan (interest rate: 8%, term: 15 years) from the Consolidated Fund.
c. The income tax of 50% of the profit after depreciation is paid to the government.
d. A dividend of 4% on the capital investment by the government is paid to the Consolidated Fund.

3) The revenue/expenditure and the financial position of the Port after an average 25% of conceptual raise in the port tariff other than the container tariff are shown in Table-S.13.

4) Assuming that the foreign currency portion can be financed with the interest rate of 3% and the loan term of 30 years, an average 18% raise in the port tariff, excluding the container tariff, is enough for maintaining the self-supporting system of the Port.

5) The conditions under which any raise in the port tariff is unnecessary are as follows:

a. Foreign currency portion: interest rate: 8%, loan term; 20 years
b. Local currency portion: interest rate: 0%, loan term: 20 years
c. Dividend on the capital investment by the Government: 0%

(3) Internal Rates of Return (FRR)

The internal rate of return of the Plan is 8.22%.

The internal rates of return corresponding to average raises in the port tariff, other than the container tariff, are shown in Table-S.14.

## Table – S.1 Traffic Forecast of the Port of Colombo

(Unit: Thousand Tons)

| Items | Export | | | | | Items | Import | | | | | Total | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1978 | 1983 | | 1988 | | | 1978 | 1983 | | 1988 | | 1978 | 1983 | | | 1988 | | |
| | Total | Total | Container | Total | Container | | Total | Total | Container | Total | Container | Total | Total | 1988/1978 | Container | Total | 1988/1978 | Container |
| Dry Cargo | | | | | | Dry Cargo | | | | | | | | | | | | |
| Tea | 464 | 517 | | 575 | | Rice | 141 | 55 | – | – | – | | | | | | | |
| Rubber | 141 | 146 | | 148 | | Flour | 538 | 320*1 | – | 371*1 | – | | | | | | | |
| Coconut | 38 | 50 | | 60 | | Sugar | 157 | 127 | – | 100 | – | | | | | | | |
| Coconut Fiber | 132 | 172 | (560) | 225 | (1,470) | Wheat | – | 75 | – | – | – | | | | | | | |
| Coconut Oil (In Drum) | 11 | 31 | | 40 | | Cement | – | 75 | – | 380 | – | | | | | | | |
| General Cargo | 254 | 489 | | 941 | | Fertilizer | 435 | 370 | – | 461 | – | | | | | | | |
| | | | | | | General Cargo | 624 | 886 | (339) | 1,272 | (928) | | | | | | | |
| Sub Total | 1,040*2 | 1,405 | (560) | 1,989 | (1,470) | Sub Total | 1,895 | 1,908 | (339) | 2,584 | (928) | 2,935 | 3,313 | 1.128 | (899) | 4,573 | 1.558 | (2,398) |
| Wet Cargo | | | | | | Wet Cargo | | | | | | | | | | | | |
| Coconut Oil | 23 | 30 | – | 39 | – | Crude Oil | 1,457 | 2,350 | – | 2,350 | – | | | | | | | |
| Refined Oil | 84*3 | 84*3 | – | 84*3 | – | Refined Oil | 126 | 401 | – | 635 | – | | | | | | | |
| Sub Total | 107 | 114 | – | 123 | – | Sub Total | 1,583 | 2,751 | – | 2,985 | – | 1,690 | 2,865 | 1.695 | – | 3,108 | 1.839 | – |
| Grand Total | 1,147 | 1,519 | (560) | 2,112 | (1,470) | Grand Total | 3,478 | 4,659 | (339) | 5,569 | (928) | 4,625 | 6,178 | 1.336 | (899) | 7,681 | 1.661 | (2,398) |

1) *1 includes local transport.
*2 excludes export of rice (10,000 tons)
*3 excludes export of refined oil (162,000 tons)
2) Tranship Container (245,000 tons for 1983 and 408,000 tons for 1988) is excluded in the Table.

Table – S.2 Requirements for the Port of Colombo

| Requirement | Details |
|---|---|
| 1. Increase in cargo handling capacity | a. To meet expected demand in cargo traffic forecast |
| 2. Improvement of service level/coverage | a. To relieve port congestion<br>b. To prepare container facilities |
| 3. Effective use of land | a. Removal of facilities/functions unrelated to the Port<br>b. Effective use of idle spaces<br>c. Unification/integration of boat/barge repairing shops |
| 4. Improvement of road network | a. Improvement/widening of the existing road<br>b. To insure proper interfacing of port and city road plans |
| 5. Improvement of safety | a. Improvement of approach channel and turning/mooring basin<br>b. Removal of the existing Oil Dock |
| 6. Increase in large ship repairing capacity | a. Construction of a 65,000 DWT dry dock.<br>b. Modification of existing cargo handling berths to ship repair berths |

## Table – S.3 Summary – Master Plan

| Item | Unit | Q'ty | Cost | | Target Year | Note |
|---|---|---|---|---|---|---|
| | | | Value (1,000 US$) | Share (%) | | |
| Conventional Berths | | | | | | |
| KQ #2 (New Berth, Temporary) | Berth | 1 | – | | 1983 | Modified to CTNR Berth after 1988 |
| NP (Widening, 1 Berth → 2 Berths) | Berth | 2 | 3,538 | 2.7 | After Removal of Oil Dock | Widening of 50m, Two –9m Berths |
| NGP/SP (Cargo Berth → Ship Repair Berth) | Berth | 3 | – | | 1983 (1B) After Completion of NP (2B) | |
| QFQ #5 (Container → Conventional) | Berth | 1 | – | | 1988 | |
| Cargo Handling Equipment | Set | 1 | 7,537 | 5.8 | 1980 | |
| Sub Total | | | 11,075 | 8.5 | | |
| Container Berths | | | | | | |
| QFQ #5 (Crane Foundation, etc.) | Set | 1 | 1,628 | 1.2 | 1981 | |
| KQ #1/#2/#3 | Berth | 3 | 47,736 | 36.6 | 1983 (#1) 1988 (#2/#3) | #2 (Conventional → Container) |
| Dredging | M.m³ | 1.5 | 2,580 | 2.2 | 1983, 1988 | |
| Container Equipment | Set | 1 | 31,092 | 23.9 | 1981, 1983, 1988 | |
| Sub Total | | | 83,336 | 63.9 | | |
| Oil Berth* | | | | | | *A feasibility study including an in situ survey of the bed-rock depth along the approch channel should be carried out. |
| Dolphines | Set | 1 | 937 | 0.7 | Set by F/S* | |
| Pipelines, etc. | Set | 1 | 11,515 | 8.8 | " | |
| Bunkering Facilities | Set | 1 | 686 | 0.5 | " | |
| Improvement of Port Entrance | Set | 1 | 12,011 | 9.2 | " | |
| Extension of SW Breakwater | (m) | (150) | (6,171) | | | |
| Removal of the Southwest End of NW Breakwater | (m) | (75) | (514) | | | |
| Seawall/Wave Dissipation Work along NW Breakwater | (m) | (700) | (5,326) | | | |
| Dredging | M.m³ | 3.24 | 6,900 | 5.4 | " | |
| Tug Boat | No. | 1 | 1,919 | 1.5 | " | |
| Sub Total | | | 33,968 | 26.1 | | |
| Road | km | 5.7 | 1,981 | 1.5 | 1982 (2 Lanes) 1988 (4 Lanes) | |
| Grand Total | | | 130,360 | 100.0 | | |

Note: Engineering fee and physical contingency are not included in the Table.

## Table – S-4 Number of Alongside Berths (Dry Cargo)

| | Exsisting | | Planned | | Transferred | | Balance | |
|---|---|---|---|---|---|---|---|---|
| | Large*1 | Small*1 | Large | Small | Large | Small | Large | Small |
| Alongside Berths | 14 | 3 | 5 | 0 | 3*3 | 0 | 16 | 3 |
| Conventional | 14 | 3 | 2*2 | 0 | 3 | 0 | 13 | 3 |
| Container | 0 | – | 3 | – | 0 | – | 3 | – |

Note: *1 "Large" denotes for quaywalls with the water depth of -7.5m or deeper and "small" for quaywalls with that shallower than -7.5m.

*2 North Pier

*3 2 berths at North Guide Pier and 1 berth at South Pier.

## Table – S-5 Conventional Cargo Handling Equipment and Cost Estimates for Master Plan

(Unit: Thouthand US$)

| Equipment | Nos. to be purchased | Cost per Unit | Total Cost |
|---|---|---|---|
| Forklift Trucks | 38 (3T) | 12.2 | 464 |
| | 47 (5T) | 22.1 | 1,039 |
| | | (Sub Total) | 1,503 |
| Mobil Cranes | 8 (30T) | 182.8 | 1,462 |
| | | | 1,462 |
| Floating Cranes | 1 (100T) | 4,572.0 | 4,572 |
| Total Cost | | | 7,537 |

## Table – S.6 Container Equipment and Cost Estimates for Master Plan

(Unit: $1,000 USD)

| Equipment | QEQ | | Korteboam | | Total | |
|---|---|---|---|---|---|---|
| | Quantity | Cost | Quantity | Cost | Quantity | Cost |
| Container Crane | 1 | 3,017 | 6 | 18,102 | 7 | 21,119 |
| Straddle Carrier | 3 | 960 | 22 | 7,040 | 25 | 8,000 |
| Yard-use Tractor | 2 | 52 | 15 | 390 | 17 | 442 |
| Yard-use Trailer Chassis 40' | 2 | 18 | 20 | 180 | 22 | 198 |
| " 20' | 8 | 56 | 30 | 210 | 38 | 266 |
| Forklift Truck 15 ton | 2 | 274 | – | – | 2 | 274 |
| " 1.5 ton | 6 | 84 | 36 | 504 | 42 | 588 |
| Weighing Scale | – | – | 5 | 205 | 5 | 205 |
| Total | | 4,461 | | 26,631 | | 31,092 |

Table – S.7 Construction Schedule for Master Plan

| Item | | | Quantity | | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | Target year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Civil Engineering Works | QEQ #5 | Containerization | 200 | m | | | | | | | | | 1981 |
| | KQ | Quaywall & Revetment | 1,910 | m | | | | | | | | | Quaywall 550m 1983 350m 1987 |
| | | Reclamation | 2,600,000 | $m^3$ | | | | | | | | | |
| | | CFS and Others | 1 | Set | | | | | | | | | |
| | NP | Revetment | 410 | m | | | | | | | | | 1985 |
| | | Reclamation | 198,000 | $m^3$ | | | | | | | | | |
| | Road | | 5,700 | m | | | | | | | | | 1982 2-Lanes 1986 4-Lanes |
| | Dredigng | | 1,500,000 | $m^3$ | | | | | | | | | |
| Equipment | Conventional | | 1 | Set | | | | | | | | | 1980 |
| | QEQ #5 | | 1 | Set | | | | | | | | | 1981 |
| | KQ | | 1 | Set | | | | | | | | | 1 Berth 1983 2 Berths 1987 |
| Oil Berth | Feasibility Study | | 1 | Set | | | | | | | | | |
| | Berth | Dolphines | 1 | Set | | | | | | | | | |
| | | Pipelines | 1 | Set | | | | | | | | | |
| | Dredging (Turning Basin) | | 2,000,000 | $m^3$ | | | | | | | | | |
| | Dredging (Waterway) | | 1,240,000 | $m^3$ | | | | | | | | | |
| | Improvement of Port Entrance | SW Breakwater Extension | 150 | m | | | | | | | | | |
| | | NW Breakwater Removal | 75 | m | | | | | | | | | |
| | | NW Breakwater Seawall/ Wave Dissipating Work | 700 | m | | | | | | | | | |

## Table – S-8 Rough Estimate of Construction Costs

(Unit: US$)

| | No. | Facility | Main item | Quantity | | Unit Price | Rough Cost Estimate |
|---|---|---|---|---|---|---|---|
| | | | | | | (US$) | (Thousand US$) |
| Container & Conventional Berths | 1 | QEQ #5 | Crane foundation | 200 | m | 6,540 | 1,308 |
| | | | Heavy Pavement | 40,000 | m² | 8 | 320 |
| | | | (Sub Total) | | | | (1,628) |
| | 2 | KQ Container terminal | -12.0m Quaywall | 900 | m | 20,750 | 18,675 |
| | | | -7.5m Revetment | 610 | m | 9,960 | 6,076 |
| | | | -10.0m Revetment | 400 | m | 14,200 | 5,680 |
| | | | Reclamation | 2,600,000 | m³ | 2.5 | 6,500 |
| | | | Heavy Pavement | 235,000 | m² | 31 | 7,285 |
| | | | C.F.S | 16,000 | m² | 220 | 3,520 |
| | | | (Sub Total) | | | | (47,736) |
| | 3 | North Pier | -4.0 ~ -10.0m Revetment | 360 | m | 5,680 | 2,045 |
| | | | -10.0m Revetment | 50 | m | 14,200 | 710 |
| | | | Reclamation | 198,000 | m³ | 2.5 | 495 |
| | | | Pavement | 18,000 | m² | 16 | 288 |
| | | | (Sub Total) | | | | (3,538) |
| | 4 | Road | | 5,700 | m | | 1,981 |
| | 5 | Dredging | -12.0m Dreding | 1,500,000 | m³ | 1.92 | 2,880 |
| | Total | | | | | | 57,763 |
| Oil Berth | 6 | Oil Berth | Main dolphins | 1 | Set | | 937 |
| | | | Bunkering dolphins | 1 | Set | | 686 |
| | | | Piplines | 1 | Set | | 11,515 |
| | | | (Sub Total) | | | | (13,138) |
| | 7 | Dredging (Turning Basin) | -14m Dredging | 2,000,000 | m³ | 1.9 | 3,800 |
| | 8 | Dredging (Waterway) | -15.5m Dredging | 1,240,000 | m³ | 2.5 | 3,100 |
| | 9 | SW Breakwater | 150m Extension | 150 | m | 41,142 | 6,171 |
| | 10 | NW Breakwater | 75m Removal | 75 | m | 6,857 | 514 |
| | | | Seawall/Wave Dissipating Work | 1 | Set | | 5,326 |
| | 11 | Tug boat | | 1 | No. | | 1,919 |
| | Total | | | | | | 33,968 |
| Grand Total | | | | | | | 91,731 |

## Table – S.9 Summary – Urgent Plant

| Item | Unit | Q'ty | Cost | | Target Year | Note |
|---|---|---|---|---|---|---|
| | | | Value (1,000 US$) | Share (%) | | |
| Conventional Berths | | | | | | |
| KQ #2 (New Berth, Temporary) | Berth | 1 | – | | 1983 | Modified to CINR Berth after 1988 |
| NGP #1 (Cargo Berth → Ship Repair Berth) | Berth | 1 | – | | 1983 | Transferred to CDL |
| Cargo Handling Equipment | Set | 1 | 7,537 | 10.7 | 1980 | |
| Forklift (3t) | (No.) | (38) | (464) | | | |
| Forklift (5t) | (No.) | (47) | (1,039) | | | |
| Mobile Crane (30t) | (No.) | ( 8) | (1,462) | | | |
| Floating Crane (100t) | (No.) | ( 1) | (4,572) | | | |
| Sub Total | | | 7,537 | 10.7 | | |
| Container Berth | | | | | | |
| QEQ #5 (Crane Foundation, etc.) | Set | 1 | 2,293 | 3.2 | 1981 | |
| KQ #1 (Bulkhead, etc.) | Set | 1 | 33,912 | 48.1 | 1983 | Includes Construction Cost for 250m of #2 |
| Dredging | | | 2,880 | 4.1 | 1983 | |
| Container Equipment | Set | 1 | 13,794 | 19.6 | 1981, 1983 | |
| (Container Crane) | (No.) | 3 | (9,051) | | | |
| (Straddle Carrier) | (No.) | 11 | (3,520) | | | |
| (Others) | (Set) | 1 | (1,223) | | | |
| Sub Total | | | 52,879 | 75.0 | | |
| Road (2 Lanes) | km | 5.7 | 1,524 | 2.2 | 1982 | 2 Lanes, Ditchs and Sidewalks |
| Engineering | Set | 1 | 2,111 | 3.0 | | |
| Physical Contingency | Set | 1 | 6,407 | 9.1 | | |
| Grand Total | | | 70,458 | 100.0 | | |

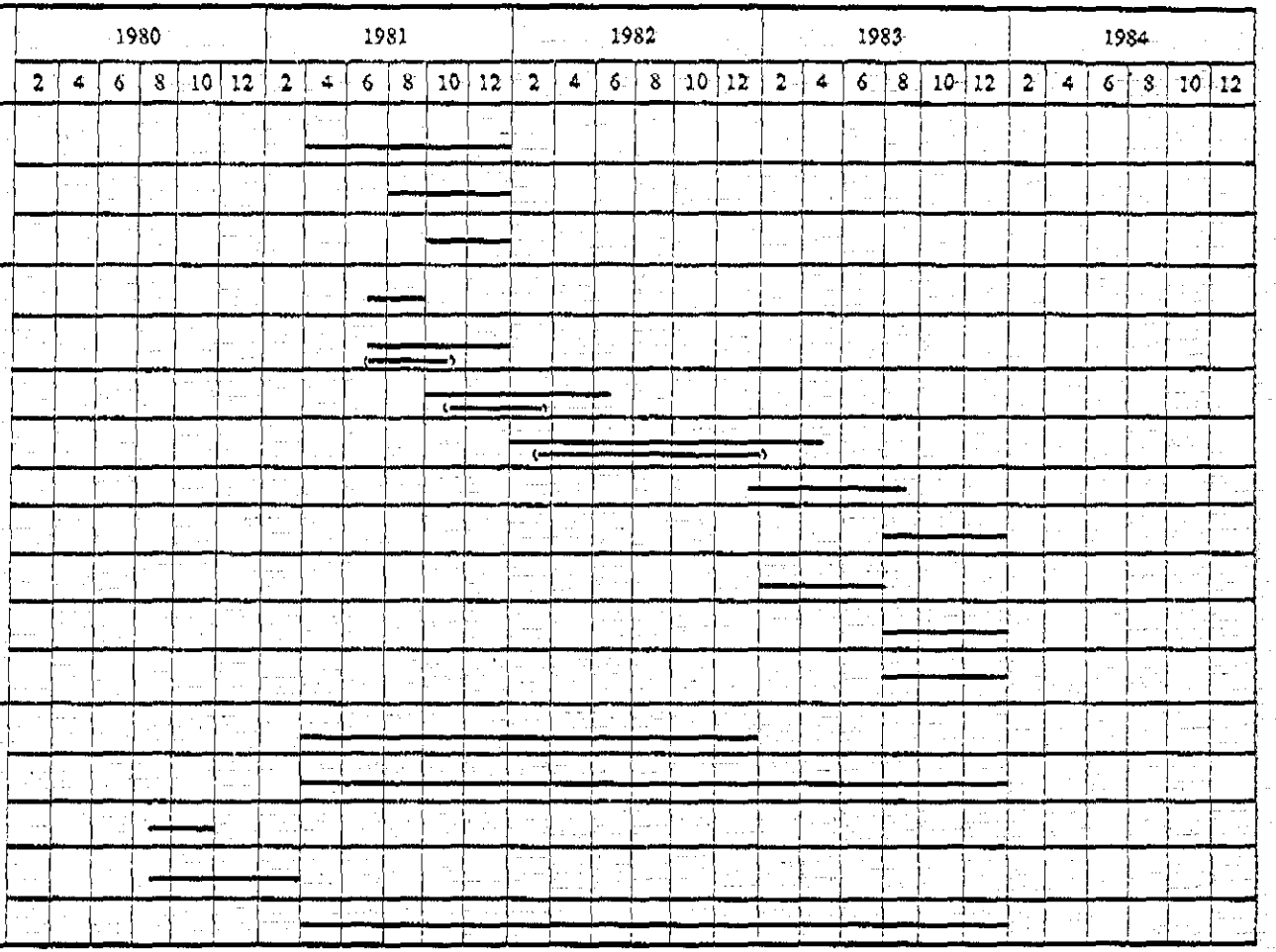
Table – S.10 List of Equipment required for QEQ #5 and Korteboam Container Terminals and Cost Estimates for Urgent Plan

(Unit: Thouthand US$)

| Equipment | Principle Particular | QEQ #5 | | Korteboam | | Total Cost |
|---|---|---|---|---|---|---|
| | | Q'tity | Cost | Q'tity | Cost | |
| Container Crane | Rated load under hook 35 tons (under spreader 30.5 tons) Rail span 16 meters | 1 | 3,017 | 2 | 6,034 | 9,051 |
| Straddle Carrier | Rated load under spreader 30.5 tons. Stacking 3 high for 20'/40' | 3 | 960 | 8 | 2,560 | 3,520 |
| Yard-use Tractor | Coupling load 12.5 tons, Hydraulic lifting coupler type | 2 | 52 | 5 | 130 | 182 |
| Yard-use Trailer Chassis | Rated load 30.5 tons for 40' | 2 | 18 | 15 | 135 | 153 |
| | Rated load 20.5 tons for 20' | 8 | 56 | 20 | 140 | 196 |
| Forklift Truck | Rated load 15 tons with spreader Stacking 3 high | 2 | 274 | – | – | 274 |
| Forklift Truck | Rated load 1.5 tons, Battery driven | 6 | 84 | 18 | 252 | 336 |
| Weighting Scale | 50 tons load | – | – | 2 | 82 | 82 |
| (Total) | | | 4,461 | | 9,333 | 13,794 |

## Table – S-11 Construction Schedule for Urgent Plan

| No. | Item | | Unit | Quantity |
|---|---|---|---|---|
| 1 | | Crane foundation | m | 200 |
| 2 | QEQ | Paving | m² | 40,000 |
| 3 | | Offices & Others | m² | 1,135 |
| 4 | | Access road | m | 150 |
| 5 | | South revetment | m (caisson) | 310 (16) |
| 6 | | North revetment | m (caisson) | 350 (20) |
| 7 | | Quaywall | m (caisson) | 550 (39) |
| 8 | KQ | Reclamation | m³ | 1,830,000 |
| 9 | | Yard paving | m² | 165,000 |
| 10 | | C.F.S | m² | 6,000 |
| 11 | | Electric & Others | Set | 1 |
| 12 | | Offices & Others | m² | 3,450 |
| 13 | Road | | m | 5,700 |
| 14 | Dredging | | m³ | 1,500,000 |
| 15 | Survey | | Set | 1 |
| 16 | Design | | Set | 1 |
| 17 | Construction Supervision | | Set | 1 |




Note: Shown in ( ) is caisson production

## Table – S.12 Yearly Investment Plan

(Unit: Thousand US$)

| Construction year | | | 1980 | | | 1981 | | | 1982 | | | 1983 | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Foreign | Local | Total | Foreign | Local | Total | Foreign | Local | Total | Foreign | Local | Total | Foreign | Local | Total |
| Civil engineering facilities | OEQ | Crane foundation | | | | 1,248 | 60 | 1,308 | | | | | | | 1,248 | 60 | 1,308 |
| | | Heavy paving | | | | | 320 | 320 | | | | | | | | 320 | 320 |
| | | Offices & Others | | | | 226 | 146 | 372 | | | | | | | 226 | 146 | 372 |
| | | Power, lighting and water supply | | | | 251 | 42 | 293 | | | | | | | 251 | 42 | 293 |
| | | Sub total | | | | 1,725 | 568 | 2,293 | | | | | | | 1,725 | 568 | 2,293 |
| | KQ | Access road | | | | 378 | 62 | 440 | | | | | | | 378 | 62 | 440 |
| | | South revetment | | | | 4,055 | 521 | 4,576 | 51 | 39 | 90 | | | | 4,106 | 560 | 4,666 |
| | | North revetment | | | | 1,856 | 251 | 2,107 | 1,190 | 168 | 1,358 | | | | 3,046 | 419 | 3,465 |
| | | Quaywall | | | | | | | 7,913 | 1,004 | 8,917 | 2,118 | 340 | 2,458 | 10,031 | 1,344 | 11,375 |
| | | Reclamation | | | | | | | 525 | 50 | 575 | 3,672 | 351 | 4,023 | 4,197 | 401 | 4,598 |
| | | Paving of yard | | | | | | | | | | | 5,050 | 5,050 | | 5,050 | 5,050 |
| | | C. F. S. | | | | | | | | | | 792 | 516 | 1,308 | 792 | 516 | 1,308 |
| | | Offices and Others | | | | | | | | | | 589 | 382 | 971 | 589 | 382 | 971 |
| | | Power, lighting and water supply | | | | | | | | | | 1,913 | 126 | 2,039 | 1,913 | 126 | 2,039 |
| | | Sub total | | | | 6,289 | 834 | 7,123 | 9,679 | 1,261 | 10,940 | 9,084 | 6,765 | 15,849 | 25,052 | 8,860 | 33,912 |
| | Dredging | | | | | | 960 | 960 | | 960 | 960 | | 960 | 960 | | 2,880 | 2,880 |
| | Roads | | | | | | 762 | 762 | | 762 | 762 | | | | | 1,524 | 1,524 |
| | Sub total (1) | | | | | 8,014 | 3,124 | 11,138 | 9,679 | 2,983 | 12,662 | 9,084 | 7,725 | 16,809 | 26,777 | 13,832 | 40,609 |
| Equipment | Q. E. Q (Container) | | | | | 4,461 | | 4,461 | | | | | | | 4,461 | | 4,461 |
| | K. Q (Container) | | | | | | | | | | | 9,333 | | 9,333 | 9,333 | | 9,333 |
| | Conventional berth | | 7,537 | | 7,537 | | | | | | | | | | 7,537 | | 7,537 |
| | Sub total (2) | | 7,537 | | 7,537 | 4,461 | | 4,461 | | | | 9,333 | | 9,333 | 21,331 | | 21,331 |
| Engineering | Survey and design | | 594 | 169 | 763 | 238 | 69 | 307 | | | | | | | 832 | 238 | 1,070 |
| | Construction supervision | | | | | 278 | 69 | 347 | 278 | 69 | 347 | 278 | 69 | 347 | 834 | 207 | 1,041 |
| | Sub total (3) | | 594 | 169 | 763 | 516 | 138 | 654 | 278 | 69 | 347 | 278 | 69 | 347 | 1,666 | 445 | 2,111 |
| Physical contingency [15% of (1) + (3)] | | | 89 | 25 | 114 | 1,280 | 489 | 1,769 | 1,493 | 458 | 1,951 | 1,404 | 1,169 | 2,573 | 4,266 | 2,141 | 6,407 |
| Total | | | 8,220 | 194 | 8,414 | 14,271 | 3,751 | 18,022 | 11,450 | 3,510 | 14,960 | 20,099 | 8,963 | 29,062 | 54,040 | 16,418 | 70,458 |

Table - S. 13 Revenue / Expenditure and Financial Position

(Unit: Million Rs.)

| | 1978 | 1983 | 1984 | 1990 ~1994 | 1995 ~1999 | 2000 ~2004 |
|---|---|---|---|---|---|---|
| Revenue | 390 | 561 | 667 | 3,430 | 3,430 | 3,430 |
| Profit after Depreciation | 132 | 82 | 101 | 829 | 972 | 1,040 |
| Fixed Assets | 1,296 | 2,368 | 2,333 | 1,983 | 1,808 | 1,633 |
| Long-term loan | -- | 844 | 844 | 283 | -- | -- |
| Consolidated fund | -- | 257 | 257 | -- | -- | -- |
| Reserve and Provision | 156 | 312 | 309 | 515 | 736 | 991 |

Table – S.14 Internal Rates of Return (FRR)

| Tariff Raise | Internal Rate of Return (FRR) |
|---|---|
| 10% | 1.87% |
| 18% | 5.08% |
| 25% | 8.22% |
| 30% | 10.47% |

Fig. – S.1 Port Layout – Master Plan
(L: 250m)

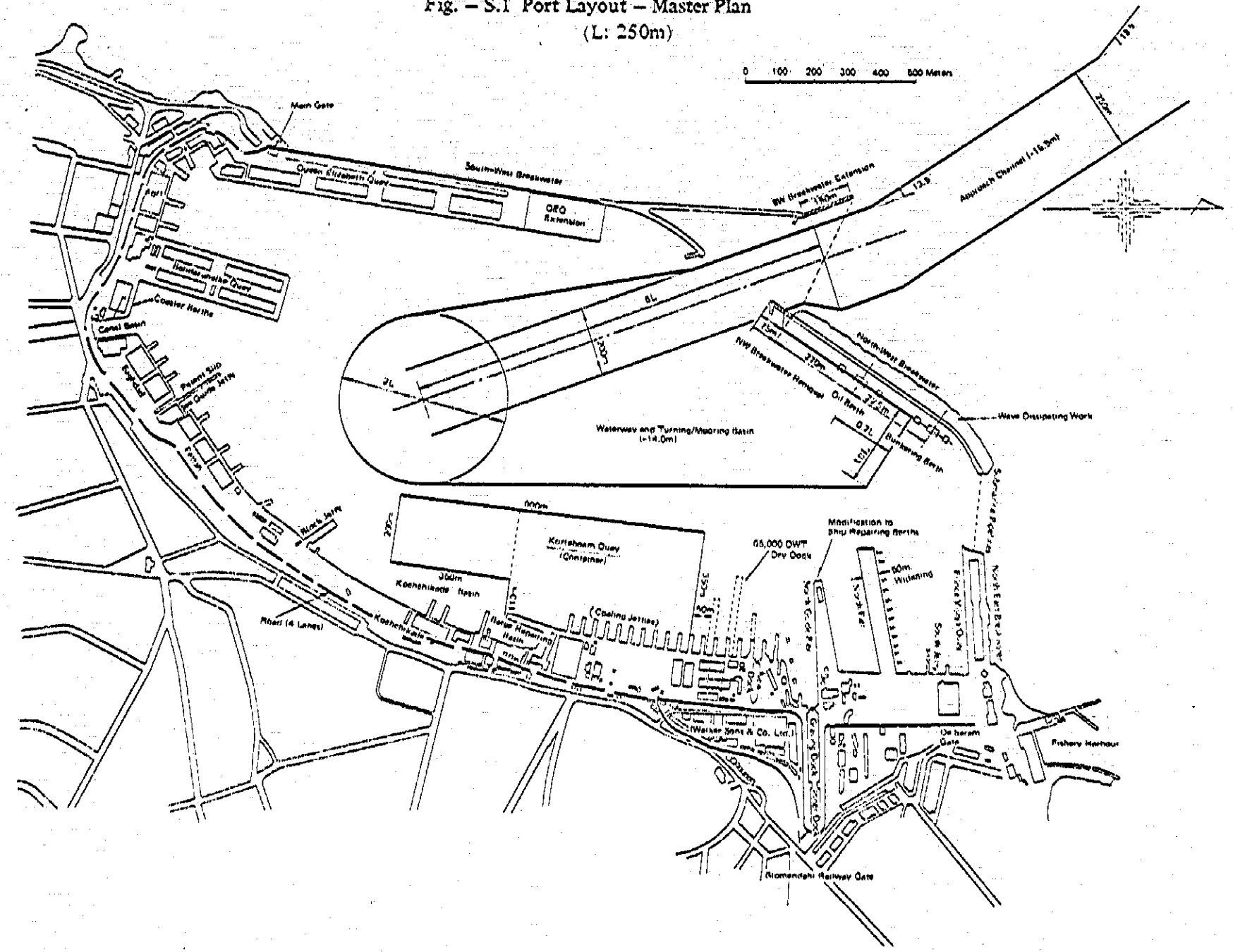


Fig. – S.2 Port Layout – Urgent Plan
(L: 250m)