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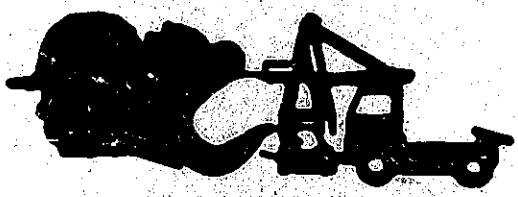
(Government of Guam)



New Master Plan for the Commercial Port of Guam

Final Report

September 1990

TAMS CONSULTANTS, Inc.
J. Agi & Associates, Inc.

Port Authority of Guam
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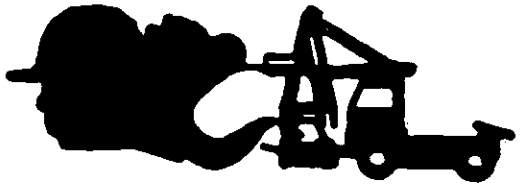

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INTRODUCTION

While Guam is the primary focus of the economic studies that are described in this report, the island also serves at the present time as a transshipment point and entrepot for other islands in Micronesia. Therefore, the economic prospects of the Commonwealth of the Northern Marianas Islands, the Federal States of Micronesia and Palau are also reviewed in this chapter.

Economy of Guam

The sectors of Guam's economy that generate most of the demand for commercial port facilities and services, are tourism, military activities, local private and public consumption and the construction industry. The first two sectors are exogenous to the local economy in that their level of activity is determined by forces over which Guam has little or no control. The local consumption and construction sectors are in part reactive to the level of activity in the tourism and military sectors but also respond to such independent variables as the population growth and federal subsidies and grants.

Guam's economy has witnessed a rapid, double-digit rate of growth in recent years. The near-term outlook is excellent, mainly because of the continued expansion of tourism. Despite periodic efforts to diversify the economy by promoting exports and import substitution programs, it is generally agreed that, for the foreseeable future, Guam's economy will remain focused on services because of the Island's lack of natural resources, its small market size and relatively high labor costs.

There are several reasons for believing that tourism to Guam will continue its rapid growth during the period under review. It remains a favorite destination for East Asians who have a growing interest in travel; the Government of Guam has encouraged its growth and investment is strong. It is reasonable to assume a two-digit

growth rate for tourism in the near-term with the slower and declining growth rates in the more distant future.

Regarding military activities, the recent easing of tensions in Europe and the demands for cuts in military spending suggest a decline in the overall level of military activities. Tensions have not, however, eased to the same degree in Asia and Guam's location as the furthest west piece of U.S. soil gives reason to believe that it will continue to play a military role during the period under review. What that role will be is not yet clear.

In Guam, construction is the principal form of investment activity and a barometer of the Island's near-term expectations. While tourism will remain the most dynamic segment of the construction industry, a parallel growth rate can be expected in public works construction, and there will be continued growth in residential, office and commercial construction, reflecting higher levels of economic and tourist activities.

Local consumption demand for imports will continue to be determined primarily by the size and growth of population, employment, per capita income and the extent of import substitution programs. As such its growth will reflect the strength of the other sectors.

Economy of the CNMI

The economy of the Commonwealth of the Northern Marianas Islands (CNMI) has certain similarities to that of Guam. It, also, is largely oriented towards services, with strong tourism and construction sectors, concentrated largely in Saipan. The economy differs from that in Guam, however, inasmuch as Commonwealth status means that the CNMI is exempt from various U.S. laws. Furthermore, since the population of the CNMI is quite young, a high rate of population growth is foreseen (among citizens). Because of its position on the learning curve, a high rate of increase in productivity is foreseen in the CNMI's Overall Economic Development Strategy. Restraints on economic growth include the present state of infrastructure, a small labor force that needs additional training and, perhaps in the future, a limited amount of privately-owned land.

That growth will stem primarily from the continued expansion of tourism and from expenditures for the construction of infrastructure and tourism facilities--the latter being made possible by Federal funds and outside investment. The manufacturing sector was important in recent years but no further permits will be issued for garment plants and there may be some repatriation of foreign workers. Nevertheless high rates of growth are forecast, because of the strength of tourism and construction.

Economy of the FSM and Palau

The economic bases of the Federated States of Micronesia (FSM) and Palau are subsistence agriculture and fishing, limited tourism and the recycling of U.S. funds through government salaries and contracts for various services.

The outlook for the FSM is one of rather slow growth, with some spending for infrastructure as greater use is made of the U.S. funds allocated for this purpose. While population growth rates in the FSM are relatively high, natural increase may be offset by out-migration.

Palau may grow more rapidly, should its tourism sector take off and closer links be forged with Japan. The institutional base for a market economy and a skilled work force are still lacking, so rapid growth in the near future is unlikely.

EXISTING SHIP SERVICES AND TRAFFIC

At the present time regular service to Guam is provided by two domestic carriers in the mainland U.S.-Guam trade, four lines in inter-regional trade between Guam and the Far East and Australia and six lines in intra-regional trade between Guam and other islands in Micronesia. Two of the intra-regional lines operate joint services with the inter-regional lines and may be subsidiaries of those lines.

Table S-1 on the following page provides a summary of regularly scheduled cargo services calling at Guam. In addition to these liner services, vessels may also call on an induced basis with specialized cargoes.

TABLE S-1
EXISTING SHIPPING SERVICES

	Carriers	Frequency of Service	Type of Service	Routing or Area Served
Domestic Carriers				
a	American President Lines	Weekly	Containers	U.S. West Coast, Guam, Kaohsiung
b	Sea-Land Service Inc.	Weekly	Containers	U.S. West Coast, Honolulu, Guam Kaohsiung
Inter-Regional Carriers				
c-1	Kyowa Shipping Co.	Tri-weekly	Mainly Containers Some Break-bulk	Hong Kong-Keelung-Pusan-Guam
c-2	Kyowa Shipping Co.	Tri-weekly	Mainly Containers Some Break-bulk	Pusan-Kobe-Yokohama-Guam
c-3	Kyowa Shipping Co.	Every 4 wks	Containers, Break-bulk	Singapore-Manila-Guam-Saipan
c-4	Kyowa Shipping Co.	Monthly	Containers, Break-bulk	Kobe-Yokohama-Saipan-Guam
c-5	Kyowa Shipping Co.	Monthly	Containers Break-bulk	Kobe-Yokohama-Saipan-Guam-Pohnpei Kosrae-Majuro
d	Kambara Kisen Co. and Far East Micronesia Line (plus Palau Shipping Co.)	Tri-weekly (now--may soon be monthly)	Containers Break-bulk	Pusan-Hong Kong-Keelung-Guam-Saipan
e	NYK Line	(Jointly with No. c-5 above at the present time)		
f	Zim Israel Navigation Co.	25-28 days	Containers	Sydney-Melbourne-Brisbane-Guam
Intra-Regional Service				
g	Saipan Shipping Co.	Weekly	Containers Break-bulk	Guam-Saipan-Tinian
h	Seabridge Pacific Co.	Weekly	Containers Some Break-bulk	Guam-Saipan-Tinian
i	Angyuta Shipping Co.	Weekly	Containers Break-bulk	Guam-Rota
j	Taputso-Saipan	2-3/month	Break-bulk	Guam-Rota
k	Palau Shipping Co.*	Tri-weekly	Containers Break-bulk	Saipan-Guam-Yap-Palau
l	The Tiger Line**	Monthly	Container Break-bulk	Saipan-Guam-Truk-Yap-Palau

There are also induced calls for sporadic cargo requirements, such as various bulk commodities, some neo-bulk items, vehicles and scrap.

* Palau Shipping Co. and Far East Micronesia Line have joint services with Kambara Kisen Co. (see d above).

** The Tiger Line has joint service with Kyowa Shipping Co. (see c-4 above).

Also, a growing number of cruise ships are either calling at Guam or are based here for several months of the year. Other vessels ranging from 40 passengers up to 149 or more passenger offer day excursions and dinner cruises.

Finally, the Commercial Port is also used by two types of fishing vessels: purse seiners that call at Guam to load provisions and salt, plus fuel; and tuna longliners that discharge their loads of fish for air shipment to Japan and load salt, ice and fuel for their next trips.

Cargo Volumes

Since 1980, the total volume of imports, exports and transshipments (unduplicated) recorded by the Port has nearly doubled (from 656,000 revenue tons to 1,277,000 revenue tons) rising at 7% annually. It may be noted that Port records identify transshipments as goods that are discharged from one vessel and loaded aboard another vessel without leaving the Port. Review of port cargo data indicate the need for a further adjustment to net out what may be referred to as "hidden transshipments". These consist of goods contained in larger shipments consigned to distributors and dealers in Guam which are then re-exported to the other islands of Micronesia. Both types of transshipments represent the imports and exports of other countries or commonwealths. Therefore, they must be subtracted from the recorded export figures before future imports and exports are forecast.

Using a sample survey of the bills of lading and other published sources, base year imports have been grouped into categories that reflect the four sectors of Guam's economy: the tourist industry, military installations, construction activity and local (private and public) consumption. Using the same sample survey, over 90% of the exports have been classified as military-related cargo. The balance includes some miscellaneous foreign exports.

As a result of the various adjustments, which are discussed in detail in the Report, and application of the sample survey, the following net figures are derived for 1989 imports and exports:

Commodity Group	000 Rev. Tons
Imports	
Tourist Industry	188.2
Military Installations	165.8
Construction Activity	146.4
Local Consumption	475.3
Total	975.7
Exports	
Military Installations	112.8
Locally Generated	12.3
Total	125.1
TOTAL IMPORTS & EXPORTS (ADJUSTED)	1,100.8

Transshipments recorded by the Port in 1989 totalled 99,738 rev. tons, 72% arriving from the mainland United States and 28% from foreign ports, including the Far East, Australia and the CNMI. As discussed above, this figure does not include "hidden transshipments" which are goods consigned to distributors and dealers in Guam that are then re-exported to other islands in Micronesia. Also, an adjustment to the above figure is needed because of a difference in the way garments are tabulated on the inbound leg and the outbound leg. Total transshipments in 1989 are, therefore, estimated as follows:

Tabulated inbound transshipments (adjusted)	90,200 rev. tons
"Hidden" transshipments	23,800
Transshipped garments	38,000
TOTAL TRANSSHIPMENTS	152,000 rev. tons

Other Port Activities

While the transfer of skipjack tuna is now done at ports such as Tinian, purse seiners still call at Guam for reprovisioning, refueling, repairs and rest and recreation

for their crews. In fiscal 1989, 338 visits by purse seiners were recorded and on a given day four or so may be in port.

Beginning in 1986 longliners have called at Guam to land their catches of yellowtail and bigeye tuna, destined for sashimi markets in Japan. On any given day there may be 25 to 30 longliners in the Port though only a quarter to a third may be in need of a berth for discharging their catch.

Apra Harbor has become a port of call for a number of larger cruise ships. Nineteen such ships called in 1989. In addition, a 120 passenger cruise ship homeported in Apra in the first three to four months of each year offers four and five day cruises to other Micronesian ports. The U.S. Coast Guard reports that there were 20 commercial passenger vessels homeported in Guam in early 1990. Besides the cruise vessel noted above, they included motor ships, catamarans and trimarans, dive boats, cabin cruisers, launches and one submarine offering various excursions.

PORT FACILITIES

What is now the Commercial Port is a series of wharves and facilities that were started in 1964 and completed in 1969. Originally the facilities constituted an extension of other Naval facilities in Apra Harbor. They include the following:

Berth F(oxtrot)-3 (753-foot long);
Berths F-4, F-5 and F-6 (totaling 1,950 feet), served by two container cranes;
Sheds 1 and 2 (each 122 feet by 452 feet);
Container Freight Station, now used as a repair shop (80 feet by 302 feet);
The present Container Yard (containing about 15.2 acres);
The proposed Expansion of the Container Yard (which will provide an additional 12.5 acres);
Equipment Maintenance Facilities (located behind Shed 1);

Other port facilities in Apra Harbor that are used by civilian traffic include:

H(otel) Wharf is a former Navy ammunition wharf (500 feet long) that is used primarily as a passenger vessel facility.

Berth F(oxtrot)-2 is used for cement and repair of fish nets and vessels.
Berth F-1 and G(olf) Pier, with their attendant tankage, are both petroleum handling facilities.

Vessels are worked at the Port 24 hours a day, seven days a week. Under recently extended hours, the Port is nominally open for deliveries five days a week from 6 AM to 7 PM.

Wharf Capacity

In estimating the current capacity of the Commercial Port, only Berths F-4, F-5 and F-6 are considered. For all practical purposes, Berth F-3 is fully occupied by fishing vessels. Since H(otel) Wharf is devoted primarily to passenger vessels, it makes little contribution to the cargo-handling capacity of the Port.

Considering present handling rates and acceptable levels of berth occupancy, noting that cargo volumes are not uniform throughout the year and recognizing that fishing vessels also make use of the facility, the practical operating capacity of the Commercial Port is estimated to be: 1,490,000 rev.tons/year.

This figure is quite close to the 1989 cargo volume of 1,405,000 rev. tons (including transshipments both in and out). This bears out what can be observed--that Berths 4, 5 and 6 are operating at levels that are not very far from capacity at the present time.

Container Yard Capacity

The capacity of the container yard is a function not only of the area of the yard but also the manner in which it is operated. At the Port of Guam, a stacked operation is the predominant form right now--largely because of land restraints--and the analysis is based upon this type of operation. The analysis, indicates that close to 18 acres of space should have been available to handle the number of containers moving through the Port in 1989. If two vessels should arrive on successive days, as occurs now with APL and Sea Land, there is further peaking in the yard requirements, so that the area required may be over 19 acres. Thus, capacity of the present container yard is roughly 80% of the traffic actually handled in 1989.

Other Uses of Apra Harbor

Because of its expanse and protected water, Apra Harbor is also used for a range of water-oriented recreational activities and these are expected to expand in the future as tourism continues to grow. The Harbor is used by a mix of both privately-owned boats and commercial vessels engaged in water sports such as snorkeling, scuba diving and water-skiing or providing daytime and evening dinner cruises.

CARGO FORECASTS

Imports

The basic approach to port traffic forecasting used herein has been to segment major cargo flows into subgroupings with common economic characteristics. For each subgrouping, one or more independent socio-economic variables have been identified which help explain and predict its future trend. Individual segments for the period under review have been projected and then aggregated to arrive at the combined port traffic forecast.

The first segment to be considered is tourism. Even with the remarkable growth of recent years, Guam's tourism potential has not been fully realized, largely because of the lack of tourist facilities. There is at present a substantial pent-up demand in Japan for Guam vacations which will materialize once the various hotel and resort projects now under construction are finished. Furthermore, new markets, elsewhere in East Asia and in Australia are being developed. It is assumed here, probably conservatively, that the number of visitors to Guam will rise as follows:

1989-1995	12% annually
1995-2000	9%
2000-2005	6%
2005-2010	3%

This compares with the actual average annual growth of 13% during the 1984-89 period.

The second segment is military activities, which historically have been very important to Guam. In view of past trends and future uncertainties, through, it is most

reasonable to assume status quo in the level of military use of commercial port facilities during the period under review. This "no growth" assumption underlies the best judgment forecast for the military component of the commercial port traffic.

Local consumption imports are determined primarily by the growth of population, and real per capita income, and import substitution programs. The sources of growth for real per capita income will be primarily the tourism industry and military activities. Import substitution will have little impact. It is reasonable, therefore, to assume that the future development in the tourism and military sectors will bracket the growth of individual per capita incomes. Rates of growth for real per capita income may gradually decline from 5.5%-6.0% initially to 2% towards the end of the forecast period. Combined with the projected population growth, the effective demand for local consumption imports will rise as follows:

Period	Average Annual Growth Rate
1989-1995	7.7%
1995-2000	7.0
2000-2005	5.6
2005-2010	4.0

The construction sector is dependent upon the other sectors. Construction for tourism (45-50% of the total) will initially grow faster than tourism itself before slowing down. There may be a slight decline in military construction programs initially before they level out to a constant rate. Construction for various local sectors, such as residential and commercial building, will reflect population growth and overall economic activities. Public works construction will be high during the next five years. The combined growth rate for the construction industry will be as follows:

Period	Average Annual Growth of Construction Imports
1989-1995	9.4%
1995-2000	6.8
2000-2005	5.0
2005-2010	3.0

The following table summarizes basic, best judgment import forecasts for the Commercial Port. According to this table, imports through the Port will rise from 975,700 revenue tons in FY 1989 to over 3.2 million tons at the end of the review period.

IMPORT FORECASTS FOR THE COMMERCIAL PORT
(000 Revenue Tons)

Year	Tourist Industry	Military Installations	Local Consumption	Construction Activity	Total Imports
1989	188.2	165.8	475.3	146.4	975.7
1995	371.5	165.8	733.4	250.9	1,521.6
2000	571.7	165.8	1026.7	348.6	2,112.8
2005	765.0	165.8	1348.1	444.8	2,723.7
2010	886.6	165.8	1640.7	515.5	3,208.6

Exports

Roughly 90% of the true exports from Guam are military goods including personal vehicles, household goods and equipment being sent back to the United States. The remaining 10% consists of a small volume of garments processed locally and a range of miscellaneous items. Few of the exports are expected to grow in the future; though, in the long run, the Commonwealth status for Guam and the general rise in the prosperity of the region may encourage local manufacture for exports.

The combined effect of these divergent trends will probably mean little change in the overall volume of exports during the period under review. Accordingly, no export growth is assumed initially and only marginal increases thereafter. Total exports

will rise from 125,100 revenue tons in FY 1989 to 168,000 revenue tons in the year 2010.

Transshipments

Transshipment volumes may come from two sources--one is continued transshipments of goods to other areas of Micronesia, the other would be the possible growth of Guam as a location for receiving goods, processing them and re-exporting them to other countries around the Pacific Rim.

Regarding transshipment to/from the CNMI, the three major sectors of the Commonwealth's economy are tourism, construction and general consumption. A fourth sector, manufacture of garments, has been important but will decline in the future. There is also a military presence on Tinian but it is relatively small.

During the 1990-1995 period, tourism demand is expected to remain very strong and new facilities are being developed to meet this demand. It is estimated that the growth rate for the construction sector in this period will be very high. Other sectors of the CNMI's economy may grow at a more moderate rate; the weighted average of the growth rates for the three sectors is about the same as the rate that would result if the Overall Economic Development Strategy targets for productivity increases are met and population grows as projected. Averaging these two approaches indicates a growth rate for the economy and for imports of 9.8% annually to 1995. In subsequent years population growth should moderate, as natural increase slows and some alien workers are repatriated.

A new port project in Saipan is expected to be completed by 1994 or 1995, which will allow more direct shipment of goods to the CNMI rather than transshipment through Guam. It is assumed that the volume of transshipped goods destined for CNMI will begin to decline in 1996 and by the year 2000 about 50% will have been lost.

Given the slow growth forecast for the economies of the Federated States of Micronesia and Palau, it is assumed that shipments to these islands will grow at a rate of 1% above the rate of population growth. Based on population projections or the

South Pacific Commission, a weighted average figure of 4.2% annually is used for estimating the level of future transshipments and re-exports to the FSM and Palau. It is also assumed in the basic forecast that the interplay of competitive factors and new entrants into the trade between Honolulu, Micronesia and Guam will be such that Guam's share of transshipments to the FSM and Palau will not increase or decrease.

TRANSSHIPMENTS TO/FROM OTHER ISLANDS OF MICRONESIA

	Revenue Tons			
	1990	1995	2000	2010
CNMI (excluding Garments)	95,100	151,000	108,000	180,900
Garments	40,300	53,900	62,500	62,500
FSM, Palau, etc.	28,600	35,100	43,100	66,300
	164,000	240,800	213,600	309,700

Guam's potential as a center for the transshipment of goods moving between the U.S. mainland and various countries in the Far East, Southeast Asia, Australia and New Zealand was discussed at some length in the 1981 Master Plan and reviewed again during the course of preparing this New Master Plan. The earlier study saw little potential for Guam as a major transshipment center and changes in its economy since 1980 would tend to further reduce this potential. Guam has evolved as primarily a service-oriented economy with generally higher costs than surrounding countries and territories. Unemployment is low and no large pool of semi-skilled or skilled labor exists. Offsetting Guam's relatively high costs and small pool of available labor is a well-developed infrastructure and network of support services, including excellent communications. Therefore, Guam may have a bright future as a business and financial center. However, few, if any, physical shipments would be involved.

Fishing Activities

Because of its existing port infrastructure, network of agents and frequent flights to Japan, Guam has become a major transshipment point for chilled fresh tuna destined for sashimi. Some operators and their agents are quite optimistic about

further growth but others cite restraints upon growth and threats to Guam's position. It is not impossible that the current activity of transshipping chilled tuna at Guam could decline as quickly as it grew. Consequently, it is difficult to forecast future volumes with any confidence. The tonnage of chilled tuna currently landed at Guam is estimated to be 7-8,000 tons annually. In the basic forecast, allowance is made for a modest increase--up to about 9-10,000 tons annually.

For the planning of future port facilities it should be noted that, while purse seiners are expected to continue landing their fish at Tinian or transferring them at sea, they may continue to use Guam for reprovisioning, etc. Also, much of the eastern Pacific fleet may move to the western Pacific. Therefore, calls at Guam by purse seiners may rise by 50-60%.

Forecast by Mode of Shipment

In FY 1989, 80% of total port traffic was containerized. The prospects for faster containerization of Guam's foreign traffic are limited by three considerations. First, auto imports, will continue to be imported by Ro-Ro ships. Second, some construction materials, which are imported primarily from East Asia, cannot be containerized. Finally, foreign vessels calling at Guam also call at other ports that either do not have container handling facilities or are too small to justify full container service. It seems unlikely, therefore, that containerization of foreign traffic will grow faster than its volume. Accordingly, it is assumed here that containerization will decline slightly from its present level of 80%.

Summary Forecasts

Table S-2 summarizes the aggregate port traffic forecast for imports, exports, transshipments and fishing activities. The total volume of cargo is projected to rise from 1.26 million revenue tons in FY 1989 to 3.7 million revenue tons in the year 2010.

TABLE S-2

AGGREGATE FORECASTS
(000 Revenue Tons)

Year	Imports	Exports	Trans-shipments*	Fishing	Total
1989	975.7	125.1	152.0	7.5	1,260.3
1995	1,521.6	125.1	240.8	9.5	1,897.0
2000	2,112.8	131.5	213.6	9.5	2,467.4
2005	2,723.7	144.6	257.2	9.5	3,135.0
2010	3,208.6	167.6	309.7	9.5	3,695.4

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* Transshipments are unduplicated--that is they are shown for one direction (inbound or outbound) only. For cargo handling requirements, this figure should be doubled.

Alternative port traffic forecasts have also been prepared to illustrate the possible range of future demand for facilities in the Commercial Port. In this study, low and high growth scenarios are identified for each major cargo flow and their impacts upon these cargo flows are quantified--mainly by reference to the basic, best judgment forecast. These forecasts are presented in the Main Report.

FORECASTS OF PASSENGERS

In looking at passenger vessels that will use port facilities it is necessary to look at several different markets. The first group is based upon cruise ships with overnight accommodations that may be based in Guam or larger ships that call at Guam. These vessels may range in size from those with accommodations for 120-150 passengers to ships that accommodate 600 to 800 passengers. Another market consists of day excursions and evening dinner or dance cruises for those tourists staying in Guam. Vessels involved in this service may range in size from oversize yachts, up to vessels with capacities of 750 passengers or more.

Extended Cruise Traffic

In 1989 approximately 9,150 people arrived in Guam on cruises originating in ports in Japan, Europe or the U.S. With the introduction ships based in Guam, a new dimension is added and, now, an estimated 1,500 people each year take three and four day cruises from Guam to Saipan, Palau or ports in the FSM. Both categories of cruise patrons are expected to grow roughly in proportion to the total number of visitors. Because of low load factors at present and growing ship sizes, however, this does not translate to a corresponding increase in the berthing facilities required.

	Guam-Based Vessels		Visiting Vessels	
Year	No. of Passengers	No. of Vessels	No. of Passengers	No. of Ship Calls
1995	2,900	2	18,000	33
2000	4,500	2	27,000	39
2005	6,000	3	36,500	41
2010	7,000	3	42,000	42

Local Excursion Traffic

The local excursion traffic is very different market. Day cruises and dinner/dance cruises are included in many tour packages and are very popular. Total patronage is estimated to be about 150,000 per year. If this traffic grows at the same rate as tourists as a whole, then by 2010 about 700,000 visitors may take one or another of these day or evening cruises. Considering different vessel capacities, three large vessels, five mid-range and fifteen small vessels may be involved in this market and will require some type of berthing space, either in the Harbor of Refuge or in Apra Harbor itself by that year.

Demand for Marina Space

While the lack of marina space has been a restraint on the growth in the number of larger boats in Guam, it's not the only factor. Other factors are the high cost of larger boats, the amounts still owed by purchasers of small boats and, in future years,

the annual cost of marina space, even if it is available. Assuming a fairly rapid take-up of spaces already applied for, further growth in the local demand for marina space of about 6-8 percent annually is foreseen.

Development of a new marina at Agana will provide some (338 - 50 = 288) new spaces and the Agat Marina will add another 156. Thus, a total of 444 new spaces will be available, of which 109 may be taken up within a relatively short time, leaving 335 for future demand. With the growth rates estimated above, local demand would fill these spaces in about 11 or 12 years.

NEW PORT FACILITIES

Early Actions to Increase Capacity of Commercial Port

Forecasts of cargo to be handled in the future by the Commercial Port indicate the need for an almost threefold expansion of cargo handling capability by the Year 2010, as well as a substantial need for additional passenger facilities.

The first step of expansion has already been taken by the Port, with the expansion of the Container Yard from about 15 acres to 26.5 acres. This expansion will provide just about enough container storage area to meet the Port's projected requirements through 1995, if improvements are also made in the existing yard. The next set of steps will be those needed to match the capacity of the wharf to that of the expanded container yard.

Initially, the most effective action will be to improve productivity across the wharf. Again, the Port has taken the first step by proceeding with the acquisition of new transtainers, which will remove some of the restraints on the productivity of the existing container cranes. The next step will be the acquisition of two new container cranes--one to replace the existing Container Crane 1 and one to provide additional capacity.

A tentative recommendation is made that the new cranes to be acquired by the Port should be able to serve Post-Panamax vessels. Before proceeding with the selection of an alternative that permits these vessels to be worked, the Port should

also meet further with the two major U.S. shipping lines to get a better sense of how soon larger vessels might enter service on the Guam route and also review the Corps of Engineers pending study on channel deepening.

The cost of the new cranes, if purchased in the Far East is expected to be about $6.0 million each if two are ordered. The total cost for two new container cranes and the installation of a new crane rail with supporting structure would be about $14,450,000.

Alternatives Considered for Further Expansion

For the next stage of expansion, in the 1990-2000 period, two options have been considered in this Study and costs have been developed. (See Main Report)

For expansion of the Commercial Port after 2000 three alternatives have been explored and their costs developed. (See Main Report).

On the basis of a comparison of the costs of these options and alternatives and what each may achieve, a recommended program for expansion has been developed. The 1990-2000 phase of expansion under this program will lead to a practical operating capacity for the Commercial Port of about 2,680,000 rev.tons/year. Further expansion, in the 2000-2010 period will lead to a practical operating capacity of 4,200,000 rev.tons/year.

Recommended Plan for Expansion Before 2000

Early Improvements in Container Yard

At the time that the two new cranes are installed, container yard operations can be improved by:

- Relocating the substation that is behind Berth F-5 to the rear of the container yard; and,
- Demolishing the Container Freight Station that is now used as a chassis repair area by various tenants.

Expansion of Wharf Length

The recommended plan provides for the relocation of facilities for fishing vessels to another site in Apra Harbor, in order to release Berth F-3 so that it can once again be used to accommodate general cargo vessels. Fishing activities don't properly belong in the middle of a commercial port -- requirements are different, vessel sizes are different and activities at berthside are different. In a new location, specialized facilities and almost 1,400 feet of berthing space can be provided. These are described in a later section.

Once the new fishing port is available, various improvements to Berths F-3 and F-4 can be made. These include dredging Berth F-3 and rehabilitation of Shed 1. (A location atop a rehabilitated Shed 1 has been considered as a possible location for a new Harbormaster's office but staff members have expressed a preference for a location at H(otel) Wharf or Pier D(og).) Reclaiming Berth F-3 for cargo handling will also offer the opportunity to develop an efficient operation for handling bulk materials.

Expanded Area for Maintenance Operations

The present Equipment and Maintenance Building, with over 20,000 square feet of space, probably has sufficient area for the repair work, regular maintenance procedures requiring indoor facilities and parts storage required by the above equipment. Additional yard space can be provided north of the existing equipment and Maintenance Building in an area now used on occasion for parking. Some replacement parking can be developed north of Route 11.

Expansion of the Container Yard

To expand the container yard at its western end and allow unhindered operation, Shed 2 will also be demolished. This will permit all the container cranes to operate efficiently on Berth F-4. This and other changes will add about 4.5 acres to the container yard and provide more space for neo-bulk cargoes.

At the eastern end, the container yard will need to be expanded by another 5.0 acres, in order to provide a total of 36 acres by Year 2000. When this expansion

is undertaken, the gate complex near the eastern end will need to be enlarged to provide another entry lane, so that three entry lanes and two exit lanes will be available.

Cost of Expansion 1990-2000

The costs of this recommended expansion, prior to Year 2000 have been estimated as follows:

Total for New Cranes, including Mobile Crane	$15,425,000
Cost of Relocating Facilities for Fishing Vessels	$18,690,000
Cost of Improvements at F-3 to F-6 and Container Yard Expansion	$6,900,000

The aggregate cost of Commercial Port expansion in the 1991-2000 period, exclusive of minor equipment acquisitions and ongoing work, therefore, will be $41,015,000. The economic return on this investment is considered below.

ESTIMATED BENEFITS AND ECONOMIC RETURN

Future Ship Traffic

As noted earlier, the Commercial Port is operating now at levels that are close to the capacity of the wharf and exceed the capacity of the existing yard. Completion of the present yard expansion project will provide additional capacity but within a few years the capacity of the wharf will also need to be increased.

If the improvements outlined above are not undertaken, all vessels will be subjected to increased waiting for a berth at the Port. Ultimately, congestion would reach levels at which cargo would be lost--with severe consequences for the economy of Guam. Even before those levels are reached, the costs of vessels having to wait for a berth will be translated into higher charge for the transportation of goods to Guam and, thus, higher prices in stores and elsewhere.

Benefits, therefore, are taken as the difference between the costs incurred by vessels waiting for a berth at an improved and expanded port and the costs they would incur at an unimproved port. Near the end of the forecast period, additional

benefits will stem from the fact that cargoes that might otherwise be lost will continue to be imported or transshipped.

New container cranes should be acquired by 1993 and the other port improvements described above completed by 1997. Using a 20-year analysis period and discounting the stream of costs for improvements and the stream of benefits back to the present day, with a discount rate of 10%, yields a benefit/cost ratio of 3.32. The Internal Rate of Return for the proposed Commercial Port improvements is 19.2%.

Recommended Plan for Expansion After 2000

Further Expansion of Wharf Capacity

Under the recommended program, the post-2000 phase of expansion would consist of the extension of the wharf face of Berths 4, 5 and 6 some 900 feet to the east. At the time the wharf face is extended (to provide a total of 2,850 feet of container ship berthing, plus 750 feet at Berth F-3, for a total of 3,600 feet) an additional container crane should be acquired, for a total of four cranes[1] serving three potential container berths. During the same period another one or two transtainers will also need to be acquired.

Further Expansion of Container Yard

In the post-2000 period, the container yard will need to be expanded further--to 40 to 43.5 acres in 2005 and 46 to 50.5 acres by 2010. In the same period, the gate complex will need to be further modified in order to provide a total of four inbound lanes.

Costs of Expansion 2000-2010

The costs of the expansion needed under the recommended alternative after Year 2000, to meet traffic requirements in 2010, have been estimated as follows:

[1] Sometime before 2005, it is virtually certain that Container Crane 2 will also need to be replaced.

Total Cost of Improvements (by 2003 -- Step 1)	$33,400,000
Total Cost of Improvements (by 2006 -- Step 2)	$3,500,000

PROTECTION OF SEAWALL AND ROUTE 11

With the elimination of old Route 11, the road on the new alignment along the northern side of Cabras Island provides the only access to the Port and the adjacent industrial zone. The road in this location is very exposed and when it was constructed in 1985, an existing, low seawall north of the road was extended for most of this exposed length.

The design of the seawall (both the original section and the newer section of a lighter design) has proven to be inadequate. A suggested design has been developed for a protective structure that envisions a revetment placed on the seaward side of the seawall. It would require 8-ton blocks, and have a crest elevation a foot above the existing wall.

The estimated cost of removing unsuitable material, excavating the foundation and transporting and placing the rock is $1,980,000. The cost of purchasing the rock at the point where it is quarried will need to be negotiated within the framework of the existing agreement with the contractor removing the rock from the Industrial Park site.

OTHER FACILITIES IN APRA HARBOR

In order to maintain the integrity of the cargo-handling operation in the Commercial Port, it is necessary to develop appropriate facilities at different locations on the periphery of Apra Harbor to accommodate other water-oriented activities that share the Harbor with the Port (and the Navy). The Harbor also contains a range of fragile environments and, if the present attractiveness of the Harbor for tourist activities is to be maintained, these environmentally sensitive areas must be respected. For these reasons, but also to hold down costs, locations for facilities to serve other activities have been selected that have already been developed in the past.

Fishing

It has been noted that, at present, some 25-30 longliners may be in port at any given time. It is conservatively estimated that the number of vessel calls may increase by no more than 20 percent, so that 30-35 longliners may be in port. Of this number, only 10-11 will need a berth at the same time to discharge fish and take aboard fuel and provisions.

Of the purse seiners that now call at Guam, perhaps eight are in port at any given time. Because of an anticipated move by the eastern Pacific tuna fleet to western Pacific waters, this number may rise to 10-12. Only a fraction of this number, however, will require berths for refueling and reprovisioning at the same time. Four berths are considered sufficient for this purpose, which will actually accommodate 7 or 8 vessels if a second is rafted out from the one at berth, while anchorage sites for others will be needed.

Three sites have been considered for the development of facilities to serve the fishing fleets, away from the Commercial Port. After review, a site adjacent to the old Coast Guard seaplane ramp has been selected.

Development Plan

For the proposed Fishing Port a pier will be developed along the edge of the existing coral shelf in the cove where the Marianas Yacht Club used to be. On the outboard side, the pier will have 24 feet to over 30 feet of water depth and sufficient berthing length for four average purse seiners. On the inboard side, a basin will be excavated to provide a water depth of 10 feet and provide a sheltered area of about 4.5 acres for accommodating longliners. About 795 feet of berthing length will permit at least 11 vessels to unload their fish at the same time.

The pier will be about 190 feet wide. On it, a 40-foot wide shed will be provided, that will, in the other direction, be divided into a series of modules, each about 72 feet long. Two-thirds of each module will be open on the sides and one-third will be enclosed. The open areas will provide unobstructed space for grading, trimming and packing fish and loading them on trucks waiting next to the shed. Behind this shed

will be a 30-foot wide roadway for trucks picking up fish in the evening. Across this roadway from the shed will be a set of warehouses with at least 40,000 sq.ft. of space for gear and provisions. Outboard of these warehouses will be a 40-foot wide apron for the purse seiner berths. Support facilities will be provided within the existing land area and will include 6,000 sq.ft. of office space, 12,000 sq.ft. of salt storage, a relocated ice plant and other facilities. This area can be developed in a way that will allow access to the seaplane ramp for the launching of small recreational craft.

The estimated cost of the Fishing Port is $18,690,000 (which is shown in the preceding section as the cost of relocation from Berth F-3).

Passenger Facilities

The vessels involved in each type of passenger traffic are different and have different requirements for on-shore facilities. The types and numbers to be accommodated have been estimated as follows:

- Ships engaged in extended cruises that originate and end elsewhere may be 500 to 800 feet long. They generally stay one day or less. Passengers continue to use their on-board accommodations and no baggage transfer is involved. Provision for customs and immigration formalities will be needed, however.

- Vessels offering shorter cruises to other islands are likely to be smaller than the preceding type. Currently, they are about 300 to 350 feet long. In the future, larger ships will also be used and it is estimated that by 2010, some three or four ships, representing a mix of larger and smaller vessels, will be operating out of Guam during the high season. Facilities for these vessels must include provision for baggage handling, as well as customs and immigration procedures.

- The kinds of vessels involved in the third kind of traffic may vary widely--from smaller craft, often of multi-hull design, up to excursion vessels with a capacity of 800 passengers or more. By 2010, it is estimated that three large vessels (500+ passengers), about five mid-range vessels (149 passengers) and perhaps 15 smaller vessels (75 passengers), will be offering excursions of several hours duration. Some of the small and mid-range vessels will be based in or near the Harbor of Refuge, but facilities will also be needed within Apra Harbor itself.

Outside of the Commercial Port, there is only one site that can be developed for cruise ships without incurring both high costs and considerable environmental damage. That site is H(otel) Wharf. Given the proximity of Pier D(og) to H(otel) Wharf, plus other factors and concerns, it seems most logical to reconstruct this former pier as a facility for excursion vessels.

Proposed Development

Temporary facilities on H(otel) Wharf may be developed by a private group. The building complex proposed as a replacement for the temporary structures may provide a series of facilities in an open plan under a single roof, which will provide shade but permit breezes to flow through. Facilities would include a restaurant, local souvenir shop and duty-free shop, food preparation areas for cruise ships, baggage holding areas, customs, immigration and administrative offices.

Pier D(og) will be reconstructed as two 80-foot wide fingers that would serve vessels on both sides as well as vessels berthed on the inshore bulkhead, thus providing about 1,400 feet of berthing length. It would be integrated with H(otel) Wharf, though it also would have buildings with food preparation areas and administrative offices. Either Pier D(og) or H(otel) Wharf may also serve as the site of a relocated Harbormaster's office.

Cost of Facilities in Passenger Complex

The costs of reconstruction, upgrading and new construction for the passenger complex have been estimated as follows:

Total for Reconstruction of Pier D(og), Improvement of H(otel) Wharf and New Facilities on both structures.	$9,600,000
Total for Extension of H(otel) Wharf	$4,185,000

Not all of the above costs need to be borne by the Port Authority of Guam. The reconstruction of Pier D(og), provision of utilities to the site, and the later extension of H(otel) Wharf may be undertaken by the Port and then leased for a specified number

of years. Construction above the level of the pier and wharf surface, totaling $4,215,000, may be financed and developed by private interests.

Accommodation of Small Craft

In addition to the Marianas Yacht Club moorings and Sumay Cove, the area in the back channel behind the Harbor of Refuge is used now for small craft. Most of these are privately-owned pleasure craft but some vessels are engaged in the provision of tourism services, e.g. ferry to the submarine "Aquarius", dive boats, etc. Projections of the number of smaller commercially-operated craft offering harbor and dinner cruises, snorkeling, etc. indicate that there will be a growing need for slips to accommodate these vessels. It is suggested that, if the number of available slips in the back channel behind the Harbor of Refuge (and perhaps on the periphery of the Harbor of Refuge, itself) is increased, through rationalization of the slip layout or other means, this additional capacity should be used for commercial vessels serving the tourist trade.

Vessel Repair Services

There has recently been some interest expressed by two firms that are operating in Guam--one a maritime service company and the other a fishing fleet owner--in developing facilities for the maintenance and repair of the purse seiners that currently operate out of Guam. It is intended that the services provided by such a facility will include hull repairs and other work below the waterline, in addition to the topside and engine repairs that can be done now in Guam. Thus, the facility will center on a drydock able to take vessels of 1,500-2,000 g.r.t. with a light draft of 8-9 feet.

The ship repair facility will be developed by private interests but space is required. Several sites have been considered but the most likely site, at present, is on the south side of Cabras Island Channel, opposite the Commercial Port and east of Wharf E. The navigation chart indicates that water depth in the area is 22 feet and the south side of the channel, as well as the adjacent land area on Drydock Point, is unlikely to be needed for port expansion purposes until after Year 2010

PORT MASTER PLAN

The program described in the preceding sections for the expansion of the Port of Guam will lead to a functioning port consisting of three major components, each of which will be distinct and each of which will serve a specific type of traffic with its own special needs. These major components are:

Commercial Port: This is by far the largest of the three components. The Port will include a total of 3,600 feet of deepwater berthing and 50.5 acres of container yard, as well as shed space, maintenance area and other support facilities.

Fishing Port: This component is intended to serve two types of vessels and will include a pier with eleven berths for unloading longliners, a shed for processing their catch, four berths for the provisioning of purse seiners and warehouse space, plus an upland support area.

Passenger Complex: This complex is intended to serve both cruise vessels at an extended H(otel) Wharf and local excursion vessels at a reconstructed Pier D(og).

The investment required for these three Port components, and specific improvements proposed, are presented in chronological order in Table S-3. The timing of early investments may be considered to be reasonably definitive but later investments, particularly those after Year 2000 may have considerable latitude in their timing; they must be checked against actual traffic levels at that time.

The investment shown in Table S-3 translates to average annual capital outlays of $5.56 million before Year 2000 and $4.35 million after Year 2000. These figures may be compared with net earnings of the Port of Guam in 1988 of $2.86 million. Future revenues of the Port, not only from cargo but also from passenger traffic, may be expected to triple by the end of the forecast period (not counting inflation) and net earnings may keep pace. Thus, earnings in the future should be sufficient to cover investment costs but early investments will need to be financed through debt instruments.

TABLE S-3

SUMMARY OF INVESTMENTS 1990–2000

Implementation or Construction Period	Port Component Affected	Improvement	Investment
Now	Commercial Port	Repairs to Wharf	$2,895,000 *
1990–1991	Commercial Port	Container Yard Expansion (to 26.5 acres)	6,400,000 *
1993	Commercial Port	Installation of New Cranes and Acquisiton of Mobile Crane	15,425,000
1994–1996	Fishing Port	Development of Basin, Pier and Support Facilities	18,690,000
1996–1997	Commercial Port	Completion of Berth F-3, Miscellaneous Demolition & Rehabilitation Work, and Container Yard Expansion (to 36 acres)	6,900,000
1996–2000		Revetment to Protect Seawall	2,380,000 **
1997–1998	Passenger Complex	Reconstruction of Pier D(og) and Improvements to H(otel) Wharf	5,385,000
		(Private Improvements)	(4,215,000)
2000–2003	Commercial Port	Extension of Main Wharf Face and Container Yard Expansion (to 42.5 acres)	26,900,000
2003	Commercial Port	Installation of New Crane	6,500,000
2003	Passenger Complex	Extend H(otel) Wharf	4,185,000
2005–2006	Commercial Port	Container Yard Expansion (to 50.5 acres)	3,500,000
Total, excluding Private Investment			$99,160,000 ***

* Work currently under contract.
** Does not include cost of rock.
*** In 1990 dollars

LAND USE PLAN

Several earlier studies have been concerned with an overall plan for the lands surrounding Apra Harbor that are under the control of the Government of Guam. Development demands upon these lands have continued to grow and an adequate plan has become essential. In addition to the Port there are two other uses that will have a major impact on the Land Use Plan:

Cabras Island Industrial Park

In late 1989, the Port Authority of Guam negotiated a lease for development of the Cabras Island Industrial Park in the area east of the Port that is currently being quarried and levelled by a local contractor under a separate agreement. This Industrial Park will be able to accommodate a range of port-related industries and activities, as well as storage functions. In doing so the Park will form a natural adjunct to the Port of Guam.

Because of the need to accommodate future Container Yard expansion, the 65 acre Industrial Park may consist of a 40 acre site on Cabras Island itself and another 25 acres or so located at the intersection of Marine Drive and the road to Drydock Point. The "build-out" period for development of these areas is eight years.

Powerplant Expansion

The Cabras Island Plant of the Guam Power Authority (GPA) located at the eastern end of the island, contains two 66 MV oil-burning units and is the chief source of power for the civilian community on Guam. Some time in the future, the GPA may take over the Navy's Piti Plant. When added to its other plants, the GPA will then have a total installed capacity of about 250 MV.

In view of Guam's rapid growth, now and in the future, the GPA has already started on an expansion plan that will initially provide another 60 to 100 MV of capacity. The GPA has decided upon Cabras Island for this additional capacity and there is enough room on the site of the present plant to accommodate the new generating units.

Since the Guam Economic Development Administration has cited the need for a site to accommodate a waste-to-energy (WTE) plant and this has been given priority, there will not, however, be enough land near the existing powerplants to construct a new GPA Operations Center. This center will be located elsewhere.

Proposed Land Use

The major restraints upon development are environmental. As noted above, Apra Harbor contains some valuable and even unique natural communities and the Port Master Plan has recognized those restraints. These include:

- Coral reefs,
- Mangroves,
- Emergent wetlands,
- Beaches.

Other restraints to development stem from the Navy's continuing interests in Apra Harbor. Two Navy fuel docks (Wharfs D and E) are located at the northwest corner of Drydock Island. Also, the Navy still has an interest in H(otel) Wharf until 1992.

In addition to the three Port components serving cargo ships, fishing vessels and passenger vessels, the proposed Cabras Island Industrial Park and the Guam Power Authority installations, facilities to serve other types of activity either occupy space within the planning area or have sought space within this area. Development demands have gone beyond those accommodated in earlier plans, so that, outside of areas that clearly need to be protected or held open to accommodate future growth, virtually the entire area is spoken for.

Plate 8 at the end of the Main Report shows the recommended land-use plan for the northern and eastern edges of the Outer Harbor. Proceeding from west to east along the Glass Breakwater and Cabras Island, thence south along Marine Drive and out to Dry Dock Island, the chief recommended land uses are may be summarized as follows:

- Family beach, which will remain as a public facility;

- Pier D(og) and H(otel) Wharf, which form the Passenger Complex;
- Pier A, used now as an access point for divers and snorkelers, will continue in this use;
- G(olf) Pier, which continues as POL berth;
- The proposed Fishing Port, incorporating the old seaplane ramp;
- The Shell-Guam oil berth, F-1, continues in its present use;
- The industrial area between Route 11 and Berth F-2 also continues in its present use;
- Berth F-2 will remain in its present use;
- Berths F-3 to F-7 and the land area behind will make up the expanded Commercial Port;
- Next is the proposed Cabras Island Industrial Park I;
- Across Piti Channel from the Industrial Park lie the Harbor of Refuge and the back channel behind that Harbor;
- East of these facilities is the entire power generation complex, including a proposed WTE plant and, north of Route 11, a site for the Ocean Thermal Energy Conversion facility;
- South of the road to Dry Dock Point is the proposed Cabras Island Industrial Park II;
- The area along both sides of the road to Dry Dock Point between Industrial Park II and the area reserved for Port expansion may be left undeveloped for the present;
- Further west along Dry Dock Point Road is the area reserved for Port expansion, may, in the meantime, be used for vessel repair facilities;
- South of the future port area and facing Sasa Bay is the new site of the Marianas Yacht Club;
- At the end of Dry Dock Point is Dry Dock Island, where the Navy's fuel berths are located;
- South of this area lies Sasa Bay almost all of which will not be developed.

CHAPTER I
INTRODUCTION AND ECONOMIC BACKGROUND

INTRODUCTION

Responsibilities of the Port Authority of Guam (P.A.G.) have grown considerably in the last decade. One reason has been the two-fold increase in the volume of goods passing through the Commercial Port, Guam's only facility for oceanborne trade. Other reasons, however, are the growing use of Apra Harbor by passenger vessels and recreational craft, expansion of the land areas bordering Apra Harbor that are under the control of the P.A.G., and the development, by private interests, of water-oriented facilities elsewhere on Guam--under the auspices of the P.A.G. To help the Port in discharging these expanded responsibilities and provide guidance for future growth, this New Master Plan for the Port of Guam (and Land-use Plan) has been prepared.

While Guam is the primary focus of the economic studies that are described in this report, the island also serves at the present time as a transshipment point and entrepot for other islands in Micronesia. Therefore, the economic prospects of the Commonwealth of the Northern Marianas Islands, the Federal States of Micronesia and Palau are also reviewed in this chapter.

Guam

Guam is the southernmost island of the Marianas chain of islands, located 3,300 nautical miles west of Hawaii--which makes it the westernmost piece of U.S. soil. It is the largest and most heavily populated island in Micronesia, with about 157,000 permanent and temporary residents living in 209 square miles. The original inhabitants of Guam and the other Marianas are the Chamorros, and Chamorro traditions are still very strong. Today, however, the population is a mixture of peoples with varying ethnic backgrounds, including Filipino, American, Spanish, Japanese and Polynesian.

With the landing of Ferdinand Magellan in 1521, Guam and the other Marianas Islands were claimed by Spain, though that country had no permanent presence until the 17th century. Two and a half centuries of Spanish rule were ended in 1898 when Guam was ceded to the United States as a result of the Spanish-American War.

Until 1950, the island was administered by the U.S. Navy (except for the period of Japanese occupation in World War II). In 1950, Guam was placed under a civilian administration but the first governors were still appointed by the President of the United States. It was only in 1971 that the first elected governor took office. In addition to the governor, Guam has a unicameral legislature made up to 21 senators elected at-large for two-year terms. As a U.S. territory, Guam is represented in the House of Representatives by an elected, non-voting delegate.

Other Islands of Micronesia

Other islands in Micronesia of interest to this study are located in the Commonwealth of the Northern Marianas Islands (CNMI), the Federated States of Micronesia (FSM) and the Republic of Palau.

The Northern Marianas include Saipan, Tinian, Rota and four smaller islands. Total land area is 177 square miles and current population is about 42,000, including 18,000 aliens. The islands were also claimed by Spain during Ferdinand Magellan's voyage and permanent Spanish settlement dated from 1668. When Spain lost Guam in 1898, she sold the Northern Marianas to Germany, which held them until 1914, when they were taken over by Japan. At the end of World War II, the U.S. was granted trusteeship over much of Micronesia and until 1976 the U.S. interest in the Northern Marianas was largely military. The years 1976-1978 constituted a period of transition towards self-government, which was formalized in 1978 when the Commonwealth of the North Marianas Islands was established. In 1986, qualified residents of the CNMI were declared U.S. citizens.

The Caroline Islands, lying south of Guam and extending over 2,000 miles from east to west include the Federated States of Micronesia, with about 105,000 people on more than 600 islands which total 271 square miles, and Palau, with about

PORT OF GUAM • NEW MASTER PLAN

MAP OF GUAM

TAMS CONSULTANTS, Inc.
J. Agi and Associates

Plate 1

15,000 people living in an area of 178 square miles. The Carolines were also taken from Germany by Japan in 1914 and formed a part of the Japanese empire for about three decades. In 1945 the islands became a part of the Trust Territories of the Pacific Islands, administered by the United States under a United Nations trusteeship. Four of the five districts in the Carolines, Pohnpei, Truk, Yap and Kosrae ratified a constitution in 1979 that established the present nation of the Federated States of Micronesia and also entered into a 5-year Compact of Free Association with the United States. In 1981, the fifth district, Palau, became the Republic of Palau but, to date, a formal treaty defining its relationship with the United States has not been ratified by the country's people. Thus, while Palau has a functioning elected government, its status remains unclear.

OVERVIEW OF GUAM'S ECONOMY

Present Situation

Guam is largely a service economy with most people employed by and deriving income from the service industries. There is no mining and very little manufacturing. The agricultural and fishing sectors are minuscule and stagnant.

The four major sectors of the economy, which generate most of the demand for commercial port facilities and services, are tourism, military activities, local private and public consumption and the construction industry. The first two sectors are exogenous to the local economy in that their level of activity is determined by forces over which Guam has little or no control. They also provide, directly or indirectly, most of the island's employment and income. The local consumption and construction sectors are in part reactive to the level of activity in the tourism and military sectors but also respond to such independent variables as the population growth and federal subsidies and grants.

In recent years, tourism has been the main engine of economic growth and progress. The growth of the tourist industry has fueled the boom in the construction industry, while the expanded employment and income generated by tourism and

construction has raised per capita incomes and consumption by the island's population. Only expenditures by military installations in Guam has shown little growth during this period.

Future Prospects

Guam's economy has witnessed a rapid, double-digit rate of growth in recent years. The near-term outlook is excellent, mainly because of the continued expansion of tourism. Despite periodic efforts to diversify the economy by promoting exports and import substitution programs, it is generally agreed that, for the foreseeable future, Guam's economy will remain focused on services because of the Island's lack of natural resources, its small market size and relatively high labor costs.

Recently, the Government of Guam has moved to provide an economic policy framework to guide future development and agencies such as the Department of Commerce, Guam Economic Development Authority and the Territorial Planning Commission are playing an active role. This appears to be a response to concerns expressed by local business representatives on the earlier lack of the goal-oriented economic policy. Officials have noted that, as yet, there is no direct linkage between economic policy and land-use planning and current land-use legislation, including zoning, needs to be updated in order to provide effective guidelines for development. The consequences of earlier passivity include localized shortages of potable water, inadequate sewers and power generation and distribution facilities, growing labor problems and regional development imbalances. There is also the more fundamental concern about whether economic growth at any cost is good for local population and whether unregulated inflow of foreign labor and capital will bring with it a gradual loss of cultural identity.

To grapple with these and other related issues, the Government of Guam has sought to redefine the socio-political situation of the island and to obtain for it the Commonwealth status. The proposed draft of the Commonwealth Act, now under review by the U.S. Congress, would not only grant Guam a greater measure of politi-

cal self-determination, but would also substantially change its economic relationship with the United States.

TOURISM

Tourism generates demand for port facilities in two ways. First, there are the material needs of the tourists themselves, including food, supplies, duty free goods, transport vehicles, etc. all of which have to be imported. The port area also provides space and facilities for water-related tourist recreation including open sea and dinner cruises, sightseeing, sport fishing, diving, sailing and so on. Only the first aspect of tourism is examined in this chapter. The tourist use of port facilities is reviewed in Chapter II.

Present Situation

Nearly 669,000 visitors arrived in Guam in 1989 including 659,000 by air and 10,000 by sea. Some 556,000--or 83%--came from Japan, followed by 43,000 or 6% from the United States and 23,000 or 3% from Northern Marianas. According to a survey conducted in 1989, more than 60% of all visitors to Guam are young (in their twenties) and are employed as administrative or office workers. They stay in Guam an average of four days and spend close to $1,000 on local purchases, including over $500 on merchandise. Most come to Guam because of the beautiful seas, proximity to Japan and attractive price.

Tourist travel from Japan has grown rapidly in recent years, averaging a growth rate of 13% annually since 1984. Much of it has been due to the affordability of foreign travel to most Japanese and to the fact that foreign travel from that country is only now beginning to have a mass appeal. It is believed that travel to Guam--now representing only 6% of Japan's foreign travel--could have grown much faster had it not been for the lack of hotel facilities on the island which kept the airlines from increasing flight frequencies.

Future Prospects

There are several major reasons for believing that tourism to Guam will continue its rapid growth during the period under review.

(a) Favorite Destination: The residents of Japan and other Far Eastern countries are attracted to Guam. It is beautiful, it is a part of the U.S., it is close and, for them, it is cheap. And, almost every day there is more for the tourists to do (and spend their money on). For many, it is their first foreign vacation.

(b) Interest in Travel: The Japanese are increasingly able and willing to travel abroad. This has been mostly as a result of high personal incomes, favorable exchange rates and universal education.

(c) Government Encouragement & Promotion: The Japanese Government is actively encouraging foreign travel as one way to reduce its foreign trade surpluses. Its official goal to send 10 million Japanese abroad by 1992 may already be attained in 1990. The U.S. Government, for its part, promotes Japanese tourism to Guam by waiving its entry visa requirements. Both the U.S. and Guam governments actively promote Guam tourism in Japan and other Asian countries.

(d) Business Investment: Japanese business has been investing heavily in Guam's tourist industry. In addition to 3,950 existing hotel rooms and 4,000 under construction, applications have been filed to build another 10,000 rooms by the year 2000. Japanese business has a vested interest in the success and growth of tourism in Guam.

(e) New Markets: As more Far Eastern countries become prosperous and relax restrictions on foreign travel, their citizens have become interested in traveling abroad. The markets in South Korea, Taiwan, Hong Kong, Malaysia, Thailand and other countries have not been seriously tapped until now, but their potential for Guam is great.

Based on the above, it is reasonable to assume a two-digit growth rate for tourism in the near-term with the slower and declining growth rates in the more distant future.

MILITARY INSTALLATIONS

Present Situation

(a) Background

Guam has been of direct interest to the military ever since the United States acquired the island from Spain at the turn of this century. At first, Guam served as a coaling station for U.S. Navy ships, only to become a forward bastion of U.S. defenses in the World War II. During that period and for many years thereafter, the whole island was in effect a U.S. military base. Opened to the outside world in 1962, Guam remains home to major installations of the U.S. Navy and the Air Force. Even today, the President of the United States has the authority to close Guam's commercial port and airport in peacetime without local consent or approval.

(b) Present Role

The Navy and Air Force, as well as a small Coast Guard contingent, are represented on Guam. The military contributes to Guam's economy in direct expenditures ($445 million in 1988 compared with local government expenditures of $277 million), income generation (approximately 44% of the gross territorial income in 1988) as well as civilian employment (about 6000 in 1988). Military installations occupy one-third of the island's land area and, together with military dependents, account for about 15% of the island's population. Because many military personnel live and shop off-base and their dependents hold jobs in the local economy, the integration of the civilian and military sectors is widespread and thorough.

(c) Military Impact on the Commercial Port

In 1989, about 28% of all commercial port traffic consisted of military shipments. For the military, 85% of all its cargo and equipment moved through the commercial port. Military cargo brought to Guam is destined not only for the needs of local detachments but is also distributed by the U.S. Navy supply ships to the U.S.

fleet at sea in the Western Pacific and Indian Oceans. Only ammunition, classified cargo and cargo transshipped to remote areas not served by U.S. commercial carriers utilize the Navy's berthing facilities on the southern side of Apra Harbor. Demand for commercial port facilities on the part of the military is not only the function of the number of U.S. military personnel on Guam but it also reflects the nature and changes in the military missions, weapons systems and military technology.

Future Prospects

(a) Near-term Developments

The level of military activity in Guam in recent years has been generally flat. The reduction in the U.S. Air Force presence when the 3rd Air Division moved to Hawaii and the B-52G mission was changed to a conventional one, was partly offset by the addition of another U.S. Navy vessel (U.S.S Haleakala) to the fleet homeported in Guam. The total military population on the island declined from 23,600 in 1985 to 22,400 at the end of 1988. Another cut of about 1000 positions is expected when the U.S. Air Force 60th Bomb Squadron and its B-52's is withdrawn from Andersen AFB later in 1990.

It is difficult to prognosticate the future of U.S. military establishment in Guam, not only because of the very nature of military activities but also because of the rapidly changing geo-political situation in the world. In general terms, the recent easing of tensions in Europe and the demands for cuts in military spending suggest further decline in the overall level of military activities. On the other hand, the lack to date of comparable easing of military tensions in Asia and Guam's strategic role as the location of the most forward military bases in this part of the world on U.S. soil give reason to believe that the military presence on the island will continue during the period under review.

(b) The Transfer of Subic Bay Naval Base and Clark AFB to Other Locations

Subic Bay Naval Base and Clark AFB are major U.S. military installations in the Philippines. They are home to 18,000 U.S. military personnel and 20,000 dependents. They also employ 68,000 local civilian personnel. The base agreement between the United States and Philippines expires in 1991 and it now appears that it may not be renewed or that it will be substantially modified. Guam and Singapore have been mentioned as alternative locations for the two bases.

A total or even major transfer of these facilities to Guam is not possible for a number of reasons. Among those mentioned are the incompatibility of many military missions now performed by the two bases in the Philippines with the location and facilities in Guam. To illustrate, the size and draft of naval installations at Apra Harbor are insufficient to handle all naval vessels now using Subic Bay. Guam also lacks adequate ship repair facilities and skilled personnel to perform ship repairs. Similarly, Andersen AFB could not provide the tactical support facilities available at Clark AFB. Just as important is the fact that between them the Subic Bay and Clark AFB installations employ more local labor than the entire labor force on Guam and more than half of Guam's total civilian population. It is, however, reasonable to expect that should the Subic Bay and/or Clark AFB close, the existing military missions will be dispersed throughout the region, including Guam.

CONSTRUCTION SECTOR

Present Situation

In Guam, construction is the principal form of investment activity and a barometer of the Island's near-term expectations. For the last few years, Guam has been in the midst of a construction boom which shows no signs of letting up.

According to the Department of Public Works, total construction expenditures from permits issued are expected to reach $300 million in 1989, up 80% from the year

before and up 445% from the level reached 10 years ago. The number of construction employees on payroll during the first quarter rose from 1240 in 1983 to 5910 in 1990. The latter figure is less than it could have been because of the difficulties experienced by the industry in finding construction workers.

Construction industry in Guam can be grouped into four distinct categories including local residential and commercial, public works, military and tourism. According to an industry spokesman, in the most recent period tourism accounted for 40-50% of all construction activity including hotels, resorts, condominiums and golf courses. It was followed by private local construction (20-30%), mostly in residential units, office buildings and shopping facilities. Military construction done by private contractors, which consists of housing for military personnel, storage facilities and repairs, was next with some 20%, while the public works projects, including post offices, utilities, port expansion and road repairs accounted for about 10%.

Of the four segments, tourist construction has been most dynamic and has been almost totally financed by foreign (Japanese) investments. There has been also substantial activity in private local construction and public works projects. Only military construction showed little growth in recent years and actually declined since 1987.

Future Prospects

All available information points to a sharp rise in the level of construction activity in the next ten years. The Governor of Guam recently stated that near-term growth could result, within a few years, in construction activities averaging $800 million annually, compared with $300 million in 1989.

According to an industry spokesman, the level of <u>military</u> construction should remain steady at about $60 million annually and could actually drop if the current construction freeze continues. However, substantial growth in military construction will take place if the Naval Air Station is moved to the Andersen AFB or if some U.S. military missions are transferred to Guam from other Western Pacific countries.

<u>Tourism</u> will remain the most dynamic segment of the construction industry. The proposed tripling of hotel rooms on Guam before the year 2000 will require an

early and substantial expansion of construction activity and imports. And this does not include the anticipated construction of new condominiums, water-related resorts and 10 new golf courses.

A parallel, albeit somewhat slower, growth rate can be expected in public works construction to provide necessary infrastructure including water, power, sewers and roads. Substantial outlays will be needed not only to construct new facilities but also to repair and replace existing infrastructure some of which is quite old and under-maintained. This growth will be propelled, in part, by a recent $53 million bond issue for public improvements, as well as a commitment by a consortium of developers to provide funding for needed sewerage and water distribution lines in areas where a number of hotels are planned or under construction.

There will be also continued growth in residential, office and commercial construction to upgrade existing homes, build new ones to accommodate future population growth and to provide office and commercial facilities for higher levels of economic and tourist activities.

LOCAL CONSUMPTION

Local consumption demand for imports is measured as (total imports less imports by the military, the tourist industry and construction firms). It is local because transshipment demand for imports and exports is considered elsewhere in this report and it is called consumption because, apart from construction considered above, there is virtually no investment or export activity in Guam which would require imports of raw or semi-finished materials.[1] About 90% of all goods consumed locally are imported and virtually all of these imports are manufactured products for final consumption.

Local consumption demand for imports is determined primarily by the size and growth of population, employment, per capita income and the extent of import substitution programs.

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[1] The only local industry importing semi-finished goods for manufactured exports is one small textile plant.

Population

The current year (1990) is the decennial population census year and only estimates of the present population are available. According to these sources, Guam's permanent population numbers 131,000, excluding military personnel and dependents (22,400) and temporary migrant workers (3,400 in September 1989). The U.S. Bureau of Census estimates in its medium projection that Guam's permanent population will be 159,000 and 218,000 in the year 2000 and 2020 respectively.

Employment

For the past several years Guam's economy has worked under conditions of full employment. The current unemployment rate of 2.3% is the lowest ever recorded by the Guam Bureau of Labor Statistics and lower than in any state in the United States. During the five year period ending in 1989, total employment grew at 8.6% annually and employment in private sector at 13.8% annually. At 53,270 in September 1989, Guam's total payroll employment was at its highest level ever and everyone who wanted could find work.

Recently released official forecasts show further growth in total payroll employment with the sharpest increases projected for the tourist and construction industries (Table I-1). Already, serious labor shortages have emerged in both industries and it is reportedly not uncommon for some hotels to pirate employees from other establishments. To cope with this problem, the island will have to depend increasingly on migrant labor and on greater participation in the labor force by the homemakers, teenagers and the retirees. The Government has recently sent a mission to the Philippines to facilitate the movement of temporary migrant workers.

TABLE I-1

PAYROLL EMPLOYMENT FORECASTS

	March 1989	March 1992	Percent Growth
Total Payroll Employment	52,110	65,247	25
Public Sector	17,610	18,385	4
Private Sector	34,500	46,862	36
Construction	5,910	9,749	65
Tourism (hotels)	3,730	6,130	64
Other	24,860	30,983	25

Source: Bureau of Labor Statistics

Per Capita Income

Territorial Income accounting in Guam is still in its infancy and surrounded by a great deal of controversy. To illustrate, depending on the source and definition, per capita income estimates for 1988 ranged between $7,470 and $20,200. The estimate used in this study employs the per capita adjusted gross income estimates for individuals, which have the advantage of being more consistent and offering longer historical trends.

According to this source, per capita income, unadjusted for inflation, had risen by 10.5% annually between 1983 and 1988. After adjustment for intervening price increases in the United States, where most Guam local consumption imports originate, the real per capita income grew at about 6% annually.

Import Substitution Programs

Projections of imports can be affected by import substitution programs which, in turn, depend on the current status and future prospects for Guam's manufacturing and agricultural sectors. A brief analysis of both sectors is presented below.

Manufacturing: Guam has no natural resources used in manufacturing and only a limited entrepreneurial tradition in industrial production. Its market size is too

small and labor costs too high to allow it to compete with foreign goods at home and in the world markets.

According to the recent (1987) census of manufacturing industries, manufacturing sales actually dropped between 1977 and 1987 and, in 1987 accounted for only 5% of total business receipts.

Guam is a duty free port allowing opportunity to import materials for manufacturing duty free. It is also a participant in two major trade programs--Headnote 3(a) of the U.S. Tariff Code and the Generalized System of Preference--both of which benefit export-oriented manufacturing. Despite these advantages, the island has failed to develop any viable industry, in part because of Customs restrictions on goods shipped to the mainland U.S. The proposed Commonwealth Act addresses many of the problems affecting Guam's manufactured exports to the United States and its passage should help the industry grow in the more distant future. In the meantime, there is a limited potential for capturing greater local market share through a cottage scale industry and handicraft manufacturing.

Agriculture and Local Fisheries are the smallest sectors in Guam's economy, accounting for less than 1.5% of the Gross Territorial Product. They have stagnated in recent years and the output of some major products has actually declined. The Island is far from self-sufficient in food production and depends on imports for most of its food supplies.

Agricultural development is a limited long term proposition. As long as its costs are high and production inefficient it will be less expensive to import food than to produce it locally. The potential for any exports of food faces the further obstacle of non-existent or inadequate pest control facilities.

Local fisheries are limited in output. There are only about four locally-based full-time fishermen. Most of the fish landed from Guam's nearby waters are from part-time fishermen and charter-boat owners, who may sell through the Guam Fishermen's Cooperative or directly to hotels, or may give their catch to friends. Nearly half these fish are reef fish caught a short distance from shore. Some larger fish may be caught on banks located 30 to 50 miles south of Apra Harbor. Local fishermen have

commented on falling catches and the outlook for large scale fishing within Guam's waters is not bright.

One possibility for import substitution does lie in aquaculture. The Port is currently reviewing a proposal for a shrimp farm in Piti Channel and a report on aquaculture prepared by a senior staff member in the Department of Commerce foresees potentials for raising tilapia and shrimp at other sites.

OVERVIEW OF THE ECONOMY OF THE CNMI

Present Situation

The economy of the Commonwealth of the Northern Marianas Islands (CNMI) has certain similarities to that of Guam. It, also, is largely oriented towards services, with strong tourism and construction sectors, concentrated largely in Saipan. Government services also make up a significant proportion of the economy, albeit far less than in 1978 when government jobs accounted for 45% of all jobs--compared to 15% now.

The economy differs from that in Guam, however, inasmuch as Commonwealth status means that the CNMI is exempt from various U.S. laws, such as the Jones Act, minimum wage provisions and some immigration requirements. Because of these differences, plants for the manufacture of garments have been attracted to the CNMI and the transfer of frozen fish from purse seiners to transport vessels, which was a growing activity at the Port of Guam in the early 1980's, is now done at Tinian. Also, under the Covenant with the U.S. Government in 1978 and a further agreement in 1985 the CNMI will continue to receive federal funds for capital improvements and government operations for most probably another 8-9 years, in addition to being eligible for all categorical federal programs available to the states and territories. As a result, the Commonwealth has considerable public sector-financial resources relative to its population and economic base. However, infrastructure needs are substantial--the road network dates from World War II, the water and sewerage systems need to be greatly expanded and new port facilities are essential.

Future Prospects

The population of the CNMI is quite young and a high rate of population growth is foreseen (among citizens). Because of its position on the learning curve, a relatively high rate of increase in productivity is foreseen in the CNMI's Overall Economic Development Strategy document.

Actual growth will stem primarily from the continued expansion of tourism and from expenditures for the construction of infrastructure and tourism facilities--the latter being made possible by Federal funds and outside investment. In the manufacturing sector, no further permits will be issued for plants to produce garments and it is intended that, over time, the aliens who make up most of the work force in these plants will be repatriated. Any growth in manufacturing, therefore, will need to come from improvements in productivity.

Restraints on economic growth include the present state of infrastructure, a small labor force that needs additional training and, perhaps, in the future, the fact that only about 18% of the land is privately owned and available for commercial development. In the near term, however, a continuation of the very high rates of growth experienced in recent years is foreseen.

OVERVIEW OF THE ECONOMIES OF THE FSM AND PALAU

Present Situation

The economic bases of the Federated States of Micronesia (FSM) and Palau are subsistence agriculture and fishing, a limited tourism and the recycling of U.S. funds through government salaries and contracts for various services. The earlier subsistence economy that was self-sufficient has been replaced by one that is dependent upon imports. Thus, the economy of the FSM has become essentially a consumption-driven economy dependent upon payments from the U.S. under the Compact of Free Association. Before significant growth can be realized, a transition to a higher level of self reliance will be necessary and U.S. payments under the Compact are intended to assist in this transition. A minimum of 40% of the funds must be spent

on capital projects, but so far almost all of these capital funds remain unspent. At this point, adherence to earlier traditions, the lack of institutions needed for a market economy, the lack of resources other than marine products and the fact that relatively small population is spread over several hundred thousand square miles of ocean makes a transition to a production economy very difficult.

In Palau, U.S. funds are limited, because of the failure to ratify a compact similar to that approved in the FSM but the tourism sector is beginning to grow as a result of a direct air link to Japan. Also, a Taiwanese group is investing in a fish transshipment facility in Palau to take advantage of the direct air link.

Future Prospects

The outlook for the FSM is one of rather slow growth, with increased spending for infrastructure as capital projects are developed and greater advantage is taken of the U.S. funds allocated for this purpose. While population growth rates in the FSM are relatively high, natural increase may be offset by out-migration. Already, Yapese and Trukese may be seen working in Guam in low-skill occupations.

Palau may grow more rapidly, particularly if its tourism sector should take off and closer links are forged with Japan. The institutional base for a market economy and the development of a skilled work force will still be needed, however. Rapid growth in the near future, therefore, is unlikely.

CHAPTER II
GUAM PORT TRAFFIC

SHIPPING SERVICES

Shipping services to Guam reflect its present status as an integral part of the United States, yet a part that is also a consumer of more and more East Asian products and a center for the transshipment and re-export of goods to other islands in Micronesia. Also reflected is the growth of trade with Australia.

In discussing shipping services, it is necessary to take note of two factors which may affect the manner in which the Commercial Port is utilized. The first is that trade between Guam and the mainland United States is classified as domestic commerce. Therefore, the Merchant Marine Act of 1920, commonly referred to as the Jones Act, applies to this trade and the transport of goods is reserved to United States flag carriers. This means that foreign flag carriers cannot carry goods and merchandise between mainland U.S. or Hawaii and Guam even as part of longer trade routes linking the U.S. to the Far East, Australia and New Zealand. Normally, the vessels that are used would also have to be built in the United States but Title 46, Section 11 of the U.S. Code allows foreign-built vessels to engage in trade between the mainland and Guam as long as they are U.S. owned--a fact that is important to American President Lines in the utilization of its J-9 vessels. One advantage of the commonwealth status that is being sought by Guam could be exemption from the Jones Act. Since the CNMI and American Samoa are already exempt from the provisions of this act, the feeling is that it could affect the costs of transshipment through Guam.

The second factor is that the rates of domestic carriers in the mainland U.S.-Guam trade are subject to regulatory control by the Federal Maritime Commission or, in the case of intermodal cargo, the Interstate Commerce Commission. Should Guam become exempt from the Jones Act, either through achieving commonwealth status or by other means, rates would be free of such controls. They would become subject to

competitive pressures but presumably U.S. carriers would become eligible for operating differential subsidies on their Guam services, just as they are eligible now for such subsidies on their services to foreign ports. For destinations beyond Guam, domestic carriers are members of steamship conferences which set the applicable rates. Whether such a conference would come into existence for Guam services, should exemption from the Jones Act be obtained, cannot be known at this time. It may be noted, however, on the trade between Guam and various ports in the Far East that is carried by foreign lines, these lines set their own rates.

Existing Steamship Services and Routes

At the present time regular service to Guam is provided by two domestic carriers in the mainland U.S.-Guam trade, four lines in inter-regional trade between Guam and the Far East and Australia and six lines in intra-regional trade between Guam and other islands in Micronesia. Two of the intra-regional lines operate joint services with the inter-regional lines and may be subsidiaries of those lines.

Mainline U.S.-Guam Services

(a) American President Lines

American President Lines (APL) operates three weekly services from the U.S. West Coast to the Far East. One of these weekly services calls at Guam on the westbound leg before continuing on to Taiwan and Japan. Cargoes on these routes are fully containerized. Typically, some 250-300 containers are off-loaded on each call at Guam and a like number are picked up. Forty-foot containers predominate, accounting for 82% of the total off-loaded at Guam. Another 10% are 20-foot containers and 8% are 45-foot. Fourteen percent of the containers are reefers, all of which are 40-foot long. While all inbound containers are full, only 25% of the containers picked up by APL vessels are loaded. As a rule each vessel tries to pick up all the empties consigned to it, since they are needed at Kaohsiung, the next port of call. However, because of tight schedules, they may on occasion be left for the following week's vessel.

Vessels used by APL on the Guam service at present are either C-8's, which have a capacity of 1,000 FEU's, or J-9's, which are foreign-built vessels with a capacity of 1,350 FEU's. The Commercial Port at Guam does not have a deep enough channel or enough depth at berth to accommodate C-9's or C-10's. Had APL's application to serve Hawaii been approved, however, enough containers might have been off-loaded in Honolulu to permit a C-9 to come into Guam.

(b) Sea Land Services

Sea Land took over the Pacific routes and ships of United States Lines when the latter company went bankrupt two or three years ago. The weekly service to Guam departs from the U.S. West Coast and calls at Hawaii before coming to Guam. It then continues to Okinawa and Kaohsiung before returning to the U.S. The service, like all others of Sea Land is fully containerized. Normally from 200 to 250 containers are off-loaded at Guam and a similar number are picked up. Forty-foot containers account for 81% of all containers. About 15% are 20-foot containers and only 4% are 45-foot containers, though this percentage will rise in the future. Some 10% of the containers handled by Sea Land are 40-foot reefers. As with APL only about 25% of Sea Land's outbound containers are loaded.

The ex-U.S. Lines vessels operated by Sea Land on its service to Guam are older vessels, ranging from 670 feet to 813 feet in length. Most of them are in the Lancer class, which have a capacity of 650 FEU's, though the largest vessel, the Sea Land Trader, has a capacity of about 930 FEU's.

Far East-Guam Services

(c) Kyowa Shipping Company

This shipping line, based in Japan, operates five services between ports in the Far East and Guam. Two services, from Hong Kong, Keelung and Pusan and from Pusan, Kobe and Yokohama are tri-weekly. Another service, from Singapore and Manila, calls every four weeks and continues on to Saipan. Two monthly services

operate from Kobe and Yokohama, call at Saipan before reaching Guam and then continue on to the FSM or, through a joint service, to Palau.

Almost all of the Kyowa vessels handle both break-bulk and containerized cargoes, with an average of 300 to 400 tons of break-bulk cargo and 75 containers being off-loaded on each call. Some Kyowa vessels, however, may carry virtually entire cargoes of neo-bulk commodities such as reinforcing steel, with typical cargoes of 3,000 to 4,000 tons plus a few containers on deck. Almost 95% of the containers are 20-foot; there are few 40-foot containers. Containers aboard these vessels are generally handled by ships' gear.

Since the vessels used in these services may also serve smaller ports in Micronesia, they are much smaller than pure containerships and average about 5,000 g.r.t. and 350 feet in length.

(d) Kambara Kisen Co.

This line operates a tri-weekly service to Guam and Saipan from Pusan, Hong Kong and Keelung and under the names Palau Shipping Co. and Far East Micronesia Line continues on to Palau and Yap. The interval may soon be shortened to about 15 days with two vessels operating, each on a monthly schedule. This line also carries both containers and break-bulk cargoes aboard combination vessels. Containers are predominantly 20-foot and are typically handled by ships gear. The number of containers off-loaded in Guam on each call seems to be about the same as the Kyowa Line, though vessels of the Kambara Kisen Co. appear to be somewhat larger (about 7,500 g.r.t.) and the unitized break-bulk cargo recorded during a sample month in 1980 was about 1,650 tons.

(e) NYK Line

This major Japanese Line has normally operated a monthly service from Japanese ports to Guam, Saipan and ports in the FSM, which in combination with the service of the Kyowa Line has provided twice a month service to Pohnpei and other ports in the FSM. In recent months, however, NYK has had at least one vessel out of

service and, therefore, has operated a joint service with Kyowa Line, using the vessel Asian Lily.

(f) Zim Israel Navigation Co.

An Australian subsidiary of Zim Lines operates a service linking Guam with major east-coast Australian ports and, through transshipment, ports in New Zealand. Service frequency is about 25-28 days. This service is operated with full container-ships which are discharged with the Port's container cranes. Over 90% of the containers on this service are 20-foot. Approximately 100-150 containers may be off-loaded on each call. Vessels are modest in size, averaging a little over 500 feet in length.

Intra-Regional Services

(g) Saipan Shipping Co.

For a number of years Saipan Shipping Co. has provided a weekly barge-tug service to Saipan and Tinian. Approximately 30-40 containers are loaded out each week, containing transshipments or goods exported by suppliers in Guam. A similar number are unloaded, half of which may be empty but others may contain garments destined for U.S. markets or equipment and supplies returning to Guam. About 40% of these containers are 40-foot. In addition, small amounts of break-bulk cargo are carried--usually vehicles or construction equipment. The barges currently in use are 186 and 200 feet long.

(h) Seabridge Pacific Co.

Within the last year or so Seabridge Pacific Co. has established a competing service to Saipan and Tinian using comparable vessels. About the same number of containers are handled as on the Saipan Shipping Co. service and they appear to contain the same mix of goods. During the sample period, however, Seabridge Pacific Co. carried a higher proportion of 40-foot containers --about 56%.

(i) Angyuta Shipping Co.

This firm operates a single vessel between Guam and Rota, in the Northern Marianas, and provides a weekly service. Typical volumes per voyage are 6-8 containers and 50-60 tons of break-bulk cargo.

(j) Taputso-Saipan

This firm has operated an irregular service between Guam and Rota--handling only break-bulk cargoes which were generally loaded with a forklift truck. It appears, however, that this service has been suspended and it may have been replaced by a similar service started by another group in mid-1989. Vessels are less than 100 feet in length and cargoes average about 25 tons.

(k) Palau Shipping Co.

This company provides a service to Yap and Palau jointly with the Far East Micronesia Line and Kambara Kisen Co., using vessels of the last-named line; see (d) above.

(l) The Tiger Line

This line provides a joint service to Truk, Yap and Palau with the Kyowa Line, using vessels of that line; see c-4 above.

Summary of Services

Table II-1 on the following page provides a summary of regularly scheduled cargo services calling at Guam. In addition to these liner services, vessels may also call on an induced basis with specialized cargoes. Examples may include ro-ro ships discharging autos and light trucks, as well as vessels calling to discharge salt, basaltic and silica sand, etc. or to pick up scrap being exported to mills in East Asia.

Also, as discussed later in this chapter, a growing number of passenger vessels are either calling at Guam or are based here for several months of the year.

TABLE II-1
EXISTING SHIPPING SERVICES

	Carriers	Frequency of Service	Type of Service	Routing or Area Served
Domestic Carriers				
a	American President Lines	Weekly	Containers	U.S. West Coast, Guam, Kaohsiung
b	Sea-Land Service Inc.	Weekly	Containers	U.S. West Coast, Honolulu, Guam Kaohsiung
Inter-Regional Carriers				
c-1	Kyowa Shipping Co.	Tri-weekly	Mainly Containers Some Break-bulk	Hong Kong-Keelung-Pusan-Guam
c-2	Kyowa Shipping Co.	Tri-weekly	Mainly Containers Some Break-bulk	Pusan-Kobe-Yokohama-Guam
c-3	Kyowa Shipping Co.	Every 4 wks	Containers, Break-bulk	Singapore-Manila-Guam-Saipan
c-4	Kyowa Shipping Co.	Monthly	Containers, Break-bulk	Kobe-Yokohama-Saipan-Guam
c-5	Kyowa Shipping Co.	Monthly	Containers Break-bulk	Kobe-Yokohama-Saipan-Guam-Pohnpei Kosrae-Majuro
d	Kambara Kisen Co. and Far East Micronesia Line (plus Palau Shipping Co.)	Tri-weekly (now--may soon be monthly)	Containers Break-bulk	Pusan-Hong Kong-Keelung-Guam-Saipan
e	NYK Line	(Jointly with No. c-5 above at the present time)		
f	Zim Israel Navigation Co.	25-28 days	Containers	Sydney-Melbourne-Brisbane-Guam
Intra-Regional Service				
g	Saipan Shipping Co.	Weekly	Containers Break-bulk	Guam-Saipan-Tinian
h	Seabridge Pacific Co.	Weekly	Containers Some Break-bulk	Guam-Saipan-Tinian
i	Angyuta Shipping Co.	Weekly	Containers Break-bulk	Guam-Rota
j	Taputso-Saipan	2-3/month	Break-bulk	Guam-Rota
k	Palau Shipping Co.*	Tri-weekly	Containers Break-bulk	Saipan-Guam-Yap-Palau
l	The Tiger Line**	Monthly	Container Break-bulk	Saipan-Guam-Truk-Yap-Palau

There are also induced calls for sporadic cargo requirements, such as various bulk commodities, some neo-bulk items, vehicles and scrap.

* Palau Shipping Co. and Far East Micronesia Line have joint services with Kambara Kisen Co. (see d above).

** The Tiger Line has joint service with Kyowa Shipping Co. (see c-4 above).

Finally, the Commercial Port is also used by two types of fishing vessels: purse seiners which are substantial vessels, averaging 200 feet in length and 1,060 g.r.t., that call at Guam to load provisions and salt plus fuel; and tuna longliners which discharge their loads of fish for air shipment to Japan and then load salt, ice and fuel for their next trips.

The impact of this mix of vessels and activities upon the facilities of the Commercial Port are discussed later.

PORT TRAFFIC - GENERAL

This section reviews the current port traffic, including both cargo and passenger movements. Only Commercial Port traffic is considered; cargo handled over private and military facilities is outside the purview of the master plan.

Cargo movements consist of three separate categories: domestic and foreign imports and exports, transshipments and fishing. This section describes domestic and foreign imports and exports; then looks at transshipment and, finally, fishing.

Passenger traffic reviewed at the end of this section includes both cruise travel and the people and vessels that use the commercial recreational facilities located within Apra Harbor.

IMPORTS AND EXPORTS

The analysis of imports and exports considers their volumes, direction, composition and physical characteristics.

Traffic Volume

Historical growth trends in the volume of port traffic are presented in Table II-2. Since 1980, the total volume of imports and exports recorded by the Port has nearly doubled (from 656,000 revenue tons to 1,277,000 revenue tons) rising at 7% annually or more than three times as fast as estimated in 1980.

TABLE II-2

PORT TRAFFIC BY TRADE AREA

(000 Revenue Tons)

Fiscal Year	Imports			Exports(a)			TOTAL
	Domestic (U.S.)	Foreign	Total	Domestic (U.S.)	Foreign	Total	
1980	390,110	125,399	515,509	91,458	48,768	140,226	655,735
1981	463,432	138,959	602,391	132,335	38,213	170,548	772,939
1982	360,234	133,925	494,159	108,248	28,048	136,296	630,455
1983	365,527	223,322	588,849	130,768	42,936	173,704	762,553
1984	437,764	276,881	714,645	157,031	49,477	206,508	921,153
1985	459,033	273,921	732,954	127,003	58,476	185,479	918,433
1986	481,122	318,823	799,945	142,999	69,854	212,853	1,012,798
1987	461,230	330,447	791,677	146,299	92,248	238,547	1,030,224
1988	523,320	296,571	819,891	145,667	118,068	263,735	1,083,626
1989	650,747	348,732	999,479	154,792	122,324	277,116	1,276,595

(a) Exports include transshipments

Source: Port Authority of Guam

Cargo information shown in the tables is produced by the Port of Guam Authority as part of its billing department's operations. It is recorded for fiscal years and is presented in terms of the tons shown on the bills of lading, which are normally revenue tons.[1] The fiscal year of the Port Authority runs from October 1st through September 30th of the following year.

Port records identify transshipments as those goods that are discharged from one vessel and loaded aboard another vessel without leaving the Port. The tonnage figures recorded by the Port show inbound transshipments separately from imports. However, transshipments are tabulated again as a part of exports and are thus counted twice. This is appropriate from a cargo handling standpoint but it means that the figures must be adjusted for the purposes of economic projections. Since transshipments represent the imports and exports of other countries or commonwealths, they must be subtracted from the recorded export figures before future imports and exports are forecast.

Review of port cargo data indicate the need for a further adjustment to net out what may be referred to as "hidden transshipments". These consist of goods contained in larger shipments consigned to distributors and dealers in Guam which are then re-exported to the other islands of Micronesia. Like the recorded transshipments, future growth in the volume of these "hidden transshipments" is dependent upon the economic prospects of these other island countries or commonwealths.

As a result of these adjustments, which are discussed later under transshipments, the following net figures are derived for 1989 imports and exports:

Imports:	975,700 rev. tons;
Exports:	125,100 rev. tons.

Unduplicated total transshipments in 1989 were about 152,000 rev. tons (see below).

[1] Revenue ton figures include a mixture of weight tons and measurement tons that results in the highest revenue to a ship owner and operator.

Direction of Cargo Traffic

Table II-2 shows that nearly two thirds (63%) of Guam's domestic and foreign commerce in 1989 was with the United States of America. This compares with 73% in 1980 suggesting that Guam is becoming less dependent on its economic ties with the USA.

After the United States, Guam's major trading partners are Japan, South Korea, Taiwan and Hong Kong. Japan is the main source of vehicle and equipment imports, while South Korea and Taiwan provide most of Guam's construction material imports. All but a few thousand tons of the exports from Guam are commodities related to military activities destined mostly for the mainland United States but also for U.S. military installations in the Philippines and South Korea.

Composition of Cargo Traffic

Statistical reporting on the composition of imports and exports ceased after 1984. The Department of Commerce has recently resumed processing foreign trade data for 1988 but this information will not be ready in time for this study.

Because of this, an alternate method has been developed to classify exports and imports by their end use. Using a sample survey of the bills of lading and other published sources, base year imports have been grouped into four major categories including the imports for the tourist industry, military installations, construction activity and for local (private and public) consumption. Using the same sample survey, over 90% of the exports have been classified as military-related cargo. The balance includes some miscellaneous foreign exports--frozen by-catch of tuna vessels, scrap metals, household goods, etc.--and the output of a single textile plant in Guam.

Based on this classification, the base year (FY 1989) imports and exports have been allocated as follows:

Commodity Group	000 Rev. Tons
Imports	
Tourist Industry	188.2
Military Installations	165.8
Construction Activity	146.4
Local Consumption	475.3
Total	975.7
Exports	
Military Installations	112.8
Locally Generated	12.3
Total	125.1
TOTAL IMPORTS & EXPORTS (ADJUSTED)	1,100.8

Physical Attributes of Import and Export Traffic

Physical attributes refer to the method of cargo handling. In Guam, most port cargo is containerized. In 1989, 81% of the total foreign trade cargo (including some transshipments) was containerized. This compares with 86% for 1980. The intervening decline in containerization rate can be explained by the fact that the U.S. trade, which is fully containerized, grew more slowly than the trade with other countries (such as Japan, South Korea, Taiwan and Hong Kong) which still ship a substantial part of their cargo in conventional break-bulk or ro-ro vessels. The respective growth of containerized and break-bulk cargo during the 1980s is shown in Table II-3.

For containerized cargo, the preferred container type has been the 40' container. It represented over 80% of container movements on the Guam-USA route and 58% of all container cargo movements. In the Far East commerce, 20' containers still predominate in part because of the lack of fully containerized vessels on these routes.

The distribution of container traffic by size during the 1980-89 period is shown in Table II-4. It can be observed that this period has also registered a significant growth in the largest (45') containers while other container sizes have virtually disappeared from port traffic. Not shown in the table is the breakdown of 40' containers

TABLE II-3

PORT TRAFFIC BY HANDLING METHOD

(000 Revenue Tons)

Fiscal Year	Container			Break-Bulk			TOTAL
	Imports	Exports	Total	Imports	Exports(a)	Total	
1980	444,085	118,733	562,818	71,424	21,493	92,917	655,735
1981	515,159	159,485	674,644	87,232	11,063	98,295	772,939
1982	410,223	128,767	538,990	83,936	7,529	91,465	630,455
1983	431,981	165,479	597,460	156,868	8,225	165,093	762,553
1984	516,214	194,039	710,253	198,431	12,469	210,900	921,153
1985	541,657	169,072	710,729	191,297	16,407	207,704	918,433
1986	601,849	200,799	802,648	198,096	12,054	210,150	1,012,798
1987	622,463	226,008	848,471	169,214	12,539	181,753	1,030,224
1988	657,281	242,748	900,029	162,610	20,987	183,597	1,083,626
1989	769,959	263,603	1,033,562	229,520	13,513	243,033	1,276,595

(a) Exports include transshipments.

Source: Port Authority of Guam

TABLE II-4

CONTAINERS HANDLED BY SIZE

(Number of Containers)

Fiscal Year	Other	20-Foot	27-Foot	40-Foot	45-Foot	Total
UNLOADED						
1980		8,219	476	13,030		21,725
1981		8,652	113	16,992		25,757
1982		6,943	52	14,013	28	21,036
1983		7,972	64	14,573	127	22,736
1984		9,062	38	15,545	364	25,009
1985		8,579	17	16,062	299	24,957
1986		10,530	18	17,338	358	28,244
1987	13	12,485	1	22,935	500	35,934
1988	14	13,234	2	19,924	1,011	34,185
1989	3	13,314	1	20,476	1,577	35,371
LOADED						
1980		8,198	677	12,934		21,809
1981	4	8,731	127	17,041		25,903
1982		6,829	54	13,885	28	20,796
1983		7,772	62	14,480	127	22,441
1984		9,251	38	15,509	348	25,146
1985		8,231	19	15,879	315	24,444
1986		10,356	15	17,508	365	28,244
1987	12	11,815	1	22,333	488	34,649
1988	13	13,229	3	20,174	988	34,407
1989	1	12,881	1	19,911	1,561	34,355

into the conventional and reefer containers. The latter category accounted for estimated 12% of all 40' containers in 1989.

Transshipments

Transshipments recorded by the Port in 1989 totalled 99,738 rev. tons, including 71,788 rev. tons coming in from the mainland United States and 27,950 rev. tons arriving from foreign ports, including the Far East, Australia and the CNMI. As discussed above, this figure does not include "hidden transshipments" which are goods consigned to distributors and dealers in Guam that are then re-exported to other islands in Micronesia. Also, a minor adjustment is needed to allow garments which are included in domestic exports as revenue tons but tabulated under inbound transshipments from foreign ports as weight tons, to be included in the final total as revenue tons.

As a result of the detailed tabulation of two sample months it has been determined that, except for about 8,300 rev. tons of miscellaneous exports to the Far East, all foreign exports are, in fact, transshipments, either explicit or "hidden". Therefore, if 90,200 rev. tons (which represents inbound transshipments tabulated by the Port minus the estimated weight tons of garments coming in from the CNMI) and 8,300 rev. tons of miscellaneous exports are subtracted from total foreign exports of 122,300 rev. tons, the result is an estimate of "hidden transshipments" in 1989 of 23,800 rev. tons. Transshipments of garments from plants in the CNMI to the U.S. mainland was about 38,000 rev. tons in 1989. Adding these three components, yields the following estimate of unduplicated transshipments:

Tabulated inbound transshipments (adjusted)	90,200 rev. tons
"Hidden" transshipments	23,800
Transshipped garments	38,000
TOTAL TRANSSHIPMENTS	152,000 rev. tons

FISHING ACTIVITIES

Three types of fishing vessels utilize facilities in Guam and each represents a very distinct fishery. Two of these vessel types use facilities in the Commercial Port.

In 1980 a number of purse seiners called at the Port for the purpose of transferring their catch, consisting primarily of skipjack tuna, to reefer vessels destined to canneries in the Far East and elsewhere, as well as for reprovisioning and refueling. Because of the search for lower costs and, for U.S. owners, relief from taxes, the transfer of fish is now done at ports such as Tinian, where 130,000 tons of fish were transferred last year, or at sea. Purse seiners still call at Guam, however, for reprovisioning, refueling, repairs and rest and recreation for their crews. In fiscal 1989, 338 visits by purse seiners were recorded, with an average stay of 3-1/2 to 4 days. Reprovisioning by purser seiners may account for about 7,500 tons each year of food and provisions and perhaps 12-15,000 tons of salt.

Beginning in 1986 Japanese, and now Taiwanese, longliners have called at Guam to land their catches of yellowtail and bigeye tuna, which are long-lived species marketed in Japan for sashimi. It is a market in which freshness and quality are paramount and Guam has grown as a port for this fishery because of its excellent air service to Japan and its proximity to prime fishing areas within the waters of the F.S.M. According to the Fresh Tuna Longline Transshipment Study of the spring of 1989, about 120 Japanese and 45 Taiwanese longliners, plus a few of other countries regularly unload their catch in the Commercial Port. In fiscal 1989 the Port recorded 1,293 visits by these vessels. There are some differences in fishing techniques and the proportion of the two tuna species caught by each. The Japanese boats are larger and may bring in 16-20 tons on each trip; they bait more hooks when setting their lines and fish deeper. The Taiwanese vessels have less capacity, only 8 to 10 tons per trip, they bait fewer hooks and fish shallower. As a result, they may catch more bigeye tuna. Each group believes that its technique results in a higher quality catch.

The vessels operate on roughly a three week cycle, though the Japanese vessels may be out longer than the Taiwanese boats, given their higher capacity, and at the end of each trip they spent roughly 3½ to 4 days in Guam. On any given day

there may be 25 to 30 longliners in the Port. The fish are unloaded in the early evening and, after they are graded, placed in specially designed boxes and loaded into Conex containers. Planes to Japan leave in the early morning and within a day or so each captain knows the price his boat's fish have received on the market. The longliners purchase relatively few provisions in Guam but they do buy some fresh foods, ice, and fuel for their next trips.

U.S. Customs requires documentation of the fish that are landed but there are problems in the paper trail so that overall data on the tonnages, as well as other information of economic or biological interest is not readily available. In 1988 about 6,800 tons of tuna were airshipped to Japan and in 1989 the figure was between 7,000 and 8,000 tons.

The third type of fishing is local fishing, including charter fishing, in the waters around Guam. A range of species are caught, including various reef fish, mahimahi, wahoo and blue marlin. Most of the local fishermen are part-time or operate and crew charter boats. There are only four full-time commercial fishing vessels. Fish that are caught may be sold through the Guam Fishermen's Cooperative, sold directly to hotels or given to friends and relatives. Recorded tonnages are relatively low, fluctuating between 320 and 500 tons during the past six years.

All but a few of the vessels engaged in local fishing are based in the Agana Marina. This facility will be discussed later, together with various water sports activities.

PASSENGER TRAFFIC

Apra Harbor has become a port of call for a number of larger cruise ships. Nineteen such ships totalling 209,700 g.r.t. and carrying over 9,000 passengers called in Apra in 1989 as shown in Table II-5. In addition, a 120 passenger cruise ship homeported in Apra between January and April of each year, offers four and five day cruises to Saipan, Rota and ports in the F.S.M.

TABLE II-5

PORT OF GUAM
PASSENGER SHIP TRAFFIC IN 1989

Name	GRT	Nationality	Passen-gers	TIME IN PORT				Itinerary (Ports of Call)
				Arrival		Departure		
				Date	Time	Date	Time	
Utopia	9,587	Japanese	450	1/9	11:54	1/10	19:05	Japan - Saipan
New Utopia	11,564	Japanese	500	1/10	08:11	1/12	12:17	Saipan - Sendai
Sunflower #7	7,511	Japanese	500	1/10	06:53	1/11	20:35	Sendai - Saipan
Sunflower #7	7,511	Japanese	300	2/8	07:50	2/9	21:57	Japan - Saipan
Sunflower #7	7,511	Japanese	300	3/5	07:00	3/5	08:00	Saipan - Japan
New Utopia	11,564	Japanese	590	3/29	07:07	3/29	21:00	Japan - Saipan
Utopia	9,587	Japanese	584	3/30	07:16	3/30	20:35	Japan - Saipan
New Utopia	11,564	Japanese	517	5/3	05:55	5/3	17:05	Saipan - Japan
Nippon Maru	11,564	Japanese	522	5/3	10:24	5/3	22:06	Japan - Saipan
Fair Star	21,620	Australian	1,149	6/12	06:57	6/13	20:02	Japan - Britain
Nippon Maru	11,564	Japanese	485	7/26	12:00	8/3	12:00	Japan - Japan
Coral Princess	9,639	Hong Kong	400	7/29	10:01	7/31	21:06	Japan - Saipan
New Utopia	11,564	Japanese		8/9	07:00	8/10	20:33	
Utopia	9,587	Japanese	500	8/8	08:00	8/9	20:00	Japan - Saipan
Sunflower #7	7,511	Japanese	315	8/13	12:46	8/14	21:58	Japan - Saipan
Fairstar	21,620	Australian	450	10/27	08:19	10/27	20:18	Britain - Japan
Utopia	9,587	Japanese	584	12/27	20:35	12/28	20:33	Sendai - Saipan
Sunflower #7	7,511	Japanese	500	12/29	07:26	12/31	21:00	Sendai - Saipan
New Utopia	11,564	Japanese	500	12/31	07:07	12/31	18:00	Japan - Saipan
Total Vessels: 19	209,730		9,146					

The U.S. Coast Guard, which certifies and periodically inspects all larger passenger vessels homeported in Guam, reports that there were 20 commercial passenger vessels homeported in Guam in early 1990. They included the cruise vessel noted above, motor ships, catamarans and trimarans, dive boats, cabin cruisers, launches and one submarine. A list of all commercial passenger vessels homeported in Apra is shown in Table II-6. The total passenger carrying capacity of these vessels is 1,096 passengers, excluding three launches contracted by the U.S. Navy to provide passenger transport within the port area. Aside from one berth that is regularly used by commercial passenger vessels, the Apra Harbor area includes the Harbor of Refuge and another marina in the Piti Channel, one private yacht club on Dry Dock Point, and a marina for military personnel, all of which are used by commercial and privately-owned recreational craft.

Future Trends

A substantial increase in the number of commercial passenger vessels and in the passenger carrying capacity is planned by companies using the Apra Harbor area. During 1990, as many as six new vessels with a total capacity of 2,106 passengers may be based in the Harbor during at least part of the year, if space can be found to berth them. They, too, are listed in Table II-6. The list includes only those vessels which have advised the U.S. Coast Guard of their plans to use Apra Harbor. Several new large cruise ships have also made plans to call Guam in 1990.

TABLE II-6

COMMERCIAL PASSENGER VESSELS HOMEPORTED IN APRA IN FEBRUARY 1990

Name of Vessel	Type of Vessel	Passenger Capacity	Type of Activity	Remarks/Location
I. EXISTING				
Micronesia Dream	Catamaran	149	Day & Evening Cruises	Apra Harbor
Polynesian Princess	Power/Sail	149	Day & Evening Cruises	Apra Harbor
Stars & Stripes	Catamaran	149	Day & Evening Cruises	Harbor of Refuge
Umidori	Trimaran	49	Sightseeing & Snorkeling	Harbor of Refuge
Umidori II	Trimarin	49	Sightseeing & Snorkeling	Harbor of Refuge
Sea Odyssey II	Monohull	60	Sightseeing & Diving	Harbor of Refuge
Oz	Catamaran	36	Sightseeing & Snorkeling	Harbor of Refuge
Iruka	Monohull	54	General Recreation	Harbor of Refuge
Helsal	Sail	49	General Recreation	Apra Harbor
Pura Vida	Sail	32	General Recreation	Harbor of Refuge
Chamorrita	Monohull	49	Diving & Sightseeing	Harbor of Refuge
Revenge	Monohull	20	Diving & Sightseeing	Harbor of Refuge
Sea Odyssey	Monohull	24	Diving	Harbor of Refuge
Reef Runner	Monohull	12	Diving	Harbor of Refuge
Z Best	Cabin Cruiser	49	Charter Fishing	Harbor of Refuge
Atlantis V	Submarine	46	Underwater Sightseeing	Harbor of Refuge
Oceanic Grace	Cruise Ship	120	Multi-Day Cruises	Apra (Jan-Mar only)
Sub-Total		1,096		
II. PROPOSED				
Sound of Seto	Cruise Ship	800	Multi-Day Cruises	Apra (High Season only)
Courageous	Excursion	799	Harbor Cruises	N/A
JAL/Pacific Star	2 Catamarans	2x149= 298	Day & Evening Cruises	N/A
Micronesia Dream II	Catamaran	149	Day & Evening Cruises	N/A
Ocean Fast	Hydrofoil	60	Coastal Tours & Diving	Apra Harbor
Sub-Total		2,106		
TOTAL		3,202		

CHAPTER III

EXISTING PORT OF GUAM AND OTHER MARINE-ORIENTED FACILITIES

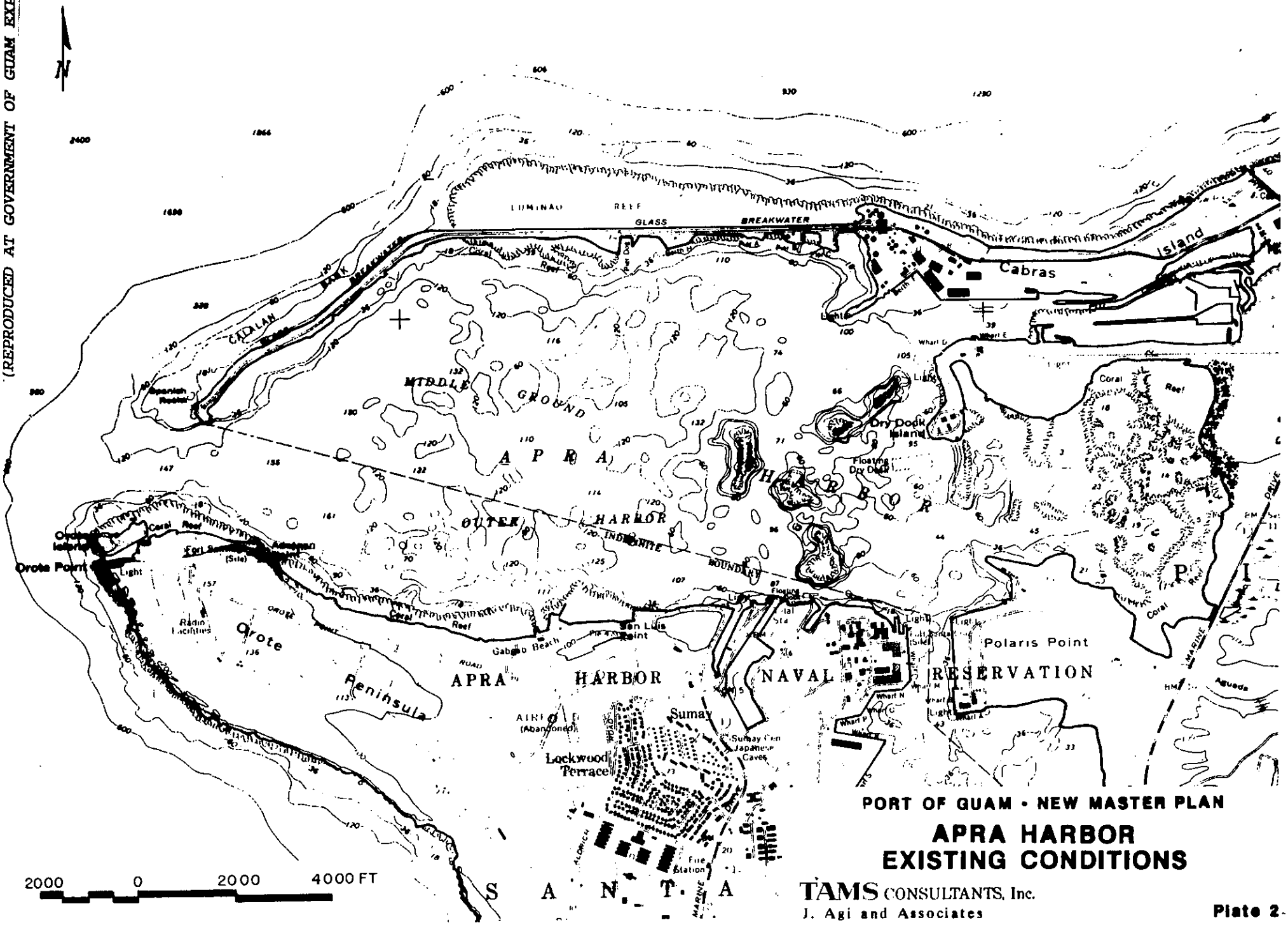
APRA HARBOR

Apra Harbor, where the Port of Guam is located is a natural harbor used by Spanish fleets and later by the U.S. Navy. In 1944 and 1945, after Guam was retaken from the Japanese, the Harbor was greatly improved by the construction of the Glass Breakwater atop Luminao Reef and Calalan Bank. This provided a larger sheltered anchorage area 4 miles long and 1.5 miles wide (Plate 2). The average depth of water in the Outer Harbor and the Middle Ground is over 100 feet deep. Within this area there are 4 anchorages for commercial vessels and 3 that are reserved for the Navy. South of the Outer Harbor is the Inner Harbor, which is entirely within the Naval Reservation. The north side of the Outer Harbor is bounded by the Glass Breakwater, and in the northeast is Cabras Island where the Commercial Port is located.

Cabras Island Channel, which lies north of two large shoals, serves the Port area. This channel is 700 feet wide and over 40 feet deep until it approaches the berths themselves, where it drops to 35 feet or less. In 1983 the Corps of Engineers undertook a feasibility study for deepening the channel, plus one or more berths, to 40 feet. This study is discussed in Chapter VI.

LAND AREA

Prior to 1969, all the land around Apra Harbor was owned and controlled by the Navy. In that year the Navy transferred 62 acres to the Government of Guam for port uses. About half of this original area is occupied now by the Commercial Port; the remainder is leased to various private firms for periods of 50 or 60 years. Most of the income from these leases goes to the Guam Economic Development Administration, though the Port shares in recent increases in the rent. Among the lessees are the four petroleum companies in Guam, the Island's sole cement importer, a vessel



PORT OF GUAM • NEW MASTER PLAN

APRA HARBOR EXISTING CONDITIONS

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Plate 2-

and fishnet repair firm and a trucking company. In 1983 a 32-acre parcel north of the Port was transferred to the Government of Guam by the Navy, which permitted expansion of the Port's container yard, in accordance with the 1981 Master Plan. East of these parcels is a 133-acre parcel that was transferred in 1985 and includes much of the rest of Cabras Island. This parcel will accommodate the expansion of the container yard, the first stage of which is due to start shortly. Most of the area, to the extent it is not required for container yard expansion, may be used for the proposed Cabras Island Industrial Park.

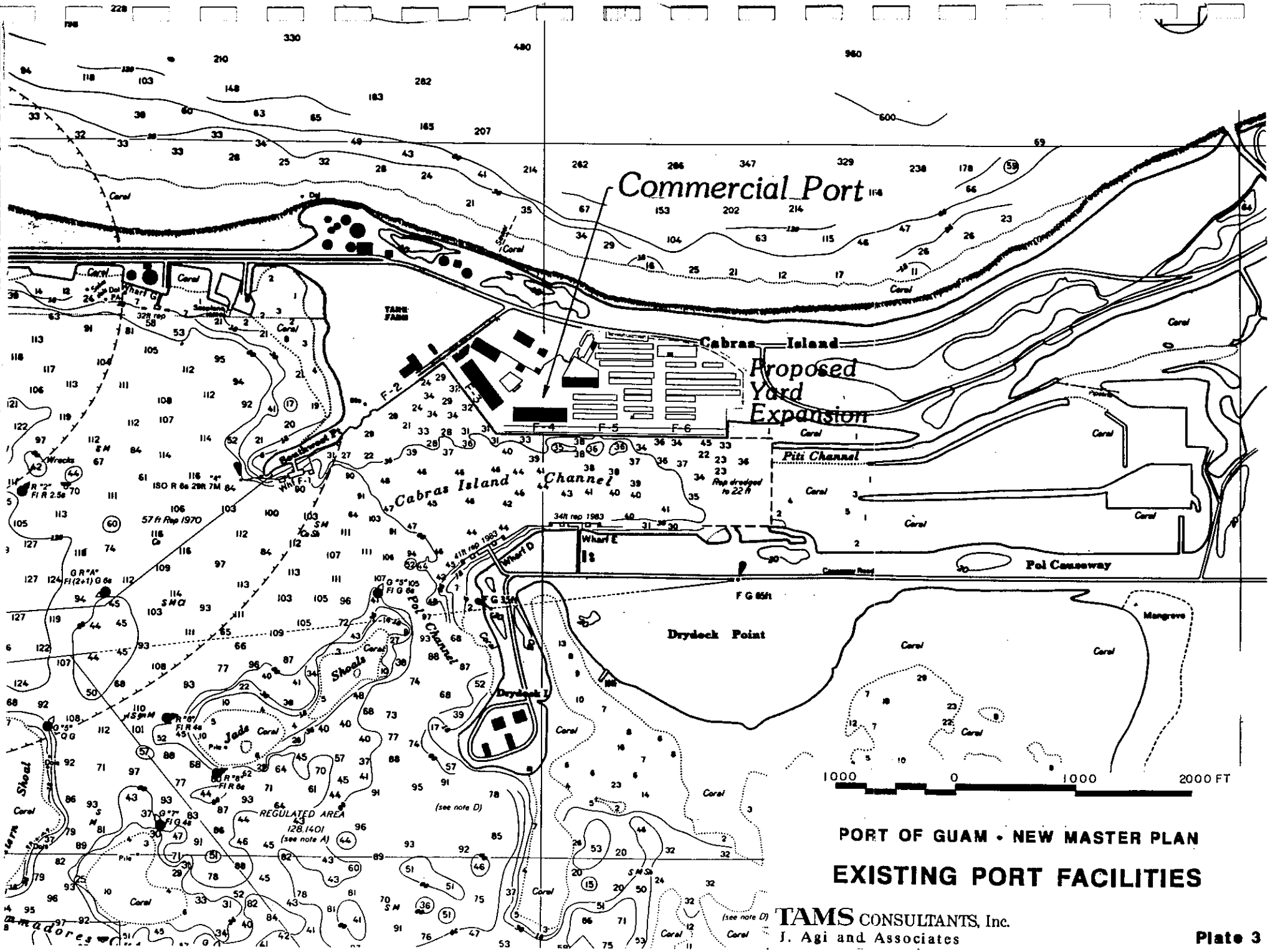
More recently, other lands, including the strip of land lying south of the Glass Breakwater--but not the breakwater itself, behind it--and a 208-acre parcel--which includes the Piti Channel and Sasa Bay, the area lying west of Marine Drive and south of the Navy and Cabras Island Power Plants and much of the spit of land known as Dry Dock Point--have been transferred by the Navy to the Government of Guam for the use of the Port Authority of Guam. Much of this last parcel consists of environmentally sensitive areas and shallow inlets that cannot be developed. An updated land-use plan for all of these land areas will be prepared as a part of the current study.

Certain restrictions have been placed on the future disposition of these lands--primarily on the terms of future lease or sale--and, in some cases, the Navy reserves the right to use specific facilities with three days advance notice.

FACILITIES IN COMMERCIAL PORT

What is now the Commercial Port is a series of wharves and facilities that were started in 1964 and completed in 1969. Originally the facilities constituted an extension of other Naval facilities in Apra Harbor and the numbering system for the berths reflects the old Navy designations. These facilities are shown in Plate 3.

Berth F(oxtrot)-3 is a 753-foot long marginal wharf that consists of a steel sheetpile bulkhead that was placed in front of an earlier deteriorated sheetpile wall and a concrete cap that extends below the waterline. Behind this



PORT OF GUAM • NEW MASTER PLAN

EXISTING PORT FACILITIES

TAMS CONSULTANTS, Inc.
J. Agi and Associates

Plate 3

bulkhead is an 85-foot wide paved apron in front of Shed 1. Water depth alongside varies from 21 feet adjacent to Berth F-2 to 30+ feet at the outer end.

This berth is currently occupied almost exclusively by a mix of purse-seiners and longliners, awaiting provisions, refueling and, in the case of the longliners, discharging their catches of tuna. If a measure of feet-hours of occupancy is used, vessels other than fishing vessels occupied the berth for less than 3% of the total in 1989. Fishing vessels used 93% of the available foot-hours. In several months this measure of occupancy was over 100%--which may be explained by the fact that four or five longliners may raft out from the bulkhead in a single boat length.

Shed 1 is a reinforced concrete structure 122 feet wide and 452 feet long that is located behind Berth F-3. Because of differences in the floor slope and that of the outside paved areas, the front of the shed is at the same grade as the apron but the rear has a series of raised truck docks. Except for three bays (out of 15) that are used for salt storage the shed is occupied by businesses involved in or serving the tuna fisheries.

Behind Shed 1 is a triangular area largely occupied by an oil drum storage area that is part of the fishing vessel support operation.

Berths F-4, F-5 and F-6 make up the heart of the Commercial Port. These berths total 1,950 feet in length and may accommodate two full container vessels, three smaller break-bulk and container vessels, a number of the smaller vessels (60' to 200') that serve the other islands or any combination of the above. The wharf itself consists of a steel sheetpile bulkhead with a concrete cap that extends below the low water mark. In the westernmost portion of the wharf there is a 100-foot wide apron between the face of the wharf and Shed 2. Elsewhere, the paved apron extends back into the container yard.

Water depth alongside is 34-35 feet, though 150 feet in front of Berth 6 there are some coral heads only 22 feet below the water's surface. Vessels berthing at Berth F-6 must maneuver around the obstruction. If there is no vessel at Berth F-5, maneuvering may add 45 minutes to berthing time; if a vessel is occupying Berth F-5 more time will be required or it may not even be possible to berth or unberth a ship.

Using the same measure of foot-hours for occupancy levels, in 1989 vessels took up about 40% of the available foot-hours; in some months the figure was close to 50%. This was primarily by cargo vessels, though long-liners also use Berth F-6, and, on occasion, the other two berths if space is available. These vessels used 8% of the total foot-hours available. Not included in these figures is the use of Berth F-6 for the mooring of a small drydock belonging to the Port and leased to Cabras Marine Co. While these average figures indicate a moderate level of occupancy, on certain days--when a containership, plus one or two smaller combination break-bulk/container ships or inter-island vessels are lined up and a clutch of longliners occupy part of Berth F-6, the port has both the appearance and reality of substantial congestion.

Two rail-mounted container cranes serve all three berths; with a rail gauge of 50 feet, they are able to pass in front of Shed 2.

Shed 2 is a reinforced concrete structure, 122 feet wide and 452 feet long, that is the twin of Shed 1. Like Shed 1, it has a series of raised truck docks at the rear. The western end is occupied by a duty-free shop, one fishing company (upstairs) and several importers. Most of the space, however, is used by the Port for receipt and storage of break-bulk and unitized cargo pending customs clearance. It is not intensively used. The area behind Shed 2 is used for storing neo-bulk commodities such as reinforcing steel, etc.

The former Container Freight Station (CFS) is similar in construction to Sheds 1 and 2 but smaller in size, being 80 feet wide by 302 feet long. It also has

raised truck docks at the rear. The CFS is no longer used for its intended purpose but is, instead, used as a repair facility and maintenance shop by APL, Sea-Land and Cabras Marine Corp.

The present Container Yard extends from Shed 2 to close to the end of Berth 6 (the last 200 feet or so is occupied by a feed mill that is being dismantled and containers used by some fishing companies) and from 75 feet behind the rear container crane rail to a fence line near Route 11. It contains about 15.2 acres.

A salient feature of the container yard is that most of the area was originally laid out for a chassis operation for 20-foot and 40-foot containers. Because of increasing traffic and a sharp rise in the number of containers handled, the Port has converted to what is primarily a stacked operation. (Containers are typically block-stacked, in blocks that are five or six containers wide and two or three high.) While the Port has changed over to a different mode of operation, the lines of dolly blocks used for the chassis operation remain in place and act as a restraint to the development of a more suitable layout. Also, there is no system for numbering individual cells for containers and marking the pavement and light standards accordingly. As a result, while the general location of a container is posted as it comes in, it is not always easy to retrieve them. The yard is also dotted with typhoon tie-downs that are no longer used. Other elements that inhibit a more rational layout include a substation behind Berth F-5 (the container crane mechanics' shop is also located here), the CFS and the feed mill that is being demolished.

Expansion of the Container Yard is expected to be started shortly. Phase I of this expansion will provide an additional 12.5 acres. After allowing for a wider-gauge crane (which would reduce the available area somewhat) it is estimated that the expanded container yard will contain 26.5 acres. In Phase II, the existing yard is to be resurfaced. Changes in the yard layout are also a part of this

work; it is important that the new yard layout be consistent with the type of operation that is foreseen and that the entire 26.5 acres be conceived and operated as a single unit.

The Equipment Maintenance Facilities are located behind Shed 1 and include the 24,000 sq.ft. Maintenance and Repair Building, a 3,600 sq.ft. Equipment Shed, a small filling station and open yard space for equipment storage and staging.

OTHER PORT FACILITIES

In addition to the Commercial Port itself, there are other facilities along the northern rim of Apra Harbor that are used for port purposes or allied functions. One of these facilities is operated by the Port Authority of Guam; the others are in the area covered by long-term leases.

H(otel) Wharf is a former Navy ammunition wharf located on the sheltered side of the Glass Breakwater about a mile west of the Commercial Port. This 500-foot long structure is composed of fill bounded by a steel sheetpile bulkhead with a concrete cap that extends below the low water mark. The Navy formally transferred this facility, together with the remains of Pier D(og), to the Government of Guam in October 1989, but retained the right to use the wharf with 72 hours advance notice if it perceived a need for it. This restriction will end in October 1992 and, so far, the Navy has not exercised this right. The Port operates the wharf primarily as a passenger vessel facility. The Oceanic Grace uses H Wharf regularly during the periods that she is based in Guam and excursion vessels also use it. In addition, the wharf is used for exports of scrap metal and for the import of cars and light trucks carried aboard car carriers when space in the Commercial Port is unavailable. Water depth at this wharf is about 32 feet.

Berth F(oxtrot)-2 is located at a right angle to Berth F-3. It is taken up entirely by long-term leases and is used for the delivery of cement and the repair and restoration of large fish nets, as well as ship repair. The berth face occupied by vessels unloading cement and purse seiners undergoing minor repairs or unloading or loading fish nets. The depth of water at this berth varies from 21 feet adjacent to Berth F-3 to 30 feet at the cement facility.

Berth F-1 and G(olf) Pier, with their attendant tankage, are both petroleum handling facilities--one under long-term lease from the Port and the other covered by a management agreement with a private operator. In 1989 these facilities were used for the import of some 6,060,000 barrels of petroleum products destined for civilian uses in Guam, as well as handling about 1,050,000 barrels exported to other islands. Berth F-1 was originally built for the now-defunct GORCO but it is now leased by Shell Guam Inc. and is also used by Esso Eastern Inc. G Pier was previously leased by Mobil Oil Co. but in 1989 the facility was rehabilitated by the Port and is now managed by PRI South Pacific Inc. and is used by both PRI and Mobil. This pier is also frequently used to moor purse seiners that may be awaiting provisions, etc.

Storage tanks, managed or owned by Mobil Oil Guam, Esso Eastern, Shell Guam and PRI South Pacific, are located within the old Industrial Area north of Berths F-1 and F-2. The total capacity provided is 625,270 bbls. of petroleum products.

PORT EQUIPMENT

The two largest pieces of equipment in the Commercial Port are rail-mounted Container Cranes (Gantries) 1 and 2. Container Crane 1 was installed in 1971, at which time it was already a used crane, having been acquired from Pacific Far East Lines. It has a lifting capacity of 30 long tons. Container Crane 2, with a lifting capacity of 40 long tons, was acquired in 1979. Both cranes have a 50-foot rail gauge and are limited in their height and reach. They can usually pick up containers stacked up

to four high above a vessel's deck and can reach ten rows out (their outreach is 150 feet from the centerline of the two rails). This is not enough for the vessels used by APL and Sea-Land on the Guam route, which have 13 rows of containers and could have containers stacked up to six high. Both these lines load their vessels at the present time with three rows of empties on the outboard side when they leave the West Coast and these are not touched in Guam. Particularly, Container Crane 1 is considered to be in poor condition and has a high failure rate.

For the handling of containers in the yard, the Port currently has three rubber tire-mounted gantries, or transtainers, which can stack containers four-high and five wide with room for a truck lane on one side. The rubber tired wheels can be rotated 90° to move the transtainers laterally from one stack to the next. Ruts have developed in the asphalt paving where these transtainers operate and where the wheels have been turned the pavement has failed. Reinforced concrete pads are needed where these pieces of equipment are operating. Two of the transtainers are over ten year old, have insensitive controls and lack anti-sway devices and "flippers" for easy centering of the spreader bar atop the containers. Working with these units, therefore, is slow and tedious. The third transtainer is only a year old and, when it's working, functions very well. However, it has a history of extended downtime because of inadequate protection of the generator windings against the corrosive salt atmosphere in Guam. Earlier problems with the computerized controls have been corrected and the manufacturer has provided the Port with a spare generator. Since it has eight smaller wheels instead of four large ones, however, the areas where it can work are limited to those where the pavement is relatively smooth.

Other container-handling equipment includes one Hystainer, which can only stack two-high and is outfitted for 40-foot containers only; one toplifter, which has a stacking limit of three 8-foot high containers. (This toplifter is currently the only piece of equipment available for delivering containers when a large containership is in Port and both container cranes are working); and a sideloader, suitable for stacking empties, which is now back in service. For moving containers about the yard, the Port has 24 tractors (about 80% are in operating condition) and has 12 chassis on order. Right

now the Port uses APL and Sea-Land chassis under an understanding with these two lines.

The Port has a range of other equipment, for handling break-bulk, neo-bulk and unitized cargoes, including a 20-ton Hyster, three 10-ton Hysters, five 5-ton fork-lifts and a number of 3-4 ton forklifts. Most of these are in operating condition.

Also, the Port has a 140-ton Manitowoc mobile crane that is quite old and is not working at the present time. This crane, or a replacement, could be used effectively for unloading rebar or lumber and, if equipped with a spreader bar, for unloading containers that are carried as deck cargo on break-bulk ships.

By the time of this report, the Port may have already received a new toplifter and additional forklift trucks. The Port is also proceeding with the acquisition of two additional transtainers with tight specifications on corrosion protection and maintainability.

WORKING HOURS

Vessels are worked at the Port 24 hours a day, seven days a week. Under recently extended hours, the Port is nominally open for deliveries five days a week from 6 AM to 7 PM. Within the Port's operating arm, the Terminal Division (responsible for the storage and delivery of containers and other cargoes) and the Transportation Division (responsible for operating all equipment) work the same hours. Ideally, the daytime hours are covered with two eight hour shifts, with a five hour overlap in the busiest period (less an hour for lunch). Often, however, staff shortages make one extended shift and the payment of overtime necessary. Night shifts depend upon the hours needed to work a ship. A full shift consists of 11 hours (7 PM to 7 AM) less a one hour break, though often less time is required. The third operating division, the Stevedore Division (responsible for working the vessel itself) normally works an 8 AM to 5 PM day shift and a "long shift" at night, from 7 PM to 7 AM. Those on the day shift may work extended hours and receive overtime if a vessel is being worked.

WHARF CAPACITY

In estimating the current capacity of the Commercial Port, only Berths F-4, F-5 and F-6 are considered. For all practical purposes, Berth F-3 is fully occupied by fishing vessels. The number of cargo vessels using this berth is extremely limited. Since H(otel) Wharf is devoted primarily to passenger vessels, it makes little contribution to the cargo-handling capacity of the Port--outside of some exports of scrap and occasional imports of automobiles and light trucks.

Cargo vessels calling at the Port have been divided into four basic types:

Type A - Full containerships;
Type B - Combination container/break-bulk vessels;
Type E - Car carriers (shown in Port records as ro-ro);
Type C - Small inter-island barges and vessels.

The proportion of cargo handled by each of these types in 1989 was as follows:

Type A - 63% of total cargo;
Type B - 18% of total cargo;
Type E - 9% of total cargo;
Type C - 10% of total cargo.

The Port's container cranes were used to work the Type A and Type C vessels. Type B vessels, however, were generally worked with ships gear, either because the container cranes were in use or because of possible interference between the vessel's cargo masts and booms in the stowed position and the spreader bar and lines of the container crane. Type E vessels, of course, were unloaded by side and stern ramps.

Analyses of cargo handling operations and actual ship records indicate that the following handling rates were achieved during the same sample month:

Type A: 19.65 Containers or 345 Rev. Tons/Crane Hour
38.4 Containers or 675 Rev. Tons/Ship Hour (avg.of 1.95 cranes)
Average Time at Berth: 16.1 hours or 1.3 times working time

Type B: 6.1 Containers or 78 Rev. Tons/Gang Hour
9.4 Containers or 120 Rev. Tons/Ship Hour (avg. of 1.54 gangs)
Plus Break-bulk: 35 Rev. Tons/Gang Hour
Plus Break-bulk: 53 Rev. Tons/Ship Hour

C

SPEC.
PROJ.
COORD.

D

OPERATIONS
MANAGER

E

SPEC.
PROJ.
COORD.

F

ENGINEERING AIDE III
CLERK III (REAK PROPERTY0
CLERK I (ENGINEERING)
TRAINEE

G

SPEC. PROJ. COORD.
SPEC. PROJ. COORD.
ADMIN. ASSIST.
ADMIN. ASSIST.

A

PORT
ENGINEER

B

C.I.P.

SAFETY

SAFETY

SAFETY OFFICERS

SAFETY

SAFETY
ADMINISTRATOR

Property Planning & Development

Engineering/CIP/Real Property

Combined handling rates
54 Rev. Tons/Gang Hour
82.5 Rev. Tons/Ship Hour
Average Time at Berth: 38.6 hours or 1.15 times working time

Type E: 650 Rev. Tons/Ship Hour
Average Time at Berth: 6.6 hours or 1.75 times working time

Type C: (5.9 Cont. + 9.0 Rev. Tons of B.B.) or 85 Rev. Tons/Vessel Hour
Average Time at Berth: 26 hours or 3.83 times working time

In the case of Type A vessels (full containerships), productivity rates are comparable to those found in most well-run ports and observation of container-handling operations suggest that these rates would be higher were it not for the inability of the transtainers to handle the containers in the storage area more rapidly. The low productivity in handling containers with ships gear in the cast of Type B vessels is evident. With Type C vessels, the number of containers carried is quite small and preparation time has a greater impact. Also containers may be stowed athwartship, thus requiring that they be turned 90% and often they must be secured with cables and other devices. Clearly, the extended time spent at berth by these inter-island vessels relative to their actual working time reflects the fact that most are based in Guam and use a berth on a "when available" basis.

Estimate of Practical Operating Capacity

(1) Noting that the larger containerships will occupy both Berth F-5 and Berth F-6, leaving room only for longliners to be berthed astern of them; (2) affording these containerships priority berthing as is the current practice; and (3) also noting the relative proportions of total cargo handled by each type, given current trade patterns: the practical operating capacity of the Commercial Port can be estimated as follows.

A berth occupancy factor of 0.25 is used for the Type A vessels (full containerships), which is appropriate for vessels of this nature arriving on a semi-scheduled basis, but, at the same time, allowing enough time for other vessels. Based on a factor of 0.25 the following amounts of cargo might be discharged from or loaded aboard Type A vessels if cargo volumes were uniform throughout the year.

$$0.25 \times \frac{675}{1.30} \times 8{,}760 = \underline{1{,}140{,}000 \textit{ rev. tons/year}}$$

If a berth occupancy factor of 0.40 is used for the Type B vessels (combination container/break-bulk vessels) and Type E vessels (car-carriers) but it is recognized that container ships already occupy two of the three berths for 25% of the time, the following volumes might be handled by the Type B and Type E vessels:

$$\textit{Type B}: (0.40 + 0.15 + 0.15) \frac{82.5}{1.15} \times 8{,}760 \times 0.91 = 400{,}000 \textit{ rev. tons/year}$$

$$\textit{Type E}: (0.40 + 0.15 + 0.15) \frac{650}{1.75} \times 8{,}760 \times 0.09 = 250{,}000 \textit{ rev. tons/year}$$

However, Berths F-4 and F-6, and to a lesser extent Berth F-5 are used by fishing vessels also, when they are not used by the containerships, the berths are really available to other cargo only about 83.25% of the time. Thus, the volumes that can be handled by Type B and E vessels would be actually less than the above, or:

Type B: 330,000, and

Type E: 170,000.

These volumes are consistent with the ratios of cargo carried by Type B and Type E vessels to that carried by Type A vessels. Therefore, these amounts will be used. Considering the number of Type C (inter-island) vessels that might occupy the length of berth available, if no other vessels were present, an occupancy factor of 0.65 would be appropriate for the berths but the actual number of vessels worked would be limited by the number of cranes. Accordingly, with only two cranes available a crane usage rate of 0.5 is used and the following cargo volume may be handled:

$$\textit{Type C}: (0.50 - 0.25) \times 2 \times \frac{85}{\textit{Say } 2.0} \times 8{,}760 = 175{,}000 \textit{ rev. tons/year}$$

The above figure is essentially consistent with the ratio of cargo carried by Type C vessels to that carried by Type A vessels.

If there were no month to month variation, total port capacity would, therefore, be:

$$1{,}140{,}000 + 330{,}000 + 170{,}000 + 175{,}000 = 1{,}815{,}000 \textit{ rev. tons/year}$$

The ratio of the average month to the peak month in 1989 was 0.825, so the annual capacity figure should be reduced accordingly to allow for some peaking:

$$1{,}815{,}000 \times 0.825 = 1{,}490{,}000 \textit{ rev.tons/year}$$

This figure is quite close to the 1989 cargo volume of 1,405,000 rev. tons (including transshipments both in and out). This bears out what can be observed--that Berths 4, 5 and 6 are operating at levels that are not very far from capacity at the present time.

CONTAINER YARD CAPACITY

The capacity of the container yard is a function not only of the area of the yard but also the manner in which it is operated. The basic choice is between a chassis-based operation and a stacked operation. The former method is often preferred since it is more straightforward and it is easier to store, locate and retrieve containers. It requires from 30 to 40% more land area, however, than a stacked operation. The latter requires a greater degree of organization but is more frugal in its use of land. At the Port of Guam, a stacked operation is the predominant form right now--largely because of land restraints--and the analysis is based upon this type of operation.

Because of several factors related to how the yard is operated now and current space restraints, the analysis first addresses the yard area that would be required to accommodate existing containerized cargo movements with desired operating conditions. Subsequently, the capacity of the yard is taken as a proportionate share of the present traffic level.

In estimating the yard area required, the following operating parameters are assumed:

1. Inbound containers are to be grounded and transtainers used for stacking and retrieval. Stacking to be in a 1:2:1:2:1 pattern to minimize the moves required and thus, the cost of retrieval.

2. Each day, 20% of the inbound containers are to be mounted on chassis ahead of time to expedite delivery; space is provided for these containers.

3. Outbound empties are to be grounded and stacked an average 2.5 high in a dense stack using a sideloader.

4. Outbound full containers are to be grounded and stacked in the same pattern as inbound containers but with 25% additional allowance for stacking containers by vessel.

5. Average dwell time for containers is:
   - Inbound containers - 7 days
   - Outbound containers - 5 days
   - Outbound full containers (export and transshipment) - 9 days

In 1989 an average of 1,460 containers were handled each week, with approximately equal numbers being inbound and outbound. If the peaking factor (peak month to average month) that is used above for wharf capacity is applied here, then the Commercial Port may have handled as many as 1,760 containers in some weeks--710 20-foot containers and 1,050 40-foot containers, with half being inbound and half outbound. Table III-1 shows the calculation of container yard space required to properly handle this number of containers.

Table III-1 indicates that close to 18 acres of space are needed to handle the number of containers moving through the Port in 1989, with the operating parameters noted above. If two vessels should arrive on successive days, as occurs now with APL and Sea Land, there is further peaking in the yard, as additional containers are coming in before the containers from preceding vessels can be delivered from the yard. The effect of this peaking from closely-spaced vessels is to increase the area required to 19.3 acres. Thus, capacity of the present container yard is roughly 80% of

the traffic actually handled in 1989--assuming a basic transtainer operation and dwell times that are not excessive. Therefore, the container yard is currently operating at levels exceeding its capacity and this is evident in the crowding found at the yard. Furthermore, the condition is exacerbated by the fact that chassis-mounted containers occupy 6.5 acres in the yard, so the transtainer operation is limited to 8.7 acres--compared with a need for 14 to 15 acres if the operation is to be run smoothly, with efficient storage and retrieval.

TABLE III-1

CONTAINER YARD REQUIREMENTS

1)	Inbound Ground Storage;	
	20' Containers - 355/7 = 51 blocks @ 1,650 SF	84,150 SF
	40' Containers - 526/7 = 76 blocks @ 3,150 SF	239,400
2)	Chassis Storage:	
	20% of ground storage: 20' - 355	
	40' - 526	
	881 x .2 = 177 @ 872 SF	154,350
3)	Outboard Empties 75% of outbound containers x 5/7	
	0.75 x 5/7 x 355 ÷ 2.5 high x 8 x 20 (40' x 320') =	12,800
	Aisle 35' x 320	11,200
	0.75 x 5/7 x 526 ÷ 2.5 high x 8 x 40 (40' x 920') =	36,800
	Aisle 35' x 920	32,200
4)	Outbound Full:	
	(25% of outbound containers x 9/7 x 1.25 diversity factor)	
	0.25 x 9/7 x 355 = 114/7 x 1.25 = 21 blocks @ 1,650 SF	34,650
	0.25 x 9/7 x 526 = 169/7 x 1.25 = 30 blocks @ 3,150 SF	94,500
5)	Aisle space in Ground Storage Area	78,000
	(2 aisles, 60' x 650' traversing container area)	
		778,050 SF
		Need 17.9 acres

Present Yard Operations

Over three-quarters of the container movements in the Container Yard are generated by the weekly calls of APL and Sea Land vessels and calls by other pure containerships. When the vessels are being worked by the two container cranes, few or no deliveries of containers to consignees are made from the yard. The two transtainers that are normally operating must be used to handle the import containers. (The new Mitsubishi transtainer has a history of low availability and can not be used in certain rutted areas in the yard.)

If these vessel calls occur on consecutive days, the nondelivery of containers from the yard leads to further congestion--namely imported containers stacked two and three high--causing many rehandlings of containers. This rehandling often leads to the references to the containers' locations being lost, necessitating a yard survey to reestablish their locations.

The lack of sufficient chassis also aggravates the above problem because import containers can not be mounted on chassis ready for delivery. Much of the yard space devoted to the stacking of inbound containers and outbound empties is in the area formerly used for chassis storage of containers. The dolly blocks in the chassis storage area interfere with its efficient use for the stacking of containers. The area can be striped and numbered for both chassis storage and the stacking of containers thus providing a ready reference for first-time users of the yard.

Preventive maintenance should be scheduled for <u>all</u> equipment. This is particularly important as new equipment is phased in. Regular maintenance plus adequate spare parts, and operator training provides reliable equipment operation when needed.

UTILITY SYSTEMS SERVING CABRAS ISLAND

Water Supply

Cabras Island, including the Port, is in a PUAG service area that includes Asan and Piti. This is a dependent system served by wells in Asan Springs. These have a

capacity of 250 gpm (about 350,000 gpd) and the remainder is provided by an agreement with the Navy which provides a maximum of 300,000 gpd.

The $53 million bond issue for public improvements includes money for extending a water line from the Route 4 intersection in Agana to Cabras but it's not a top priority. One section of this line may be built earlier, which would provide a link from the Governor's Office area in Anigua down to the Asan-Cabras-Piti system. The Navy is currently considering a booster pump to send water to the north and for this reason feels that it cannot increase the amount is is currently committed to provide. An alternative approach suggested by some of the PUAG's staff may be for the Navy and the PUAG to renegotiate existing short-term agreements, so that the Navy could serve more of the PUAG's needs in the south on a permanent basis and the PUAG could take care of the Navy's needs in the north.

At the present time, Cabras Island is served by a 16 inch line that is fed from a loop, consisting of a 12-inch leg and an 8-inch leg, that is connected to the Navy's 20-inch line along Marine Drive, and also to the 500,000 gallon reservoir of the PUAG's Piti-Asan service area. These pipes can deliver far more water to the Port and other users on Cabras Island than is available from present sources under existing agreements.

The water lines on Cabras Island are probably over 30 years old, as is much of Guam's water system. A recent leak detection survey, however, indicates that the system as a whole, which contains a mix of cast iron, asbestos cement and PVC pipes, is holding up reasonably well.

Sewerage

The Port of Guam is currently served by a 50,000 gpd package treatment plant that is located near the present main gate to the port area. This plant is an extended oxidation unit that has an 8-inch outfall. (This outfall, encased in concrete, can be seen entering the water on the north side of the island.) An earlier sludge-drying bed has been removed, so sludge is pumped out every six months or so.

The Sewerage Master Plan, prepared for the EPA in 1987 suggests that the collection systems serving the Port and adjacent industrial area be connected to the system serving Agat and Santa Rita, which would have a new treatment plant. Under this plan, which is not yet funded, the existing package plant would be retired.

PITI CHANNEL - HARBOR OF REFUGE AND AQUA WORLD

Because of its expanse and protected water, Apra Harbor is also used for a range of water-oriented recreational activities and these are expected to expand in the future as tourism continues to grow. The Harbor is used by a mix of both privately-owned boats and commercial vessels engaged in water sports such as snorkeling, scuba diving and water-skiing or providing daytime and evening dinner cruises.

Most of the commercial vessels are berthed either in a series of slips near Aqua World or in the Harbor of Refuge. Both of these areas are located at the eastern end of the Piti Channel, east of the Commercial Port. Only the northern side of the Harbor of Refuge is utilized for berthing vessels, most of the moorings are vacant so that the harbor can serve its intended purpose when needed. Some privately-owned boats are also located in the slips near Aqua World, as well as at the relocated Marianas Yacht Club and in Sumay Cove (which is open only to active and retired military personnel).

The Piti Channel, east of the Commercial Port is only about 60-70 feet wide, has a depth of 8 feet or less at Mean Low Water and contains some shoaling areas where depths of only 3 feet have been reported. Craft drawing 8 feet, such as the Aqua World submarine, can just about pass through and on occasion have had to remain outside in Apra Harbor. At the eastern end, the branch of the channel going to the Aqua World area is crossed by a submarine pipeline owned by Shell Guam Inc. that serves the power plant storage tanks. Water depth over this pipeline is limited to 8 feet. (Because of silting, it is somewhat less at present.) The silt deposits are expected to be removed soon to reestablish the 8-foot depth but the costs of relocating or lowering the pipeline precludes any further increase in depth.

Some channel improvements are warranted but these may be limited to ensuring a depth of 8 feet throughout the length of the channel and widening it to perhaps 100-120 feet in the reaches near the Commercial Port in order to allow safe passing.

Observation of the back channel where Aqua World is located indicates that with further rationalization of the slip layout additional boats could be accommodated. How these spaces might be allocated is discussed later, in Chapter VII.

MARINAS

Agana Marina

The present Agana Marina, located on the waterfront of Guam's business and administrative center, is home to about 50 boats belonging to private owners, fishing charter operators and the University of Guam. Built in the pre-World War II era, the marina consists of two small lagoons formed by a series of breakwaters consisting of earth fill retained by steel sheetpiles. Within those lagoons are floating slips and moorings with a total capacity of about 50-55 boats. Other boats are out of the water on blocks, where they are being repaired, or are mounted on trailers parked in the area.

The Marina is too small to meet current demand (there is a waiting list of 64 applicants for space) and has also deteriorated in recent years. The floating docks and slips are in need of repair and the steel sheetpiles are corroded in many areas. Furthermore, access from Marine Drive is neither safe nor convenient.

Because of the need to replace the Agana Marina, with a modern facility and provide additional spaces--and consistent with the Port Authority of Guam's privatization program--proposals were requested in 1988 from developers for a facility to be financed with private capital. These proposals were received and last year one was selected, which is currently being considered by the Legislature.

As currently conceived, the new Agana Marina will have a total of 338 boat slips, plus boat launching ramps and 48 pull-through car and trailer stalls, a harbormaster's control center, fueling facilities, a boat chandlery and a fishing station. A

singular feature of the new marina development will be an international hotel and marina club with 120 overnight units for boaters and 320 guest rooms for tourists and businessmen. The hotel will be the key to the overall financial viability of the project and will permit affordable fees for the rental of ships.

Agat Marina

The Agat Marina is a new facility, funded directly by the Port Authority of Guam. It is expected to start operation in late 1990 or early 1991. The design of the facility provides for a protected harbor containing slips and moorings for 156 boats, plus shoreside support facilities such as fuel and loading docks, car and trailer parking places, water hook-ups and pump-out facilities. The Agat Marina will also have a full-service restaurant for about 40 people and an outdoor dining facility. At the present time there are 45 applicants waiting for spaces at the marina.

CHAPTER IV
CARGO FORECASTS - COMMERCIAL PORT

GENERAL

Port traffic forecasts have been prepared from three different perspectives, each of which is needed for the port master planning process. Initially basic, best judgment estimates of the future volume of port traffic have been prepared. These estimates have been made separately for major cargo flows including imports, exports, transshipments and tuna fishing. Next, these forecasts have been expressed in terms of cargo handling characteristics as container and break-bulk/neo-bulk cargo. Finally, alternative cargo forecasts have been developed to estimate the effects of other less likely but nevertheless possible, development scenarios.

The basic approach to port traffic forecasting used herein has been to segment major cargo flows into subgroupings with common economic characteristics. For each subgrouping one or more independent socio-economic variable has been identified which helps explain and predict its future trend. Individual segments for the period under review have been projected and then aggregated to arrive at the combined port traffic forecast.

Only cargo forecasts are presented here. The outlook for cruise passenger traffic and water-related tourist activities in Apra Harbor and elsewhere is discussed elsewhere in this report.

BASIC FORECASTS OF IMPORTS AND EXPORTS

Total Imports In Base Year

Imports are the single most important cargo flow at the Commercial Port, accounting for over 70% of the total port traffic in fiscal 1989. They have been segmented into the following four major subgroupings as follows:

Subgrouping	FY 1989 000 Rev.Tons	Percent of Total
Tourist Industry	188.2	19.3
Military Installations	165.8	17.0
Local Consumption	475.3	48.7
Construction Activity	146.4	15.0
Total	975.7	100.0

As noted earlier, imports comprise only the commodities consumed in Guam. Commodities imported into Guam for subsequent re-export to Micronesia are handled as transshipments.

Tourist Industry Import Forecasts

Base Year Estimates

The method used to estimate the figure shown above for base year imports by the tourist industry is presented below.

Base Year (FY 1989) Estimates for Tourist Industry

Total tourist expenditures: 668,700 tourists x $944 per tourist		$631,253,000
Value of imported inputs to the tourism sector (from SRI study): $631,253,000 x 22%		$138,876,000
Unit value of imports--updated from 1983 commodity data ($/ton)		$738
Volume of tourist industry imports (tons)		188,197
Total volume of imports (tons)		975,700
Tourist industry share of total imports	19%	

Sources: Stanford Research Institute, Economic Benefits of Tourism to Guam, Menlo Park CA 1986; Merrill & Associates, Visitor Exit Survey, Guam 1986; Department of Commerce; Port Authority of Guam; Guam's Visitors Bureau; U.S. Department of Commerce.

Based on the above, the tourist industry imports are estimated at 188,200 tons in FY 1989. This is a conservative estimate as it is based on direct tourist expenditures and does not take into account hotel imports (supplies, replacements, etc.) that may be included in the hotels' overhead costs.

Forecasts

Tourist expenditures are a function of the number of tourists and their per capita expenditures. Guam is the favorite destination of younger, lower income Japanese tourists. This trend is expected to continue, particularly if Guam is successful in opening new tourist markets in other less affluent Asian countries. If this is the case, future tourist expenditures will reflect primarily the growth in the number of tourists.

Despite its remarkable growth in recent years, Guam's tourism potential has been limited by the lack of tourist facilities. As a result, there is at present a substantial pent-up demand in Japan for Guam vacations which will materialize once the various hotel and resort projects now under construction are finished and opened for business. It is assumed here, probably conservatively, that the number of visitors to Guam will rise as follows:

1989-1995	12% annually
1995-2000	9%
2000-2005	6%
2005-2010	3%

This compares with the actual average annual growth of 13% during the 1984-89 period.

Military Installation Import Forecasts

As reviewed earlier in this report, there is very little known about the plans for the military installations on Guam. Even the spokesmen for the military establishment profess to be baffled by the rapidly changing geo-political and military situation in the world and the Pacific region.

In view of past trends and future uncertainties, it is most reasonable to assume status quo in the level of military use of commercial port facilities during the period under review. This "no growth" assumption underlies our best judgment forecast for the military component of the commercial port traffic.

Local Consumption Import Forecasts

Local consumption imports are determined primarily by the growth of population, of real per capita income and import substitution programs. According to forecasts presented earlier in this study, Guam's population is projected to rise at 2% annually through the year 2020 and not much can be expected from import substitution programs in manufacturing and agriculture.

It is more difficult to project the real per capita income growth. As we have seen, the real (adjusted for inflation) per capita income of individuals has grown at 6% annually in recent years. Much of this growth can be explained by the rapid rise in employment and income of the tourist industry, offset only in part by the lagging growth of civilian employment and income from the military installations on the Island. It is reasonable to assume that the future development in those two exogenous sectors will bracket the growth of individual per capita incomes. Taking this approach, the real per capita income should grow at rates that may gradually decline from 5.5%-6.0% in the 1989-95 period to 2% in the 2005-10 period. Combined with the projected population growth, the effective demand for local consumption imports will rise as follows:

Period	Average Annual Growth Rate
1989-1995	7.7%
1995-2000	7.0
2000-2005	5.6
2005-2010	4.0

Construction Import Forecasts

According to the sample survey of consignees conducted as part of this study, some 15% of imports through the Commercial Port in FY 1989 were destined for the construction industry. This may be on the low side, as not all construction imports were consigned to the construction firms.[1]

Based on the volume of building projects and allowing for the fact that not all projects will be implemented, it seems reasonable to expect that construction in the tourist sector (45-50% of the total), will grow initially (1989-95) faster than tourism itself to meet the backlog demand. Later, this growth should approximate the expected growth in tourism.

For military construction (20% of the total), there may be a slight decline in 1990 because of the recently declared construction budget freeze, to be followed by a constant level of construction activity.

The growth in residential construction (25% of the total) will reflect primarily the projected population growth with some adjustment for improvements and housing for migrant labor. These latter variables are difficult to predict with any degree of accuracy. Hence, it is simply assumed that the combined effect of all variables will result in an annual growth of 3% during the period under review.

Local public works construction (10% of the total) will grow fast during the 1989-95 period and slower later on. Its growth is estimated at half way between the growth of tourist and residential construction.

The combined growth rate for individual subsectors of the construction industry will be as follows:

Period	Average Annual Growth of Construction Imports
1989-1995	9.4%
1995-2000	6.8
2000-2005	5.0
2005-2010	3.0

[1] These estimates exclude cement imports which are unloaded over privately-operated port facilities.

These are long-term trend forecasts. In reality, the construction industry and its imports are very cyclical. Actual imports in any one year may be considerably higher or lower than suggested by the forecast.

Summary Import Forecasts

Table IV-I summarizes basic, best judgment import forecasts for the Commercial Port. According to this table, imports through the Port will rise from 975,700 revenue tons in FY 1989 to over 3.2 million tons at the end of the review period.

TABLE IV-1

IMPORT FORECASTS FOR THE COMMERCIAL PORT
(000 Revenue Tons)

Year	Tourist Industry	Military Installations	Local Consumption	Construction Activity	Total Imports
1989	188.2	165.8	475.3	146.4	975.7
1995	371.5	165.8	733.4	250.9	1,521.6
2000	571.7	165.8	1026.7	348.6	2,112.8
2005	765.0	165.8	1348.1	444.8	2,723.7
2010	886.6	165.8	1640.7	515.5	3,208.6

Exports

Roughly 90% of the true exports from Guam are military goods including personal vehicles, household goods and equipment being sent back to the United States. The remaining 10% consists of a small volume of garments processed locally and a range of miscellaneous items, including scrap metals, frozen fish (by-catch and tuna rejected from sashimi shipments), household goods, etc. Most of the exports are not expected to grow in the future: the military exports because of expected budget cuts and longer tours of duty, the garments because of the U.S. Customs quotas and the fish for reasons noted below. Exports of scrap and some other items may grow with the economy but these make up a small fraction of total exports. In the long run, the

Commonwealth status for Guam and the general rise in the prosperity of the region may encourage local manufacture for exports.

The combined effect of these divergent trends will probably mean little change in the overall volume of exports during the period under review. Accordingly, no export growth is assumed initially and only marginal increases thereafter. Total exports will rise from 125,100 revenue tons in FY 1989 to 168,000 revenue tons in the year 2010.

BASIC FORECAST OF TRANSSHIPMENTS

Transshipment volumes may come from two sources--one is continued transshipments of goods to other areas of Micronesia, particularly the CNMI, the FSM and Palau; the other would be the possible growth of Guam as a location for receiving goods, either in larger shipments or from a number of sources, processing or assembling them and re-exporting them to other countries around the Pacific Rim.

Transshipment to/from Other Micronesian Islands

The three major sectors of the economy of the Commonwealth of the Northern Marianas Islands are tourism, construction and general consumption. A fourth sector, the manufacture of garments, is discussed below. Also, there is a military presence on Tinian but it is relatively small.

During the 1990-1995 period, tourism demand is expected to remain very strong and new facilities are being developed to meet this demand. A continued growth rate of 13% is forecast. Propelled by the demand for new hotels and a major program of infrastructure development, funded in part by Covenant funds, the estimated growth rate for the construction sector in this period is at least 15%. Other sectors of the CNMI's economy may grow at a more moderate rate and based on the Commonwealth's Overall Economic Development Strategy, a rate of 6% is estimated. The weighted average of these three growth rates is about the same as the rate that would result if the Overall Economic Development Strategy targets for productivity increases

are met and the total population grows as projected. Averaging these two approaches indicates a growth rate for the economy and for imports of 9.8% annually to 1995.

In subsequent years population growth is projected to moderate, as natural increase slows and some alien workers are repatriated. Some slowdown in productivity increases is also assumed, so the resulting growth rate for the 1995-2000 period is 7.3% annually. After the year 2000, population may continue to grow at a lower rate and productivity increases will slow further. The resulting growth rate for the year 2000 to 2010 period is 5.3% annually.

The transshipment of garments manufactured in the CNMI is expected to grow no faster than increases in productivity, since no new plants are being permitted. The volume of transshipped garments, therefore, will grow at the rate of 6% until 1995, 3% from 1995 to the year 2000 and zero thereafter.

The new port project in Saipan, referred to as "Charlie Dock", is expected to be completed by 1994 or 1995. With more goods originating in the Far East, this will allow more direct shipment of goods to the CNMI rather than transshipment through Guam. Therefore, it is assumed that the volume of transshipped goods destined for CNMI will begin to decline in 1996; and the year 2000 about 50% will have been lost. In the following years Guam will continue to transship about half of what it would have without port improvements in Saipan.

Given the slow growth forecast for the economies of the Federated States of Micronesia and Palau, it is assumed that total exports and transshipments to these islands will grow at a rate of 1% above the rate of population growth. This allows for some investment in infrastructure funded by U.S. funds under the Compact of Free Association. The current rate of population growth in the FSM is about 3.4% annually; in Palau it is only 0.7% annually. These growth rates are based on projections prepared in 1988 by the South Pacific Commission and presumably they reflect current levels of out-migration. A weighted average figure of 4.2% annually is used for estimating the level of future transshipments and re-exports to the FSM and Palau.

It is also assumed in the basic forecast that the interplay of competitive factors and new entrants into the trade between Honolulu, Micronesia and Guam will be such

that Guam's share of transshipments to the FSM and Palau will not increase or decrease.

The basic, best judgment estimates of future transshipments via Guam to and from the CNMI, the FSM and Palau that result from the above considerations are as shown in Table IV-2.

TABLE IV-2

TRANSSHIPMENTS TO/FROM OTHER ISLANDS OF MICRONESIA

	Revenue Tons			
	1990	1995	2000	2010
CNMI (excluding Garments)	95,100	151,000	108,000	180,900
Garments	40,300	53,900	62,500	62,500
FSM, Palau, etc.	28,600	35,100	43,100	66,300
	164,000	240,800	213,600	309,700

Potential of Guam as a Transshipment Center

Guam's potential as a center for the transshipment of goods moving between the U.S. mainland and various countries in the Far East, Southeast Asia, Australia and New Zealand was discussed at some length in the 1981 Master Plan for the Commercial Port.

The geographic factors pointed out in that earlier report and what they mean, in terms of voyage distances, sailing times and costs, have not changed in the intervening decade. The overall geopolitical situation and the size and structure of Guam's economy have, of course, changed significantly.

In terms of Guam's potential as a major transshipment center, changes in its economy since 1980 would tend to further reduce this potential. Guam has evolved as primarily a service-oriented economy with generally higher costs than surrounding countries and territories. Unemployment is very low and no large pool of semi-skilled or skilled labor exists. Furthermore, Guam is still subject to the provisions of the Jones Act, though this may change if Commonwealth status should be achieved. The

fact that Guam's manufacturing sector consists of one small plant and a few cottage industries is testimony to the fact that prospects are poor for significant processing of raw or intermediate materials into finished goods. Such processing would be a necessary adjunct to large-scale transshipments, inasmuch as geographic factors militate against the use of Guam as a Western Pacific transshipment center.

Given their protected status under the Jones Act, discussions were held with the local and headquarters personnel of both U.S. carriers regarding the potential for feeder services and related transshipment activity based at Guam. Outside of limited interchanges (e.g. APL might bring in some containers destined for Okinawa that would be loaded out on Sea-Land ships for shipment to their destination) the likelihood of transshipment at Guam, in conjunction with feeder service is considered to be minimal. What is considered more likely is that one of the trans-Pacific services may stop at Guam on the eastbound leg, thus competing with Japanese and other carriers in carrying goods from Eastern Asian ports to Guam.

Offsetting Guam's relatively high costs and small pool of available labor is a reasonably well-developed infrastructure and network of support services, including excellent communications. For this reason, Guam may grow as a business and financial center for U.S. Firms doing business in Asia. Already, there are some 300 Foreign Sales Offices, which have located in Guam to take advantage of the tax benefits offered, and the Guam Economic Development Authority (GEDA) is involved in promoting an office complex in the area of the old Guam hospital. While prospects are bright for this type of activity, few, if any, physical shipments would be involved. GEDA is also pressing for the development of some light industry as an alternative to tourism but, once again, these would be industries in areas such as watch assembly or robotics, which would depend more on airfreight than waterborne shipments.

Outside of the new exports that are considered possible later in the planning period, significant volumes of transshipments to places other than the other islands of Micronesia are not foreseen.

FUTURE SHIPMENTS OF FISH

The volume of fish landed at Guam and shipped to other destinations is governed much more by relative costs at Guam and competing ports and by various exogenous factors than it is by such variables as the growth of the market or overall harvests versus potential yields.

As an example, it was noted earlier that what had been a growing activity at the Commercial Port, the transshipment of frozen tuna from purse seiners to reefer containers, declined and ended in the mid-1980's. High labor costs in Guam played a role but much more important was the failure of canneries in United States, which were replaced by canneries in American Samoa and Southeast Asia. As a consequence, U.S. flag vessels were replaced by those sailing under foreign flags and transshipment now takes place in Tinian, where port charges and labor costs are lower and tax exemptions are available, or transfer may take place at sea.

Because of its existing port infrastructure, network of agents and frequent flights to Japan, Guam has now, however, become a major transshipment point for chilled fresh tuna destined for sashimi. Approximately 165 longliners use Guam for air shipment of their tuna catches and some operators and their agents are quite optimistic about further growth. Others, however, cite the restraints upon growth and the threats to Guam's position. These include recently enacted limits on the number of Japanese vessels allowed to land fish outside of Japan, investments by Taiwanese entrepreneurs in alternative transshipment facilities in Palau and technological changes, such as blast freezing to supercold temperatures that would remove the time constraint on getting the fish to market. It is not impossible that the current activity of transshipping chilled tuna at Guam could disappear as quickly as it came.

Consequently, it is very difficult to forecast future volumes with any confidence. The tonnage of chilled tuna currently landed at Guam is estimated to be 7-8,000 tons annually. For the basic, best judgment forecast it is considered likely that future tonnage will not be significantly higher than this; in the forecast, allowance is made for a modest increase--up to about 9-10,000 tons annually.

For the planning of future port facilities it should be noted that, while purse seiners are expected to continue landing their fish at Tinian or transferring them at sea, the advantages of Guam as a place for reprovisioning, bunkering and vessel repair, as well as for crew rest and relaxation, are considerable. These attractions have gained additional significance inasmuch as owners of eastern Pacific tuna fleets are beginning to move their fleets to the western Pacific in order to avoid the problems caused by the fact that, in the fishing grounds off the coasts of North and South America, dolphins are found above the schools of tuna. The owners and crews feel that the techniques needed to minimize dolphin kills in those areas will be unduly expensive. Therefore, calls at Guam by purse seiners for reprovisioning, etc. are expected to rise by 50-60% as the eastern fleet joins the western fleet.

Summary of Basic Port Traffic Forecasts

Aggregate commercial port traffic forecasts are presented in Table IV-3. The total volume of port cargo is projected to rise from 1.26 million revenue tons in FY 1989 to 3.7 million revenue tons in the year 2010.

FORECAST BY MODE OF SHIPMENT

In FY 1989, 80% of total port traffic was containerized. Included in this figure was transshipment traffic which was 97% containerized and domestic traffic with the United States whose degree of containerization was nearly 100%. On the other hand, only 48% of foreign traffic in the same year was shipped in containers.

In recent years, foreign traffic has been the fastest growing segment of Guam's maritime commerce. There are reasons to believe that, in the foreseeable future, trade with foreign countries will grow faster than the trade with the United States. If this is the case, the overall degree of containerization may decline slightly in the near-term future (as it actually did between 1980 and 1989), unless the containerization rate for foreign traffic grows faster than its volume.

TABLE IV-3
AGGREGATE FORECASTS
(000 Revenue Tons)

Year	Imports	Exports	Trans-shipments*	Fishing	Total
1989	975.7	125.1	152.0	7.5	1,260.3
1995	1,521.6	125.1	240.8	9.5	1,897.0
2000	2,112.8	131.5	213.6	9.5	2,467.4
2005	2,723.7	144.6	257.2	9.5	3,135.0
2010	3,208.6	167.6	309.7	9.5	3,695.4

* Transshipments are unduplicated--that is they are shown for one direction (inbound or outbound) only. For cargo handling requirements, this figure should be doubled.

The prospects for faster containerization of Guam's foreign traffic are limited by three considerations. First, auto imports, which represent a substantial share of the total, will continue to be imported by Ro-Ro ships. Second, some construction materials, which are imported primarily from East Asia, cannot be containerized. Finally, Guam is one of several ports of call for the vessels carrying foreign cargo. Other ports of call either do not have container handling facilities or are too small to justify full container service. For all these reasons, it seems unlikely that containerization rate for foreign traffic will grow faster than its volume. Accordingly, it is assumed here that containerization will decline slightly from its present level of 80% as shown in Table IV-4.

ALTERNATIVE FORECASTS

General

Alternative port traffic forecasts are needed to illustrate the possible, though less likely, range of future demand for facilities in the Commercial Port. In this study, low and high growth scenarios are identified for each major cargo flow and their impacts upon these cargo flows are quantified--mainly by reference to the basic, best judgment forecast. In turn, all low and high forecasts are aggregated to obtain low and high port traffic forecasts.

Imports

Tourist Industry Imports

Low Forecast - There are two aspects of tourism which may be adversely affected in the future. On the supply side, Guam may be unwilling or unable to provide all the labor force needed to operate the many new hotels and resorts under construction or in the planning stage. Also on the supply side, inadequate utilities may slow down the tourist growth rate. On the demand side, tourism may grow less than

TABLE IV-4

CARGO FORECAST BY MODE OF SHIPMENT
(000 Revenue Tons)

Fiscal Year	Imports			Exports			Transshipments*			Total		
	Container	Break-Bulk	Total	Container	Break-Bulk	Total	Container	Break-Bulk	Total	Volume	% Container	% Break-Bulk
1989	746.2	229.5	975.7	111.6	13.5	125.1	147.4	4.6	152.0	1,252.8	80.0	20.0
1995	1,163.7	357.9	1,521.6	111.6	13.5	125.1	233.6	7.2	240.8	1,887.5	80.0	20.0
2000	1,605.7	507.1	2,112.8	117.0	14.5	131.5	207.2	6.4	213.6	2,457.9	79.0	21.0
2005	2,070.0	653.7	2,723.7	128.7	15.9	144.6	249.5	7.7	257.2	3,125.5	78.0	22.0
2010	2,438.5	770.1	3,208.6	149.2	18.4	167.6	300.4	9.3	309.7	3,685.9	78.0	22.0

* Unduplicated

expected if Japan's economy goes into recession, if the yen exchange rate weakens substantially or if Japan-U.S. relations should change in unforeseen ways.

High Forecast - If all hotels and resorts now under construction or on the drawing board are completed on schedule, the present room capacity will triple before the year 2000. If these rooms, are to be filled at a normal occupancy rate, tourist arrivals will need to grow faster than projected in this study.

Military Installations

In the low forecast, the present momentum in defense cuts is assumed to continue and to include the Asian theater of military operations. It is also assumed that the U.S. military presence in the Far East will be reduced absolutely, rather than dispersed to bases such as Guam.

For the high forecast, it is assumed that military threats or instability in Asia will continue and that some military missions of Subic Bay Naval Base and Clark AFB will be moved from the Philippines to Guam. This forecast does not include any specific volume estimates directly related to such a move but only an estimate of greater military imports, assuming an increased level of military activities on the Island. Under this scenario, there will be a substantial rise in military imports during the 1989-95 period but little or no growth thereafter.

Local Consumption

For the low forecast, the same population growth is assumed as for the basic, best judgement forecast but the per capita income growth rate is reduced to reflect slower growth in the tourist and military sectors, the two main pillars of the local economy.

In the high forecast, the population growth rate is increased to allow for more immigrant labor. Also, the per capita income growth rate is increased to reflect faster growth in tourism and military complex for reasons explained in the high forecasts of these two sectors.

Construction

The construction industry is a reactive economic sector in that its growth reflects the level of activity in other economic sectors, primarily tourism, military and local consumption. Accordingly, the low growth scenario for construction reflects the consequences of low growth in the other economic sectors. Similarly, the high growth scenario for construction reflects the improved growth prospects of the other sectors.

Exports

Since about 90% of all true exports stem from military activities, the low export scenario is the same as low scenario for military installations that is described above.

The high export forecast focuses on the economic liberalization and diversification that may result from the proposed Commonwealth status. Specifically, if Commonwealth status is attained before 1997, there is a possibility of a large inflow of capital and skilled labor from nearby Hong Kong seeking safety, investment opportunities and free access to the U.S. market. Should this happen, new export industries would spring up overnight contributing also to parallel imports of raw and semi-finished material imports. In time, however, this growth might lead to local opposition if there are no significant benefits to the local economy and it could be thwarted by U.S. protectionist measures.

Alternative Forecasts--Transshipments

Low Forecast

This estimate is based on the following alternative scenarios for the three major components of transshipments:

- The economy of CNMI will continue to grow but at a somewhat lower rate than that developed for the basic estimate, with productivity increases of about half the targeted rates. Growth rates during the forecast period would be as follows:

1989-1995:	6.5% annually;
1995-2000:	4.8% annually;
2000-2010:	3.7% annually.

Furthermore, Charlie Dock will be completed one year earlier than expected and by 1999, 50% of Guam's transshipment traffic to the CNMI will have been lost.

- The transshipment of garments manufactured in CNMI will not grow beyond 1989 levels and will decline after the year 2000 by 3% annually.

- Total exports and transshipments to the FSM and Palau will grow no faster than the population and competitive factors, including new entrants on routes from mainland U.S. or Hawaii to Micronesia will result in a loss of 25% of Guam's share of total cargo moving to Micronesia within the next five years.

High Forecast

This estimate is based on the following scenarios for the major components of transshipments:

- The economy of CNMI will grow at the same relatively high rate of growth as in the basic estimate for the next five years but it is further assumed that productivity will continue to increase at 6% annually until the year 2000 and will increase at about 4% annually after that. Growth rates during the forecast period would, therefore, be as follows:

1989-1995:	9.8% annually;
1995-2000:	8.3% annually;
2000-2010:	6.3% annually.

Charlie Dock will be completed in 1995, as expected, but is completion will result in the loss of only 30% of Guam's transshipment traffic to CNMI by the year 2000.

- Garment exports by CNMI will grow as forecast in the basic estimate.

- The economy of the FSM will grow at a rate that is 3% above population increase and in Palau a growth rate of 7% annually will be achieved after 1995 as a result of investments in tourism. Also, the interplay of competitive factors and the selection of Guam as a hub by certain of the lines serving Micronesia will result in Guam's share of cargo moving to that area by 25% in the early 1990's.

Alternative Forecasts--Fish Landings

Low Forecast

In this estimate, it is assumed that the restrictions on the number of Japanese vessels able to land their catch at Guam will have a substantial effect and that up to 50% of the Taiwanese fleet will move to new bases in Palau and elsewhere. As a result, landings of chilled tuna in Guam might drop to about 50% of their present level or about 4,000 tons annually.

High Forecast

In this estimate, it is assumed that there will be no effective restrictions on the number of Japanese longliners landings at Guam and no economic restraints on vessel operations. It is also assumed that the number of Taiwanese vessels operating out of Guam will grow in accordance with more optimistic estimates. Resulting landings of fish will then be in the range indicated by estimates contained in the 1989 Longliner Study or some 15-18,000 tons annually.

Summary Alternate Port Traffic Forecasts

Table IV-5 summarizes all port traffic forecasts for the basic, low and high growth alternatives. According to these figures, the aggregate port traffic volume may range from 2.6 million revenue tons to 6.2 million revenue tons at the end of the forecast period depending on the set of underlying assumptions.

For the first 11 years of the master plan period (1989-2000), the average annual traffic growth rate will range from 4.2% for the low growth forecast to 6.3% for the basic growth forecast and to 9.4% for the high growth forecast. This compares with an average annual growth rate of 7.0% actually attained during the 1980-1989 period.

TABLE IV-5
AGGREGATE ALTERNATIVE FORECASTS
(000 Revenue Tons)

Year	Imports	Exports	Trans-shipments	Fishing	Total
BASIC					
1989	975.7	125.1	152.0	7.5	1,260.3
1995	1,521.6	125.1	240.8	9.5	1,897.0
2000	2,112.8	131.5	213.6	9.5	2,467.4
2005	2,723.7	144.6	257.2	9.5	3,135.0
2010	3,208.6	167.6	309.7	9.5	3,695.4
LOW					
1989	975.7	125.1	152.0	7.5	1,260.3
1995	1,351.6	125.1	189.2	4.0	1,669.9
2000	1,705.0	119.0	146.9	4.0	1,974.9
2005	2,056.9	107.4	163.9	4.0	2,332.2
2010	2,329.8	92.4	182.8	4.0	2,609.0
HIGH					
1989	975.7	125.1	152.0	7.5	1,260.3
1995	1,889.5	125.1	154.8	18.0	2,187.4
2000	2,884.9	201.4	288.2	18.0	3,392.5
2005	4,105.0	295.9	372.4	18.0	4,791.3
2010	5,311.0	395.9	481.3	18.0	6,206.2

CHAPTER V

FORECASTS OF PASSENGERS AND RECREATIONAL CRAFT

CRUISE AND EXCURSION TRAFFIC

Based on the growth rates discussed earlier in this chapter, the number of tourists visiting Guam annually is expected to grow as follows:

TABLE V-1

ESTIMATED ANNUAL NUMBER OF VISITORS TO GUAM

1989	669,000
1995	1,300,000
2000	2,000,000
2005	2,675,000
2010	3,100,000

In looking at passenger vessels that use port facilities now or may do so in the future, it is necessary to look at two totally different markets. The first type is based upon cruise ships with overnight accommodations that offer cruises of several days to two months or more. These vessels may range in size from vessels that are about 300 to 350 feet long with accommodations for 120-150 passengers to ships that are 500 to 800 feet long and typically accommodate 600 to 800 passengers.

The second market consists of day excursions and evening dinner or dance cruises for those tourists staying in Guam. Vessels involved in this service may range in size from oversize yachts, carrying 100 to 150 passengers and often of a multi-hull design, up to larger vessels with capacities of 750 passengers or more. Vessels serving both types of traffic are listed in Table II-6.

Extended Cruise Traffic

In 1989 approximately 9,150 people arrived in Guam on cruises originating in ports in Japan, Europe or the U.S. With the introduction of the Oceanic Grace and

the Sunflower, a new dimension is added and, now, an estimated 1,500 people each year take three and four day cruises from Guam to Saipan, Palau or ports in the FSM.

Both categories of passengers are expected to grow roughly in proportion to the total number of visitors. This does not translate to a corresponding increase in the berthing facilities required, however, since the vessels offering multi-day cruises that are, or will be, based in Guam operate now at relatively low load factors (and it will be a while before the capacity of existing and new vessels in this market will be absorbed). Those based elsewhere called 18 times in 1989. As traffic grows, the size of vessel in both these services may be expected to increase, so the number of vessels or calls will not increase proportionately. Estimates of future traffic are as follows:

	Guam-Based Vessels		Visiting Vessels	
	No. of Passengers	No. of Vessels	No. of Passengers	No. of Vessels
1995	2,900	2	18,000	33
2000	4,500	2	27,000	39
2005	6,000	3	36,500	41
2010	7,000	3	42,000	42

Local Excursion Traffic

The local excursion traffic is very different from the extended cruise market. Day cruises and dinner/dance cruises are included in many tour packages and are very popular. At the present time three larger boats, each with a capacity of 149 passengers, and ten smaller boats (excluding dive boats, charter fishing boats and the submarine) with an average capacity of 47 passengers are engaged in this market. This fleet has a total capacity of almost 800 passengers and may sail once or twice a day, four or five days a week, through much of the year. If average load factors of 80% on the larger boats and 60% on the smaller boats are used and vessels work an average of nine months, total patronage is about 150,000 per year or close to 25% of all visitors. If this traffic were to grow at the same rate as tourists as a whole, then by 2010 about 700,000 visitors may take one or another of these day or evening cruises.

Some tourists coming to Guam for a second time may look for other activities but this may be offset by those who may have missed such a trip the first time. If growth and patronage on this estimated scale should occur, larger vessels will undoubtedly be introduced, and already this trend is seen, with the anticipated introduction later this year of a vessel with a capacity of 799 passengers. If an average vessel capacity of 500 is considered for the largest vessels, while the 149 passenger vessel is assumed to still be popular and 75 is used for the smallest vessels, about 3 large vessels, 5 mid-range and 15 small vessels will be involved in this market by 2010 and will require some type of berthing space. For smaller vessels, this will be found in the Piti Channel area (either in the Harbor of Refuge or the back channel behind it) while larger vessels will use facilities in Apra Harbor itself.

DEMAND FOR MARINA SPACE

Looking next at smaller boats (50' or less, though a few of these are still registered by the Coast Guard, since they may carry up to 60 passengers) it is estimated that approximately 300 or so boats are kept in the water now, either in marinas or at moorings. About 6 locations are used--Agana Marina, Piti Channel (Aqua World and Harbor of Refuge), Achang Marina, Merizo Landing, the marina in Sumay Cove (for present and ex-military) and the Marianas Yacht Club.

In looking at the likely growth in the number of vessels that will require in-water storage (or dry storage with suitable lifting devices) it is necessary to separately consider three categories: dive-boats, charter fishing boats, and private pleasure craft. Other sports, such as water-skiing, parasailing and day sailing, generally use smaller boats, which are trailerable.

In addition to five dive boats registered with the Coast Guard (plus a sixth about to join the fleet), perhaps another ten or so smaller boats may take out divers on a commercial basis. Privately-owned pleasure craft will also be used for diving but they are considered below. The numbers of regularly-used dive-boats may not grow very rapidly for several reasons. A high proportion of the divers are U.S. military personnel, estimated by some to account for 70 percent of the weekend diving, and the

military sector is expected to have little or no growth. Most of the others are tourists, mainly from Japan. Japanese tourists engaged in diving are usually either novices entering from the shore (or the raft at Cocos Island) or they go in large groups and a typical boat may only be engaged to carry such a group 50 percent of the time between Monday and Friday. It is expected that boats already in the business will be utilized more intensively before there are many new entrants. Newer boats will probably be larger, with space for an average of 40-50 people, compared to 30-35 today. With a new boat being added in 1990, there may be no further increases in the next few years; after 1995 an increase at a rate of one new 40-60 passenger vessel every other year is forecast.

At the present time, there are 12 to 15 boats that may be chartered for offshore fishing. Opinions on future prospects cover the full range between pessimism and optimism. Margins are rather thin and, because of low levels of capitalization, smaller vessels (in the 28'-30' range) are used rather than larger vessels. Also charter fishing has not been actively promoted by tour operators in Japan, albeit with the formation of fishing clubs in that country, this restraint may be overcome. The lack of marina slips and mooring sites has acted as another restraint and some charter boat owners have indicated that they would get another boat if space were available. In the longer term, however, it should be noted that the chartering of boats for fishing is essentially an upscale activity. Guam has passed the period of upper-income pioneering tourism and is now tapping mass-markets, so that charter fishing is likely to grow at a lower rate than tourism as a whole. Therefore, after an initial jump to perhaps 20 boats, a subsequent growth rate in the range of 5-6 percent annually, or about one new boat every year, is foreseen.

In view of the market served by Guam, consideration was also given to "party boats" for which people buy tickets for a space aboard the boat. A person can drop a line into the water and fish all day for less than $20. These boats, which carry 40-60 people, are very popular on the U.S. East Coast. TAMS/Agi has learned, however, from local fishermen that party boats are not suited to the waters around Guam, since

there is no continental shelf with the large areas of shallow water that are home to schools of bottom-feeding fish.

There are roughly 250 to 275 other boats that are currently stored in the water, either in marina slips or at moorings in sheltered waters. Virtually all of these are privately-owned craft. Analysis of data on registrations in the Guam Harbor Police office indicates that new boat registrations each year amount to about 12 percent of the total. This relatively high growth rate applies to all sizes of boats, however, plus jet-skis. Almost 90 percent of all registered watercraft are less than 25 feet long and, with the exception of some sailboats with keels, may be assumed to be trailerable. The recorded annual increase in boats that are 25 feet or larger (excluding larger vessels recorded by the Coast Guard) is about 6 percent or half the rate for all boats.

As noted above, the lack of marina space has been a restraint on growth in the number of larger boats; there is a waiting list of 64 applicants for space in an expanded Agana Marina and 45 applicants for space in the soon-to-be-completed Agat Marina. Other factors, however, are the high cost of larger boats and the amounts still owed by purchasers of small boats which limit their ability to upgrade. In future years, the annual cost of marina space is likely to be another restraint, even if space is available, and many will find it cheaper to purchase a trailer for a boat in the 23-27 foot range. Assuming a fairly rapid take-up of spaces that are already applied for (which would include the initial increase in charter fishing boats) further growth in the local demand for marina space of about 6-8 percent annually is foreseen.

Development of a new marina at Agana will provide some (338 - 50 = 288) new spaces and the Agat Marina will add another 156. Thus, a total of 444 new spaces will be available, of which 109 may be taken up within a relatively short time, leaving 335 for future demand. With the growth rates estimated above, local demand would fill these spaces in about 11 or 12 years.

It is most unlikely that the developers of the new Agana Marina or the operators of the Agat Marina will want to wait that long to fill their marina slips. The proposal of IDC indicated that the slips at the Agana Marina would be fully occupied about six years after completion. If only local demand is considered, there may still be 150

or so slips unoccupied at that time. Indeed, should the cost of marina space be a constraint on local demand, the number could be even higher. There is little doubt that the developers/operators would look to off-island owners to fill those slips. If they do so, then additional marina space would be needed shortly after 1996 or 1997. There are few places where such space may be developed. A new marina is being considered in Inarajan Bay, Achang Bay marina can accommodate limited expansion and a marina could be developed south of Dry Dock Point, either by the Marianas Yacht Club or through an agreement with them. Further expansion in the vicinity of either Agana or Agat Marina would be very costly, though it may be possible to stage the development of slips to match local demand only, so that some slips would be developed in the post-1997 period. Development of a marina at a site south of Dry Dock Point, if it is done in an environmentally acceptable manner, may make a lot of sense, since it would serve as a base for the continued use of Apra Harbor for recreational boating but would be outside of Piti Channel, where increased use of small craft may conflict with the safe maneuvering of larger vessels.

For further expansion, an economical alternative that is increasingly popular elsewhere in the U.S. where protected anchorage areas are at a premium is dry boat storage. Such a facility, which would include open sheds for stacking boats, two pile-supported parallel platforms projecting into the water and a device such as a "Travel-lifter" for lifting boats from the water and transporting them to the shed, might be located at Agat, Merizo, Inarajan or the Dry Dock Point area.

CHAPTER VI

PROPOSED EXPANSION OF COMMERCIAL PORT

EARLY ACTIONS TO INCREASE CAPACITY

Forecasts of cargo to be handled in the future by the Commercial Port indicate the need for an almost threefold expansion of cargo handling capability by the Year 2010, as well as a substantial need for additional passenger facilities.

The first step of expansion has already been taken by the Port, with the expansion of the Container Yard from about 15 acres to 26.5 acres. This expansion will provide just about enough container storage area to meet the Port's projected requirements through 1995, provided that improvements such as the removal of existing dolly blocks, repaving, striping and the installation of reinforced concrete runways for the transtainers are undertaken in the existing yard. The next set of steps will be those needed to match the capacity of the wharf to that of the expanded container yard.

Initially, the most effective action will be to improve productivity across the wharf, through the acquisition of new equipment and the institution of an effective program of preventive maintenance. Once again, the Port has taken the first step by proceeding with the acquisition of new transtainers, which will remove some of the current restraints on the productivity of the existing container cranes. The next step will be the acquisition of two new container cranes--one to replace the existing Container Crane 1 and one to provide additional capacity. Specific requirements for these cranes are discussed in the next section. In addition, it is suggested that a modern replacement be acquired for the older 140-ton mobile crane that is now seldom if ever used because of its deteriorated condition. This new mobile crane will allow neo-bulk cargoes to be handled more rapidly and can be equipped with a 8-yard bucket for unloading bulk materials. Also, if equipped with a spreader bar, it will allow much better handling rates for the 20' and 40' containers carried aboard the combination vessels, which are now handled by ships gear. With new pieces of equipment, it is

estimated that the container cranes should be able to regularly achieve handling rates of 25 containers/hour when working full containerships and rate of 8 to 10 containers/hour should be achievable when the mobile crane is discharging containers carried aboard the combination vessels. With three container cranes in operation and higher productivity the Port will be able to handle traffic through 1995 and a bit beyond.

CONTAINER CRANE ALTERNATIVES

The existing container cranes, particularly Crane No. 1, are limited in terms of their height and outreach and also lack certain modern operating features. Crane No. 1 is also near the end of its useful life and is frequently down for minor repairs. For the two new cranes that have been recommended, several alternatives are considered. These alternatives are governed by the fact that the rails along which the existing container cranes move have a gauge of 50' and the structure under the front rail limits the maximum wheel load to about 71^{k} when working or 85^{k} when stowed in storm conditions.[1]

The first alternative would be to purchase two new container cranes able to serve Panamax vessels, such as those seen now in Guam, with none of the limitations on outreach and air draft that curtail the efficiency of the existing cranes. A review of possible crane types indicates that cranes of 40-long ton capacity with a single trolley, with the capability to serve Panamax vessels, can most probably be obtained with a gauge of 50 feet and maximum wheel loads that don't exceed the figures noted above. They would, however, be at the upper limit of what the support structure could accept. Further increases in capability would require changes in this structure.

A second alternative would be to install a new rail and support system 100 feet behind the existing front rail and increase the gauge to this dimension for the new cranes (see below regarding the future disposition of Shed 2). The present rear rail

[1] This limit is based upon the design load of the piles and the assumption that the design strength of the support beams is consistent with that of the piles. The beams are 2'-0" wide by 2'-6" deep and available drawings show the placement of the reinforcing but not its size. If further investigation doesn't yield this information, it will be necessary to remove the concrete at one or two points in the beams and measure the diameter of the bars before the actual crane specifications are written.

and its support would be left in place to carry Crane No. 2, which would remain in service. As in the first alternative, the new cranes would be able to serve Panamax vessels and with the wider gauge there would be no difficulty in obtaining a 40-long ton crane with maximum wheel loads that would not exceed the limits noted above. With no increase in capability, the only advantage to this alterative is that the wider gauge would permit the installation of container cranes in the future that could serve Post-Panamax vessels, or the later retrofitting of the first set of new cranes to serve these vessels.

The third alternative would be to install two new 40-long ton cranes with a 100-foot rail gauge and the capability to serve Post-Panamax vessels, which are already in service on other trans-Pacific routes. If the American President Lines new C-10 vessels are to be served, these cranes would need an outreach of up to 150 feet from the front rail, an air draft of over 100 feet and a maximum wheel load within the limits of the existing structure supporting the front rail. (Post-Panamax cranes with a 50-foot gauge are available but they would require strengthening of both the front and rear rail supports. A quick analysis indicates that this would be more expensive than installing another support beam 100 feet behind the existing front rail.)

The question posed by these alternatives is that of whether to serve Post-Panamax vessels and this question is linked to the issue of a deeper channel. The 1983 Corps of Engineers study of channel deepening found that deepening at least one berth to 40 feet to accommodate vessels of Post-Panamax dimensions was feasible.[1] With regard to U.S. Flag vessels calling at Guam, the study noted that "their service to Guam is incidental to U.S. flag lines transpacific trade, and economics related to the latter determine ship size. Therefore, absent deepening at the Port, the prospect is for declining service by older, smaller U.S. vessels until they are ultimately replaced, when there may be no more regular liner service between Guam and the U.S." Given Guam's rapid growth in recent years, the latter eventuality is a good ways

[1] The study recommendations were not carried out because a review of 1980 Census data pointed toward slower economic growth than forecast by the study. These data, however, contained little hint of the rapid growth in Guam's economy that has occurred and is continuing. An update, based upon recent growth is being done by the Corps of Engineers.

off but it suggests the prudence of being able to serve the larger vessels. The need to accommodate larger vessels has also been noted by representatives of U.S. steamship lines in discussions with TAMS/Agi. In this regard, the greater air draft may be more important than additional water depth, since the large containerships stop at Guam on their westbound voyages when most of the containers they are carrying are empties bound for Far East ports. Thus, they are riding high when they call at Guam. A fully-loaded C-10 will draw 41 feet but may draw only 37-38 feet on the westbound voyage. Until such time as trade patterns change or a stop at Guam is added on eastbound voyages, a 40-foot depth for the approach and one berth (as recommended in the Corps of Engineers 1983 study) plus the removal of the coral heads near Berth F-6, may be sufficient.

A tentative recommendation is made that the new cranes to be acquired by the Port be able to serve Post-Panamax vessels. Before proceeding with the selection of one or the other of the last two alternatives, however, the Port should determine the results of the Corps of Engineers updated study on the timing of channel deepening and the depth recommended. The Port should also meet further with the two major U.S. shipping lines to get a better sense of how soon larger vessels, such as the C-10's, might enter service on the Guam route--if the capability to handle them is provided.

The cost of a post-Panamax crane, if purchased in the U.S. would be about $7.0-7.5 million delivered and installed in Guam (or about $1,500,000 more than a Panamax crane). It is believed, however, that comparable cranes could be acquired in the Far East for about $6.0 million each if two are ordered at one time. The total cost, therefore, for two new container cranes and the installation of a new crane rail with supporting structure would be about $14,450,000.

ALTERNATIVES CONSIDERED FOR FURTHER EXPANSION

Expansion Prior to Year 2000

For the next stage of expansion, two options have been given detailed consideration in this Study, while other options were given less attention. Of those looked at in detail, Option 1 involves the extension of the wharf face of Berth F-6, about 900 feet to the east. This will ultimately allow three full container berths along this face, though initially the additional length will be of greater benefit to the various combination vessels and inter-island vessels calling at the Port. If this is done and the container yard is further expanded to provide a total of 37 to 40 acres, the practical operating capacity of the Port will be increased to about 3,000,000 rev. tons annually. If the basic forecast of future traffic is borne out, then the Port will be able, with this improvement, to handle projected cargoes through Year 2002. This alternative will require that the area of the proposed Industrial Park be reduced by 10.5 to 13.5 acres in order to meet the needs of the container yard in this phase of expansion. A figure as low as 7 acres could, however, be reached by a program of demolishing under-used facilities and relocating others that is described below.

Option 2 involves the relocation of all fishing vessels to another site in Apra Harbor. (Alternative sites for a facility to serve these vessels and the proposed development at the selected site are discussed in the next chapter.) Berth F-3 will thus be released to serve the various combination vessels calling at the Port (as well as various break-bulk ships and vessels with bulk cargoes), which may continue to be unloaded with ships gear or would be unloaded with the new mobile crane. This alternative is expected to be lower in cost than Option 1, since pier structures in the water depths needed by fishing vessels are significantly less expensive than bulkheading where depths of 35' or 40' are needed and extensive dredging within the Piti Channel would not be required in this stage. Following meetings with representatives of the fishing industry, a larger facility with more berthing length and substantial warehouse space has been developed. The cost of this larger facility is considerably higher than that of the original concept so the total cost of Option 2, while still less than that of

Option 1, is only marginally so--though Option 2 has other advantages, as discussed below. The practical operating capacity of the wharf under Option 2 will be about 2,680,000 rev. tons/ year. This is somewhat less than the wharf capacity under Option 1 but it also means that container yard requirements will be somewhat less--about 33-36 acres. About 4.5 of the 6.5 to 9.5 additional acres needed could be gained by demolishing the Container Freight Station and Shed 2 and by relocating the Seamen's Club. Additional acreage could be gained by utilizing the parking area between the Administrative Building and the maintenance area for maintenance activities and equipment storage, providing replacement parking area on the other side of Route 11 (in front of the coralline rock hillocks) and devoting the entire area behind Shed 1, as well as some area behind Berth F-4, to the storage of neo-bulk cargoes. Shed 1 would need to be rehabilitated under this option, since salt storage has resulted in damage to the sprinkler system, electrical system and portions of the structure itself within three bays. The shed was inspected during the course of the study and outside of the affected area was found to be in generally good condition. With the above program of demolition and relocation it may be possible to reduce encroachment into the Industrial Park area in this stage of expansion to virtually zero.

Expansion Between 2000 and 2010

Three alternatives for expansion of the Commercial Port after 2000 have been explored. The first alternative amounts to simply adding Option 2 of the 1990-2000 expansion stage to Option 1, or vice-versa, depending upon the option selected in the first period. This alternative, therefore, means that Berths F-4, 5 and 6 will be extended to the east by 900 feet and fishing activities will be relocated away from Berth F-3. In addition, a fourth container crane will be added to the 2,850 foot long wharf and the container yard expanded to an area of 46 to 50 acres. The program of demolition and relocation described in the preceding section will also be carried out to reduce the acreage that would need to be taken from the Industrial Park. The resulting overall practical operating capacity of the Port would be about 4,200,000 rev. tons/year,

indicating that it will be able to accommodate the traffic foreseen in Year 2010 with the basic forecast.

The second alternative for further expansion is linked to Option 2 of the 1990-2000 period. That option minimizes any encroachment by the expanded container yard into the area currently proposed for the Industrial Park. In the second alternative, further expansion would involve the development of new berths and a container yard on the south side of Piti Channel. Thus, the area intended for the Industrial Park would only be reduced by about two acres. This alternative, however, would be more expensive and would result in a "split" operation, which is normally less efficient than a unified port area and may be appropriate only if "dedicated" berths, each operated by a separate shipping line, are considered. The practical operating capacity of the Port with this alternative would total about 4,400,000 rev. tons/year, which is more than adequate to handle traffic in 2010 under the basic forecast.

The third alternative is linked to Option 1 of the 1990-2000 period and involves the extension of the channel and the wharf face of Berths 4, 5, 6 (and 7) another 900 feet to the east. At the same time, a fourth container crane would be acquired. Also, the container yard would be expanded to 46-50 acres. The overall practical operating capacity with the third alternative would be about 4,300,000 rev. tons/year. Again, this is greater than the level of traffic forecast by the Year 2010.

Comparative Costs of the Different Expansion Concepts

The costs of the two options described above for expansion before the Year 2000 are as follows:

(a) Option 1, including the dredging of a new berth (35' now, 40' future), construction of a 900-foot extension of the wharf (including bulkhead, ship services, crane rails and paving to the rear of the cranes), expansion of the container yard by about 13 acres and provision for contingencies and engineering: $29,830,000.

(b) Option 2, including the dredging of Berth F3 to 30 feet, relocation of fishing activities to another site in the harbor, removal of Shed 2 and CFS and restoration of the area as

container yard, further expansion of the container yard by about 5.0 acres and provision for contingencies and engineering: $25,270,000.

The above figures do not include certain items, such as a new office for the Harbormaster or a portable hopper for bulk materials that would be common to both options and which are discussed later in this chapter.

The costs of further expansion, after the Year 2000 have been estimated as follows:

(c) Alternative 1:

For the addition of Option 2 to Option 1 (if the latter is undertaken first); plus an additional container crane: $32,340,000.

For the addition of Option 1 to Option 2 (if Option 1 is undertaken first); plus an additional container crane: $36,900,000.

(d) Alternative 2:

For the addition of two new berths on the south side of Cabras Island Channel to Option 2 of the prior period, the work would include the dredging of about one berth length, construction of a new wharf structure, development of a new 14.5 acre container yard, relocation of the road to Dry Dock Island and acquisition of two container cranes for the new berth. The cost, including engineering and contingencies: $59,950,000.

(e) Alternative 3:

For the addition another berth at the east end of the Port to Option 1 of the prior period, including dredging an additional berth, construction of a second 900-foot extension to the present wharf, expansion of the container yard by 11 acres, the acquisition of an additional container crane and engineering and contingencies, the cost is: $37,400,000.

It is recommended on the basis of costs and other factors that, following the acquisition and installation of two new cranes within the next year or so, Option 2

above be undertaken to meet requirements for port facilities prior to Year 2000. The reasons for this recommendation are:

- A cost differential that is not as great as it would be with a smaller fishing facility but which is still significant;

- The fact that total berthing length for fishing vessels in Option 2 will be 1,650' in a separate facility, compared with only 753' in Option 1, which means that a portion of the container and breakbulk berths would continue to be used. Thus, a potential for conflict would remain if that option were adopted.

Subsequently , on the basis of costs and the desire to avoid a split operation, the first alternative for the post-2000 period should be adopted. This involves the addition of Option 1 to Option 2 to bring the capacity of the Commercial Port up to the levels needed by Year 2010. Total cost through the Year 2010, including the cost of new container cranes but excluding miscellaneous equipment items, would be $76,620,000 compared with $99,670,000 for Alternative 2 and $81,680,000 for Alternative 3. The costs of the first alternative are detailed later in this chapter.

It may be noted that Alternatives 2 and 3, though not recommended for the first 20 years, demonstrate how oceanborne commerce may be accommodated in the years following Year 2010 or how commerce that may grow faster than indicated in the basic, best judgment, forecast may be accommodated.

RECOMMENDED PLAN FOR EXPANSION BEFORE 2000

Early Improvements in Container Yard

At the time that the two new cranes are installed, container yard operations can be improved by:

- Relocating the substation that is behind Berth F-5 to the rear of the container yard (the capacity of this 750 KVA installation may also be increased at the same time to permit additional reefer outlets); and,

- Demolishing the Container Freight Station that is now used as a chassis repair area by various tenants. These repair activities can be more

appropriately located in the proposed Cabras Island Industrial Park, so that the yard area closest to the berth can be dedicated solely to the handling of cargo. The costs of relocating the repair facilities will be much less than the costs stemming from inefficient container operations.

The existing control tower for container operations would remain. With the recommended 1:2:1:2:1 arrangement for inbound stacked containers, the tower's current height is adequate. It needs some rehabilitation work, though, and new windows need to be installed that can be regularly washed from the inside for better visibility.

Expansion of Wharf Length

Option 2, as described above, provides for the relocation of facilities serving fishing vessels to another site in Apra Harbor, in order to release Berth F-3 so that it can once again be used for its intended purpose--accommodating general cargo vessels.

Fishing activities don't properly belong in the middle of a commercial port--requirements are different, vessel sizes are different and activities at berthside are different. In a new location, specialized facilities and almost 1,400 feet of berthing space can be provided. These are described in detail in the next chapter.

Income accruing to the Port of Guam from fishing vessels is in the range of $600,000-650,000 annually. This amount would probably allow recovery of investments by the Port in the most minimal of new facilities to serve these vessels and only if this income were assured in future years. The use of Guam by fishing vessels is so driven by the relative costs of various ports in the western Pacific and by other exogenous factors that this assurance is not possible. Provision of new facilities would, therefore, be very risky were it not for the fact that the cost of building replacement facilities for fishing vessels, with drafts of 8-24 feet[1] is much less than the cost of extending the wharf east of Berth F-6 and dredging a new berth for deep-draft vessels.

[1] Purse seiners may draw more than this when fully loaded with fish but since they do not use Guam to discharge their catch, the draft after reprovisioning and refueling is the appropriate criterion.

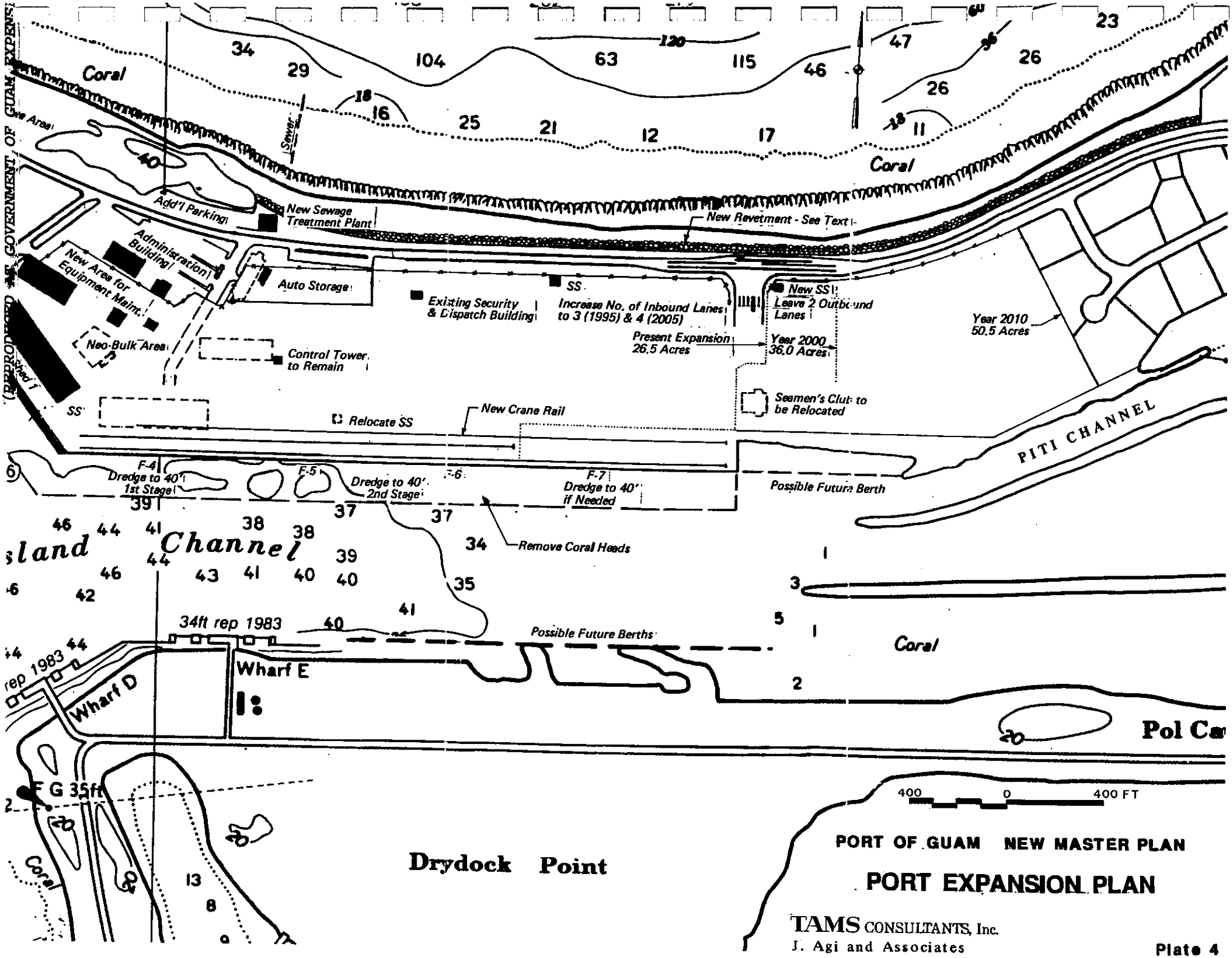
Thus, a new facility can be justified in terms of the need for the kind of general cargo facility that Berth F-3 can provide, once it is made available.

Once the new fishing port is available, various improvements to Berths F-3 and F-4 can be made. Berth F-3 should be dredged to its 30-foot design depth throughout its length. The electrical and sprinkler systems and some of the structure of Shed 1 will need to be restored or rehabilitated so it can be used for the small amount of break-bulk cargo that is still received at the Port. Behind Shed 1, the oil drum storage area will be demolished, as a replacement facility will be developed at the fishing port. The 1½-2 acres behind this shed can then be used as additional space for stacking inbound neo-bulk cargoes (Plate 4).

The present location on the Harbormaster's Office on the Administration Building does not allow a view of the berths or a clear view of the approach channel. A possible location for a new Harbormaster's Office atop Shed 1 at the southernmost corner was, therefore, considered. This would provide an unobstructed view of the harbor area and wharf area for those responsible for controlling traffic. Further discussions with the Harbormaster indicate that the preferred location, however, would be at Hotel Wharf or Pier D(og), since the wharf itself is covered by the Dockmaster's staff. This is discussed further in Chapter VII.

Reclaiming Berth F-3 for cargo handling will also offer the opportunity to develop an efficient operation for handling bulk materials such as basaltic or quartz sand, salt, etc. Wharf space is too valuable to permit its being used to store these materials. What is needed is an expeditious means to discharge them from vessels and transport them to a convenient site for stockpiling. The new 150-ton mobile crane can be equipped with an 8 cu.yd. bucket and, together with a portable overhead hopper (with a capacity of 40-60 cu.yds) can be used to obtain discharge rates of about 350 tons/hour. The hopper can be stored in the equipment staging area and towed out to the berth when needed. Wheels on the hopper can be retracted, so that it sits on steel pads when in use.

If the area across Route 11 from DeWitt Transportation and Mobil (where several tanks used to be located) is used for storage, only one 32 cu.yd. truck may be



PORT OF GUAM NEW MASTER PLAN

PORT EXPANSION PLAN

TAMS CONSULTANTS, Inc.
J. Agi and Associates

Plate 4

needed to match the handling rate of the crane (considering an 8-min. cycle for the truck). If an area in the Cabras Island Industrial Park were used, however, two trucks would probably be needed to achieve the same rate.

Expanded Area for Maintenance Operations

The Port of Guam is starting to give greater attention to preventive maintenance for equipment and facilities and may, over the next few years, institute a range of programs to improve performance in this area.

Estimated equipment requirements for the Commercial Port during the forecast period are as follows:

	1995	2000	2010
Container Cranes	3	3	4
Transtainers	4	5	6
Tractors - Yard	20	24	28
Top Loaders (stacking empties)	2	2	3
Fork Lifts 5-20 tone	9	11	13
Smaller Fork Lifts		(Indeterminate)	
Mobile Crane (150 tons)	1	1	1

Maintenance for Container Cranes, Transtainers and Yard Tractors should be scheduled to coincide with days when no containership is at berth. This should leave at least 2/3 to 3/4 of the equipment available for yard operations during these periods. Experience will show when Top Loaders can be scheduled for maintenance. This may be in evening hours when there are no deliveries from the container yard.

The present Equipment and Maintenance Building, with over 20,000 square feet of space, probably has sufficient area for the repair work, regular maintenance procedures requiring indoor facilities and parts storage required by the above equipment. Additional yard space is desirable, however, for the staging of equipment and performance of routine maintenance. Another 1½ acres can be provided north of the existing equipment and Maintenance Building in an area now used on occasion for parking and for overflows of imported vehicles arriving on car carrier vessels. Re-

placement parking for about 70 cars can be developed north of Route 11, in front of the coral hillocks that face the Administrative Building.

Storage of Imported Vehicles

Space on Cabras Island will continue to be at a premium and will need to be fully utilized. The area for newly-imported vehicles shown on the present container yard expansion plan, plus another 0.5 acre of the yard, can be used in the early years before the rest of the yard approaches capacity. After that, it may be necessary to advance the date of further container yard expansion by a year or so unless alternative space can be found within the Industrial Park or other nearby area. In any event, auto processors must be encouraged by Port charges to move vehicles to their vehicle preparation facilities promptly, so that space in the Port need only accommodate the vehicles offloaded from a single ship--estimated to be about 450 vehicles in the future, which will occupy about 2 to 2.5 acres if block storage is used.

Expansion of the Container Yard and Gate Complex

To expand the container yard at its western end and allow unhindered operation, two buildings should be demolished: the Container Freight Station (if it isn't demolished earlier) and Shed 2. The demolition of Shed 2 will permit all the container cranes to operate efficiently on Berth F-4, in addition to releasing yard space. The area occupied by these buildings will need to be regraded and repaved to match the grading of the surrounding yard area. The small parking area by the present Main Gate and, later, the sewage treatment plant, can be relocated to the other side of Route 11 (see below). All these changes will add about 4.5 acres to the container yard and provide more space for neo-bulk cargoes (Plate 4), as well as allowing the area designated in the present yard expansion plan for the storage of newly imported vehicles to be shifted to the west, so that it will consume half an acre less of the container yard.

At the eastern end, the container yard will need to be expanded by another 5.0 acres, in order to provide a total of 36 acres by Year 2000. The area required for

the container yard in Year 2000 is based upon a "stacked" operation, using the practices and equipment that are described in Chapter III. (This area could be reduced to 33 acres if the present pattern of container vessel arrivals can be modified so that vessels don't arrive on successive days.) As can be seen on Plate 4, this additional area does not include a strip 175 feet wide behind the extended line of Berths 4, 5 and 6, which will be used for container crane operations in the next stage of expansion--after Year 2000.

When this expansion of the container yard to 33-36 acres is undertaken, the gate complex near the eastern end will need to be expanded to provide another entry lane, so that three entry lanes and two exit lanes will be available. This number of lanes is based on the assumption that, with documentation being largely computerized, remote terminals at the gate complex will provide the information and checks needed to eliminate trips to the office by drivers. Processing at the gate should take about two minutes per entering truck. Exiting trucks can be cleared more rapidly.

Cost of Expansion 1990-2000

The costs of the above recommended expansion prior to Year 2000 have been estimated as follows:

Step 1: Acquisition of Two New Container Cranes	
Acquisition and Erection of Two Post-Panamax Cranes	$12,000,000[1]
Construction of New Crane Rail and Support (1,300'long)	1,950,000
Acquisition of New 140-ton Mobile Crane	975,000
Sub-Total	$14,925,000
Engineering and Contingencies	500,000
Total for New Cranes, including Mobile Crane	$15,425,000

[1] Far East sources.

Step 2: Relocation of Fishing Activities	
Total cost (see Chapter VII for details)	$14,952,000
Engineering and Contingencies	3,738,000
Total Cost of Relocation	$18,690,000
Step 3: Improvements at Commercial Port	
Dredging of Berth F-3 to 30 feet	$100,000
Rehabilitation of Shed 1	325,000
Construction of New Harbormaster Office (Hotel Wharf or Pier D(og)	100,000
Removal of Shed 2 and CFS, plus Restoration of the Area to Provide 4.5 acres for Container Yard	1,760,000
Wheel-mounted Hopper for Bulk Materials	160,000
Extension of New Crane Rail 600 Feet	900,000
Substation Expansion (2,000 kva)	75,000
Expansion of Container Yard (5 acres)	2,096,950
Sub-Total	$5,516,950
Engineering and Contingencies	1,383,050
Total Cost of Improvements	$6,900,000

The aggregate cost of Commercial Port expansion in the 1991-2000 period, exclusive of minor equipment acquisitions, therefore, will be $41,015,000. The economic return on this investment is considered in the next section.

ESTIMATED BENEFITS AND ECONOMIC RETURN

Future Ship Traffic

As noted earlier, the Commercial Port is operating now at levels that are close to the capacity of the wharf and exceed the capacity of the existing yard. Completion

of the present yard expansion project will provide additional capacity but within a few years the capacity of the wharf will also need to be increased.

Based on estimated changes in vessel sizes and the average cargoes handled at Guam, as well as the forecasts of Chapter IV, the number of calls at Guam by each vessel type has been estimated for the forecast period. These are as follows:

	Number of Calls by Cargo Vessels				
	Now	1995	2000	2005	2010
Full Containerships	120	165	200	235	260
Combination Cont/BB Ships	100	145	190	240	275
Car Carriers (Ro-Ro)	35	45	55	65	70
Inter-island Barges, etc.	220	295	215	215	220
	475	650	660	755	825

With this increase in the number of cargo vessels calling at the Port of Guam, together with a 30% increase in average cargo size, if the improvements outlined above are not undertaken, all vessels will be subjected to increased waiting for a berth at the Port. Ultimately, congestion would reach levels at which cargo would be lost with severe consequences for the economy of Guam. Even before those levels are reached, the costs of vessels having to wait for a berth will be translated into higher charges for the transportation of goods to Guam and, thus, higher prices in stores and elsewhere.

Benefits of the proposed improvements that will ultimately accrue to residents of Guam, therefore, will include the difference in costs incurred by vessels waiting for a berth after the new cranes, additional wharf length and yard area are in place and the costs incurred without these improvements. Towards the end of the forecast period, additional benefits will stem from the fact that cargoes that might otherwise be lost will continue to be imported or transshipped.

Daily capital and operating costs of vessels waiting in the Harbor or offshore for a berth are estimated as follows:

Containerships (Mainly U.S. Flag)

28,000 dwt	$37,850 *
42,000 dwt	42,250
54,000 dwt (future)	49,400

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* For first 10 years a figure of $28,100 is used for 50% of the ships of this size.

Combination Cont/BB Ships (Foreign Flag)

7,500 dwt	$13,250
10,000 dwt	14,750

Car Carriers (Foreign Flag)

7,500 dwt	$16,250

Tug/Barge Combinations (Mixed)

Up to 2,000 dwt	$3,500

In this analysis, it is assumed that arrivals of container vessels are semi-scheduled and that they will continue to have priority berthing. Thus, they would experience little delay until levels are reached when, even with scheduling, there would be times when a containership in port will prevent another from berthing. The arrival of other vessels is assumed to be random. Their waiting time would, therefore, rise exponentially as higher occupancy levels are reached and containerships occupy two of the three berths in the Port more and more of the time. Even before berth occupancy at the unimproved port reached about 90-95%, these other vessels would stop calling and cargo would be lost. It is assumed that the first to be lost would be transshipped goods, later, lower-value goods, particularly those used in construction, would be lost. The value to Guam's economy of the first group is taken as the amount received by the Port (about $26.50 per ton), the comparable value of the second group is very conservatively estimated at $400 per ton.

Even with the recommended improvements there will be some vessel delays. Indeed, by the end of the analysis period, these delays will increase to levels indicating the need for the next stage of expansion, as described in the next section. The benefits from savings in ship delay times, therefore, reflect only the difference in waiting times with and without expansion.

Observation of existing conditions in the Commercial Port and review of the level of benefits indicate that the new container cranes should be acquired by the end of 1993 and the other port improvements described above completed by 1998. Table VI-1 on the following page shows the stream of costs and benefits for the 20-year analysis period if this timing is followed. (It should be noted that the costs do not include the cost of one container crane or the mobile crane, since they will be replacements for Container Crane 1 and the Manitowoc crane, which are beyond their economic lives.) The cost stream includes the costs of maintaining the new equipment and facilities, but do not include additional operating costs. With the new facilities in place operating costs per ton should, in fact, be lower than they would be in the unimproved port.

Discounting these streams of costs and benefits back to the present day and using a discount rate of 10% for this purpose yields a benefit/cost ratio of 3.32. Another measure of economic value is the Internal Rate of Return, which is 19.2% for the proposed Commercial Port improvements. These measures indicate that these improvements are highly desirable in terms of their value to the economy of Guam.

RECOMMENDED PLAN FOR EXPANSION AFTER 2000

Further Expansion of Wharf Capacity

As recommended in the beginning of this chapter, the post-2000 phase of expansion would consist of the addition of Option 1 to an already-completed Option 2 (Plate 4). This means that the wharf face of Berths 4, 5 and 6 would be extended 900 feet to the east. The bulkhead would be similar in construction to the existing bulkhead. Future costs have been estimated on the basis that the new berth would have

TABLE VI-1

COST VS. BENEFITS FOR COMMERCIAL PORT IMPROVEMENTS

Year	1993 Base – No Discount	
	Costs	Benefits
1993	$8,450,000	
1994	$6,732,000	$851,000
1995	$6,733,000	$1,004,000
1996	$6,732,000	$1,408,000
1997	$6,733,000	$2,067,000
1998	$1,130,000	$2,431,000
1999	$1,130,000	$2,805,000
2000	$1,130,000	$3,604,000
2001	$1,130,000	$6,847,000
2002	$1,130,000	$10,014,000
2003	$1,130,000	$13,970,000
2004	$1,130,000	$18,933,000
2005	$1,130,000	$23,857,000
2006	$1,130,000	$32,319,000
2007	$1,130,000	$42,354,000
2008	$1,130,000	$58,783,000
2009	$1,130,000	$88,376,000
2010	$1,130,000	$118,128,000
TOTAL	**$50,070,000**	**$427,751,000**
Salvage Value	$17,185,000	

a water depth of 40 feet. Whether this depth would actually be needed should be reviewed at that time. If one or more deeper berths are to be provided, as indicated by the Corps of Engineers' 1983 study now being updated, the deepening will necessarily have to start with Berths F-4 and F-5.

At the time the wharf face is extended (to provide a total of 2,850 feet of container ship berthing, as well as the 750 feet of Berth F-3, for a total of 3,600 feet) an additional container crane should be acquired, for a total of four cranes[1] serving three potential container berths. During the same period another one or two transtainers will also need to be acquired.

Further Expansion of Container Yard

In the post-2000 period, the container yard will need to be expanded further--to 40 to 43.5 acres in 2005 and 46 to 50.5 acres by 2010. The range shown for each year is once again a function of the arrival patterns of the major container vessels. By the time 2010 is reached, it is likely that four or five large containerships will be calling each week. If these are distributed evenly throughout the week, the lower end of the range will be applicable but if they are bunched within a period of a few days, the higher figure will need to be used. Once again, the required yard area is based upon a "stacked" operation for inbound containers, with only a limited number, including reefers, being pre-mounted on chassis.

In the post-2000 period, the gate complex will need to be further modified in order to provide a total of four inbound lanes. It is expected that two outbound lanes will continue to be sufficient, since the main check of documentation is when bobtails, or trucks with empty containers enter to pick up full containers.

[1] Sometime before 2005, it is virtually certain that Container Crane 2 will also need to be replaced.

Costs of Expansion 2000-2010

The costs of the expansion needed after Year 2000 in order to meet traffic requirements in 2010, if constructed according to the recommended alternative, have been estimated as follows:

Step 1 - Extend Wharf to East

Dredging of New Berth of 35 feet Initially	$ 6,250,000
Construction of New Wharf (incl. bulkhead, ship services crane rails and paving to rear of cranes)	12,150,000
Acquisition of 1 Additional Container Crane	6,500,000
Substation Expansion (2,000 kva)	75,000
Expansion of Container Yard from 36 acres to 43.5 acres and Gate Complex Modification	3,060,450
Sub-Total	$28,035,450
Engineering & Contingencies	5,364,550
Total Cost of Improvements (Stage 1)	$33,400,000

Step 2 - Expand Container Yard Further

Substation Expansion	75,000
Expansion of Container Yard from 43.5 acres to 50.5 acres	$2,725,000
Sub-Total	$2,800,050
Engineering & Contingencies	699,950
Total Cost of Improvements (Stage 2)	$3,500,000

EXPANSION OF UTILITY SERVICES

Utility services will need to be improved in the 1995-2000 period in order to serve an expanded Port, including the Commercial Port, the Fishing Port and Passenger Facilities, plus Cabras Island Industrial Park .

Current workforce in the Port itself is about 360 people, while agents and companies in the adjacent area may employ another 500. Also, at any given time there may be up to 400 fishermen and brokers in the Port area--for a total population of about 1,200-1,300 people (Cruise vessels could add another 800 or so but their use of water at present is minimal). The Port is a 24-hour operation, so not all of these people will be working at the same time. It is estimated that daytime population may be 1,050 or so.

With the growth of the Port and development of the Industrial Park, this could grow to the following levels by Year 2010.

Port	750
Agents & Nearby Companies	700
Fishermen & Brokers	500
Industrial Park (Ch.VIII)	1,150
	3,100
Cruise & Excursion Passengers (occasional)	1,500-2,000

Daytime population may be 2,450 workers and visitors, excluding cruise passengers.

In developing water consumption figures for Year 2010 it is necessary to also consider deliveries of water to vessels, which may average 60,000 gpd by 2010, and process water in the Industrial Park, which is difficult to assess. (A figure of 75 gpd/industrial worker is used.) If an average use of 35 gpd per worker and 5 gpd per cruise passenger is used, total daily consumption by Year 2010 may be about 265,000 gpd. (In Year 2000 it may be 150,000 gpd.) The 16" pipe serving the Port area beyond the Cabras Island Powerplant[1] can deliver considerably more than this amount each day and is believed to be in good condition. The limit on the amount of water that can be delivered is set by the capacity of the PUAG's present sources.

As noted in Chapter III, the P.U.A.G. Water Master Plan is being updated at the present time. While the 16" line and the loop that feeds it (consisting of a 12" and

[1] Since the boiler make-up water requirements of this plant in the future are not known, no assessment of the adequacy of the line between Route 1 and the power plant has been made.

8" line) are able to deliver more water than will actually be needed, present limits are imposed by the capacity of the Asan Springs well system and current Navy agreements. A recent bond issue for public utility improvements includes funding for extending a water line from the center of Agana to Cabras Island, as well as points further south. It is not considered by the P.U.A.G. to be a top priority, however, and further agreements with the Navy could change the nature of the project (see Chapter III). Therefore, it may be towards the end of the period before improvements are undertaken. The Port has a back-up pump to maintain water pressure when pressure in the entire system drops. This pump has, however, failed on occasion and consideration has been given to the possibility of providing elevated storage at the Port. The primary concern would be the need to have fire-fighting capability at all times. This requirement may be served by a more effective program of preventive maintenance for the back-up pumps. It is more than likely, however, that the Cabras Island Industrial Park will need elevated water storage. At the time that such storage is developed, the Port of Guam should make arrangements so that in the future it will be able to draw from this storage in the event of an emergency, such as a fire occurring when normal back-up systems have failed.

In 1987 a Sewerage Plan was prepared for the EPA, which suggested that the collection system for the Port of Guam be tied into a system that would serve Agat and Santa Rita and would have a new treatment plan. This is still a possibility but, since the distances involved are long, the P.U.A.G may find it cheaper to replace the present 50,000 gpd package plant with a larger plant. Since neither water delivered to vessels nor process water consumed in the Industrial Park would pass through this plant and a factor of 0.8 is normally used to estimate domestic wastewater, a plant with a capacity of 100,000 to 150,000 gpd should be sufficient. This replacement plant should be located either close to Route 11 or, preferably, should be a largely underground installation, adequately protected against waves, on the north side of Route 11.

Regarding electric power requirements, the main load will continue to be imposed by the outlets for connecting reefer containers. It is estimated that if all 90 of

the present outlets were working and in use, about 70-80% of the present installed capacity of 2,250 kva would be consumed by reefers. If another 120 outlets, with a higher amperage rating, are to be provided in the present expansion program, together with additional lighting and the needs of the gate complex, the Port's installed capacity should be about 5,500-6,000 kva by 1995. An estimated 2,000 to 2,200 kva of additional capacity will be needed in each five year period after that, so that by Year 2010 total installed capacity at the Port is expected to be in the range of 12,000 kva.

PROTECTION OF SEAWALL AND ROUTE 11

With the elimination of old Route 11, the road on the new alignment, along the northern side of Cabras Island, provides the only access to the Port and the adjacent industrial zone. The road in this location is very exposed and when it was constructed in 1985, an existing, low seawall north of the road was cut back to 700 feet in length and extended by another 3,050 feet. (For some odd reason, this extension was not continued east to the point where rocky hillocks provide natural protection. Thus, a gap of two hundred feet exists.

The design of the seawall (both the original section and the newer section of a lighter design) has proven to be inadequate. There is little dissipation of wave energy in front of the seawall and it doesn't have proper toe protection in the areas where it is exposed to wave attack. The stone paving in front of it cannot support the dynamic pressures produced by typhoon waves running and breaking at the toe of the structure. These pressures probably propagate under the paving and this phenomenon is likely to have caused the lifting of these stones and loose rocks on the natural slope over the wall and on to the roadway that occurred during Typhoons Ray and Koren.

Storm conditions produce a surge that may be conducive to higher waves breaking closer to the structure than during normal weather conditions. A typhoon surge around Guam is mostly due to the barometric tide produced by the low of the storm, as the shallow water shelf around the island is very narrow. A design barometric surge of three feet can be assumed for this case, which corresponds to a central low of around 2.6 inches of mercury. The maximum theoretical wind of such a storm

would be around 100 mph. This barometric surge might also correspond to a more severe typhoon which passes well to the east of Guam--as did Koren. For design of a protective structure, a high astronomic mean tide of around one foot may be added to the storm surge, so that the sea water level would be four feet.

The highest typhoon waves may be in the order of 20 feet or larger, but these would break before reaching the location of the seawall. Theoretical breakers can be assumed to break at the toe of the protective structure. (If the toe of the structure is located at an elevation of +2.0 feet, the water depth for design is 2.0 feet. This depth corresponds to a breaking wave height of about five feet.

A suggested design for a protective structure envisions a revetment with a sea slope of 1 on 2, placed on the seaward side of the sea wall. This would require 8-ton blocks, with an estimated dimension of about five feet. The required crest elevation of the revetment for the theoretical wave run-up would be 16 feet, or one foot higher than the crest of the present seawall (Plate 5).

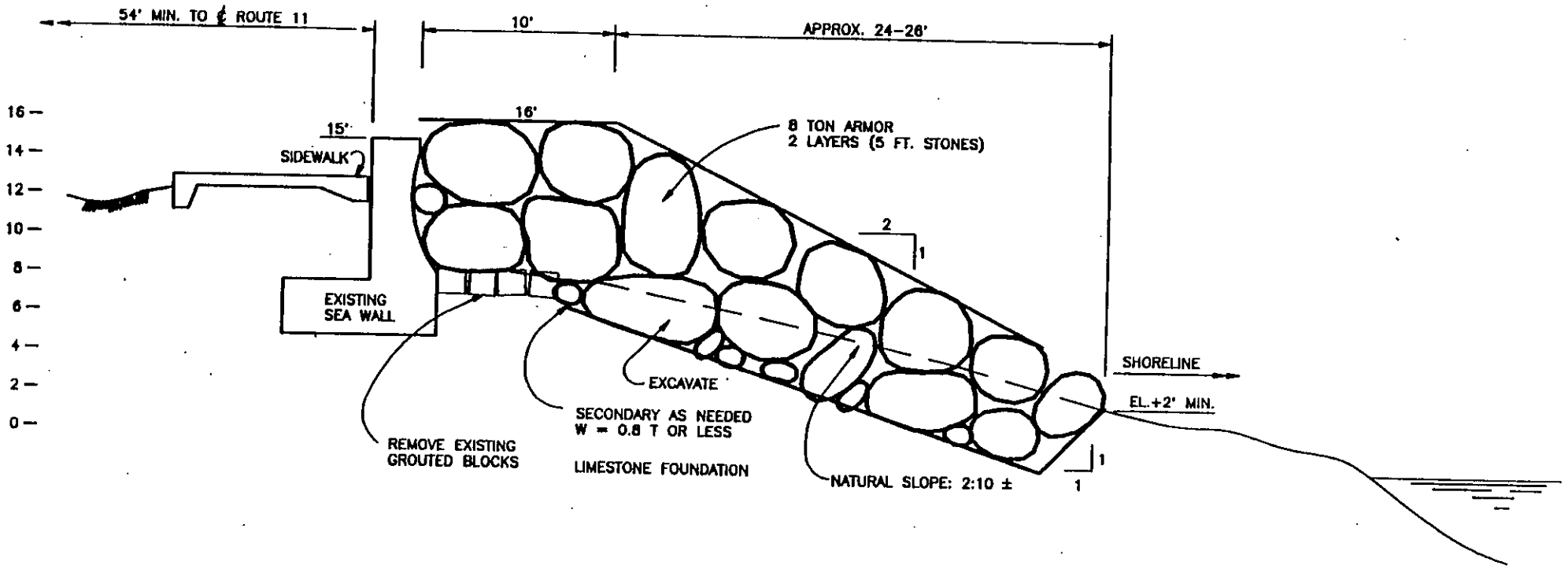
Rock of the required size can be secured from the ongoing operation of leveling the rocky hillocks in the area that is to be occupied by the Cabras Island Industrial Park. The coralline limestone being removed is similar to that found in the existing Glass Breakwater. It will, however, be necessary to change present blasting and quarrying techniques in order to produce rock of the size required for the two layers of armor stone, as well as secondary sizes--as needed.

It is estimated that 52,000 cu.yds. of rock, mainly of the 8-ton size noted above will be required. The estimated cost of removing unsuitable material, excavating the foundation and transporting and placing the rock is $1,980,000. The cost of purchasing the rock at the point where it is quarried will need to be negotiated within the framework of the existing agreement with Hawaiian Rock, which is currently removing the rock from the Industrial Park site. At the time this work is done, the seawall should also be extended to close the gap that exists between the present end of the wall and the higher ground to the east. The cost of this work would be about $400,000.

The protective structure will be most exposed in the segment closest to the shoreline. It is estimated that its toe must be at Elevation 2.0 or higher. This will not

only improve the stability of the rock armor and the wall but also decrease splash and overtopping toward the road. In order to assure that this is the case, it may be necessary to move the seawall several feet to the south and closer to the road. This could affect the space available for a queuing lane required for the gate complex that is proposed in conjunction with the present stage of the container yard expansion.

If this suggested design for a structure to protect the seawall and the road is pursued, more detailed analyses, a refined design and construction documents will be required. Subsequent analyses should include a more extensive documentation of typhoons in the western Pacific, hindcasts of wave heights and a detailed survey of the shore area in front of the existing road and seawall to see if any adjustments to the seawall, the roadway lanes and the gate complex would be required.



NOT TO SCALE

PORT OF GUAM • NEW MASTER PLAN

CONCEPT FOR PROTECTION OF SEAWALL

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Plate 5

CHAPTER VII
OTHER FACILITIES IN APRA HARBOR

GENERAL

In order to maintain the integrity of the cargo-handling operation in the Commercial Port it is necessary to develop appropriate facilities at different locations on the periphery of Apra Harbor to accommodate the other water-oriented activities that share the use of the Harbor with the import and export of essential goods (as well as the movement of naval vessels to and from the Inner Harbor).

The Harbor also contains a range of fragile environments, including coral communities, mangroves and some salt-water marshes. If the present beauty and attractiveness of the Harbor for tourist activities is to be maintained, most of these environmentally sensitive areas must be totally protected, the potential for damage to others must be minimized and the displacement of any communities must be avoided if at all possible.

Primarily for these reasons, but also to hold down costs, locations for facilities to serve the various activities have been selected that have already been developed in the past for similar uses. The earlier facilities may have fallen into disuse or they may still be used for other activities. In either case they will need rehabilitation or redevelopment in order to be used for a new set of activities but this work can generally be done with less disturbance to the environment and at lower cost than constructing new facilities in previously undisturbed sites. Undisturbed areas that have not been considered for the location of new facilities include all of Piti Bay south of Dry Dock Point. For much the same reason, major changes in the areas served by Piti Channel have been avoided, though concerns about excessive traffic passing through the Port have also played a role, as discussed later in this chapter.

Thus, a large universe of potential sites for facilities to serve various water-oriented activities, other than the handling of cargo, has not been considered.

Instead, various ways in which existing facilities can be adapted and expanded to serve new uses has been studied and the most advantageous solutions adopted.

FISHING PORT

Vessels Using the Port

Activities of the various types of fishing vessels are described in Chapter II and an estimate of future volumes of fish landed provided in Chapter IV.

Two types of fishing vessel currently use the Port of Guam. The first type includes Japanese and Taiwanese longliners which catch yellowfin and bigeye tuna for the sashimi market in Japan. Their preference for Guam as a port from which to operate is based upon its proximity to the main fishing areas of the F.S. M. combined with excellent air service to Japan for the timely shipment of fish. The second type of fishing vessel calling at Guam is the purse seiner. These vessels are mainly American and Korean, though other nationalities including Australian, Taiwanese and Philippine have been recorded. Up until the mid-1980's purse seiners landed their catches in Guam for transshipment to canneries in the U.S., the Far East and elsewhere. Because of costs and tax policies, transshipment now takes place on Tinian or at sea. These vessels continue to call at Guam, but only to reprovision, refuel and provide their crews some time for "r and r". For both types of vessels, some repair work may also be undertaken.

Approximately 165 to 170 longliners now use Guam for landing their catches and, because of their schedules, some 25-30 vessels may be in port at any one time. Given the interplay of cost factors and technological changes, it has been estimated in Chapter IV that the total tonnage landed may not rise by much more than 25 percent and could even decline. Thus, it can be conservatively estimated that the number of vessels and vessel calls may increase by no more than 20 percent, so that 30-35 longliners may be in port at a given time. While this number may be in port, only 10-11 berths will be needed for discharging fish and taking aboard fuel and provisions. The rest of the longliners will be awaiting word from their agent and payment

for their catch. These may be rafted out from vessels that are actually working or may ride at anchor. The longliners range from 45 to 85 feet in length and average 68 feet. Approximately 795 feet of berthing space, therefore, is needed.

About 30 or so purse seiners now call at Guam and, of this number, perhaps 8 are in port at any given time. Because of an anticipated move by the eastern Pacific tuna fleet to western Pacific waters, this number may rise to 40-50, and the number in port at one time may be closer to 10-12. Only a fraction of this number, however, will require berths for refueling and reprovisioning at the same time. Four berths are considered sufficient, which will actually accommodate 7 or 8 vessels if they are rafted out from the ones at berth, while anchorage sites may accommodate another four or more purse seiners. Based upon an average length of 190 feet, about 850 feet of berthing space is needed.

Site Selection

Three sites have been considered for the relocation away from the Commercial Port of facilities to serve the fishing fleets. These sites are: (A) Pier D(og) on the south side of the Glass Breakwater, (B) adjacent to the former Coast Guard seaplane ramp, where the Marianas Yacht Club used to be located, and (C) an area adjacent to Dry Dock Island. Each of these sites has certain drawbacks. Site A would require the longest extension of utility lines but, more importantly, facilities at this location would have to be carefully planned and operations closely controlled to avoid the degradation of adjacent Family Beach and nearby reefs and to avoid noisome odors at Hotel Wharf downwind of the site. Site B is bracketed by two of the petroleum wharves in Apra Harbor and some concern has been expressed about whether these may present a safety or environmental hazard for a new fishing port. Site C would require an entirely new facility offshore from land that is still owned and controlled by the U.S. Navy. At this point in time, use of this site is most unlikely.

The use of Site A, Pier D(og), gives rise to concerns over whether operations involving the unloading and trimming of fish, handling of bait and rejects and the cleaning of the vessels themselves can be adequately controlled. Furthermore, fore-

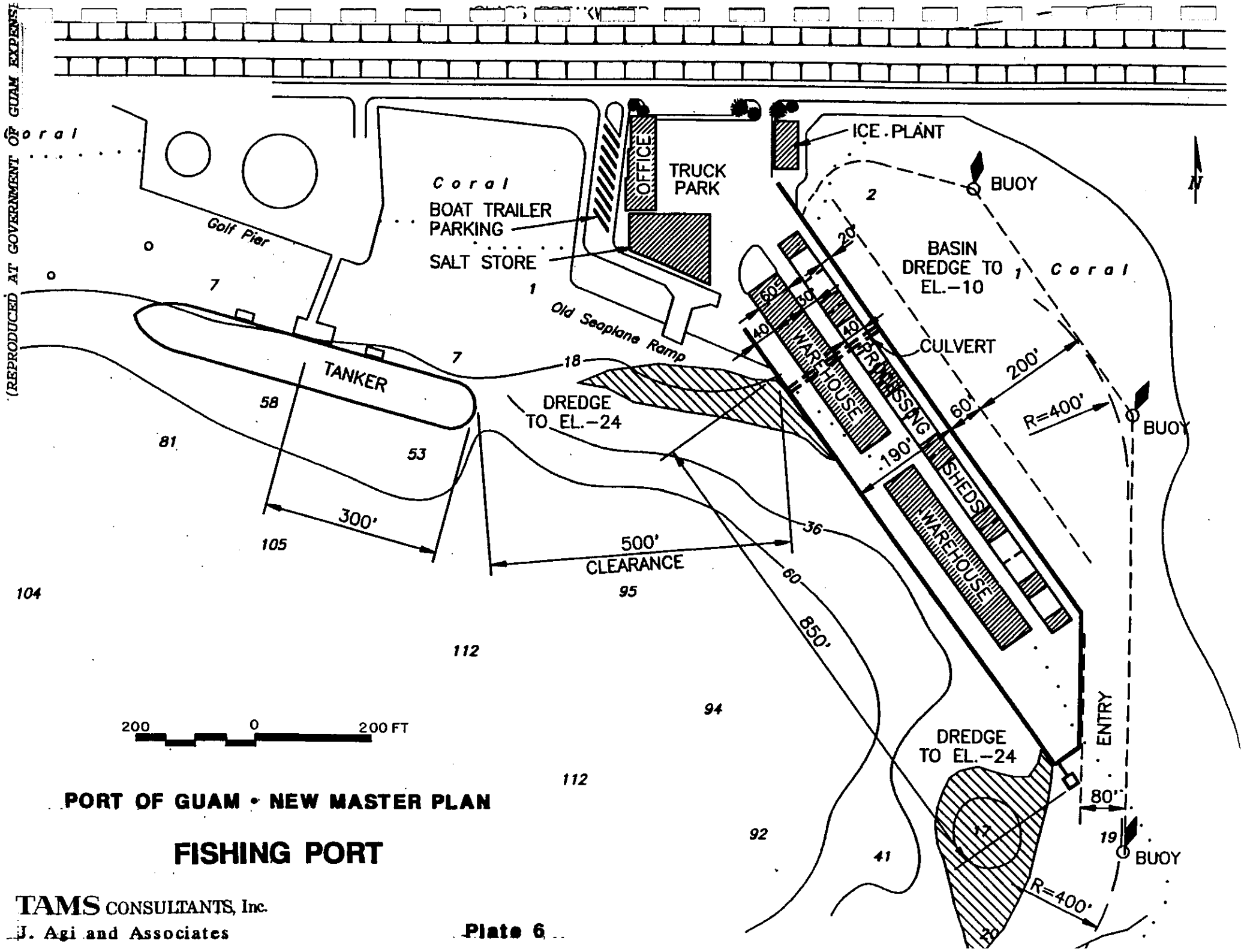
casts of the number of passenger vessels offering day excursions, dinner cruises, etc. indicate that space will be needed for berthing vessels of this nature that will be too large to use the Harbor of Refuge area. The site of Pier D(og), near H(otel) Wharf, where cruise vessels will be berthed, would be a logical place to locate additional passenger berths and, therefore, would not be available for fishing activities.

Therefore, Site B, adjacent to the old Coast Guard seaplane ramp has been selected. A plan has been developed for this area that provides a minimum of 500 feet between a vessel at the Fishing Port and the bow or stern of a tanker discharging petroleum products. (Plate 6)

Development Plan

For the proposed Fishing Port a pier will be developed along the edge of the existing shelf of degraded (or dead) coral in the cove where the Marianas Yacht Club used to be. Following discussions with representatives of various fishing groups this Port has been expanded considerably and additional facilities provided. The pier will have at least 24 feet of water depth on the outboard side and sufficient berthing length for four average purse seiners. Near the center, over 30' will be available for vessels discharging salt. On the inboard side, a basin will need to be excavated in the mixed sand and coralline material. This basin will have a water depth of 10 feet and provide a sheltered area of about 4.5 acres for accommodating longliners. Some 795 feet of berthing length will permit at least 11 vessels to unload their fish at the same time.

The pier itself will be 190 feet wide. For discharging and processing the catch of longliners, an apron only about 20 feet wide will be provided, with a shed open on the sides directly behind this apron. The shed will be about 40 feet wide and in the other direction will be divided into a series of modules each about 72 feet long. Two-thirds of this length will be entirely open on the sides and one-third will be enclosed with simple block walls. The open areas will provide unobstructed space for setting up semi-permanent tables for grading, trimming and packing fish into boxes, placing the boxes in Conex containers and loading the containers on trucks waiting next to



PORT OF GUAM • NEW MASTER PLAN

FISHING PORT

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Plate 6

the shed. (The actual arrangement to be used can be developed to suit each individual agent and the captains he represents.) The enclosed areas will provide space for storing equipment, etc.

Behind the shed will be a 30'-wide roadway for trucks picking up fish in the evening. On the other side will be a set of warehouses, 60' wide, containing 40,000 sq.ft. of space for storing gear and provisions. On the Harbor side of these warehouses will be a 40'-wide apron. Traffic on this apron and the central roadway will be one-way, in opposite directions (Plate 6) so that trucks, including double-bottom tankers with avgas, can be accommodated on the pier.

Hydrant fueling is to be provided on the pier and provision should be made for connecting the line serving the hydrants to the storage facilities of all the petroleum companies, if they desire it. This will allow the companies either to provide fuel on a rotating basis or to bid to provide fuel for specific time periods.

Onshore support facilities, located in the vacant area behind the old seaplane ramp, will include 6,000 sq.ft. of office space for agents, a timber structure with about 12,000 sq.ft. for storing salt, a relocated ice plant and a truck parking area. Some of these facilities may be developed later by private interests, and supplemented by a provisions store and ship chandlery.

This area can be developed in a way that continues to allow access to the seaplane ramp for the launching of small recreational craft a shown on Plate 6. Pier A, some 1, 500' further east, is an area, however, that can also provide access to the waters of Apra Harbor and, indeed, is heavily used by divers and snorkelers at present. It may prove to be desirable to build a new ramp for sailboards and other small recreational craft at Pier A, so that the area adjacent to the proposed Fishing Port can be fully utilized to support the fishing fleet. As the use of Apra Harbor for recreational purposes grows, yet another public launching facility could also be developed on the south side of Dry Dock Point--near the area now occupied by the Marianas Yacht Club.

Cost of Facilities

With different water depths on the two sides of the pier for the Fishing Port, two possible methods for constructing this pier have been sketched out and costed. The first method would use two rows of sheetpile cells with fill placed between them. The second method would use a central fill section with pile-supported platforms on each side (front piles would be socketed into the coral substrata). The second method has proven to be less expensive and, therefore, is used for the overall cost estimate. The estimated cost of the Fishing Port is as follows:

Development of Basin	$ 973,000
Construction of Pier	6,587,440
Utility Installations	577,000
Warehouses & Sheds on Pier	5,440,000
On-shore Support Facilities	1,375,000
Sub-Total	$14,952,440
Engineering and Contingencies	3,737,560
TOTAL for Fishing Port	$18,690,000

PASSENGER FACILITIES

Vessels to be Accommodated

In Chapter V, forecasts are made for three types of passenger traffic, all of which are related to the growth of tourism activities in Guam. The three types of traffic considered are:

- Cruises that start and end elsewhere in the Far East or in Europe or North America;
- Cruises of less than a week duration that include visits to other Micronesian ports and start and end in Guam;
- Day excursions, dinner cruises and other short trips that are a part of the vacation experience in Guam.

The vessels involved in each type of traffic are different and have different requirements for on-shore facilities. The types and numbers to be accommodated have been estimated as follows:

- Ships engaged in extended cruises that originate and end elsewhere called at Guam some 18 times in 1989 and this number is expected to rise to 42 visits each year by 2010. These vessels may be 500 to 800 feet long and accommodate 600 to 800 or more passengers. Calls are generally one day or less. Passengers continue to use their on-board accommodations and no baggage transfer is involved. Provision for customs and immigration formalities will be needed, however.

- Vessels offering shorter cruises to other islands are likely to be smaller than the preceding type. The two ships currently in use are about 300 to 350 feet long and offer a more personalized form of service to about 120-150 passengers. In the future, larger ships will also be used; later this year an 800-passenger ship may offer multi-day cruises originating in Guam. Therefore, it is estimated that by 2010, some three or four ships, representing a mix of larger and smaller vessels with an average capacity of about 550 passengers, will be operating out of Guam during the high season. Any facility that is developed for these vessels must include provision for baggage handling, as well as customs and immigration procedures.

- The kinds of vessels involved in the third kind of traffic may vary widely--from smaller craft, often of multi-hull design, that may not be much larger than the dive boats, etc. that are considered in a later section, up to excursion vessels with a capacity of 800 passengers or more. By 2010, it is estimated that three large vessels, with an average capacity of 500+ passengers, about five mid-range vessels with a capacity of 149 and perhaps 15 smaller vessels, with an average capacity of 75, will be offering excursions of several hours duration. Some of the small and mid-range vessels will be based in or near the Harbor of Refuge, as they are now, but not all can be accommodated and some will be too large to navigate the Piti Channel, even after it is improved. Facilities will be needed within Apra Harbor itself.

Siting of Facilities for Cruise Ships

Outside of the Commercial Port, there is only one site available to the Port Authority of Guam that can be developed for cruise ships without incurring both high costs and considerable environmental damage. That site is H(otel) Wharf. This facility

accommodates passenger ships now and, after the Navy's option to use it with three days notice expires in 1992, it can be further improved.[1] Accommodations on the wharf can be expanded and made permanent and some amenities can also be provided. The forecasts in Chapter V indicate that by Year 2000 it will be necessary to provide enough berthing length for two cruise ships, one of which may still be only 300 feet or so in length while the other may be in the range of 600 feet. The three to four Guam-based cruise ships that are expected by this time should be able to use this facility, since cruises may be three to four days long and schedules can be worked out for its use on alternate days. H(otel) Wharf can be extended 450 feet to the east to provide a total berthing length of 950 feet. Little dredging will be needed and the extension will not be too close to the shore to affect ship handling.

Regarding cruise ships that originate in other parts of the world and call at Guam, even with 42 visits per year, each of which may last for a day or so, the occupancy of a berth dedicated to such vessels would only be in the range of 12 percent. It would be difficult to justify a separate berth, costing $30 to 40 million, for such limited use. They will be able to use H(otel) Wharf when it isn't occupied by Guam-based vessels but during the high-season it would only be available 30 to 40 percent of the time. Therefore, provision should be made to allow these vessels to ride at anchor and be served by launches--as is done at various holiday ports in the Caribbean and elsewhere. A landing stage can be provided at H(otel) Wharf for the launches.

Facilities for Local Excursion Vessels

The potential increase in day excursions, dinner cruises and the like indicates that facilities will be needed to accommodate the wide range of vessel sizes and types that will be engaged in this market. As noted above, space not dedicated to emergency use in the Harbor of Refuge, as well as space in the channel behind it, is very

[1] Should the Navy, in the future, wish to handle ammunition again on this wharf during some emergency, it would be necessary to remove all people except essential personnel but, with a 100-foot wide apron left on the wharf it could be expeditiously handled. As for the handling of commercial explosives, these are handled elsewhere in the world as "red label" cargo over regular wharves. With their designation as "red label" cargo, though, special handling procedures and special areas, clear of non-essential people, are required.

limited. Also, some of the excursion vessels will be too large to use even an improved Piti Channel. While the larger excursion vessels will not be as large as ships of similar capacity with overnight accommodations are expected to be in the range of 250 feet with a draft of 14-16 feet. Mid-range vessels may be catamarans, similar to the Stars and Stripes or Micronesian Dream, or they may be monohull vessels about 125 feet long and drawing 6-8 feet.

Given the existence of Pier D(og), its proximity to H(otel) Wharf, the reservations of the Port and others about placing the Fishing Port at this site and its current state of decrepitude, it seems to be most logical to reconstruct this former pier as a facility for excursion vessels. Its configuration with two finger piers is appropriate to passenger vessels, where there is no cargo, other than catered meals and laundry, to be loaded and it can be developed for a range of vessel configurations and drafts.

Furthermore, a reconstructed Pier D(og) can be largely integrated with those portions of H(otel) Wharf that are outside the customs barrier into a single passenger complex. The adjacent beach areas could also be linked with this complex, though Family Beach would remain accessible to all. Family Beach is an important and well-used area that is a favorite among residents, as well as a point of entry for novice divers. It needs to be maintained and it is intended that this integration could also provide the means and incentive to take care of all the beach areas and prevent their degradation[1]. As reconstructed, Pier D(og) would have 1,400 feet of berthing length with deeper berths on the outside and shallower berths in the basin area (Plate 7).

Proposed Development

Temporary facilities on H(otel) Wharf may be developed by a private group. The building complex proposed as a replacement for the temporary structures will provide a series of facilities in an open plan under a single roof, which will provide shade but permit breezes to flow through. As shown on Plate 7, two buildings would

[1] Construction of a marginal wharf for excursion vessels east of Hotel Wharf has been suggested. This location would not provide the same berthing length as a reconstructed Pier D(og) but more importantly there is concern that construction in this virgin area poses too great a risk of degrading the reef areas that are the focus of diving activity in the vicinity of Pier A.

be provided, separated by an open but shaded seating and refreshment area. One building may house a restaurant, local souvenir shop and duty-free shop as well as food preparation areas for the cruise ships. The other building would contain a baggage holding areas, customs, immigration and administrative offices. This complex could also serve as a site for a relocated Harbormaster's office and traffic control center, which would be two stories above the passenger facilities. These facilities would be concentrated within the present length of H(otel) Wharf, though they could be extended at a later date. The roof above these facilities would be extended at the western end to shelter the landing stage for launches. Elsewhere, a 100 foot wide apron would be left for the loading of passengers, baggage and provisions.

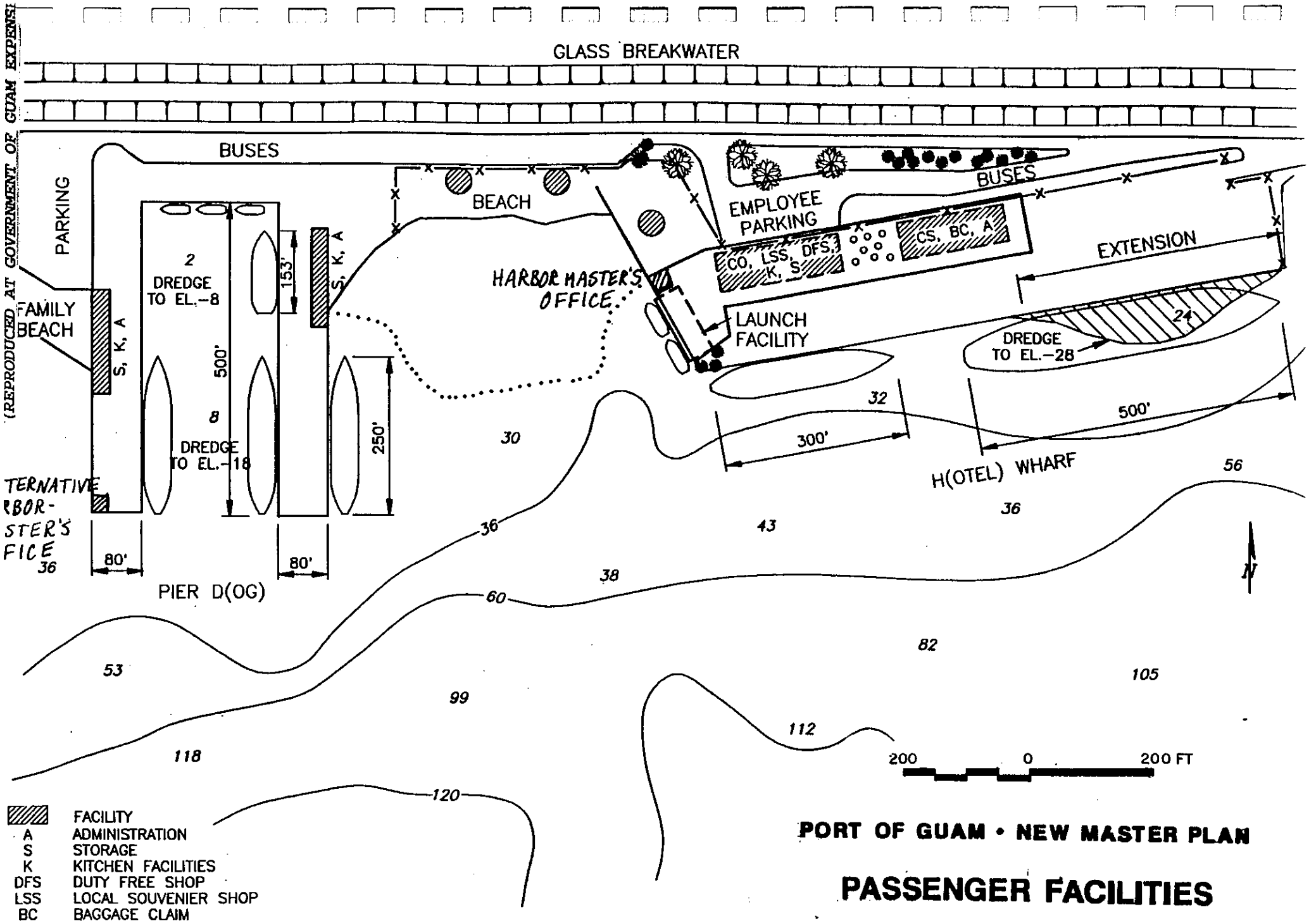
The existing road to H(otel) Wharf will be widened and resurfaced and behind the building complex, bus unloading areas and employee parking will be provided. Because of the nature of this facility, a barrier between the shipside "sterile" area and the landside area will be needed for customs and immigration control but the impact of this barrier on the aesthetics and amenities of the area should be minimized.

Pier D(og) will be reconstructed as two 80-foot wide fingers that would serve vessels on both sides as well as vessels berthed on the inshore bulkhead. Except as needed for separating ticketed passengers from others, few barriers will be needed. A building will be provided at the foot of each finger with food preparation facilities, administrative and ticket collectors' offices and storage space. At the head of one finger would be an alternative location to a new Harbormaster's office.

The road that now reaches as far as H(otel) Wharf will be extended and a bus unloading area will be provided between the reconstructed pier and the road. Also, a bus turning area and parking for Family Beach will be provided west of the pier. Much of the limited upland area for this facility should be shaded, with trees and thatched structures.

Cost of Facilities in Passenger Complex

The costs of reconstruction, upgrading and new construction for the passenger complex have been estimated as follows:



▨	FACILITY
A	ADMINISTRATION
S	STORAGE
K	KITCHEN FACILITIES
DFS	DUTY FREE SHOP
LSS	LOCAL SOUVENIER SHOP
BC	BAGGAGE CLAIM
CS	CUSTOMS
CO	COFFEE SHOP, RESTAURANT

PORT OF GUAM • NEW MASTER PLAN

PASSENGER FACILITIES

TAMS CONSULTANTS, Inc.
J. Agi and Associates

Plat

Reconstruction of Pier D(og)	$3,575,000
Improvement of Hotel Wharf and Provision of New Passenger Facilities	2,760,000
Provision of New Facilities on Pier D(og)	610,000
Utilities	730,000
Subtotal	$7,675,000
Engineering and contingencies	1,925,000
Total Prior to Extension of H(otel) Wharf	$9,600,000
Extension of Hotel Wharf	$3,050,000
Engineering and contingencies	775,000
Total for Extension	$4,185,000

Not all of the above costs will be borne by the Port Authority of Guam. The reconstruction of Pier D(og), extension of H(otel) Wharf and provision of utilities to the site may be undertaken by the Port and then leased for a specified number of years. Construction above the level of the pier and wharf surface, totaling $4,215,000, may be financed and developed by private interests.

ACCOMMODATION OF SMALL CRAFT

In addition to the Marianas Yacht Club moorings and Sumay Cove, the area in the back channel behind the Harbor of Refuge is used now for small craft. Most of these are privately-owned pleasure craft but some vessels are engaged in the provision of tourism services, e.g. ferry to the submarine "Aquarius", dive boats, etc.

It appears that, with some further rationalization of the layout of the slips in this back channel, more space could be developed. The estimates in Chapter V of future demand for marina space indicate that the construction of Agat Marina and the expansion of Agana Marina, under private auspices, will relieve the present pressure for marina space. It could be a decade or so before significant shortages are once again felt.

With the growth of traffic in the Commercial Port, it may become necessary to limit the amount of unregulated traffic passing through the Cabras Island and Piti Channels. This would apply mainly to craft, virtually all of which are privately-owned, that are too small to have a radio for communication with, and hence control by, the Harbormaster's Office. Private pleasure craft that now use the back channel would, no doubt, continue to do so in the future. Projections of the number of smaller commercially-operated craft offering harbor and dinner cruises, snorkeling, etc. indicate, however, that there will be a growing need for slips to accommodate these vessels. It is suggested, therefore, that, as the number of available slips in the back channel behind the Harbor of Refuge (and perhaps on the periphery of the Harbor of Refuge, itself) is increased, either through rationalization of the slip layout or through attrition of current users, this capacity should be used for commercial vessels serving the tourist trade. These would be smaller vessels, for which there would be no room at Pier D(og) but they would be required to have licensed operators and two-way radios for contact with the Harbormaster's Office, so their movements through the Port can be tightly controlled.

As the number of vessels offering tourist-related services and using the Piti Channel increases, this channel should be increased to a uniform width, of about 120 feet, and maintained throughout at a depth of eight feet at MLLW.[1] This will allow safe passage and daytime passing of vessels up to the size of some of the 149-passenger, multi-hull vessels offering harbor cruises.

For privately-owned pleasure boats using Apra Harbor that would have no "grandfather" privileges for use of slips in the back channel, it is suggested in Chapter V that a marina might be developed south of Dry Dock Point or that dry boat storage be developed on Dry Dock Point. Preferably this development would be undertaken by private interests, who would prepare their market studies and size the marina on the basis of what may happen at the Agana Marine. It is expected that it would involve an appropriate agreement with the Marianas Yacht Club.

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[1] A pipeline belonging to Shell-Guam and serving the oil storage tanks of the power plant prevents any further deepening of the channel.

VESSEL REPAIR SERVICES

Existing capability in Guam for undertaking vessel repairs consists of a private company located at Berth F-2, which cannot do hull repairs; a small drydock that can accommodate vessels up to 120 feet long and 600 g.r.t.; and the U.S. Navy's Ship Repair Facility, which provides services to outside parties only in exceptional cases and when space is available.

The development of major ship repair facilities in Guam for most commercial vessels is unlikely, inasmuch as labor and material costs are high relative to other Far East ports, space for such a facility would be expensive to create and Guam is not a final destination where ships would be emptied of their cargo. For cargo vessels, therefore, the only demand would be for emergency services.

There has, however, been some interest expressed recently by two firms that are operating in Guam--one a provider of various maritime services and the other an owner of a fishing fleet--in developing facilities for the maintenance and repair of the purse seiners that currently operate out of Guam, as well as the various passenger vessels that will be based in Apra Harbor. It is intended that the services provided by such a facility will include hull repairs, periodic maintenance and removal of marine growth ("shave and a haircut") and shaft and propeller repairs, in addition to the top-side and engine repairs that are done now. The maximum size of vessel to be served would be in the range of 1,500-2,000 g.r.t. with a light draft of 8-9 feet.

One company is considering upgrading the existing floating drydock from a capacity of 600 g.r.t. to about 1,000 g.r.t. and may also be looking for a larger drydock. The other firm has mentioned a more permanent installation, although a floating drydock may be among the options it would consider.

The ship repair facility will be developed by private interests but space is required. Space in Apra Harbor that is adjacent to water of adequate depth is at a premium, however. Pier D(og) has been mentioned by some as a possible site but, given the use of H(otel) Wharf as a cruise ship terminal, the development of Pier D(og) as an industrial site would be no more appropriate than its development as a fishing port. In addition, there is the need for a facility to serve large and mid-size vessels for

local excursions. As noted above, this use is most logical for a reconstructed Pier D(og) and would complement the cruise ship facility at H(otel) Wharf.

Barring the transfer of Dry Dock Island to civilian use by the Navy, which is very unlikely in the near future, there are no other sites in the outer Apra Harbor suitable for a permanent on-shore facility. What may be found, instead, is a site where 18-20 feet of water depth for the mooring of a floating drydock can be found near a possibly temporary, 4 to 5 acre site on land for shops and material storage.

The most likely site, at present, is on the south side of Cabras Island Channel, opposite the Commercial Port and east of Wharf E. The navigation chart indicates that water depth in the area is 22 feet and the south side of the channel, as well as the adjacent land area on Dry Dock Point, is unlikely to be needed for port expansion purposes until after Year 2010 (Chapter VI). If a floating drydock were moored close to the shore, 600 to 650 feet of channel width would still be available for maneuvering vessels in and out of Berth F-6 and a new Berth F-7.

An alternative location might be found north of Piti Channel in the coral shelf area adjacent to the proposed Cabras Island Industrial Park (see next chapter). Part of the Piti Channel would need deepening and a basin for the drydock and an approach channel would have to be excavated in the coral shelf but on-shore space for support facilities could be leased from the Industrial Park. Vessels entering the repair facility would have to transit the Commercial Port and share Piti Channel with passenger vessels but the number of vessels seeking repairs would be relatively small.

PETROLEUM DISCHARGE AND STORAGE FACILITIES

As noted in Chapter III, petroleum companies serving Guam imported 6,060,000 barrels of petroleum products and transshipped another 1,050,000 barrels in 1989. These companies expect these volumes to increase by about 6% annually during the next five years, which is consistent with projected imports of vehicles. After that, consumption may moderate somewhat as traffic mounts and energy conservation becomes more important. By Year 2000, about 11,500,000 barrels may be handled,

including transshipments, and by Year 2010 this figure may increase to 15,500,000 barrels.

At the present time, G(olf) Pier and Berth F-1 have occupancy levels of about 19.5% and 15.2%, respectively (excluding purse seiners using G(olf) Pier for bunkering and lay-up--which will decline with more competitive bunkering at the Proposed Fishing Port). These percentages reflect a number of smaller vessels with lower discharge and loading rates, as well as some time awaiting instructions. Therefore, it is concluded that the two existing berths will be able to handle future imports and transshipments of petroleum products, though some higher capacity equipment may be needed in future years.

Tankage may be more of a restraint. The capacity of existing tanks in the Port area is 625,270 barrels and there is little space for expansion. Some additional tankage may be developed in the area on the other side of the road from the cement silo by changing the pattern of facilities in this area, rebuilding the old tanks north of Route 11 in a more rational layout may be possible and one or two new tanks may be built near G(olf) Pier, where there used to be some tanks. Beyond these possibilities, it may become necessary to pump petroleum to storage facilities further from the Port.

CHAPTER VIII

PORT MASTER PLAN AND LAND USE ON CABRAS ISLAND AND ITS ENVIRONS

PORT MASTER PLAN

The program described in the preceding two chapters for the expansion of the Port of Guam will lead to a functioning port consisting of three major components, each of which will be distinct and each of which will serve a specific type of traffic with its own special needs. These major components are:

Commercial Port: This is by far the largest of the three components. The Port will include a total of 3,600 feet of deepwater berthing and 50.5 acres of container yard, as well as shed space, maintenance area and other support facilities. Given the importance of imported goods to the economy of Guam it will account for the major share of the proposed investment: $59,225,000, not including the $18,690,000 to be spent for relocating facilities for fishing vessels or work currently under contract. Investment will be $22,325,000 in the 1990-2000 period and $36,900,000 in the 2000-2010 period.

Fishing Port: This component is intended to serve two types of vessels and will include eleven berths for unloading longliners and a shed for processing their catch, plus four berths and warehouse space for the provisioning of purse seiners. The total investment in this new facility will be about $18,690,000, of which $12,600,000 will be for the replacement of berthing space and facilities that will be returned to use by cargo vessels at the Commercial Port and $6,090,000 will be for new berthing space and support facilities in the Fishing Port. All of this investment will be in the 1990-2000 period.

Passenger Complex: This complex is intended to serve both cruise vessels at an extended H(otel) Wharf and local excursion vessels at a reconstructed Pier D(og). As such, the facility will serve as an important adjunct to Guam's tourist industry. Total investment in this facility will be about $13,785,000, of which $4,215,000 could be raised by private interests. $9,600,000, which includes the private portion, will be invested before 2000 and $4,185,000 after that year.

Table VIII-1 presents investments in all three Port components, and the purpose of these investments, in chronological order. The timing of early investments may be considered to be reasonably definitive but later investments, particularly those

TABLE VIII-1

SUMMARY OF INVESTMENTS 1990-2000

Implementation or Construction Period	Port Component Affected	Improvement	Investment
Now	Commercial Port	Repairs to Wharf	$2,895,000 *
1990-1991	Commercial Port	Container Yard Expansion (to 26.5 acres)	6,400,000 *
1993	Commercial Port	Installation of New Cranes and Acquisiton of Mobile Crane	15,425,000
1994-1996	Fishing Port	Development of Basin, Pier and Support Facilities	18,690,000
1996-1997	Commercial Port	Completion of Berth F-3, Miscellaneous Demolition & Rehabilitation Work, and Container Yard Expansion (to 36 acres)	6,900,000
1996-2000		Revetment to Protect Seawall	2,380,000 **
1997-1998	Passenger Complex	Reconstruction of Pier D(og) and Improvements to H(otel) Wharf	5,385,000
		(Private Improvements)	(4,215,000)
2000-2003	Commercial Port	Extension of Main Wharf Face and Container Yard Expansion (to 42.5 acres)	26,900,000
2003	Commercial Port	Installation of New Crane	6,500,000
2003	Passenger Complex	Extend H(otel) Wharf	4,185,000
2005-2006	Commercial Port	Container Yard Expansion (to 50.5 acres)	3,500,000
Total, excluding Private Investment			**$99,160,000** ***

* Work currently under contract.
** Does not include cost of rock.
*** In 1990 dollars

after Year 2000 may have considerable latitude in their timing and this must be checked against actual traffic levels at that time.

As shown in Table VIII-1, indicated investments by the Port of Guam under the recommended plan will be about $99 million (in 1990 dollars) over the next 16 to 20 years. This does not include the local share of the deepening of Cabras Island Channel, since the amount of deepening required will depend upon future shifts in vessel sizes, the nature of trans-Pacific traffic and the number of larger vessels to be accommodated. If deepening of the channel, plus a single berth with 40-foot depth is sufficient, as indicated in Chapter VI, the local share may be in the range of $6.5-7.0 million.

Financial Impacts

The investment shown in Table VIII-1 translates to average annual capital outlays of $5.56 million before Year 2000 and $4.35 million after Year 2000. These figures may be compared with net earnings of the Port of Guam in 1988 of $2.86 million. Future revenues of the Port, not only from cargo but also from passenger traffic, may be expected to triple by the end of the forecast period (not counting inflation) and net earnings may keep pace. Thus, earnings in the future should be sufficient to cover investment costs but early investments will need to be financed through debt instruments.

CABRAS ISLAND INDUSTRIAL PARK

In late 1989 the Port of Guam negotiated a lease with a partnership called Cabras Island Developers for development of the Cabras Island Industrial Park in the area east of the Port that is currently being quarried and levelled by a local contractor under a separate agreement. The lease agreement is expected to be ratified by the Guam legislature within a few months.

Cabras Island Developers have prepared a subdivision plan for the Industrial Park[1] that provides for a number of parcels, averaging 1.75 to 2.0 acres each, to accommodate various port-related industries and storage activities. The developers plan also provides for a bulkhead along a portion of the southern edge of the Park, which indicates that it could be used for berthing shallow draft vessels, though the draft of such vessels may be limited by the sub-aqueous pipeline that belongs to Shell-Guam and crosses Piti Channel at a depth of a little over eight feet. (Also, mangroves along this southern edge may need to be protected.)

Among the various uses for which the developers say they have received requests for space are refrigerated warehousing and cold storage, bonded warehousing, vessel repair (if space is available west of Shell-Guam's pipeline crossing) and various convenience services. Other possible uses include equipment repair facilities for the shipping lines and truckers, container stripping (de-vanning) and trucking, vehicle processing (de-waxing and dealer preparation) storage of construction materials, etc. In accommodating uses of this nature, the Industrial Park will form a natural adjunct to the Port of Guam.

Because of the need to accommodate future Container Yard expansion, 65 acres to be occupied by the Industrial Park may consist of a 40 acre site on Cabras Island itself and another 25 acres or so located at the intersection of Marine Drive and the road to Dry Dock Point. The "build-out" period for development of these areas is eight years. By the end of that time, the daytime population of the two areas of the Park may be about 1,000-1,400. The same utility service areas that contain the Port of Guam (see Chapters III, and VI) will also be the source of utility services for the Industrial Park, though the pipeline on Cabras Island that serves the Port will serve only the 40 acre site (see estimate in Chapter VI).

[1] This subdivision plan is being modified to reflect a change in the area of the park that stems from the Port's need to reserve space for expansion of the Container Yard, as detailed in Chapter VI.

POWERPLANT EXPANSION AND COAL OPTION

Existing and New Electrical Installations

The Cabras Island Plant of the Guam Power Authority (GPA) located at the eastern end of the island, contains two 66 MW oil-burning units and is the chief source of power for the civilian community on Guam. (Another GPA plant, with two 26 MW units, is located at Tanguisson, on the northwestern coast of Guam.) Adjacent to the Cabras Island Plant is the Navy's Piti Plant, which has a total capacity of 67 MW and is the main source of power for the Navy's installations. Some time in the future, the G.P.A. expects to take over the Piti Plant, at which time the Authority will have a total installed capacity of about 250 MW.

In view of Guam's rapid growth, now and in the future, the GPA has already started on an expansion plan that will initially provide another 60 to 100 MW of capacity. After investigating a number of sites, the GPA has decided upon Cabras Island for this additional capacity. The area is sheltered, yet emissions are normally carried away from the island by prevailing trade winds, port facilities are nearby and there is enough room on the site of the present plant to accommodate the new generating units.

The GPA had earlier considered acquiring additional land in the same general area in order to construct a new Operations Center. The recent survey of the wetlands in the area, however, has indicated that the amount of developable land is not sufficient to accommodate this facility as well as the WTE plant. Therefore, the GPA will locate its Operations Center elsewhere.

Guam finds itself in the same situation as many other U.S. communities: existing landfills are running out of capacity and the Island has very few areas where new ones might be developed. Therefore, to ease its solid waste disposal problems, the Guam Economic Development Authority has recommended the development of a Waste-to-Energy (WTE) plant. A net area of about 15 acres is available at the intersection of Marine Drive and the road to Dry Dock Point (opposite the smaller piece of

the Industrial Park) and this may be a logical site for such a plant. It has the same advantages as the present Cabras Island Plant site, is convenient to GPA's existing switchyards and need not encroach upon or present any danger to the nearby wetland.

Possibility of Coal Firing

The Guam Power Authority has also mentioned the need to make provision for the possibility that coal may be used to fire the powerplants' boilers at some point in the future, should the price of oil rise too high and should other technologies prove not to be suitable. During the oil crises of the late 1970's and early 1980's, a study was made of the possibility of coal firing and a plan was developed for a 1,000-foot dock to accommodate dry-bulk vessels in the 30-60,000 DWT range. This dock would be connected by conveyor to a storage silo located on a 3-acre site within the area that is now the larger parcel of the Cabras Island Industrial Park. Other conveyors would transport the coal to a breaker house and thence to bunker storage within the plants.

This plan to accommodate the receipt, handling and storage of coal can be developed within the general context of the Port Master Plan and the Land Use Plan described in the following section. It would, however, affect the properties along the southern edge of the Industrial Park and, because of the need to first ensure that the port expansion plan outlined in this report can be carried out, the coal dock would probably be located in the Upper Piti Channel. Therefore, extensive dredging would be required. Both the economic costs and the environmental costs of any plan for coal-firing would be very high, though it may, one day, need to be realized. Other technologies for the production of electrical energy have been considered and may be considered again if oil prices rise too high. These include Ocean Thermal Energy Conversion (research ended for such a unit on Guam when oil prices fell below $25 per barrel), various forms of solar energy (which may be well-suited to Guam) and, possibly, LNG (for which discharge and tankage facilities could be developed at a remote site, with gas being piped to the plants).

LAND USE PLAN

Several earlier studies have been concerned with the planning of the lands surrounding Outer (Apra) Harbor that are under the control of the Government of Guam. The most recent of these studies was the Commercial Port of Guam Master Plan prepared in 1981 by Dravo-Van Houten for the Port Authority of Guam. The potential for substantially greater development demands upon the area, as well as the release by the Navy of additional lands, have changed many of the earlier planning considerations. Nevertheless, the first three of the assumptions by the Port Authority of Guam that guided the earlier plan are still valid. These are:

1. Port facilities must be developed sufficiently to accommodate current traffic and the expected increases in future years.

2. The Port Authority will coordinate the planning and prioritization of water-oriented activities to be located around Apra Harbor in order to minimize any adverse impact upon port operations.

3. The multiple use of Apra Harbor for shipping, industry, recreation, conservation, and defense, is beneficial for all concerned.

Two other assumptions regarding H(otel) Wharf have been changed by the phasing out of the Navy's interest in the facility by 1992.

Environmental and Other Restraints Upon Development

The major restraints upon development are environmental. As noted in Chapter VII Apra Harbor contains some valuable and even unique communities and the Port Master Plan has recognized those restraints. These include:

- Coral reefs, particularly towards the western end of the harbor, around the shoals south of the Cabras Island Channel and in Sasa Bay. These reefs attract a number of divers, as well as being valuable in their own right.

- Mangroves, which fringe the eastern edge of Sasa Bay, south of the causeway to Dry Dock Point. This is a natural habitat for certain crustacea. It is unlikely that permits could be obtained for altering this area in

any way. Mangroves are also found along Piti Channel. The Guam Coastal Management Program surveyed and found that four mangrove species are represented along the shoreline and on islets in the channel. These four species are considered threatened or endangered on Guam and are primary candidates for inclusion on official listings.

- Emergent wetlands have been identified at the eastern end of the planning area in a survey by the Fish and Wildlife Service that was part of the National Wetlands Inventory.

- Several beaches in the Outer Harbor, including Family Beach, are used by local residents and visitors and should not be degraded by other activities in the Harbor.

Other restraints to development stem from the Navy's continuing interests in Apra Harbor. Two Navy fuel docks (Wharfs D and E) are located at the northwest corner of Dry Dock Island and are considered to be essential to the Navy strategic requirements. Also, the Navy has stated that it intends to retain Dry Dock Island in order to have access to, and to support, a floating drydock operation at this site should the need arise. This island is expected to remain under Navy control for the foreseeable future. Also, until the Navy relinquishes its remaining interest in H(otel) Wharf in 1992 it could be used for ammunition unloading when sea conditions at the new ammunition wharf pose a hazard. At those times, other occupants would have to vacate the facility.

Development Requirements

In addition to the three Port components serving cargo ships, fishing vessels and passenger vessels, the proposed Cabras Island Industrial Park and the Guam Power Authority installations, facilities to serve other types of activity either occupy space within the planning area or have sought space within this area. Total development demands have gone beyond those accommodated in earlier plans so that, outside of areas that clearly need to be protected or held open to accommodate future growth, virtually the entire area is spoken for. Nevertheless, the various uses have a logical relationship to one another.

Among the activities to be accommodated that have not yet been mentioned are:

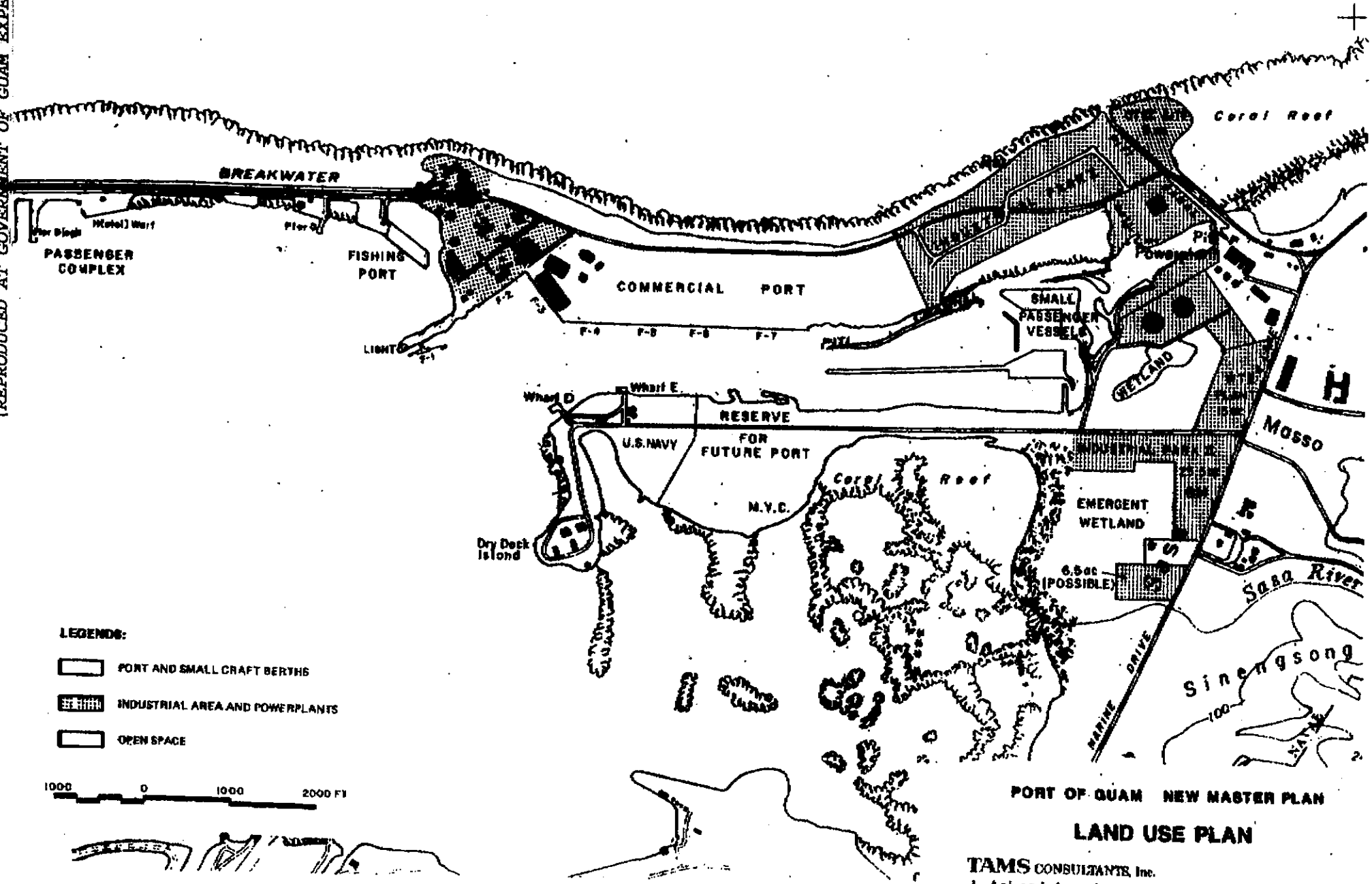
- The industrial area west of the Port that is bounded by Route 11 and Berth F-2 contains substantial investments in tank farms, a bulk cement plant, machine shop, chassis and container repair shops, warehouses and fishnet and vessel repair activities. These are all port related industries, and if they weren't located here they would logically be found in the proposed Industrial Park east of the Port. While space is limited, there is still some room for increasing the tankage available for petroleum products. As the need for additional tankage arises, some of the warehousing and allied activities in this area may be relocated to the Industrial Park east of the Port.

- The Port of Guam has received a request from an investment group based in Guam that is interested in developing a prawn farm in one of the shallow water areas south of Piti Channel. This area has only a foot or so of water, with shoals that are exposed at low tide. The area has also been suggested as a site for water skiing but considerable dredging would be needed for this purpose, which may have adverse environmental use. The prawn farm, which requires much less dredging may be a preferred use but further testing of water quality and evaluation of environmental effects is needed, so it is not included in the Plan at this time.

Other activities, which have been mentioned only briefly in earlier chapters include:

- Repair and maintenance of fishing vessels, primarily purse seiners, for which a floating drydock might be moored on the south side of Cabras Island Channel and some land for shops, storage, etc. allocated along the shore of Dry Dock Point.

- The accommodation of smaller passenger vessels on the margins of the Harbor of Refuge (most of the buoys in the Harbor of Refuge would be held open for emergency use) and in the back channel behind the Harbor of Refuge. Any new slips developed in these areas would be for smaller commercial passenger vessels, providing harbor cruises, etc.



PORT OF GUAM NEW MASTER PLAN

LAND USE PLAN

TAMS CONSULTANTS, Inc.
J. Agi and Associates

Plate 8

Recommended Land Use Plan

Plate 8 shows the recommended land-use plan for the northern and eastern edges of the Outer Harbor.

Progressing from west to east along the northern perimeter of Apra Harbor, across Cabras Island, then southward along Marine Drive and out onto Dry Dock Point and Dry Dock Island, the recommended land uses are as follows:

- Family beach will remain as a public facility and measures should be taken to ensure that it is clean and attractive.
- Pier D(og) and H(otel) Wharf will together form the Passenger Complex.
- Pier A, about 1,200 feet east of H(otel) Wharf, should be kept as a public access point for divers and snorkelers. A ramp for launching sailboards and small sailboats may also be provided at this location.
- G(olf) Pier currently managed by PRI South Pacific Inc. should remain in this service.
- The proposed Fishing Port will provide a protected basin for mooring and unloading of smaller fishing boats as well as berthing space for purse seiners. The facility will incorporate the old seaplane ramp and may leave room for the use of the ramp to launch small boats and sailboards.
- The Shell-Guam oil berth, F-1, will continue in its present use.
- The industrial area between Route 11 on the north and Berth F-2 will continue in its present use. Additional tankage may be developed in this area and on the north side of Route 11.
- Berth F-2 is used for imports of cement and the repair of fishnets and fishing vessels--it will remain in these uses.
- Berths F-3 to F-7 and the land area behind will make up the Commercial Port. It is fully described elsewhere.

(Pending further investigation of the need for a coal dock in the future, the plan does not specifically allow for such a facility. To do so would pre-suppose that other technological solutions would not be feasible.)

- East of the Commercial Port is the proposed Cabras Island Industrial Park I, described earlier in this chapter.

- Across Piti Channel from the Cabras Island Industrial Park lie the Harbor of Refuge and the back channel behind that Harbor, which will provide slips for smaller passenger vessels.

- East of these facilities is the entire power generation complex, consisting of an expanded Cabras Island powerplant, the Piti powerplant and the proposed waste-to-energy plant. North of this complex, on the other side of Route 11 is a site for the possible Ocean Thermal Energy Conversion facility. If this facility should not prove feasible, the site will be reconsidered for other possible uses in five years' time.

- South of the road to Dry Dock Point is the proposed Cabras Island Industrial Park II, which will skirt an emergent wetland area and not intrude upon that area.

- Turning back to the west and north of the road to Dry Dock Point this area may be left undeveloped until more environmental reviews are made.

- Further west along Dry Dock Point Road is the area reserved for further expansion of the Port after 2010. This area may, in the meantime, be used to moor a floating drydock with some onshore support facilities.

- South of the future port area and facing Sasa Bay is the new site of the Marianas Yacht Club. An adjacent area may be developed as the site of a dry boat storage facility and additional moorings may be developed in an offshore marine in a defined area of Sasa Bay.

- Finally, at the end of Dry Dock Point is Dry Dock Island, where the Navy's fuel berths are located. This area will remain under Navy control.

- South of this entire area lies Sasa Bay, almost all of which, including its shoreline, will not be developed.