MINISTRY OF AGRICULTURE & LABOR
ST. VINCENT & THE GRENADINES

BASIC DESIGN STUDY REPORT
ON
THE FISHERY COMPLEX CONSTRUCTION PROJECT
IN
ST. VINCENT & THE GRENADINES

JANUARY 1996

JAPAN INTERNATIONAL COOPERATION AGENCY
OVERSEAS AGROFISHERIES CONSULTANTS CO., LTD.

BASIC DESIGN STUDY REPORT ON THE FISHERY COMPLEX CONSTRUCTION PROJECT IN ST. VINCENT & THE GRENADINES
JANUARY

MINISTRY OF AGRICULTURE & LABOR
ST. VINCENT & THE GRENADINES

BASIC DESIGN STUDY REPORT

ON

THE FISHERY COMPLEX CONSTRUCTION PROJECT

IN

ST. VINCENT & THE GRENADINES

JANUARY 1996

JAPAN INTERNATIONAL COOPERATION AGENCY
OVERSEAS AGROFISHERIES CONSULTANTS CO., LTD.

PREFACE

In response to a request from the Government of St. Vincent and the Grenadines, the Government of Japan decided to conduct a basic design study on the Fisheries Complex Construction Project and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to St. Vincent a study team from July 2 to August 10, 1995.

The team held discussions with the officials concerned of the Government of St. Vincent, and conducted a field study at the study area. After the team returned to Japan, further studies were made. Then, a mission was sent to St. Vincent in order to discuss a draft basic design, and as this result, the present report was finalized.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of St. Vincent and the Grenadines for their close cooperation extended to the teams.

January, 1996

Kimio Fujita
President
Japan International Cooperation Agency

January 1996

LETTER OF TRANSMITTAL

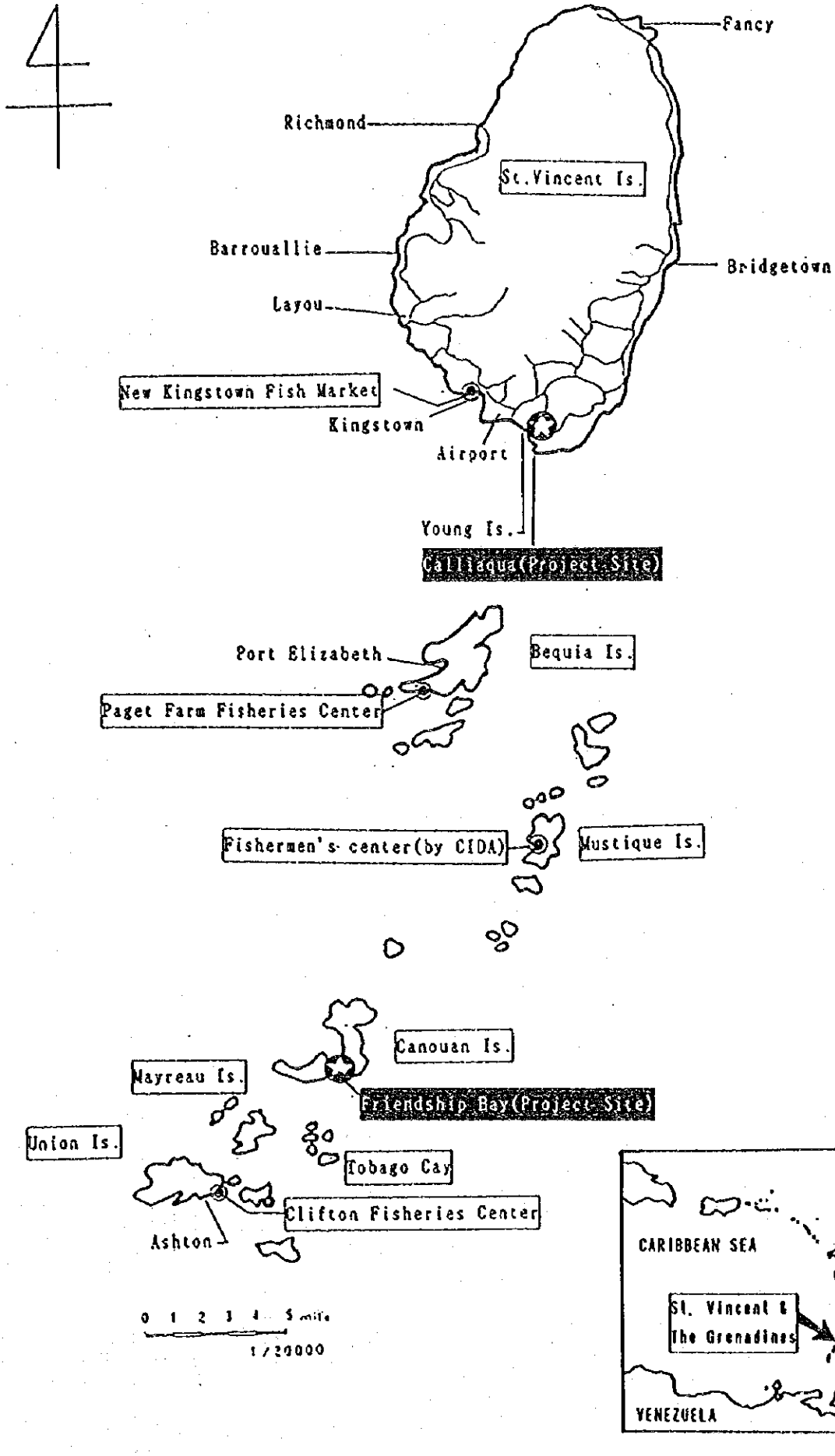
We are pleased to submit to you the basic design study report on the Fisheries Complex Construction Project in St. Vincent and the Grenadines.

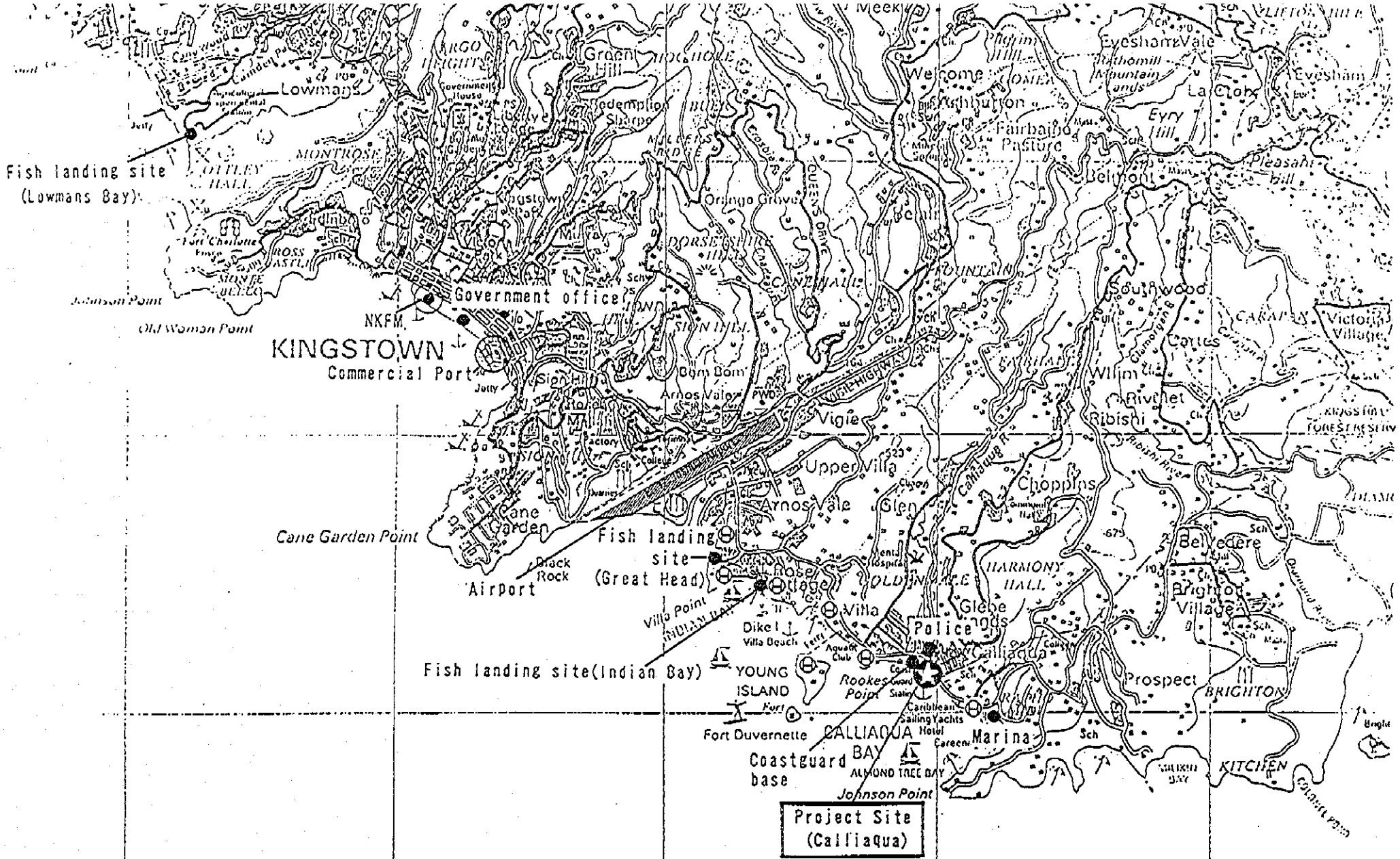
This study was conducted by Overseas Agro-Fisheries Consultants, Co., Ltd. (OAFIC), under a contract to JICA, during the period from June 28, 1995 to January 16, 1996. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of St. Vincent and formulated the most appropriate basic design for the project under Japan's grant aid scheme.

Finally, we hope that this report will contribute to further promotion of the project.

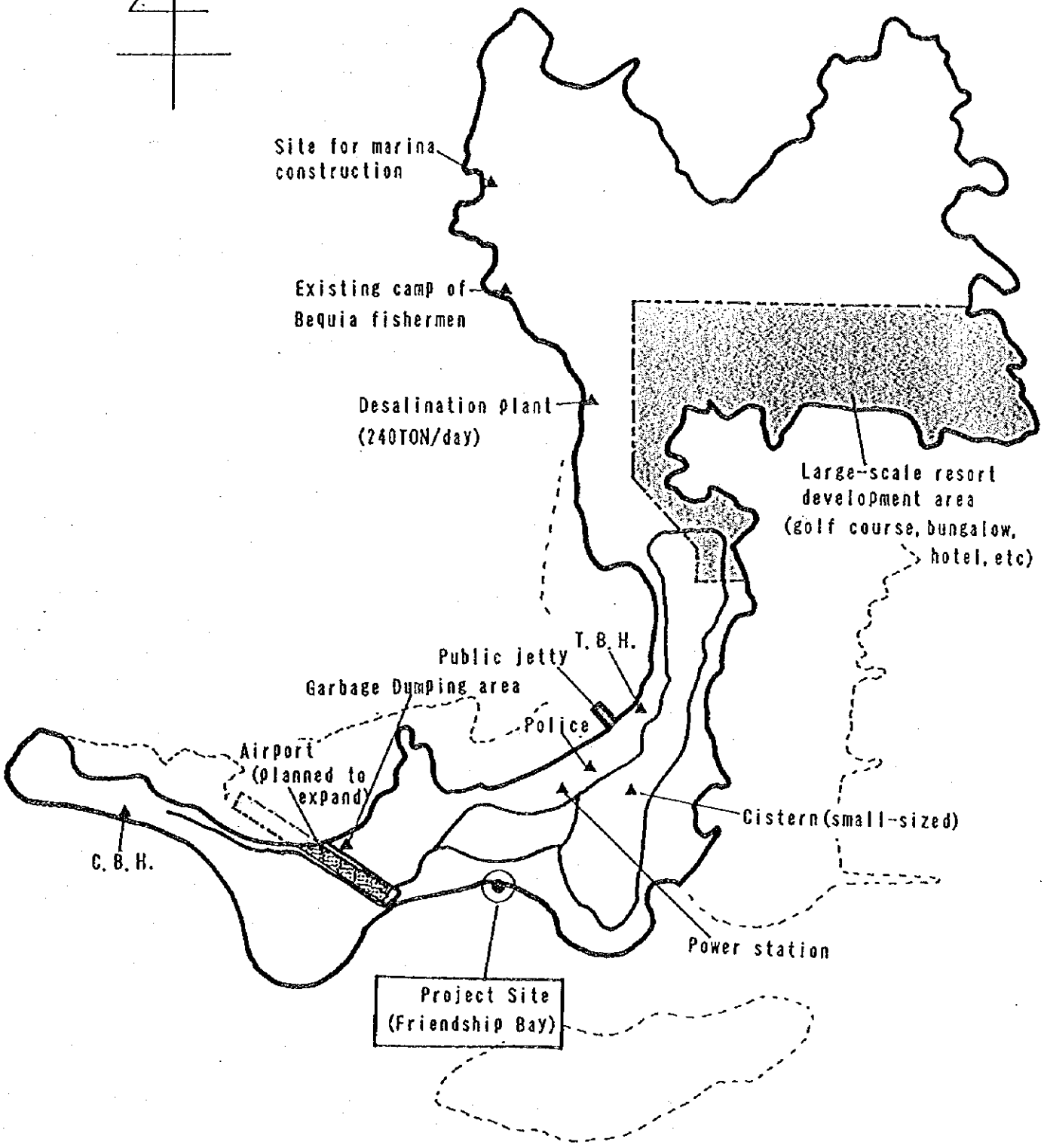
Very truly yours,

Hiroshi Fukao
Project manager,
Basic design study team on
the Fisheries Complex Construction Project
Overseas Agro-Fisheries Consultants, Co.,
Ltd. (OAFIC)

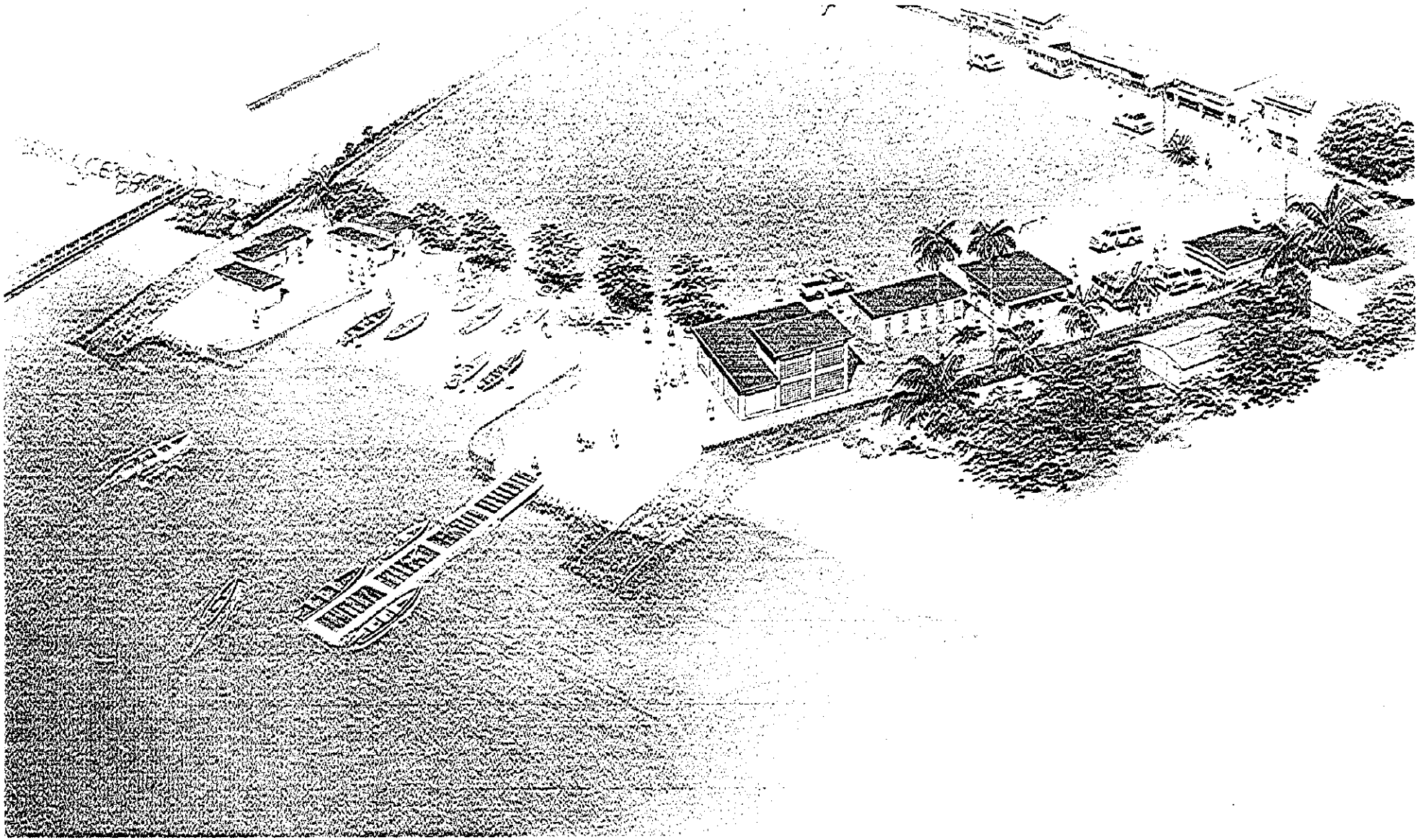

Fancy
Richmond
St.Vincent Is.
Barrouallie
Bridgetown
Layou
New Kingstown Fish Market
Kingstown
Airport
Young Is.
Calliaqua(Project Site)
Port Elizabeth
Bequia Is.
Paget Farm Fisheries Center
Fishermen's center(by CIDA)
Mustique Is.
Canouan Is.
Mayreau Is.
Friendship Bay(Project Site)
Union Is.
Tobago Cay
Clifton Fisheries Center
Ashton
0 1 2 3 4 5 mile
1/20000
CARIBBEAN SEA
St. Vincent &
the Grenadines
VENEZUELA


Fish landing site
(Lowmans Bay)
Government office
NKFM
KINGSTOWN
Commercial Port
Old Woman Point
Cane Garden Point
Airport
Fish landing site
(Great Head)
Fish landing site(Indian Bay)
Fort Duvernette
Coastguard base
Project Site
(Calliaqua)
Map of Calliaqua Area
: Hotels

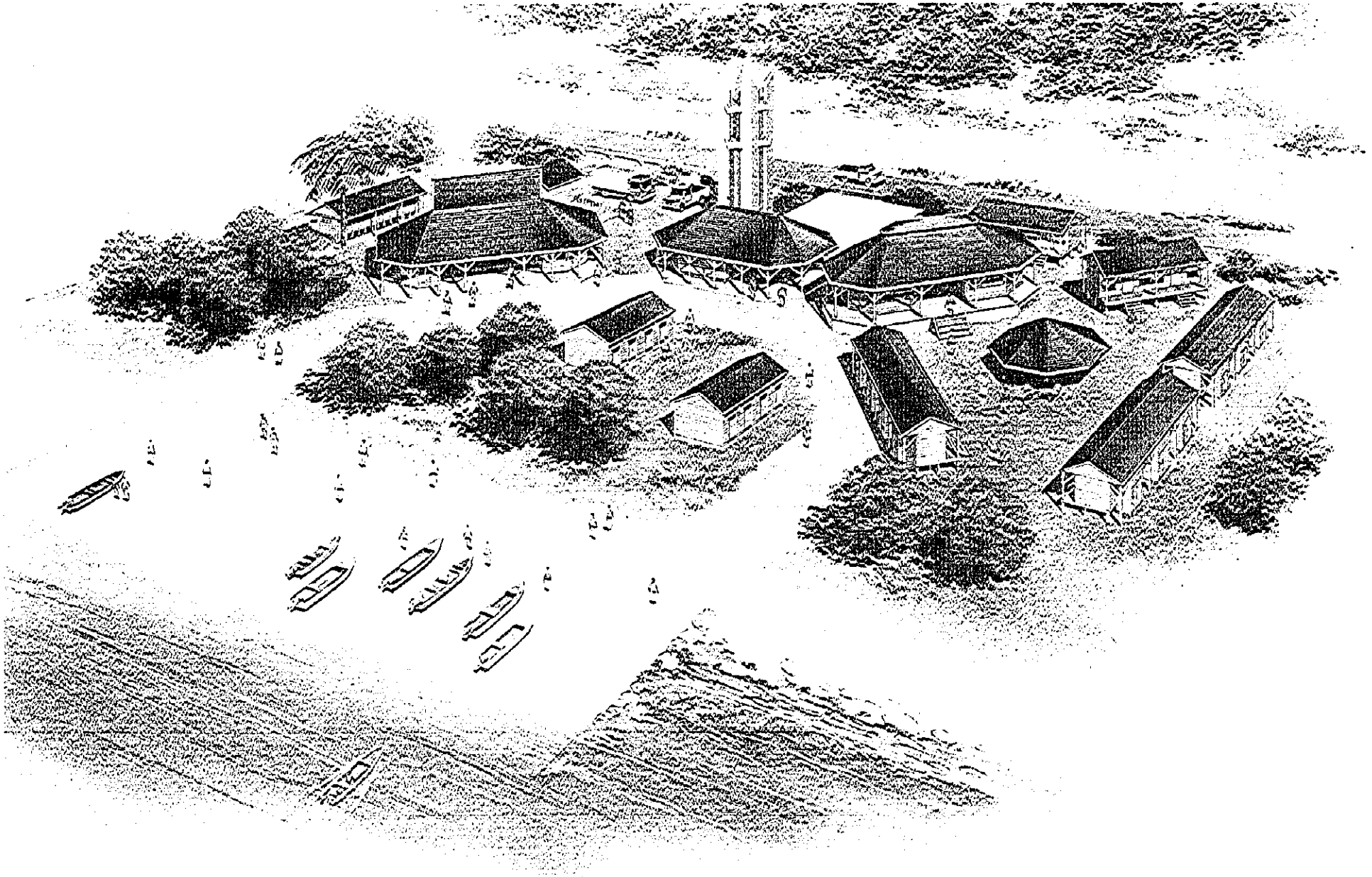
4



Map of Canouan Island



Calliaqua Fisheries Complex St. Vincent and the Grenadines



Canouan Fisheries Complex St. Vincent and the Grenadines

TABLE OF CONTENTS

CHAPTER 1 BACKGROUND OF THE PROJECT

St. Vincent and the Grenadines is a volcanic island group located in the East Caribbean Sea. It gained its independence from the United Kingdom in 1979. The country is surrounded by rich fishing grounds containing pelagic fish resources such as skip jack and tuna, etc. and demersal fish on the continental shelf. However, as the fishing industry on the islands is small scale, productivity is limited. The national economy has developed based on a mono-cultural formed agriculture industry revolving mainly around the export of bananas. However, following the emergence of a unified European market, the banana export business has started to show signs of recession. For this reason, the government decided to institute a national five-year development plan (1991-1995) with the aim of restructuring the economic structure through the diversification of primary industry, based on the slogan of "Balanced Growth and Sustainable Development". With regard to the fishery sector in particular, because of abundant unused resources and due to the fact that there is a demand for marine products in both the domestic and international markets, plus the fact that the local people have a traditional affinity with the sea, the fishery is positioned as a prominent field which can be expected to develop in the future. Unfortunately, the establishment of facilities and systems to support the fishery sector is not advanced due to insufficient funds within the country.

Regarding the issues and policy directions of fisheries development in the country, these are indicated in the Fisheries Development Plan (1984-1991) prepared by FAO in 1984, and the Fisheries Development Plan (1986-1992) prepared by CIDA in 1986. In the FAO plan, emphasis was placed on "development of offshore fish resources", "assurance of a stable supply of fish to inland areas" and "improvement of the fish marketing system", while the CIDA plan placed emphasis on "establishment of fisheries-related organizations and fostering of people", "construction of the fisheries infrastructure in fish landing bases" and "establishment of the domestic distribution and export systems". In following years, CIDA continued to provide technical assistance and materials and equipment, etc. based on its own plans until February 1992.

At the same time as the CIDA assistance, Japan has also provide fisheries grant aid assistance to St. Vincent and the Grenadines. The contents of the projects conducted under Japanese fisheries grant aid are summarized below.

① 1987-88: New Kingstown Fish Market Construction Project (I and II)

* Fish market (sorting area, retail market, refrigeration facilities, small shops, bus terminal, etc.)

* Fish landing facilities (wharf, refueling equipment, etc.)
* Fish market equipment, quality inspection equipment

② 1990: Fisheries Development Project

* Provision of fishing boats and fishing gear, etc.

③ 1993: Coastal Fisheries Development Project

* Construction of the Paget Farm fisheries complex on Bequia Island (breakwater, mooring quay, fisheries center)
* Construction of the Clifton fisheries complex on Union Island (wharf, mooring quay, fisheries center)
* Provision of ice-making plant and cold storage, and equipment for fish processing and quality assurance for New Kingstown Fish Market

These grant aid projects have steadily contributed to the development of fisheries in the country. In specific terms, the amount of fish supplied to New Kingstown Fish Market increased from 100 tons to 450 tons between 1987 and 1991, and fish landings are also said to be on the increase in recent years.

The Government of St. Vincent and the Grenadines, wishing to further stabilize the supply of fish to inland areas and establish systems for distribution between the remote islands and St. Vincent and for export, etc., made a further request to the Government of Japan in April 1993 for grant aid in order to establish fish landing and distribution centers in Calliaqua, which is the second largest fish landing area on St. Vincent behind New Kingstown Fish Market, and on Canouan Island, which is remotely situated in the Grenadines.

CHAPTER 2 CONTENTS OF THE PROJECT

2-1 Objectives of the Project

Since the start of the National Five-year Development Plan (1991-1995) in 1991, the Government of St. Vincent & the Grenadines has expressed its intent to diversify the primary industrial base due to the fact that there is a cloud hanging over the production of bananas, the country's main industry; and within the diversification plan, development of the fisheries sector, for which there are abundant natural resources, is a prominent target. This Project forms one part of the improvement of fish landing and marketing infrastructure in the country, being proposed in the fisheries development plan prepared by FAO as well as CIDA, and is a continuation of Japan's previous grant aid project which resulted in the construction of fisheries centers on the islands of Bequia and Union.

The Project will include the construction of fishery complex in both Calliaqua (the main island), where the population is rapidly increasing through the expansion of the capital sphere, and on the island of Canouan, which is the only one of four main islands of the Grenadines yet to possess a fisheries base. The Calliaqua complex is aimed to improve fish distribution and stabilize fish supply ro the major consumption area, while the Canouan complex will be developed to promote export of fish as well as to meet the local demand in live with tourism development. The Project will also involve the provision of fishing boats and equipment wihch are necessary for development and extension of fishery technology having bases on these complex.

The short-term targets of the Project can be summarized as follows.

(1) Provide fishermen with better fishing environments and opportunity to increase their catches and incomes.

(2) Supply high quality fresh fish to residents living in the rapidly expanding residential area, hotels and restaurants in relation to tourism industry.

The medium and long-term targets of the Project can be summarized as follows.

(1) Upgrade fishing efficiency and increase fish catch in the Grenadines waters by providing fishermen with appropriate facilities as fishing bases.

(2) Supply more demersal fish from the Grenadines to a main island "St. Vincent", for satisfying local demand, import substitution as well as increase in fish export.

(3) Utilize effectively the fish resources in the Grenadines through improvement of quality and development of processed fish.

2-2 Basic Concept of the Project

2-2-1 Suitability and Necessity of the Project

This Project intends to develop the fish landing and distribution base, which is one of the priority development targets in the fisheries sector. The Project fits in with the Fisheries Development Plan that was prepared by FAO and CIDA in the past.

Development of fisheries in the Grenadines had been slow due to insufficient basic facilities and limited local demand, however, following assistance projects carried out by Japan and other donor countries in the past, construction of fishery facilities was carried out on three islands such as Bequia, Union and Mustique, out of the four major islands in the Grenadines. Moreover, on the island of St. Vincent, fisheries distribution in the capital has improved dramatically following the opening of the New Kingstown Fish Market in 1990, resulting in the increase of fish landings from 100 tons/year to 450 tons/year. However, as a result of a dispersion of the capital's population into the suburbs, structural problems have started to appear in the distribution system that relies totally on Kingstown alone. The Project intends to construct fishery complex on Canouan Island and in Calliaqua, which were the main areas to be overlooked by past fisheries infrastructure development projects, and as a result of this development, it is expected that the fundamental base for fish landing and distribution will be completed in the demand center of the capital sphere and in the Grenadines having abundant fish resources.

① Canouan Fishery Complex

It has not been possible to gain an accurate understanding of the fishery situation around Canouan. However, from examining the Fisheries Department and CIDA study reports and results of the interview surveys, it is estimated that fish catch in Canouan amounts to approximately 62 tons/year (including fish sold to the schooners). There are about 70 local fishermen with 23 fishing boats on this island. As well as these, 21 migrant fishermen (seven boats) from Bequia engage in bottom long living having a base on the beach on the north-west of the island. In addition, 25 fishermen (five boats) from Bequia catch lobsters and conch by diving in the waters of neighboring Tobago Cays, which is due to be made a fishing prohibited area from the beginning of 1996. These migrant fishermen

spend most of the year living in the camp on the natural beaches. There are also around 50 local fishermen (15 boats) on Mayreau Island to the south of Canouan. As these islands have only a limited demand and most of the fish are sold off to the private schooners, which visit two or three times per month, the operating efficiency is extremely low at times when the schooners do not visit, with fishing only being performed by a few boats that have contracts with hotels.

At present, a total of ten such schooners are currently operating in the Grenadines and, of these, three make trips to and from Canouan. One of these schooners is registered in Bequia and moves around together with the migrant fishermen of the said island, and the other two, which are registered in Petit Martinique, hop from island to island coming up from the south. These schooners are able to carry approximately two tons of fish at a time. In terms of operating frequency, those operating in the waters around the national borders with Grenada (Petit Martinique, Petit St. Vincent and Union), where facilities are well developed, make frequent trips to and from Martinique once a week, whereas those schooners that collect fish from Canouan only visit one or two times per month.

It can thus be seen that the absence of any landing and storage facilities on Canouan makes fishermen to go out fishing after the private schooners have arrived. As well, the schooners have to wait on the island for one or two weeks until enough fish is collected and necessary ice has to be brought in from Kingstown or Petit Martinique (territory of Grenada). These situations cause extreme inefficiency of fishing operation and marketing.

The government is making great efforts into tourism development in the southern Grenadines. Particularly on Canouan, having the untouched natural tourism resources, a large-scale resort development (through Italian capital) is underway in the north of the island, together with the Canouan Airport Expansion Project. Canouan is linked to St. Vincent by a regular ferry service, which operates three times per week, and by small Cessna (10 passengers) regular services (three times per week) and charter flights, which operate at all times. It is expected that access to the island will gradually improve with the development of tourism. It is also hoped that this tourism development will lead to increases in the demand for locally caught fish.

In view of the above-mentioned conditions, it is judged that improvements to the working and living environments of the local and migrant fishermen on Canouan

and its surrounding islands, together with improvements in the efficiency levels of fishing and distribution are necessary. If these improvements are carried out, it is forecast that fish catch will increase as a result of a greater desire to fish among the fishing community, that fish exports will increase as a result of more frequent private schooner services, and that a stable supply of fish to local residents and the growing tourist industry will be established (see Figure 2-1).

② Calliaqua Fishery Complex

It was found in the national census of 1991 that the population of Calliaqua (20,290 persons) has increased dramatically in the past 10 years, while that of the capital Kingstown (15,466 persons) has been decreasing during same decade (-6.4%). This result shows that Calliaqua had become a main commuter suburb for Kingstown. Moreover, the area has been a center for tourism development and is the site of numerous hotels and restaurants. These trends are expected to gain pace in the future. Calliaqua district possesses three fish landing beaches at Calliaqua, Great Head and Indian Bay. As there are no fish storage facilities in the area, however, the local residents have to make the long journey to New Kingstown Fish Market in order to obtain fresh fish. Moreover, as there are hardly any fishermen or landing beaches on the shores to the east of Calliaqua, the residents on the eastern seaboard and inland areas are unable to obtain fresh fish nearby and are mainly living on imported canned fish and salt-dried fish.

Figure 2-1 Fish Distribution in the Grenadines

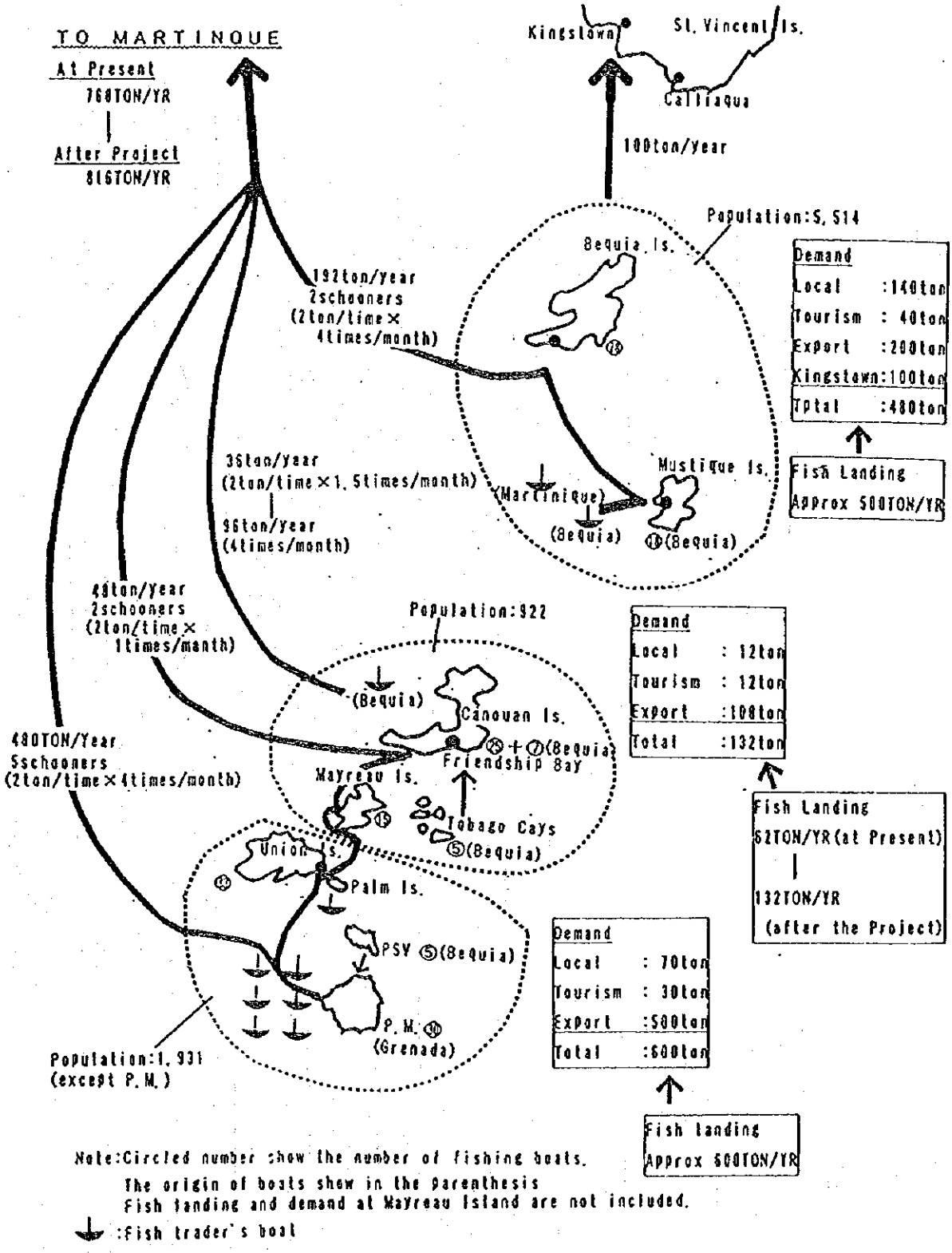
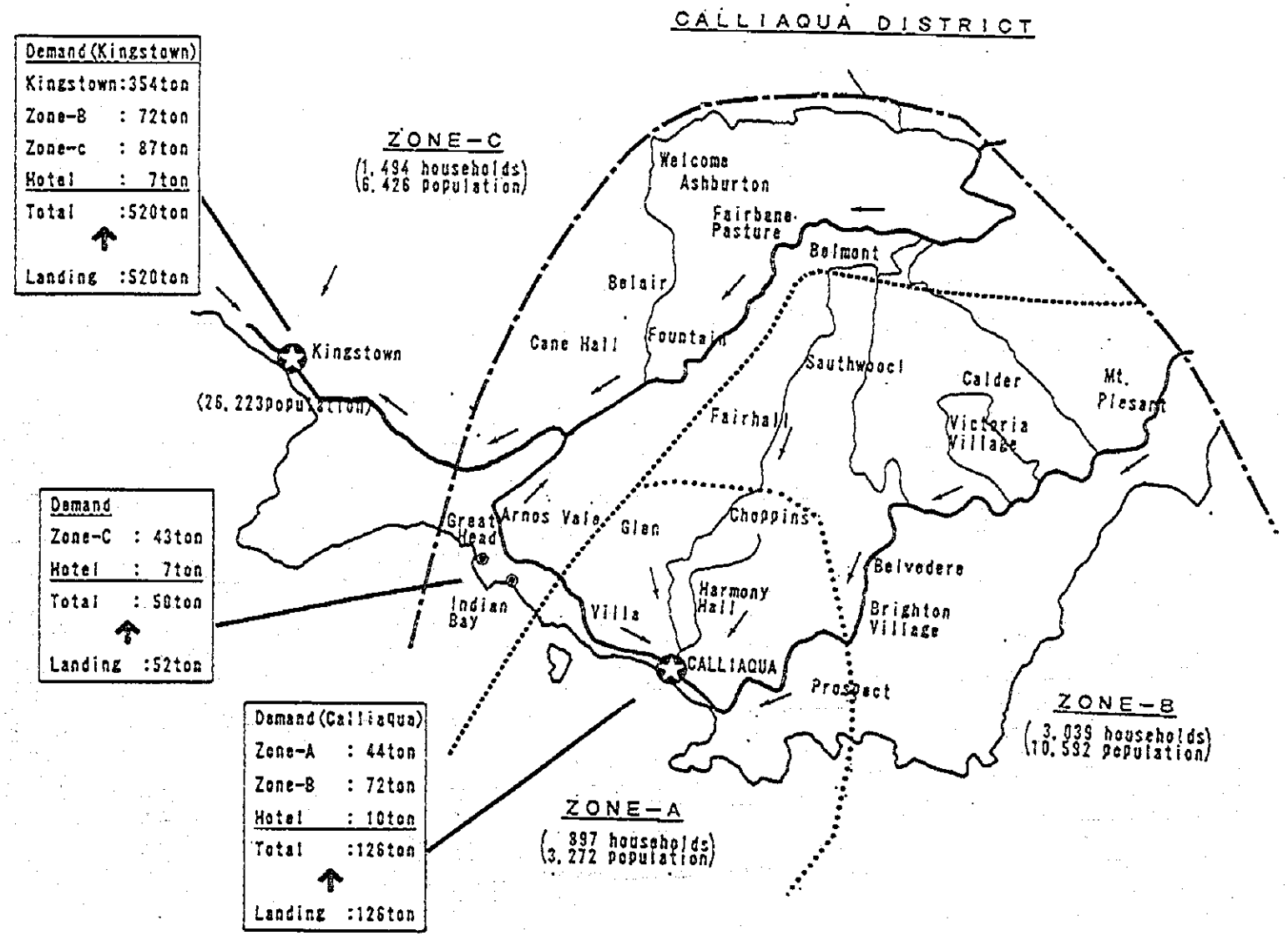


Figure 2-2 Fish Landing & Distribution Plan in Kingstown and Calliaqua



Calliaqua is a fish landing site that is the closest to the fishing grounds. Many of the local fishermen catch large pelagic fish in the waters of the Atlantic on the south-east side of the St. Vincent. Calliaqua only possesses 13 fishing boats and its combined hauls in 1994 amounted to a mere 16 tons. This is due to the low level of fishing efficiency resulting from the fact that the fishermen have to directly sell their catch to hotels and land fish at New Kingstown Fish Market, because of no ice making or storage facilities or any suitable retail market. Thus, even though there is a local demand as fishery center by both fishermen and consumers in Calliaqua, the area has to depend on a landing and distribution network of New Kingstown Fish Market.

Judging from the traffic network linking the area with Kingstown and the purchasing pattern of the residents, it is expected that approximately two-thirds of the locals would use the project facilities. Combining with the potential demand from the surrounding tourist industry, it is estimated that the area would demand 126 tons of fish every year (see Figure 2-2). In addition the operating efficiency of the local fishing boats would be improved, and it would be also expected for not only the fishing boats of Calliaqua, but also for those of Great Head and Indian Bay to land their catch at Calliaqua, considering the geographical merits.

③ Fishing Boats

The fishery has been traditionally carried out in the Grenadines and the local people are accustomed to work on the sea. Although the marine resources in coastal areas have already been exploited, the demersal fish on the continental shelf and its slope far from the islands are virtually untouched. The five 12.7 m tuna long-line fishing boats (of which one belongs to the Fisheries Department), were introduced under the fisheries development project of 1991, and are actively operated having a base in Kingstown for the development of tuna long-line fishing. However, it will take much time for such boats to extend to the local fishermen due to large gap to move away from outboard motor boats. In addition, the current tuna long-line fishing has little link with fisheries development in the Grenadines. As for the existing outboard motor boats, it is necessary to expand the navigation range, to maintain fish quality on boats, and to improve fuel consumption rate in the course of the exploitation of demersal fish resources. With these circumstance in mind, the Project will introduce one 10 m multi-purpose boat and four 7 m diesel outboard motor boats in an attempt to develop fishing operations in the waters around the Grenadine Islands.

In conclusion, it is judged that the Project is both highly necessary and suitable in that it will aid improvements in the living standards of local subsistence fishermen, it will contribute to the promotion of local economic development, and it will lead to the effective exploitation of untouched marine resources and improve quality levels.

2-2-2 Relation to Similar Projects

Past projects with a similarity to this Project are, in the area of landing and distribution facilities construction, the Japan's grant aid project of 1987/1988 which resulted in establishment of New Kingstown Fish Market, and the project of 1993 which resulted in construction of the fishing bases on the islands of Bequia and Union. In the area of offshore fisheries development, the project of 1991 saw the provision of tuna long-line fishing boats and fishing equipment. In addition to the above, the following two facilities have already been constructed for migrant fishermen in the past.

① Mustique Fishermen's Facility

On this island, fishermen's facility was constructed by a local private real estate company the Mustique Company with the support of the Government of Canada in 1992 at a cost of approximately 1,000,000 US$. This facility is mainly used by migrant fishermen from the island of Bequia. The contents of the facilities are as described below:

a)	Simple accommodation:	7 buildings	(four 4-person rooms × two buildings, two 4-person rooms × five buildings),
b)	Toilets and showers:	2 buildings	(1 urinal, 2 toilets and 3 showers per building),
c)	Kitchen:	2 buildings	
d)	Fish processing and selling area:	1 building	(1 counter, 1 freezer (7 m^3), ice making machine (500 kg/day))

There is no charge for using the facilities and the fishermen only need to pay EC$10/month for fresh water. This facility has led to an improvement in the living environment of the local fishermen and has enabled stable supplies of fish to be provided to tourists.

② Petit St. Vincent Fishermen's Facility

This facility was constructed by the private company (hotel operator) that has been entrusted with the tourism development of the island and is used by the migrant fishermen from Bequia, who spend seven months of the year on the

island and mainly fish by diving. The facilities, which can accommodate 15 fishermen (five 3-person rooms), are similar in content to those on Mustique, and the fishermen pay a fixed rent to the operating hotel.

2-2-3 Examination of Project Component

The intended functions of the facilities and equipment of the Project can be broadly divided into the following:

① Landing of fish and mooring of boats,
② Handling, storage and distribution of fish,
③ Improvement of the fisheries environment,
④ Development and extension of fisheries technology.

All these functions are both indispensable and indivisible in the promotion of coastal fisheries and, only when these functions are mutually effective can comprehensive fisheries development take place. In this respect, the components of the Project are judged to be neither lacking nor too excessive.

2-2-4 Forecast Project Catch and Demand Levels

The forecast catches of the target boats and target fishermen at each of the Project facilities have been set in the manner shown in Table 2-1, based on consideration of improved operating efficiency levels of existing boats and the introduction of the Project boats. The Project demand levels have been set in the manner shown in Table 2-2, based on the existing demand levels for marine products. It must, however, be noted that, unlike the case of the New Kingstown Fish Market which saw a rapid increase in its handling loads due to the flocking of boats and merchants to it from its first year, regional fishing villages need to put much greater effort into making fishermen and distributors aware of the availability of facilities, and as it is considered that such a process requires much time, it will take several years for the Project fishery facilities to attain the forecast handling loads.

A. Canouan Fishery Facilities

The fishing grounds around Canouan are located on the continental shelf beyond the atoll which surrounds the island. Many of the local fishermen live in the central hilly belt on the south of the island and have made the beaches of Bachelor's Hall Bay to the north and Friendship Bay to the south the bases for their operations. As the fishing grounds surround the whole island, the living

district is no more than some 500 m from both the northern and southern beaches, and the fishermen's lockers will remove the need for fishermen to carry their fishing gear home, there will hardly be any inconvenience involved in transferring the fishing bases from the existing beaches to the Project facilities site. Seen in terms of fish distribution, too, it is clear that the private schooners, which are the main demand sources for fish, will utilize the Project facilities in that they are more convenient for collecting loads and procuring ice and fuel, and thus the fishermen will also utilize the facilities for landing due to the advantages they offer in terms of fish storage and selling. In the same way, the migrant fishermen who are based on Canouan will move into the Project facilities equipped with a better living environment because such transfer will in no way restrict their fishing grounds or distribution routes. Moreover, as the waters of Tobago Cays will be officially designated as a National Marine Park and fishing prohibited area in 1996, the migrant fishermen operating in those waters, too, will inevitably have to move to the Project facilities, which are located closest to their existing bases. Government agencies concerned in St. Vincent are making efforts to coordinate the actual relocation of those fishermen in discussion therewith. It is therefore considered that all the local and migrant fishermen currently operating on and around Canouan and Tobago Cays will utilize the Project facilities for landing and also for obtaining supplies of ice and fuel. Furthermore, it is needless to say that the migrant fishermen will be able to beach their boats (currently numbering 14) following the landing of fish at the facilities. As for the 23 fishing vessels of the local fishermen, it is considered that the seven vessels currently based in Friendship Bay plus another eight of the remaining 16 will use the Project facilities as their base.

① Target boats and fishermen: 39 boats, 131 fishermen

Migrant fishermen:	14 boats, 54 fishermen (12 boats and 46 fishermen from Bequia, and two boats and eight fishermen from Arnos Vale)
Local fishermen:	23 boats and 69 fishermen (15 boats and 45 fishermen targeted for landing and resting, eight boats and 24 fishermen targeted for landing only)
Project boats:	two boats for eight fishermen (one 10 m multi-purpose boat and one 7 m outboard motor boat)

② Project catches: 132 tons/year (440 kg/day)

Migrant fishermen: 46.6 tons/year

Local fishermen: 66.3 tons/year

Project boats: 18.6 tons/year (9.6 tons from multi-purpose boat and 9 tons from the outboard boat)

③ Project Distribution Quantity: 132 tons/year

Local residents: 12 tons/year (18 kg/person × 650 people)

Tourist industry: 12 tons/year (4.9 tons for hotels, 5.0 tons for yachts, 2.7 tons for northern villas)

Schooners: 108 tons/year (96 tons for Bequia-registered schooners, 12 tons for Petit Martinique-registered schooners)

B. Calliaqua Fishery Facilities

The coastal waters to the south-east of St. Vincent contain the main fishing grounds of the fishermen living in the south of the island. To the east of Kingstown are three landing beaches: Calliaqua, Great Head and Indian Bay. The fishermen of Great Head are particularly active and possess the highest operating efficiency levels, and it is estimated that the fish catches here total some 100 tons each year. According to the fish catch statistics for each landing beach compiled by the Fisheries Department, 30 - 50 tons of fish is landed at Great Head annually and this is all sold off at the fish market located some 500 m away from the beach. There is no data concerning landed quantities by port of registration of boats in New Kingstown Fish Market, however, it can be inferred that the fishermen of Great Head land around half of their catches in Kingstown. Judging from this situation, if fishery facilities are constructed in Calliaqua, not only the local fishermen of Calliaqua but also the fishermen of surrounding areas (Great Head and Indian Bay) will land the fish that they currently land in Kingstown (equivalent to half of their catches) in Calliaqua, which is both closer to the fishing grounds and also possesses a sufficient demand for fish. Moreover, fishermen will perform the refueling of and loading of ice onto their boats at the more conveniently placed Project facilities. However, concerning the resting of fishing boats, as the Project facilities and surrounding area landing beaches are separated by a number of kilometers, the local fishing boats of Calliaqua shall only be allowed to use the facilities, while the surrounding area boats shall return to their respective beaches following landing at Calliaqua.

①	Target boats and fishermen:	34 boats, 102 fishermen
	Local fishermen:	13 boats and 39 fishermen (targeted for landing and resting)
	Surrounding area fishermen:	16 boats and 48 fishermen (from Great Head and Indian Bay, targeted for landing only)
	Project boats:	two boats for eight fishermen (two 7 m outboard motor boats)
②	Project catches:	126 tons/year (420 kg/day)
	Local fishermen:	50 tons/year
	Surrounding area fishermen:	52 tons/year
	Project boats:	24 tons/year
③	Project Distribution Quantity:	126 tons/year
	Local residents:	44 tons/year (13.5 kg/person × 3,272 people)
	Surrounding area residents:	72 tons/year (13.5 kg/person × 10,592 people × 50%)
	Tourist industry:	10 tons/year

Table 2-1 Planned Catches in the Project Facilities

(1) Canouan

Fishermen Type	Breakdown	Number of Boats (Fishermen)	Basis for Estimated Catches	Planned Catch (tons/year)	Remarks
Migrant Fishermen	Bequia fishermen (Canouan, Little Bay)	Seven 5-6 m boats (21 fishermen)	30 kg/day × 7 boats × 15 days/month × 12 months	37.8	Demersal fish, large pelagic fish (hand-line, bottom long-line fishing)
	Bequia fishermen (from Tobago Key)	Five 4-5 m boats (25 fishermen)	10 kg/day × 5 boats × 20 days/month × 8 months 10 kg/day × 1 boat × 20 days/month × 4 months	8.8	Lobster, conch (diving)
	Arnos Vale fishermen (irregular)	Two 7 m boats (8 fishermen)	Not included due to irregularity	-	
	Subtotal	14 boats (54 fishermen)		(46.6)	
Local Fishermen	Friendship Bay	Three 5-6 m boats (9 fishermen) Four 4-5 m boats (12 fishermen)	30 kg/day × 8 boats × 16 days/month × 12 months	46.1	The 5-6 m boats mainly catch demersal fish and large pelagic fish through hand-line fishing. The 4-5 m boats catch lobster, conch and demersal fish through diving, submersible guns and hand-line fishing.
	South Glossy Bay	One 5-6 m boat (3 fishermen)			
	Bachelor's Hall Bay	Four 5-6 m boats (12 fishermen) Nine 4-5 m boats (27 fishermen)	10 kg/day × 9 boats × 16 days/month × 8 months	20.1	There are two 12 m, onboard motor boats and a 7 m canoe boat dumped in Batchelor's Hall Bay
	Charles Bay	Two 4-5 m boats (6 fishermen)	10 kg/day × 6 boats × 4 days/month × 4months (part working)		
	Subtotal	23 boats (69 fishermen)		(66.3)	
Project Boats	10 m multi-purpose boat	1 boat (4 fishermen)	400 kg/trip × 2 trips/month × 12 months	9.6	Tuna and other large pelagic fish (tuna seine nets), demersal fish (bottom seine nets)
	7 m boat	1 boat (4 fishermen)	50 kg/day × 16 days/month × 12 months	9.6	Demersal fish (bottom seine nets)
	Subtotal	2 boats (8 fishermen)		(19.2)	
Total		39 boats (131 fishermen)		132 tons (440 kg/day)	

(2) Calliaqua

Fishermen Type	Breakdown	Number of Boats (Fishermen)	Basis for Estimated Catchs	Planned Catch (tons/year)	Remarks
Local Fishermen		Four 7 m Trinidad boats (12 fishermen)	30 kg/day × 4 boats × 20 days/month × 12 months	28.8	Demersal fish and large pelagic fish (hand-line fishing and trolling), small pelagic fish (seine nets)
		Eight 4-5 m B & S boats (24 fishermen)	10 kg/day × 8 boats × 16 days/month × 12 months	15.4	Same as above
		One 7 m canoe boat (3 fishermen)	30 kg/day × 1 boat × 16 days/month × 12 months	5.8	Same as above
	Subtotal	13 boats (39 fishermen)		(50.0)	
Surrounding Area Fishermen	Great Head	Ten 7 m Trinidad boats (30 fishermen) Two 7 m B & S boats (6 fishermen) Two 7 m canoe boats (6 fishermen)	30 kg/day × 10 boats × 20 days/month × 12 months × 50% 30 kg/day × 2 boats × 16 days/month × 12 months × 50% 30 kg/day × 2 boats × 16 days/month × 12 months × 50%	46.5	Demersal fish and large pelagic fish (hand-line fishing and trolling), small pelagic fish (seine nets)
	Indian Bay	Two 6-7 m canoe boats (6 fishermen)	30 kg/day × 2 boats × 16 days/month × 12 months × 50%	5.8	It is assumed that the surrounding area fishermen will land 50% of their catches at the Project facilities and the remaining 50% locally.
	Subtotal	16 boats (48 fishermen)		(52.3)	
Project Boats		Two 7 m boats (8 fishermen)	50 kg/day × 2 boats × 20 days/month × 12 months	24.0	Demersal fish (bottom long-lines)
	Subtotal	2 boats (8 fishermen)		(24.0)	
Total		31 boats (95 fishermen)		126 tons (420 kg/day)	

Table 2-2 Forecast Fish Demand Levels at the Project Facilities

(1) Canouan

Category	Destination	Current Distribution Quantities		Forecast Demand Following Project Implementation	
		Basis for Calculation	Distribution Quantity (tons/year)	Basis for Calculation	Distribution Quantity (tons/year)
Local Residents		153 households × 1 kg/week × 52 weeks (12 kg/person/year)	8.0	153 households × 1.5 kg/week × 52 weeks (18 kg/person/year)	12.0
	Subtotal		(8.0)		(12.0)
Tourists	Hotels	100 rooms × 25% × 1.5 people × 0.3 kg/person/day × 365 days	4.1	100 rooms × 30% × 1.5 people × 0.3 kg/person/day × 365 days	4.9
	Yachts	5 yachts/day × 4 people/yacht x 0.3 kg/person/day × 365 days	2.2	10 yachts/day × 4 people/yacht × 0.3 kg/person/day × 365 days	4.4
	Northern villas	(Currently under development)	-	300 people × 0.3 kg/person/day × 30 days/year (first phase only)	2.7
	Subtotal		(6.3)		(12.0)
Private Schooners	Bequia-registered	1 boat × 2 tons/trip × 1.5 trips/month × 12 months	36.0	1 boat × 2 tons/trip × 4 trips/month × 12 months	96.0
	Puchi Martinique-registered	2 boats × 0.5 tons/trip × 1 trip/month × 12 months	12.0	2 boats × 0.5 tons/trip × 1 trip/month × 12 months	12.0
	Subtotal		(48.0)		(108.0)
Total			62.3 tons (200 kg/day)		132 tons (440 kg/day)

(2) Calliaqua

Category	Destination	Basis for Calculation	Demand (tons/year)	Remarks
Local Residents	Calliaqua Zone-A	3,272 people × 13.5 kg/person/year	44.2	Population figures are based on national census of 1991.
	Calliaqua Zone-B	10,592 people × 13.5 kg/person/year	71.5	Consumption per person is calculated by dividing the annual haul in 1994 by
	Subtotal		(115.7)	the total population in the south of the island (from Calliaqua to Questelles)
Tourists	Surrounding hotels (Zone-A)	120 rooms (10 buildings) × 50% × 1.5 people/room × 0.3 kg/person/day	9.9	(748 tons ÷ 55,377 people =13.5 kg). It is assumed that 50% of the surrounding area residents will utilize
	Subtotal		(9.9)	New Kingstown Fishing Market.
Total			126 tons (420 kg/day)	The hotel accommodation rates and numbers of room are current values.

2-2-5 Examination of Contents and Scale of Facilities and Equipment

(1) Landing and Mooring Facilities

On the island of Canouan, hardly any of the catch is brought onto land but is instead directly sold to the schooners that are anchored off shore. Only a very small fraction of the catch is landed for selling to hotels and local consumers. The only existing jetties are the public jetty used for freight and passenger boats and two or three small jetties privately owned by hotels. These jetties are not suitable for fishing boat mooring or fish landing, and can not be used constantly. Moreover, as the island has no refueling facilities and is completely reliant on fuel and oil carried from Kingstown by ferry three times a week, the fuel supply to the boats is unstable. Many of the island's beaches are privately owned for tourist development purposes, and the number of beaches suited to the landing of fishing boats is growing fewer all the time. For this reason, the local fishermen make rocky beaches with protruding reefs the centers for their operations, however, the hauling up of boats on these beaches is difficult and there is a risk of damage to ship hulls. In view of these circumstances, a jetty that allows the schooners, the Project boats and the local boats to come alongside and easily carry out landing, loading, refueling and water loading, etc. is required as part of the fisheries facilities on the island. Moreover, a slipway / boat ramp shall be constructed to enable the local fishing boats to be easily landed onshore.

In the case of Calliaqua on St. Vincent, there are currently no jetty and the local fishing boats either land on the sandy beaches or anchor offshore. Although Project implementation will enable the landing of fish by both the fishermen of Calliaqua and also of the surrounding areas, it will not be able to carry out those fish landing activity at the existing sand beach because of it is too small. In order to attract more fishermen other than those of Calliaqua, a small jetty for use by outboard motor boats is required in order to make the landing of catches proceed more smoothly. Moreover, it is expected that this jetty will be used for mooring of small boats without beaching during the normal weather. Incidentally, as there is no problem in the current landing of the outboard motor boats on the sandy beaches, it is judged that there is no need to construct a slipway / boat ramp.

The scale of the jetties, slipways and refueling facilities are as shown in the following tables.

① Small Jetty

Project Site	Target Boats	Mooring Frequency	Required Berths
Canouan	Three 16 m schooners	24 days/month (2 days/trip × 4 trips/month × 3 boats)	20 m × 1 berth (exclusive)
	One Project boat (10 m)	9 days/month (3-4 days/trip × 2-3 trips/month × 1 boat)	14 m × 1 berth (exclusive)
	One project boat (7 m)	Daily landing and constant mooring	8 m × 1 berth (exclusive)
	37 local boats (4 - 6 m)	3.2 boats/trip (30 minutes/boat trip × 37 boats × 16/30 ÷ 180 minutes/day)	6 m × 3 berths
	Total		82 m
Calliaqua	Two Project boats (7 m)	Daily landing and constant mooring	8 m × 2 berth (exclusive)
	29 local boats (4 - 7 m)	2.5 boats/trip (30 minutes/boat trip × 29 boats × 16/30 ÷ 180 minutes/day)	6 m × 2 berths
	Total		28 m

Remarks:

a) Specifications of the Target Boats

Boat Type	Length (m)	Width (m)	Full Draft (m)	Full Draft Rudder Height (m)
Schooner	15 - 16 m	4.0 - 4.5 m	2.0 - 2.2 m	1.6 - 1.8 m
Project boat (10 m)	10 - 11m	3.0 - 3.5 m	1.5 - 1.6 m	1.0- 1.2 m
Project boat (7 m)	7 m	1.7 - 1.8 m	0.4 - 0.5 m	0.4 - 0.5 m
Local boat	4 - 6 m	1.2 - 1.5m	0.3 - 0.4 m	0.3 - 0.4 m

b) As the boats leave in early morning and return in the evening, and as the jetties are small, the berths will not be divided for preparation and landing. The fish landing activity will concentrate during 3 hours in the afternoon.

c) The local fishing boats will land and rest on the slipways or sandy beaches, and the other boats will moor against the jetties.

d) The average mooring time of local fishing boats is about 30 minutes including time required for fish landing, boat mooring and rest.

Assuming that the both sides of jetties can be used for mooring, in the case of the jetty on Canouan, a length of 45 m from the base will be required to ensure a water depth of 2.5 m for mooring schooners. The jetty at Calliaqua will only be used by small fishing boats, so securing sufficient water depth is not a problem and jetty length will need to be 20 m, including the 5 m long access bridge considering the necessary boat turning space.

The width of jetties both for Canouan and Calliaqua will need to be only 3 m, considering that the fish transport from jetty to the complex will be conducted using hand carts and the volume of fish landing is small.

② Slipway / Boat ramp (Canouan)

Target Boat	Required Slipway Width	Remarks
16 local boats (4-6 m)	29 m (1.8 m × 15 boats)	Of the 23 local boats, 15 including 7 boats who have a fishing base at Friendship Bay are specially targeted to use the facilities.
14 migrant boats(4-6 m)	18 m (1.8 m × 14 boats × 0.7)	All migrant boats are targeted.
Total	45 m	Required slipway width is calculated assuming a boat width of 1.2 m plus an allowance of 0.6 m.

From the above, it is necessary to have a slipway/boat ramp (Canouan) of 45 m wide and more than 7 m long from beach line considering the length of target boats.

③ Refueling Facility

The sizes of the refueling facility have been set as indicated below. The supplying of fuel to the facility itself will be handled by contracting with private oil company.

Project Site	Fuel Type	Target Boats	Required Fuel	Required Equipment
Canouan	Gasoline	37 outboard motor boats	20 L/day × 37 boats × 15 days/month = 11,100 L/month	1.5 KL tank + dispenser
	Diesel oil	One Project boat	1,000 L/trip × 2 trips/month = 2,000 L/month	
		One diesel outboard motor	20 L/day × 1 motor × 25 days/month = 500 L/month	1.5 KL tank + dispenser
		Three schooners	300 L/trip × 8 trips/month = 2,400 L	
Calliaqua	Gasoline	37 outboard motor boats	20 L/day × 29 boats × 15 days/month = 8,700 L/month	2 KL tank + dispenser
	Diesel oil	Two diesel outboard motors	20 L/day × 2 motors × 20 days/month = 800 L/month	Drum can (180 L)

(2) Fish Handling, Storage and Distribution Facilities

As there are currently no ice making and storage facilities on Canouan and Calliaqua, no fish can be stored at all. This leads to a dampening of the will to work among the local fishermen and consequently results in low operating efficiency levels. The main sales destinations on Canouan are the schooners,

however, the fishermen cannot fish until the schooners have arrived, and the fact that the schooners need to carry more ice than usual means that the distribution costs are more expensive than usual. In the case of Calliaqua, the local and surrounding residents are the main consumers, however, the absence of a nearby market means that all of the fish cannot be sold off unless most of it is carried the long distance to New Kingstown Fish Market.

The installation of ice making and storage facilities, including fish handling and treatment areas, are required in order to improve the said situation. Moreover, as most fish is distributed fresh, cold storages are basically unnecessary, and the fish shall be stored in ice in chilled storages for a few days. The introduction of such facilities will enable fishing activities to be pursued irrespective of the schedules of the schooners, and the improved operating levels can be expected to lead to large increases in catches. Moreover, Project implementation will enable treatment of fish with ice on the fishing boats, leading to the improvement of fish quality, and will allow fish handling and storage to be performed in hygienic environments. In addition to this, it will become possible to respond to the demand for fish from local residents through the stable supply of fresher fish.

The handling, storage and distribution of the fish catches in the Project facilities are as illustrated in Figure 2-3 and Figure 2-4.

Figure 2-3 Fish Distribution Plan in the Canouan Fishery Complex

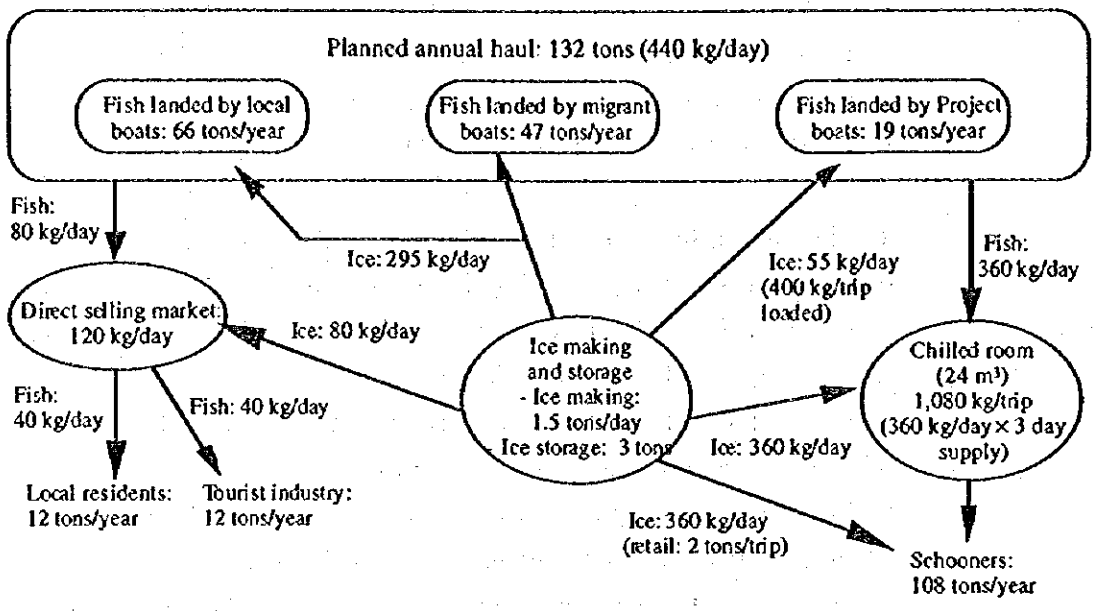
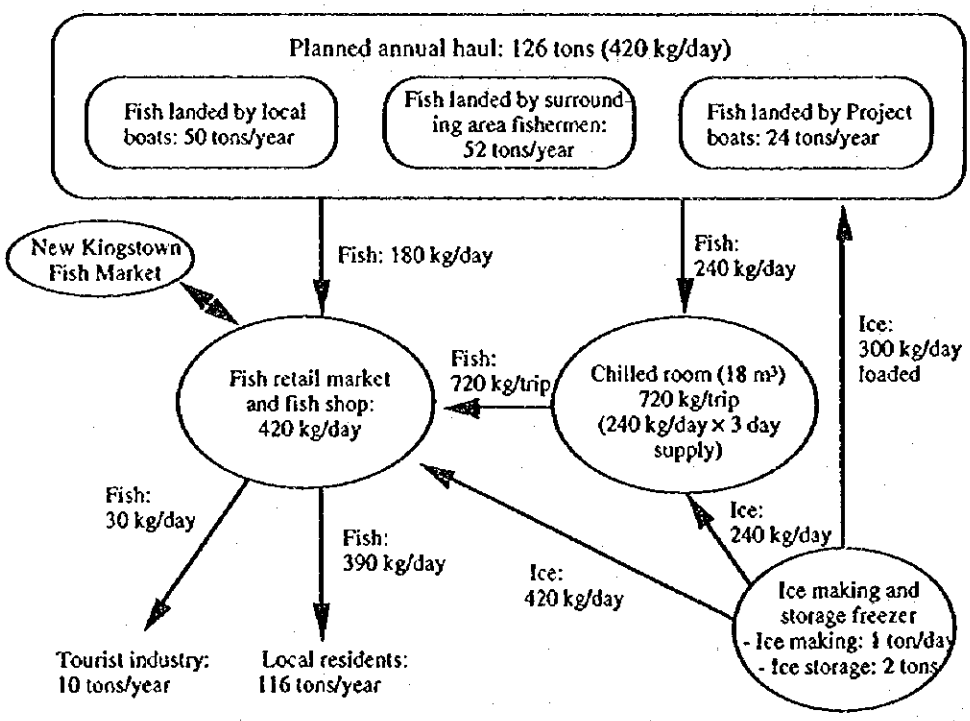


Figure 2-4 Fish Distribution Plan in the Calliaqua Fishery Complex



From the above figures, the necessary ice making and storage ice and fish storage (chilled rooms) are calculated as shown below.

① Ice Making Plant

Project Site	Purpose of Use	Basis for Calculation	Required Ice Quantity
Canouan	For loading onto boats	10 m Project boat: 400 kg/trip × 2 trips/month ÷ 30 days = 27 kg/day 7 m Project boat: 50 kg/day × 16 days/month ÷ 30 days = 27 kg/day Local boats: 15 kg/day × 16 days/month × 37 boats ÷ 30 days = 296 kg/day	350 kg/day
	For fish preservation	Chilled room-stored fish 360 kg/day + local distribution 80 kg/day (Fish : ice = 1:1)	440 kg/day
	For schooners	Fish 108 tons/year ÷ 300 days = 360 kg/day (fish : ice = 1:1)	360 kg/day
	Total		1,150 kg/day
Calliaqua	For loading onto boats	7 m Project boats: 50 kg/day × 20 days/month × 2 boats ÷ 30 days = 67 kg/day Local boats: 15 kg/day × 16 days/month × 29 boats ÷ 30 days = 232 kg/day	300 kg/day
	For fish preservation	Chilling room-stored fish 240 kg/day (Fish : ice = 1:1)	240 kg/day
	For retail market	Handled amount 420 kg/day (Fish : ice = 1:1)	420 kg/day
	Total		960 kg/day

From the above table, the required capacity of ice making plant is 1.5 ton/day for Canouan and 1.0 ton/day for Calliaqua respectively.

② Ice Storage

Project Site	Purpose of Use	Basis for Calculation	Required Stored Ice
Canouan	For loading onto boats	10 m Project boat: 400 kg/trip loaded Local boats: 300 kg/day × 30 days ÷ 25 days (because there is no fishing on Sundays)	760 kg
	For schooners	2 tons/trip	2,000 kg
	Total		2,760 kg
Calliaqua	For loading onto boats	300 kg/day × 30 days ÷ 25 days (because there is no fishing on Sundays)	360 kg
	For small pelagic fish	For seine net caught fish landing (1-2 tons/trip, fish : ice = 1:1)	1,500 kg
	Total		1,860 kg

From the above table, the required capacity of ice storage is 3 ton Canouan and 2 ton for Calliaqua respectively.

③ Fish storage (chilled rooms)

The fish will be stored with ice (fish : ice = 1:1) in plastic fish boxes (70 L, approx. 0.9 m × 0.5 m × 0.2 m), in order to preserve freshness. It will thus be possible to pack 20 kg each of fish and ice into one fish box. The fish boxes will be piled in the chilled rooms to a maximum height of five boxes. The required capacity of chilled rooms in each Project site is calculated in the manner described below.

Canouan: Average fish storage quantity 1,080 kg ÷ fish 20 kg = 54 boxes

0.45 m^2/fish box × 54 boxes ÷ 5 layers = 4.9 m^2

If an area ratio of 0.5 and effective ceiling height of 2.2 m are assumed in consideration of allowing operators to work inside the storage, the required capacity will be as follows:

4.9 m^2 ÷ 0.5 × 2.2 m = 21.6 m^2 (interior size: 3.4 m × 3.4 m × 2.2m)

Moreover, as the local fishermen and migrant fishermen have different fishing practices and social backgrounds, each will be given separate units in order to avoid confusion. Thus, two units of 12 m^3 (interior size: 1.6 m × 3.4 m × 2.2 m) each will be provided.

Calliaqua: Average fish storage quantity 720 kg ÷ fish 20 kg = 36 boxes

0.45 m^2/fish box × 36 boxes ÷ 5 layers = 3.3 m^2

Assuming the same area ratio and ceiling height described above, the required capacity will be:

3.3 m^2 ÷ 0.5 × 2.2 m = 14.5 m^2 (interior size: 2.5 m × 2.5 m × 2.2 m)

However, large quantities of seine net-caught small pelagic fish are landed according to the season in this area can also be considered a possibility. In view of this, a capacity of 18 m^3 (interior size: 3.4 × 2.5 m × 2.2 m) shall be set just to be on the safe side.

Moreover, separate units shall be provided for the local fishermen and the surrounding area fishermen in order to avoid chilled room management problems and confusion. Each unit will thus have a capacity of 9 m^3 (interior size: 1.6 m × 2.5 m × 2.2 m).

④ Retail Market

In Calliaqua, two or three merchants come to sell fish at weekends (Fridays and Saturdays). In addition to these merchants, it is possible that some retailers based at New Kingstown Fish Market will start selling at Calliaqua, too. It is thus forecast that a maximum of five retailers will use the facilities, so a small fish retail market possessing five stalls shall be established. Moreover, in order to attract consumers, it is necessary that the market, albeit small, function as a general market. As around 10 housewives currently sell fruit and vegetables every Saturday on the road in front of the Project site, the market shall combine the functions of a fruit and vegetable market able to accommodate these sellers. The fruit and vegetable market shall also be used as a place for technical training in such areas as fishing gear and outboard motor repairs.

In the case of Canouan, a simple fish direct selling area shall be established within the facilities to enable the local fishermen to sell off their catches by themselves. This will make it possible for the local consumers and tourists to buy fish even when merchants are not there and, most important of all, it is hoped that this will lead to the development of a fishermen's organization and the boosting of fishery activities. Moreover, as the demand for frozen fish from tourists can be considered a possibility and there are seasonal shortages of bait fish, a small freezer shall be installed to allow the selling of frozen fish and the storage of bait fish.

⑤ Insulated Fish Boxes

The insulated fish boxes will be introduced for the trial transportation of demersal fish from Canouan to Kingstown with a view to the future expansion of distribution routes. For similar reasons, insulated fish boxes shall also be provided to the facilities in Calliaqua so as to allow the shipping of fish in insulated fish boxes loaded on pick-up truck, in order to advance the carrying of fresh fish to the inland areas. Calliaqua shall also be provided with large insulated fish boxes for temporary storage (in ice and water) until shipping, because large catches (1 - 2 tons per trip) of small pelagic fish are landed here.

It is also necessary to extend the use of ice on the boats for keeping of fish freshness. It is expected that the Fisheries Department provides guidance in the gradual development of insulated fish boxes that are suited to the local

fishing boats. Based on the above considerations, the quantities of insulated fish boxes to be introduced through the Project are calculated in the following manner.

Canouan:

Boxes for experimental fish transport to Kingstown (150 L):
5 (loaded on pick-up truck)

Calliaqua:

Boxes for fish transport to the inland area (150 L):
5 (loaded on pick-up truck)

Boxes for temporary storage of small pelagic fish (500 L):
2 (2,000 kg/trip × 50%)

(3) Improvement of the Fisheries Environment

In the case of Canouan Island, migrant fishermen (mainly from Bequia) have fishing bases on the island and in Tobago Cays (Petit Tobago), and different migrant groups take it in turns in coming over and spending the majority of the year in the area. These fishermen live in appalling conditions without such necessities as drinking water, electricity and fuel, etc., and there are concerns for their health and safety. Moreover, as a result of the encroaching tourist and local development, it has become necessary to move or merge the existing camps into the Project area. Better camping facilities for migrant fishermen have already been built on Mustique and Petit St. Vincent, and Canouan is now the only migrant fishermen center in the country yet to possess such facilities. The fact that there also many local fishermen on Canouan is another reason why the construction of fishermen's lockers (fishing gear storage), toilets and showers and lodges for migrant fishermen is necessary, in order to enable both the local and migrant fishermen to lead rich and healthy fishing lifestyles in harmony.

In the case of Calliaqua, the local fishermen do not have any stores for their fishing tackle and outboard motors, and the deterioration of the existing toilets and showers has made them almost unusable. For this reason, the fishermen must carry their fishing gears, etc. home every day, and this is another factor behind the low operating efficiency levels. In view of this situation, fishermen's lockers will be built at the landing areas to enable the fishermen to easily prepare for fishing trips and clear up afterwards.

① Fishermen's Lockers

On Canouan, 16 lockers shall be provided for the local fishermen in accordance with the number of their boats. Moreover, lockers shall be provided with each lodge for the migrant fishermen.

In Calliaqua, there will be 13 local fishing boats and two Project boats, however, as it is thought that some fishermen will continue to take their fishing gear and outboard motors home, 10 fishermen's lockers shall be provided.

② Toilets/Showers

Canouan:	For 131 fishermen	three units each
Calliaqua:	For 95 fishermen	two units each

③ Lodges / Mess Room (Canouan)

Each fishing group (migrant fishermen) consists of three to five fishermen, and in consideration of safety, each group shall be provided with a separate room capable of housing four fishermen each. The migrant fishermen spend most of the year on Canouan with different groups taking it in turns and staying for one or two weeks at a time. For this reason, the lodges and mess room shall be provided as public fishermen's living places that can be used by different groups alternately.

Bequia fishermen:

Enough for seven groups of fishermen (from Little Bay):	seven rooms
Enough for five groups of fishermen (from Tobago Cays):	five rooms

Arnos Vale fishermen:

Enough for two groups of fishermen:	two rooms

④ Air Compressors for Diving Cylinder (Canouan)

Diving is the main fishing method adopted around Canouan, however, as the charging of air into cylinders has to be done at distant private diving shops, much time and money is lost. In order to ensure more smooth operation of the diving fishermen, a small air compressor for diving cylinder shall be provided.

⑤ VHF Radio (Canouan)

The OECS (Organization of East Caribbean States) is currently preparing for implementation of a marine radio communication improvement project with the aim of preventing accidents of fishing boats, and it plans to set up radio stations in various areas and install portable VHF radio sets on each fishing boat. In relation with these plans, radio stations shall be set up within the facilities on Canouan in order to keep links with other fishery facilities and to preserve the maritime safety of the fishing boats. This radio equipment will also prove to be an important means of maintaining contact with the private schooners, which will be the major buyers of caught fish for the immediate future.

(4) Development and Extension of Fisheries Technology

Until now, the Fisheries Department had dispatched short-term fishery extension officers to the islands of the Grenadines, however, it did not conduct any organized or systematic training and guidance for fishermen. The extension officers only gave their signatures to export permits and did not possess the necessary ability, equipment or facilities to perform positive technical guidance. This was due to the fact that the scattered nature of the fishermen made it difficult to conduct concentrated training programs. This situation was changed through the construction of fisheries bases on the islands of Union, Bequia and Mustique. If the Project facilities on Canouan are constructed, it will mean that research and development and training facilities will exist throughout the whole of the Grenadines. It is planned to periodically conduct technical research and development and fishermen training and extension into such areas as outboard motor repairs, fishery resource management, fishing gear and fishing methods, quality control, fishermen's organization and environmental conservation, etc. It is also planned to effectively develop training at the regional landing area in Calliaqua. In order to achieve these goals, multi-purpose spaces shall be provided within each facility. These spaces shall, moreover, be utilized as areas for the daily fishing gear repairs and general rest of the fishermen. The equipment and materials required in the performance of the above-mentioned activities are summarized below.

① Engine Maintenance and Repair Tools (Canouan)

In order to establish a simple outboard motor maintenance and repair setup for the fishermen of Canouan, these tools will be utilized in the training of the

necessary technology. The main tools and items of equipment shall consist of general repair tools, a bench drill, an air compressor, an electric welder, and so on.

② Data Processing Equipment

This equipment will be used mainly in the preparation of fish catch and distribution statistics and the general operation and management of the facilities.

Moreover, the construction of fishery resource data bases for each country is being advanced through the Caribbean Fisheries Resource Assessment & Management Project (CFRAMP) of CARICOM, and the provided equipment shall be used in the bolstering of data collection and processing functions at each of the Project landing areas.

③ Education / Training Equipment (Canouan)

Audio-visual equipment shall be introduced onto Canouan with the aim of implementing fishermen training (especially in the areas of marine resources, fishing gear and methods, and environmental conservation). As the school attendance rate of fishermen on Canouan is particularly low compared to that on other islands, the use of practical and audio-visual methods of training will be more effective. Furthermore, in order to bring across the importance of marine resource and environmental conservation and the effectiveness of fishing gear experiments to the fishermen, actual underwater conditions shall be shown through video recordings and photographs, and for this purpose, diving equipment and an underwater camera and video camera shall also be provided.

2-3 Basic Design

2-3-1 Design Concept

(1) Concept Relating to Natural Conditions

1) As the summer season is hot and rainy, the design of facilities shall give ample consideration to shading and ventilation. Moreover, the collection of rainwater shall be made possible in the facilities on Canouan, due to the serious water shortages that occur on the island during the dry season (February to May).

2) Against the splash of sea water and tidal winds on the coast line, salt-resistant building materials and equipment shall be adopted.

3) Attention shall be paid to the materials, colors and shapes of the buildings to ensure that their external appearances match with the surrounding environments.

4) Facility layouts shall be planned so as not to hinder the surrounding sea and land transport, and optimum locations in terms of topographical and geological conditions, too, shall be selected.

5) The foundation level of the site shall allow easy drainage and shall be of a height that has not been inundated due to water level rises and maximum waves caused by the highest hurricanes in the past 30 years.

6) To ensure that sand does not drift at the fronts and sides of the sites, jetties shall be of a pile support structure with good permeability, and the lengths of all structures projecting out to sea (training levees, retaining wall) shall be minimized. The training levee at Calliaqua shall be submerged.

7) The structural forms of sea structures (revetment, retaining walls, jetties) shall be such that the forms of beaches are permanently preserved.

8) As the bottom sediments of sea front are sand, covering armor rocks shall be placed around perimeters of the site to prevent the scouring of the sand by waves.

9) Care shall be taken to ensure that the drainage systems do not directly pollute the waters in front of the Project facilities. In particular, measures need to be taken at Calliaqua to improve the smell and pollution caused by the existing sewage gullies. In the case of Canouan, treated water shall be sprinkled or permeated within the site in order to improve the soil quality and encourage the growth of vegetation.

10) The trees and vegetation within the Project sites shall be left untouched in order to preserve the natural landscape and secure shadow against the sun.

(2) Concept Relating to Social Conditions

As the facilities on Canouan will be utilized by both the local fishermen and migrant fishermen, the layout plan shall ensure that the site and facilities are divided according to the respective origins of fishermen, in order to prevent confusion arising between the different groups. Moreover, care shall be taken to

make sure that the cleaning and tidying, etc. of the facilities is performed in a joint effort by the different fishermen groups.

The facilities in Calliaqua will mainly be used by the local fishermen, however, as it is expected that fishermen from surrounding areas will also land their catches here, care shall be taken to ensure that no problems arise in the use of the related facilities.

(3) Concept Relating to the Construction Situation

With regards to the administration of construction including local plans in St. Vincent and the Grenadines, the Central Planning Department of the Ministry for Finance and Planning has total control over the compilation of important national plans right down to the issue of permission for the construction of individual facilities. Although the Project implementing agency is the Ministry of Agriculture and Labor and, the Central Planning Department is only cooperating in the formation of the plans, its permission must be obtained prior to the tender of the construction work, so that prompt design and permission application shall be conducted in order to ensure that no delays arise in the work schedule.

Public works in St. Vincent and the Grenadines are basically executed in accordance with the construction-related laws and standards of Great Britain and the United States. These related laws and standards, together with the Cubic Code prescribed by the countries of the Caribbean, shall be closely followed to in the design of the Project facilities, and also Japanese technical standards shall be used for reference purposes. With regard to environmental standards (noise, drainage, pollution, etc.), as there are no local laws and regulations for land or sea areas, so the works shall be advanced in accordance with the standards of Europe, America and Japan, or standards that are the equivalent of these or stricter.

The local construction companies can provide workers skilled in general building works, however, engineers from Trinidad and other surrounding countries are procured for the execution of marine structure works. There is no skilled labor at all on Canouan. As the supply of common laborers is also limited, manpower shall be procured from surrounding islands (throughout the whole of the Grenadines) according to necessity.

Construction materials can easily be procured locally (including imported materials), and efforts shall be made to make full use of the local technology and

utilize durable materials. Moreover, as there are no local bodies for testing sand and crushed stone, etc. used for making concrete, careful judgments of the use of such materials will have to be made through detailed quality inspections in advance.

(4) Concept Relating to Utilization of Local Contractors and Local Equipment and Materials

A number of contractors in St. Vincent and the Grenadines are considered to be quite capable of executing the construction of the level of facilities being planned under the Project. These contractors were also selected in the construction of facilities under past similar projects and, as there are no particular problems in terms of technology and finances involved in the construction of the facilities for this Project, the local contractors shall be selected as far as is possible. However, as the local contractors have almost no experience of constructing marine structures such as jetties and slipways, etc., contractors from Trinidad or other surrounding countries shall be selected in this field.

(5) Concept Relating to the Maintenance Capacity of the Implementing Agencies

Local materials and construction methods shall be adopted in the cases of the fishermen's lockers, toilets/showers, temporary rest facilities and cooking facilities, in order to allow the fishing groups who will borrow them to take the responsibility of maintaining the facilities. In the case of the ice making / storage facilities, fishing boats and equipment, the design shall be such so as to ensure that local maintenance is possible and that, in consideration of economic feasibility, the minimum operating costs (power, fuel costs, etc.) can be secured. Furthermore, sufficient quantities of those spare parts which are difficult to obtain locally shall be provided and care shall be taken to ensure that no problems arise in the running of the facilities.

(6) Concept Relating to the Setting of Scopes and grades of Facility and Equipment

① On-land Facilities

Structural materials that are commonly used locally shall be employed in the buildings to be constructed in Calliaqua. Columns, beams and floors shall be made of reinforced concrete, and the walls shall be made of concrete blocks. Roofs shall consist of wooden framework and backing to keep them light, and hot varnished steel plate or asphalt shingles shall be used as the finishing material. As the procurement of water, aggregate, cement and reinforcing

steel is difficult on Canouan, the buildings shall be wooden structures in consideration of the local labor conditions and surrounding environment on the island.

② Marine Civil Engineering Facilities

The jetties shall be permeable pile supported structures in view of the required strength, natural conditions and environment, ease of maintenance and price, and the piles themselves shall be made of reinforced concrete. Moreover, with regard to the jetty floorboards, they shall be a permeable structure (void area ratio $\geqq$ 20%) in order to mitigate the impact and upward pressure forces of high waves and, upon giving full consideration to durability in the marine areas, they shall be made of wood (or composite wood), which is the most suitable in terms of appearance. In case of Canouan, slipway shall be made of concrete in view of the fact that there is a hard reef on the front beach, however, the beach sands shall be used as existed as the natural boat ramp. In Calliaqua, the natural sand beach shall be utilized as slipway and boat ramp.

③ Boats and equipment

With regard to the boats and equipment, procurement shall be made local or from surrounding third party countries, if they meet the required specifications, in consideration of the ease of procurement and the costs of transportation. Moreover, equipment that has previously been introduced in the past in the Project country and surrounding countries shall be adopted in view of the ease of maintenance.

(7) Concept Relating to Works Schedule

Although the Project facilities are to be constructed in two separate sites, in consideration of the small scale of the facilities, the fact that the construction is basically possible through local methods and the fact that there are almost no restraints on the work from the natural conditions unless hurricane come during August to November, the works at the two sites shall be carried out simultaneously, and the Project can be implemented within a single fiscal year.

2-3-2 Design Criteria

(1) Design Criteria Relating to Natural Conditions

The following two tables indicate the design criteria relating to natural conditions that have been studied in the basic design of the Project.

Table 2-3 Design Criteria for Cailliaqua, St. Vincent

	Item		Design Value	Remarks
Natural Conditions	Maximum wind velocity		60 m/sec.	When hurricanes approach
	Maximum wave height (meaningful)		1.6 m/SW	Offshore waves once every 30 years, wave height Ho = 7.0 m (To = 12 sec.)
	Water level	Tide level (at springs)	CDL+0.12 - 0.73 m	Maximum tide difference = 60 cm Average =0.24 - 0.64 (tide difference 40 cm)
		Suction height	+0.5 m	Once every 30 years when a hurricane approaches
	Maximum flow coefficient		2 knots (1 m/sec.)	
	Seismic vibration		0.14	Short period T = 0.3 sec. T ≧ 1 sec. is 0.05
	Bottom sediment		Gravel-mixed sand	
	Rainfall		2,073 mm per year	
	Tempera-ture	Annual variation	Maximum temperature 35°C	Maximum 33.5°C (August), Minimum 18°C (December)
		Daily difference		Average 8.2°C, Annual average temperature 27.1°C
	Humidity		80%	Average 78% (Kingstown)
	Water temperature		Maximum 32°C (fresh water)	Sea water temperature 27 - 30°C
Geology			Surface	Foundation Bed
	Wet density		1.74 - 2.0 ton/m^3	2.8 ton/m^3
	Moisture content		5 - 40%wt	-
	Soil/Grading		Upper part is sand or silt-mixed sand and lower part is coral sand/gravel	Volcanic rock or gravel
	N value		2 - 30	100 or more
	Layer thickness		2.5 - 5 m (BH/1,3,4) 9 - 14 m (BH/2,5)	(BH/1,3):CDL-4.4 - 5.5 m (BH/2,4):CDL-8 - 9 m (BH/5):CDL-15 m

CDL: Chart Datum Level (±0.000 m in this Project)

Meteorological conditions are based on measured values during 1982~1995 at the Kingstown Airport Meteorological Observatory.

The soil conditions are based on the boring and soil tests conducted on the site.

Table 2-4 Design Criteria for Friendship Bay, Canouan

	Item		Design Value	Remarks
Natural Conditions	Maximum wind velocity		60 m/sec.	When hurricanes approach
	Maximum wave height (meaningful)		2.2 m/SW	Offshore waves once every 30 years, wave height Ho = 7.0 m (To = 12 sec.)
	Water level	Tide level (at springs)	CDL+0.12 - 0.73 m	Maximum tide difference = 60 cm Average = 0.24 - 0.64 (tide difference 40 cm)
		Suction height	+0.5 m	Once every 30 years when a hurricane approaches
	Maximum flow coefficient		2.3 knots (1 m/sec.)	
	Seismic vibration		0.14	Short period T = 0.3 sec. T ≧ 1 sec. is 0.05
	Bottom sediment		Coral sand	
	Rainfall		Approximately 1,000 mm per year (estimate)	
	Tempera-ture	Annual variation	Maximum temperature 35°C	No data available. Data from Kingstown adopted
		Daily difference		No data available. Data from Kingstown adopted
	Humidity		80%	No data available. Data from Kingstown adopted
	Water temperature		Maximum 32°C (fresh water)	Sea water temperature 27 - 30°C

		Surface	Foundation Bed
Geology	Wet density	1.63 - 1.89 ton/m^3	1.90 - 2.10 ton/m^3
	Moisture content	10 - 70%wt	16 - 30%wt
	Soil/Grading	Coral sand, partly clay, mixed with silt	Coral consolidated sand, mixed with stones
	N value	5 - 30	35 - 70
	Layer thickness	9.5 (BH/7) - 15.5 (BH/10)	Water depth 8.0 m (land side) - 18 m (BH/10)

CDL: Basic standard surface (±0.000 mm in this Project)

Meteorological conditions are based on measured values during 1982~1995 at and from the Kingstown Airport Meteorological Observatory.

The soil conditions are based on the boring and soil tests conducted on the site.

1) Wind

The normal prevailing wind direction on St. Vincent is 70°-120° (NE-SE), and the annual average wind velocity is 12 knots (5.6 m/sec.) with a maximum wind velocity of 35 knots (18 m/sec.) (data from the St. Vincent Meteorological Observatory).

2) Typhoons

It is said that hurricanes (980 mb. or less, wind velocity of 64.8 knots (33 m/sec.) or more) strike the immediate area of St. Vincent (10°-15° N, 60°-

65° W) 15 times in every 100 years (according to the US Naval Weather Service). St. Vincent itself has only been struck by one hurricane in 1895 and three tropical storms in 1955, 1979 and 1981 (maximum wind velocity 34-63 knots = 17.5 - 32.4 m/sec.). The maximum estimated wind velocity on these occasions was 45 knots with a maximum gust velocity of 65 knots (33.4 m/sec.). The worst hurricane to strike surrounding areas in recent years was Hurricane Allen in 1980, which struck Jamaica and had a central pressure of 930 mb. and a maximum wind velocity of 150 knots (77.1 m/sec.).

As can be seen from the above, St. Vincent and the Grenadines has not been hit by a hurricane in more than 20 years, and the country is outside of the effective wind range of hurricanes that strike surrounding areas (areas within 50-550 km). It is thus considered enough to set the design wind velocity for the Project facilities at the same value as that adopted in Japan (maximum 60 m/sec.).

3) Current Velocity

① Calliaqua

According to the survey, the round-current of SW-NE in parallel with shoreline was excelled but its velocity has not exceeded 0.16 knots (8 cm/sec.) However, the velocity of the offshore current at Calliaqua is indicated 2 knots at maximum according to the sea chart.

② Canouan

The survey found that the current velocity was not more than 0.16 knots in outstanding direction of east. According to the yacht chart (IMARAY LOLAIRE), however, the velocity and direction of offshore current of Canouan (between Canouan and Tobago Cays) vary depending on high and low tide. At low tide it ranges from 0.9 to 2.3 knots in the SE direction, and at high tide it ranges from 1.2 to 2.2 knots in the NW direction. The neap tide current velocity is weak at around half the above.

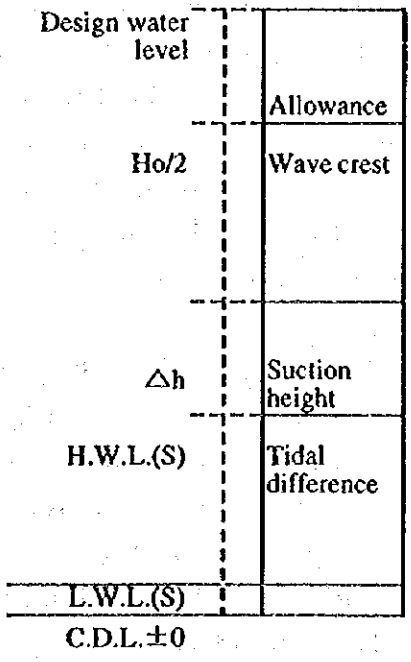
4) Water Level Fluctuations

The variance in the water level caused by the astronomical tides ranges between 2.1 feet – 0.8 feet = 1.3 feet (around 40 cm), and the variance even at springs is small at 60 cm. When hurricanes approach, as regard with the

rise in the water level caused by the drop in air pressure, static suction (△hs) in deep waters and dynamic suction (△hd) in shallow waters also contribute. For the Bequia New Airport and the Union Island Airport Extension projects, static suction height (△hs) was estimated as follows based on research in Holland (R-11).

Distance from Hurricane Center	Static Suction Height (△hs)
0' (nautical miles)	0.71 m
30'	0.28
50'	0.18
100'	0.10

Based on these estimation results, △h = 1 m is assumed as standard in the design of Bequia Airport, however, for the Project facilities, a value of △h = 1.0 m has been adopted in consideration of the rise of water level (△hs) = 0.991 (1,013 – p) = 102 cm when the hurricane (910 mb) approaches.



LWL: Synodic average low tide level
HWL: Synodic average high tide level

Moreover, when estimating the maximum design water level, it is assumed that the water rise due to an approaching hurricane and the maximum wave height would occur simultaneously.

5) Wave Height

① Abnormal Time

Regarding the abnormal waves used in the design of port engineering facilities, etc., it is normal to express them as the probable wave height in the recurrence interval between maximum waves. As this process takes much time, wave estimations were performed using data obtained from a number of hurricanes selected in descending order of size from long-term hurricane data (observation data from the National Hurricane Center (NHC) in Miami), and the estimated values were used to calculate the probable wave height.

Offshore waves in the Caribbean Sea were calculated regarding the five particular hurricanes selected among 54 hurricanes passing through an area of 400 km east to west and 800 km north to south (Long. 59° 36' to 63° 17' W., and Lat. 10° 26' to 17° 40' N.) - an area that covers Dominica and St. Vincent, during the past 40 years. The 5 hurricanes used in the calculations were three of the hurricanes (Hurricane David in August 1979, Hurricane Allen in July 1980 and Hurricane Flora in September 1963) recorded to have the strongest wind velocities at the point of entry to the Caribbean Sea were selected from the past forty years (1955-1994), and the other two (Hurricane Luis in September 1995 and Hurricane Iris in August 1995), which caused extensive damage in the area under question.

The method used to estimate offing waves involved using the spectral method (one-point method (Gotoh method) and MRI model) to calculate a total of 39 offing waves taken from one observation point in the Roseau waters (during Hurricanes David and Luis) and five observation points in St. Vincent waters (during Hurricanes Allen, Flora and Iris). Using Weibull distribution, the non-overprobability for the heights of each of these estimated offing waves was calculated. It is generally the case for 30-year probable waves to be used in port design, and this was the case in these calculations, too. As a result, offshore waves with a height of 7.0 m, an interval of 12 seconds and a direction of SW were adopted. The converted offshore waves for Canouan and Calliaqua were calculated to be between 2.1-2.4 m from this (see attachment 5-2).

② Normal Time

Based on statistical analysis of the 18,678 data (wave direction, wave height and period/See Wetteramt Hamburg) observed from normal time waves by ships in St. Vincent and its surrounding waters (10-14° N, 60-65° W) over the past 21 years, the wave height that occurs at a frequency of once in X years was estimated as follows (Kocks Consult GmbH). 93% of the observed examples showed an easterly wave direction (NE, E, SE) and a cycle period of seven seconds is prevalent. These estimation results (offshore waves) have been adopted in the airport projects on Bequia and Union.

Table 2-5 Offshore Wave Height Ho (m) That Reoccurs Once every X Years

Reoccurrence Probability	NE	E	SE	S	SW	W	NW	N
1 Year	3.8	4.1	2.8	1.6	0.8	0.7	1.0	2.4
10 Years	4.9	5.2	3.5	2.8	3.3	1.8	2.6	3.8
20 Years	5.2	5.5	3.8	3.2	3.8	2.2	3.1	4.2
50 Years	5.6	6.0	4.0	3.8	4.5	2.5	3.7	4.8

③ Design Wave Height in front of Project Facility

The design values of maximum wave height in front of each site have been calculated through the following procedure.

Offshore waves
↓
Wave deformation
↓
In front of facilities wave height

Coefficient of diffraction caused by island reefs, coefficient of shallow sea, coefficient of refraction

The designed wave heights are calculated as shown on the table 3-6, namely, ① max. wave height (at peak), ② wave height in front of revetment, and ③ wave height at the tip of jetty. The designed waves applied for calculation of over-wall wave volume and the crown height are different from ① , ② and ③, and these waves are determined based

on the conditions of facility operation, the surrounding environment and frequency distribution of wave (wind).

Table 2-6 Designed Wave Height in front of Project Facility
(based on the 30-year probable wave calculation)

Site		Calliaqua	Canouan
Main direction of offshore wave		SW	SW
Height of offshore wave Ho (m)		7.0	7.0
Cycle of offshore wave To (sec)		12.0	12.0
Length of offshore wave Lo (m)		224.64	224.64
Converted height of offshore wave Ho' (m)		2.35	1.34
Ho'/Lo		0.01048	0.005947
Wave direction to shallow water		S38.0° W	S46.8° W
Level of land (m)		3.41	1.94
Wave height at peak	Depth h (m)	4.05	2.58
	h/Ho'	1.72	1.93
	H/Ho'	1.94	1.80
	Wave height H (m)	4.57	2.40
Level of land (m)		0.50	1.50
Wave height in front of revetment	Depth h (m)	1.14	2.14
	h/Ho'	0.48	1.60
	H/Ho'	0.48	1.53
	Wave height H (m)	1.13	2.04
Level of land (m)		1.00	3.00
Wave height at the tip of jetty	Depth h (m)	1.64	3.00
	h/Ho'	0.70	2.25
	H/Ho'	0.67	1.70
	Wave height H (m)	1.58	2.27

Note) Slope of sea bottom: i = 1/20
Tide level: H.W.L. + 0.64

Calliaqua is located on the south of St. Vincent and its south side is open, however, Young Island is to the west and the peninsula acts as a breakwater. Thus, when one considers the diffraction of shields and the refraction of the sea bottom topography, the converted offshore waves will decline much in every direction. As shown on the above table, the designed wave heights are 1.6 m at the tip of jetty and 1.1 m in front of revetment. It was judged that the wave heights do not exceed 1.7 m and 1.4 m respectively even though consideration is made to the set-up of sea surface.

The Friendship Bay site on the southern side of Canouan is surrounded by the Taffy Hill (170 m) peninsula to the west and the Jim Hill (97 m) peninsula to the east. There are barrier reefs in the south-east direction, Tobago Cays is 6 km to the south and Mayreau Island is 9 km to the south-west. The project site is located inner area of the lagoon. The designed wave heights are calculated 2.3 m at the tip of jetty and 2.0 m in front of revetment. As the navigation channel are to the south-west (water depth less than 10 m). The wave height does not exceed 2.4 m (at peak).

6) Earthquakes

CUBIC (building standards of the Caribbean countries) Part 2/Sec. 3 contains standards relating to seismic loads on buildings (excluding civil engineering structures such as jetties and revetment). Because it is judged that these standards can also be applied to civil engineering structures, they have been adopted for the purposes of the Project. For example, the recommendations for the design of concrete sea structures/FIP (Federation of International Prestress Concrete), October 1973 use the American UBC, which provides the basis for CUBIC, as standard.

This standard is a method of modified seismic coefficient that considers the natural periods of structures, and the horizontal seismic load (V) against the dead load of structures (W) is obtained by the following expression.

$V = K' (W)$

Modified seismic coefficient = $K' = ZCISK$

Z: local coefficient, maximum 0.75 (north of St. Lucia)

Minimum is 0.0 to 0.25 (Guyana) and St. Vincent is 0.5

I: Coefficient of importance of structure: Hospitals are 1.5, meeting places are 1.2, others are 1.0. Civil engineering facilities are not directly concerned with human life and thus have a coefficient of 1.0.

C: Damping coefficient of earthquakes that considers the natural period (T) of structures $1/15\sqrt{T}$. Maximum is 0.12.

S: Foundation bed coefficient, related to C, maximum $CS \leq 0.14$.

Seismic coefficient K:Maximum 2.0 for gravity-type structures, generally 0.8 - 2.0

Based on the above, the modified seismic coefficient in relation to natural periods (T) of structure will be as follows.

T (natural period)	K' (modified coefficient)	Remarks
0.3 sec	0.14	k=2.0
1.0	0.07	
5.0	0.035	

In the case of this Project, as no ductile civil engineering structures of long period are planned, the maximum design coefficient of K' = 0.14 is considered appropriate.

7) Bottom Sediment Movement

At the tidal currents around Canouan and Calliaqua are weak at around 2 knots in line with the ebb and tide, and as the tide directions vary by approximately 180° between the low and high tides, the bottom sediment is stable at the present time when there exist no structures to obstruct the currents. Moreover, the underwater surveys found the vegetation on the sea bottoms to be extremely stable.

However, as only the seaward sides of the shore lines (boundary lines between sea and land, HWL in St. Vincent) will be filled up to a set width (B) on both sites, the accumulation of sand through bottom sediment movement at a width of L = 1 x B on both sides of the filled up land is forecast. For this reason, the ranges of the filled up land must be selected so as to minimize the effects of bottom sediment movement on the existing facilities in surrounding areas.

8) Geological Conditions

The soil that forms the top layer in both Canouan and Calliaqua is either coral sand or coral sand mixed with coral gravel.

In Calliaqua, the inland topsoil is silt mixed with sand, and this is thought to be top soil carried over from other areas. Moreover, there is no silt content in the surface layers on the site central beach and the east side. There is much silt, however, in the surface layers on the site west side and central sea. The lower side soil of the surface layer is sand mixed with coral gravel, however, the N value is 2 - 25 even for the upper parts of the surface layer, indicating a low level of consolidation. The foundation is hard volcanic

rock sinking to the direction of the drainage gully on the west side, this is deep at 4.5 - 5.5 m on the east side, 8 - 9 m in the site center and 14.6 m on the west side.

On Canouan, the foundation is consolidated coral sand, with an N value of approximately 40 - 70 consolidation, and depth is 8 - 12 m on land and 14 - 15 m at sea. Part of the surface layer contains much silt and clay content and ranges in thickness from 3 m ~ 4 m to 6 m. The consolidation in this layer is low at N = 5 - 8, however, as this is relatively high at N ≥ 10 in other parts, the construction works except heavy structures should not present a problem. The surface layer on land is composed of coral sand, however, the beach contains an outcropping hard reef (N ≥ 35) of width 5 - 10 m and the thickness of this, according to the boring survey, is estimated to be 3 m.

Except for the reef part, the upper section of surface layer is sand mixed with coral gravel and, with a consolidation of N ≥ 5, the construction of a pile jetty should not be a problem.

(2) Design Standards for Structures

1) Design Standards

As for St. Vincent there is no technical standards, it has been decided to apply internationally adopted standards. BS standards and ASTM standards are generally applied to steel and concrete materials in St. Vincent. The following standards, which are the equivalent or stricter than the above, shall be applied for the purposes of the Project.

① Fishing Port Structure Standard Design Method: National Fishing Port Association

② Road Paving Guidelines: Japan Road Association

③ Soil Testing Method: Japan Soil Engineering Association

④ Concrete Standards Guideline: Japan Civil Engineering Association

⑤ Japan Industrial Standards (JIS): Japan Standards Association

⑥ Road Bridge Guideline and Commentary: Japan Road Association (1975)

⑦ Road Bridge Shoes: Japan Road Association

2) Design Loads

Of the design loads, the materials dead loads have been decided in the manner shown in Table 2-7, based on the results of the soil tests. In cases where sea sand (reef sand) is used for reclamation, it is necessary to screen and separate large diameter pieces of gravel. Moreover, in cases where hill earth is used for reclaiming in both Calliaqua and Canouan, it is necessary to sieve the quarry-run gravel or gravel mixed with crushed stone to make sure that gravel pieces with a diameter of 50 cm or more are removed.

Table 2-7 Materials Loads (after compaction)

Type		Density (ton/m³)		Internal Frictional Angle	Remarks
		In air	In water		
Load	Crushed stone	1.80	1.00	40°	Calliaqua/Canouan
	Reef gravel	1.60	0.90	35°	Canouan
	Reef sand	1.75	1.05	30°	Calliaqua/Canouan
	Filling earth	1.85	1.05	35°	Calliaqua/Canouan
	Stone	2.80	-	-	Andesite
	Non-reinforced concrete	2.30	-	-	
	Reinforced concrete	2.45	-	-	
Live load		1 ton/m² (slipway, jetty, revetment)			

(3) Design Standards for Facilities and Equipment

1) Architectural and Structural Standards

CUBIC (building standards of the Caribbean countries) shall be applied as a rule, however, AIJ or ACI shall be used for calculating aggregate sections.

2) Disaster Prevention Standards

Judging from the sizes and contents of the facilities, there is no particular need to consider disaster prevention. BS shall be applied in relation to escape corridors, disaster prevention equipment and fire limits, and the Fire Protection Law of Japan shall be used as reference. The on-site incinerators shall be surrounded by fire resistant walls and the gasoline tanks shall be the buried type.

3) Electrical Equipment

Both sites possess an ample power supply. An access road is planned for construction on Canouan between the island's main road and the Project site, and the budget measures to allow its completion by October 1996 have