社会開発協力部報告書

VOLUME 2 MAIN REPORT

THE STUDY ON THE DEVELOPMENT OF THE PORTS IN WESTERN SAMOA

FINAL REPORT

SEPTEMBER 1987

JAPAN INTERNATIONAL COOPERATION AGENCY

PREFACE

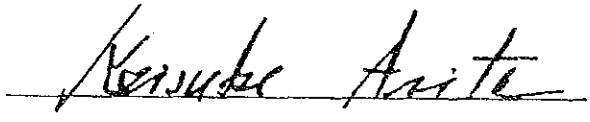
In response to the request of the Government of Western Samoa, the Japanese Government has decided to conduct a feasibility study on the Project for Developing Ports and entrusted the study to the Japan International Cooperation Agency (JICA). JICA sent to Western Samoa a study team headed by Mr. Katsuhiro Suzunai, The Overseas Coastal Area Development Institute Japan (OCDI) and comprising experts from OCDI and Nippon Tetorapod Co., Ltd. from January to March, 1987.

The team had discussions on the Project with the officials concerned of the Government of Western Samoa and conducted a field survey. After the team returned to Japan, further studies were made and the present report has been prepared.

I hope that this report will serve for the development of the Project and contribute to the promotion of friendly relations between our two countries.

I wish to express my deep appreciation to the officials concerned of the Government of Western Samoa for their close cooperation extended to the team.

September, 1987



Keisuke Arita
President
Japan International Cooperation Agency

LETTER OF TRANSMITTAL

September 1987

Mr.Keisuke Arita
President
Japan International Cooperation Agency

Dear Mr. Arita:

It is my great pleasure to submit herewith the Report for the Study on the Development of the Ports in Western Samoa.

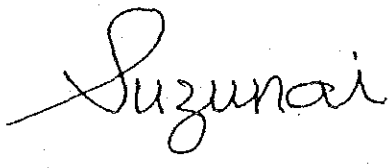
This report is the result of studies carried out by the Overseas Coastal Area Development Institute of Japan and Nippon Tetrapod Co., Ltd. at the request of the Japan International Cooperation Agency. Regarding this project, our study team conducted two series of field surveys, one of which took place for 67 days from January 18, 1987, to collect a variety of data including data concerning natural conditions.

The findings of these surveys were discussed to prepare a Master Plan and a First Stage Plan for the ports in Western Samoa, and were then compiled into this report. The study shows that the First Stage Plan is extremely important, so I hope the First Stage Plan will be executed promptly.

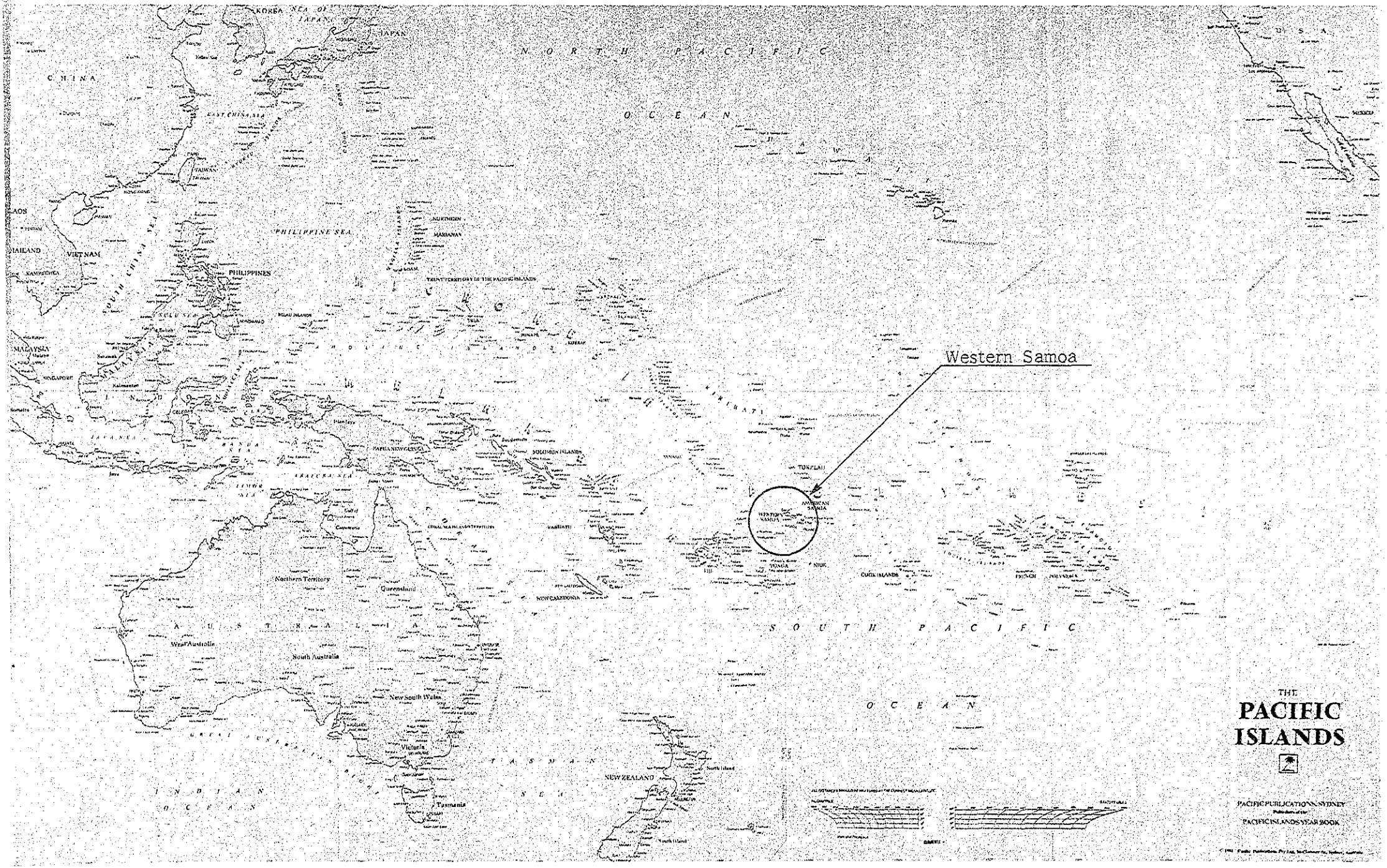
On behalf of the study team let me express my heartfelt thanks to the Ministry of Transport and to the other related agencies of the Government of Western Samoa for the genenous cooperation and assistance and the warm hospitality which were extended to the study team during their stay in Western Samoa.

Our thanks are also due to the Japan International Cooperation Agency, the Ministry of Transport, the Ministry of Foreign Affairs and the Japanese Embassy in New Zealand for their valuable advice and support during the field surveys and the preparation of this report.

Your Faithfully,



Katushiro Suzunai
Head
Japanese Study Team for the Study on
the Development of the Ports in
Western Samoa
(Adviser, the Overseas Coastal Area
Development Institute of Japan)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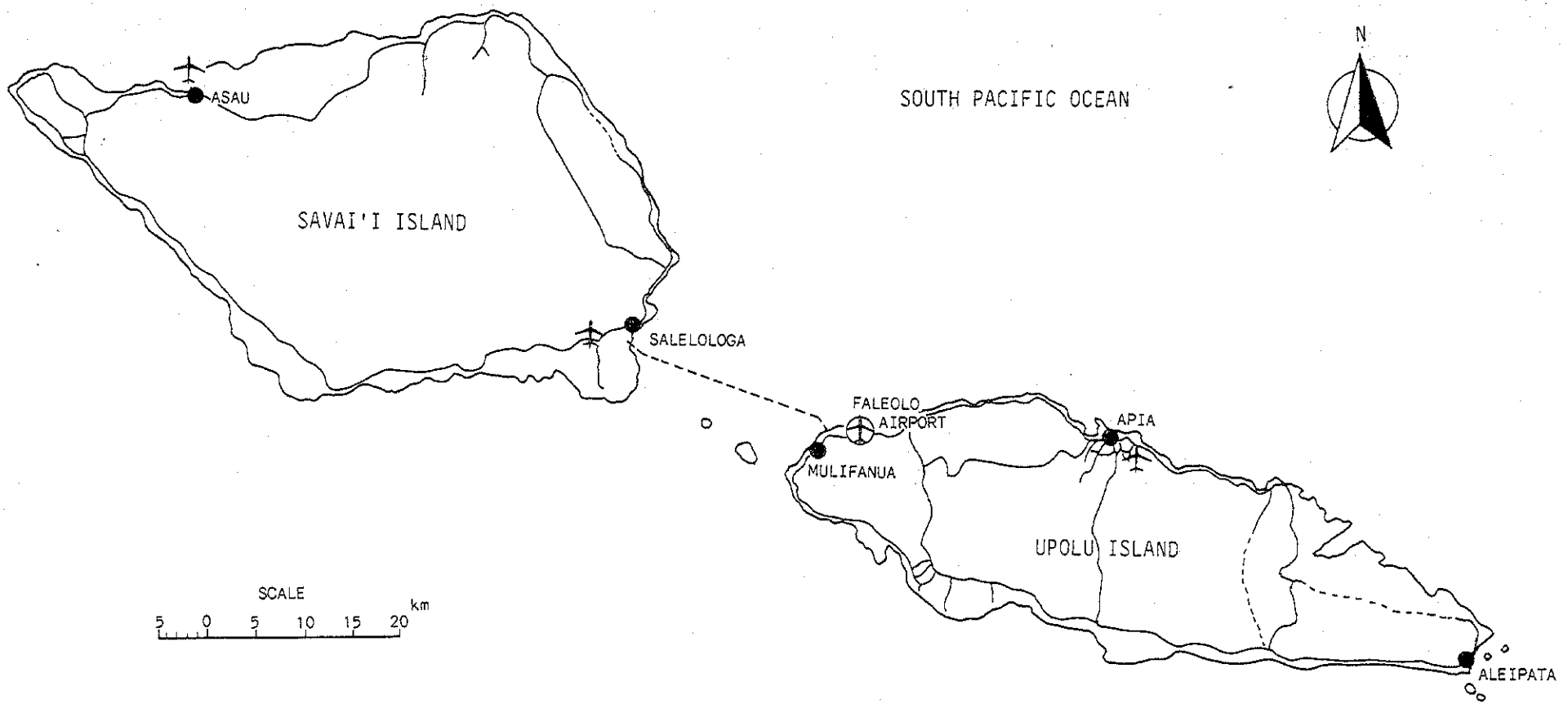
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Foreign Exchange Rate

US$ 1 = WS$ 2.08 = ¥ 152

(As of March, 1987)

Abbreviations

bd ft	board feet
BP	Burns Philip
CD	*Customs Department*
CFS	Container Freight Station
CIF	Cost, Insurance and Freight
DED	Department of Economic Development
EIRR	Economic Internal Rate of Return
FCL	Full Container Load
FIRR	Financial Internal Rate of Return
FOB	Free on Board
GDP	Gross Domestic Product
GRT	Gross Registered Tonnage
JIS	Japanese Industrial Standard
LCL	*Less than Full Container Load*
LOA	Length Over All
MH	Morris Hedstrom
MOT	Ministry of Transport
MS	Maintenance Shop
NZ	New Zealand
PFL	Pacific Forum Line
PWD	Public Works Department
Ro/Ro	Roll on/Roll off
SMB	Sverdrup, Munk, Bretschneider
SSS	Samoa Shipping Services
TEU	Twenty Foot Equivalent Unit
US$	United States Dollar
WESTEC	Western Samoa Trust Estates Corporation
WSSC	Western Samoa Shipping Corporation
WS$	Western Samoa Dollar (or Tala)
¥	Yen

CONTENTS

List of Tables

List of Figures

CONCLUSION AND RECOMMENDATIONS

CONCLUSION

Western Samoa has an area of about 2,800 sq km which comprises two main islands, Upolu, the seat of the Government, and Savaii which is located northwest of Upolu. The total population of the country is 159 thousand in 1986, of which 72% live on Upolu. As the economic activities and livelihood of the people depend on port activities because of the geographical situation of the country, port development is considered essential for the economic and social development of the country.

Of the four ports in Westren Samoa, Apia Port, which is located in the northeast part of the capital, is the most important and almost all international trade cargoes are handled there. Asau Port promotes the development of reforestration of Savaii. Salelologa and Mulifanua Ports connect the two main islands as ferry terminals.

Though some studies on ports in Western Samoa have been carried out since 1970s, no comprehensive, long-term development plan has been prepared. The main objective of the projects under the Master Plan is to provide necessary port facilities to cope with the present problems and the future demands, and thus to contribute to the economic and social development of Western Samoa.

The proposed Master Plans include the following components: i) a commercial port, a ferry terminal, port management infrastructure and tourism development with a marina at Apia Port, ii) a commercial port at Asau Port and (iii) ferry terminals at Salelologa and Mulifanua Ports.

The First Stage Plan concentrates on Apia Port. The main objectives of the first stage projects (hereafter the Project) are to resolve the present bottlenecks, to meet the present demand, to provide economic benefit to Western Samoa and to upgrade the safety of the port.

The Project, therefore, includes the following components: i) constructing a 100 meter long breakwater which will improve the calmness in the basin in the rainy season; ii) Extending the life of the existing main wharf through anti-corrosion measures to the H-shaped steel piles; iii) replacing the existing superannuated ferry terminal; iv) expanding the yard behind the main wharf; v) purchasing a tugboat and vi) providing lighting on the tanker buoys.

The cost of the Project is estimated at 23 million WS$ of which 16 million WS$ will be the foreign currency portion (excluding interest) and 7 million WS$ the local currency portion.

The Project will result in significant economic benefits. The improvement of Apia Port will reduce the staying cost of ships, the cargo handling cost and the waiting time of consignees.

The economic internal rate of return for the Project is estimated at 13.4 percent, and therefore the Project is viable from the economic point of view. But, since the financial internal rate of return for the Project is estimated at -2.7 percent, it is difficult to execute the Project using a loan.

To resolve the present port management problems it would be desirable to establish a Port Authority after a detailed study on its financial aspects, humen resources and business plan.

RECOMMENDATIONS

The following items are recommended to resolve the present bottlenecks in the port activities.

1. Urgent Implementation of the Project

The repair of the main wharf, which has become superannuated, and the expansion of yard behind the main wharf will greatly contribute to the effective usage of the existing facilities and greatly improve the cargo handling efficiency.

The construction of a breakwater will also greatly improve the calmness in the basin in the rainy season, which has been pointed out as critacal in past studies including the study "Report on Apia Harbour Study" June 1975 by A.J.Raudkivi.

The replacement of the ferry terminal will resolove the congestion of cargoes and passengers and improve the safety of the port by separating the cargo handling and the passenger flow in the port area.

The purchase of a tugboat and the lighting of the buoys will also improve the safety of the port, facilitating safe maneuvering and mooring in the limeted water area.

2. Establishment of a Port Authority

We propose the establishment of a Port Authority as a port management body, which would have control of all aspects of port activities except for the cargo handling which should continue to be executed by the private sector as at present, after a detailed study on its financial aspects, human resources and business plan.

3. Stuff Training

Since human resources concerning port planning, construction, maintenance and management are not sufficiently developed in Western Samoa, it is necessary for the proposed Port Authority to make every effort to develop its own human resources for the smooth implementation of the port

activities. But for a while it may be necessary to retain foreign experts to serve advisers to the Port Authority.

4. Improvement of the Road Network in the Hinterland

Although the development of roads is outside the scope of the port development plan, roads are closely related with port activities. The present roads between the port and downtown Apia, and between the port and Vaitele are not sufficient for the passage of heavy vehicles.

It will be necessary to upgrade the pavement on these roads to accomodate heavy traffic. Traffic control should also be improved.

INTRODUCTION

INTRODUCTION

1. Objectives of the Study

The objectives of the study are to formulate a Master Plan for the development of the ports in Western Samoa for the period up to the year 2005 and to prepare a First Stage Plan within the framework of the Master Plan.

2. Backgroung

The Government of Western Samoa requested the Government of Japan to carry out a study on the development of the ports in Western Samoa.

In response to the request, the Government of Japan dispatched the Japanese Preliminary Study Team headed by Mr. Mineo Tokuda to Western Samoa in June 1986. The team held a series of discussions about the study with the Government of Western Samoa. The Scope of Work for the study was agreed upon on 5 August 1986 by Mr. Mineo Tokuda, leader of the Japanese Preliminary Study Team, and Hon. Toeolesulusulu Siueva Toalepaialii, the Minister of Transport of Western Samoa.

Based on the Scope of Work, JICA organized a study team headed by Mr. Katsuhiro Suzunai, Adviser, OCDI. The study team then executed the study, including two field surveys, from January to September of 1987.

3. Contents of the Study

The contents of the Study are as follows.

1) Analysis of the present situation

2) Formulating a Master Plan
(the target year is 2005)

3) Preparing a First Stage Plan

4) Economic and financial analysis

5) Investigation of the port management

4. Study Schedule

The study was conducted as follows.

1) Preparation in Japan : January, 1987

2) First Field Survey : January - March, 1987

① Presentation of the Inception Report
② Field Survey
③ Submission of the Progress Report

3) First Analysis in Japan : April - June, 1987

4) Second Field Survey : June - July, 1987
Submission of the Draft Final Report

5) Second Analysis in Japan : August - September, 1987
Preparation of the Final Report

5. Organization of the Study Team

The Japanese study team was comprised of six specialists from OCDI and Nippon Tetrapod, and a JICA representative. Their names, duties and present positions are as follows.

		Name	Present Position
1)	Project Manager, Port Management & Administration	Katsuhiro Suzunai	Adviser, OCDI
2)	Port Planning and Cargo Forecast	Yutaka Sunohara	OCDI
3)	Economic Appraisal and Financial Analysis	Tomoo Amano	OCDI

4)	Structures Planning	Tetsuji Hashimoto	OCDI
5)	Design of Structures, Construction Planning & Cost Estimation	Koichi Igari	Tetrapod
6)	Natural Conditions	Shigeki Ishikawa	Tetrapod
7)	Coordinator	Masaru Suzuki	JICA

6. List of Counterparts

The counterpart personnel from the Government of Western Samoa are listed below.

1)	Hon. Toeolesulusulu Siueva Toalepaialii	Minister of Transport
2)	Mr. Nofo Vaaelua	Acting Secretary Ministry of Transport
3)	Mr. Feturi Elisaia	Deputy Secretary Ministry of Foreign Affairs
4)	Mr. Epa Tuioti	Deputy Financial Secretary Treasury Department
5)	Ms. Lusia Sefo	Senior Planning Officer Department of Economic Development
6)	Mr. Noel Hawkins	Chief Civil Engineer Public Works Department
7)	Mr. Ray Bancroft	General Manager Western Samoa Shipping Corporation

CHAPTER 1
EVALUATION OF THE PRESENT SITUATION

Chapter 1 Evaluation of the Present Situation

1-1 Socio-economic Situation

1) Outline of Western Samoa

1. Western Samoa is situated between south latitude 13° and 15° and west longitude 171° and 173°, just east of the International Dateline. The country is located about 8,000 km from Japan and 3,000 km from New Zealand.

2. The land area of 2,800 square kilometers comprises two large islands, Savaii with 1,700 square killometers and Upolu with 1,100 square kilometers and several smaller islands. The islands are volcanic, and most of the coastal areas are covered with coral reefs. The city of Apia, the capital of Western Samoa, is located on the more developed island of Upolu.

3. The country has been independent since 1962 following 48 years of New Zealand administration and trusteeship and before that, 15 years of German colonisation. Since 1977 Western Samoa has held a seat in the United Nations.

4. The culture is basically Polynesian, but distinctively Samoan. Traditional authority is vested in the matai of the country. Each extended family, or aiga, has at least one matai as its head, who is appointed by consensus of all the aiga. Ownership of land is legally vested in the matai who directs the economic, social and political affairs of the aiga. There are 362 villages with an average population of 200 - 500 people and a total of 12,600 matai. Each village is governed by its fono, or council of matai, which can fine or otherwise punish offenders of village rules.

5. Each village also has women's committees which assume responsibilities for health matters, handicrafts and some agricultural projects such as poultry development.

6. Missionaries first came in 1830 and Christianity in one form or another is now almost universal. Every village has at least one church and pastor. Pastors command great influence and respect in the villages.

7. The climate of the country is tropical and oceanic and consists of rainy and dry seasons. The dry season is from May to August and the rainy season is from December to March. The south and southeast area of the country receives from 5,000mm to 7,000mm of rain annually. The leeward side of the country receives from 2,500mm to 3,000mm of rain. The average rainfall at Apia is 3,000mm a year. The monthly average temprature at Apia ranges from 25°C to 28°C. The monthly average maximum ranges from 29°C to 31°C and the monthly average minimum from 23°C to 24°C. East and southeast winds dominate throughout the year. However, the direction of heavy storm winds, more than 20m/sec, is mainly northwest.

8. Waves

Western Samoa has no data station equipped with a wave recording gauge. Apia Port is well protected during the season of southeast trade winds, May - October. Between the months of December to March, northerly winds, waves and swells enter the harbour through a wide entrance. Regarding resonance, it is reported that throughout the season of northeast waves from December to March resonance occurs more or less regularly due to the propagated long wave component of the waves from the outer sea.

9. Tide

Tidal data are recorded at the tide station located at the inner part of Apia Port. The mean high water interval at Apia Port is 6 hrs 27 min.

The tide table of Apia Port is as follows:

Highest Astronomical Tide	(HAT)	+ 1.2m
Mean High Water Spring	(MHWS)	+ 1.8m
Mean High Water Neap	(MHWN)	+ 0.8m
Mean Sea Level	(MSL)	+ 0.5m
Mean Low Water Neap	(MLWN)	+ 0.2m
Mean Low Water Spring	(MLWS)	± 0.0m
Lowest Astronomical Tide	(LAT)	- 0.2m

10. Earthquakes

Western Samoa lies at the vertex of two vigorous systems of seismic activities, one extending southwestward through Tonga Island to New Zealand, the other in a more westerly direction through Fiji to the New

Hebrides. The two systems form a great seismotectonic salient, marking the contact of the Indian and Pacific structural plates.

2) Society

(1) Population

11. According to the 1986 census the population of Western Samoa is 158,940 of which about 72% live on Upolu island. The record of the population in 1966, 1971, 1976, 1981 and 1986 is shown in Table 1.1.1.

12. The population growth rate between 1976 and 1986 is about 0.45% per year. This small increase in the population is attributable to the high rate of emigration to New Zealand, North America and Australia. During the period 1974 - 83, the net outward migration averaged 2,676 persons per year.*

13. There are three high density population areas which are Apia, the northwest coastal area on Upolu and the southeast coastal area on Savaii. The highest population density is in Apia. The population of Apia in 1981 is about 33,000.*

14. In 1981, about 45% of the national population are fourteen years of age or under. The economically active population is about 41,500* in 1981 (Table 1.1.2). The population distribution by age group is shown in Table 1.1.3.

* Source: Western Samoa Socio-economic Situation Development Strategy and Assistance Needs, November 1985.

Table 1.1.1 Record of the Population, Western Samoa 1971, 1976 1981 and 1986

Year	Total Population	Upolu	Savaii
1966	131,377	-	-
1971	146,627	106,046	40,581
1976	151,983	109,765	42,218
1981	156,349	113,119	43,510
1986	158,940	114,815	44,125

Source: Report of the Census of Population and Housing 1981 and Data of the Department of Statistics.

Table 1.1.2 Economically Active Population by Industrial Activity (1971 - 1981)

	1971	1976	1981
Agriculture, forestry and fisheries	25,403	23,373	25,050
Manufacturing	819	712	757
Electricity, gas and water	252	468	447
Construction	1,617	1,813	2,279
Wholesale retail trade, restaurants and hotels	2,418	2,407	1,821
Transport and communication	1,248	2,058	1,353
Finance and insurance	223	322	1,305
Community and other services	5,756	6,893	8,216
Others	4	203	278
Total	37,340	38,249	41,506

Source: Western Samoa Socio-economic Situation Development Strategy and Assistance Needs, November 1985.

Table 1.1.3 Population Distribution by Age Group (1961 - 1981)

Age	1961	1966	1971	1976	1981
0 - 14	57,452	67,440	73,840	73,246	69,635
15 - 64	53,853	60,312	68,749	74,240	81,951
65 +	3,115	3,625	4,038	4,497	4,763
Total	114,427	131,377	146,627	151,983	156,349

Source: Western Samoa Socio-economic Situation Development Strategy and Assistance Needs, November 1985.

(2) Land

15. According to the Report of Investment in Western Samoa, the total land area of Western Samoa is 706,560 acres.

Samoan lands are divided as follows:

Customary Land	565,760 acres	(81%)
Government Land	80,640 acres	(11%)
WSTEC *	32,640 acres	(4.5%)
Freehold including Missions	27,520 acres	(3.5%)
Total	706,560 acres	(100%)

*WESTEC: Western Samoa Trust Estates Corporation

16. About 81% of the total land is customary land which is administered in accordance with the traditional practices of the Samoan people. Under these practices, no individual owns any specific part of the land with control being vested in the aiga or more precisely, the matai who administers the land for the benefit of the group.

17. About 70% or 500,000 acres of the total land are estimated to be suitable for agriculture and cattle grazing, but at present about 150,000 acres of land are used for agriculture, either permanent crops, short-term crops or cattle grazing.

Table 1.1.4 Land Used for Agricultural Production

(Unit: acres)

	Village	WSTEC	Total
Coconut	113,014	10,097	123,111
Cocoa	9,783	2,526	12,264
Banana	8,594	210	8,804
Taro	3,067	472	3,539
Total	134,413	13,305	147,718

Source: Investment in Western Samoa

(3) The Government

18. The congress of Western Samoa is unicameral. The congress is composed of 45 Samoan members and two members which are elected from the Samoan European community. The Samoan members are elected from local constituencies by a franchise limited to matai.

19. The present head of state will continue in office for life. After that, the head of state will be elected from the members of the congress for a five-year term.

20. The executive branch consists of the Prime Minister and eight other Ministers. The Prime Minister is elected by a majority of the members of the congress. Other Ministers are appointed by the Prime Minister.

3) Economic Activitiy

(1) Gross Domestic Product (GDP)

21. The GDP in 1985 is 98.6 million WS$ in 1980 prices. The annual growth rate of real GDP from 1981 to 1985 is about 1.6% per year. Per capita GDP in 1980 prices from 1981 to 1985 grew about 1.2% per year.

22. According to the report of Western Samoa's Fifth Development Plan 1985 - 1987, most sectors of the economy have declined, including agriculture, forestry, construction, trade, hotel, public administration and community services. Subsistence income remained unchanged but the manufacturing and electricity sectors expanded. GDP at producer prices by industrial origin is shown in Table 1.1.6.

Table 1.1.5 Real Gross Domestic Product and Per Capita GDP from 1981 to 1985

	1981	1982	1983	1984	1985
Real GDP (1980 prices, million WS$)	92.7	93.2	95.2	97.1	98.6
GDP (market prices, million WS$)	130.4	154.4	183.5	n/a	n/a
Population ('000)	156.3	156.8	157.3	157.8	158.4
Per Capita GDP (1980 prices)	593WS$	594WS$	605WS$	615WS$	622WS$

Source: Western Samoa Socio-economic Situation Development Strategy and Assistance Needs; Data from Treasury Department

Table 1.1.6 Gross Domestic Product at Producer Prices by Industrial Origin 1979 - 1983 (in constant 1980 prices)

	1979	1980	1981	1982	1983
Subsistence sector	27,629	27,625	27,671	27,870	27,823
Agriculture	13,642	10,393	8,826	11,032	10,761
Forestry	1,972	1,981	1,633	1,338	1,197
Fishery	1,305	1,140	1,200	1,252	1,355
Manufacturing	3,655	4,874	5,226	5,414	6,373
Electricity	1,675	1,788	2,028	2,591	3,290
Construction	4,485	4,260	3,571	3,644	3,500
Trade, hotels etc.	6,483	6,072	5,594	5,262	
Transport and storage	3,090	3,100	3,044	2,819	
Finance, insurance, real estate	4,327	3,675	3,698	3,371	
Public administration	20,360	18,160	16,452	14,545	31,106
Community Service,etc.	4,381	4,686	3,956	2,720	
International organizations	1,560	1,568	1,349	1,027	
Gross Domestic Product at producer prices	94,564	89,322	84,248	82,885	85,405

Source: Western Samoa's Fifth Development Plan 1985 - 1987

(2) International Trade

23. In the international trade of Western Samoa, the import value usually exceeds the export value. In 1985, the international trade of Western Samoa totaled about 150 million WS$ of which about 75% was the import value. Samoa's principal export markets in recent years are the United States, West Germany, Australia, New Zealand and Japan. Import sources are more diversified with leading suppliers being Australia, New Zealand, the United States, Japan and Singapore. Exports are mainly agricultural or agriculture-based processed products with coconut products playing a predominant role. In 1985, coconut oil, copra meal and copra exports comprised about 53 percent of total export earnings. Cocoa and taro provided about 7 percent and 16 percent, respectively. Private remittances play an important role in offsetting the trade deficit. Table 1.1.7 shows the export value from 1981 to 1985 by commodity.

24. According to Western Samoa's Fifth Development Plan, imports are heavily dominated by transport equipment, industrial supplies, fuels and lubricants. Together with other capital and intermediate goods, these components account for nearly two-thirds of total imports, with the remainder comprising consumption goods and a small group of miscellaneous items. Among the main consumption goods are canned meat and fish, sugar, flour, rice, frozen chicken and dairy products.

25. Since the WS$ is linked to a basket of the currencies of the country's five major trading partners which are the U.S.A., Germany, Japan, New Zealand and Australia, developments in exchange markets abroad are reflected in the movements of the WS$ against other currencies.

Table 1.1.7 Export Value by Commodity

(Unit: thousand WS$)

	1981	1982	1983	1984	1985
Coconut oil	-	4,121	11,084	20,725	15,622
Cocoa	1,436	986	4,617	2,258	2,356
Copra meal	-	382	672	592	560
Copra	3,924	2,760	1,398	-	954
Taro	2,136	2,179	2,371	2,753	5,113
Timber	289	1,271	541	1,258	817
Veneer	-	315	471	325	169
Others	2,513	3,066	4,329	4,827	6,821
Total	10,298	15,080	25,483	32,738	32,412

Source: The 1987 Budget Statement

Note) Not including re-exports

Table 1.1.8 Imports by Broad Economic Categories 1978 to 1982

(Unit: thousand WS$)

	1978	1979	1980	1981	1982
Capital goods	8,720	18,971	10,305	19,918	7,097
Capital goods (excluding transport equipment)	5,914	5,037	8,362	6,922	5,166
Transport equipment, industrial	2,806	13,934	1,943	12,996	1,931
Intermediate goods	16,686	25,475	28,009	29,488	32,603
Food and beverages, primary mainly for industry	457	643	64	566	175
Food and beverages, processed mainly for industry	1,940	3,163	3,931	3,526	4,107
Industrial supplies n.e.c.	9,767	13,042	15,903	13,767	18,024
Fuels and lubricants, primary	-	3	135	-	4
Fuels and lubricants, processed (other than motor spirit)	2,980	5,622	6,262	8,303	6,477
Parts and accessories of capital goods (except transport equipment)	633	1,301	696	1,408	1,494
Parts and accessories of transport equipment	909	1,701	1,081	1,918	2,322
Consumption goods	12,787	16,057	18,673	19,958	20,069
Food and beverages, mainly for household consumption	580	259	482	533	1,133
Food and beverages, processed, mainly for household consumption	6,439	8,571	7,849	8,500	9,345
Transport Equipment nonindustrial	34	424	154	97	93
Consumer goods n.e.c.	5,491	6,803	6,990	6,717	6,922
Motor Spirit	243	-	3,198	4,111	2,576
Goods n.e.c.	374	443	238	281	379
Goods n.e.c.	81	226	12	54	100
Passenger motor cars	293	217	226	227	279
Total Imports	38,567	60,946	57,225	69,645	60,148

Source: Western Samoa's Fifth Development Plan

(3) Consumption

26. According to the report of Western Samoa Socio-economic Situation Development Strategy and Assistance Needs, Western Samoa has been plagued in recent years by rising price levels. The inflationary pressure has been felt particularly since 1979, when among other things, devaluation of the WS$ contributed to a rise in the Consumer Price Index (CPI) in which two-thirds of the items included are imported goods. From 1980 to 1985, the CPI increased by about a hundred per cent. The CPI from 1981 to 1985 is shown in Table 1.1.9. The government of Western Samoa has been executing price control. The list of commodities subject to price control is shown in Table 1.1.10.

27. The consumption of this country is dominated by private consumption. However, the ratio of government consumption is higher than in other countries in the region. Private consumption in 1984 occupied about 84% of the total consumption. Table 1.1.11 shows the ratio of private consumption in total consumption from 1980 to 1984.

28. In 1985, there were 45,000 vehicles in Western Samoa. The rate of increase of the number of vehicles from 1980 to 1985 is about 2.1% per year. Trucks show the highest rate of increase, about 7.5% per year from 1980 to 1985. The largest category of vehicles in 1985 is pick-ups, with about 1,970 vehicles. Table 1.1.12 shows the number of motor vehicles registered from 1980 to 1985.

29. Aside from wood, the necessary natural resources are virtually all imported from foreign countries. Especially the import of energy resources has been dominating the national economy. In 1981, the import bill for mineral fuel comprised 21.8 per cent of the value of the total imports, exceeding the earnings from merchandise exports. According to the report of Western Samoa's Fifth Development Plan, the main emphasis in the energy sector has been on the development of an ambitious hydro-power programme to reduce the country's dependency on imported fuel. Table 1.1.13 shows the energy production in Western Samoa.

Table 1.1.9 Consumer Price Index

1980 = 100

Year	1981	1982	1983	1984	1985
CPI	120.5	142.6	166.4	185.7	202.6

Table 1.1.10 List of Commodities Subject to Price Control

1. ALL CANNNED FISH
   All brands of Mackerel
   Sardines
   Pilchards

2. ALL CANNED MEAT
   All brands of Corned Meat
   Corned Beef
   Camp Pie
   Pork Luncheon Meat

3. FROZEN GOODS
   Mutton Flaps/Breast
   Lamb Flaps
   Lamb Shanks
   Lamb Neck Slices
   Lamb Carcass
   Lamb Chops
   Lamb Fores
   Lamb Legs

   Turkey Tails
   Turkey Wings

   Whole Fryers
   Chicken Backs
   Chicken Legs
   Chicken Wings
   Chicken Parts
   Chicken Drumsticks

   Beef Briskets
   Beef Neck Bones

   Pig Tails
   Pig Trotters

   Anchor Butter (NZ)
   Deveondale Butter (Aust.)
   Margarine

4. ALL MILK PRODUCTS
   Long Life
   Zaps (all flavour)
   Milk Powder
   Skim Milk Powder
   Glaxo Milk
   Highlander Milk
   Other Brands

5. FOOD ITEMS
   Potatoes
   Onions
   Garlic
   Carrots
   Brown Sugar
   White Sugar
   Flour
   Salt
   Curry Powder
   Rice
   Fat Dripping
   Bulk Dripping
   Tea
   Coffee
   Cocoa
   Milo
   Soy Sauce
   Cooking Oil
   Vermicelli
   Seimen (all brands)
   Noodles
   Cabin Biscuits
   Fruit Juices

6. MISCELLANEOUS
   Motor Vehicles
   All Cigarettes
   Tobacco
   Cigarette Papers
   Safety Matches
   Laundry Soap
   Toilet Soap
   Mosquito Coils
   Toothpaste
   Toothbrushes
   Toilet Paper
   Flashlight Batteries

7. HARDWARE GOODS
   Cement
   Hardboards
   Plywood

Source: Replies to IMP Mission Questionaire, November 24, 1986

Table 1.1.11 Ratio of Private Consumption in Total Consumption

Unit: %

Year	1980	1981	1982	1983	1984
Ratio	83.1	81.7	82.6	86.2	83.7

Table 1.1.12 Number of Motor Vehicles Registered

Year	Private Cars	Pick-ups	Trucks	Buses	Taxis	Motor-cycles	Tractors	All Other Vehicles *2	Total
1980	1,188	1,628	301	128	395	121	68	257	4,086
1981	1,242	1,889	378	139	573	133	59	58	4,471
1982	1,076	1,532	253	157	353	104	5	442	3,922
1983	1,258	1,800	358	193	264	105	15	23	4,016
1984	1,498	1,909	398	187	297	144	11	26	4,470
1985 *1	1,406	1,969	432	192	351	165	8	14	4,537

Source: The 1987 Budget Statement

*1 Provisional figures

*2 Includes landrovers, forklifts and government vehicles in 1980 and 1982

Table 1.1.13 Energy Production in Western Samoa, 1982 - 1985

(Unit: million kilowatt hours)

	1982	1983	1984	1985
Hydro	12.29	12.13	15.74	24.41
Diesel	18.43	19.86	18.07	11.50
Total	30.72	31.99	33.81	35.91

Source: The 1987 Budget Statement

4) Government Finance

30. The annual revenue of the Central Government can be divided into tax revenue (about 80% - 85% of the total revenue) and non-tax revenue. The main sources of the tax revenue are income tax and tax on international trade. Income tax comprises about 25% of the tax revenue, and trade tax comprises about 60%. Grants from foreign countries usually comprise about 30% - 40% of the total revenue. The 1.1.14 shows the annual revenue and grants of the Central Government from 1983 to 1986.

31. Regarding the annual expenditures at the Central Government, the largest item is social services usually representing about 40% of total expenditures. The next biggest item is general services, comprising about 30%. The third main item is economic services. For example, in 1986, the expenditures on general services, social services and economic services were about 10,825 thousand WS$, 16,734 thousand WS$ and 8,351 thousand WS$, respectively, representing about 27%, 42% and 21% of the total expenditures in that year. Table 1.1.15 shows the Government expenditures from 1983 to 1986.

Table 1.1.14 Revenue and Grants of the Central Government (1983 - 1987)

(Unit: thousand WS$)

	1983	1984	1985	1986
Tax Revenue	33,786	46,829	52,100	57,790
Taxes on Income	10,954	11,350	12,500	13,720
Excise Taxes	3,896	6,600	7,800	9,000
Taxes on International Trade	18,272	28,171	30,780	34,500
of which:				
Import Duties	(13,777)	(26,941)	(28,200)	(30,050)
Primage Duty	(3,410)	-	-	-
Export Surcharge	(257)	(175)	(1,380)	(1,050)
Foreign Exchange Levy	(828)	(1,055)	(1,200)	(1,400)
Other Taxes	664	708	1,020	570
Business Licenses	(51)	(55)	(60)	(65)
Airport Departure Tax	(549)	(575)	(600)	-
Other	(64)	(78)	(360)	(505)
Non Tax Revenue	7,341	6,533	11,812	11,775
Fees, Service Charges, etc.	2,222	2,857	3,680	5,743
Operating Surplus of Departmental Enterprises	3,176	1,437	5,232	3,529
Rent, Royalties, Interest	1,428	1,784	2,680	1,079
Sale of Government Surplus	138	98	100	156
Sale of Government Shares	-	160	-	340
Other	377	197	120	928
Total Revenue	41,127	53,362	63,912	69,565
Total Grants	23,800	19,250	16,991	27,100
Cash and Commodity Grants	2,000	-	-	4,100
Project Aid Grants	21,800	19,250	16,991	23,000
Total Revenue and Grants	64,927	72,612	80,903	96,665

Source: The 1987 Budget Statement

Table 1.1.15 Expenditures of the Central Government, 1983 - 1986

(Unit: thousand WS$)

	1983	1984	1985	1986
General Services	7,310	9,590	10,174	10,825
General Administration	5,620	7,468	8,008	8,361
Justice, Police & Prisons	1,690	2,122	2,166	2,464
Social Services	11,952	12,275	13,882	16,734
Education	6,837	6,853	7,765	9,624
Health	4,811	5,091	5,798	6,758
Broadcasting	304	331	319	352
Economic Services	5,280	5,916	6,326	8,351
Agriculture	1,292	1,275	1,442	1,550
Public Works	2,203	2,354	2,516	5,083
Transportation	854	1,156	1,268	476
Labor	107	132	148	162
Land & Survey Titles	824	899	952	1,080
Public Debt Interest	4,331	3,922	3,728	4,351
External Debt	1,700	1,972	1,502	1,986
Domestic Debt	2,631	1,950	2,226	2,365
Other Expenditure	26	-	-	-
Arrears (Increase)	1,338	-	-	-
Total Current Expenditure	30,327	31,703	34,110	40,261

Source: The 1987 Budget Statement

1-2 Present Situation of Ports

1) Outline of the Ports

32. Western Samoa is a maritime country which presently depends upon trade with foreign nations for most household commodities. Thus, ports play a key role in the daily lives of the Western Samoans. The foreign trade ports are Apia and Asau, but most foreign trade cargoes are handled at Apia on Upolu Island.

33. Apia Port has a main wharf with a length of 185m and a depth of -10m, three mooring buoys for tankers, ferry facilities to Pago Pago (American Samoa) with a depth of -3.4m, four transit sheds and two coconut oil tanks (one is under construction).

34. Asau Port is located on Savaii Island and is used for export of timber and import of oil products. It has one deep sea wharf with a length of 120m and a depth of -10m, a mooring buoy for tankers and a transit shed, but as the depth and the width of its approach channel are only -6.9m and 38m respectively, the deep sea wharf is not used much at present.

35. Transportation between the two islands (Upolu and Savaii) is presently provided by domestic ferry service between the ports of Mulifanua on Upolu and Salelologa on Savaii. The ferry facilities with a depth of -3.2m were reconstructed in 1986 using Japanese aid.

36. Thus the country presently has four operating ports - Apia, Asau, Mulifanua, and Salelologa - and one more port, Aleipata, which is situated at the southeastern tip of Upolu Island and has been under construction for about ten years.

2) Present Situation of Each Port

(1) Apia Port

i) Port Area

37. The Port of Apia is located on reclaimed land on the northeast edge of a reef-protected natural harbour, as shown in Fig. 1.2.1. The Port Area is defined by the Shipping Act 1972 No. 18 to include all sea areas within a two mile radius from the main wharf and all harbour works, wharves, jetties, installations and buildings directly used in connection with the port.

ii) Existing Port Facilities

38. The port area was reclaimed in 1962. The single marginal wharf was completed in 1966. It is 184.7m long and 13.1m wide and is built using steel piles encased in concrete sleeves.

39. The approach channel and the basin in front of the wharf were dredged in 1967 to a water depth of 11.0m (36 feet), but the present depth is -10m. Behind the main wharf a small 80m ship berth is available and at the southeast corner of the port area there is a ferry berth, while there are mooring buoys for petroleum tankers on the opposite side of the main wharf in the basin.

40. The land area is 3.0 hectares and there are four main sheds with a total area of approximately 10,500 square metres. The total land area within the customs compound measures about 38,200 square metres including roads and buildings. Information on existing port facilities and equipment is presented in Table 1.2.1.

41. In 1985 rubber fenders were installed at the wharf by the Australian Government. No other rehabilitation works have been carried out at the port.

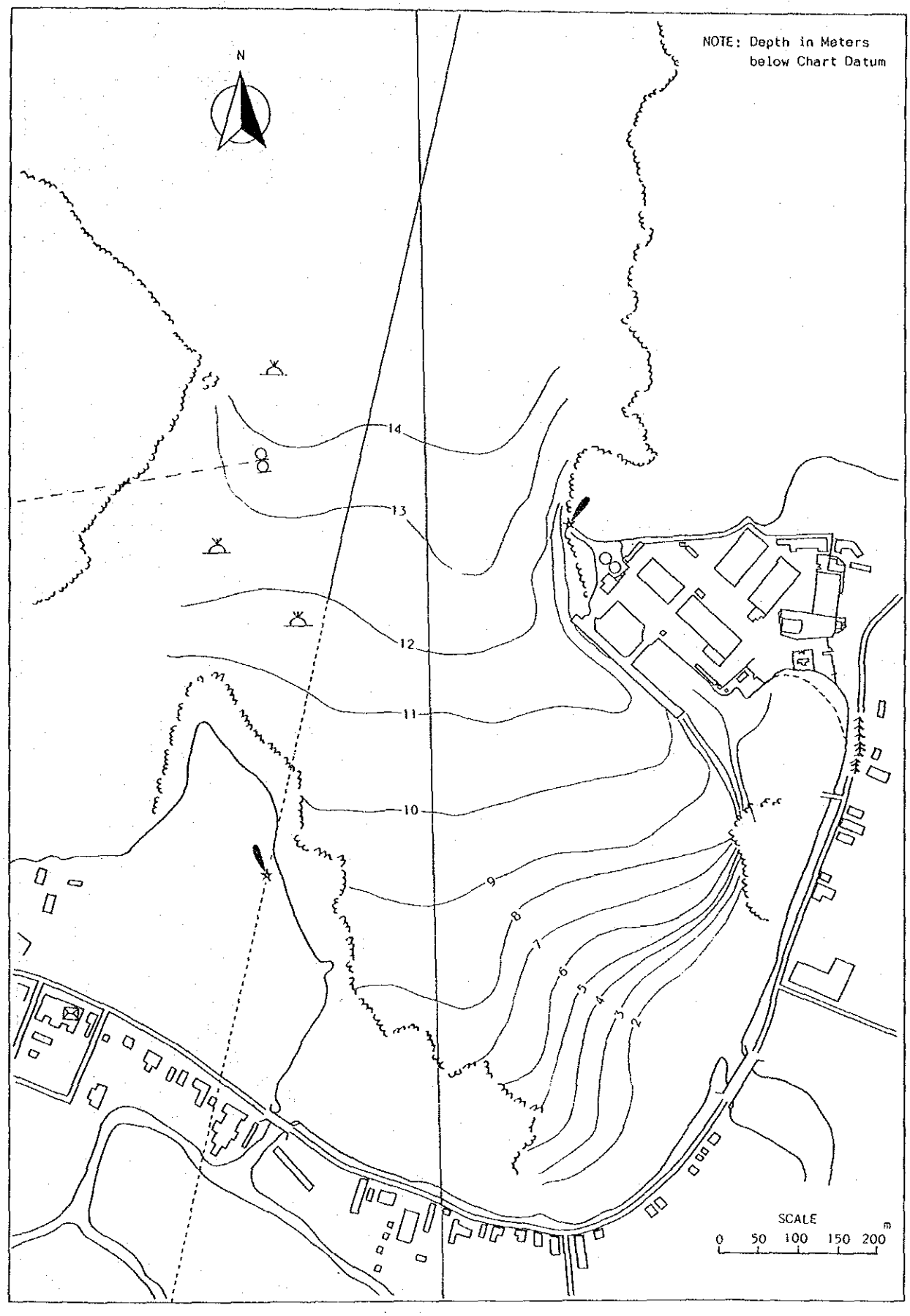


Fig. 1.2.1 Location of Apia Port

Table 1.2.1 Existing Port Facilities and Equipment (Apia)

Facilities/Equipment	Number/Capacity	Construction Year	Owner
Wharf	・main berth (length 184.7m) (width 13.1m) (depth -10.0m) ・small ship berth (length 80.0m)	1966	M.O.T.
Mooring Buoy	3 buoys	1960's	Private
Turning Basin	depth -11.0m	1967	M.O.T.
Ferry Berth	depth - 3.4m		M.O.T.
Shed No.1	3,645m^2		M.O.T.
Shed No.2	1,792m^2		M.O.T. (damaged by fire)
Shed No.3	2,541m^2		M.O.T.
Shed No.4	2,486m^2		Copra Board
Coconut tanks	1,500t x 2 (one is under construction)		Samoa Coconut Products
Storage Shed (Copra Meal)	1,500t (about 300m^2)		Samoa Coconut Products
Chemical Shed	about 100m^2		Agriculture Department
Cool Storage	about 800m^2		Produce Marketing Dept.
Leading Light			M.O.T.
Beacon			M.O.T.
Tugboats	"Pualele" 425 bhp "Savaii" 175 bhp	1972 1964	M.O.T.
Pilot-boat	120 bhp	1960's	M.O.T.

iii) Cargo handling

42. Cargo handling is being performed by private stevedoring companies. All containers and other cargoes are first lowered to the wharf using ship gear and then conveyed to the container park by forklift. Following is a list of stevedoring companies and the number and capacities of their forklifts.

Company	Forklift Capacity (tons)	Number	Year of Purchase
Pacific Forum Line	25	2	1979
	7	1	1982
	2	2	1982
Burns Philp	22	1	1980
	3	1	1984
Union Maritime	20	1	1970's
	3	2	"
Triangle Stevedoring	10	1	1970's
	1.4	1	"
	1.3	1	"
Apia Haulage	3	1	1970's

43. The number of laborers for delivery and stevedoring are as follows:

	P.F.L.	BP	Union Maritime
(Delivery)			
. Senior delivery clerks	2	1	1
. Delivery clerks	5	2	2
. Laborers	10	4	4
(Stevedoring)			
. Manager	1		
. F/lift drivers	4		
. Crane operators	1+(1-3 persons)		
. Supervisors	(1-2 ")		
. Laborers	3+(10-40 ")		

Note: Figures in parenthesis are the number of laborers when a ship is at berth.

44. The handling charges by cargo type are as follows:

. General cargo	5 WS$/ton
. Containers	40-50 WS$/TEU
. Empty containers	15-25 WS$/TEU

45. The average cargo volume handled per hour by packing type is:

. Copra mill	25 tons/hour crane
. General cargo	14-20 tons/hour crane
. Containers	
good weather	15-18 TEU/hour
bad weather	8-12 TEU/hour

iv) Connection between Port Area and Hinterland

46. Apia Port is an international port and most of the foreign trade cargoes of Western Samoa are handled at this port, so the hinterland of Apia comprises the entire nation.

47. Transportation between the port and its hinterland is provided by pick-ups, trucks, trailers, etc. We counted the number of vehicles out from the port in this study. The survey results are presented in Table 1.2.2. The total number of vehicles over 7 days is 3,121 vehicles, so the average is about 450 vehicles per day.

Table 1.2.2 Vehicles out from Apia Port

(Date: From 18 Feb to 24 Feb)

time	cars	pick-ups	trucks	trailers		others	total
				with-container	without-cont.		
7:00- 8:00	52	51	11	-	-	68	182
8:00- 9:00	55	60	20	1	1	84	221
9:00-10:00	58	70	23	6	2	76	235
10:00-11:00	90	66	22	6	2	76	262
11:00-12:00	95	75	31	10	-	84	295
12:00-13:00	79	64	28	12	-	68	251
13:00-14:00	81	78	40	11	2	78	290
14:00-15:00	98	83	32	16	2	93	324
15:00-16:00	66	80	36	9	2	98	291
16:00-17:00	73	60	20	8	-	98	259
17:00-18:00	75	70	18	8	1	77	249
18:00-19:00	68	75	13	6	1	99	262
Total	890	832	294	93	13	999	3,121

Note: Data from 9:00 - 11:00 on 24 Feb. was not collected.

48. In 1982 the Public Works Department carried out a survey on the movement of vehicles along the main beach road, and the result is as follows:

. Date: 17th (Sat.), 19th (Mon.) Apr. 1982
. Time: 6:00 - 19:00
. Station: Aggie Grey's Hotel

	17th (Sat)	19th (Mon)
Light Vehicles	3,970	5,565
Loaded Pickups	80	343
Buses	430	592
Trucks	297	416
Total	4,777	6,916

49. Vehicles moving out from the port do not seem to contribute significantly to traffic congestion in the city area.

50. At Apia Port the ferry terminal to Pago Pago (American Samoa) and the copra shed are located near the cargo handling area.
Thus, the passengers of the Pago Pago ferry and carriers of copra may interfere with the cargo handling, and this situation is not suitable for port activities.

51. We also counted the number of vehicles to the Ferry Terminal and the Copra Shed. These vehicles account for about 50 percent of the total vehicles to the port.
The results of this survey are as follows:

. Date: 5th (Thur.) March 1987
. Time: 7:00 - 17:00

Total Vehicles to the Port	459 (100%)
To the Ferry Terminal	162 (35%)
To the Copra Shed	71 (15%)

52. Copra is gathered mainly from farms in Savaii and the western part of Upolu and carried to the shed at the port area, and it is then carried out to the mill at Vaitele. Thus, it is not necessary for copra to pass through the port area.

(2) Asau Port

i) Port Area

53. The Port of Asau is located on the northwest coast of Savaii, and the Port Area is defined to include all sea areas within a two mile radius from the main wharf.

54. This port was opened by dredging a channel through the broad coral reef obstructing the extrance to the extensive deepwater lagoon, as shown in Fig. 1.2.2.

ii) Existing Port Facilities

55. The channel is approximately 850m long with a northwest - southeast orientation, and lies approximately 45° to the general east-west line of the coast in the vicinity. The design width is 68.5m with a minimum depth of approximately 9.25m below M.L.W.S. The channel was not completed as designed and the actual dimensions were checked by a survey in 1973. The channel depth is approximately 5.9m below M.L.W.S. over a least width of 54m and approximately 6.9m over a least width of 38m.

56. A 120m long, 13m wide reinforced concrete deck wharf is located at the east of the harbour. Piles appear to be concrete encased steel and the whole wharf is apparently in good condition. There is a mooring buoy for petroleum tankers at the opposite side of the basin to the wharf.

57. A summary of the existing port facilities and equipment is presented as Table 1.2.3.

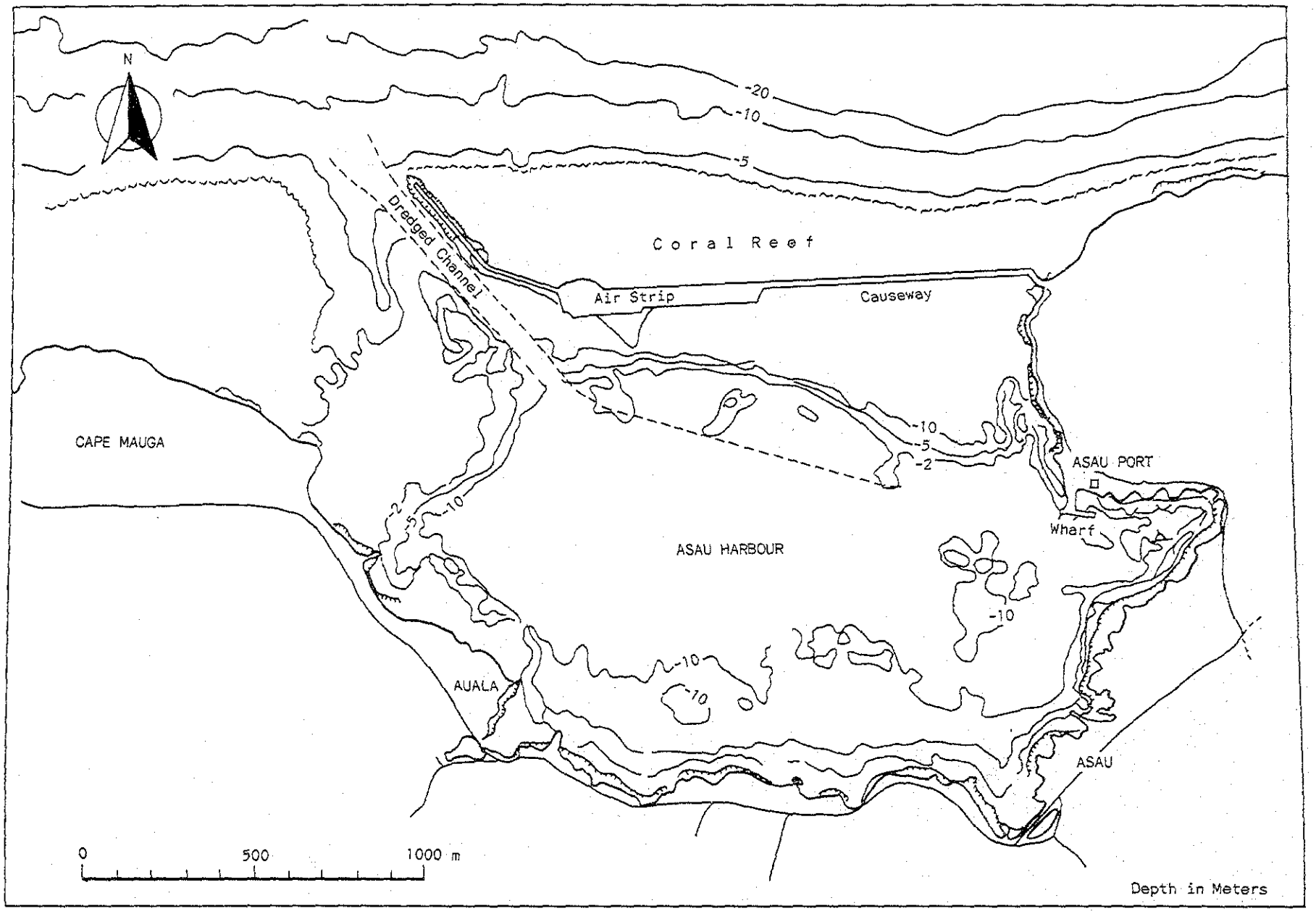


Fig. 1.2.2 Location of Asau Port

iii) Cargo Handling

58. Asau Port was constructed specifically to service the timber industry established adjacent to the harbour. It continues to serve this function, but since export timber is sold and delivered "at the mill gate," shipping arrangements including cargo handling are the responsibility of the purchaser.

Table 1.2.3 Existing Port Facilities and Equipment (Asau)

Facilities/Equipment	Number/Capacity	Construction Year	Owner
Channel	depth -6.9m *1 width 38m	1966	M.O.T.
Wharf	length 120m width 13m depth -10m		M.O.T.
Mooring Buoy	1 buoy		Private
Wharf Shed	about 500m^2		M.O.T.
Leading Marker			M.O.T.
Channel Marker			M.O.T.

*1 Channel depth is 5.9m over a least width of 54m and 6.9m over a least width of 38m

(3) Mulifanua & Salelologa Ports

i) Existing Port Facilities

59. The principal link between the islands of Upolu and Savaii is the passenger/vehicle ferry service. The crossing of approximately 11 nautical miles includes a total of about 3 nautical miles of approach channels through reefs fringing the islands and several nautical miles of open sea which is frequently rough, as shown in Figs. 1.2.3 and 1.2.4.

60. The ports were developed in 1972/73 for Roll-on/Roll-off ferry operation with new wharf construction, channel dredging and land facilities for passengers and vehicles. And in 1984/85 the main part of the ferry port facilities were upgraded with Japanese aid (Exchange of Note dated Feb. 28th 1985).

61. Information concerning the existing port facilities and equipment is presented in Figs. 1.2.5 and 1.2.6 and Table 1.2.4.

ii) Operation

62. The ferry terminal and other facilities have been modernized, but operations are not carried out systematically. The main operation problems are as follows:

① The sailing schedule is fixed but vessels do not operate on schedule.
② There is no reservation system.

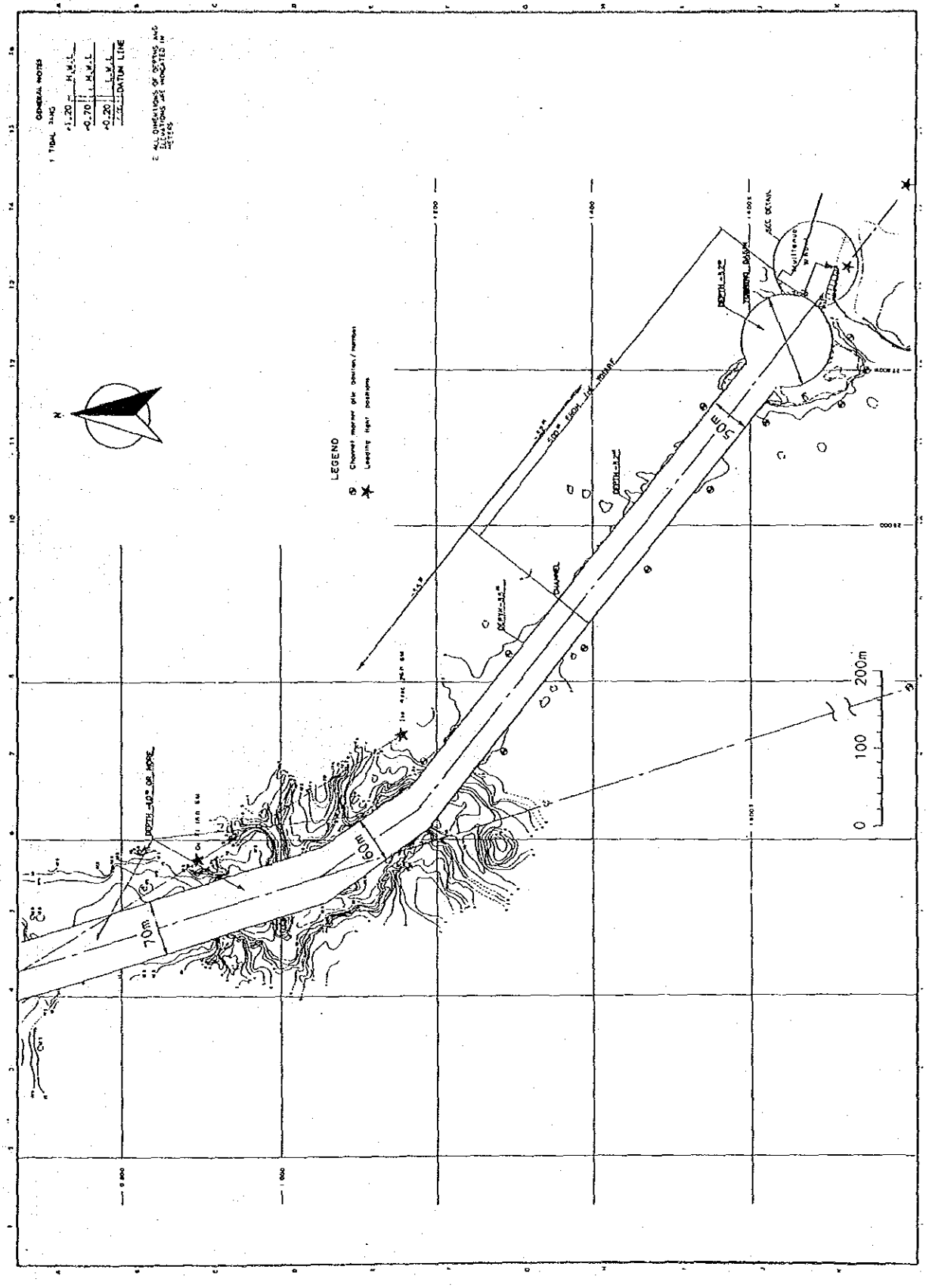


Fig. 1.2.3 Channel of Mulifanua Port

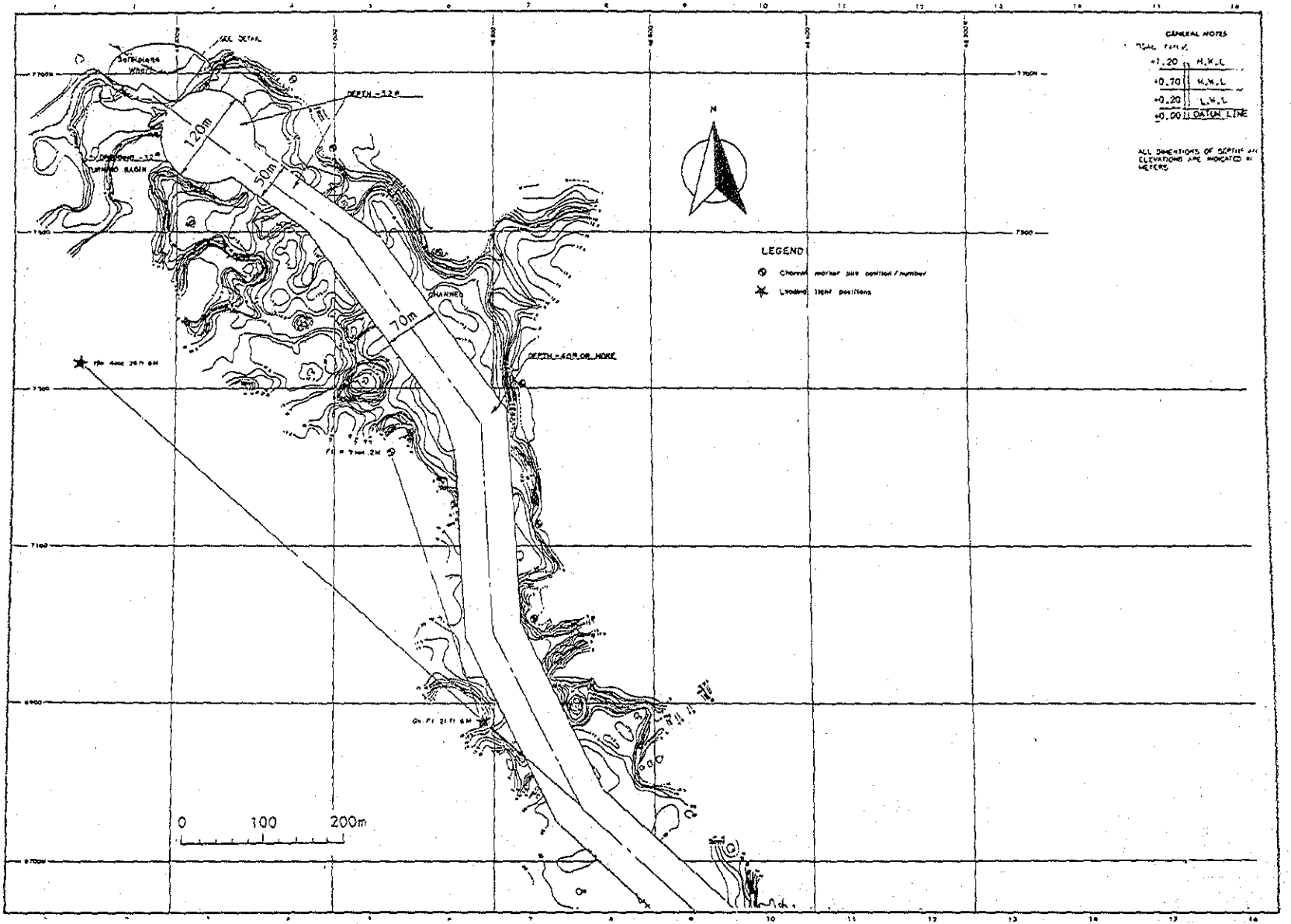


Fig. 1.2.4 Channel of Salelologa Port

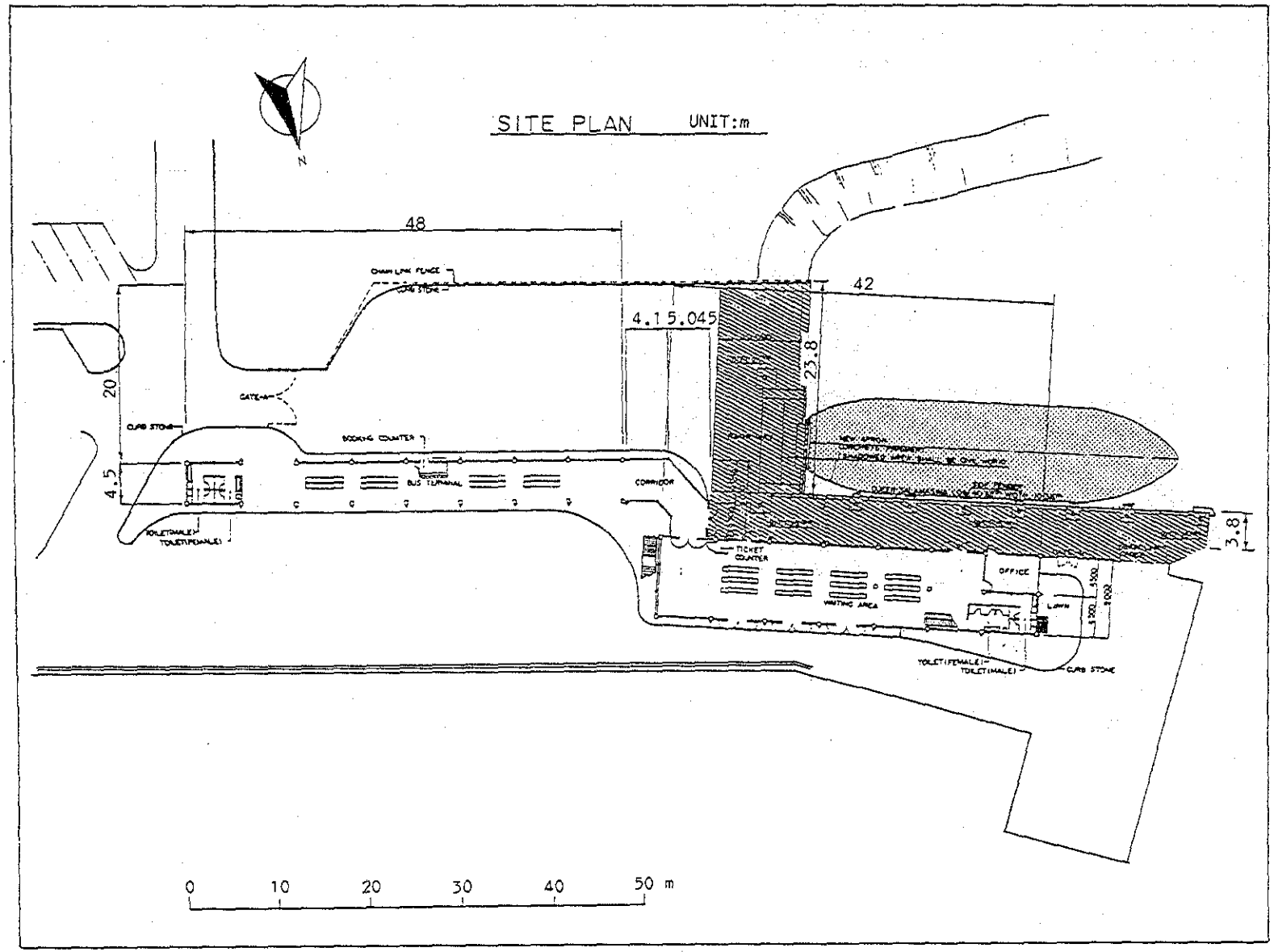


Fig. 1.2.5 Mulifanua Ferry Terminal

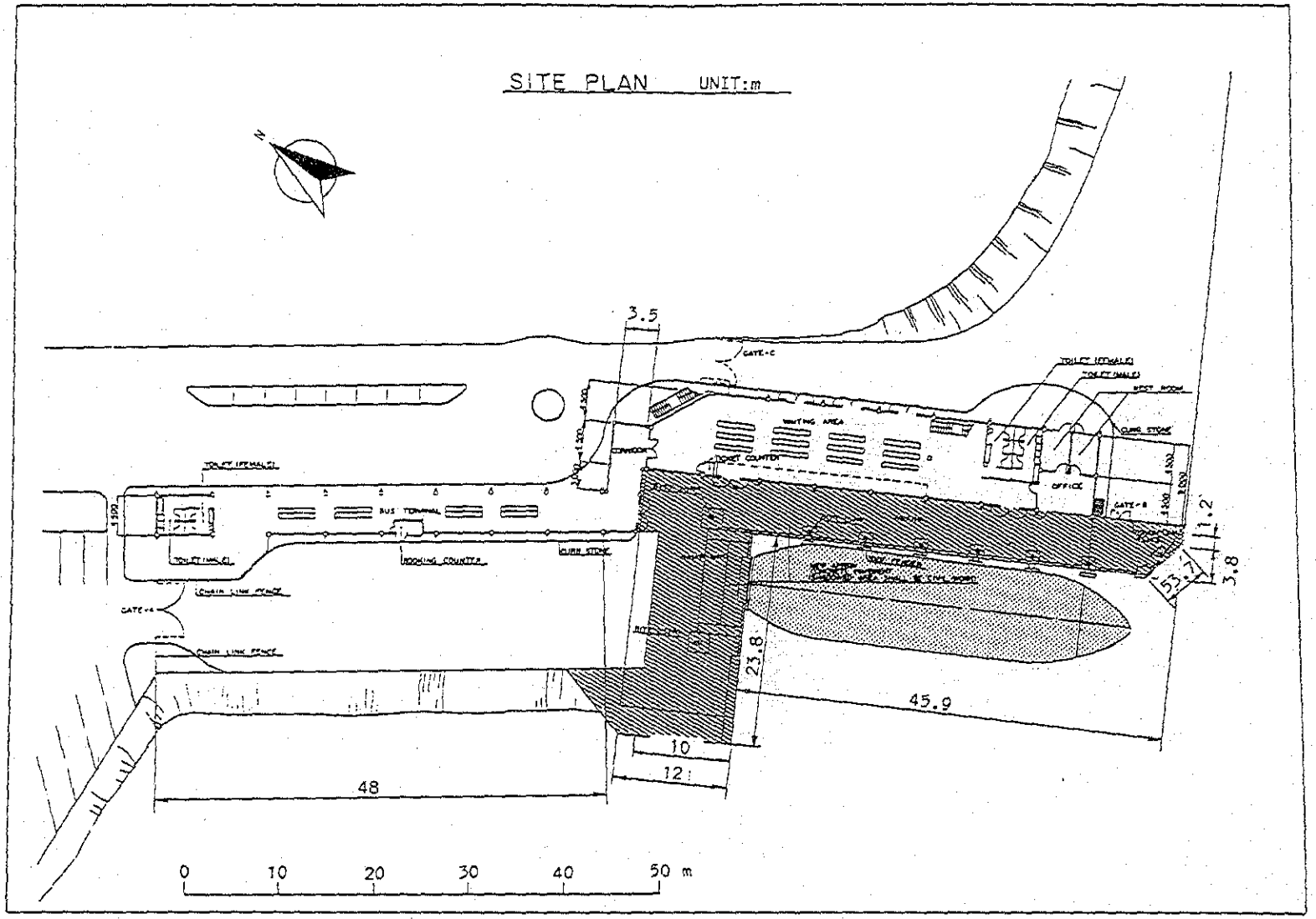


Fig. 1.2.6 Salelologa Ferry Terminal

Table 1.2.4 Existing Port Facilities and Equipment
(Mulifanuna & Salelologa)

Facilities/Equipment	Number/Capacity	Construction Year	Owner
Wharf	length 70m depth -3.2m	1985	M.O.T.
Turning Basin	depth -3.2m diameter 120m	1985	M.O.T.
Channel	depth -3.2m width 50-70m	1985	M.O.T.
Ferry Passenger Terminal	560m^2	1985	M.O.T.
Bus Terminal	240m^2	1985	M.O.T.
Leading Light			M.O.T.
Channel Marker			M.O.T.

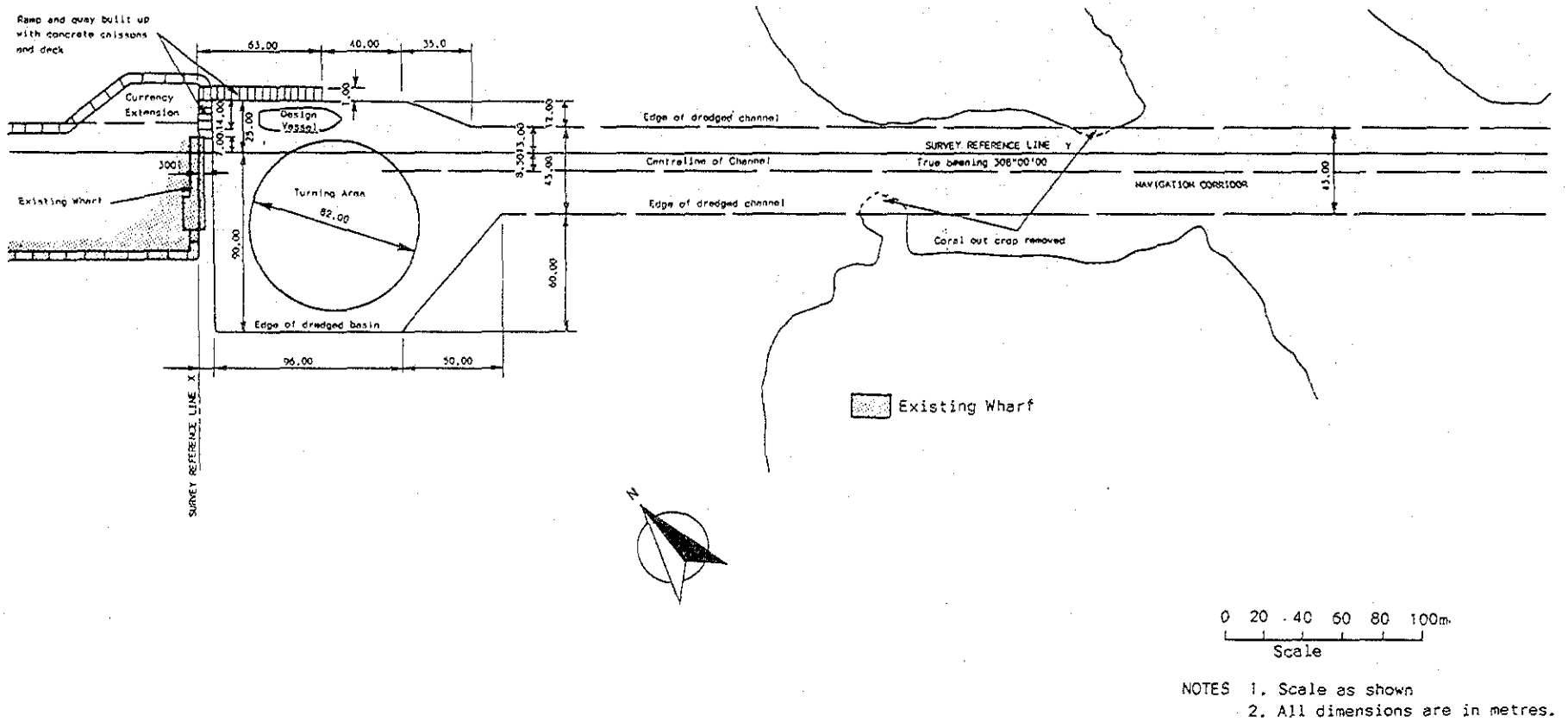
(4) Aleipata Port

63. Construction of Aleipata Port was started for the purpose of connecting the southeast part of Upolu Island with Pago Pago (American Samoa) by a passenger/vehicle ferry and generating trade from this area. But the port has remained under construction for about ten years.

64. The existing wharf as shown in Fig. 1.2.7 has a reinforced concrete deck on steel caisson piles at the wharf face. It is approximately 46m long by 8m wide and has a causeway approach approximately 340m long.

65. There is a minimum depth of approximately 1.3m below low water alongside and the turning basin and the approach channel has localized minimum depths of 0.7m.

66. Road development in eastern Upolu has already connected the hinterland district with Aleipata site, but the greater part of the road between Aleipata and Apia has not been paved. So it takes nearly 2 hours from Aleipata to Apia. Further, the road includes wooden bridges which cannot be crossed by heavy vehicles.



NOTES 1. Scale as shown
2. All dimensions are in metres.

Fig. 1.2.7 Layout Plan of Aleipata Port

3) Natural Conditions

(1) Apia Harbour

i) Background of the Study and Study Items

67. Field surveys were carried out to obtain data for analysis of wave and siltation and to determine the subsoil conditions for the basic design of port facilities. The study items, methods and purposes are as follows.

Item	Purpose	Method/Equipment
Wave Investigation	Wave Conditions	Ultrasonic Wave Recorder
Sounding Survey	Siltation Conditions	Ultrasonic Echo Sounder
Current Observation	Siltation Conditions	Float
Bed Material Sampling	Siltation Conditions	Sampler, Soil Tests
Soil Investigation	Design Conditions	Boring, Soil Tests

A full analysis has been carried out based on the collected data.
In this Main Report only a summary is presented, and the details of the analysis are described in the Technical Report.

ii) Waves

(a) Objectives and Results of the Analysis

68. The objectives of the wave analysis at Apia Harbour are divided broadly into two items as follows:

① Analysis of the resonance phenomenon in the harbour
② Improvement of the calmness in the harbour

The schematic flows of the analysis are shown in Fig. 1.2.8 and Fig. 1.2.9. The main flows are represented by bold lines.

69. All the results of the resonance analysis showed the same results. The results are summarized as follows.

① The dominant wave period of component waves is about 10 sec. at the mouth of the harbour and at the inner port of the harbour.

② A resonance phenomenon of long period components can occur in the harbour.

③ The dominant periods of resonance are 60 sec. in the east-west direction and 600 sec. in the south-north direction.

④ The magnitude of the amplification of these long period components in the harbour is 1.5 to 3 times that offshore.

⑤ The energy density of the amplified components in the harbour is rather small, about 1 percent of that of the dominant wave component offshore.

70. The analysis of the calmness in the harbour was carried out by analysis of occurrence probability of waves in the harbour based on the wave deformation calculation of ordinary waves.

71. The required calmness in the harbour will be obtained by construction of a 100m long breakwater at the northern port of the existing wharf.

72. The structural design of the breakwater is carried out in Chapter 4 based on the design wave at the location of the breakwater calculated by the anomalous wave analysis.

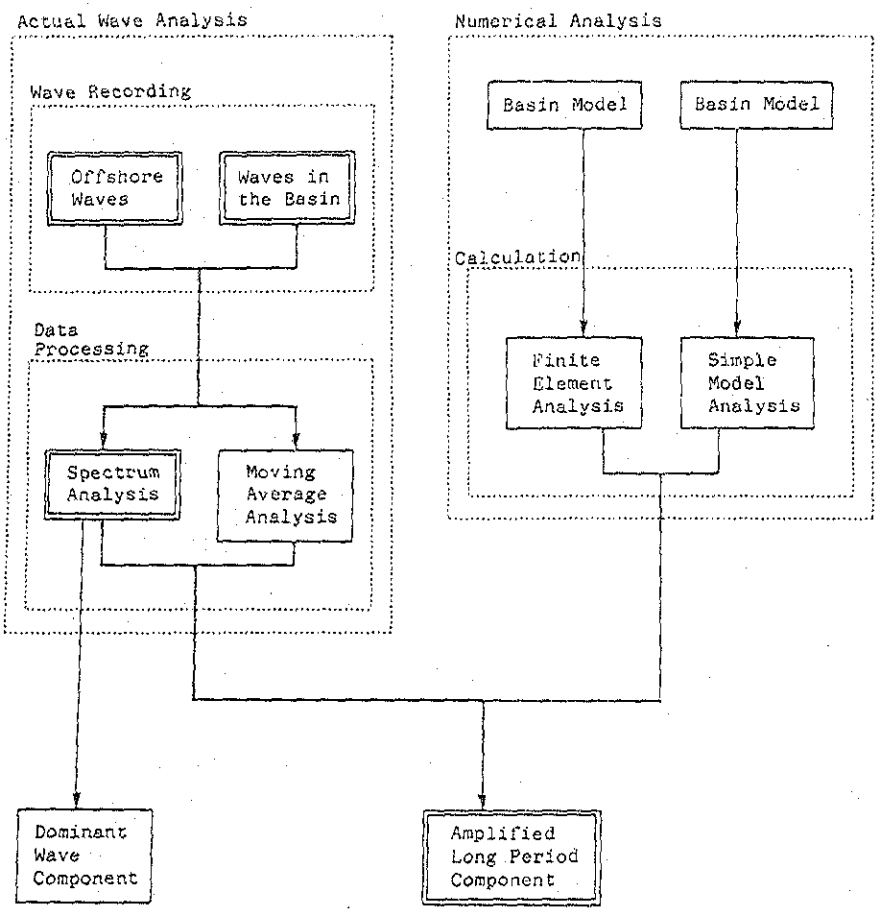


Fig. 1.2.8 Flow Chart of the Resonance Analysis

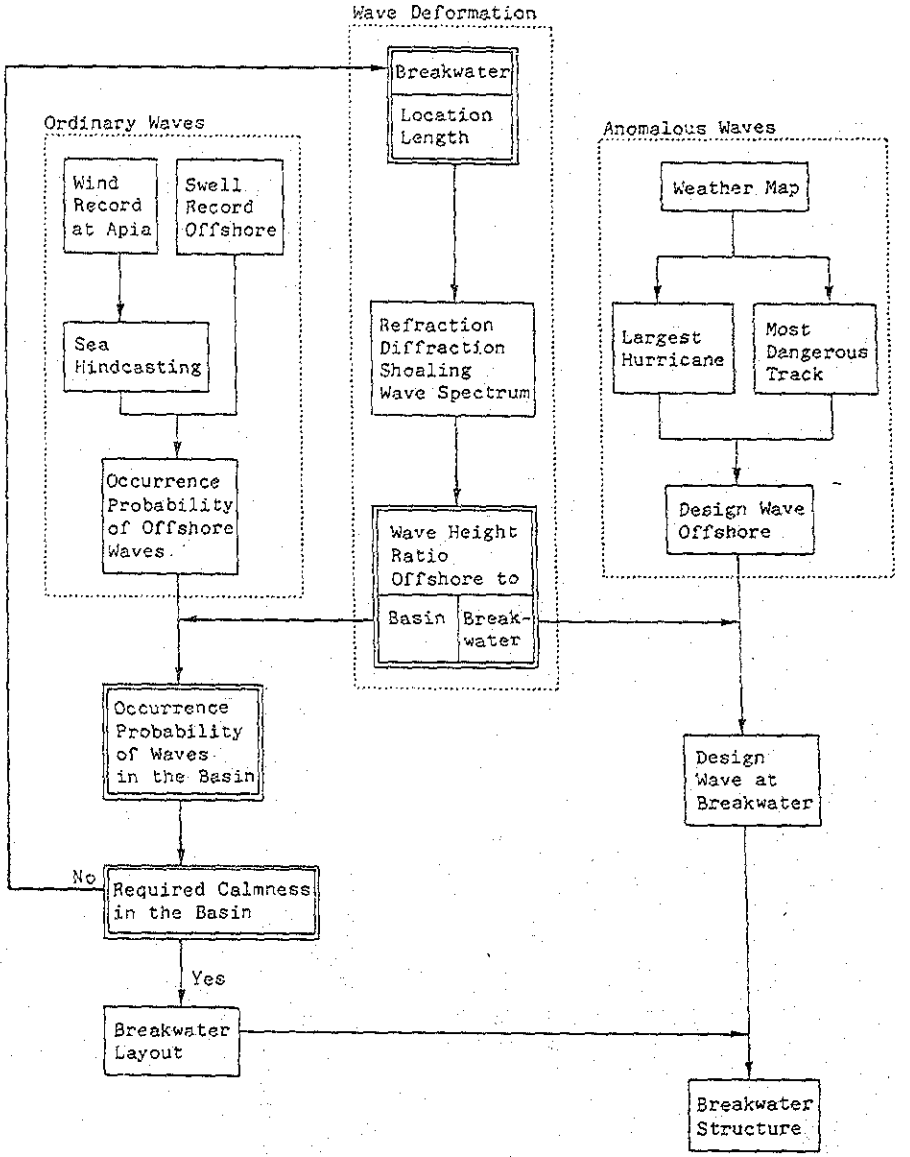


Fig. 1.2.9 Flow Chart of Improvement of the Clamness in the Harbour

(b) Resonance Analysis

a) Wave Recording

73. Ultrasonic wave recorders were used for wave recording. Fig. 1.2.11 shows the location of the wave recording stations (S.T.).

b) Analysis of Resonance
- Spectrum Analysis -

74. The irregular waves can be broken down into a number of component sine waves. The way in which the component waves are distributed is expressed by plotting the component wave energy, or the square of the component amplitude, against the frequency of the component waves.
In the case of sea waves, the energy distribution maintests itself as a continuous curve because there exist a infinite number of frequency components. Such a continuous spectrum is called the frequency spectral density function, and it has units of m^2 sec., or units of similar dimensions.

75. Fig. 1.2.12 and Fig. 1.2.13 show samples of the power spectrum and the wave height ratio recorded at S.T.1 (at the mouth of the harbour) and S.T.4 (at the northern end of the wharf).

76. Fig. 1.2.12 shows a result of analysis for 1,024 sec. Both data have a peak of the energy density at frequency (F) of 7×10^{-2} $sec.^{-1}$ (about 14 sec.). S.T.1 has only one peak, while S.T.4 has second peak at $F = 1.6 \times 10^{-2}$ (about 60 sec.). The second peak of S.T.4 shows evident tendency of amplification of long period component.

77. As shown in the figure of the wave height ratio, the magnitude of amplification of the component in the harbour is about 2.6 against offshore waves. However, figure of the energy density shows that the energy density of the amplified components in the harbour (at S.T.4) is small: about 1 percent of that of the dominant wave component offshore (at S.T.1). It means that the wave height of the amplified component in the harbour is about 10 percent of that of the dominant wave component offshore ($\sqrt{1/100}$ =

1/10).

78. Fig. 1.2.13 is a result of the continuous 4,096 sec. analysis to analyze the amplification in the zone lower than F = 10^{-2} x $sec.^{-1}$ (100 sec.).

79. In this figure amplifications of low frequency components are shown. The amplification rates of wave height are 1.2 to 1.4.

- Moving Average Analysis -

80. Fig. 1.2.14 shows the actual wave profile and the wave profile processed by the moving average method. This method highlights low frequency waves by the process of calculation using a high-pass filter which neglects the high frequency component and emphasizes the low frequency component.

81. The figure is the result of the process for the data of Fig. 1.2.12. At S.T.1, no low frequency wave profile is shown. On the other hand wave height of the long period component is about 10 cm. The result of this analysis is equivalent to the result of spectrum analysis.

- Finite Element Analysis -

82. Finite Element Method Analysis was conducted to analyse the amplification of the long period component in the harbour.

83. Fig. 1.2.15 shows the results of the calculation of amplification at four points in the harbour. A dominant amplification is shown in the period of 60 sec. at the inner part of the harbour. However, no amplification is shown at the mouth of the harbour. There is another peak at about 630 sec. including the point of mouth of the harbour, and a small peak at about 300 sec.

- Simple Model Analysis -

84. Apia Harbour can be assumed to be a closed basin between the wharf and

the western reclaimed area in the northeast-southwest direction with 600m length and 10m mean depth (Model A).
And the harbour can also be assumed to be a rectangular basin with one open end in the north-south direction with 1500m length and 15m mean depth (Model B).

85. Under the conditions mentioned above, the dominant periods of amplification of long period components are calculated as follows.

Model A (northeast - southwest)	60 sec.
Model B (north - south)	600 sec.

(c) Improvement of Calmness in the Harbour

a) Wave Hindcasting

- Ordinary Waves -

86. The probability of NW-ENE seas is estimated as 12.6%, or 46 days per year based on wind data observed at Apia, and that of NW-NE swells is estimated as 11.0%, or 40 days per year based on swell data observed by the U.S. Navy.
The occurrence probability of the offshore waves which can reach Apia Harbour is estimated as follows.

1 m and more	32 days/year
2 m and more	16 days/year
3 m and more	8 days/year

- Anomalous Waves -

87. Two hurricanes were chosen for the estimation of anomalous waves. One is the hurricane in 1944 (Hurricane A) which is one of largest hurricanes for which the weather map is available, and the other is the hurricane in 1941 (Hurricane B) whose track is most dangerous to Apia. The weather map of Hurricane A was imposed on the track of Hurricane B for the estimation of the most dangerous hurricane which could occur.

88. The design deep water wave conditions at Apia Harbour can be determined as follows:

H = 7.0m T = 10 sec.

b) Wave Deformation

- Wave Deformation -

89. Fig. 1.2.16 shows the calculated wave height ratio at each point in Apia Harbour and the numbers in the figure are the percentages to deep water wave height. The wave period is 10 sec. and the deep water wave direction is N10°E along the deep line of the harbour.

90. The results of the calculation show a high correlation with the actual wave recording data as follows:

	ST 1	ST 2	St 4
Recording	0.9	0.7	0.3
Calculation	0.88	0.66	0.31

- Degree of Sheltering -

91. Fig. 1.2.17 shows the wave height ratio with a 112.5m breakwater provided about 200m north from the existing breakwater. The relation between the breakwater length and the wave height ratio in front of the existing wharf is as follows:

Breakwater Length (m)	0 (Present Condition)	112.5 Fig. 1.2.16	100	75
Ratio to Deep Water Wave (%)	28.3	9.2	12.3	18.6
Ratio to Present Condition (%)	100	33	43	66

c) Calmness in the Harbour

92. As mentioned in Chpter 3, the wave height in fron of the wharf must be reduced to less than 45% of the present condition from the viewpoint of

cargo handling.

93. As shown above, after the construction of a 100m long breakwater at about 200m north of the existing wharf, the wave height in front of the wharf will be reduced to 43% of the present condition and the required calmness will be obtained.

iii) Siltation

(a) Objectives and Result

94. The object of the study on siltation is the estimation of the annual volume/rate of sediment deposited in Apia Harbour. The flow of the siltation study is shown Fig. 1.2.10.
The main flow is drawn by bold lines and the area enclosed by dotted lines is discussed in this chapter.

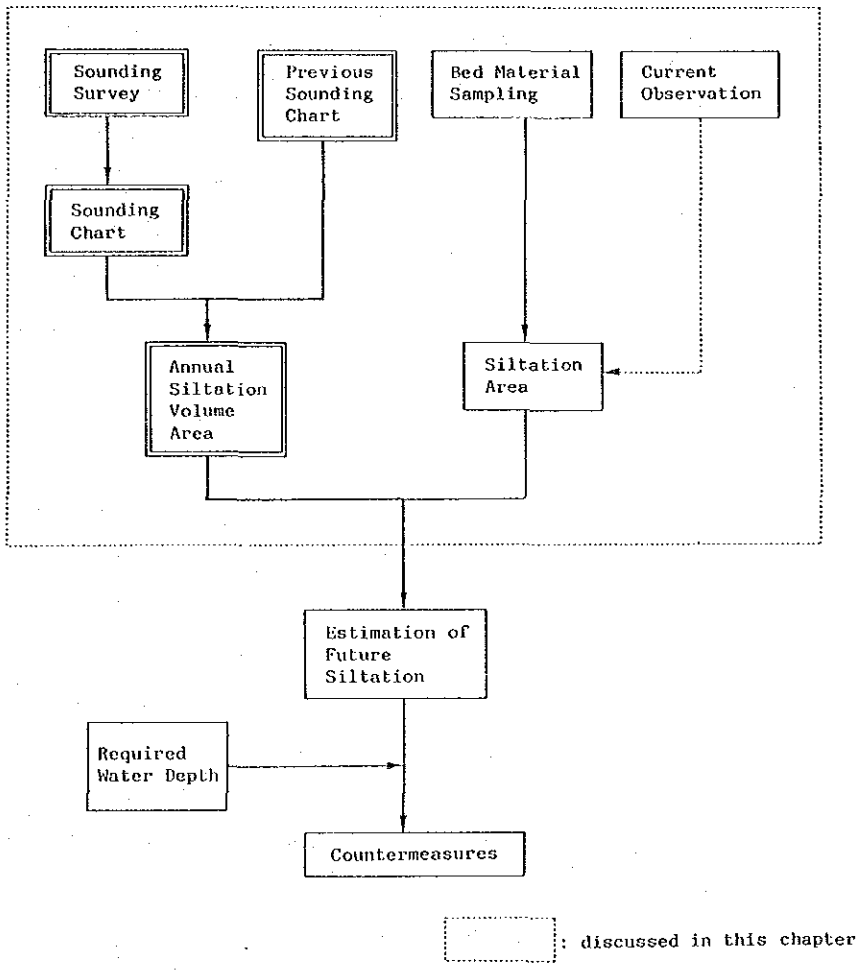


Fig. 1.2.10 Study Flow of Siltation Analysis

95. The siltation volume in the turning basin, 126,000 m^2, is estimated as 9,500m^3/year, i.e. 7.5cm/year, and the maximum siltation rate is estimated as 12cm/year at the center of the turning basin.

(b) Sounding Survey

a) Comparison of Sounding Charts

96. Fig. 1.2.18 shows the movement of contours, comparing the sounding charts of 1981 and 1987. The contours are compared in 1 meter intervals in the depth of 8m to 13m below Chart Datum in the turning basin.
A tendency of siltation is clear at most parts of the turning basin.

97. On the other hand, there is an indication of erosion in front of the wharf. This may have occurred mainly due to the frequent and strong agitation of sediment by ship propellers. And a tendency of erosion is shown at the west inner part of the harbour.

b) Estimation of Siltation Volume in the Turning Basin

98. The calculated volume of sediment in the turning basin is approximately 9500m^3/year, i.e. the annual shoaling rate is 7.5cm/year, and the maximum shoaling rate can be read as 12 cm/year at the center of the turning basin.

(c) Bed Material Sampling

99. A bed material sampling survey was carried out in Apia Harbour.
Fig. 1.2.19 shows the locations of sampling and the organic material content.

100. There are two clear distinctions on soil properties. One is the difference between No.31 and No.2, i.e. between the estuary of the Vaisigano River and the inner part of the harbour. The other is the difference between No.4 and No.5, i.e. between the approach channel and the turning basin. The materials are classified as river material, basin material and channel material. River material consists of gravel and sand,

basin material is mainly silt, and channel material is silty sand.
There are clear differences of organic material content among them, i.e. 3 to 6 percent for river material, 13 to 17 percent for basin material and 17 to 29 percent for channel material.

(d) Current Observation

101. The currents during ebb tide at Apia Harbour are observed as follows:

East side: 5 to 6 m/min, toward the outer port along the main wharf
Center : 10 m/min, fastest towards the northwest
West side: slow northward current

102. Even during flood tide, currents to the north and northwest toward the outer harbour dominate, and whirlpools and stagnations are observed at the west side of the harbour.

103. In order to obtain the data for hydraulic analysis of the siltation mechanism, further observations on such items as bottom current, suspended sediment concentration and flood volume of the rivers are required.

iv) Geotechnical Conditions

(a) Outline of the Soil Survey

104. The object of the soil survey was to provide fundamental data on soil conditions to be used for basic design and improvement of the port structures.
The soil investigation was carried out at two bore holes in order to obtain:

① the information on the soil profile of strata and N-value
② the physical and mechanical properties of the soil determined by in-situ and laboratory tests including the data obtained by undisturbed soil samples, and
③ the bearing stratum up to bedrock or to a hard stratum with an N-value of more than 50.

(b) Sounding and Sampling

105. The location of bore holes is shown in Fig. 1.2.20. The items of the on-site soil investigation are shown as follows.

Bore Hole No	Water Depth below MLWS (m)	Depth below Seabed (m)	SPT	Undisturbed Samples
A2	-9.0	26	11	0
A3	-9.0	25.5	8	3
Total		51.5	19	3

106. Three undisturbed samples were collected at bore hole A3 using a thin-walled sampler.
The soil profile is shown in Fig. 1.2.21.

(c) Soil Structure

107. The sediment stratum consists of two different materials. The upper layer is sandy silt transported by the Vaisigano River, and it is very soft with an N-value of 0.

108. The second layer is silty sand with a thickness of 13 to 17 meters and with an N-value of 1 to 40. The lower part of this layer contains coarse land.

109. A thin coral layer with a thickness of 5 to 10cm is located between these two layers. There is also a hard coral layer with a thickness of 0.5 to 3.5 meters above the bedrock. The bearing layer is very hard volcanic basalt rock.

(d) Laboratory Tests

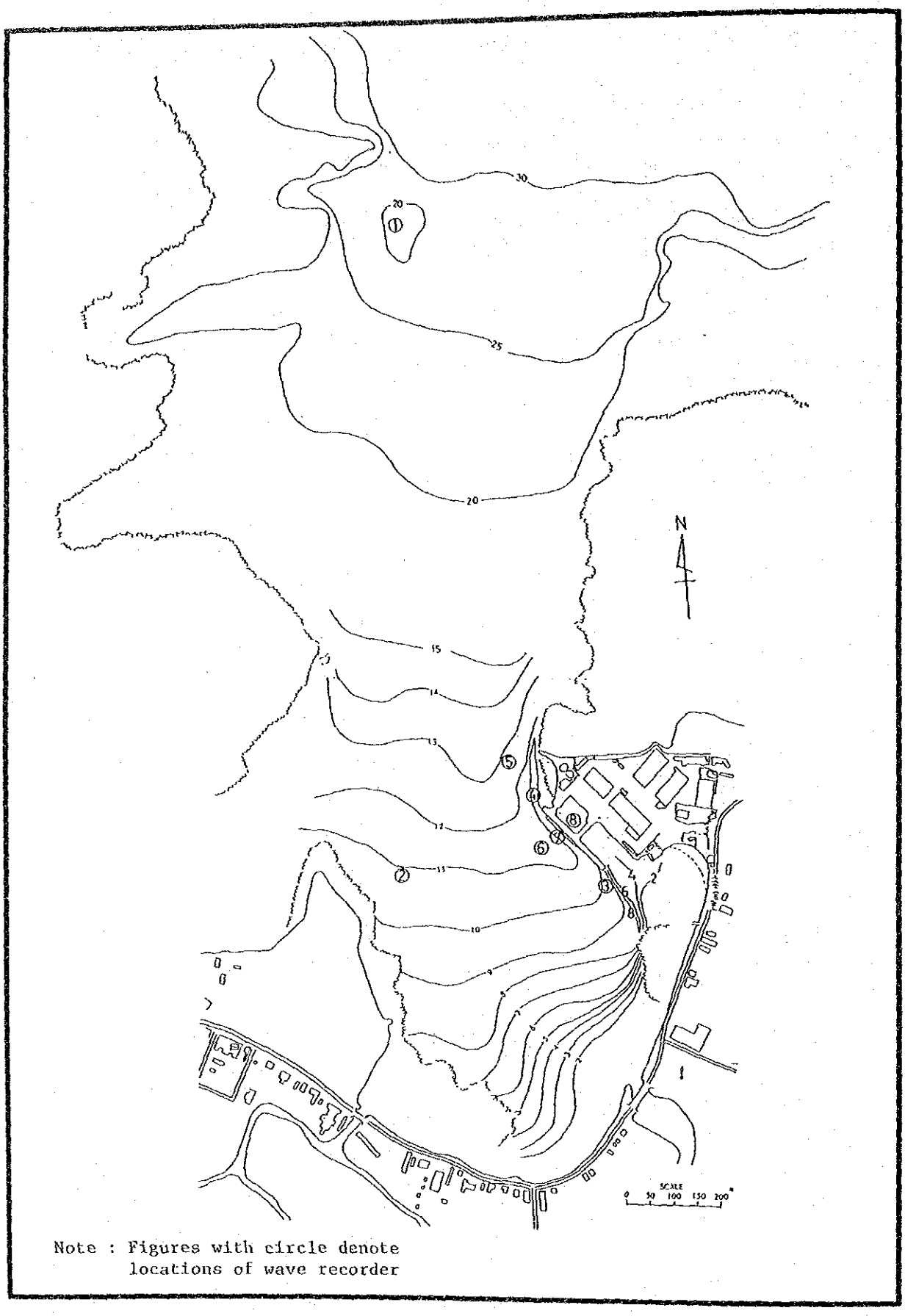
110. The confirmed compression strength (qu) and cohesion (Cu) are as follows:

$$Cu = \frac{qu}{2} = 0.0405 \ (kg/cm^2)$$

where Z is the depth below the sea bed.

111. The coefficient of consolidation (Cv) and coefficient of volume compressibility (Mv) are as follows.

Bore Hole	Depth below L.W.L (m)	Mv (cm^2/kg)	Cv (cm^2/sec)
A3	16.50-17.35	4.8×10^{-2}	2×10^{3}
	20.00-20.85	3.0×10^{-2}	1.2×10^{3}



Note : Figures with circle denote
locations of wave recorder

Fig. 1.2.11 Location of Wave the Recording Stations

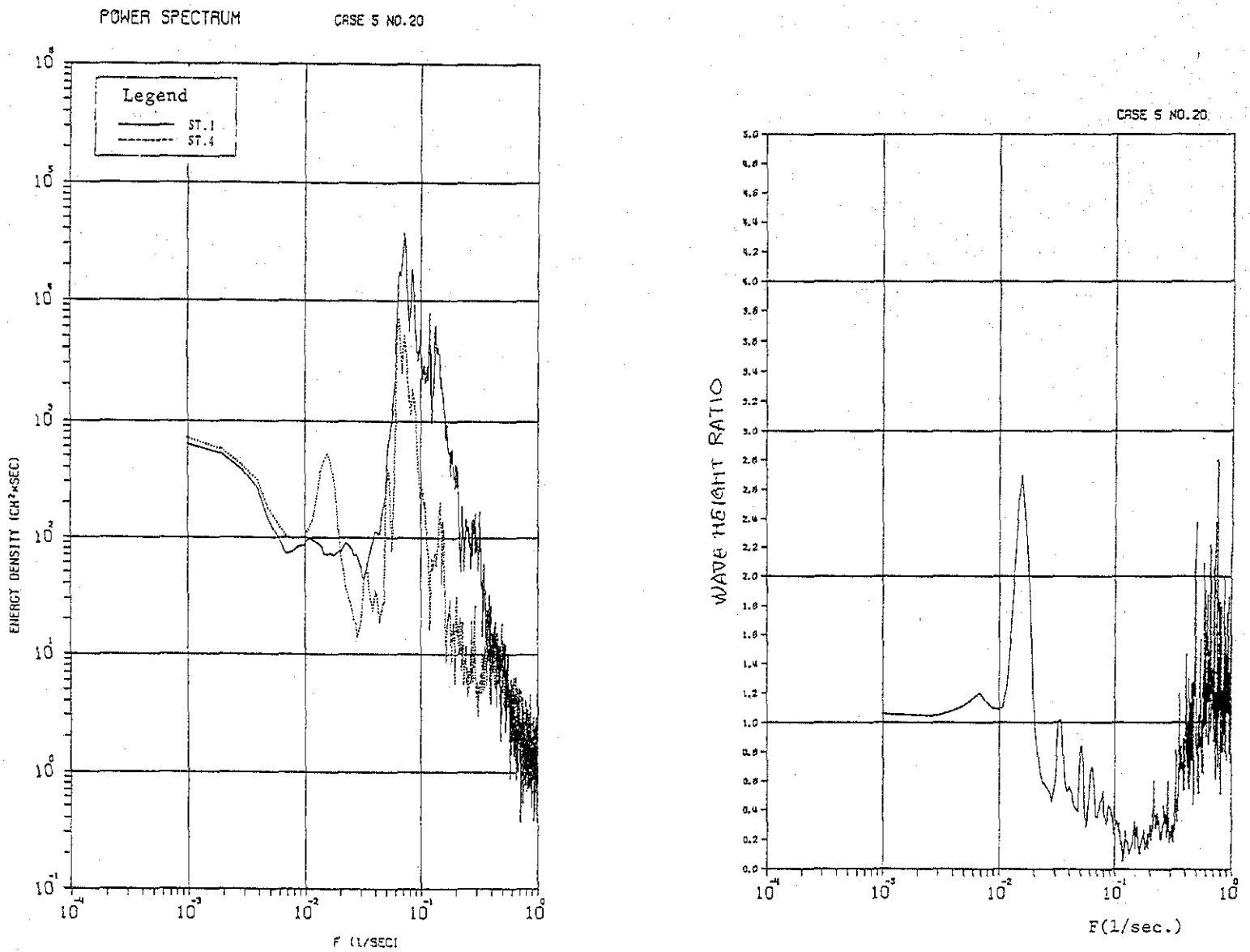


Fig. 1.2.12 Spectrum of Waves (Case 5, Wave Group No.20, 1024 sec.)

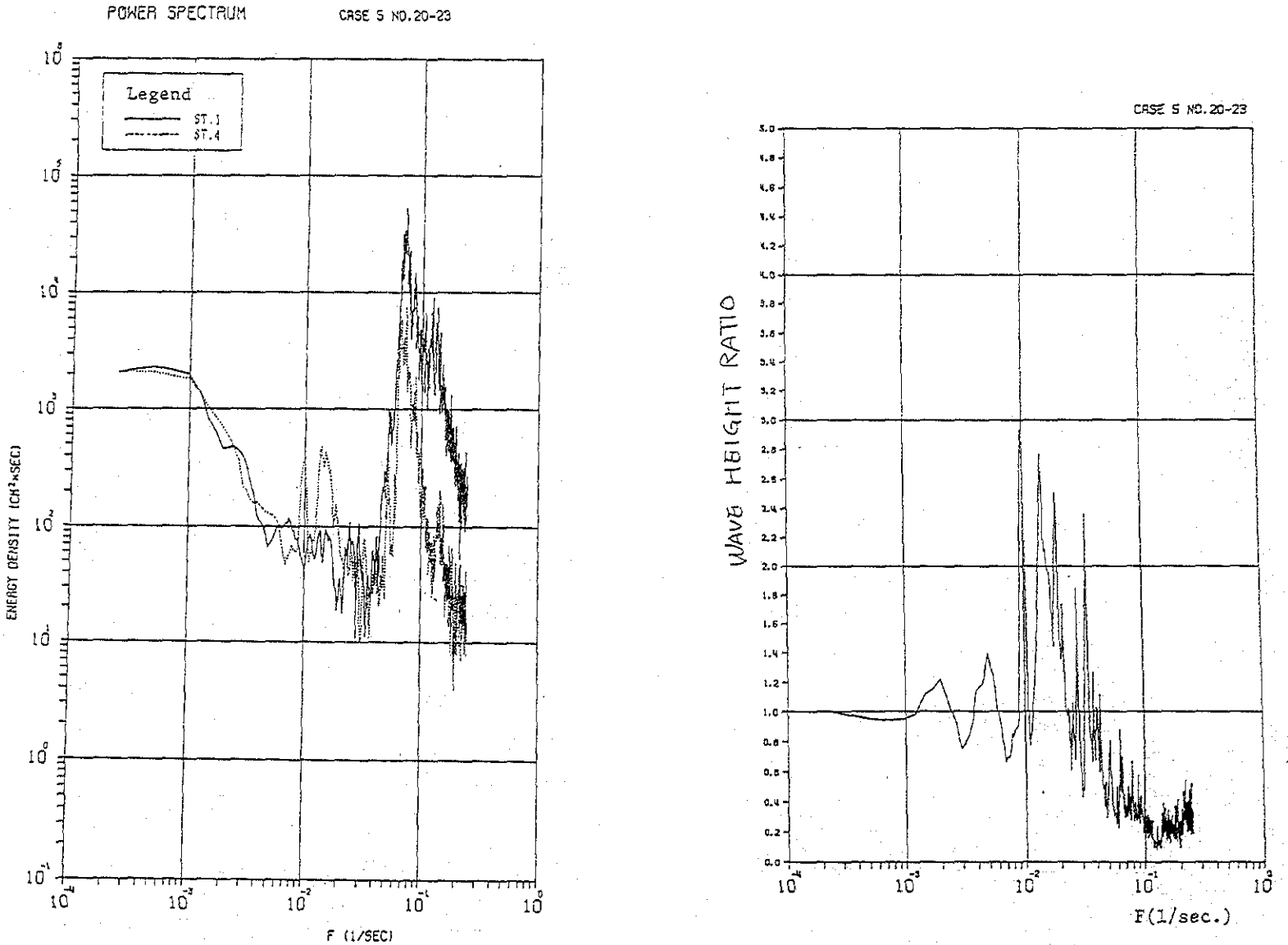


Fig. 1.2.13 Spectrum of Waves (Case 5, Wave Group No.20-23, 4096 sec.)

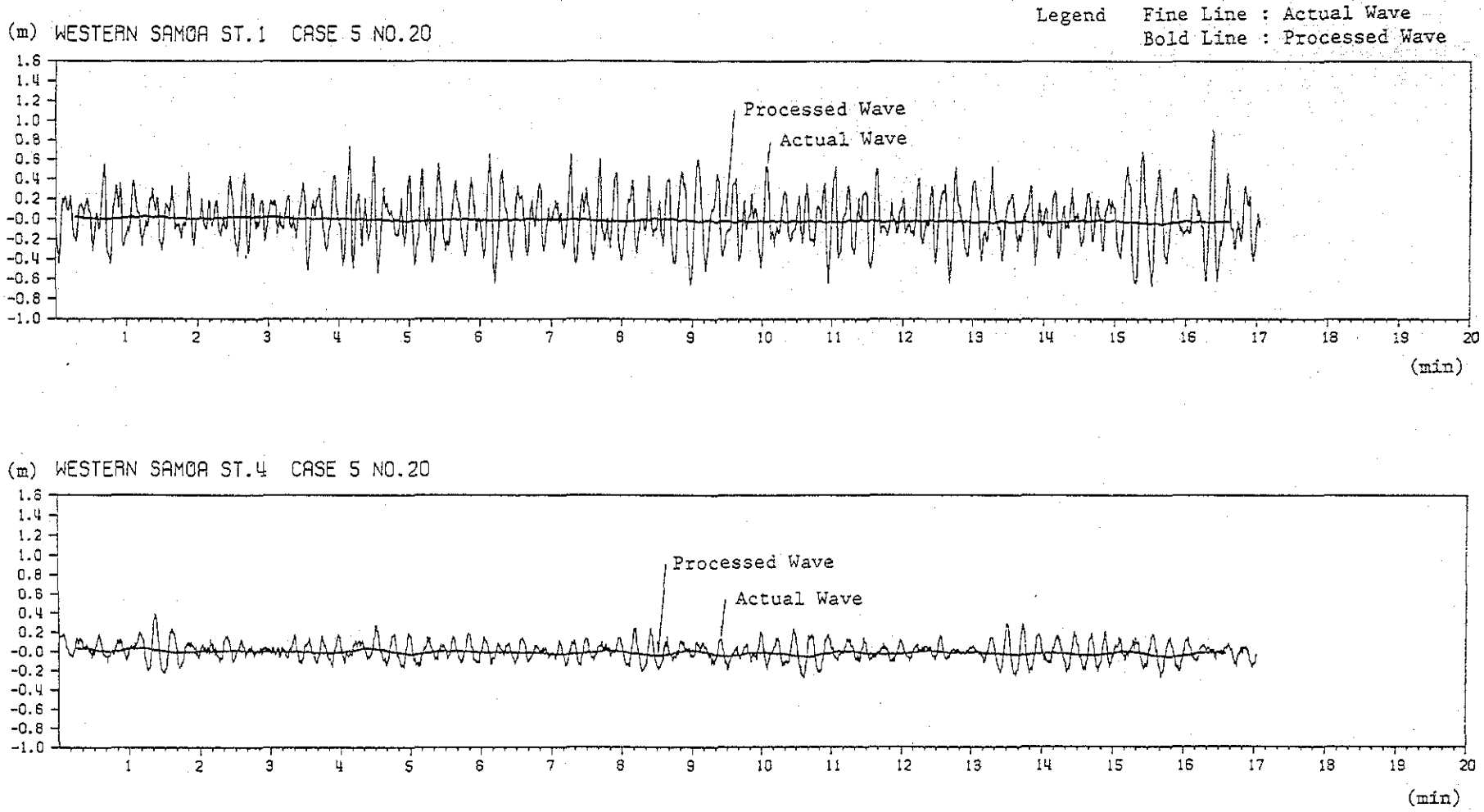


Fig. 1.2.14 Result of Moving Average Method (Case 5, Wave Group No.20, 1024 sec.)

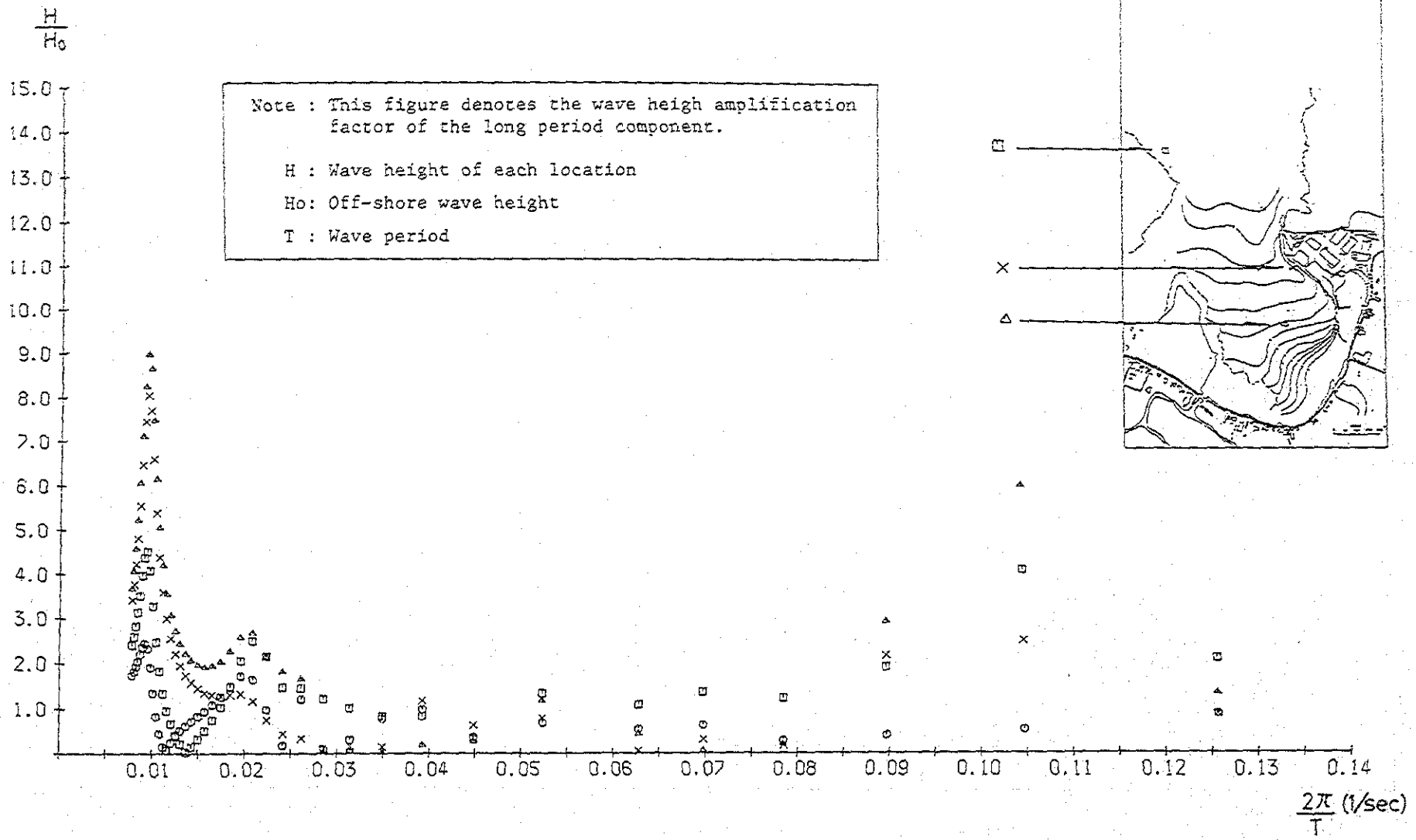


Fig. 1.2.15 Reslut of Finite Element Analysis

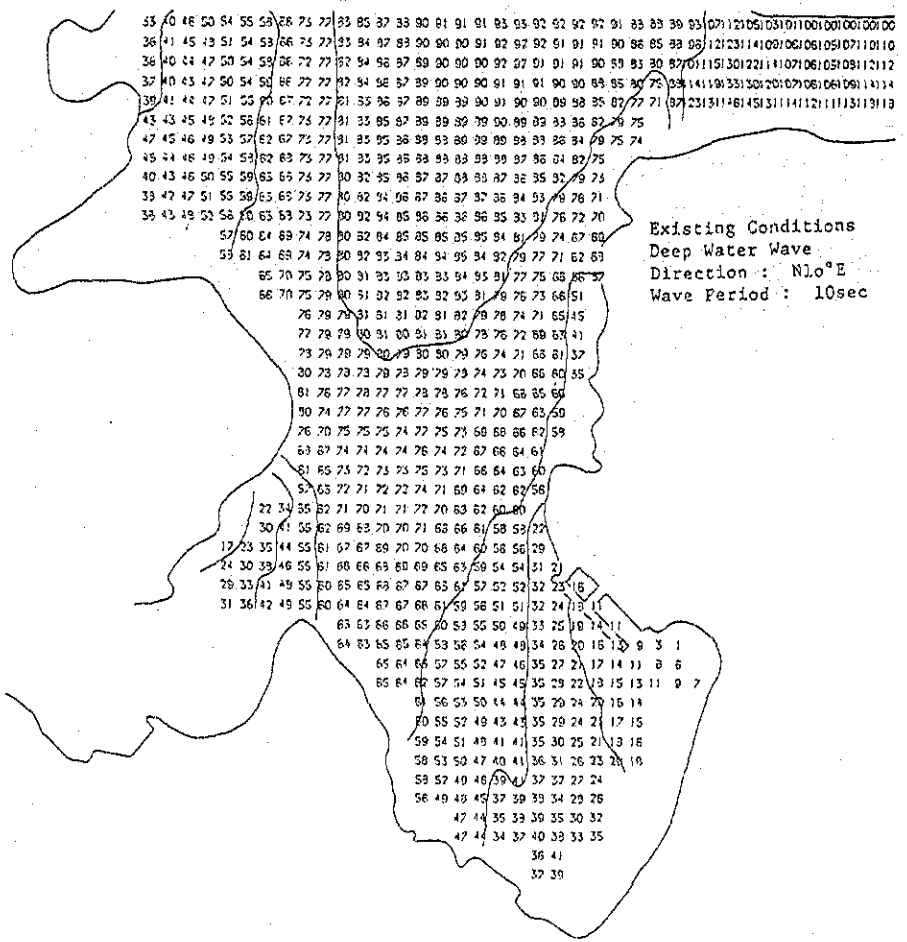


Fig. 1.2.16 Wave Height Ratio (Existing Conditions)

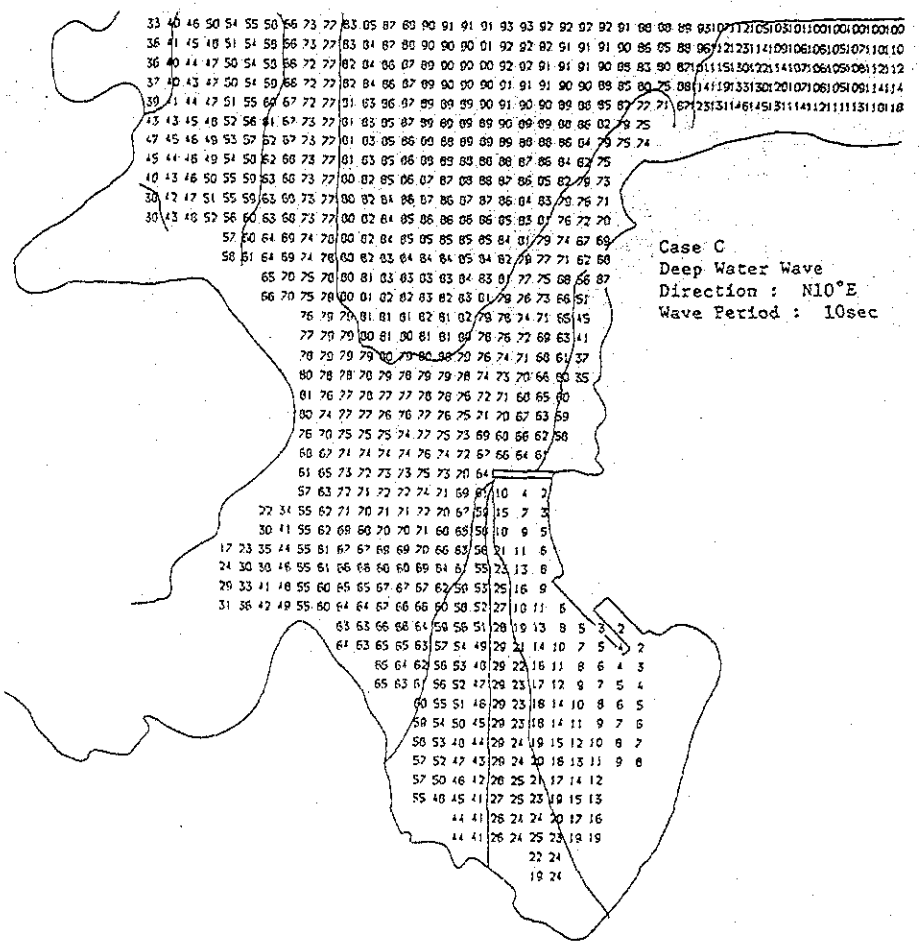


Fig. 1.2.17 Wave Height Ratio (Case C)

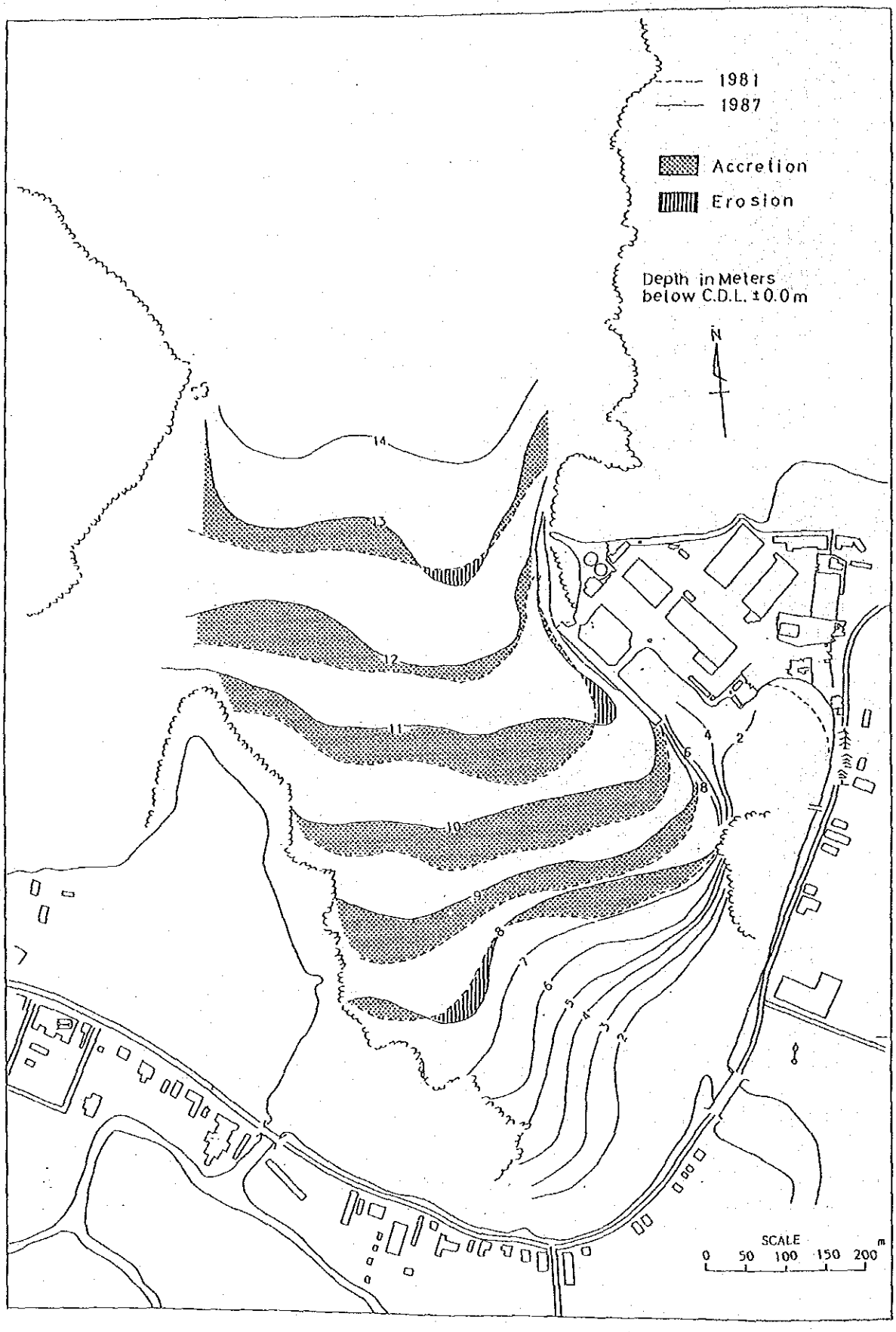


Fig. 1.2.18 Comparison of Water Depth, 1981 and 1987

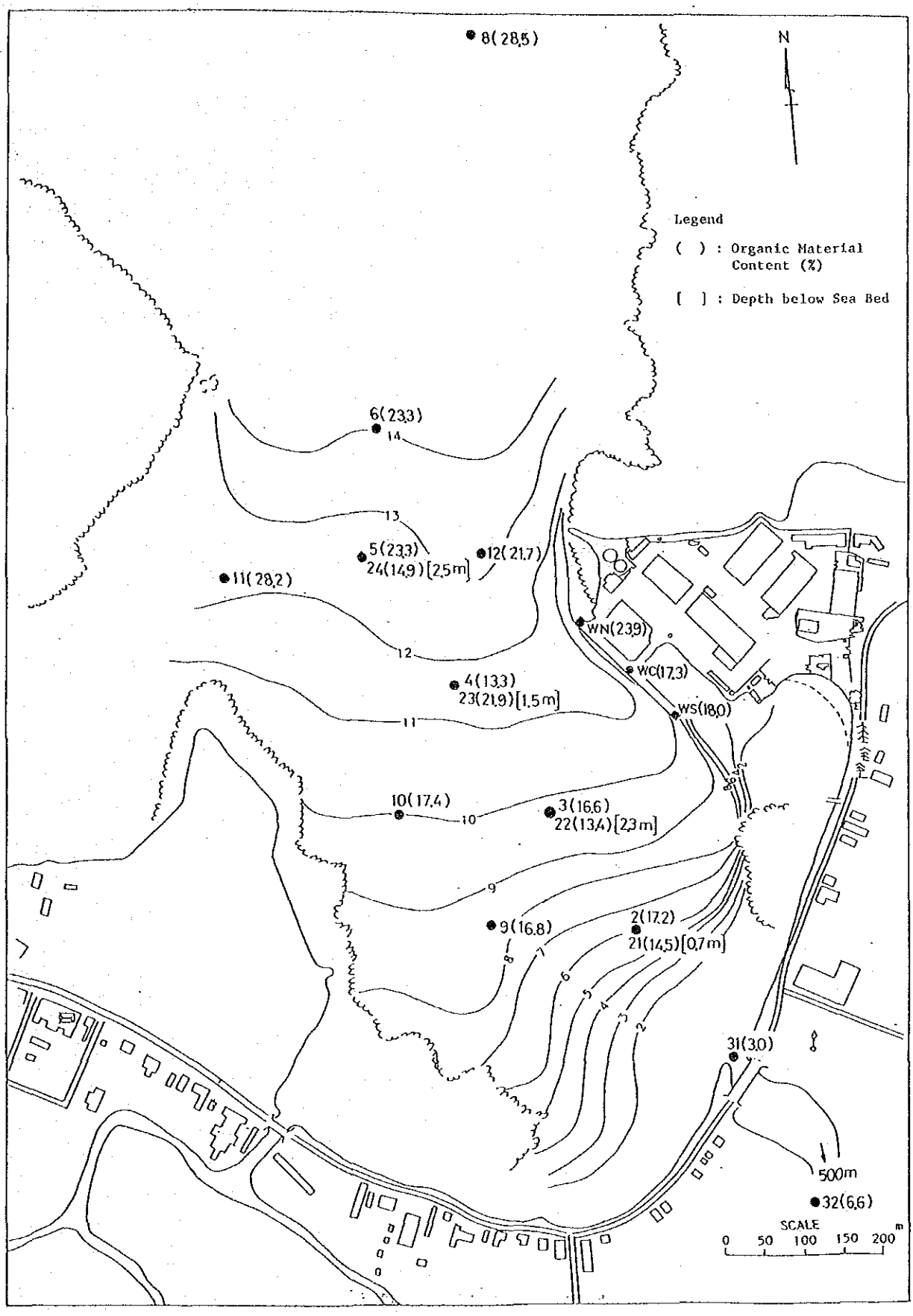


Fig. 1.2.19 Location of Bed Material Sampling (Apia Harbour)

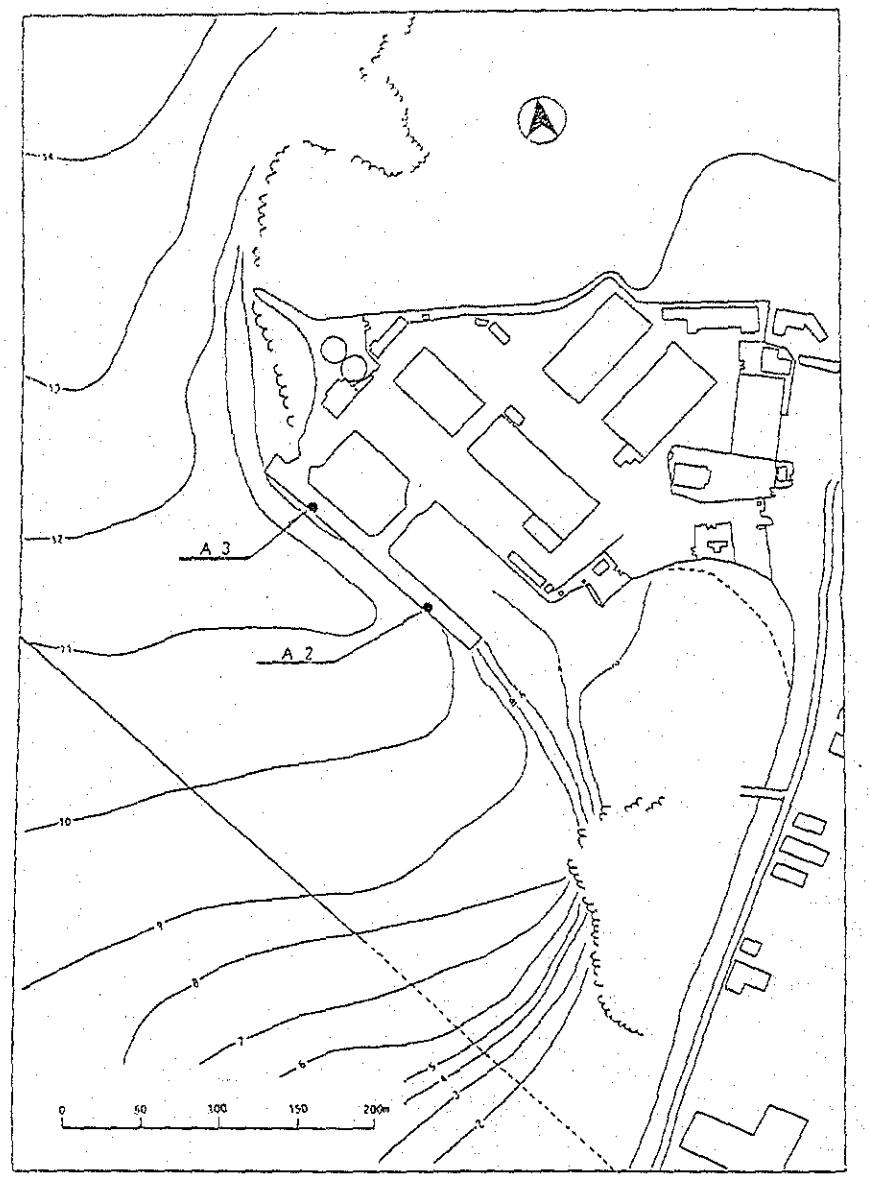


Fig. 1.2.20 Location of Bore Holes (Apia Harbour)

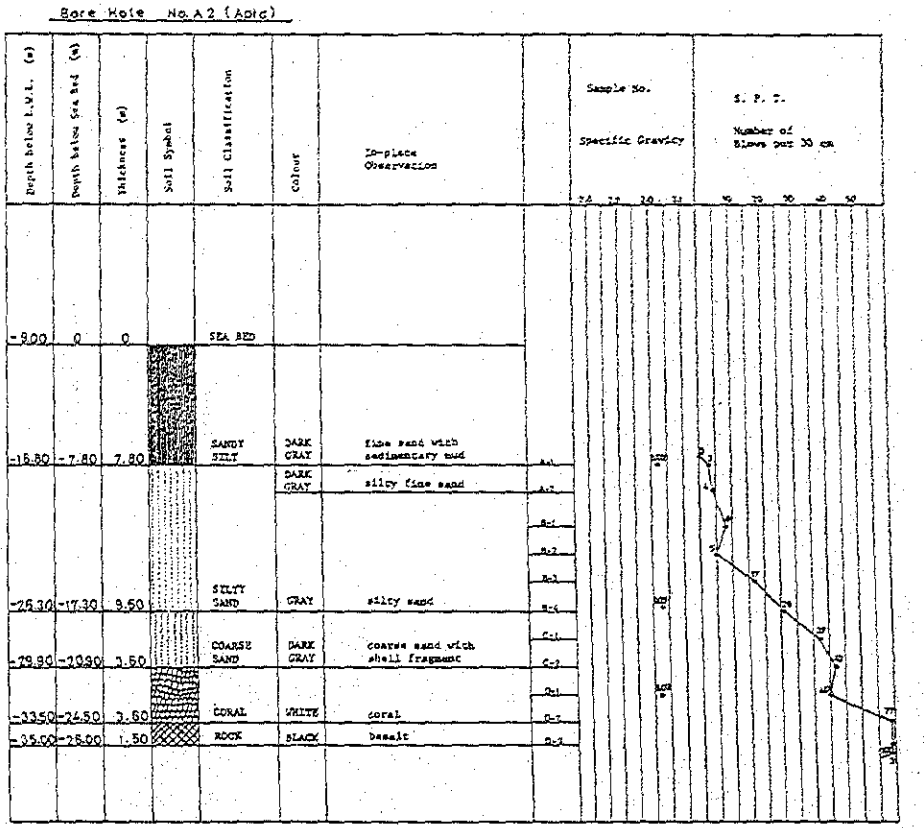


Fig. 1.2.21 Soil Profile (Apia Harbour, A2)

(2) Asau Harbour

i) Sounding Survey

112. The inside of Asau Harbour is well protected from waves by the coral reef. However, the waves at the northwest part of the entrance channel are rather rough in the wet season because of the dominant northeast wind. An area of turbulent water was observed towards the northward end of the entrance channel.

113. Fig. 1.2.22 shows the sounding chart inside of the harbour.

The minimum depth along the faceline of the wharf is 8.2m below chart datum at 30m east from the west end of the wharf. 20m of the west side and the entire east side of the wharf have a depth of more than 10m.

114. Two shallow areas are shown near the wharf. One is located about 100 meters southward from the east end of the wharf and the minimum depth of it is 8m below chart datum. The other is located about 300 meters southwestward from the west end of the wharf, and the minimum depth is 5.3m.

115. The approach between the southern end of the entrance channel and the wharf has a depth of more than 12m. The center area of the harbour, about $400,000m^2$, has a depth of more than 15m and a maximum depth of 17m.

ii) Current Observation

116. Current during ebb tides in the entrance channel were observed using floats on March 5, 1987. Tow theodolites set on the eastern end of the embankment and on the sand bank located on the western side of the channel were used for tracking the floats.

117. Current velocity at the northwestern end, the center and the southeastern end of the channel are as follows:

	SE End	Center	NW End
Current Velocity (cm/sec.)	10 - 15	20 - 25	30 - 40

118. The currents concentrate to the center line of the channel and diffuse at the northwestern end of the channel. At the outside of the channel, westerly currents caused by northeasterly waves were observed.

iii) Bed Material Sampling

119. Bed materials were collected at two points. Sample S1, collected at the wharf 2m below sea bed, consists of white gray silt containing fragments of shell and coral. Sample S2, collected at the southern end of the sand bank, consists of gray coral sand.

The results of the physical tests are as follows.

Sample No.	Water Depth (m)	Depth below Sea Bed (m)	Specific Gravity	Max	Grain Size (mm) 60%	30%	10%
S1	11.0	2.0	2.801	9.520	0.022	0.115	0.0032
S2	1.0	1.2	2.812	9.520	0.4	0.29	0.18

iv) Tide

120. The mean high water spring tide at Asau Harbour is +1.21m above chart datum. In the period of the survey, an anomalous high tide of +1.76m was observed at 21:10 on February 28, 1987 under a new moon. This anomalous high tide was caused by the approach of a low atmospheric pressure.

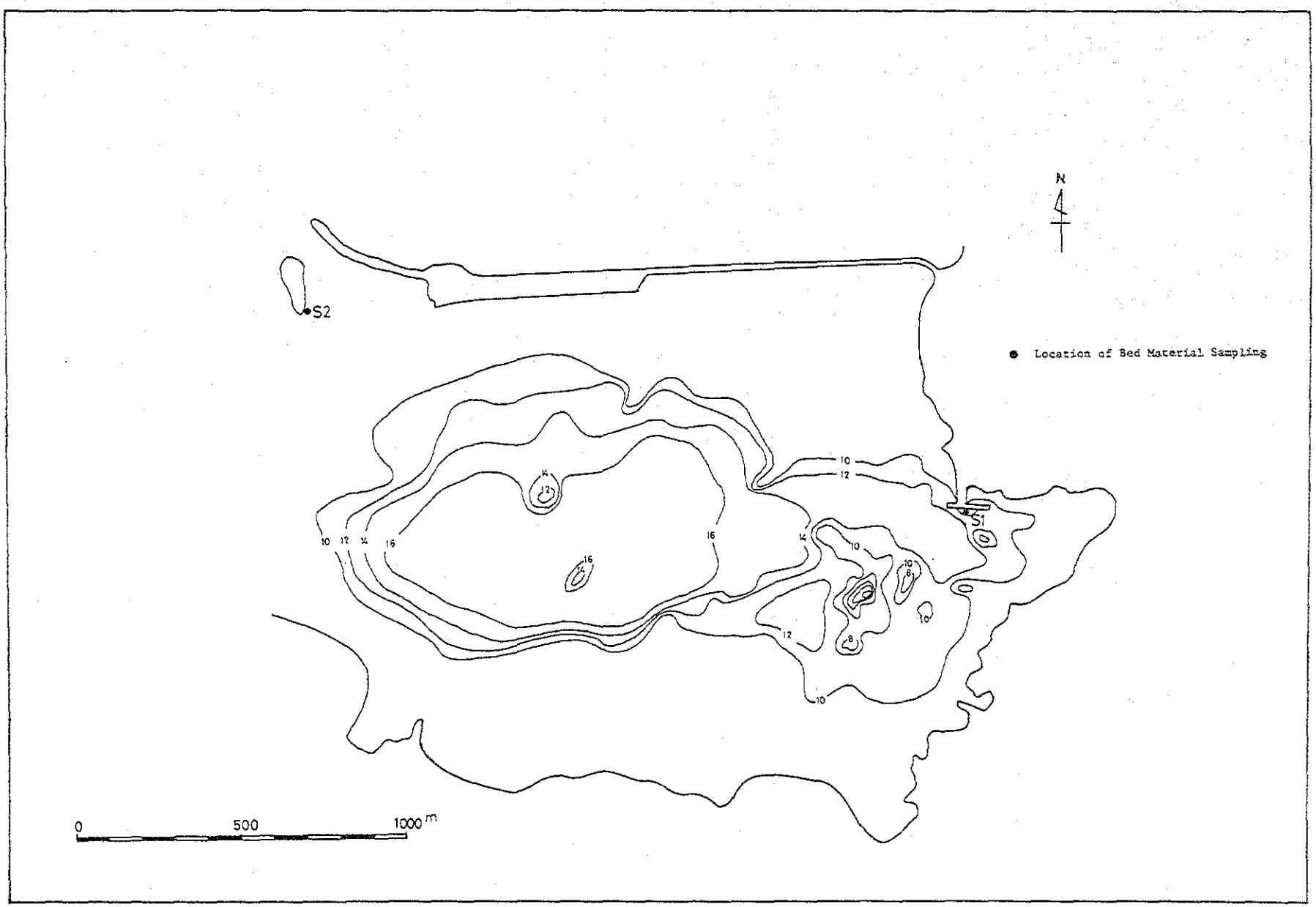


Fig. 1.2.22 Sounding Chart, Asau Harbour, 1987

(3) Vaiusu Bay

i) Sounding Survey

121. Fig. 1.2.23 shows the sounding chart at Vaiusu Bay.
The east and north sides of the area are surrounded by coral reefs. The inside of the coral edge is filled with coarse coral sand and is well protected from waves. The water depth falls in a very narrow range of +0 to -1m and is almost flat.

122. A deep inlet with a length of approximately 600m in the east to west direction and a width of approximately 200m in the north to south direction is shown in the southern part of the eastern reef. The edge of the reef is very steep and most of the area is deeper than 15m.

123. Current with a speed of approximately 1m/sec. was observed during ebb and flood tides at the coral edge of the inner part of the inlet.

ii) Boring

124. A boring survey was carried out at the westward side of the inner part of the inlet. The location of the bore holes is shown in Fig. 1.2.23.
The surface of the lagoon is covered by coarse coral sand, and coral lumps of 30 to 100cm in diameter lie throughout the area.

125. Fig. 1.2.24 shows the boring log.
The subsoil consists of mainly silty coral sand. From the results of SPT and grain size tests, the soil is divided into two strata at about 15m below sea bed.
The upper layer is loose with an N-value of zero to 3; especially the layer up to 5m below sea bed has an N-value of zero. This layer contains coral fragments, shells and silt. The lower layer has an N-value of 9 at 17.3m below sea bed and consists of coarse coral sand and gravel.

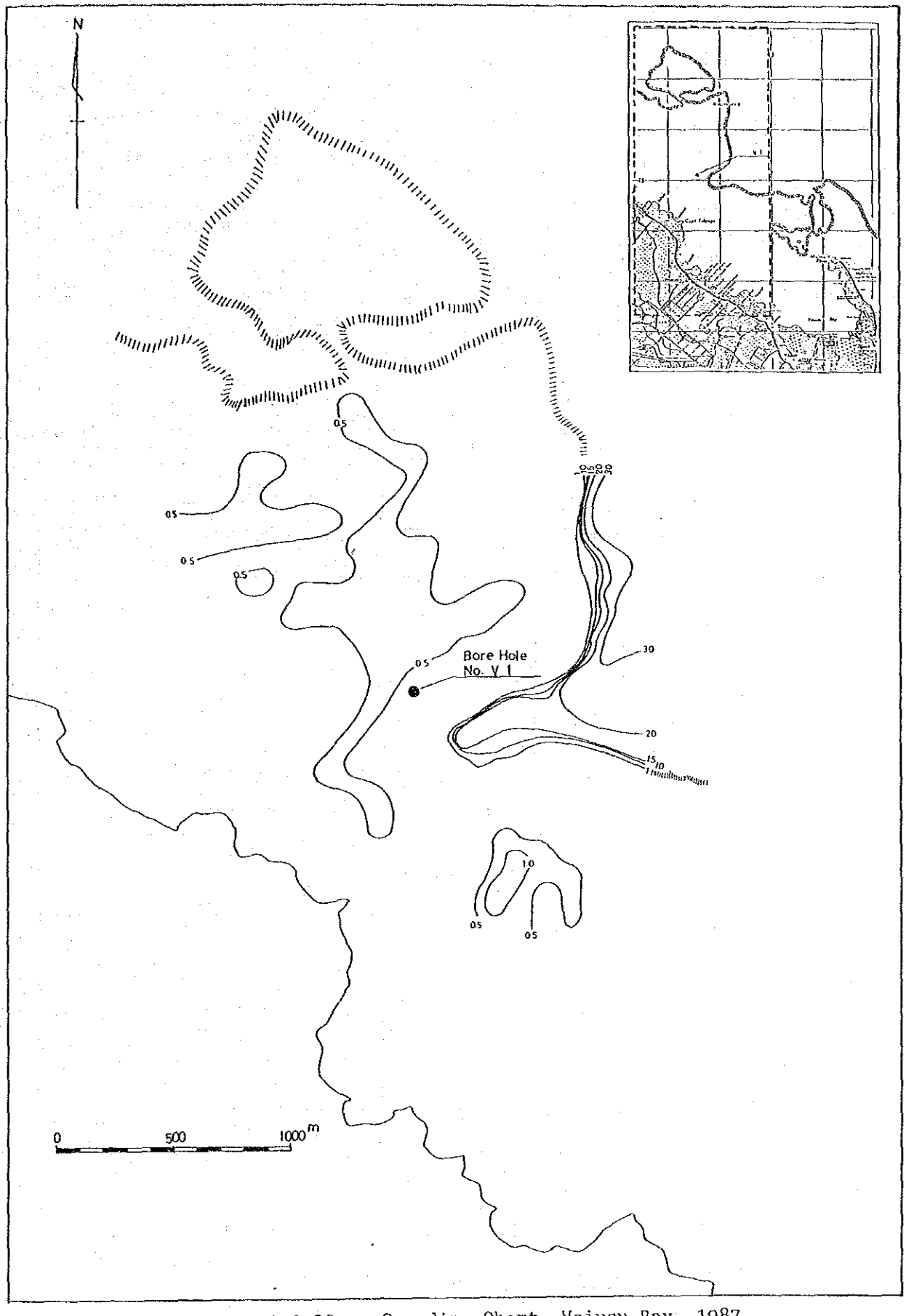


Fig. 1.2.23 Sounding Chart, Vaiusu Bay, 1987

Bore Hole No. V 1 (Vaiusu)

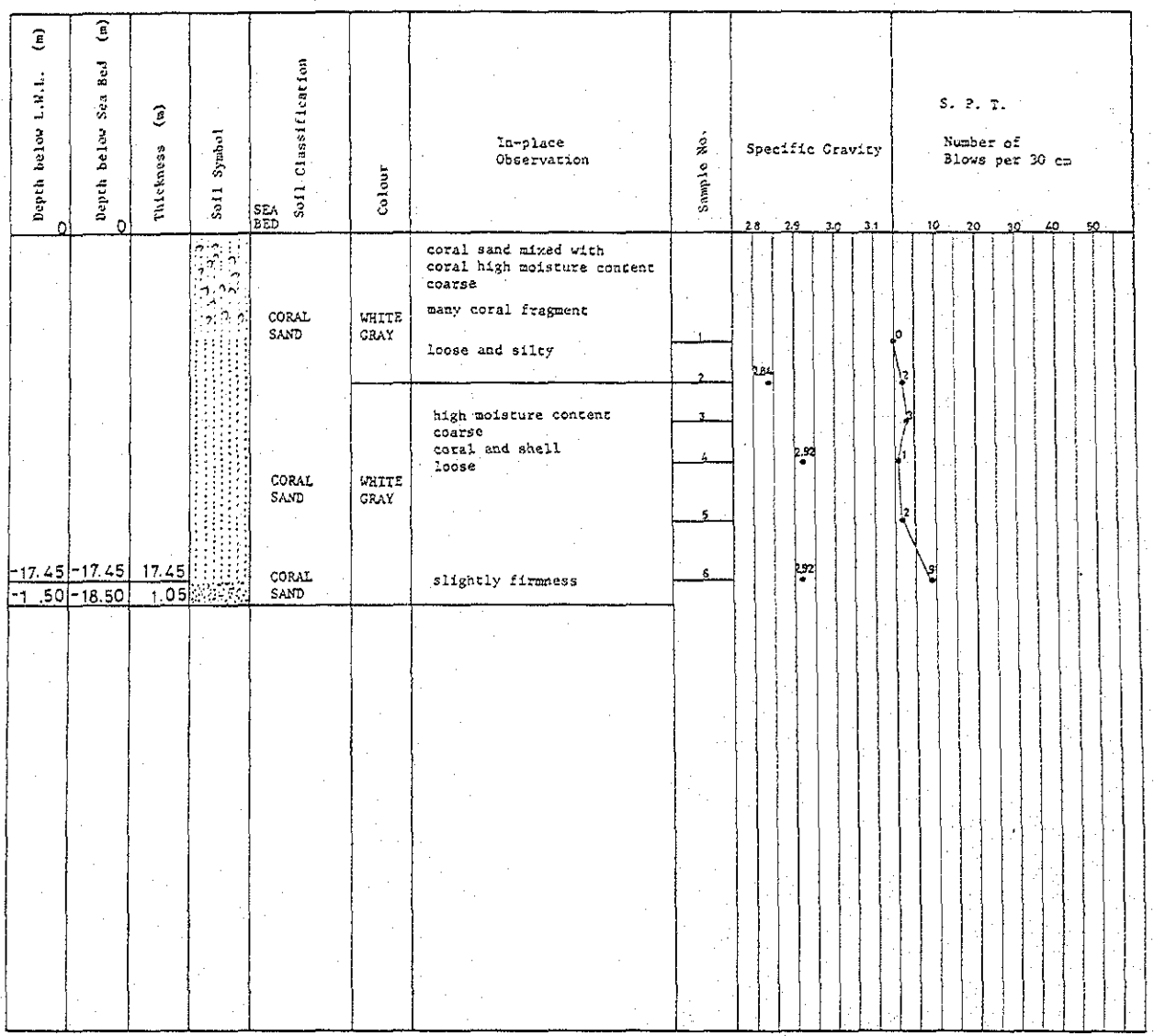


Fig. 1.2.24 Soil Profile (Vaiusu Bay V1)

4) Port Activities

(1) Overseas Transportation System

i) Shipping services network

126. Apia is mainly connected with foreign ports by liner services. Apia is regularly served by some 9 shipping lines, and in this respect it benefits from its proximity to Pago Pago, since the majority of the liners call at both ports.

127. In addition, the government owned Western Samoa Shipping Corporation operates a regular service between Apia and Pago Pago using a ferry boat, the Queen Salamasina.

128. But few trampers call at Apia. Many of these are tankers which import oil products and export coconut oil, and some bulk cargo vessels such as cement carriers.

129. The current shipping services are summarized in Table 1.2.5. The most important are:

to/from Australia and New Zealand	:	Pacific Forum Line, Warner Pacific Line
to/from Japan	:	Bali Hai Service, Kyowa Line, Toyofuji Kaiun
to/from U.S.A.	:	Polynesia Line
to/from Europe	:	Columbus/Bank Line joint services

The Pacific Forum Line is the main line in this region. This line is considered separately below.

130. There are no liner services at Asau Port. Trampers call at the port to load timber from the Asau Sawmill and to unload oil products.

Table 1.2.5 Calling Ships at Apia

No.	Name of Line	Calling Ship	Calling Frequency (Times per Year)	Destination	Agent	Stevedore	Import Container (TEU) (full)	Import Container (TEU) (empty)	Export Container (TEU) (full)	Export Container (TEU) (empty)
1.	Bali Hai Service	"Pacific Islander"	6	Japan	BP (SS)	BP (SS)	240	0	30	210
		"South Islander"	6	Japan						
2.	Toyofuji Kaiun	"Toyofuji"	12	Japan						
3.	Pacific Fourm Line	"Fourm Samoa"	17	N.Z	PFL	PFL	3,630	240	1,170	2,720
		"Fua Kavenga"	14	Australia						
4.	Polynesia Lines Ltd.	"Polynesia"	12	U.S.A.						
5.	Columbus Line	"Tausala Samoa"	12	Europe						
		"Moray Bank"								
6.	Bank Line	"Cycle Bank"								
		"Tamaitai Samoa"								
					Union Maritime	Union Maritime	240	0	30	170
7.	Polynesia Triangle Line	"Capricornia"	21	N.Z. Hawaii						
8.	Kyowa Line	"Kyowa Hibiscus"	12	Japan	MH	Triangle Cargo	240	0	0	240
		"Asian Lily"								
9.	Warner Pacific Line	"Coral Chief"	12	Australia	Warner Pacific	"	540	0	120	400
		"Rex Star"	12	N.Z.						
						Total	4,890	240	1,390	3,740
							5,130		5,130	

131. Passenger vessels sometimes call at Apia Port, usuallly less than ten times per year. Most of the passenger vessels which call at Apia are short-term cruises in the South Pacific Ocean.

132. The number of yachts which call at Apia is also relatively small, generally less than 100 boats per year.

ii) The Link with Pago Pago

133. The connection with Pago Pago, American Samoa, is locally referred to as the "inter-island" service, reflecting the links between Western and American Samoa which include a common language.

134. The Western Samoa Shipping Corporation operates a twice weekly return service of approximately 78 nautical miles each way. The service is provided by the Queen Salamasina, a Roll-on/Roll-off vessel designed for the domestic route between Upolu and Savaii, but which proved unsuitable. The Queen Salamasina is not operated on the Pago Pago service as a true Roll-on/Roll-off vessel, and all cargo is loaded and unloaded manually from trucks or pick-ups which drive onto or beside the vessel. The frequency was reduced in 1983 from thrice weekly to its present frequency. The Salamasina now normally sails from Apia on Tuesday and Thursday and returns from Pago Pago on Wednesday and Friday.

135. International lines, such as the Pacific Forum Line, also carry cargo between Apia and Pago Pago. These services are the only ones capable of moving the containers transshipped at Pago Pago on to Apia.

136. No official statistics are available on the traffic flow between Apia and Pago Pago. Table 1.2.6 is a summary of the traffic by the Queen Salamasina, and Table 1.2.7 presents visitors from American Samoa by mode of travel. The number of air passengers from American Samoa has been increasing and the number of sea passengers has been decreasing. The number of passengers using the Queen Salamasina has remained almost the same.

137. The tariff of the Queen Salamasina is as follows:

Passenger Fares:	Adults	(over 12 years)	WS$ 40	return
	Children	(2 - 12 years)	20	"
	Infants	(under 2 years)	10	"
Cargo	WS$45 per metric ton or cubic meter			

Table 1.2.6 Transportation Apia/Pago Pago by Ferry

(1) Passengers

	1982	1983	1984	1985	1986
Outward	21,596	16,493	20,134	19,251	17,158
Inward	17,753	13,642	18,969	16,156	13,053
Total	39,322	30,134	39,103	35,407	30,211
(A.I.R.)	-	0.77	1.30	0.91	0.85

(2) Cargo

(Tons)

	1982	1983	1984	1985	1986
Outward	2,073	2,379	3,052	3,291	2,581
Inward	3,672	3,817	8,026	7,922	6,705
Total	5,745	6,196	11,078	11,213	9,286
(A.I.R.)	-	1.08	1.79	1.01	0.83

(3) Trips

	1982	1983	1984	1985	1986
Outward	50	40	49	48	51
Inward	50	40	49	48	51

Source: Western Samoa Shipping Corporation

Note: 1. A.I.R. is Annual Increase Rate

2. The data of the Customs Department covers about 100 trips

Table 1.2.7 Visitors from American Samoa by Mode of Travel

	1984	1985	1986
Air	12,001 (77.3)	14,118 (81.1)	17,735 (96.5)
Sea	3,528 (22.7)	3,281 (18.9)	636 (3.5)
Total	15,529 (100)	17,399 (100)	18,371 (100)

Source: Western Samoa Visitors Bureau

Note: Visitors whose usual residence is American Samoa

iii) Pacific Forum Line

138. Concerning the overseas transport in Western Samoa, the most important line is the Pacific Forum Line (PFL). PFL was established in June 1977 by the member countries of the South Pacific Forum (SPF), and became operational as a regional shipping line for the Central and South Pacific regions in May 1978.

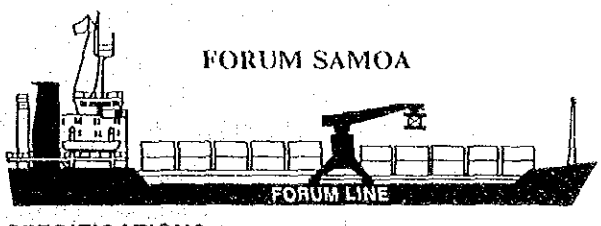
139. The objectives of PFL are:

- To operate a viable shipping line
- To provide in special circumstances shipping services to meet the special requirements of particular areas
- To pursue a policy directed towards making a profit in each year

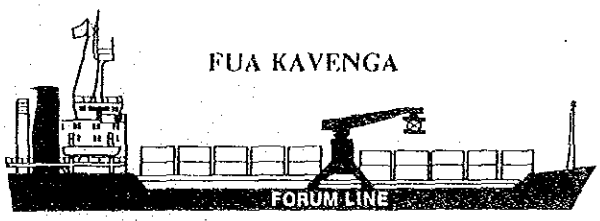
140. The PFL operates three modern self-sustaining vessels with Roll-on/Roll-off and Lift-on /Lift-off capabilities for fast, efficient cargo handling. The specifications of the three vessels are summarised in Fig. 1.2.25. Of the three vessels, Forum Samoa and Fua Kavenga (sister ships on charter from the Samoa Shipping Corporation and Shipping Corporation of Polynesia, respectively) call at Apia.

141. The financial performance of PFL from the beginning has been poor, with growing losses in absolute terms. Net losses over the period, however, have decreased to a smaller proportion of gross revenue. The recent financial performance is not known, but according to M.O.T. information, in 1985 PFL made a profit for the first time.

142. At the port of Apia, PFL is not only a shipping company but also conducts stevedoring. About 75 percent of the general cargo at Apia is handled by PFL including cargo handled during stevedoring.



SPECIFICATIONS:
SPEED: 15.3 knots.
CAPACITY: 310 TEU including 84 slots for refrigerated cargo. Has bulk tanks for caustic soda and special tanks for vegetable oils.
LOADING: Access to roll on/roll off deck by quarter ramp. Also 26 tonne gantry crane.



SPECIFICATIONS:
SPEED: 15.3 knots.
CAPACITY: 310 TEU including 68 slots for refrigerated cargo. Has bulk tanks for caustic soda and special tanks for vegetable oils.
LOADING: Access to roll on/roll off deck by quarter ramp. Also 26 tonne gantry crane.

SPECIFICATIONS:
SPEED: 16.5 knots.
CAPACITY: 339 units general or refrigerated.
LOADING: This is carried out by Tugmasters and trailers driving up a quarter ramp with a 38 tonne travelling gantry crane which lifts off and places the units in the appropriate slow.

Fig. 1.2.25 The Vessels of P.F.L.

Source: Pacific Forum Line

Table 1.2.8 PFL Summary Profit and Loss Statement
(million WS$)

	1978	(%)	1979	(%)	1980	(%)
Gross Revenue from Trading	1.7		4.5		16.1	
Total Operating Expenses	2.8	(100)	7.0	(100)	20.8	(100)
of which: Charter Hire	0.9	(32)	2.0	(19)	4.4	(21)
Equipment Costs	0.1	(4)	0.8	(11)	4.2	(20)
Fuel Costs	0.3	(11)	1.2	(17)	3.5	(17)
Loading Costs	0.6	(21)	1.4	(20)	3.2	(15)
Discharging Costs	0.4	(14)	0.7	(20)	2.9	(14)
Port Costs	0.3	(11)	0.6	(9)	2.4	(12)
Other Costs	0.2	(7)	0.3	(4)	0.2	(1)
Operating Loss	(1.1)		(2.5)		(4.7)	
Administration Costs	0.3		0.6		1.2	
Net Loss for Period	(1.4)		(3.1)		(6.0)	

Source: "A Study of the Pacific Forum Line"
July 1981
Touche Ross & Co.

143. Concerning PFL, some comment should be made concerning Samoa Shipping Services Co., Ltd. (SSS)

Following is an outline of SSS.

. Ownership	:	50% Government of Western Samoa 50% Columbus Line of West Germany
. Responsible	:	For managing the "Forum Samoa" on behalf of the Government of Western Samoa which also owns the vessel.
. Time Charter	:	To PFL

SSS is responsible for the crew on behalf of the Government. This means that the charter rate includes crew wages, etc., together with maintenance of the vessel.

(2) Port Activities

i) Vessel Calls at Apia and Asau

144. In Western Samoa there are two ports for foreign trade, the Port of Apia and the Port of Asau. But at present almost all vessels and cargo pass through the Port of Apia, and the Port of Apia connects to the South Pacific Region, Japan, USA and Europe by liner services as noted above.

145. The number of vessels which call at Apia is recorded by the Ministry of Transport, the Customs Department and by the Department of Statistics. The Customs Department publishes an annual report "Return of the Trade, Commerce and Shipping of Western Samoa," and the Department of Statistics reports the "Economic Statistics of Shipping" annually.

146. According to the "Return of the Trade, Commerce and Shipping of Western Samoa," the number of vessels calling at Apia remained stable at 460 to 480 per annum over five recent years. This figure includes ferries between Apia and Pago Pago and yachts (see Table 1.2.9).

147. On the other hand, accordidng to the "Economic Statistics of

Shipping," the number of calling vessels at Apia varied from 185 to 223. The Ministry of Transport data are very close to these (See Table 1.2.10).

148. These data do not include

- Ferries between Apia and Pago Pago (about 100)
- Yachts (about 80 - 100)
- Uncounted Commercial Vessels (about 50)

The Customs Department data on ferry services shows 100 round-trips between Apia and Pago Pago, about double the number recorded by Western Samoa Shipping Corporation.

149. The types of commercial vessels that call at the Port of Apia are listed in Table 1.2.11 based on the "Economic Statistics of Shipping." The vessels are divided into six categories which are General Cargo Vessels, Container Vessels, Semi-Container Vessels, Roll-on/Roll-off Vessels, Passenger Cruise Vessels and Others (mainly tankers).

150. The number of general cargo vessels has been decreasing recently. On the other hand the number of container vessels has been increasing. Semi-container vessels call only several times annually. Roll-on/Roll-off vessels are one of the main vessel types. As mentioned in Section 3) of this Chapter, PFL operates Roll-on/Roll-off vessels. Passenger cruise vessels call less than ten times annually. Tankers which unload oil products or load coconut oil call about twenty times per year.

151. The total tonnage decreased from 1.1 million GRT in 1980 to 0.72 million GRT in 1986.
The average tonnages of the calling vessels have also decreased from 5,760 GRT in 1980 to 3,890 GRT in 1986. The biggest ships which call at Apia are passenger vessels of 20,000 - 25,000 GRT.

152. The berth occupancy of the main wharf fluctuates during the year. The average annual berth occupancy is 50 - 60%. But this rate is calculated covering all mooring time and includes resting time. The team estimates the real berth occupancy rate for the cargo handling at 30 - 40% at best (Fig. 1.2.27).

153. The average monthly frequency of the vessel calls varies from 13 in September to 20 in March (see Table 1.2.12).

154. At the Port of Asau only some 20 vessels call each year: six or seven are tankers and the rest are general cargo vessels (see Table 1.2.13).

Table 1.2.9 Number of Vessel Calls at Apia

	1976	1978	1979	1980	1981	1982	1983	1984	1985	1986
Vessels	355	517	563	525	415	388	401	-	-	-
Yachts	51	89	97	115	76	94	81	-	-	-
Total	410	606	660	640	491	482	482	462	466	487

Source: Customs Dept. "Return of the Trade, Commerce, and Shipping of Western Samoa"

Table 1.2.10 Number of Calls by Type of Vessel

	1980	1981	1982	1983	1984	1985	1986
General Cargo	112	95	94	88	95	87	84
Container	16	15	30	46	46	34	42
Semi-Container	3	5	6	4	5	4	3
Roll-on/Roll-off	30	48	53	44	46	45	35
Passenger Cruise	9	9	9	4	7	7	-
Others (mainly Tankers)	22	18	21	29	24	19	21
Total	192	190	213	215	223	196	185

Source: Dept. of Statistics "Economic Statistics of Shipping"

Note : Excludes ferries and yachts

Table 1.2.11 Average Tonnages of Calling Vessels (Unit: 1,000 GRT/Vessel)

Type of Vessel	1980	1981	1982	1983	1984	1985	1986
General Cargo	4.05	2.51	1.61	1.57	1.98	2.39	2.80
Container	7.31	8.87	6.47	7.83	7.43	6.59	7.12
Semi-Container	9.67	6.60	3.33	3.50	3.60	2.50	11.33
Roll-on/Roll-off	5.53	4.33	3.83	3.89	3.76	3.82	3.77
Passenger Cruise	21.67	21.33	7.78	21.00	13.71	8.57	-
Others	6.59	7.33	9.62	5.90	3.54	3.16	0.95
Total	5.76	4.93	3.94	4.36	4.04	3.74	3.89

Table 1.2.12 Number of Vessel Calls per Month

Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
19	15	20	17	17	16	18	18	13	16	15	18

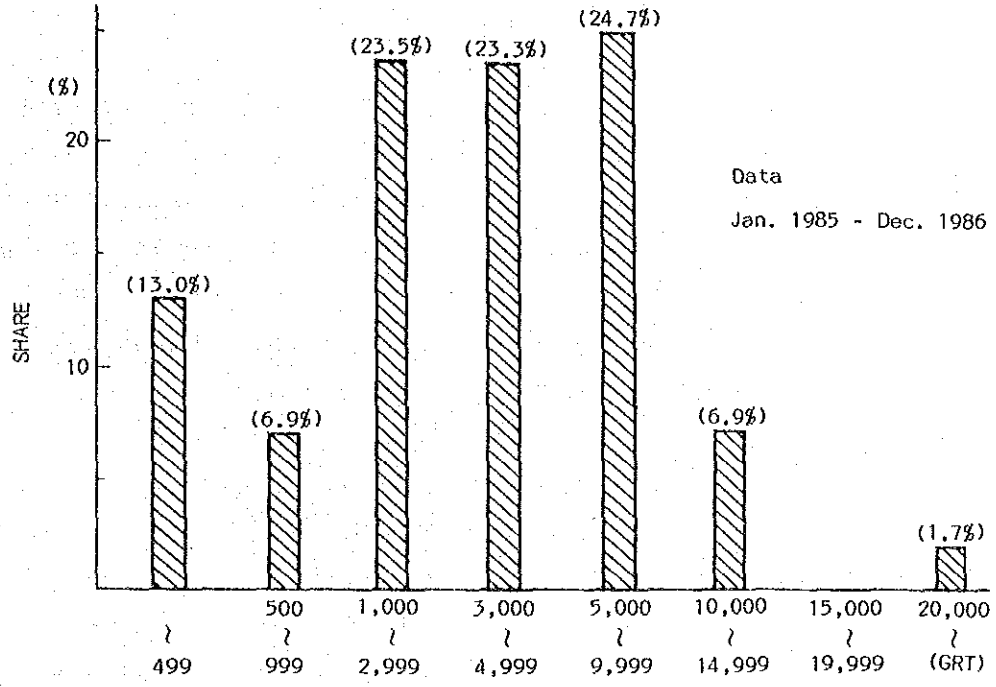
Source: Dept. of Statistics

Note: Average 1984 - 1986

Table 1.2.13 Number of Vessel Calls at Port of Asau

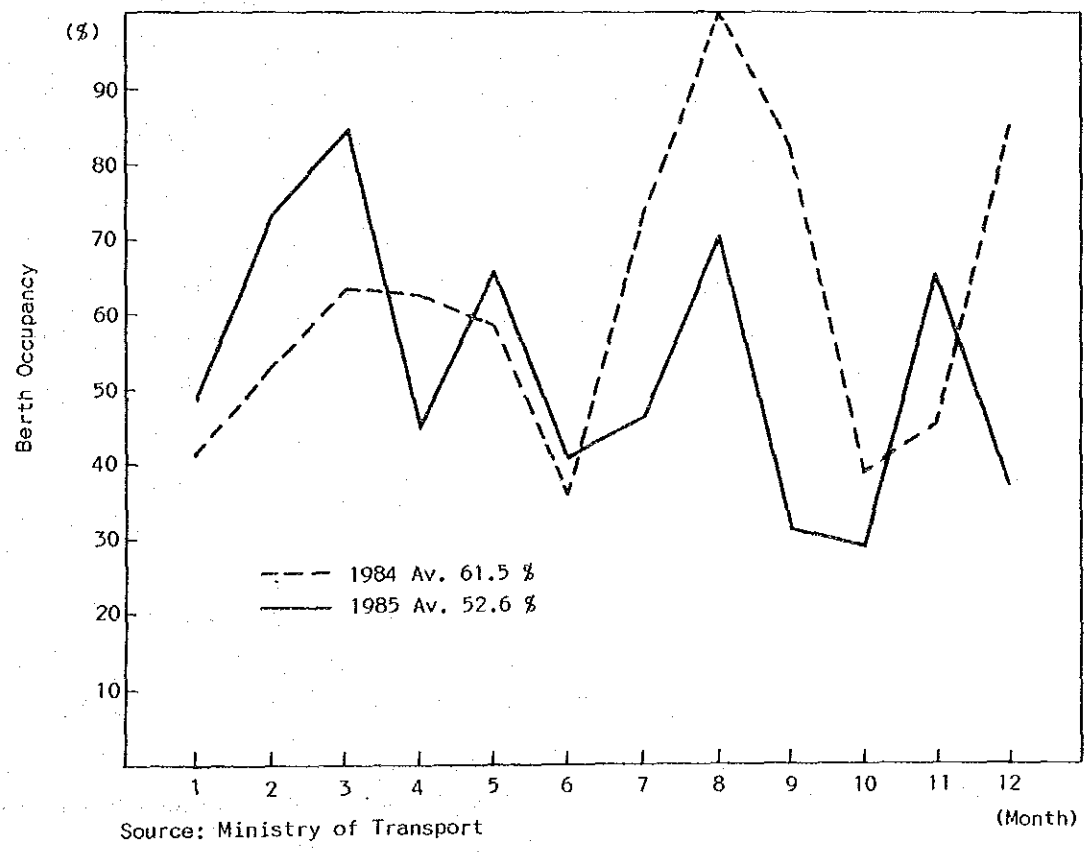
Type of Vessel	1982	1983	1984	1985	1985
General Cargo	16	21	12	13	5
Tanker	6	6	6	7	6
Total	22	27	18	20	11

Source: Ministry of Transport



Source: Ministry of Transport

Fig. 1.2.26 Vessels Using the Main Wharf by Vessel Size



Source: Ministry of Transport

Fig. 1.2.27 Berth Occupancy

ii) Cargo Volume

155. Concerning the cargo volume loaded and unloaded there are two sets of statistics, one prepared by the Customs Department showing the total cargo in Western Samoa, and the other prepared by the Department of Statistics for Apia only. In Table 1.2.14, the total cargo volume in Western Samoa is summarized from 1974 to 1983 using the data of the Customs. And in Table 1.2.15, the cargo volume handled at the Port of Apia is summarized using the data of the Statistics Department and other sources.

156. From Table 1.2.14, we can read that the total cargo volume increased from 75 thousand tons in 1974 to 159 thousand tons in 1983. The annual increase rate during this period was 8.8 per cent.
Imports in this period increased from 51 thousand to 116 thousand tons (a 9.6 per cent annual increase). On the other hand exports increased from 24 thousand to 43 thousand tons (a 6.8 per cent annual increase).

157. From Table 1.2.15, we can read that the total cargo volume has been increasing in the 1980's. In 1981 the volume was 132 thousand tons and in 1986 it rose up to 181 thousand tons, a 6.3 per cent annual increase. In this period imports increased from 129 thousand tons to 160 thousand tons, a 5.2 per cent annual increase. But exports increased from 33 thousand to 52 thousand tons, a 9.4 per cent annual increase, because of the increase of coconut oil exports.

158. As for Asau Port, there is no official data. The main cargoes handled at the port are oil products (import) and timber (export). All oil products consumed in Savaii are unloaded at Asau. The volume was 2,400 tons in 1986. The volume of timber exports is estimated at 3,000m^3 per annum.

159. Table 1.2.16 is a summary of the main commodities imported to Western Samoa. The volume of oil product imports is the largest, but shows no clear trend. In 1981 the volume was up to 32 thousand tons but in 1982 it dropped to 16 thousand tons. Within this volume 2,000 - 3,000 tons of oil products unloaded at the Asau Port are included. In Table 1.2.17, the oil products imported by tanker are divided into three categories: motor

spirit, kerosene & white spirit (jet fuel), and distillate fuels (diesel). Within the oil products, distillate fuels comprise almost 50 percent of the total volume. And recently the volume of kerosene and white spirit has been increasing because of the increase of jet flights.

160. Outside of the oil products, foods such as cereals, sugar, preserved fish, meat, salt and vegetables are the main commodities. The total tonnage of these foods amounts to 22 thousand tons in 1983, almost 20 percent of the total import volume.

161. Cement and iron are also main commodities here. Along with increased public works and private investment, the volume of these two commodities has been increasing.

162. The import of vehicles is relatively small. The records show the number of vehicles, and the tonnage varies from 10 to 50 tons per unit.

163. Table 1.2.18 is a summary of the main export commodities from 1974 to 1985. Until the beginning of the 1980's copra was the main commodity, but recently copra products, coconut oil and copra meal have become the main commodities. The export of cocoa has declined and the export of bananas has stopped. Taro is one of the most important export commodities.
Timber is also exported, but the volume is relatively small.

164. In Table 1.2.19, imports are described by area of origin. In most years Australia and New Zealand have provided more than half of Western Samoa's imports. And imports from North America have decreased. Most of the cargo from Asia is from Japan.

165. New Zealand, Europe and North America are major export markets for Western Samoa. But exports to Asia are low.

iii) Container Cargo

166. Concerning container cargo, the Container Park Study was executed by the Asian Development Bank in 1984, and the results of the study are now being reviewed.

167. There are no official statistics concerning container movement. In the Container Park Study, the total container movement was calculated based on private stevedoring statistics. In 1983 the figure was 5,500 TEU. In our study the movement was calculated using the same method. In 1986, the total container throughput was 5,100 TEU as described in Table 1.2.5. The percentage of empty containers in 1986 was 5 percent for imports and 73 percent for exports.

168. In order to know the average daily container stock within the port area, a daily count was conducted on February 14, 21 and 28. The results are as follows:

Date	Feb. 14	21	28
TEU	355	290	263

These numbers are a little larger than those presented in the Container Park Study. In that study the maximum number was 293 and the minimum was 235 with an average of 272 TEU.

169. Due to the lack of statistics, container dwell time cannot be calculated accurately. But according to the stevedoring report, the average is 19 days per container.

iv) Passengers

170. The cargo statistics produced by the Department of Statistics exclude most of the trade between Western Samoa and American Samoa, and thus they also exclude passenger statistics on the ferry service. Every year 30 - 40 thousand passengers use the ferry services between Apia and Pago Pago. For comparison there were 125,675 international arrivals and departures by air in Western Samoa in 1984. Thus sea passenger traffic represents about a quarter of the total.