No.

MINISTRY OF AGRICULTURE, LANDS,
HOUSING AND THE ENVIRONMENT
IN THE STATE OF ANTIGUA AND BARBUDA

PREPARATORY SURVEY REPORT
ON
THE PROJECT FOR CONSTRUCTION OF ATISANAL FISHERIES FACILITIES IN BARBUDA
IN
THE STATE OF ANTIGUA AND BARBUDA

MAY 2009

JAPAN INTERNATIONAL COOPERATION AGENCY

SYSTEM SCIENCE CONSULTANTS INC.
SENC 21 CO., LTD.

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PREFACE

In response to a request from the Government of Antigua and Barbuda, the Government of Japan decided to conduct a preparatory survey on the Project for Construction of Artisanal Fisheries Facilities in Barbuda in the State of Antigua and Barbuda and entrusted the survey to the Japan International Cooperation Agency (JICA).

JICA sent to Antigua and Barbuda a survey team from 5 January to 31 January 2009. The team held discussions with the officials concerned of the Government of Antigua and Barbuda, and conducted a field study at the survey area. After the team returned to Japan, further studies were made. Then, a mission was sent to Antigua and Barbuda 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 Antigua and Barbuda for their close cooperation extended to the teams.

May, 2009

Ariyuki MATSUMOTO

Vice-President
Japan International Cooperation Agency

May, 2009

LETTER OF TRANSMITTAL

We are pleased to submit to you the preparatory survey report on the Project for Construction of Artisanal Fisheries Facilities in Barbuda in Antigua and Barbuda.

This survey was conducted by the Consortium of System Science Consultants Inc. and SENC 21 Co., Ltd., under a contract to JICA, during the period from December 2008 to May 2009. In conducting the survey, we have examined the feasibility and rationale of the project with due consideration to the present situation of Antigua and Barbuda and formulated the most appropriate basic design for the project under Japan's Grand Aid scheme.

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

Very truly yours,

Tamotsu TOMIYAMA
Project Manager
Preparatory Survey Team on
the Project for Construction of Artisanal Fisheries Facilities in Barbuda
in the State of Antigua and Barbuda

the Consortium of
System Science Consultants Inc.
and SENC 21 Co., Ltd.

SUMMARY

Summary

1. Country profile

Antigua and Barbuda is a small island state which is part of the Lesser Antilles in the eastern Caribbean sea. It gained independence from the United Kingdom in 1981. National land area is 442 km^2 (about the same size as Yokohama city). The country comprises two populated islands, i.e. Antigua island (280 km^2; population 84,000 [estimated figure as of 2006]) and Barbuda island (161 km^2; population 1,500), and one uninhabited island: Redonda island (1.6 km^2).

Barbuda is located approximately 40 km to the north of Antigua. Both islands fall within the tropical maritime climate category, subject to year round trade winds blowing from the northeast. Average temperature throughout the year ranges 25~28°C. Rainfall is slightly heavier during September~November, with an average monthly rainfall of around 130 mm per month. Hurricanes occur frequently, and often cause damage. Barbuda where the Project site is located exhibits generally flat topography overall with an elevation of around 3 m, and a 40 m high calcium prominence at one corner of the island in the northeast. The western side of the island comprises a 1~2 m deep coastal lagoon. The northern part of the lagoon is a broad mangrove wetland, designated by the government as a bird sanctuary.

Antigua and Barbuda has a relatively high per capita income compared to other Caribbean nations in the region (US$ 10,900; World Bank 2006 estimate). Industry-wise structure of the country's GDP is 3.7% by primary industries, 22.9% by secondary industries and 73.4% by tertiary industries. The economy relies heavily on tourist oriented service industries.

The tourist sector accounts for roughly 60% of the GDP and 40% of investment. The national economy is according heavily affected by increase or decrease in the number of tourist visitors. At present, the fishery sector is characterize mainly by small-scale coastal fishing. Nevertheless, the country sits atop a broad coral sea area and has in place an exclusive economic zone (EEZ) boundary. These factors are encouraging signs for future effective utilization of marine resources.

2. Background and overview of the requested project

In 2004, the government of Antigua and Barbuda released its Manifesto 2004 outline for a national development plan calling for economic development through industry diversification. Within the Manifesto, the fishery sector is posited as an important industry in terms of exploiting domestic resources and fostering national economic independence. Under the Antigua and Barbuda Fisheries Development Plan 2006~2010 (Draft) the core target is to contribute to the national economy through the sustained and effective exploitation of marine resources. Eleven development issues are covered under

the plan. Of these, (i) establishing fishery infrastructure pertaining to fish harvesting, distribution and marketing, (ii) increasing the supply of animal protein by greater quantity of fish harvested, and (iii) upgrading fishery technology and vitalizing the livelihood of small fishermen, etc. are directly compatible with the objectives under the Project.

The Point Wharf area on Antigua island and the Codrington area on Barbuda island are integrally related in terms of demand, supply and distribution of marine products.

Under the Japanese grant-aid Project for Construction of Fishery Development Center (2004, 2005), the appropriateness of constructing fishery center facilities in both areas was confirmed. A fishery center was subsequently constructed at Point Wharf. Nevertheless, it was assessed at the time that the fishery center plan for the Codrington area should be postponed for later implementation pending confirmation of the operational status at Point Wharf for receiving and processing fish catches. It was subsequently concluded as the Point Wharf center went operational that the lack of fishery facilities at Codrington would hinder development of the domestic marine product distribution and marketing sector.

In addition, major issues have emerged including (i) upgrading competitiveness in terms of product quality as the Caribbean region shifts to a single integrated economic sphere, and (ii) capacity to meet North American and European standards with regard to marine product sanitation and quality.

Against this background, the Antigua and Barbuda government formulated the Project for Construction of Artisanal Fisheries Facilities in Barbuda Island aimed at establishing fishery infrastructure in the Codrington area of Barbuda, and promoting small fishery and overall regional development of the island by improving the distribution system for fresh fish. The Antigua and Barbuda government subsequently requested grant-aid cooperation from Japan in the construction of ① a landing jetty, mooring sea wall and slipway, and ② Fisheries Division branch office, administration and fish handling building, and appurtenant facilities under the Project.

In response to this request, JICA conducted a preliminary survey in August, 2008.

3. Summary of survey findings and Project content

In light of the above, the Japanese government decided to carry out a cooperation preparatory survey, resulting in the following dispatch of experts to the field.

Preparatory survey team:	January 5~31, 2009
Basic design briefing mission:	May 18~22, 2009

On the basis of field survey, the following conditions were confirmed for the Project site area.

Quantity of marine products in Antigua and Barbuda increased from 1274 tons to 2257 tons over the period 2001~2007. Nevertheless, this has still fallen short of meeting domestic demand, and the country relies on roughly a 35% import of marine products. The greater part of fishery output is based on Antigua island. Barbuda lags significantly behind, with marine products at 130 tons per year.

Out of the country's fish catch, high price varieties are exported. As of 2007, this comprised 80 tons per year of fresh fish from Antigua, and 45 tons of live lobster from Barbuda. Nevertheless, the export of fresh marine products needs strict adherence to international sanitary control standards, and the Fisheries Division is confronted with urgent pressure to respond to this requirement.

The Project site is at Codrington, which accounts for 70% of the Barbuda population, and 80% of the island's fishing boats. However, the absence of catch landing, mooring and slipway facilities causes significant time loss in carrying out fishing operations, as well as the beaching and relaunching of boats in need of repair. In addition, the lack of appurtenant facilities including fishing gear storage lockers, a fishing gear sales outlet and a workshop forces fishermen to not only take fishing gear and fuel tanks home with them, but also makes it necessary to go to Antigua island for fishing gear purchase and outboard engine repair. Furthermore, the fact that there are no distribution facilities (including ice making and cold storage) available, the freshness of landed catches cannot be maintained. Movement of marine products off the island is limited to the immediate export by air of live lobster.

As a result, fishing off Barbuda relies heavily on lobster harvesting by small boat. The effective exploitation of other marine varieties is extremely limited. On the other hand, the fishing industry in Antigua has developed to a point where certain fish varieties due to fishing pressure have neared the maximum sustainable yield. Accordingly, steady fresh fish supply from Barbuda to Antigua is a pressing issue.

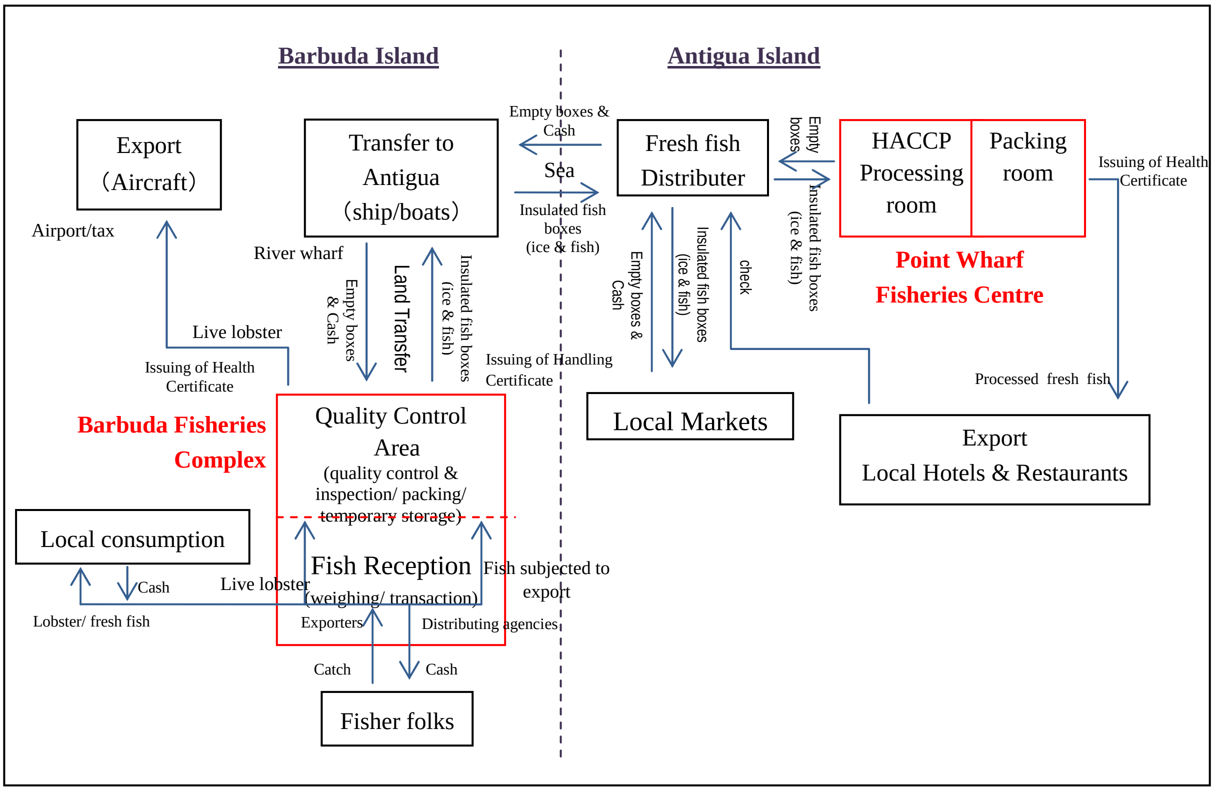
Records have not been kept on Barbuda with regard to quantity of landed catches. Existing fishery production data is of low reliability, and formal government statistics on fishery production for the island are not available.

The requested Project will establish infrastructure of small fishery, facilities for sanitary control of fish catches and fishery administrative duties in the Codrington area. On this basis, the Project exhibits the necessity, appropriateness and urgency for implementation under the Japanese grant-aid program.

[Fish catch distribution from Barbuda]

Live lobster and fresh fish for export are to be subject to sanitary inspection, sanitization processing and packing prior to shipment. This takes place in the sanitation control area within the envisioned complex. Export of live lobster from Barbuda, shipment of fresh fish to Antigua, and overall fish marketing is delegated to private merchants by the Fisheries Division, with an emphasis on sanitary control. Accordingly, distributing agents after purchasing fish catches will then export or ship to Antigua after sanitary control processing in the fish handling area under the Project.

Also, it is considered that a portion of the fresh fish shipped from Barbuda to Antigua will be exported. This fish will be received, inspected and accorded export certification at the HACCP compliant processing plant at the Point Wharf fishery complex operated by the Fisheries Division. The fish catch distribution pattern based on the above is shown in the figure below.



Based on the above study results, a Project basic design was formulated to address issues within the fishery sector by (i) constructing fishery infrastructure and (ii) establishing sanitary distribution facilities to strengthen both domestic and export marketing of marine products.

Under the Project, primarily the following 6 categories of facility construction and equipment procurement will be carried out.

① Construction of basic fishery infrastructure (landing jetty, mooring seawall).
② Construction of slipway for fishing boat repair, and boat evacuation in the case of hurricane.
③ Construction of sanitary fish catch handling and distribution facilities appropriate for domestic consumer needs and export requirements.
④ Construction of fishermen support facilities (fishing gear lockers, kiosk, workshop, toilet).
⑤ Construction of Project operation and maintenance office.
⑥ Procurement of necessary equipment for fish handling, engine repair, fishermen training, and communication with fishing boats at sea.

An overview of facilities and equipment to be provided under the Project is given in the following tables.

1) Overview of civil and building facilities

Facility		Structure / specifications	Scale / quantity
Civil works	Landing jetty	・Concrete block ・Catch landing and resupply for small fishing boats	Width: 3.5m Length: 40m
	Mooring seawall	・Concrete block ・Seawall enabling mooring of small fishing boats	Width: 3.0m, apron Length: 37m
	Slipway	・RC slope; both slipway with slider stripping and without (for dolly use) ・Facility for raising boats for repair and maintenance works	Width: 4.5m each Length: 20m; 16m
	Perimeter earth retaining wall	・Gravity concrete earth retaining wall and overlaid stone masonry ・Protection against high water and wind swell from the lagoon side of the site	Height: DL.+0.9~1.9m Length: approx.340m
	On-site earth retaining wall	・Concrete earth retaining wall ・Retaining wall to raise site elevation for building protection against high water level.	Height: D.L.+1.6m; and D.L.+1.9m Length: approx.220m
	Wastewater settling basin	・Covered with protective stone masonry ・Waste water settling and purification	Area: approx.300 ㎡
	On-site road	・Concrete paving on the lagoon side ・Other on-site road is interlocking block	Concrete paving: approx.820m^2 Interlocking paving: apprpx.1,700m^2
	On-site rainwater drainage channel	・Concrete U-gutter; collection basin; discharge pipeline ・Conduit channel for rainwater runoff generated on the Project site and from the immediate landward hinterland (with grating cover).	Width: 0.3~0.5m Length: approx.170m
Buildings works	Administration and fish handling building	・Building frame: RC structure; roof: RC slab ・Fish handling, administrative office, fishermen training, ice making and ice storage, fish cold storage, mechanical room, etc.	Two-storey building Floor area: 682 m^2 Ice making and storage; 1 ton/day and 2 tons/day, respectively Cold storage: 4.8m^2
	Fishermen support building	・Same structure as above. ・Fishing gear lockers, fishing gear sales outlet, fishing gear repair area	One floor structure Floor area: 144 ㎡
	Workshop	・Same structure as above. ・Outboard engine repair; includes emergency power generator and electrical panel room.	One floor structure Floor area: 65 ㎡
	Fishermen's toilet	・Same structure as above. ・Fishermen's toilet with shower	One floor structure Floor area: 52 ㎡
	Wastewater treatment facility	・Underground tank system with RC structure ・Wastewater treatment. Combining aerating tank and contact processing tank	Three-tank type Floor area: 45m^2
	Garbage disposal area	・RC on earthen foundation; concrete block masonry wall; no roof ・Disposal area for garbage generated on site	3 areas
	Building exterior	・Concrete ramps, interlocking paving, concrete U-gutters ・On-site road an connecting ramps to buildings; passageways; drainage gutters for rainfall on buildings	Ramp width: 1.6～2.4m Gradient: 1/8~1/10 Interlocking paving: approx.180m^2 U-gutter width: 0.20～0.25m
	Exterior facilities	・Water supply and drainage channels; temporary holding basin; outdoor lighting ・On-site work flow paths; minimal security lighting	3 outdoor light units

2) Main equipment

	Equipment item	Intended use	Qt'y
Fish handling equipment	Overhead crane	To lift heavy items and cargo at the end of the landing jetty	1
	Bin cart	For transporting fish catches and ice on site	6
	Platform scale (both pound and kilogram display)	For weighing purposes	2
	Fish tray	Same as above	30
	Catch sorting and inspection table	For sorting fish catches	5
	Fish pallet	For storing insulated fish boxes	3
	Insulated fish box	For fresh fish shipment to Antigua	15
	Trolley jack	For transporting insulated fish boxes on site	1
	High-pressure water floor washer	For cleaning the sanitary control area	1
	Water quality testing kit	For on-the-spot water quality testing	1
Repair equipment	Repair tools	For outboard engine repair	1
	Chain hoist	For lifting engines	1
Fishermen training and administrative equipment	Audio-visual equipment	For audio and visual educational and training programs aimed at fishermen who are literacy challenged	1
	Meeting/class room desks	For meetings and fishermen training sessions	12
	Meeting/class room chairs	Same as above	24
	VHF marine radio	For communication with fishing boats	1

4. Project construction period and preliminary cost estimate

(1) Project construction period

The Project will be implemented on a single fiscal-year basis. Total construction period for the Project will require 2 years (24 months).

- ・Detailed design: 5.5 months
- ・Construction: 18.5 months

(2) Preliminary cost estimate

Antigua and Barbuda side: JPY 12.03 million

5. Project justification study

(1) Project impacts

Project implementation is expected to have the impacts described below. On the basis of these impacts, the Project is deemed appropriate and meaningful for inclusion under the Japanese grant-aid program.

[Direct impacts]

①Construction of the landing jetty will reduce the time for catch landing by about 9 min/boat. Since there are 35 target boats, this comes to an annual total reduction of 380 hours for catch landing.

②Construction of the mooring seawall will enable 14 out of the 23 target boats anchoring in the site area to directly moor. Preparations for fishing departure will be reduced an annual up to 36 hours per boat.

③Constructing a slipway will facilitate the beaching of fishing boats. It will further make easy boat evacuation in the case of direct hurricane strike.

④Constructing an administration and fish handling building will enable the supply of sanitary ice, and control of fish catch freshness. This in turn will make possible a stable shipment of fish catches to Antigua. An annual 19 tons of sanitary fresh fish will be shipped to Antigua.

⑤Operation of Project facilities will enable the keeping of accurate records on the size of fish catches at Barbuda.

⑥Utilization of the administration and fish handling building will promote fishermen educational and extension activities.

[Indirect impacts]

①Because fresh fish will be distributed from Barbuda island, the present fishermen over-reliance on lobster harvesting should shift towards harvesting a broader variety of fish. As a result, the harvesting pressure on lobster will be reduced, promoting a more balanced and effective exploitation of fishery resources.

②Supply of fresh fish from Barbuda will alleviate the shortage of fishery products available for consumption on Antigua.

③In light of the fact that highly reliable fishery production statistics will be available as a result of facility operation under the Project, the Fisheries Division will be better able to correctly identify fishing industry status on Barbuda, and to carry out appropriate fishery administration.

④Promoting fishermen extension activities is aimed at promoting small fishery on Barbuda by upgrading fishing technology, improving marine resource management, and enhancing fishing safety.

(2) Project operation and maintenance structure

The prime overseer agency for Project implementation is the Ministry of Agriculture, Lands, Housing and the Environment. The hands-on executing agency is the ministry's Fisheries Division. The Fisheries Division presently operates and maintains facilities similar to those envisioned under the Project, and no problem is anticipated with regard to the division's O&M capability.

(3) Points of special note and recommendations

The Project will be the first such fishery complex on Barbuda island. Accordingly, it is incumbent upon the Fisheries Division to fully apply the experience and lessons learned from its operation of existing fishery complexes in other parts of the country, in order to create an operating structure enabling sustainable operation of Project facilities. From the standpoint of facility operation, the most salient issues and recommendations are as follows:

① In most cases, staff at the Barbuda branch office of the Fisheries Division will simultaneously assume responsibilities for Project operation. It is necessary that these personnel be thoroughly educated and trained in the significance of the Project, and methods for sustainable operation and maintenance.

② Among facility operational expenses, personnel cost, electricity cost and city water cost will be allocated from the national budget via the Barbuda Council. The Fisheries Division must liaise closely with related agencies (Office of Prime Minister, Ministry of Public Works, etc.) to ensure a sustained funding outlay for the above costs, as well as agree with the Barbuda Council in establishing a shared understanding of the significance and benefit of Project implementation.

③ The success or failure of the Project will depend on whether or not fish catches can be sanitarily processed and shipped to Antigua. Because actual fish distribution will be carried out by private sector distributing agents, it is necessary that the Fisheries Division carry out a sustained collaborative effort to ensure thorough understanding on the part of distributing agents regarding the mechanism for sanitary fish distribution centering on the activities within the sanitary control area.

④ Implementing the Project will create a venue for educating and training fishermen. The Fisheries Division must avail of this opportunity to strengthen its extension activities targeting the more backward fishermen on Barbuda, aiming at more diversified fishing operations and sustainable exploitation of marine resources.

⑤ Project facilities front on Codrington lagoon which is a designated national park. The Fisheries Division must give extremely careful attention to preserving the lagoon environment and ecosystem, and should carry out regular monitoring of Project wastewater quality to ensure that wastewater from Project facilities discharged to the lagoon does not adversely impact the lagoon environment.

⑥ There are HACCP specified catch processing facilities at the Point Wharf fishery center where JICA technical expert work in facility operation. It is recommended that the Fisheries Division look to technical cooperation from this expert with regard to sanitary processing methods and technical training.

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Abbreviations

A/P	Authorization to Pay
APUA	Antigua Public Utilities Authority
B/A	Banking Arrangement
BOD	Biochemical Oxygen Demand
CARICOM	Caribbean Community
CSME	Caribbean Single Market and Economy
CUBiC	Caribbean Uniform Building Code
D.L.	Datum Level
E/N	Exchange of Notes
EU	European Union
G/A	Grant Agreement
GDP	Gross Domestic Product
GNP	Gross National Product
HACCP	Hazard Analysis and Critical Control Point
H.W.L	High Water Level
JICA	Japan International Cooperation Agency
JIS	Japanese Industrial Standard
L.W.L	Low Water Level
M.W.L	Mean Water Level
M/D	Minutes of Discussion
OECS	Organization of Eastern Caribbean State
PQ	Pre-qualification
USGS	United States Geological Survey

CHAPTER 1

BACKGROUND OF THE PROJECT

Chapter 1　Background of the Project

1-1　Background and Overview of Request for Grant-aid Cooperation

Measures to increase domestic fishery production and strictly adhere to sanitary and quality control standards for fish catches are major issues confronting Antigua and Barbuda within its fishery sector.

Since 1997, Japan has on multiple occasions extended grant-aid cooperation aimed at establishing fishery infrastructure on Antigua island. Particularly in 2003~4, the Fishery Center Construction Project called for a fishery center with a Department of Fisheries office to be constructed at Point Wharf. The center includes a fishery product processing plant that operates in line with HACCP stipulations. At that time, a request was simultaneously contemplated by the Antigua and Barbuda side for the construction of fishery infrastructure on Barbuda island, where development is relatively backward compared to Antigua, to compliment the Point Wharf processing plant with a supply of fresh fish from Barbuda. Nevertheless, it was subsequently judged more appropriate to first confirm the receiving system and operational status of the completed Point Wharf center prior to moving ahead to the next stage with facilities on Barbuda, and the Barbuda fishery infrastructure component was subsequently eliminated from the original Fishery Center Construction Project. Afterwards, however, as the receiving system went into operation at the Point Wharf fishery center, it became clear that the lack of fishery infrastructure on Barbuda was placing a constraint on balanced supply and demand for domestic marine products, as well as hindering the growth of the fresh fish export industry.

Against this background, the Antigua and Barbuda government formulated the Project for Construction of Artisanal Fisheries Facilities in Barbuda Island aimed at establishing fishery infrastructure in the Codrington area of Barbuda, and promoting small fishery and overall regional development of the island by improving the distribution system for fresh fish. The Antigua and Barbuda government subsequently requested grant-aid cooperation from Japan in the construction of ① a landing jetty, mooring sea wall and slipway, and ② Fisheries Division branch office, administration and fish handling building, etc. under the Project.

In response to this request, JICA carried out a Preliminary Study in August 2008 to confirm request content and the priority of requested components.

An overview of request content confirmed at the Preparatory Survey stage is set out below.

① Facilities: Landing jetty, mooring seawall, ice storage, cold storage, fish gear lockers, slipway, slipway access road, workshop, wastewater treatment system (septic tank), emergency generator, fish handling wing (processing room / inspection room), Department of Fisheries office wing (ice making room, cold storage, accommodation with kitchen), fishing gear store, fishermen's toilet (with shower), ice-making water reservoir tank, general water reservoir tank, parking area, fueling facility, fishing gear repair area, outdoor lighting

② Equipment: Insulated boxes, fish trays, platform weighing scale, spring weighing scale, high-pressure water floor washer, repair tools, chain hoist, office desks and chairs, water quality testing kit, meeting/classroom desks and chairs, overhead crane, trolley jack, VHF marine radio.

1-2 Natural Conditions

(1) Climate

Within the nation of Antigua and Barbuda, Antigua island itself is located at north latitude 17°05′ and west longitude 61°48′. Barbuda island, which is the site of the Project, is located at north latitude 17°38′ and west longitude 61°50′. Climate falls within the tropical oceanic category.

The nation′s Bureau of Meteorology operates weather observation stations at Bird International Airport on Antigua island and at Codrington Airport on Barbuda island. According to the Bureau of Meteorology, weather observations at Codrington Airport include air temperature, wind direction and wind velocity, etc. primarily aimed at assisting plane navigation. Data collected is automatically forwarded to the weather office at Bird International Airport. However, problems with power output and maintenance on Barbuda island, result in a low ratio of actual data acquisition at Bird International Airport. As a result, a reliable data base of information is not available. Accordingly, this Study collected and collated weather data from Bird International Airport.

1) Wind

Observational results for wind direction and wind velocity during the period 1999~2008 are shown in Figure 1.2.1.

Wind direction is mainly ESE in the course of the year, indicating a dominant easterly wind direction. A wind velocity of 11~17 knots (5.6~8.7 m/sec) occurs with the most frequency, indicated a fairly stable wind pattern.

Table 1.2.1 indicates month-wise wind direction and velocity. Wind direction exhibits little variation by month, being a relative constant E~ESE. Likewise, wind velocity shows little fluctuation being an average 6 m/sec on a month-wise basis.

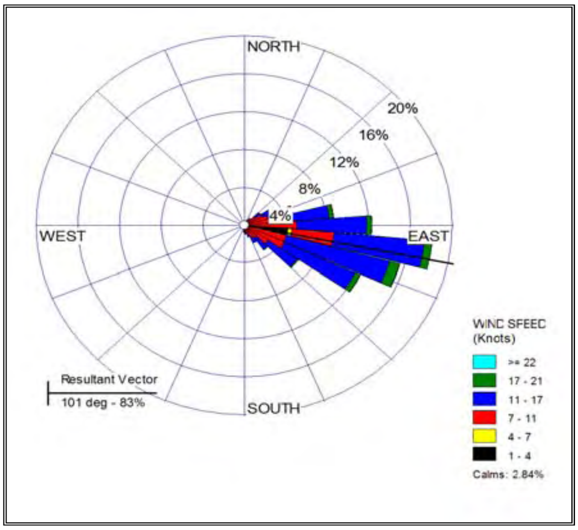


Figure 1.2.1 Wind rose diagram for Bird International Airport (1999~2008)

Table 1.2.1 Average monthly wind velocity (1969~2005) and average monthly wind direction (1981~2005) at Bird International Airport

Month	J	F	M	A	M	J	J	A	S	O	N	D	Ave.
Average wind velocity (m/sec)	6.3	6.3	6.2	6.0	6.1	6.8	7.0	6.3	5.3	4.9	5.2	5.9	6.0
Average wind direction	E	E-ESE	E-ESE	ESE	ESE	ESE	E-ESE	E-ESE	E-ESE	ESE	E	E	E-ESE

2) Air temperature

Monthly average air temperatures for the period 1996~2005 are shown in Table 1.2.2. Average temperatures over the course of a one-year period range 25~28°C, with little air temperature fluctuation by month. Average air temperature for the entire year is 27°C.

Table 1.2.2 Monthly average air temperatures at Bird International Airport (1969~2005)

Month	J	F	M	A	M	J	J	A	S	O	N	D	Ave.
Ave. air temp.	25.5	25.3	25.8	26.6	27.2	27.9	28.1	28.3	28.5	27.6	26.7	26.6	27.0
Ave. max. air temp.	28.3	28.3	28.8	29.4	30.1	30.6	30.8	31.1	31.1	30.6	29.7	28.8	29.8
Ave. min. air temp.	22.3	22.1	22.7	23.5	24.4	25.2	25.3	25.4	25.0	24.5	23.7	23.1	23.9
Max. air temp.	31.0	31.0	33.0	32.7	34.1	33.0	34.0	33.1	33.5	33.0	32.6	31.5	32.7
Mini. air temp.	17.0	17.0	17.0	18.0	20.0	19.7	20.6	21.1	21.0	20.0	19.0	16.0	18.0

3) Humidity

Monthly average humidity values for the period 1990~2005 are shown in Table 1.2.3. Average humidity over the course of a one-year period ranges 75~80°. There is little difference in monthly average humidity. Annual average humidity is 77%.

Table 1.2.3 Monthly average humidity at Bird International Airport

Month	J	F	M	A	M	J	J	A	S	O	N	D	Ave.
Average humidity	75.5	75.2	75	75	76.5	77.5	78	78	78.5	80	79.5	77.5	77.2

4) Rainfall

Monthly average rainfall values for the period 1960~2005 are shown in Table 1.2.4. Rainfall is heaviest from September to November. Monthly average rainfall is around 130 mm.

Table 1.2.4 Monthly average rainfall at Bird International Airport (1960~2005)

Month	J	F	M	A	M	J	J	A	S	O	N	D	Ave.
Ave. rainfall (mm)	56.6	40.4	44.2	67.1	101.6	55.6	87.6	96.5	129	132.3	140	86.9	86.5
Max. rainfall (mm)	159.8	110.5	179.1	198.6	459.7	223.8	244.6	279.4	410.2	358.1	588	221	286.1
Min. rainfall (mm)	18.8	9.9	7.6	12.2	5.8	5.8	14.2	24.1	27.7	12.4	22.6	12.2	14.4
Max. daily rainfall over a 24 hour period (mm)	53.6	37.5	109.9	106.6	179.3	65.5	73.9	135.9	188.5	211.6	241.8	147.3	129.3

Annual rainfall for Antigua island and Barbuda island over the period 1997~2008 is indicated in Table 1.2.5. According to this data, both islands average an annual 1150 mm per year. However, the three year period 2000~2002 exhibited an annual rainfall dropping under 1000 mm.

Table 1.2.5 Annual rainfall (1997~2008)

Year	Antigua (mm)	Barbuda (mm)
1997	962	998
1998	1,096	1,375
1999	2,104	1,526
2000	623	892
2001	840	851
2002	730	960
2003	1,341	908
2004	1,374	1,526
2005	1,254	1,326
2006	1,275	1,190
2007	1,030	1,050
2008	1,460	1,403
Ave.	1,174	1,167

5) Atmospheric pressure

Monthly average atmospheric pressure at sea surface for the period 1970~2005 is shown in Table 1.2.6. Atmospheric pressure exhibits little fluctuation in the course of the year, averaging a standard value of 1015 Hp.

Table 1.2.6 Monthly average atmospheric pressure at Bird International Airport (1970~2005)

Month	J	F	M	A	M	J	J	A	S	O	N	D	Ave.
Sea level pressure (Hp)	1016	1016	1016	1015	1015	1016	1017	1015	1013	1013	1013	1015	1015

6) Anomalous weather data

On the basis of observation data from Bird International Airport, anomalous weather phenomena possibly affecting facility design were identified. The time period covered is that for digitalized data from 1995 to 2008. Anomalous values are summarized in Table 1.2.7.

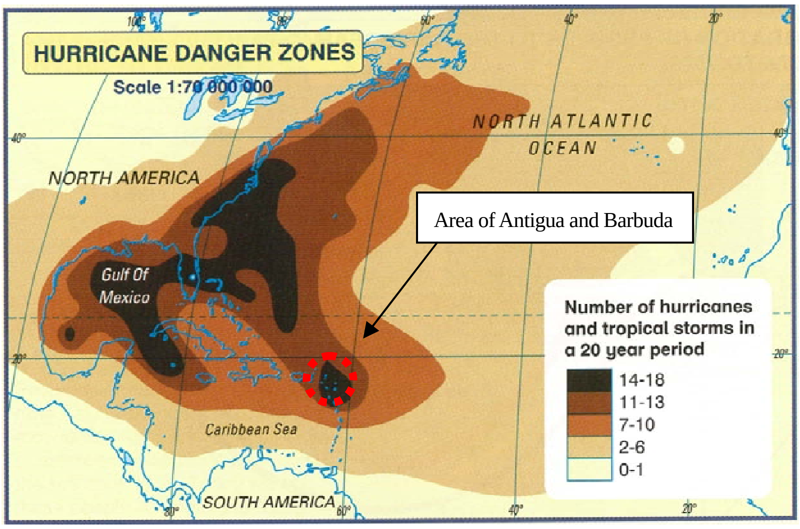
Table 1.2.7 Year-wise maximum and minimum observational data for Bird International Airport

Year	Annual maximum wind				Annual maximum rainfall				Atmospheric pressure			
	Max. wind speed		Date	Weather factor	Daily max. rainfall (mm/24hr)	Six hour max. rainfall (mm/6hr)	Date	Weather factor	Annual average atmospheric pressure (Hp)	Min. atmospheric pressure (Hp)	Date	Weather factor
	Wind speed (m/sec)	Wind direction										
1995	32.9	SW	5-Sep	H	170.5	151.8	19-Dec	O	1014.6	972.8	5-Sep	H
1996	15.4	NNE	8-Jul	H	50.7	41.2	11-Dec	O	1015.2	991.0	Aug	O
1997	13.4	SW'W	7-Sep	H	31.5	30.8	28-May	O	1015.7	1005.6	Oct	O
1998	30.9	S'E	21-Sep	H	124.2	114.2	21-Oct	O	1014.9	970.2	21-Sep	H
1999	22.6	NE	20-Oct	H	241.8	158.7	18-Nov	H	1014.6	985.8	Oct	H
2000	12.9	SE	21-Aug	O	114.8	108.1	16-Sep	O	1015.9	1005.6	22-Aug	O
2001	15.4	E	14-Oct	O	54.4	38.8	13-Dec	O	1015.7	1007.6	Nov	O
2002	12.3	SE	24-Sep	O	87.6	85.9	29-Mar	O	1016.1	1010.0	Apr	O
2003	12.9	E	7-Jul	O	38.1	37.0	15-Nov	O	1015.4	1007.1	Dec	O
2004	12.3	ESE	3-May	O	65.5	38.4	19-Nov	O	1015.2	1005.1	Aug	O
2005	12.3	SE'E	13-Jan	O	51.2	34.0	13-Jun	O	1014.3	997.5	Sep	O
2006	12.9	SE'E	10-Jul	O	45.5	34.4	11-Oct	O	1015.2	1008.2	Oct	O
2007	17.0	E'N	17-Aug	H	64.4	46.3	25-Oct	O	1015.2	1007.5	25-Oct	O
2008	15.4	SW'W	16-Oct	H	147.4	124.1	15-Oct	H	1015.1	1007.2	16-Oct	H
Ave.	17.0	-	-	-	92.0	74.6	-	-	1015.2	998.7	-	-

Note: Meteorological factors: H=hurricane; O=other

7) Hurricane

Hurricanes striking Antigua and Barbuda are a major factor in natural disaster. As indicated in Figure 1.2.2, occurrences of full-fledged hurricanes as well as intense tropical low pressure systems are numerous in comparison to other Caribbean countries.



Source: Longman Caribbean School Atlas, Third Edition2004

Figure 1.2.2 Number of hurricanes and strong tropical low depressions over the past 20 years

Hurricanes cause a range of problems including intense rain, strong winds and high sea levels. Based on records maintained by the country's National Office of Disaster Service as well as the observational data of Bird International Airport, hurricanes impacting on Antigua and Barbuda since 1950 are indicated in Table 1.2.8.

Table 1.2.8 Hurricanes impacting on Antigua and Barbuda

Year	Mon.	Day	Hurricane name	Type	Land fall	Flood damage	Wind velocity		
							Mph	m/sec	Wind speed category
1950	8	21	BAKER	H1	-	-	100	51.4	No record
	8	31	DOG	H2	-	-	165	84.9	No record
1989	9	17	HUGO	H4	-	-	110	56.6	Momentary max.
1990	10	5	KLAUS	H1	-	-	50	25.7	Average wind speed
							70	36.0	Momentary max.
1995	8	4~5	LUIS	H4	○	○	140	72.0	None listed (NW~SW)
	9	14	MARILYN	H1	-	○	-	-	-
1998	9	20	GEORGES	H2	○	-	-	-	-
1999	10	20	JOSE	H2	○	-	-	-	-
	11	19	LENNY	H4	○	○	-	-	-
2000	8	21	DEBBY	H1	-	-	-	-	-
2008	11	15~16	OMAR	H3	-	○	35	18.0	Average wind speed

According to the above, four hurricanes have made landfall on Antigua and Barbuda. Likewise, four hurricanes have caused flood damage. The hurricane passing closest to the Project site on Barbuda island, was hurricane Klaus passing the north side of the island in 1990. When comparison is made with the previous year-wise maximum and minimum observational data shown in Table 1.2.8, it can be seen that H4 class hurricanes including Luis (u = 32.9 m/sec, 972.8hPa) in 1995, Georges (u = 30.9 m/sec, 970.2hPa) in 1998, and Lenny (u = 22.6 m/sec, 985.8hPa) in 1999 record the maximum values for wind velocity and rainfall, as well as minimal values for atmospheric pressure, occurring on Antigua island since 1995.

Among the wind velocity records of the National Office of Disaster Services, the wind velocity value for hurricane Luis in 1995 (for which no wind speed category has been assigned) is assumed to be the momentary maximum wind speed based on the records for anomalous weather data as set out earlier in Table 1.2.7. This is likewise assumed to be the case for other instances where no specific wind speed category has been assigned. Also, it should be noted that the wind direction for hurricane Luis was NW~SW, which is in the opposite direction from the normal easterly prevailing wind direction in the country.

(2) Hydrographic conditions

1) Tidal levels

① Tide level fluctuations

At present, tide level measurements are not being systematically carried out in the country. In the case of bottom sounding within Codrington lagoon in the vicinity of the Project site, a tide level marker was set by the Survey Team at the end of the existing wooden jetty at the north side of the site and tidal observations were carried out over a one month period from January 14, 2009. At the same time, tide level corrections were made for sounding depth results. According to the country's Ministry of Public Works, no bench marks have been set on Barbuda island for measuring ground elevation. Accordingly, a datum level (D.L.) value for ground elevation calculation necessary in the course of facility design and construction had to arbitrarily be set by the Survey Team based on the results of tide level measurements at the site.

Barbuda island is located approximately 40 km north of Antigua island, and open-sea tide levels are assumed to be the same. In the case of Codrington lagoon, tide levels fluctuate in response to inflow from the open sea via the lagoon opening to the north. Tide level differential at the open sea is assumed at 20~30 cm based on marine charts and tidal forecast data. A same relative degree of difference in tide levels is concluded to occur within Codrington lagoon as well.

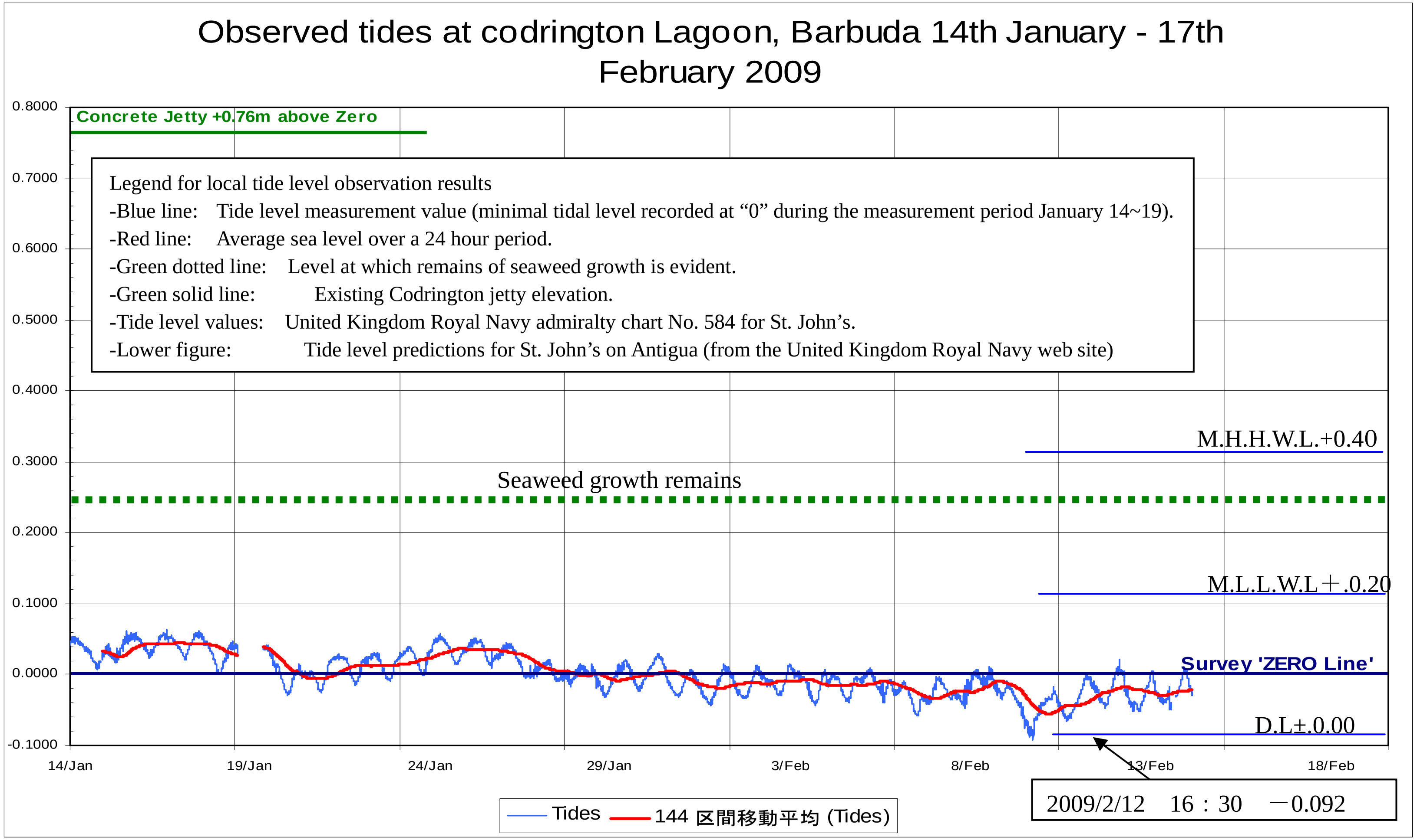
During the period of tide level measurement by the Survey Team, tide level fluctuated around 5 cm, with a monthly average sea level fluctuation of 10 cm (see Figure 1.2.4). Interview survey with local fishermen indicated that tide levels are lowest within the lagoon during the winter (December ~ February) and highest during the summer (July ~ August). Based on observations by the team at the tourist boat jetty adjacent to the Project site, the remains of seaweed and algae are seen at a 20 cm level above the tide levels monitored during the survey period, again suggesting higher tidal levels during the summer. The tide level measurements carried out under the survey were done in winter. Accordingly, the minimal value for observed tide level is adopted as the datum level value. When this is compared with tidal datum values for Saint John's as set out in admiralty chart no. 584 published by the United Kingdom Royal Navy, M.H.H.W.L. and height of seaweed remnant at the existing jetty marker show a general correlation (see Figure 1.2.3).

With regard to datum level for ground elevation, the lowest value during the tide level observation period (occurring at 16:30 February 12, 2009) is set as the datum level value (see Figure 1.2.4). According to this, the elevation for the tourist boat jetty is calculated at 0.85 m.

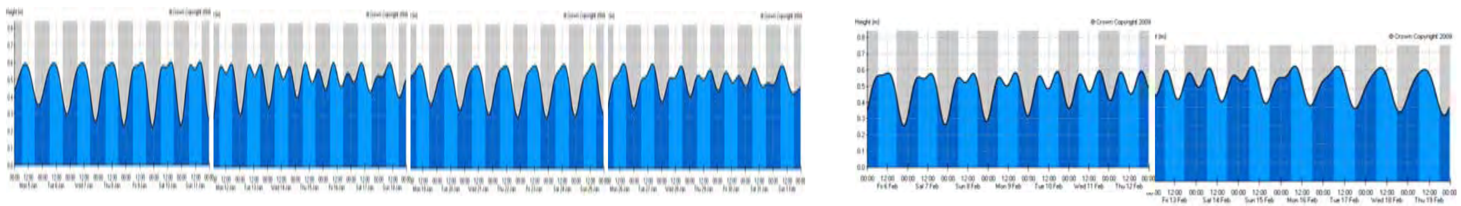
Mean highest high water level (M.H.H.W.L.)	+0.41
Mean sea level (M.S.L.)	+0.31
Mean lowest low water level（M.L.L.W.L.）	+0.21
Chart datum level（C.D.L.）	±0.00

Figure 1.2.3 Tidal level differential as indicated by admiralty chart No. 584 issued by the United Kingdom Royal Navy

Figure 1.2.4 Tide level observation results at the Project site (January 14 ~ February 17, 2009)



Tide level predictions for Antigua island (St. John's) (from the United Kingdom Royal Navy web site)



② Calculating design tide level

It is assumed that tide levels within Codrington lagoon are dependent on tide level fluctuations occurring in the open sea. Accordingly, based both on tide level measurements at the Project site, as well as referencing tide levels as recorded at St. John′s, Project related tide level values are as indicated in Figure 1.2.5.

Mean higher high water level (M.H.H.W.L.)	+0.40	
Mean sea level (M.S.L.)	+0.20	
Mean lowest low water level（M.L.L.W.L.）	±0.00	Datum level (D.L.)

Figure 1.2.5 Project area tide levels

2）Waves

Because the Project site is located at the eastern edge of the Codrington lagoon, prevailing easterly winds do not induce wave activity throughout the year in the water area in front of the site.

Lagoon size is 10 km north~south and 2.5 km east~west. Site is sheltered from open water by a sandbar to the western side that ranges in width 50~700 m. Because this sandbar even at its lowest point is around 3.0 m above sea level, there is no direct impact within the lagoon from wave activity emanating from open sea.

Nevertheless, specifically with regards to the Project site, consideration must be given to wave activity generated from north, west and south within the lagoon by strong winds occurring in conjunction with hurricanes or other intense tropical depressions.

Wave size is the result of factors including distance from the Project site to the opposite lagoon shore, wind velocity and average water depth within the lagoon.

As indicated in Figure 1.2.6, distance from the Project site to the opposite shore is NNW approximately 7.2 km, and SSW approximately 4.3 km. Based on maximum average wind velocity records for Antigua island over the period 1996~2008, and applying Weibull probability distribution, maximum correlativity occurs at a coefficient of k≒0.75. Applying this distribution function, wind velocities return periods for respective periods of time are 29.5 m/sec for a return period of 30 years and 33 m/sec for a return period of 50 years as indicated in Table 1.2.9 and Figure 1.2.7. Additionally, marine charting (Admiralty Chart 245) shows that maximum water depth within the lagoon is to the south at 3.7 m, and at the central lagoon area where the Project site is situated, water depth is logged at 3.2 m. As a result of simple depth sounding under this survey, a maximum depth of 5.5 m was observed to the south of the Project site, and maximum depth in the central lagoon was measured at around 3.5 m.

Maximum fetch at the Project site is calculated at 7.2 km, and average water depth is calculated at 3 m. Based on shallow sea-wave computational formula by Sakamoto and Ijima, calculation results for wave height in the case of wind velocity with a return period of 30 years and 50 years, respectively, are indicated in Table 1.2.10. According to this data, wave at the Project site with a return period of 50 years is: H = 0.9 m ; T = 2.55 sec.

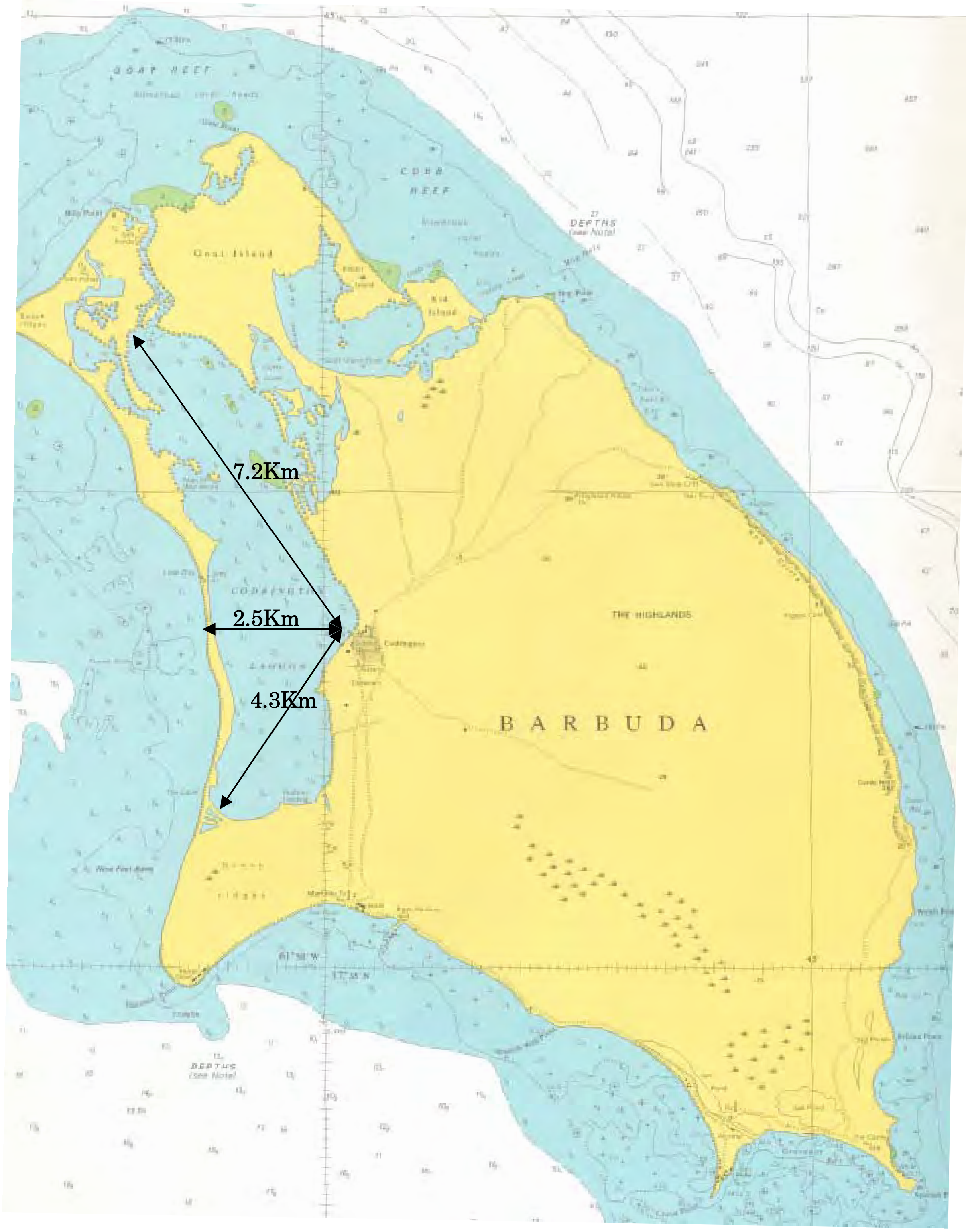


Figure 1.2.6 Distance from the Project site to the opposite lagoon shore

Table 1.2.9　Calculation results for wind velocity return periods
; Weibull (k = 0.75)

Return period Rp	2	5	10	20	30	50	100
Probability (of non-exceedance) P	0.5000	0.8000	0.9000	0.9500	0.9667	0.9800	0.9900
Rectifying variable rv	0.613	1.886	3.041	4.319	5.115	6.164	7.662
Probable wind speed ×(m/sec)	15.1540	19.1730	22.8190	26.8550	29.3700	32.6830	37.4120

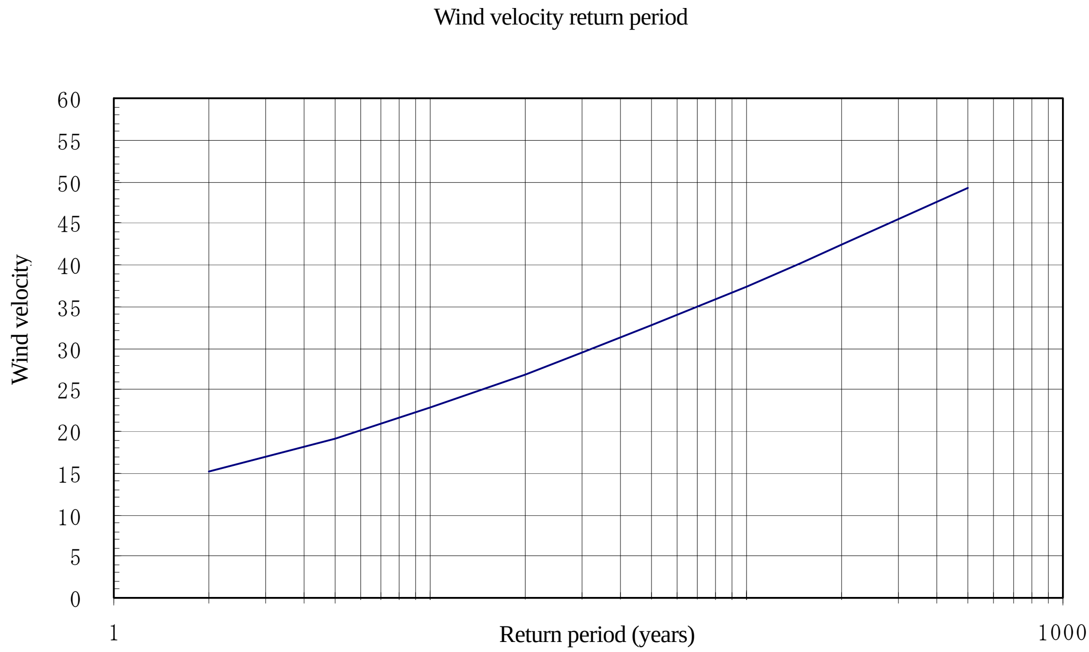


Figure 1.2.7　Results of calculation for wind velocity return periods

Table 1.2.10　Wave estimation results

Wind velocity (m/s)	Fetch (km)	Min. duration	Average water depth (m)	H1/3 (m)	T1/3 (sec)
29.5	7.2	0.89	3.0	0.83	2.47
33.0	7.2	0.85	3.0	0.90	2.55

3）Anomalous tide levels (calculating the amount of water level rise)

H4 class hurricanes strike Antigua and Barbuda such as Luis in 1995, Georges in 1998, and Lenny in 1999. Assuming a worst case scenario where an H4 hurricane strikes, and furthermore, wind direction is N~W which is potentially the most dangerous for the Project site, anomalous sea level rise is calculated as indicated below.

(a) Water level rise due to breakers

Due to the shallow water depth at the Project site, sea level rises during hurricanes as a result of breaker activity. In this light, sea level rise at the site due to wave conditions in the case of a hurricane similar to Georges with a wind velocity return period of 50 years (i.e. u = 33m/sec) was calculated. Also, in-situ seabed survey indicates a lagoon bed gradient of 1/50.

Based on Figure 1.2.8 for average water level rise due to breaker activity as taken from the Port and Harbor Design Handbook (2003 edition), calculation results for average water level rise at the Project site are indicated in Table 1.2.11.

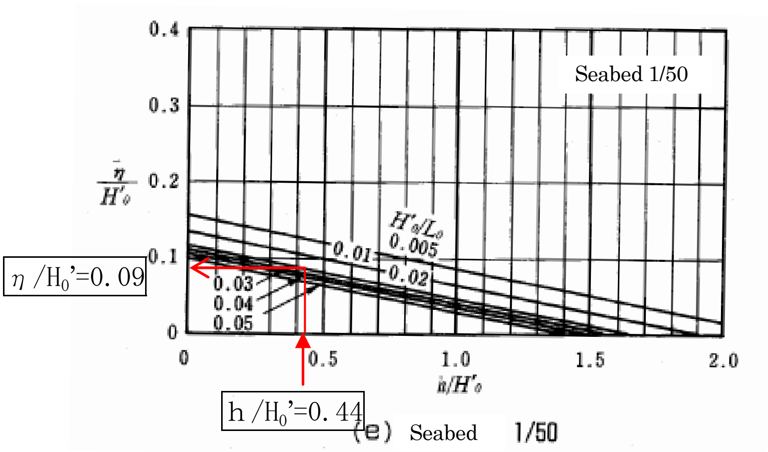


Figure 1.2.8 Average water level rise due to breaker activity

Table 1.2.11 Calculation results for average water level rise at the Project site

Wave direction	NNW (most dangerous wave direction)	Remarks
H_0=H'_0 (m)	0.9	
T (sec)	2.6	
L_0 (m)	10.55	
H'_0/L_0	0.027	
h (DL)	D.L – 0.0 m	
H (m)	0.4	Reference to tide level HHWL + 0.4 m
H/H'_0	0.44	Seabed gradient = 1/50
η/H'_0	0.09	Extrapolation from graph
η (m)	0.08	

(b) Average water level rise due to wind setup

Water level rise along a shoreline due to wind setup can be calculated by the following general formula:

$$\eta_0 = k \frac{F}{h} (U\cos\alpha)^2$$

Where:

η_0	:	average water level rise due to wind setup (cm)
F	:	fetch (km); F = 7.2 km
U	:	wind velocity (m/sec); U = 33 m/sec
h	:	average water depth (m); h = 3 m
k	:	coefficient varies depending on the bay or lagoon; (based on Baltic sea data, $k = 4.8 \times 10^{-2}$)
α	:	angle of wind direction to shoreline; here, α is assumed at 0° (direct frontal angle)

On the basis of the above, water level rise due to wind setup is calculated at 125 cm.

(c) Static suction lift due to drop in atmospheric pressure

When atmospheric pressure drops even gradually by ⊿P (hPa) at a specific region of sea, the sea level at that location rises relative to surrounding sea area due to the difference in atmospheric pressure. The amount of this suction lift ζ(cm) is calculated by the following formula.

$$\zeta = 0.99 \times \Delta P$$

Where:

ζ	:	Amount of water level rise (cm) due to drop in atmospheric pressure
⊿P	:	Atmospheric pressure deviation

Given the fact that (i) the lowest recorded atmospheric pressure for the country is U = 970 (hPa) occurring during hurricane Georges, and (ii) the average atmospheric pressure as recorded for Antigua island is 1015 (hPa), the amount of suction lift is computed as:

$$\zeta = 0.99 \times \Delta P = 0.99 \times (1015-970) = 0.99 \times 45 = 45 \text{ cm}$$

On the basis of the above, in the event of simultaneous water level rise due to breaker activity, wind setup and drop in atmospheric pressure, total water level rise is computed as:

$$0.08 + 1.25 + 0.45 = 1.78\text{m}$$

Furthermore, if expressed in terms of D.L. when the above water level rise occurs at a time of H.W.L, this is as follows:

$$\text{H.W.L. } 0.40 + 1.78 = \text{D.L.}+2.18\text{m}$$

(3) Currents

During this survey, surface current was observed by monitoring flotsam at the Project site. During the observation period, a consistently easterly wind with a wind velocity of

5m/sec was blowing. Accordingly, flotsam was seen to flow mainly in the off-shore direction, with almost no flow in the shore direction. Because tide level difference at the site is around 5 cm, tidal current is extremely weak. Instead it is concluded that surface wind current is dominant.

According to interview survey of local fishermen, tide within the lagoon flows clockwise. Given the uniformity of seabed deposit at the site area, it is assumed that there is no obviously dominant tidal current within the lagoon at the site vicinity.

Nevertheless, the landing jetty planned at a right angle to the shoreline under the Project will produce a small pocketed sea area between itself and the existing tourist boat jetty, making it recommendable that a water pass-through type structure be adopted for the planned jetty. Otherwise, it will be necessary to adopt measures such as incorporating a tidal passageway into a portion of the structure.

(4) Shore features, erosion and sedimentation

The littoral current that generates the energy constantly altering the beach contour is the result of wave action in the direction of the shoreline. The Project site is located at the east side of the lagoon, and almost no wave activity occurs due to a dominant easterly wind pattern. Accordingly, shore sedimentation or erosion as a result of littoral current is almost none.

Based on interview survey of local residents, the sand beach at the site was artificially created as a materiel shipping point in conjunction with hotel construction on the opposite side of the lagoon. According to mapping from 1966, the shore around the Project site was wetland with neither mangrove nor sand present.

Given the fact that seabed at the site consists of fine-grained, loosely deposited silt into which a person wading sinks up to the knees, it can be assumed that there is very little sea current at the site. On this basis, it is further assumed that the seashore contour in the site vicinity is generally stable. Furthermore, given the prevailing wind direction, it is concluded that erecting a structure whose axis is directly perpendicular to the shoreline would not incur adverse impacts of erosion or sedimentation due to tidal current activity.

Nevertheless, in the case where a structure is erected perpendicular to the shoreline, there is still the danger of scouring at the front end of the structure in the event of wave activity driven by westerly winds during hurricanes or intense tropical depressions. Accordingly, appropriate measures to prevent such souring must be taken.

(5) Geology and soil properties

Test drilling was carried out 7 points within the Project site area to identify the depth distribution down to the limestone layer which has the sufficient strength to function as the bearing layer for the Project structures. Specifically, test drilling comprised 7 locations (including 3 locations of off-shore drilling), augmented by 16 test pit holes (including 2 locations of off-shore test pit holes). Locations for drilling and test pit works are indicated in Figure 1.2.9. Results indicate that ground at the site exhibits a fairly simple structure comprising a layer of hard coral limestone (N>100) overlain by a 0~4 m thick deposit of organic silt or clay (N=0). From the point where limestone is exposed at the surface at B.H.2, this surface layer gets steadily thicker moving in the direction of the lagoon. To the sea side, the surface layer reaches to a maximum depth of -3.5 m below the sea surface. The layer is thickest at roughly 4 m in the vicinity of B.H.1.

Also, test drilling from a minimum of 2 m to a maximum of 5 m depth (offshore at B.H.3) was carried out in light of the possible that there may be alternating strata of underlying coral limestone and clayey/sandy soil. Drilling results subsequently confirmed no presence of intercalated clayey or sandy soil within the limestone layer (see Figure 1.2.10). A borehole value of N>100 was observed.

Results of laboratory testing of soil samples indicate a moisture content of 90% in the case of clayey soil within the surface layer, and a further organic content of around 20%. Appropriate bearing strength and horizontal resistance strength cannot be expected in the case of the structures under the Project.

The underlying coral limestone layer is not uniformly limestone. It is instead a sedimentary layer including limestone, sandstone and a coral gravel layer (locally quarried as a gravel material). Based on results of unconfined compression test, this coral limestone layer is categorized as soft rock with an MN/m^2 value of 12~17. It is judged to have ample bearing strength for the type of facilities planned under the Project.

(6) Land topography and seabed topography

Land and seabed topographical surveys were carried out during January 13~17, 2009. An enlarged diagram of the specific Project site and environs is shown in Figure 1.2.11. With regard to the datum level for both land and seabed topography, the lowest sea level occurring during the study period was adopted.

Figure 1.2.9 Locations for drilling and test pit works

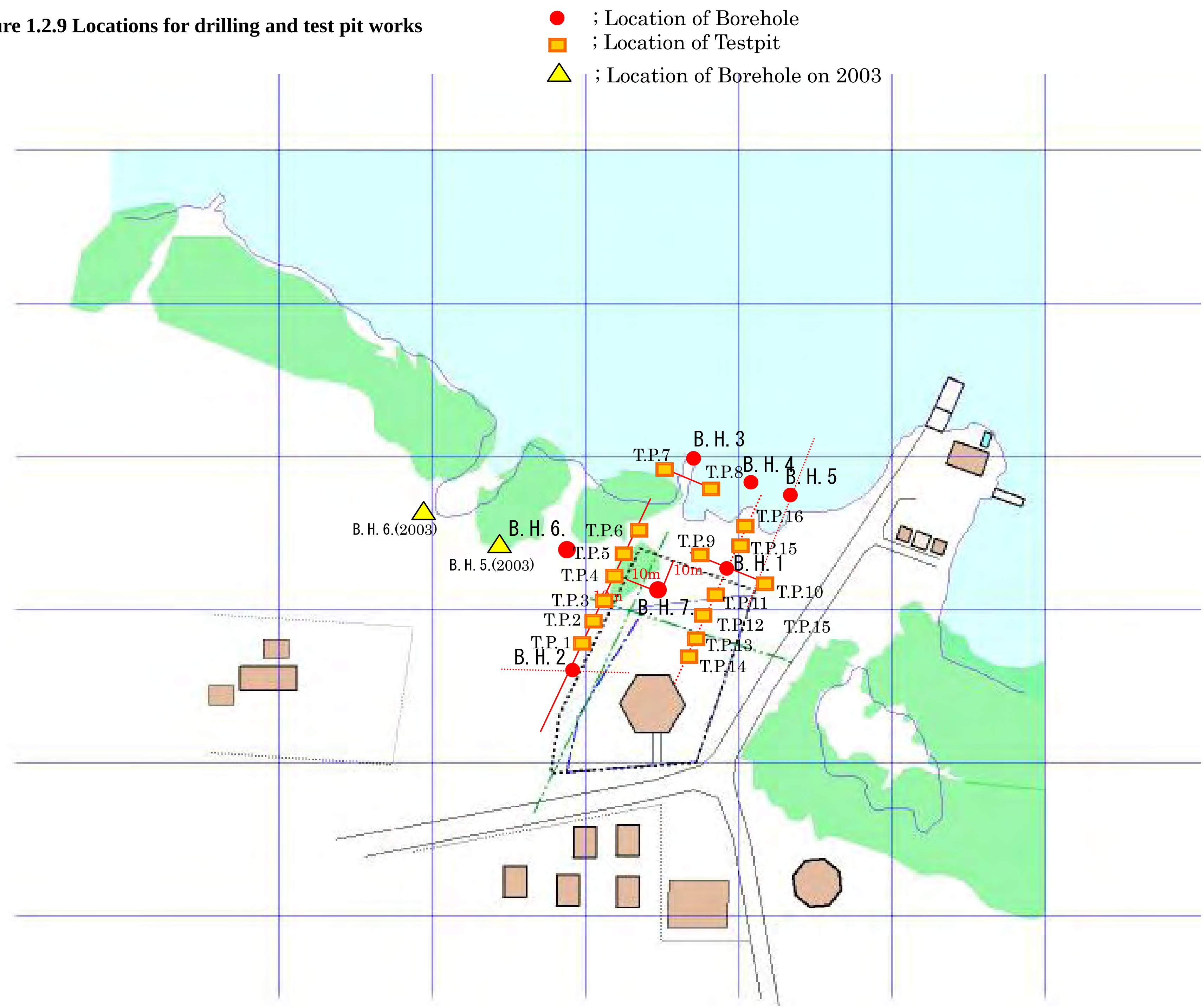


Figure 1.2.10 Outline of soil structural figure

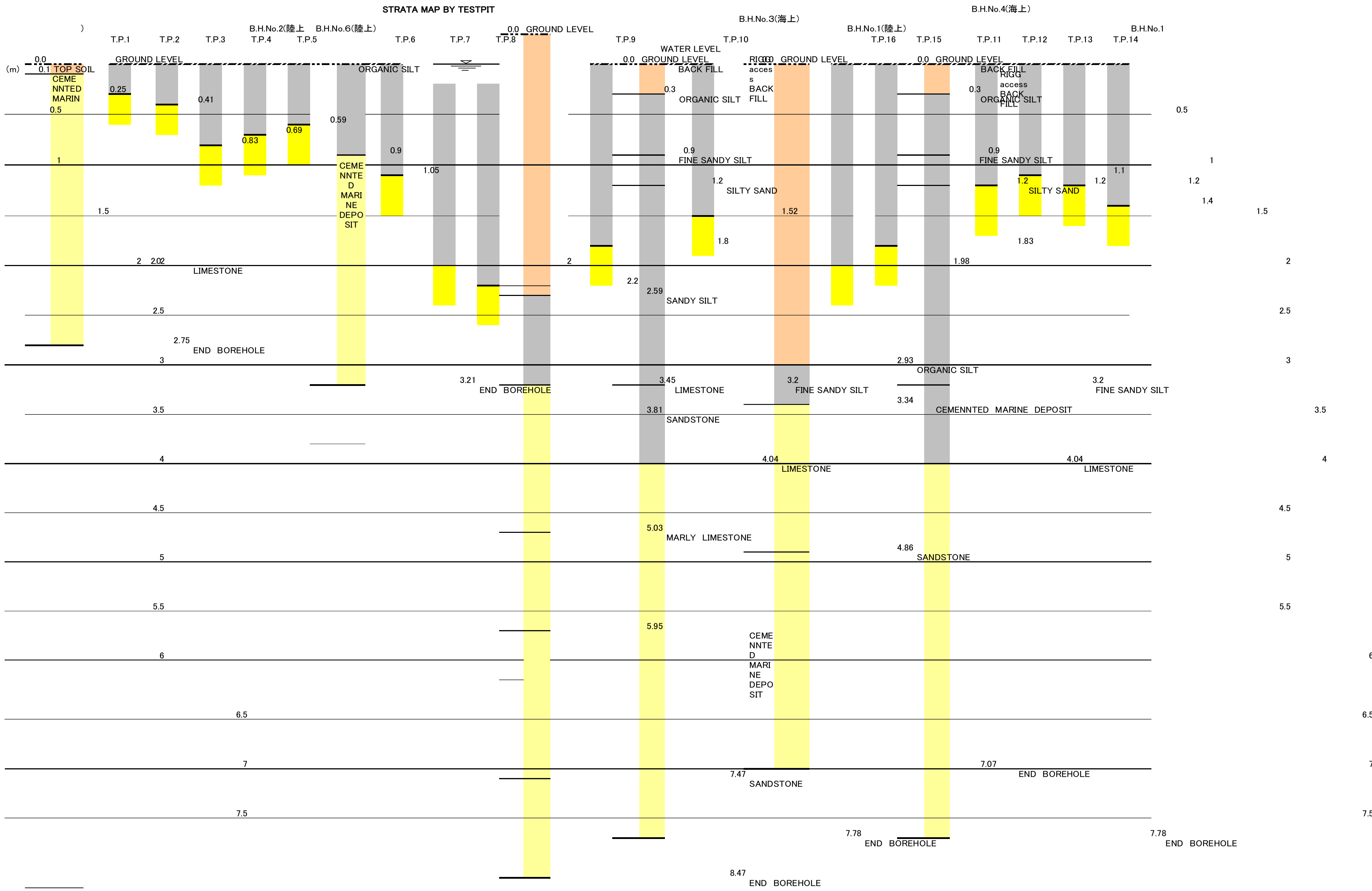
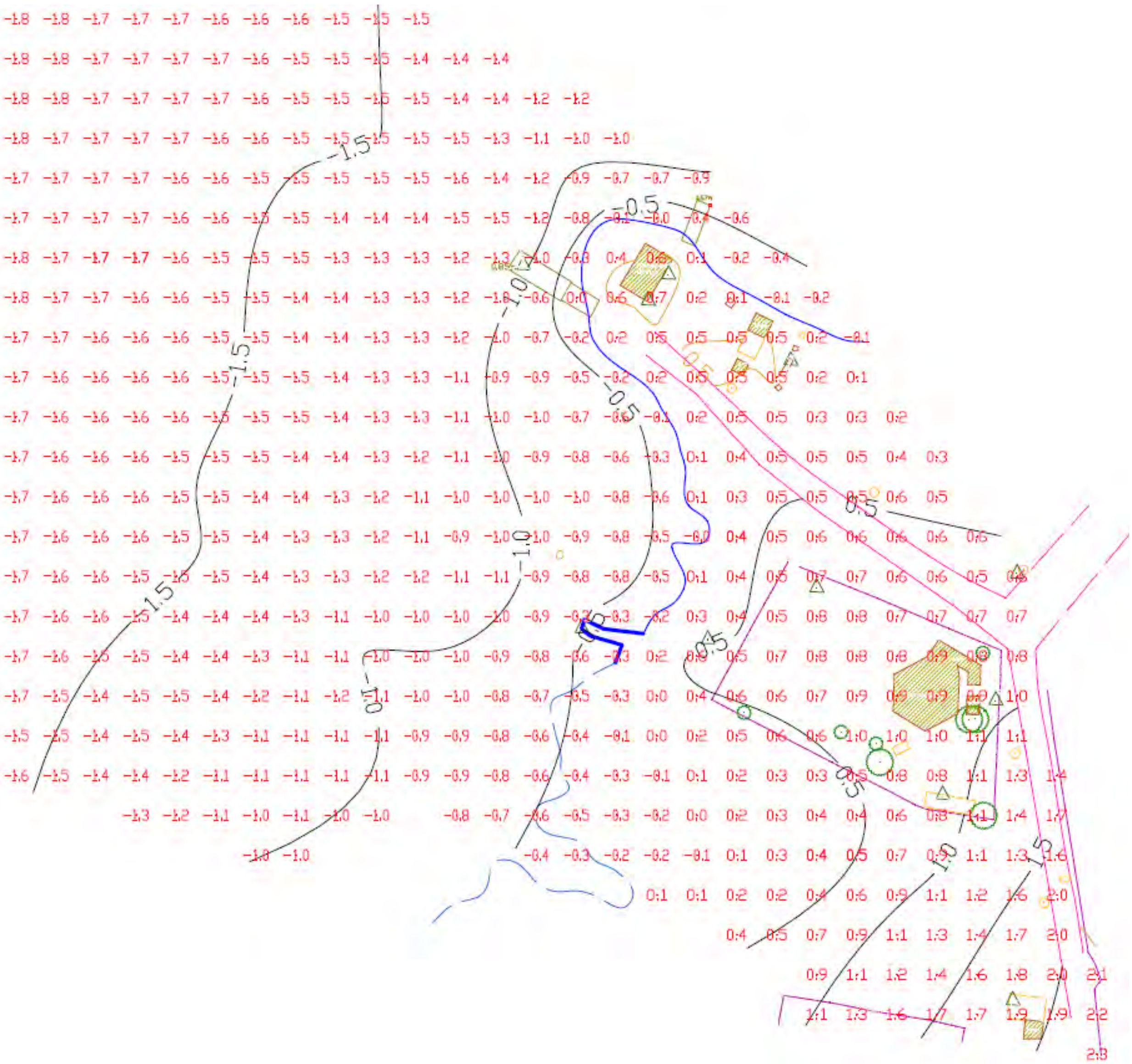


Figure 1.2.11 Land and seabed topographical survey results of the Project site and environs



(7) Rivers and streams

Maps of the area show no definitive rivers or streams flowing into the lagoon. The highest point on Barbuda island is around elevation 40 m (referred to as the “highland”), and is located at one part of the eastern side of the island.

Because Barbuda island geologically consists of sand and coral limestone, seawater permeation inland is limited. Given the above topography, surface rain runoff is westward towards the Caribbean sea side, and therefore can be assumed to flow into the lagoon. Rain runoff into the lagoon flows out to sea via the channel at the north of the lagoon. This outflow is generally believed to be slow, however, given the fact that the channel is a shallow 1.5 m depth, and the immediate sea beyond is a shallow coral reef area with water depth of 1 m or less.

It is assumed that the lagoon water level will rise in the case of a sustained heavy rainfall. According to interview survey of local residents, houses in the center of Codrington have been flooded above floor level when the island has experienced heavy rainfall accompanying hurricanes.

Given this situation, it is anticipated that on-land drainage infrastructure may perform poorly in the event of sea level rise as a result of both wind setup and low-pressure suction lift occurring at the same time.

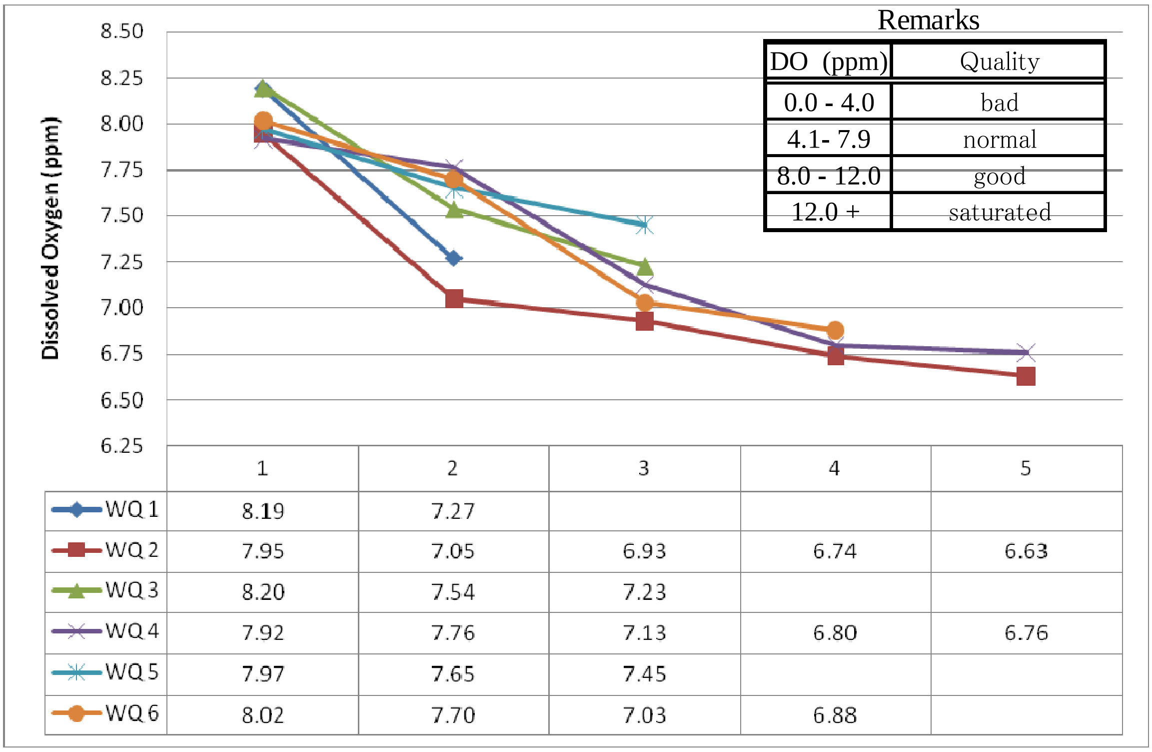
(8) Water quality and bottom sediment properties

Water quality and bottom sediment properties were analyzed at 6 locations within the sea area immediately fronting the site in order to identify base indices and environmental criteria with regard to the sea area at the Project site and environs. Water and bottom test samples were taken on January 8, 2009. Testing and analytical results are shown in Table 1.2.12 and Figure 1.2.12. Also, there are no reported obvious sources of oil contamination in and around the Project site. This was further verified by the results of visual inspection of the site area.

Table 1.2.12 Results of water quality testing

Date Jan. 8, 2009

Sampling point		WQ 1	WQ 2	WQ 3	WQ 4	WQ 5	WQ 6	Average
Sampling time		11:30 AM	11:55 AM	12:15 PM	12:35 PM	1:00 PM	1:15 PM	
Temperature(℃)		24.6	25	24.9	25.2	25	24.8	24.9
pH		8.19	8.29	8.22	8.21	8.18	8.22	8.2
COD (ppm)		1.9	1.9	2.2	2.3	1.8	2.3	2.1
DO	W. depth(ft)	2.25	5	3.2	5	3.25	4.25	3.8
	1	8.19	7.95	8.2	7.92	7.97	8.02	8.0
	2	7.27	7.05	7.54	7.76	7.65	7.7	7.5
	3	–	6.93	7.23	7.13	7.45	7.03	7.2
	4	–	6.74	–	6.8	–	6.88	6.8
	5	–	6.63	–	6.76	–	–	6.7
	Average	7.73	7.06	7.66	7.27	7.69	7.41	7.5
SS (ppm)		14	ND	ND	2	7	2	6.3
E. Coli (CFU/100ml)		0	0	0	0	0	0	0.0
Salinity (ppm)		Date	Jan. 29	Time	16:00	34	Codrington lagoon	
			Jan. 30		11:00	33	Point wharf	



DO (ppm)	Quality
0.0 - 4.0	bad
4.1- 7.9	normal
8.0 - 12.0	good
12.0 +	saturated

	1	2	3	4	5
WQ 1	8.19	7.27			
WQ 2	7.95	7.05	6.93	6.74	6.63
WQ 3	8.20	7.54	7.23		
WQ 4	7.92	7.76	7.13	6.80	6.76
WQ 5	7.97	7.65	7.45		
WQ 6	8.02	7.70	7.03	6.88	

Figure 1.2.12 Vertical profile for concentration of dissolved oxygen at respective sampling sites

Table 1.2.13 Results of bottom sediment testing

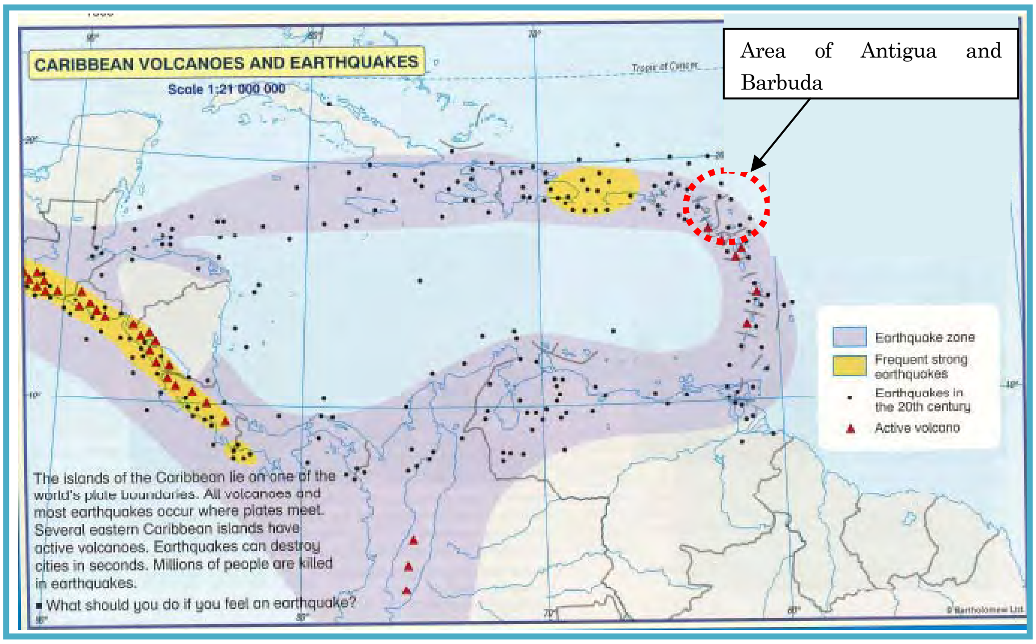
Date Jan. 8, 2009

		SQ 1	SQ 2	SQ 3	SQ 4	SQ 5	SQ 6
Sampling point		SQ 1	SQ 2	SQ 3	SQ 4	SQ 5	SQ 6
Sampling time		11:30 AM	11:55 AM	12:15 PM	12:35 PM	1:00 PM	1:15 PM
Weight per unit volume (g/mL)		1.12	1.55	1.47	1.46	1.27	1.49
Water content (%)		64	39	45	41	60	44
Grain size composition (%)	Gravel	19	13	18	10	24	19
	Sand	40	63	57	67	49	67
	Silt	20	10	11	11	12	6.5
	Clay	21	13	14	13	15	8.3
Heavy metals (ppm)	Chrome (Cr)	ND	ND	ND	ND	ND	ND
	Iron (Fe)	5100	3200	4000	2300	2700	2500
	Nickel (Ni)	ND	ND	ND	150	ND	ND
	Copper (Cu)	ND	ND	ND	ND	ND	ND
	Zinc (Zn)	ND	ND	ND	ND	ND	ND
	Arsenic (As)	ND	ND	ND	ND	ND	ND
	Silver (Ag)	ND	ND	ND	ND	ND	ND
	Cadmium (Cd)	ND	ND	ND	ND	ND	ND
	Tin (Sn)	ND	ND	ND	ND	ND	ND
	Mercury (Hg)	ND	ND	ND	ND	ND	ND
	Lead (Pb)	11	6	9	ND	5	ND
	Uranium (U)	2	5	4	4	2	3

Note: ND = not detected

(9) Earthquakes

Up to this time, there have been no reports of major damage occurring on Barbuda island due to earthquake. Nevertheless, Antigua and Barbuda sit atop the eastern edge of the Caribbean plate, in a region dotted with active volcanoes and zones of frequent seismic behavior. Locations of earthquake epicenters and active volcanoes are shown in Figure 1.2.13.



Source: Longman Caribbean School Atlas, Third Edition 2004

Figure 1.2.13 Distribution map of earthquake epicenters and active volcanoes in the Caribbean region

The design seismic coefficient for the Project site is calculated based on past earthquake records for the region within which Antigua and Barbuda lies. During the period covered by the National Earthquake Information Center data base from 1973 to February 2009, there are 51 cases within a radius of 150 km of the Project site where a large seismic energy of magnitude 5 or more was released. Applying the Port and Harbor Design Handbook (2003 edition), horizontal acceleration and seismic intensity at the Project site are calculated based on magnitude and distance from epicenter, and the maximum value for each occurrence determined. On this basis, there are 25 cases over a 36 period that fall into the category of consideration. Results are indicated in Table 1.2.14. According to these, the strongest earthquake impacting the Project site occurred on October 8, 1974, with a magnitude of 7.5 and horizontal seismic coefficient of Kh≒0.2. This earthquake caused structural damage within St. John’s city, including that to the Cathedral of St. John.

Table 1.2.14 Earthquakes (1973~2008) and corresponding seismic intensities recorded for the Project site

Outbreak date			Latitude (North)	Longitude (West)	Depth of seismic center (km)	Richter scale	Distance from seismic center (km)	Horizontal acceleration (gal)	Seismic intensity
Y	M	D							
1973	2	17	16.95	-61.42	34	5.5	86	21.58	0.0220
1974	10	8	17.30	-62.00	47	7.5	40	274.05	0.2179
1975	3	3	17.22	-61.02	39	5.2	97	12.99	0.0133
1976	3	10	16.76	-61.13	77	5.9	121	21.62	0.0220
1977	2	24	17.24	-61.49	33	5.5	56	36.17	0.0369
1978	5	29	17.69	-61.56	46	5.2	28	54.19	0.0553
1979	10	9	16.64	-61.24	62	5.3	126	10.14	0.0103
1981	8	4	16.82	-61.47	50	5.3	97	14.61	0.0149
1982	11	23	17.54	-62.11	98	5.4	31	60.71	0.0619
1983	4	5	17.80	-61.63	33	5.2	28	54.19	0.0553
1985	3	16	17.01	-62.45	13	6.8	94	78.33	0.0799
1986	12	11	17.23	-61.38	54	5.4	65	27.17	0.0277
1988	4	22	17.06	-61.54	60	5.0	69	15.90	0.0162
1990	2	21	16.90	-62.33	109	5.9	96	29.54	0.0301
1991	2	5	17.72	-61.64	41	5.3	22	76.02	0.0775
1994	7	23	16.71	-61.37	67	5.5	112	15.18	0.0155
1995	6	28	17.67	-61.60	54	5.1	24	56.62	0.0577
1997	1	25	17.74	-61.61	46	5.2	25	60.59	0.0618
1998	6	25	17.73	-61.57	44	5.6	29	79.78	0.0814
1999	12	20	17.31	-61.71	58	5.4	37	50.73	0.0517
2000	10	30	17.64	-61.19	33	5.8	67	41.07	0.0419
2001	9	25	17.02	-61.42	33	5.4	80	21.08	0.0215
2002	12	21	18.36	-62.38	52	5.4	99	15.98	0.0163
2003	6	30	17.46	-61.14	33	5.7	75	32.14	0.0328
2007	2	27	17.11	-61.49	51	5.0	68	16.19	0.0165

Source: USGS：United States Geological Survey

On the basis of the above 25 seismic data sets considered, application of both Gumbel and Weibull probability distribution indicates that the former exhibits the best correlation, and probable seismic intensities for respective return periods were accordingly calculated using the Gumbel distribution function. Results are indicated in Table 1.2.15 and Figure 1.2.14. Results of this probability calculation show that the likelihood of an earthquake with strong horizontal seismic intensity is small.

Table 1.2.15 Return period and probable seismic intensity (Gumbel distribution)

Return period :Rp	2	5	10	20	30	50	100	150	200	500
Probability (of non-exceedance) :P	0.2800	0.7120	0.8560	0.9280	0.9520	0.9712	0.9856	0.9904	0.9928	0.9971
Rectifying variable :rv	-0.241	1.080	1.861	2.594	3.012	3.533	4.233	4.641	4.930	5.849
Seismic intensity :×	0.0390	0.0500	0.0560	0.0620	0.0650	0.0700	0.0750	0.0790	0.0810	0.0880

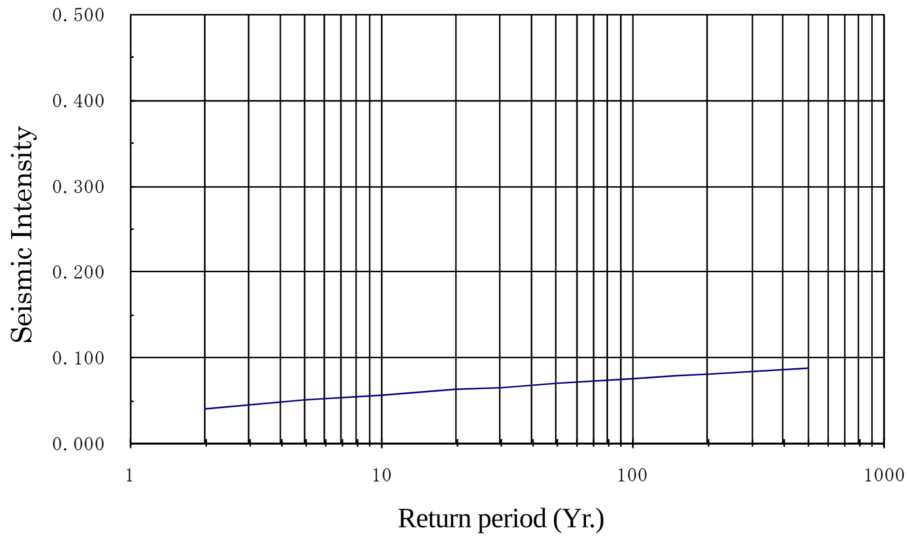


Figure 1.2.14 Return probability of seismic intensity

Nevertheless, there has been in the past seismic activity with an intensity of Kh≒0.2. This accordingly must also be taken into consideration when calculating the horizontal seismic intencity to be applied to facility design under the Project.

Design seismic intensity to be applied to harbor facility design according to the Port and Harbor Design Handbook (2003 edition), on an area-wise and facility-wise basis, is shown in Table 1.2.16 below.

10.2 Design seismic intensity

[Basic approach]

Design seismic intensity to be appropriately determined corresponding to characteristics of area and foundation, and importance of structure.

[Explanation]

(1) General

The values indicated in the Table 1-2-16 below are applicable as a standard to design seismic intensity except the case of earthquake resistant seawall.

Table 1-2-16 design seismic intensity, etc.
(except the case of earthquake resistant seawall)

Area name	Hokkaido (a), Kanto (a), Chyubu (a), Kinki (a)	Touhoku (a), Kanto (b), Kinki (b), Shikoku (a)	Hokkaido (b), Touhoku (b), Chyubu (b), Chyugoku (a), Shikoku (b), Kyushyu (a)	Hokkaido (c), Chyugoku (b), Shikoku (c), Kyushyu (b)	Hokkaido (d), Kanto (c), Chyugoku (c), Kyushyu (c)
Mooring facility A	0.18 (0.22)	0.16 (0.19)	0.14 (0.17)	0.13 (0.16)	0.10 (0.12)
Recreational water facility	0.18 (0.22)	0.16 (0.19)	0.14 (0.17)	0.13 (0.16)	0.10 (0.12)
Mooring facility B	0.15 (0.20)	0.13 (0.16)	0.12 (0.14)	0.11 (0.13)	0.08 (0.10)
Retaining facility	0.15 (0.20)	0.13 (0.16)	0.12 (0.14)	0.11 (0.13)	0.08 (0.10)
Max. acceleration of foundation (Gal)	350	250	200	150	100

Remark<1: Figures in parenthesis to be applied in case the thickness of quaternary era layer (alluvium deposit, diluvium deposit)is either

(i) more that 25m of thickness of ordinary sand and clay foundation, or

(ii) more than 5m of thickness of poor subsoil

The said "subsoil" means the sandy soil of which N value is below 4 or soil below 20kPa of unconfined compression value, and is slightly different from general idea of poor subsoil.

<2: Mooring A is a major landing quays and quays used by regular shipping and ferries. Mooring B is a wharf and landing facility except mooring A.

<3: Recreational water facility is a revetment or a breakwater considering recreational water factors.

<4: Retaining facility excludes recreational water facility and road revetment.

Source: the Port and Harbor Design Handbook (2003 edition)

Given factors including (i) the nature of earthquake occurrence at the Project site, (ii) the water depth at mooring facilities is shallow, and (iii) the ground surface layer at the site is confirmed to be an approximately 5 m thick clayey deposit, design seismic intensity as indicated in parentheses "(facility B, 0.2)" are applied. This is based on the values for category B mooring facilities (with the exception of major landing quays, and quays used by regular shipping and ferries) in areas most prone to earthquake impact. Adopted Kh is subsequently 0.20.

(10) Marine and terrestrial biology

A survey was carried out on marine and terrestrial biology in the Project site area. The lagoon bed in and around the Project site is covered with a mud layer and is subject to little disruption by boat activity. Primary species of sea grass showing robust growth in the area are turtle grass (*Thalassia testudinum*), shoal grass (*Diplanthera wrightii*) and cattail algae (*Bathophora oerstedii*).

At the southern side of the Project site, rain runoff is by natural drainage, and as discussed in (7) above, water quality analysis for the site and environs indicates normal values. Furthermore, the biofacie for the site area shows little difference with that confirmed under similar studies[1], and the area sustains a relatively high level of biodiversity {see Appendices 5 (8) Marine and terrestrial biological survey}.

On the basis of the above, nevertheless, an appropriate treatment of wastewater from Project facilities will be required to minimize any biological impact on the immediate lagoon area.

The two species of sea turtle designated under the International Union for Conservation of Nature (IUCN) "Red Book" as most endangered, i.e. *Eretmochelys imbricate* and *Dermochelys coriacea*, were not observed during this survey nor have been seen in past surveys[2] in the site area. Of the species listed in the Red Book, the only species observed in the past in the Project site vicinity is the West Indian whistling duck (*Dendrocygna arborea*)[3]. However, this species accesses the area only in search of food and does not use it as a breeding ground. The species is widely observed in areas adjacent to the site as well, and implementation of the Project is therefore judged to have a very limited impact on its livelihood.

The coastline in the northern half of the lagoon is marshland covered primarily with red mangrove (*Rhizophora mangle*) and white mangrove (*Laguncularia racemosa*). The Project site is located to the southern side of this marshland area. Mangrove forest coverage extends several meters inland, and was planted around 2000 by local residents to preserve the shoreline. Mangrove currently exhibits healthy growth.

Project implementation will unavoidably entail the cutting of a certain amount of mangrove. Total area to be felled would be approximately 300 m^2. After construction, it is judged that the effects of mangrove felling can be offset by mangrove reforestation in the immediate Project area.

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1 A proposed Ecosystem Monitoring Plan for Codrington Lagoon Barbuda (June 2000) Jarecki Lianna
2 Caribbean Environment Programme UNEP/ WIDECAST, Sea Turtle Recovery Action Plan for Antigua and Barbuda (1992)
3 Assigned a rating of "vulnerable" under the Red List.

1-3 Environmental and social considerations

(1) Environment-related procedures

The agency with jurisdiction over development permits and environmental impact assessments (EIA) within Antigua and Barbuda is the Development Control Authority (DCA). DCA makes its judgment on whether or not a project warrants an EIA, based on the Physical Planning Act in effect from 2003. Projects subject to the statute are shown in Table 1.3.1.

Table 1.3.1 Projects subject to EIA as set out in the Third Schedule of the Physical Planning Act (2003)

1.	An airport, port or harbor, including a yacht marina
2.	A power plant
3.	A crude oil or refinery facility or a petroleum and natural gas storage and pipeline installation
4.	An incinerator, sanitary landfill operation, solid waste disposal site, sludge disposal site, toxic waste disposal site or other similar site
5.	A wastewater treatment, desalination or water purification plant
6.	An industrial estate development project
7.	An installation for the manufacture, storage or industrial use of cement, paints, chemical products or hazardous materials
8.	**A** drilling, quarrying, sand mining and other mining operation
9.	An operation involving land reclamation, dredging and filling of ponds
10.	A hotel or resort complex

Because this Project includes the construction of harbor facilities as well as a wastewater treatment facility, it is subject to EIA. Because the Basic Design Report prepared by the Japanese side includes content commensurate with an EIA report, requirement for submission of a separate EIA has been waived by DCA (see Appendices 4 “Minutes of Meeting Annex 6”).

The National Park Authority manages national parks based on the National Parks Act (1984). Nevertheless, with the passage of the Barbuda Local Government Act (1976), responsibility for overseeing national parks on Barbuda island resides with the Barbuda Council. The council subsequently established the Codrington Lagoon Management Board to which it delegated authority for management of national parkland on Barbuda island.

As of present, however, the board does not have binding legal authorities.

(Barbuda Council)

The Barbuda Council has the responsibility and duty to administer land and the development of land in Barbuda. The Council shall designate areas of land in Barbuda for residential use, agriculture use, forestry, public purposes, commercial use, development, fisheries and national parks. Although the facilities provided by the Project will be owned by the national government, it is necessary to get approval of its land utilization at least in the aspect of public purposes, fisheries and national parks. Accordingly, the Fisheries Division, the Project executing agency, is required to establish close contact with the Council in the stage of planning, construction and operation, and to get their understanding and support for the Project implementation.

On the basis of the above, the procedure with regard to environmental issues in implementing the Project entails (i) the executing agency (Department of Fisheries) submitting the Basic Design Report to DCA to qualify for a development permit, and at the same time (ii) obtain development approval from the Barbuda Council. With regard to (ii), utilization of the Project site has already been approved by the council {Appendices 4 “Minutes of Meeting Annex 7”}, and this decision is expected to stand.

(2) Mitigating environmental and social impacts

The Project site is located within a national park, and is surrounded by mangrove forest. Accordingly, it is assumed that Project implementation will have both environmental and social impacts. Based on JICA Guidelines for Environmental and Social Considerations, the Project was assessed as Category B at the preliminary survey stage.

At the subsequent preparatory survey stage, perceived impacts as a result of Project implementation were discussed with stakeholders, and a scoping matrix as well as measures to specifically avoid or mitigate such impacts during construction and the following Project operational stage were drawn up {for details, see Appendices5 (8)}.

［Social environment]

Impact	Outline(Issues Concerned)	Possible Evasive action/ Mitigation Measure
Land use and utilization of local resources	Vessels moored at the Project site need to be moved during construction.	• Consensus will be made with fishers before construction starts. An alternative mooring site will be identified.
	Barbuda Council, an authority for development activities within the Island, authorised and issued permission for the land usage of the proposed Project site.	• A construction supervisor shall re-examine borders of the Project site with Barbuda Council before construction.
	Fish bates will not be collected in and around the Project site during construction.	• Consensus will be made with fishermen before construction starts.
	Barbuda Council authorised and issued permission for the usage of sand and stones for construction of the Complex.	• A construction supervisor shall examine its usage status with Barbuda Council during construction period.
	Once a fresh fish distribution system to Antigua is established, there may be an increase in fishing effort within lagoon.	• Fisheries Division shall advise on prevention measures for overfishing within lagoon and monitor resource conditions (e.g. change in body lengths of major fish species)
Social institutions such as social infrastructure and local decision-making institutions	There may be a discrepancy in understanding towards the proposed fisheries development plan between the Fisheries Division and Barbuda Council.	• Information will be actively shared between Fisheries Division and Barbuda Council.
Existing social infrastructures and services	Excessive power usage is concerned during construction.	• During construction period, a construction supervisor shall check power usage status regularly. If there is necessity, he/she will discuss with APUA. • A back-up generator will be introduced for blackouts during O&M of the Complex.
	Intensive water usage during and after construction may decrease the amount of city water to be provided to households.	• When intensive water usage is required at a certain stage of construction, both city and rain water need to be stored well in advance. Rain water shall also be actively used even after construction. • Monitoring of water usage will be conducted by a construction supervisor during construction and a Complex manager after construction in coordination with APUA.
Local conflict of interests	Activation of overall local economy is anticipated through the implementation of the Project. However, lobster traders are worried that they may not have strong impacts on fishers as they currently do.	• Barbuda Council shall facilitate a meeting among stakeholders to optimise and evenly distribute benefit of having a Complex.
	There are some who worries negative impacts on tourism.	• Negative impacts will be mitigated by introducing a buffer zone between the Project site and the site for tourism.
Sanitation	There will be some wastes to be produced during and after construction.	• The garbage bin with a lid will be introduced within the Complex in coordination with existing garbage collection system. A worker in charge of waste management shall be posted.
Hazards (Risk) Infectious diseases such as HIV/AIDS	There may be a risk that workers from outside of the Island spreading infections diseases.	• Workers can be enlightened on HIV/AIDS through activities currently conducted by 'Antiguan AIDS Secretariat' and 'Health hope & HIV foundation' (i.e. posters, pamphlets and workshops).

[Natural environment]

Impact	Outline(Issues Concerned)	Possible Evasive action/ Mitigation Measure
Soil Erosion	Soil erosion may occur at the border of the Project site by discharged rain water during heavy rain. This is because the foundation level of the site will be raised in order to mitigate hurricane damages.	• The rain water drainage based on precipitation and proper discharging channels shall be included in the plan.
Coastal Zone (Mangroves, Coral reefs, Tidal flats, etc.)	Some mangrove trees need to be cleared for construction which may negatively impact on ecosystem along the shoreline. Yet, since the mangroves are not as dense as they are in the northern part of lagoon, its negative impact is smaller than having the site in other areas of lagoon.	• The Project site and allocation of the facilities shall be selected and designed in a way to minimize number of mangroves to be cut. • Mangrove trees will be replanted around the Project site after construction in order to mitigate negative impact.
Flora, Fauna and Biodiversity	There is a possibility to cause negative impacts on ecosystem in and around the Project site by accidentally discharging waste/ muddy water, wastes or oil into the lagoon. There may be a discrepancy between conservation principles set forth by the Codrington Lagoon Management Board and optimal allowable catch set forth by the Fisheries Division.	• Silt screen will be applied during the civil construction works. • A waste water treatment facility will be planned which meets criteria set forth by the Ministry of Health. • Coordination between the Codrington Lagoon Management Board and the Fisheries Division shall be made. Two parties shall also share information on its ecosystem monitoring.
Landscape	The landscape will change by construction of the Complex.	• The layout, forms and colours of the Complex shall be well planned so that the Complex will be an appropriate facility to be within the National Park.

[Pollution]

Impact	Outline(Issues Concerned)	Possible Evasive Action/ Mitigation Measure
Water Pollution	There is a possibility of contaminated water being discharged during and after construction.	• Preparation of a prevention manual and monitoring of waste water discharge will be conducted by a construction supervisor during construction and a complex manager after construction.
Soil Contamination	There may be a possibility of soil contamination by cement dust and rinsing liquid for paints during construction. There may be a possibility of soil contamination by machinery oil from workshops when O&M of the Complex starts.	• Oils, poisonous substance, etc. will be disposed to authorized damp site on Barbuda. • Grease trap will be installed for waste water before entering waste water treatment system • Waste oil tank will be provided to the workshop
Noise and Vibration	There may be some noise and vibration generated from machineries and vehicles during construction. Yet, since the Project site is located on downwind of residential area, the impact is expected to be minimal.	• Machines with low noise and less vibration will be used. • No construction works will be conducted during evening hours and Sunday morning.
Offensive Odor	During replacement of soft layer of a foundation, there will be some level of offensive odour where organic silt is temporary piled. However, since the Project site is located on downwind of residential area, the odour is expected to be discharged towards the lagoon. Water used for cleaning fresh fish can be a potential source of offensive odour during O&M of the Complex.	• A waste water treatment facility will be planned which meets criteria set forth by the Ministry of Health. • Solid wastes will be stored in the garbage bin with a lid (see No. 11)
Bottom sediment	There may be some silt accumulation in the water area between envisioned jetty and existing jetty.	• A culvert will be installed to the envisioned jetty to minimize water stagnation between two jetties.

Impact	Outline(Issues Concerned)	Possible Evasive Action/ Mitigation Measure
Accidents	There are possible risks of threatening one's life or damaging the environment through: discharging toxic materials; fire; explosion; traffic accidents; and natural calamities (high tide, gale) during construction. Damages caused by hurricanes are also anticipated after construction.	• As setting up appropriate notices and promoting active information sharing with communities, cooperation should also be requested to the primary school and the kindergarten adjacent to the Project site. • Construction workers will be repeatedly reminded on safety control, and a construction site will be fenced. • Construction materials shall be handled and stored in a proper manner, especially the ones which are inflammable and explosive. • Based on past damages caused by hurricanes, the foundation level of facilities and introduction of hurricane shutters shall be considered during designing of the facility.

Among these impacts, following two items on lagoon environmental aspects needs to be monitored in the operating stage of the Project by the Fisheries Division as a Project executing agency.

(a) Water quality of discharged water from the Project facilities

Items : BOD, SS, pH, chroline and coli forms, based on the East Caribbean Standard recommended by the Ministry of Health,

Frequency: 4 times a year

Period : 2years

(b) Fish landing record

Items : landed volume by fish type and by lagoon or by sea

Frequency: 3 times a week

Period : all the year round

As for ecosystem of overall lagoon, research or observation data that might be collected by the Codrington Lagoon Management Committee under the Barbuda Council is to be owned jointly and monitor the ecological transition.

(3) Other development projects related to the area surrounding the Project site

In 2006, a proposal for a Codrington area development project was submitted to the Barbuda Council. As of the present, however, specifics in writing have not yet been formulated. Nevertheless, a tourist boat jetty is located adjacent to the site, and numerous tourists visit the bird sanctuary at the northern part of the lagoon. Accordingly, it is necessary to consider Project facility layout from the standpoint of this tourist traffic as well.

In conjunction with that discussed above, it will be necessary for the Department of Fisheries and the Barbuda Council to establish an interface for receiving and responding to environmental complaints in a timely manner.

(4) Responsibility for keeping stakeholders informed

The Project aims to enhance the livelihood of small fishermen on Barbuda island. But at the same time, Project implementation poses a possibility of some negative impacts on Codrington lagoon in the process of supporting local fishermen. In this regard, the executing agency (Department of Fisheries) must assume responsibility for providing relevant information to stakeholders and keeping them up to date on environmental issues pertaining to the Project. This will provide a basis for achieving consensus among stakeholders in the event that any such issue should arise.

1.4 Other (global issues, etc.)

The Project aims to establish fishery and distribution infrastructure on an outlying island, and therefore no other issues of concern are present in this regard.

CHAPTER 2

CONTENTS OF THE PROJECT

Chapter 2 Contents of the Project

2-1 Basic Concept of the Project

(1) National Objectives and Project Objectives

Under the Manifesto 2004 (framework for national development plan), economic development is espoused based on industrial sector diversification. Within this outline, development of the fishery sector is a major issue. The fishery sector is positioned as a primary sector exploiting indigenous resources and promoting national economic independence.

In the Antigua and Barbuda Fisheries Development Plan (2006~2010 : Draft), the basic objective of fisheries development plan is to contribute to national development by sustained and maximum exploitation of indigenous resources. Under this item, 11 development issues are cited in the plan.

The Project is targeted to upgrade present artisanal fisheries through providing fisheries infrastructure and improving fisheries marketing on Barbuda island, that has problems such as fisheries inefficiency, inability of keeping freshness of fish catch, etc. The Project contributes to achieve (i) establishing fishery infrastructure pertaining to fish harvesting, distribution and marketing, (ii) increasing the supply of animal protein by increasing the quantity of fish harvested, and (iii) upgrading fishery technology and vitalizing the livelihood of small fishermen in the above mentioned 11 development issues.

(2) Project description

The Project, in line with the above described objectives, is designed to provide fisheries infrastructure and improve fish marketing on Barbuda island which lags behind that of Antigua island. This is anticipated to significantly promote the livelihood and productivity of artisanal fishermen on Barbuda. The requested Japanese assistance will accordingly establish a fisheries complex (a fisheries compound facilities with the core of fisheries infrastructure: official wording used by the Fisheries Division) and procure necessary equipment for its operation at Codrington on Barbuda island.

2-2 Basic Design of the Requested Japanese Assistance

2-2-1 Design Policy

(1) Basic Policy

1) Justification of the Requested Project

Quantity of marine products in Antigua and Barbuda increased from 1274 tons to 2257 tons over the period 2001~2007. Nevertheless, this has still fallen short of meeting domestic demand, and the country relies on roughly a 35% import of marine product {see Appendices 5 (1)}. The greater part of fishery output is based on Antigua island. Barbuda lags significantly behind, with marine products at 120 tons per year (lobster roughly 50 tons, and fish at 70 tons [survey team estimate]).

Out of the country's fish catch, high price varieties are exported. As of 2007, this comprised 80 tons per year of fresh fish from Antigua, and 45 tons of live lobster from Barbuda. Nevertheless, the export of fresh marine products needs strict adherence to country sanitary control standards, and the Department of Fisheries is confronted with urgent pressure to respond to this requirement.

The Project site is at Codrington, which accounts for 70% of the Barbuda population, and 80% of marine product harvesting by the island's fishing boats. However, the absence of catch landing, mooring and slipway facilities causes significant time loss in carrying out fishing operations, as well as the beaching and relaunching of boats in need of repair. In addition, the lack of appurtenant facilities including fishing gear storage lockers, a fishing gear sales outlet and a workshop forces fishermen to not only take fishing gear and fuel tanks home with them, but also makes it necessary to go to Antigua island for fishing gear purchase and outboard motor repair. Furthermore, the fact that there are no distribution facilities (including ice making and cold storage) available, the freshness of landed catches cannot be maintained. Movement of marine products off the island is limited to the immediate export by air of live lobster.

As a result, fishing off Barbuda relies heavily on lobster harvesting by small boat. The effective exploitation of other marine varieties is extremely limited. On the other hand, the fishing industry in Antigua has developed to a point where certain fish varieties due to fishing pressure have neared the maximum sustainable yield {see Appendices 5 (2)}. Accordingly, steady fresh fish supply from Barbuda to Antigua is a pressing issue.

Records have not been kept on Barbuda with regard to quantity of landed catches. Existing fishery production data is of low reliability, and formal government statistics on fishery production are not available.

This Project contains components for small fisherman infrastructure, sanitary control of landed catches and the effective implementation of fishery policy.

In light of the above described issues, Project implementation is deemed to be highly necessary, justified and urgent.

[Study on fresh fish distribution under the envisioned Project facilities and equipment]

As discussed above, a structure for steady, efficient and sanitary supply of fresh fish from Barbuda to Antigua is essential.

The Department of Fisheries intends that all live lobster for export and fresh fish for shipment to Antigua from Barbuda be subject to sanitary inspection and packing at the Project administration and fish handling building.

To effectively implement this, it is necessary that ice used from the fish catch stage is sanitary, and that landed catch is processed through a sanitary environment including inspection, freeze processing, packaging and shipment.

The Department of Fisheries is concentrating on a sanitary control service, while at the same time enabling actual product distribution to be carried out by private-sector marketing agents. Accordingly, fish catches purchased by marketers from fishermen are to be subject to a Fisheries Division sanitary control process prior to export, or shipment to Antigua.

Of note as well is the fact that a portion of fresh fish shipped from Barbuda will then be exported. This fish will be transported to the Point Warf fishery complex operated by the Department of Fisheries, where it will be processed by an HACCP enabled plant, inspected and an export certificate issued.

A diagram of the fish catch distribution process in line with the above conditions is shown in Figure 2.2.1.

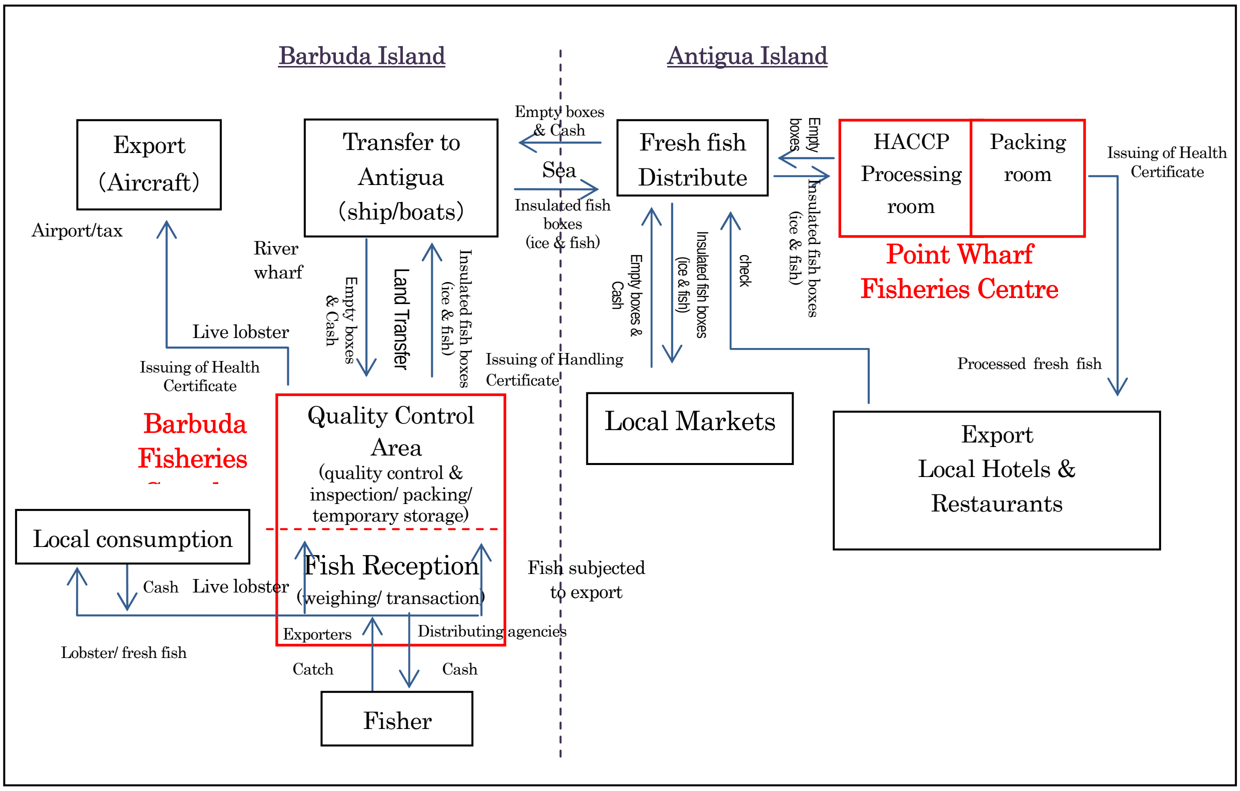


Figure 2.2.1 Fresh fish distributing system from Barbuda island

2) Justification for requested facilities and equipment, and consideration on the components of the Japanese Assistance

Followings are the requested contents discussed with Antigua and Barbuda side and confirmed by the Preparatory Survey Team during its field survey.

Civil construction:

(a) Related to fish landing/boat mooring	Landing jetty and mooring wharf
(b) Related to boat repair and evacuation from hurricanes	Slipway
(c) Related to internal movement line	Internal road

Remarks: Requested two types of slipways with slider and without slider

Building construction:

(a) Related to fish handling	Fish handling shed/processing room/test room
(b) Related to operation and management	Building for administration office(ice making room and cold storage/bed rooms with kitchen), meeting room/class room, ice making machine, ice storage, cold storage, water tank for ice machine, water tan for general
(c) Related to fishermen support	Fishing gear locker, workshop, net shed, fishing gear shop, toilet and shower for fishermen
(d) Related to other appurtenant facilities	Back-up generator, sewage system (septic tank), parking lots, external lighting, provision for fuel depot

Remark<1: As for fish handling shed, not requested HACCP applied facilities but requested enclosed space to carry out quality inspection, fish cooling, packaging and shipment.

<2: Requested to provide water for ice making that could clear the standard of coli form and number of general live bacteria

<3: Requested manually operational back-up generator

Equipment procurement:

(a) Equipment for fish handling	Over head crane on wharf, Bincart, spring scale, platform scale, fish tray, fish handling table, insulated fish box, trolley jacks, pressure washer, sampling and testing equipment
(b) Tools for outboard engine repair	Tools for repair of equipment, chain hoist for workshop
(c) Equipment for fishermen's training and for administration use	AV equipment for meeting room, equipment for meeting room/classroom

Remark<1: Confirmed that spring scale is low priority and be procured by Antigua and Barbuda side.

Remark<2: Requested that the priority of equipment for meeting room/classroom be upgraded that will be used even for fishermen's desk training.

Remark<3: Fish handling table was initially not requested, but newly requested in order to achieve sanitary fish handling.

(a) Civil construction

(i) Landing jetty

At present, there is no fisheries infrastructure at the Project site, and fishermen are forced to following fishing operation

- Fishing departure

  The sea facing the Project site is shallow for some distances from the shore. Typical boat mooring is done by anchoring in around 1m depth of water off-shore. Fishermen wade to their boats, on-load fishing equipment and engine gasoline, and depart to sea.

- Fishing return

  Upon return to the shore, some fishermen use existing sightseeing boat wharf to off-load fishing catch and fishing gear although it is restricted to use for fishing operation. But most of fishermen anchor offshore and then wade to the beach to offload fishing catch and fishing gear.

In the case of boats anchored offshore, considerable exertion is necessary on the part of fishermen wading to and from boats with heavy items such as gasoline tanks, etc. This is particularly aggravated by the muddy seabed into which feet sink considerably when wading). As a result, fishing departure preparations and off-loading upon return are carried out in an inefficient and time consuming manner {see Appendices 5 (3)}.

Accordingly, it is concluded that the construction of a dedicated landing wharf will be highly required to enable safe and efficient fishing departure preparation as well as sanitary landing of catches.

(ii) Mooring wharf

Because the area to the front of the Project site is a shoaling beach, fishing boats must anchor offshore. Also, the existing site ground is at low elevation, and there is no seawall protection. Given the tide level rise when hurricanes occur, the present situation precludes constructing a facility for daily storage of fishing gear. Accordingly a seawall is necessary, not only for boat mooring but also to protect the rearward inland area. From a cost effective perspective, it is concluded that a seawall design is appropriate that allows minimal depth for idle fishing boat mooring.

(iii) Slipway

The coastal area at the Project site has from before been mangrove wetland. Ground is soft as a result of artificially spread beach sand. When fishing boats require hull or engine repair, they are pulled onto the beach either manually or by using some type of heavy machinery. In the case of manual extraction, fishermen legs sink deeply into the soft seabed. If heavy machinery is used, this too sinks into the ground.

When hurricanes occur, fishing boats are loaded on boat trailers and hauled from the water to a safe location. Nevertheless, this operation is seriously hampered by the soft seabed.

The Project complex slipway will accordingly be used not only to raise boats for repair but also to evacuate boats in the case of hurricane. In this light, it is concluded to be a highly necessary facility.

(iv) On-site road

The Project comprises a fishery complex requiring a number of on-land facilities in addition to the slipway. It is appropriate that on-site road be constructed to facilitate the work flow among these facilities.

(b) Buildings construction

(i) Fish handling shed

At present, because there are no facilities on Barbuda to freeze process and distribute marine products, fresh fish cannot be shipped to Antigua. As discussed in Section 2-2-1 (1) 1) (Justification of the Requested Project), this facility is aimed at a closed loop of sanitary control over fish catch handling including lobster export from Barbuda, as well as fresh fish shipment to Antigua. Works relating to this facility includes marine product off-loading and receiving, quality inspection, freeze processing, temporary storage, packing and shipment. This facility is essential to upgrading the fish catch marketing on Barbuda.

Further, various equipment described in the requested list is necessary to conduct above mentioned works in the sanitary control area of this facility.

(ii) Building for administration office

This facility is essential for a range of administrative and other activities including record keeping on landed catches, quality control testing, sanitary processing, maintaining shipping records, issuing health certificates, accounting, facility operation and maintenance and on-site cleaning and upkeep, fisher training and radio communication with fishing boats

In light of the previously described functions assigned to the fish handling shed, it is deemed appropriate to incorporate the ice production machine (including ice storage room), cold storage and water supply tank for ice production together with fish handling shed.

- Ice making and storage facility

In the previous time, fish products have not been distributed from Barbuda to Antigua. The main cause was lack of ice supply facility in Barbuda. In order to improve this situation, provision of ice making and storage facility is essential that will supply ice not only for fishing operation but also for cold processing of fishing catches within the sanitation control area.

- Cold storage

At present, there are no cold storages for fish catch on Barbuda. Because shipment to

Antigua is constrained by irregular schedule of transport vessel services, a cold storage room is necessary for the temporary storage of fish processed in the sanitation control area.

- Sanitized water reservoir tank for ice making

At present, local tap water quality falls outside stipulated standards in terms of the number of bacteria. It is accordingly necessary to sanitize the tap water, and a reservoir tank for sanitized water is essential.

- Meeting room / class room

During the 20 year period following independence, Barbuda fishermen unfortunately did not receive substantial institutional support from the Fisheries Division due to a range of geological, political and budgetary reasons. As a result, following problems exist in Barbuda fisheries:

- ▫ Technical aspect: fishing method is inclined to trap fishing, etc.
- ▫ Law-abiding aspect: neglect of fishing regulation, stealing other fishermen's trap, etc.
- ▫ General knowledge of the fishing sector: due to a failure to understand the basic nursery function of the lagoon, local fishermen harvest lobsters that are smaller than allowed under fishing regulations. Lack of GPS and VHF results in fishing operations that are not only inefficient, but also preclude effective crisis management in the event of accident or natural disaster.

Nevertheless, a certain amount of support has been forthcoming from the Fisheries Division up to now, and policy under the Project is to continue this effort at a level on a par with similar fisheries complexes established on Antigua. This requires that a fishermen training classroom be created {see Appendices5 (4)}.

- Sleeping quarters

Because there are no overnight facilities on Barbuda other than first class tourist hotels, Fisheries Division's staff on assignment to Barbuda have availed themselves of lodging in private residences. In fiscal 2008, sixty person-days of business trip by the Division were logged, and this is expected to increase with implementation of the fishermen training program under the Project. Accordingly, sleeping quarters are deemed necessary {see Appendices 5 (4)}.

- Rainwater reservoir tank

Because tap water supply on Barbuda is limited (around 50 liters/ person/ day), the average household reverts to collecting rainwater. Construction of a rainwater collection and supply tank is accordingly essential under the Project.

(iii) Facilities for fishermen support

- Fishing gear locker

At present, there are no fishing gear lockers in fish landing places on Barbuda. Upon completion of fishing operations, local fishermen are forced to bring their fish catch and fuel tanks to their residence. Based on observation of a similar type facility on Antigua, various fishing gear are stored within the locker facility making it convenient to immediately access required equipment at very short distance from the moored boat. On this basis, a fishermen locker facility proximate to the mooring wharf is deemed necessary.

- Fishing gear repair area

Observing similar facilities on Antigua, it can be seen that fishermen repair and maintain fishing gear in a roofed area adjacent to the fishing gear locker facility. This type of roofed space is necessary to enable efficient repair activities regardless of scorching sun or inclement weather conditions.

- Workshop

Since there are no workshops for engine repair on Barbuda, fishermen bring their engines to their residence every time when engines need to be repaired or maintained. General engine maintenance including spark plug replacement, etc. is currently carried out by the fishermen themselves. Repairs requiring special tools and equipment such as crankshaft overhaul necessitate boat transfer to Antigua island, resulting in significant livelihood opportunity loss for the fishermen concerned. Accordingly, it is concluded that establishing a workshop under the Project with necessary tools and equipment is essential.

- Fishing gear store

At present, there are no fishing gear shops on Barbuda. Fishermen should go to Antigua to purchase fishing gears individually. Further, they are buying comparatively high priced fishing gear since they are not organized.

On the other hand, in the case of fishermen support facilities on Antigua similar to that envisioned under the Project, fishing gear over-the-counter marketing is leased to either a private operator or a fishermen cooperative, enabling bulk inventory and consequently a cheaper selling price. It is accordingly concluded that the same type of fishing gear marketing outlet under the Project will effectively reduce the cost of fishing operations.

- Fishermen's toilet

In the stage of the Project operation stage, it is anticipated fishermen will stay longer in fisher's support facilities. Accordingly, it is essential to provide their toilet to secure sanitary environment in the Project site. Further, in case of similar complexes on Antigua, fishermen frequently use shower when they get return. Accordingly, it is judged shower needs to be incorporated with fisher's toilet.

(iv) Other appurtenant facilities

- Back-up generator

City power is subject to an approximate 20 minute blackout when switching generators (one time every two weeks). In addition, a 2~3 hour blackout can occur when overhead line construction or maintenance works are carried out (in many cases with no forewarning). It has also been confirmed that blackouts lasting one day or more occur when critical parts need to be procured. In light of this situation, it is deemed necessary to install an back-up generator under the Project to ensure power for water supply and sewage treatment tank pumps, as well as stable power for the cold storage.

- Sewage system (septic tank)

Given the fact that the Project site fronts on a lagoon designated as a national park, it will be necessary to establish a wastewater treatment facility that meets wastewater standards that are recommended by the Government of Antigua and Barbuda..

- Parking lots

In most cases, vehicles are being used for fish transport on Barbuda. In the Project operating stage, it is anticipated frequent traffic will be occurred not only by fishermen and staff but also by exporters, fish distributers, resident people, etc. It is accordingly necessary to control free trafficking inside the site since fish catch is transported manually such as by Bin cart, etc. Accordingly, provision of parking lot is required.

- Outdoor lighting

From view point of ensuring on-site security, minimum number of outdoor lighting is required to be installed. This is the case with the existing fisheries complexes at Parham and Urlings.

- Fueling site

A fueling site is to be included within the facility complex to accommodate the Fisheries Division future plan to establish a fueling station for fishing boats.

(c) Equipment

(i) Equipment for fish handling

The requested equipment are necessary to be procured to conduct various works related to fish handling shed such as fish landing, fish transport, sorting and weighing, fish cooling process, temporary storage, packing and shipment, cleaning, sanitary testing, etc.

(ii) Equipment for repair tools

The requested equipment are necessary to be procured to conduct repair works of the envisioned workshop.

(iii) Equipment for fisherman training and management

The Fisheries Division generally requires that registering fishing boats be equipped with VHF radio. This stipulation is waived in the case of Barbuda due to lack of on shore radio base station facilities as well as the case of the Barbuda fisheries office. There are five boats operating in the Codrington area that employ handheld radios. In addition, there are two fishermen households in the site vicinity that are equipped with VHF radio. Fishermen in general recognize that VHF radio communication can play a valuable role in ensuring operational safety.

It is appropriate to provide a VHF radio in the envisioned administration office as a radio base station in order to popularize VHF.

3) Approach to Facility Design

Approach to facility design under the Project will be in line with the following criteria.

(a) Scope of facility design

The scope of Project design encompasses the facilities and equipment described in 2-2-1 (1) (Basic Policy) among the items requested by the Antigua and Barbuda side, and confirmed by the field study during the Preparatory Survey.

(b) Scope of marine products to be processed within the fish handling sanitary control area

Under Fisheries Division policy, it will be necessary that all live lobster for export and fish destined for shipment to Antigua be received at the fish handling area for quality control inspection. In the case of marine products received for inspection and sanitary processing within this area, health certificates are to be issued with regard to health lobster for export and handling certificates are to be issued with regard to fresh fish for shipment to Antigua.

Types of fish to be shipped to Antigua are broadly defined as follows: Because of the cost entailed in icing, transport, plus a seller margin, type of fish is ideally that which has a high sales price differential between the two islands (i.e., cheaper on Barbuda and more expensive on Antigua). On the basis of fish pricing survey carried out by the Study Team, grouper and snapper show a large marketing price difference between the two islands. Other types of reef fish show a lesser price difference {for details, see Appendices 5 (5)}. Accordingly, the Project posits grouper and snapper as the primary fish category for shipment to Antigua.

(c) Fisheries related basic values for setting up of the Project scale

Setting up of the scale of envisioned facilities and equipment is based on fisheries related basic values such as “number of objective fishing boats”, “average operating frequency per week”, “number of landing boat at peak time”, “average daily landing volume on Barbuda”, “daily processed volume of fish for shipment”, “fish shipment volume per time”, etc., calculated from the data obtained from the result of “Barbuda fisheries baseline survey” carried out during the field study of the Preparatory Survey.

(i) Calculating design number of fishing boats accessing Project landing jetty

As shown in the Table 2.2.1, as of the end of year 2008, the numbers of active fishing boats on Barbuda counts 44 boats (for further details, see Appendices 5, attached Table 1).

Table 2.2.1 Numbers of active fishing boats by catch landing location on Barbuda

	Pearl Harbour	Codrington mooring wharf (Project site)	River wharf	Coco Point (tourist season only)	Total
Number of active fishing boats	12	23	9	(4)	44

Source: Vessel Frame Survey, Barbuda 2008, Fisheries Division

Note: Figures in parentheses "( )" indicate vessel numbers only during the tourist season (this comprises all boats in the case of Coco Point. These four (4) boats are from Pearl Harbor and Codrington. Accordingly they are not counted in the total number.

Of the above, 12 fishing boats registered in Pearl Harbor located near to the Project site will be instructed by the Fisheries Division to land fish at the site. But four of them will operate at Coco Point during tourist season. Accordingly, in the tourist season, only 31 boats that currently base inside the Codrington lagoon are anticipated to land fish at the Project site.

On the other hand, four 50 feet class fishing boats with inboard engines that are registered at the River wharf can not land fish at the project site since they have deeper drafts than the lagoon depth, and can not go into the lagoon. They currently base their operations on Antigua island. These vessels carry out trap fishing and catch lobster and bottom fish in the sea area between Antigua and Barbuda. Live lobster for export are then landed at River wharf, after which the boats return to Antigua to market the fish portion of their catches. Once the Project goes into the operational stage, sanitary ice supply enables fishermen to distribute fresh fish to Antigua. In that time, these four boats will not have any reason to base Antigua any more, and will base the River wharf. These four boats currently base their operations from Antigua island where ice is available. These vessels carry out trap fishing to harvest lobster and bottom fish in the sea area between Antigua and Barbuda. Live lobster for export are then landed at River wharf, after which the boats return to Antigua to market the fish portion of their catches. When the Project goes operational, a supply of sanitary ice will become available on Barbuda. Once the system for fresh fish distribution to Antigua is up and running, the above four boats will no longer have to travel to Antigua, and instead are expected to put in at the Project complex for ice supply for their fishing operations.

Fishermen who operate the five small boats fitted with outboard motors that are registered at River wharf reside in Codrington town. Nevertheless, they do not moor their boats at the Project site, and instead drive by car 10 minutes to the River mooring wharf which they use as a base for fishing operations. The reason for this is that the fishing grounds that they target are located to the southeast of Barbuda and can be better accessed from the River

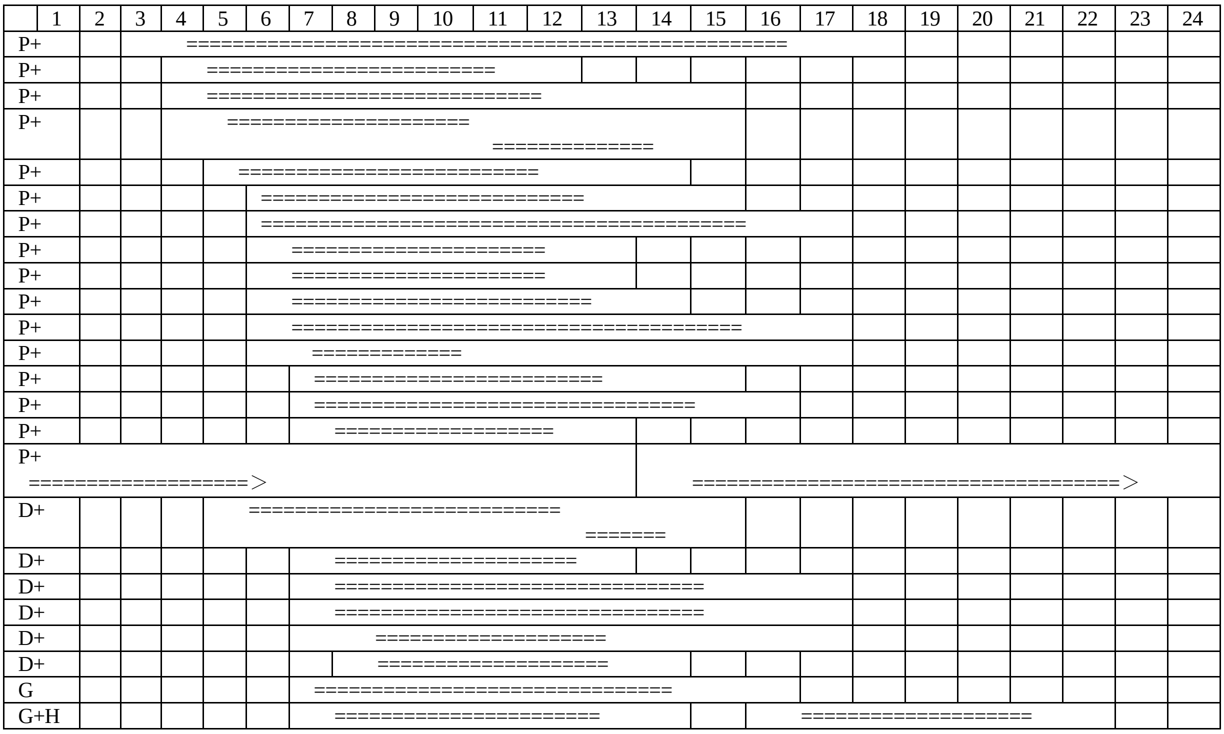
On the basis of the above, it is concluded that the fishing boats currently using the River wharf will not shift their operational base to the Project site. However, in the operational stage of the Project, they need sanitary ice produced by the Project facilities to ship target fish for export to Antigua. These nine boats will be the objective of ice supply for their fishing operation.

Accordingly, the number of boats that will land their catches at the Project site is set up at a total of 31 boats during the tourist season, comprising those currently based at Pearl Harbor and the existing Codrington wharf. Nevertheless, the number of objective boats for ice supply is set up at a total of 44 boats, that is the total active boats on Barbuda.

(ii) "Average operating frequency per week" and "Average number of landing boats at peak time in a day"

① Operating pattern of the objective boats

Operating pattern of the objective boats is shown in the Figure 2.2.2 below.



Source: Barbuda fisheris baseline survey, 2009, JICA Preparatory Survey Team

Note: P+ = mainly trap fishing for lobster, D = mainly diving for lobster, G = mainly gill netting, H = hand line

Figure 2.2.2 Operating pattern for objective boats

The above figure indicates the operating pattern when the objective boats simultaneously embark for fishing. In such case the time distribution for return to harbor is as indicated in the Table 2.2.2 below.

Table 2.2.2 Time distribution for fishing boat return to harbor

Harbor return time (1 hour units)	11:00 ~	12:00 ~	13:00~	14:00~	15:00~	16:00~	17:00~
Number of returning boats	1 (4.2%)	2 (8.3%)	6 (25%)	6 (25%)	3 (12.5%)	3 (12.5%)	2 (2.8%)

Note: The remaining one boat fishes at night and returns to harbor at 07:00 in the morning.

Accordingly, peak landing period is the time frame of two (2) hours from 13:00. During this period, six boats (25% of the total) per hour land their catches.

② "Average operating frequency per week for objective boats" and "Average number of landing boats at peak time in a day"

- "Average operating frequency per week for objective boats"

Based on the monthly total number of operation by landing site obtained from the baseline survey, average operating frequency per week during the tourist season is roughly estimates at 1.5 times per week as indicated in the Table 2.2.3 below.

Table 2.2.3 Average operating frequency for objective boats

	Pearl Harbour	Codrington Wharf	Total
Gross operating frequency per month (no. of times / 4 weeks)	61	123	184
Number of boats	10	21	31
Average operating frequency per week (no. of times / boat / week)	1.52	1.46	1.48

Source: Barbuda fisheris baseline survey, 2009, JICA Preparatory Survey Team

- "Average number of landing boats at peak time in a day"

Since average operating frequency per week is only 1.5 times for objective boats (31vessels), average number of landing boat at peak time can not be calculated without specifying the most frequent operating day in a week. However there is no such information on Barbuda fisheries activities. In this planning, as described below, average number of operating boats on a lobster export day is firstly estimated, and then average number of landing boats at peak time is estimated using returning rate at peak time (25%) obtained in (i), assuming that fishing operations are carried out in linkage with export activities for lobster during tourist season.

[Calculating monthly and weekly export frequency of lobster during tourist season]

Main fishing method of each fishing boat is indicated in aforementioned Figure 2.2.2. According to this, 22 boats out of 24 boats are primarily engaged in lobster harvesting, with landed catches being bought up by exporters. At present, there are three lobster exporters operating on Barbuda, and these use their own private aircraft for transport depending on the export destination. Figure 2.2.3 shows month-wise export quantities of lobster for 2007.

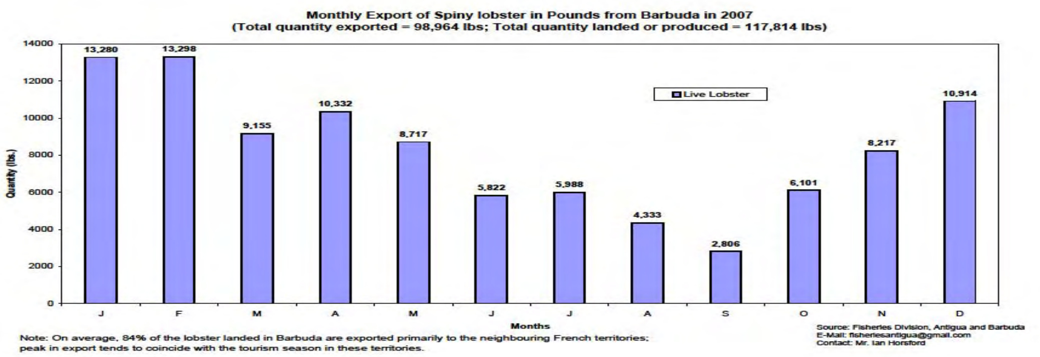


Figure 2.2.3 Month-wise export quantities of lobster for 2007.

According to the Fisheries Division, export frequency in 2005, 2006 and 2007 was 166 shipments, 179 shipments and 179 shipments, respectively. Export quantity in 2007 was 98,964 lbs/year. Accordingly, average export quantity per one shipment equates to:

98,964 lbs/year ÷ 179 shipments/year = 552.9 ≒ 550 lbs/shipment

January and February comprise the peak export period, with export quantity being around 13,200 lbs/mo. Accordingly export frequency during this peak period is calculated as follows:

13,200 lbs/mo. ÷ 550 lbs/shipment = 24 shipments/mo.

In other words, export frequency is six times per week (fishing operations are not carried out on Sundays).

[Setting up of average number of landing boats at peak time]

If it is assumed that all targeted boats (31) embark on fishing operations in a uniform manner each week, given the fact that during this period lobster exporters buy up catches six times per week, the total number of fishing embarkations per week is 46.5 (31 boats × 1.5 times per week). Per day, this equates to:

46.5 fishing embarkations ÷ 6 days = 7.75 embarkations

≒ approx. 8 fishing embarkations/day

Accordingly, number of boats landing their catches per hour during the peak return-to-harbor period is calculated at 2.25 boats (25%). In other words, peak hour landing frequency under present conditions equates to:

8 boats x 0.25 = 2 boats

Accordingly, average number of landing boats at peak time is set up at 2 boats/hour.

(iii) Average daily landed quantity by fish type in tourist season on Barbuda

Since the baseline survey estimated monthly landed quantity of fish catch by fish type, by landing place and by season (tourist and off season), daily average landed quantity by fish type in tourist season is calculated by numerical formula:

Average daily landed quantity by fish type in tourist season

=

Average monthly landed quantity by fish type in tourist season ÷ 4weeks/month ÷ 6days/week

Since most of Barbudan is Christian and take vacation during Christmas and Easter season, it is assumed that fishermen will not go fishing for totally one month. Based on this assumption, landed quantity was calculated by the base of 4weeks per month and by 48 weeks per year.

① Monthly landed quantity at Pearl Harbor and Codrington

Monthly landed quantity of objective boats (31boats) at Pearl Harbor and Codrington by catch type, by fishing method and by season is indicated in the Table 2.2.4 (for detail, see Appendices 5, attached table 2 and 3).

Table 2.2.4 Monthly landed quantity at Pearl Harbor and Codrington

Landing Place	Fish Catch Type	Trap (Pond/Month)		Fish Diving (Pond/Month)		Gill net (Pond/Month)	
		Tourist s.	Off s.	Tourist s.	Off s.	Tourist s.	Off s.
PL	Lobster	760	970	942	1,092	0	0
	Fishes	730	725	1,230	1,314	560	400
CW	Lobster	3,250	3,875	980	1,270	0	0
	Fishes	3,760	3,490	950	1,408	1,080	840
Total	Lobster	4,010	4,845	1,922	2,362	0	0
	Fishes	4,490	4,215	2,180	2,722	1,640	1,240

Source: Barbuda fisheries baseline survey, 2009, JICA Preparatory Survey Team
Remarkes: PL; Pearl Harver, CW; Codrington Wharf

The combined total of landed quantity for the tourist season and the off season at the Project site (both landing sites) is shown in the Table 2.2.5 below.

Table 2.2.5 Monthly landed quantity at the Project site

Catch type	Landed quantity: lbs/moth (kg/moth)	
	Tourist season	Off season
Lobster	5,932 (2,691)	7,207 (3,269)
Fish	8,310 (3,769)	8,177 (3,709)
Total	14,242 (6,460)	15,384 (6,978)

Source: Barbuda fisheries baseline survey, 2009, JICA Preparatory Survey Team

② Monthly landed quantity at the River wharf

Monthly landed quantity of objective boats (9 boats) at the River wharf by catch type, by fishing method and by season is indicated in the Table 2.2.6 (for detail, see Appendices 5, attached table 2 and 3).

Table 2.2.6 Monthly landed quantity at River wharf

Landing Place	Fish Catch Type	Trap (Pond/Month)		Fish Diving (Pond/Month)		Gill net (Pond/Month)	
		Tourist s.	Off s.	Tourist s.	Off s.	Tourist s.	Off s.
RW Total	Lobster	3,180	2,340	1,840	1,530	0	0
	Fishes	2,480	2,700	780	780	0	0

Source: Barbuda fisheries baseline survey, 2009, JICA Preparatory Survey Team
Remarkes: River Wharf

Monthly landed quantity in the tourist season and the off season at River wharf is indicated in the Table 2.2.7 below.

Table 2.2.7 Monthly landed quantities at River mooring

	Landed catch quantity: lbs/mo. (kg/mo.)	
	Tourist season (7 months)	Off season (5 months)
Lobster	5,020 (2,277kg/mo.)	3,870 (1,755kg/mo.)
Fresh fish	3,260 (1,479kg/mo.)	3,480 (1,579kg/mo.)
Total	8.280 (3,756kg/mo.)	7,350 (3,334kg/mo.)

Source: Barbuda fisheries baseline survey, 2009, JICA Preparatory Survey Team

③ Monthly landed quantities on Barbuda by season and by catch type

Combining totals in ① and ② above, monthly landed quantities on Barbuda by season and by catch type (excluding Coco Point during the tourist season) are as indicated in the Table 2.2.8 below.

Table 2.2.8 Monthly landed quantities on Barbuda by season and by catch type (excluding Coco Point during the tourist season)

Catch Type	Landed catch quantity: lbs/mo. (kg/mo.)	
	Tourist season (7 months)	Off season (5 months)
Lobster	10,952 (4,968kg/mo.)	11,077 (5,024kg/mo.)
Fresh fish	11,570 (5,248kg/mo.)	11,657 (5,288kg/mo.)
Total	22,522 (10,216kg/ mo.)	22,734 (10,312kg/mo.)

④ Average daily landed quantity by catch type on Barbuda in tourist season

Based on the values in the Table 2.2.8, monthly landed quantity by catch type in the tourist season is as follows:

- Lobster : 10,952 lb (4,965kg)
- Fishes : 11,579 lb (5,248kg)

Accordingly, by applying aforementioned formula;

Average daily landed quantity by catch type in tourist season

=

Average monthly landed quantity by catch type in tourist season ÷ 4weeks/month ÷ 6days/week

Average daily landed quantity by catch type on Barbuda in the tourist season is set up as follows:

- Lobster = 10,952 lb/mon. ÷ 4weeks/mon. ÷ 6days/week = 456.3 lb/day ≒ 207 kg/day
- Fishes = 11,570 lb/mon. ÷ 4weeks/mon. ÷ 6days/week = 482.1 lb/day ≒ 218 kg/day

(iv) "Average landed quantity per fishing boat at the Project site", "Average landed quantity per hour at peak time" and "Average daily landed quantity"

① Average landed quantity per fishing boat at the Project site

As calculated in (iii) ①, average monthly landed quantity of lobster and fishes in the tourist season at the Project site are 5,932 lb and 8,310, respectively. Taking into account the average operating frequency of 1.5 (times/ week) for objective boats (31 vessels), average landed quantity per fishing boat is,

- Lobster = 5,932 lb/mon. ÷ 4weeks/mon. ÷ 31 boats ÷ 1.5 times/week
  = 31.9lb/time/vessel ≒ 14kg
- Fishes = 8,310 lb/mon. ÷ 4weeks/mon. ÷ 31 boats ÷ 1.5 times/week
  = 44.7lb/time/vessel ≒ 20kg

Accordingly, average landed quantity per fishing boat at the Project site is set up at approx. 34kg/boat/day.

② Average landed quantity per hour at peak time

As calculated in 3) (ii) ②, the number of returning boat per hour at peak time is 2 vessels. Accordingly, average landed quantity per hour at peak time equates to:

= average landed quantity per fishing boat x 2 vessels

= 34kg/ vessel/hour x 2 vessel/hour = 68kg

③ Average daily landed quantity

As calculated in 3) (ii) ②, average daily number of operating boat in the Project site is 8 vessels. This, equates to:

Average daily landed quantity at the site = average landed quantity per fishing boat x 8 vessels = 34kg/vessel x 8 vessels = 272kg.

Accordingly, Average daily landed quantity is set up at 272kg/day, of which

- Lobster: 14kg/vessel x 8 vessel = 112kg
- Fishes : 20kg/vessel x 8vessel = 160kg

(v) Calculating design quantity of fresh fish to be shipped from Barbuda to Antigua

As described in 3) (b) [Scope of marine products to be processed within the fish handling sanitary control area], objective fishes for shipping to Antigua is to be high priced exportable fishes such as sea breams, groupers, etc.

According to fisheries statistics in 2004~2007 (mostly referred to the figures of Antigua), catch rate of sea breams and groupers among total catch occupies approx. 30% as indicated in the table2.2.9 (for details, see Appendices 5, attached table 6). Although there is no landed data by fish type on Barbuda, the same catch rate (30%) of sea breams and groupers could be set up on Barbuda because of close distance between both islands having the same shallow continental shelf jointly.

As calculated in the above (iii) ③, average monthly landed quantity of fishes on Barbuda is 5,248kg (11,570lb). Accordingly, annual shipment quantity could be set up at approx.19tons {5,248(kg/month) x 7months + 5,288(kg/month) x 5 months} x 0.3 = 18,952kg/year≒19tons}.

Table 2.2.9 Catch rate of exportable fish within the gross fish catch

Year	2004	2005	2006	2007
Total catch (MT)	2527	2999	3092	3092
Lobster catch (MT)	245	309	318	318
Fish and shellfish catch (MT)	2282	2690	2774	2774
Catch for exportable fish species (MT)	809	751	783	854
Catch rate of exportable fishes within the gross fish catch (%)	35.4	27.9	28.2	30.8

Source: Fisheries statistics on catch quantities by fish type, 2004~2007, Fisheries Division, (Conch is converted to edible weight)

(vi) Daily quantity for catch processing inside the sanitary control area

Among fish catch brought into the Fish Handling Shed, objective fish and shellfish for receiving sanitary processing are high priced fishes such as lobster and exportable fishes (sea breams, groupers, etc.).

① Daily processed quantity of lobster

This quantity is equivalent to the average daily landed quantity of lobster on Barbuda in the tourist season as set up in (iii) ④, that is 456.3lb/day ≒ 207kg/day.

② Daily processed quantity of fishes

As set up in (iii) ④, average daily landed quantity of fishes on Barbuda in the tourist season is 482,1lb/day ≒ 218kg/day. Of this, 30% is the high priced fishes shipped to Antigua. Accordingly, daily processed quantity of fishes is set up as 482.1lb/day x 0.3 = 144.6lb/day ≒ 65kg/day.

(2) Policy to natural conditions

- When hurricanes strike the country, there is strong wave activity when powerful winds emanate from the west. Even in the absence of a hurricane, heavy rain and low pressure system transit of the area can be expected to cause inundation of civil structures and Project area fronting on the shoreline.
- In terms of site geology, exposed limestone is observed at locations back from the shoreline. On the other hand however, over a range of several meters inland from the shoreline, an extremely soft ground layer (N value of zero) is present to a depth of 2m. Specifically in the case of the on-land side behind the mooring wharf, this has been swamp and geologically exhibits a soft layer to a depth of about 4m. Accordingly it is planned to carry out appropriate soft foundation improvement, and take into consideration as well the fact that foundation for Project facilities may have to deal with inconsistent ground hardness.
- Surface stratum at the site comprises an extremely soft clayey layer to a depth of 2~4 meters. This layer is highly impermeable (including the case of heavy rainfall). Accordingly, in light of the fact that wastewater produced at the site cannot be effectively filtrated into the ground, a wastewater processing system is to be adopted that addresses this problem.
- Rainwater shall be minded not to be streamed into the site from surrounding area, and to be discharged smoothly from the site to the outside. Necessity of repair of existing drainage running in the backyard of the site is to be recommended to the Antigua and Barbuda side since this drainage is not functioning at present.
- Design approach with regard to natural conditions is as follows:
  - Design tidal level:
    Lowest low water tide level (L.L.W.L.) is adopted as the standard sea level (D.L. = 0).
  - Design wave height:
    This is calculated on the basis of atmospheric pressure, wind direction, fetch, etc.
  - Ground conditions:
    A stable limestone layer underlies the soft surface layer with the depth of approx.4m and will serve as the bearing layer. Buildings will be supported by spread footers or by replacing the soft surface layer with sand gravel.
  - Design seismic intensity:
    This is set based on the safety coefficient for the largest past earthquake occurring in the region.
  - Wind load:
    Design value is set based on the maximum average wind speed and maximum momentary wind speed for the most intense hurricane to have traversed the region in the past, and with reference to Japanese building standards in this regard.

- Facility damage:
  Any potential damage occurring to facilities would primarily be the result of sea level rise and wave action at the time of low pressure systems and hurricanes. Floor height for Project facilities as well as measures to protect windows, etc. at the time of hurricanes will be reflected in design, based on results of interview survey of local officials and residents.
- Mangrove conservation:
  The Project will strive to preserve existing mangrove. This includes reforestation of mangrove swamp where unavoidable tree felling has been carried out.

(3) Policy to socio-economic aspect

・In light of the fact that a primary school and kindergarten are located in the Project site vicinity, safety precautions must be formulated under the Project as well as request to the schools for cooperation in implementing precautionary measures.

(4) Policy to construction/procurement conditions, special business circumstances and practices

・Antigua and Barbuda has no independently promulgated design standards with regard to either building design or civil construction. Concerning building design, the Caribbean Uniform Building Code (CUBC) is applied. In the case of civil construction, the judgment of the engineer in charge has primary influence. Accordingly under the Project, Japanese design criteria and standards will be applied. Nevertheless, this will be done based on the results of natural conditions survey, other design and materials standards applied in the country, and with reference to past grant-aid projects carried out by Japan in the region.

・Prior to the start of construction, detailed design drawings will be submitted to the Development Control Authority (DCA) for construction permit issuance. Time for project screening in this regard is 2~3 weeks. With regard to fire fighting equipment, a review by the local fire department will be requested from the standpoint of facility evacuation safety and fire prevention in site facilities that will be utilizing flame/electricity.

・Construction materials will meet criteria including durability (salt resistance), cost effectiveness, ease of construction, and facilitated O&M. Construction materials will be such that they conform to local construction practices.

・A construction approach is to be adopted that ensures good operation and maintenance upon construction completion, as well as structure durability. This will take into careful consideration local construction practices, as well as equipment and material procurement criteria.

・Electricity, water and phone services are provided by APUA. Accordingly, application for these services must be made to APUA, and arrangement made for the executing agency to internally bear these expenses.

(5) Policy to engaging local contractors

・The number and experience of construction contractors in Antigua and Barbuda is limited. However, there are some contractors that have both experiences in harbour and distribution infrastructure construction, as well as having worked on Japanese grant-aid projects. These contractors are based mainly out of Antigua island. In the case of Barbuda, contractors are involved mainly in small scale construction works. It is accordingly deemed appropriate that a local contractor from Antigua be engaged as a subcontractor working together with a Japanese construction company.

・In terms of cost effectiveness, it is considered appropriate to apply local construction methods while at the same time recruiting unskilled labour from Barbuda.

(6) Policy to operation and maintenance capability of the executing agency

・With regard to Project operation, personnel at the existing Barbuda office of the Fisheries Division will be shifted to the Project complex while at the same time new staff will be employed at the ice production and refrigeration facility. This personnel will, under the guidance of the Fisheries Division, be given training including a thorough orientation of the Project site layout and facilities.

・In order to resolve any problems occurring at the construction and operational stages of the Project, it is recommended that the executing agency (Fisheries Division) closely liaison with the Barbuda Council.

・Emphasis will be placed on simple repair and maintenance with regard to design facilities and equipment, considering the fact that part or component replacement may not always be readily possible.

(7) Policy to set up grade of facilities and equipment, etc.

The grade level of envisioned facilities and equipment will be set up taking into consideration the technical level of staff in charge of operating the Project facilities and equipment and local maintenance service companies, etc. as well as reduction of maintenance cost.

(8) Policy to construction method, procurement procedure and construction schedule

・A construction method enabling local procurement of concrete aggregate will be adopted in line with local structure specifications and construction practices, as well as to shorten the construction period. Civil facilities will be primarily of gravity-type design, precluding to the extent possible the need for heavy construction machinery.

・Buildings are to be of RC rigid frame structure, with walls constructed of concrete block in line with local specifications. Roofing framework is also put in place as RC rigid frame structure as well as pillars and beams. Adopting this type of construction aims to use the same structural materials and to still ensure adequate structural quality against hurricane.

(9) Policy to proper process of local tap water and rainwater utilization

・ Due to the high salinity and turbidity of city water, as well as not clearing the standard of the number of general live bacteria (100 individuals/ml), the city water is to be properly treated for utilizing the water for ice making. Since the supply capacity of the city water is not adequate (approx. 50L/person/day), the rainwater is to be used for general rooms except the sanitary control area.

(10) Policy to prevent environmental contamination of the site and surrounding area

・Wastewater discharge standard recommended by the local Ministry of Health should be followed on the wastewater discharged from the envisioned facilities

・In order to prevent the direct flow into the lagoon of wastewater generated within the Project complex, a storage pond will be established at one part of the site to precipitate residue that could not be collected at the source. After subsequent bio-treatment, the supernatant portion would then be released to the lagoon.

・Rainwater runoff within the Project site will be conveyed by drain gutters to a sludge pit prior to being released to the lagoon.

2-2-2 Basic Plan

Based on 2-2-1 [Basic policy], the plan will be made as follows.

2-2-2-1 Facility layout

The area located the Project site is facing to the Codrington lagoon in its west side and facing to the access road leading from urban area to existing wharf for sightseeing boats in its south side. An abandoned restaurant is situated roughly in the center of the site. The restaurant fence of the west side runs close to the lagoon, and as a result this restricts the on-land space available for facility construction on the lagoon side. The Barbuda Council has agreed to move back the existing fence to Approx. 10 meters of the restaurant building wall in the case of the south side, and to approx. 15m in the case of the west side. Because the Barbuda Council has decided to retract the location of the restaurant fence in conjunction with Project implementation, efficient operational flow lines under the Project can be achieved. The Barbuda Council also has agreed to allow the unused area on the lagoon side of the kindergarten to be utilized for construction works under the Project.

On the basis of the above, the Project site is to be zoned to effectively meet the four functions of (i) catch landing, boat mooring and fishing boat repair, (ii) hygienic management of fish catches, (iii) administrative and data control functions, and (iv) support for small fishermen. This includes as well appurtenant facilities designed to support the above functions by enhancing efficient operational flow within the Project complex.

Criteria for zoning of project function layout are described below.

① Make layout establishing effective work movement of fishermen, fish landing and movement of repair and evacuation of fishing boats inside the Project site.

② The area to the south of the access road to the existing wharf is to be an area for promoting small fishery operations. The area to the north of the access road is to be designated as an area for future development including tourism. Impacts will be avoided with regard to fishing operations during Project construction, lagoon eco-tourism and access by ferry to opposite shore hotel.

③ The landing jetty - mooring wharf and slipway (catch landing, boat anchorage and fishing boat repair functions) as well as fishermen locker facility, fishing gear store, etc. (small fishermen support) are to be located immediately adjacent to the lagoon to enhance daily convenience for fishermen.

④ Layout “sanitary control function of fish catch” and “operation and management function” to the location with comparatively better foundation since these functions are important for envisioned facilities for sanitary fish handling and operation and management of overall facilities.

Based on the above, zoning of project function layout is shown in the Figure 2.2.4.

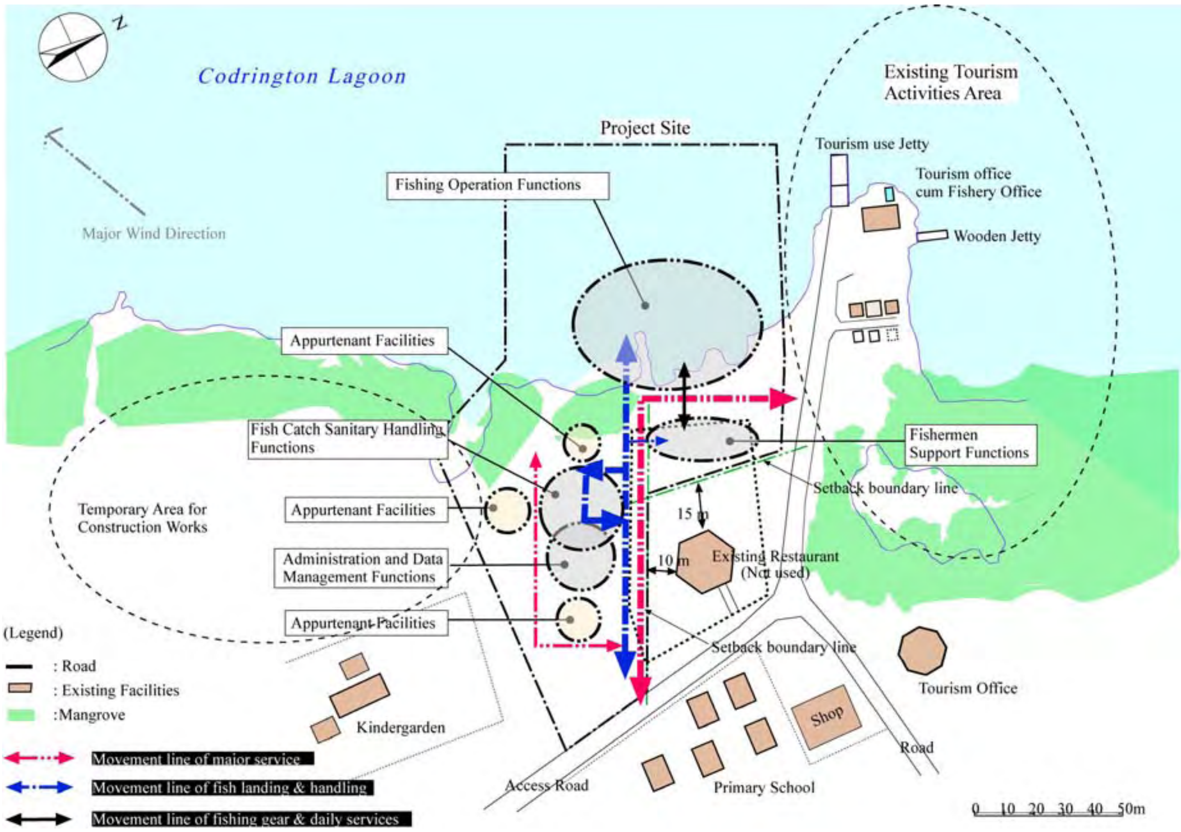


Figure 2.2.4 Zoning of Project Function Layout

2-2-2-2 Civil constructions

(1) Design criteria

1) Formulating criteria

Antigua and Barbuda lacks a definitive set of civil construction design criteria that prevails throughout the country. Each construction project falls under the discretion of the chief engineer as designated by the Ministry of Public Works.

Other grant-aid projects carried out by Japan to date at Point Wharf, Parham, and Urlings were designed and constructed applying Japanese standards with no subsequent problems.

Furthermore, the civil structures under the Project are specifically designed for fishery operations. In this regard, long term Japanese experience in the fishery sector has resulted in Japanese standards that excel from the standpoint of a comprehensive and integrated approach to facility design.

Accordingly, taking into thorough consideration natural conditions prevailing in

Antigua and Barbuda, facility design under the Project is to be carried out in line with the following criteria.

① Port and Harbor Facility Design Handbook (2003 edition), Japan Port and Harbor Association.
② Harbor Facility Engineering Criteria (and commentary), Japan Port and Harbor Association.
③ Concrete Standard Specifications, 2002, (Structural Performance Reference Edition), Japan Society of Civil Engineers

2) Conditions of use

① Targeted boats

Five gross-ton class vessels are the largest type of fishing boat that will use the Project complex. The most common type of fishing boats operating in the area are small class 3~5t boats (equipped with outboard motor).

The gross-ton class of boat envisioned to use the landing jetty is accordingly assumed as 5 GT class fishing boats (see the Table 2.2.10).

Table 2.2.10 Targeted fishing boat features

Type	Gross tonnage (GT)	Boat length (m)	Boat width (m)	Draft (m)
Small fishing boat	5 tons or less	12	2.5	1.0

Source: Results of field survey, 2009, Preparatory Survey Team

② Berthing velocity

Berthing velocity is determined by a number of factors including berthing method, weather and sea conditions, mooring sea wall structure, etc. In the case of fishing boats, the Table 2.2.11 below is considered applicable. Accordingly, berthing velocity is assumed at 0.50m/sec. In addition, applied load berthing force is also considered in structure design.

Table 2.2.11 Fishing boat berthing velocity

Boat gross tonnage	Berthing velocity (m/sec)
Under 20 tons	0.50
20 tons or more ~ under 40 tons	0.40
40 tons or more ~ under 90 tons	0.35
90 tons or more	0.30

Source: Port and Harbor Facility Design Handbook (2003 edition)

3) Natural conditions

① Tide level

Hight water level (M.H.H.W.L.) +0.40

Mean sea level (M.S.L.) +0.20

Lower low water level (M.L.L.W.L.) ±0.00 Chart datum level (D.L.)

Source: Results of natural conditions survey (tide levels), 2009, Preparatory Survey Team

② In situ seabed elevation

(a) Jetty: D.L. – 1.0m

(b) Mooring sea wall: D.L. – 0.5m

(c) Slipway: D.L. – 0.5m

③ Wave height

Wave height applied to facility design is summarized in the Table 2.2.12.

Table 2.2.12 Design wave characteristics

Design wave	Characteristic
Wave direction	N ~ NW
Wave height	H = 0.9 m
Period	T = 2.6 sec

Source: Results of natural conditions survey (wave activity), 2009, Preparatory Survey Team

④ Anomalous tide levels (calculating the amount of water level rise)

Anomalous tide level in the Project site is set up assuming that the wind direction to the site become the most dangerous direction of N~NW hit by the H-4 class hurricane such as H. LUIS in 1995, H. GEORGES in 1998, H. LENNY in 1999.

In the event of simultaneous occurrence of water level rise due to breaking activity, wind set up and drop in atmospheric pressure, total water level rise is computed as:

0.08 (wave breaking) + 1.25 (wind set up) + 0.45 (drop in atmospheric pressure) = 1.78m

Furthermore, if expressed in terms of D.L. when the above water level rise occurs at a time of H.W.L, this is as follows:

+0.40 (H..L.) +. 1.78 = D.L. +2.18m

⑤ Soil conditions

Soil conditions are as indicated in the table 2.2.13 below based on the results of soil survey.

Table 2.2.13 Soil conditions

Ground elevation	Landing jetty	Mooring sea wall	Slipway
In situ ground elevation	D.L.- 1.0m	D.L.- 0.5m	D.L.-1.0m
Thickness of clayey layer	2.5m	3.0m	3.0m
Designated foundation elevation	D.L.- 3.5m	D.L.- 3.5m	D.L.- 3.5m

Source: Results of natural conditions survey (soil conditions), 2009, Preparatory Survey Team

⑥ Design seismic intensity

Horizontal seismic intensity applying civil facility design based on the results of the natural conditions study is: lateral shear coefficient of 0.2

4) Load conditions

① Unit volume weight

- Unreinforced concrete: $\gamma c = 22.6 kN/m^3$
- Reinforced concrete :$\gamma rc = 24.0 kN/m^3$
- Steel/cast steel : $\gamma i = 77.0 kN/m^3$

Source: Source: Port and Harbor Facility Design Handbook (2003 edition)

② Vertical load

The landing jetty is designed for operation without general vehicle entry onto the jetty structure. Nevertheless, with consideration to the need for maintenance vehicles to occasionally enter onto the jetty, design vertical load is as follows in line with that for the mooring sea wall.

- Normally $w = 5 kN/m^2$
- During earthquake $w' = 2.5 kN/m^2$

Source: Port and Harbor Facility Design Handbook (2003 edition)

③ Moving load

Because the type of vehicle envisioned to enter onto the jetty will be 2t class truck or standard automobile, consideration to moving load is not given since this will be less than existing vertical load.

④ Traction force

Fishing boat traction force acting on mooring structures is calculated on the basis of (i) boat gross tonnage and (ii) number of moored vessels (see Table 2.2.14). With regard to traction force, the values indicated table below are considered standard. On this basis, normal traction force per boat is calculated at 10 kN given the fact that all boats at mooring facilities will be under 10 gross tons.

Table 2.2.14　Boat traction (per mooring berth)

Boat gross tonnage	At normal times
Less than 10 tons	10 kN
10 tons or over ~ less than 50 tons	30 kN
50 tons or over ~ less than 100 tons	50 kN
100 tons or over ~ less than 200 tons	70 kN
200 tons or over ~ less than 500 tons	100 kN
500 tons or over ~ less than 2000 tons	150 kN

Source: Port and Harbor Facility Design Handbook (2003 edition)

5) Main construction material criteria

Table 2.2.15　Concrete criteria

Material	Unit volume weight	Design standard strength (f'_{ck})
Reinforced concrete	2.45 t/ m^3	24 N/mm^2
Unreinforced concrete	2.30 t/ m^3	18 N/mm^2

Source: Port and Harbor Facility Design Handbook (2003 edition)

6) Appurtenant facilities

① Fenders: Based on the Port and Harbor Facility Design Handbook (2003 edition), fender size and number will be determined in line with targeted boats under the Project.

② Mooring posts: One set.　Based on the Port and Harbor Facility Design Handbook (2003 edition), mooring post size and number will be determined in line with targeted boats under the Project.　Given the fact that boats to utilize the facilities are small, and wind and wave conditions are normally calm, a cross-bit type mooring post is planned.

③ Curb: Because vehicles will not normally be allowed to enter onto the landing jetty, vehicle curbing is not planned.　This applies as well to the mooring sea wall.

④ Mooring rings: One set.　These will be affixed to the landing jetty for the mooring of small boats.

(2) Facility description

1) Landing jetty

(a) Design policy

For efficient operational flow with regard to off-loading fish catches, and on-loading items necessary for fishing (including fishing gear, ice, fuel and water), positioning of the landing jetty as an extension of the planned on-site road is deemed to be extended direction of internal road.　Furthermore, it is recommended that the planar configuration for the jetty be such that necessary water depth is achieved for fishing boats accessing the facility, as well as minimizing wave action on moored boats.

Fishing boats will anchor alongside the jetty when landing fish catches and taking on board necessary fishing gear and stores. At such time, mooring of boat bows in the direction of incoming waves and prevailing wind both stabilizes boats and promotes safe on and off vessel operations. The jetty axis will be aligned accordingly.

Accordingly, the jetty will be aligned at a right angle to the shoreline, as an extension of the internal road alignment. Jetty planar configuration will be “I” shaped, enabling boat mooring with bow headed into incoming waves.

(b) Jetty water depth

Required jetty water depth will be based on the maximum draft for fishing vessels presently operating within the Codrington lagoon area.

In general, in the case of water depth for mooring facilities, an excess margin of 0.5～1.0m is achieved over vessel draft when fully loaded. Other factors that come into play, however, are the geology of the seabed, wave and current behavior, etc.

In the case of fishing boats targeted under the Project, maximum size vessels are 12m (40 feet) in length with a loaded draft of around 1.0m. Because the seabed at the Project site is soft, an additional freeboard depth of 0.5m is necessary according to the Port and Harbor Handbook. This makes a total depth of 1.5m required, which is achieved (according to depth measurements) about 100m from the shoreline. This is no realistic. At present, fishermen moor their boats as close to the shore as possible while still enabling the vessel to stay afloat. Because the seabed is fine silty mud, contact by boat engine with the seabed does not result in mechanical damage.

Accordingly, design jetty depth takes into consideration the present water depth of 1.0 meters, to which an additional 0.5m is added (total of 1.5m) to accommodate future overlay of rock or other hard material in facility construction that might lead to a harder vessel impact with the seabed.

(c) Jetty length

Jetty design assumes sidewise mooring of boats to facilitate off-loading of catches, on-loading and off-loading of fishing gear, and ice loading for outgoing fishing operations.

As discussed above, it is necessary to achieve sufficient water depth for the jetty. The fore most extremity of the jetty will be at 1.0m water depth (present seabed depth). The catch landing area will be sufficient to allow for sidewise mooring of fishing boats.

Typical fishing boats under the Project are as shown in the Photo 1 below. These are 9m class fishing boats manufactured in Trinidad and Tobago. Nevertheless, there are larger fishing boats operating in the immediate Project area with a length of 12m (40 feet). Because berthing ropes are angled outward from the bow and stern of the ship when moored sideways to the landing jetty, berthing capacity is to allow for this extra length. According to the Port and Harbor Design Handbook (2003 edition), extra length (due to berthing ropes) in this case is estimated at 0.15 times the total boat length. Accordingly, maximum boat berthing capacity required is 1.15×12m＝14m{see Appendices 5 (6) Reference A}.

Results of baseline survey indicate that peak utilization of the jetty is two (2) boats per hour, with operational time per boat being 5~30 minutes. This operational time can be expected to shorten with enhanced convenience of the jetty facility following Project facility completion.

Accordingly, it is considered that efficient boat operations are possible at one (1) berth. Because of the groin type configuration, mooring is possible from both sides of the foremost end of the structure. This will enable the jetty to accommodate increased boat traffic in the future (see Figure 2.2.5).

The location of the foremost end of the jetty is to be extended up to the length of one berth (14m) from the location of present water depth of -1.0m obtained from the sounding survey results, and in result, the total length of the jetty is determined as 40m from the mooring type sea wall.

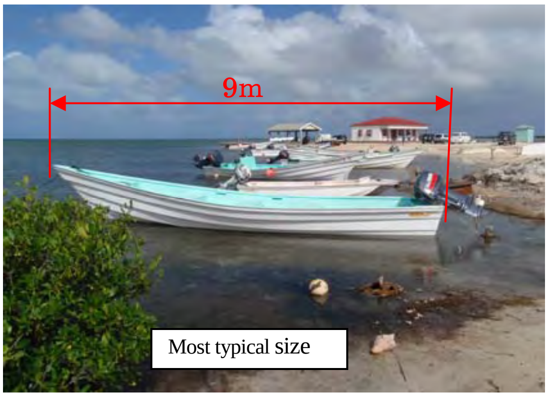


Photo 1 Size of general type boat

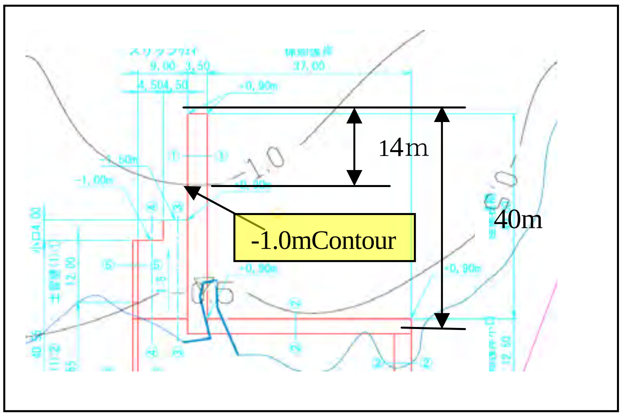


Figure 2.2.5 Relation between water depth and planned birth length

(d) Jetty width

Jetty width is determined in line with jetty use profile. In this regard, vehicle access to the jetty is in principle not allowed for, and instead all on-jetting landing loading operations are to be possible manually.

According to the Port and Harbor Design Handbook (2003 edition), an apron width of around 3m is considered necessary for catch landing, and fuel, water and fishing loading operations {see Appendices 5 (6) Reference B}. Nevertheless, it is envisioned that there may be instances in the case of facility maintenance or emergency where vehicle access to the jetty would be warranted. Accordingly, in order to allow for sufficient width to accommodate vehicle access, jetty width is designed at 3.5m.

(e) Jetty crest height

Jetty crest height includes the mean high water level (H.W.L.) to which has been added crest height in accordance with Table 6-2-5 of the Port and Harbor Design Handbook (2003 edition) delineating crest height by both tidal levels and vessel tonnage. Abnormal tides and wave activity are to be considered separately in addition to the from the above {for details, see Appendices 5 (6) Reference B}.

In light of the shallowness of Codrington lagoon, it is not expected that fishing boats exceeding the current size will operate within the lagoon. Accordingly, jetty crest height is determined on the bases of the presently active fishing boat tonnage.

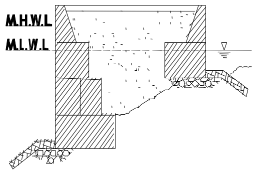
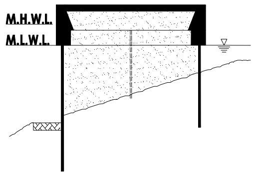
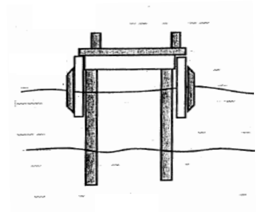
Tidal differential in the case of Codrington lagoon is 0.2m. Tonnage of active fishing boats in the lagoon ranges 0~20 tons. Accordingly, and in line with the above mentioned Table 6-2-5, design jetty crest height is set at the mean high water level (H.W.L.) +0.2m, to which is added 0.7m. {foe detail, see Appendices 5 (6) Reference C}.

Specifically, it is concluded that a crest elevation equivalent to the existing concrete jetty is appropriate. This assumption is based on performance values for existing mooring facilities within the lagoon, as well as existing facility utilization profile.

(f) Jetty structure

There are four basics type of mooring facility: ①gravity type, ②sheet pile type, ③column pile-type and ④floating pier type. Optimum structure type is determined based on a comprehensive evaluation of a) suitability to natural conditions at the site, b) conditions of intended use c) construction criteria, and d) construction schedule and cost. A floating pier type is generally advantageous in deep water where tidal differential is great. Although this type of structure has merits in terms of ease of new construction, and pier relocation if necessary, its applicability is limited to areas of very calm water. The Project site, on the other hand, has no outlying breakwater and is subject to direct wave action. Furthermore, water depth is shallow and tidal differential is not great. Post construction operation and maintenance cost is also relatively high. The floating pier type of design was accordingly eliminated from consideration, and the basic design study narrowed down comparative examination to the three fixed types of mooring facility (i.e. gravity type, sheet pile type, and column pile-type). A comparison of respective types of structure is indicated in the Table 2.2.16 below.

Table 2.2.16　Comparison of respective structure types

Study item		①Gravity type	②Sheet pile type	③Pile type
Typical cross-section				
Features		-Concrete block is placed on good foundation. -Often employed where foundation conditions are good. -Superior durability against external forces.	-This is a double sheet pile structure where sheet pile is driven on both side of the jetty, the space in between is filled with sand, which is then covered with concrete. -Corrosion over the long term is not a problem if anti-rust and anti-corrosion measures are carried out.	-Pile pier -Reflected wave action is small. -Requires counter-measures for uplift. -Corrosion over the long term is not a problem if anti-rust and anti-corrosion measures are carried out.
Natural conditions	Insitu foundation	Structure is generally suited for hard sand and gravel layer.　Depending on the nature of the sand layer at the site, the required depth of the riprap mound must be carefully investigated.	Structure is suited to sandy or soft foundation.　In the case of foundation that includes cobbles or coral rock, water jet assisted pile driving needs to be considered.	Pile driving method requires the same study and considerations as that in the case of sheet pile.
	Frontal water depth	Not suited to deep water.	Not suited to deep water.	Can be adopted in the case of deep water.
	Permeability	Poor tidal stream permeability.	Poor tidal stream permeability.	Good tidal stream permeability.
Use conditions	Structural integrity in the case of boat collision	Strongest structure against boat collision.	Relatively strong against boat collision.　Energy absorptive capacity is good.	Although strong against boat collision, structure quickly becomes unstable if damage is incurred.
	Ease of loading and unloading	Good	Good	Good
Construction conditions	Construction materials	Foundation works require riprap.	Sheet piling.	Steel piles, and materials for temporary platform.
	Construction equipment to be procured abroad	Crane for placing block.	Crane for pile placement, vibro-hammer, generator.	Pile-driving barge
	Temporary works	Block production plant site adjacent to the construction site.	Large scale scaffolding for pile driving.	Temporary platform for beam and concrete construction works.
	Construction content/technical level	Skilled engineers are required for offshore works including riprap foundation construction and block placement.	Entails offshore pile driving works.　Superstructure requires temporary works as well.	Skilled engineers are required for offshore pile driving and concrete works.
Synthetic Evaluation		○	△	△

From view point of present condition of the cite foundation, steel is to be driven into lime stone layer by hammering in the case of pile type and sheet pile type. Generally, the more number of hammering, the less efficiency of work, and that means not economical. Especially, in case of sheet pile type, it was eliminated from comparison study since its structure is continuous wall structure and needs more volume of hammering and then less economical among three types.

(g) Jetty structural cross-section

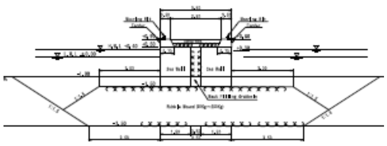
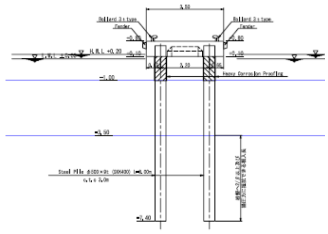
Assuming either a gravity type or column pile type design, structure cross-section is as indicated in the Table 2.2.17 below. Given the geological conditions at the site that require driving steel (in either the case of sheet pile or column pile) into limestone layer, both work efficiency and cost-effectiveness worsen the deeper driving has to be done. In this regard, sheet pile (which is a continuous wall structure) requires a greater amount of embedding work compared to column piles and was accordingly eliminated as a candidate for jetty structural foundation due to poorer cost effectiveness.

It was accordingly judged that a gravity type structure, replacing the existing jetty site foundation, would be more advantageous given Project site conditions based on seabed topographical and geological survey.

Site foundation is ground consisting of a clayey surface layer with an N value of 0 to about 4m, underlain by a composite of limestone, sandstone and coral gravel with an N value exceeding 100. The upper soft layer cannot be expected to provide bearing support for either a gravity type or pile type structural foundation. On the other hand, the underlying limestone, sandstone and coral gravel layer is judged to have adequate bearing strength.

Nevertheless, structural design will have to be such as to withstand external forces including earthquake and wave action. Because almost all building materials need to be transported to Barbuda from Antigua, given its relative isolation and lack of on-island production capacity, it is desirable that the jetty structure be as simple as possible. Nevertheless, sand and coral rock is quarried on the island, making it possible to cheaply procure riprap material for foundation replacement as well as sand and aggregate for concrete. On the basis of the above considerations, it is accordingly deemed that a gravity-type jetty structure using concrete block together with foundation replacement would be advantageous in terms of both structural design and cost-effectiveness.

Table 2.2.17　Comparison of respective structure types of landing jetty

	Gravity type	Column pile type
Cross sectional diagram		
Cost effectiveness	1.0	1.2
Evaluation	○	△

(h）Environmental considerations

On the basis of Project site survey, and given the characteristics of the immediate coastal area, ocean current is a wind current driven westward by prevailing easterly winds.　Almost no sand drift is present.

By establishing a jetty, slipway and mooring wharf, a protected harbor results that blocks incoming prevailing current, and creates a protected inner area of still water.　Nevertheless, it will be necessary for the jetty to incorporate a tide-way to allow seawater passage. Accordingly it is necessary to take measures such as installation of a culvert to proper portion of the jetty, etc.

2) Mooring wharf type sea wall

(a) Design approach

It is assumed that the mooring wharf will be used for idle fishing boats.　In this regard, as in the case of the landing jetty, it will be necessary to ensure necessary water depth for the fishing boats that will access the facility.　At the same time, a sea wall structure is essential in order to prepare rearward construction sites for on-land facilities.

From the standpoint of Project cost, the functions of mooring wharf and sea wall should be integrated into a single structure.　If design depth of the wall is 1.0 m as in the case of the landing jetty, the alignment for the quay wall would be located 40 m from the water line, which is impractical and too costly.

At present, fishermen anchor their boats as close as possible to the shore while still being able to stay afloat.　Because the seabed comprises fine-grained silty mud, there is no damage to the boat bottom or engine when contact with the sea bottom occurs.

Accordingly functional priority for the envisioned mooring wharf structure will be to act as a sea wall.　In order to minimize impact on the surrounding shoreline, the structure will be designed so as to modify the existing waterline as little as possible. This in turn, however, means there may be times, depending on specific sea conditions, when ample water depth for mooring may not be achieved (see Figure 2.2.6).

Under above mentioned view points, the designed minimum length of the wall is set as 37m to develop rearward construction sites for on-land facilities. This length will be the minimum necessary for sea wall protection in preparing on-land construction sites, and will bend in an "L" shape at the existing unpaved road side leading to the sightseeing boat wharf. In addition, sand will be supplemented to the sand beach stretching between the envisioned mooring wharf type sea wall structure and the existing sightseeing boat wharf.

As a result, the alignment of the mooring wharf type sea wall will be set at approximately the same distance from the water line as the current location where fishermen now anchor their boats offshore.

Nevertheless, water depth at the facility will be designed for 1.5 m, to prevent boat bottom or engine contact with the sea bottom given the fact that the existing soft mud foundation at the site will be replaced with rock in the course of facility construction.

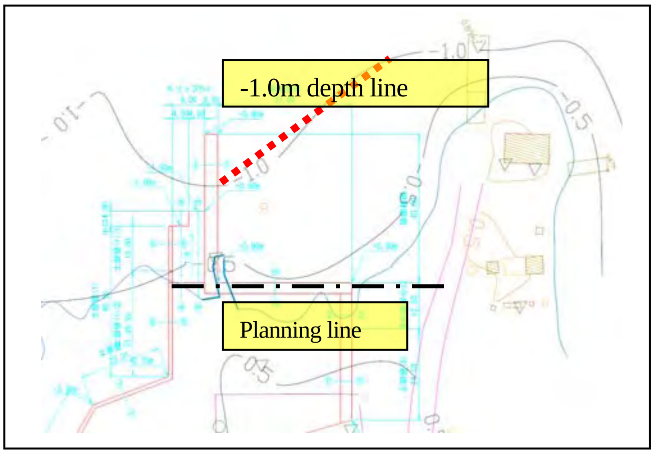


Figure 2.2.6 Relation between water depth and envisioned sea wall alignment

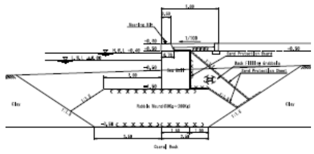
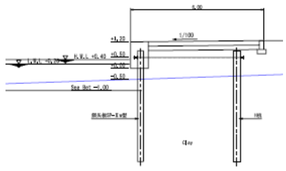
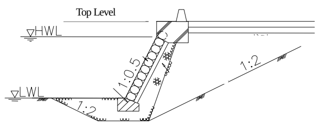
(b) Crest height

This is to be the same as the landing jetty at D.L. + 0.9m.

(c) Structure configuration

Sea wall structure configuration is to be determined on the basis of in-situ foundation conditions, water level conditions and conditions impacting on construction operations. There are three types of construction method that are considered feasible given the above in-situ status, i.e. (i) concrete block, (ii) anchor sheet-pile and (iii) stone-masonry These three methods were comparatively studied. On the basis of comparative study, concrete block method was ultimately adopted (Table 2.2.18).

Table 2.2.18 Structural comparison of types of mooring wharf / sea wall

Study item	Concrete block type	Anchor sheet-pile	Stone masonry
Typical cross-sectional diagram			
Characteristics	-This type of structure comprises concrete block laid on good foundation -It is commonly used in the case of good foundation.	-The front of the structure is steel-pile while the backside is anchor pile. -This type of structure is commonly used for landfill sea wall.	-Surface area is covered with stone masonry. -This type of structure is generally erected on foundation that is exposed during low tide.
Geological conditions	Suited to foundation where a sand and gravel layer with a relatively strong bearing capacity is present.	Suited to construction on weak foundation or sandy layer. Not adequate in this site.	Effective on soft foundation.
Comparison	○	△	○
Durability	No specific problems.	No long term corrosive effect if rust-proofing or corrosion preventive coating is applied.	Structurally weak in the case of strong direct wave action during hurricanes or tropical storms.
Comparison	○	○	△
Water depth / topographical conditions	Effective when water depth is shallow.	Effective in the case of medium water depth.	Effective when water depth is shallow.
Ease of construction	-Construction of a special material manufacture yard is not necessary. -Structure is simple and construction easy. -Dry-ground construction is possible.	-Structure is simple and construction easy. -Dry-ground construction is possible. -Necessary for piling machine and equipment	-Structure is simple and construction easy. -Dry-ground construction is possible.
Comparison	○	△	○
Cost effectiveness	Both concrete and rock material can be procured locally, making construction cost relatively cheaper.	Sheet-pile is procured from a third country. This coupled with the fact that heavy machinery is required for construction results in a higher construction cost.	Most materials can be procured locally, meaning a relatively cheaper construction cost.
Cost comparison	1.0	1.3	1.0
Construction schedule	-In-situ construction works are short. -Construction is possible with local materials.	-In-situ construction works are short. -Steel sheet-pile, etc. must be imported.	-In-situ construction works are long. -Construction is possible with local materials.
Comparison	○	△	△
Synthetic Evaluation	○	△	△

Based on the result of above mentioned comparative study, concrete block type structure will be applied together with foundation replacement

(d) Apron paving

Wave overflow and seawater flow into the area behind the sea wall will result in water permeation into the ground and possible weakening of the sea wall structure. Accordingly, the area to the rear of the sea wall is to be paved from the standpoints of engineering properties, facility protection and the intended utilization of the Project site.

Black paving, however, can lead to extremely high surface temperature given local year-round air temperatures and sunlight intensity. Furthermore, many fishermen go about their fishing operations barefoot. Accordingly, it is recommended that surface paving method at the Project site be done in a manner that minimizes to the extent possible rise in paved surface temperature during the day.

3) Slipway

(a) Design approach

The slipway is to be located next to the landing jetty planned under the Project, as an extension of the Project road alignment. This will enable fishing boats to be pulled up the slipway by vehicle. In order to keep the slipway facility as small as possible, it will be walled on one side by the landing jetty structure (on the other hand, a protective wall will necessarily be constructed for the other side of the slipway).

There will be two slipway tracks, one equipped with boat slider stripping for fishing boat repair, and one without boat slider striping to enable wheel traction when extracting fishing boats by vehicle drawn boat trailer.

(b) Width

Slipway width is determined on the basis of fishing boat width, additional freeboard on both sides as well as frequency of slipway use. Because it is not envisioned that two boats will simultaneously be raised or lowered at a given time at the site, slipway width is accordingly calculated at 2.5 m (fishing boat width) plus 1.0 m freeboard on each side, i.e. B = 4.5 m (see Photo 2).

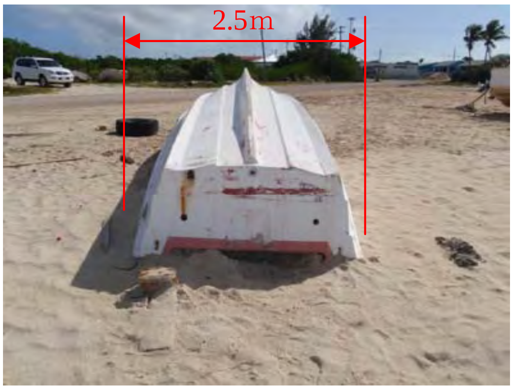


Photo 2 Width of typical fishing boat

(c) Crest height

Slipway crest height will be compatible with that of adjacent facilities.

(d) Gradient

The gradient for the slipway ramp is to be set within a range of 1:6 ~ 1:10 as stipulated in Section 8.3 (Ramp and Boatyard Design) of the Port and Harbor Design Handbook (2003 edition) {for detail, see Appendices 5 (6) Reference D}.

Although a gentle gradient makes raising and lowering fishing boats easier, it results in a longer slipway length. In the case of a fishing boat slipway, in most cases the facility gradient is set within the range of 1:6 ~ 1:8 depending on mooring location and on-land constraints.

In the case of existing slipways on Antigua island at Saint John's, Parham and Urlings, these all have a slope gradient of 1:8. Survey results for present utilization of these facilities indicate no problems.

Accordingly the slipway gradient at the Project site is to be 1:8, taking into consideration factors of ground elevation in the area behind the facility, planar layout and insitu foundation elevation on the basis of drilling survey.

(e) Fore-end depth

Maximum draft of currently used fishing boats at the site is approximately 1.0 m. Although it would be acceptable to set a slipway fore-end depth that minimally achieves boat draft depth, consideration with regard to the use of a wheeled boat trailer mandates that the facility allow an extra freeboard of 0.5 m to accommodate boat trailer operation in raising and lowering boats.

Photo 3 Boat trailer type used in Antigua Barbuda

Accordingly, slipway fore-end depth is calculated as follows:

- -Slipway for boat repair: equipped with boat slider stripping: -1.0 m
- -Slipway for boat trailer use: (no boat slider stripping) : -1.5 m

The fore-end depth of slipway is to be kept abovementioned depths, but the planned location of the slipway is shallower and is not secured these depths. Establishing a fore-end depth of -1.5 m given in situ conditions of foundation depth would necessitate a slipway fore-end location 100 m away from the shoreline, which is impractical.

As shown in the Figure 2.2.7, the fore-end of the slipway will be set up at the location of – 1.0m depth that is 10m offshore from present shoreline, and is secured the depth of -1.5m by excavation. Even though the water depth of – 1.5m is achieved for boat trailer use after the construction is completed, it is supposed this fore-end of the slipway would be sooner or later deposited by muddy soil. Present boat trailer use is carried out on the sand beach of 0.6~0.8 m depth at the north side of the existing jetty even though wheels of boat trailer are entangled by muddy sea beds. Accordingly, it will not be more harmful to a boat hull than present pattern of use even though excavated area is deposited by soft mud. Further, at the fore-end of slipway, the structure underlying seabed will be concrete or slider stripping. Therefore, no hindrance is expected for the slipway use.

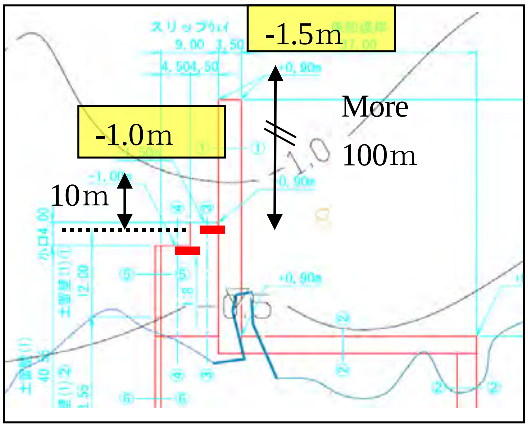


Figure 2.2.7 Relation between water depth contour and slipway alignment

4) Site perimeter revetments

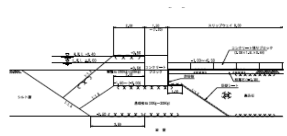
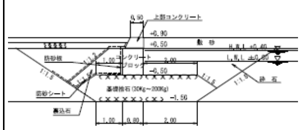
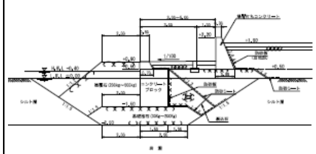
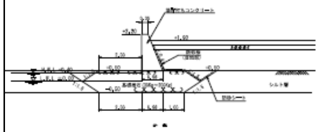
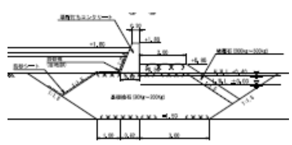
(a) Design approach

These structures serve to protect facilities constructed at the Project site from the effects of wave action as the result of sudden rise in sea level, and the effects of undertow, etc. To the lagoon side, revetments are designed to protect the landing jetty, mooring seawall and slipway structures, and to the landward side revetments will protect constructed facilities from damage as a result of sea level rise, wave action and undertow. Revetment structures will be as rational as possible given the fact that ground at the site tilts gently toward the lagoon side, the limestone bearing layer elevation likewise slopes gradually upward toward the land side with a hard limestone layer being approximately 10 cm below the surface on the landward side.

(b) Retaining wall section

In order to prepare the site area for facility construction, retaining wall type revetments will be constructed. Revetments are planned as described below in terms of lagoon side design and landward design. As in the case of the landing jetty and the mooring sea wall, revetments will be concrete-block type structures (see Table 2.2.19).

Table 2.2.19 Section of retaining wall

Seawall protection area		Basic approach to structure design	Standard cross-section
Seawall abutting the lagoon side	a) Seawall contiguous from the slipway.	This is to be a concrete block seawall, with sloped riprap placed on the seaward side, to both maintain normal wave activity and blend unobtrusively with the surrounding mangrove.	
	b) Smaller seawall extending from the main mooring seawall.	The segment of smaller seawall bending away from the main mooring seawall is to be constructed of concrete block (in the same manner as the main mooring seawall). Consistency of construction method will be aimed at by placing concrete directly insitu for the upper portion of the wall above the highest high-tide level.	
Seawall designed to protect buildings and appurtenant structures to the landward side	c) Seawall designed to protect the ground elevation of the Project site.	This will entail a duplex cross-section to ensure the ground elevation (for planned building sites) to the landward side of the seawall described in b) above.	
	d) Seawall from the mid landward-side to the site access road.	This segment of seawall will be designed in accordance with site elevation of the building foundation layer, after foundation improvement (ground replacement) in line with depth of the limestone bearing layer.	
	e) Seawall to the south side of the fishermen support facility.	Basic structure is to be identical to that in d) above. Sloped riprap is to be placed on the seaward side of the seawall to prevent any sudden deviation in elevation/level with the existing restaurant site further to the landward side. This will also prevent seawall erosion at the fishermen support facility periphery due to rainfall runoff from the Project hinterland.	

2-2-2-3 Building and facilities plan

(1) Design standards

1) Formulating critera

Building design under the Project references the Caribbean Uniform Building Code (CUBiC) as applied in Antigua and Barbuda, as well as applying related Japanese building standards and Japanese Industrial Standards (JIS).

2) Lateral standard shear coefficient during earthquake

Because Antigua and Barbuda is located on a volcanic belt, earthquakes are common in the country. The largest recorded earthquake occurring in the vicinity of the country was in 1974 with a magnitude of 7.5 as recorded by the U.S. Geological Survey. A lateral shear coefficient of 0.2 (the same as applied in Japan) is accordingly applied to building design under the Project.

3) Wind load

Based on the natural conditions survey, the most intense recorded hurricane to strike Antigua and Barbuda in the past was Hurricane Dog occurring on August 31, 1950. At that time, a momentary wind speed of 84 m/s was recorded. Despite the fact that no wind speed classification is made in the recorded data at that time, this wind speed is assumed to be the maximum momentary wind speed given the fact that it is unlikely to be the average wind speed judging from wind speed values for other hurricanes that have affected the area.

In terms of “average wind speed” classification, a maximum recorded value of 25.7 m/s occurred during Hurricane Klaus on October 5, 1990.

On the other hand, the most intense recorded typhoon to strike Japan in the past was the Second Miyakojima Typhoon occurring on September 5, 1966 with a recorded maximum momentary wind speed of 85.3 m/s. Because this value is virtually identical to that for the maximum-class hurricane striking Antigua and Barbuda, it is concluded that there will be no problems in terms of wind pressure force if existing Japanese building standards are applied. Accordingly, a reference wind speed of 46 m/s (applied to the Okinawa region where typhoon activity is most intense) is adopted under the Project.

4) Ground bearing capacity

Project buildings are all either one story or two story. Results of natural conditions survey indicate a weak surface layer with an N value of almost 0. Below that is limestone rock which would make pile driving for building support uneconomic. Accordingly, the weak upper layer is to be replaced with sand gravel, and a spread foundation using rubble concrete for building support adopted.

5) Structure design

Stress analysis for structural design will basically apply standard Japanese analysis methodology assuming lateral standard shear coefficient and wind load to be as discussed above.

6) Furnishings

Standards applied locally as well as Japanese standards for similar facilities will be applied.

7) Room floor space

This will be based mainly on similar case examples in local public facilities. If such examples do not exist or are not useful, then reference will be made to standard examples as set out in the Building Materials Encyclopedia published by the Architectural Institute of Japan. Floor area for each room will be established based on a comprehensive study of intended room utilization, required fixtures and furnishings, layout, maximized efficiency of use, building frame size, etc.

(2) Facility description

1) Administration and fish handling building

(a) Design approach

The administration and fish handling building is planned to effectively perform (i) catch sanitary control function (see Table 2.2.20) and (ii) administrative and data management function (see Table 2.2.21). With regard to the sanitary control function, respective rooms and service flow lines are designed for sanitary fish handling in line with international standards for landed catches, and to ensure that appropriately fresh fish are then shipped to the Port Wharf Fisheries Center on Antigua island. With regard to the administrative and data management function, perspective rooms comprises a office to operate and manage overall envisioned facilities, meeting /class room to hold meetings and train fishermen and complex staff, toilets and storage, etc.

(Points of special note in planning)

・In order to establish a compact and effective movement of main activities of the complex, the floor plan is designed as one building combining the catch sanitary control function and the administrative and data management function

・An ice making machine (plate type ice) will be installed at the upper part of the ice storage room. The machine room for the ice making machine and cold storage will be adjacent to these facilities. Furthermore, salt-resistant specifications will be applied to mechanical equipment, condensers, etc. This equipment will also be installed at a sufficient height to prevent water damage as a result of hurricane or exceptionally high tidal activity.

- In order to secure a sanitary floor conditions, the floor finishing schedule is to achieve easy cleaning and the floor corner is to be a R shaped. And proper floor inclination is to be designed to avoid water pool forming and to install a drain.
- Fresh water to be used for ice making and fish handling must be sterilized, supply system for this water will be separate from the general supply system for other fresh water to be used within the facility.
- A wire mesh catchment will be installed in the floor drainage pit to collect residue to the extent possible thereby reducing load on the wastewater treatment facility.

(b) Components

Contents of rooms relating to catch sanitary control function and controlled division from sanitary view points are indicated in the table 2.2.20 below.

Table 2.2.20 Rooms related to catch sanitary control function

Room	Description	Room environment
Fish receiving room	Landed fish catches are identified by owner, weighed and confirmed as to whether or not cold storage is necessary.	Open area
Data control room	Management of work operations within the fish handling room, and maintaining records of received fish catches.	Open area
Ante-room	Ante rooms leading in and out of the sanitary area.	Semi-closed area
Pre-treatment room	Sorting, sanitary inspection and fish cooling treatment	Closed area<1
Fish handling room	Temporary fish assortment, cold storage and boxing.	Closed area<1
Ice storage	Ice supply for fishing operation, fish cooling treatment, temporary fish cold storage and boxing	Closed area<1
Cold storage	Temporary fresh fish cold storage.	Closed area<1
Shipping room	Temporary storage for fresh fish insulated boxes	Open area
Locker room	Changing room and wash basin, etc. for staff working in the closed sanitary area.	Open area<2
Materials storage and bringing-in room	Storing packing materials, and managing washing of insulated boxes used in the closed sanitary area.	Open area
Inspection laboratory	Regular inspection of water used for ice making, controlling product freshness, keeping inspection records, etc.	Closed area

Note 1* Whole fish are washed, sorted and packed in insulated fish boxes.
Note 2* Clothing washing, drying and readying is carried out in front of the locker room.

Figure 2.2.8 shows relation between respective room and movement line of fish from bringing in to shipment in the sanitary control area, and entrance movement of ice delivery and working staff and equipment

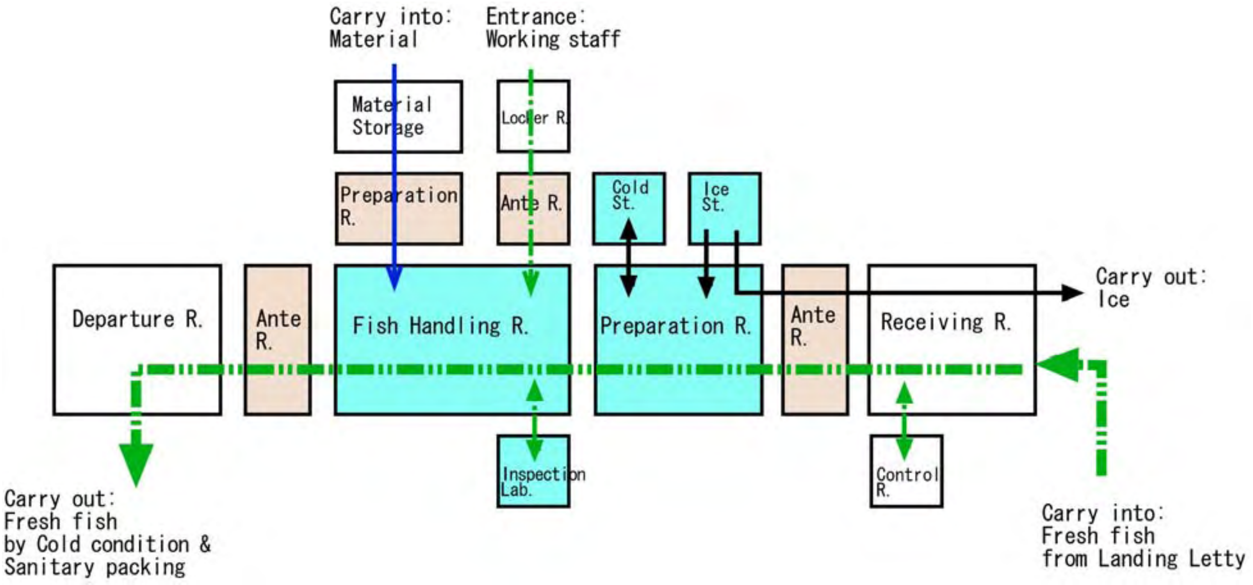


Figure 2.2.8 relation of handling flow and room relation

Contents of rooms relating administrative and data management function are indicated in the Table 2.2.21 below.

Table 2.2.21 Rooms related to administrative and data management function

Room	Description	Floor
Office	Work room for operational management personnel (comprising 8 administrative staff including facility chief, plus 2 workers)	1F
Other 1F rooms	Copy room, tea kitchen, toilet, washing room, storage closet.	1F
Multipurpose meeting room	Meeting room for operational staff and fisherman, and for fishery training sessions sponsored by the Department of Fisheries.	2F
Accommodation	Overnight accommodations for instructors for fishery training sessions and other personnel dispatched by the Ministry of Fisheries (separate accommodations for male and female).	2F
Other 2F rooms	Tea kitchen, bath room (both men's and women's including toilet and shower), storage closet	2F

(c) Scale and floor plan

- The various rooms within the sanitary control area include those related to the work flow from fish receiving to fish shipment, as well as rooms to support the sanitary handling of fish as shown in the Figure 2.2.8. These rooms will have dimensions and configuration necessary to efficiently and sanitarily receive and process fresh fish. Also, the scale of rooms related to management and data processing functions will be designed in line with the number of planned staff, operational agenda and training program.
- Specifically with regard to the sanitary control area, the quantity of received fish catch will comprise the facility processing work load. Because the daily fish catch in the area is not large, it will suffice that fish processing works be carried out manually.

Nevertheless, it will be necessary for a work flow that can smoothly process a daily average of fish catch per boat of around 34 kg of fresh fish and lobster after weighing and logging in. Accordingly, room dimensions and configuration are to consider the necessary operational space and bin cart passage space to enable the efficient processing of 34 kg of fresh fish and lobster at one time. {With regard to criteria for estimating fish catch per boat, see 2-2-1, 3) "Approach to facility design", (c) "Fishing related basic values for setting up of the Project scale"}.

- With regard to rooms for management data processing, the office is to be capable of accommodating the management staffing plan by the Fisheries Division. The meeting and class room is to be large enough to accommodate desks and chairs for approximately 24 persons given the need for meeting and training for operators of the 23 boats currently landing catches at Codrington, as well as the participation of Department of Fisheries staff (2~3 persons). In light of the fact that there are 44 fishing boats actively operating from Barbuda, the meeting and training room facility is to be designed to handle several successive meeting and training sessions. The accommodation facility will comprise two double rooms, based on the Department of Fisheries fishermen training plan and past numbers of persons dispatched as training instructors {for further justification of the meeting and class room, see Appendices 5 (4)}.
- Because produced ice will not only be used within the center, but also for fishing operations as well as fish shipment, facility layout will take into consideration the need to move ice out of the facility.
- The Project site is generally located on good ground. However, the limestone bearing layer below the soft surface layer inclines to a greater depth in the direction of the lagoon. In addition, uneven elevation at the site makes it necessary to place rubble concrete below building foundations down to the bearing layer. The quantity of rubble concrete is closely proportional to the floor area of the building first floor, and in this light the meeting and class room as well as accommodations for training instructors, and the ice making room are to be located on the building second floor in order to minimize the first floor area.
- Office room space is to be sufficient to accommodate the planned Project management staff. This does not, however, include desks and chairs for engineers, laboratory personnel or staff responsible for fish receiving. These staff will be deployed to their own specific locations within the building.

On the basis of the above, building floor plan is shown in Figure 2.2.9. The yellow shaded first floor rooms indicate the sanitary control area.

Figure 2.2.9 Floor Plan of Administration and fish handling building

2) Fishermen support building

(a) Design approach

The small fishermen support function under the Project comprises fishermen's lockers, a fishing gear kiosk and a roofed multipurpose area.

(b) Components

- Number of lockers is set based on the number of fishing boats currently landing catches at Codrington, while at the same time adding a small extra margin of locker quantity to accommodate some fishermen moving from Pearl Harbor. Past experience on Antigua island has shown that fishermen lockers are all occupied even if a locker rental fee is levied, and this will be considered under the Project in light of contribution to stable revenue for the center.
- With regard to the proposed fishing gear kiosk, similar fishing equipment sales operations are currently being carried out by the fishermen's co-op store at Point Wharf and at the kiosk within the Urlings fishery center. Accordingly, kiosk operation will be delegated to an interested party, with the minimum space required to be allocated for necessary kiosk furnishings.
- In the case of the fishery centers at Parham and Urlings, a fresh fish marketing area has been established aimed at local consumption, although utilization frequency for this facility is observed to be low. Such a dedicated fresh fish marketing facility is not present at Codrington. Instead, fishermen are seen weighing and selling whole fish at the existing jetty. Accordingly, it is concluded that a reasonable demand is present for a roofed fish marketing facility. A roofed area will be planned where fish can be directly sold from insulated fish boxes (as opposed to a fixed-type fish processing counter).

(c) Scale and floor plan

・ At the time of the Preliminary Study, fishermen's locker size was envisioned at 2.0 × 2.0m / unit. However, based on subsequent survey of similar cases in the country, as well as the results of interview survey regarding the minimum space necessary for fishermen to store their fishing gear, it was confirmed that a locker size of around 1.5 × 1.2 m would pose no problem. Main fishing gear that would be stored by fishermen in their lockers would be insulated fish boxes, nets (gill nets, etc.), fuel tanks, and small tools for operation and maintenance. Because equipment such as lobster traps can be safely maintained outside, an outdoor multipurpose service area is to be established adjacent to the locker building to be commonly utilized by fishermen to store large fishing gear.

・Layout the fishermen support building in parallel with the mooring type sea wall envisioned as a civil construction facilities to the lagoon side. The space for multi purpose use, fishing gear shop and fishing gear locker are laid out respectively from the side of administration and fish handling building. Fishing gear shop is to be adjacent to fishing gear locker. The floor plan of the fishermen support building is shown in the Figure 2.2.10 below.

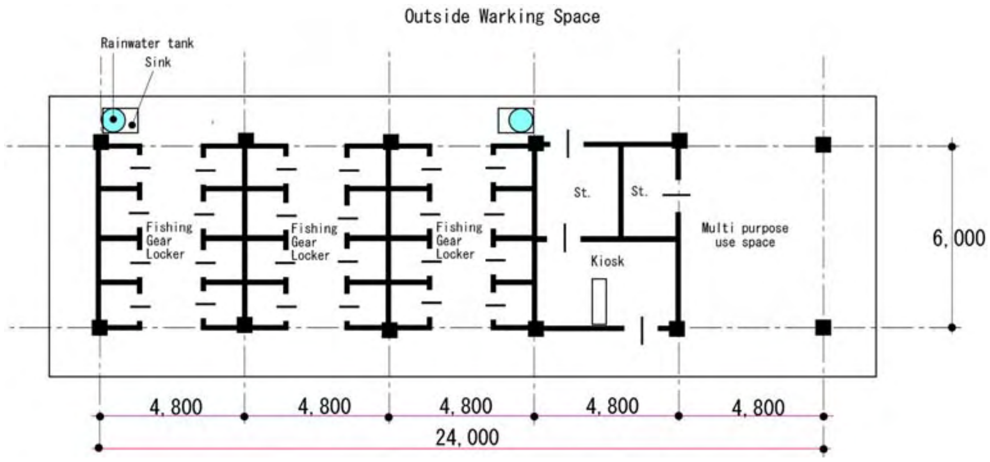


Figure 2.2.10 Floor Plan of Fishermen Support Building

3) Workshop

(a) Design approach

Workshops at existing fishery centers were surveyed, and results indicated that these facilities do not adequately meet center requirements. Because these existing workshop facilities have no walls, it is not safe to leave outboard motors in the facility overnight in the case of more lengthy repairs. Specifically in the case of repair works on the main boat hull, this does not require indoor space and can be safely handled outdoors. The envisioned workshop tools and equipment under the Project will be used for both outdoor boat and indoor engine repair. The facility building will be walled and capable of being locked for safekeeping of repair tools and equipment, and engines under repair.

Because the Fisheries Division does not employ workshop engineers, workshop operations are leased to the private sector.

(b) Components

The workshop will be mainly engaged in the maintenance and repair of outboard motors. Given its relationship to the center's service function and building layout, the workshop is to be located near the complex access road. The main power line runs alongside the access road, and it will accordingly be most cost-effective in terms of design to combine the workshop and receiving and distribution power panels and related equipment within a single building. The workshop building will thus also house an electrical panel room and backup generator.

(c) Scale and floor plan

- Workshop design is based on the fact that boat hull repair will be done outside, and that the workshop indoor area will be used primarily for outboard motor repair. The workshop will comprise a workroom with work bench, and a storeroom for repair tools and equipment. The exterior apron in front of the workshop will include an all-purpose sink and a water tank for outboard motor test operation. This external area will be roofed, in light of the frequent rainfall occurring at the site.
- The workroom size will be sufficient to enable simultaneous repair of multiple outboard motors. The workroom will have an adjacent storeroom to secure parts and tools under lock and key. The electric panel room and emergency generator room will be designed with minimum dimensions to adequately house the operating panel and generator equipment, respectively.
- A grease trap will be installed in the workshop to collect oil and grease drip in the course of repair works. Nevertheless, the workshop will be located far enough away from the lagoon to prevent any oil or grease runoff into the lagoon in the unlikely event of a large-scale oil/grease leakage accident at the workshop.
- Wastewater from the motor test tank will first be conveyed to a grease trap for thorough oil and water separation, after which it will then be conveyed to a settling basin. After precipitation, only the supernatant portion will then be released to the lagoon via an on-site rainwater drainage channel.

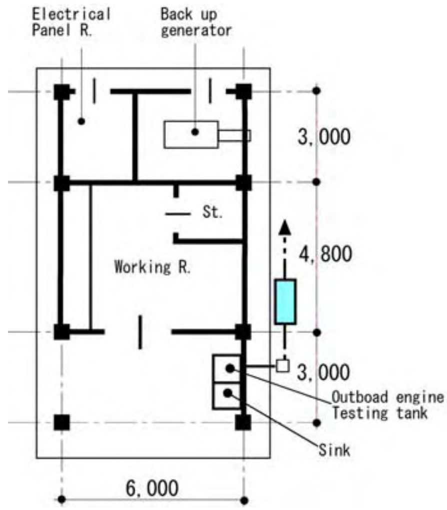


Figure 2.2.11 Floor plan of workshop

Based on the design approach mentioned above, the floor plan of the workshop is shown in the Figure 2.2.11.

4) Other facilities

(a) Fishermen's toilet

For sanitary purposes, fishermen's toilet and shower facility is planned. The facility will be appropriately located within the complex taking into consideration flow lines for fishermen utilization of Project facilities as well as layout for wastewater treatment pipeline.

Water used in the facility will be rainwater collected from the roof into a rainwater reservoir tank. Design will also take into account the possibility of diverting water from the rainwater tank at the administration and fish handling building when the tank at the toilet facility is dry. Wastewater generated at the fishermen's toilet will be conveyed to the wastewater treatment tank for processing.

Based on the design approach mentioned above, the floor plan of the fishermen's toilet is shown in the Figure 2.2.12.

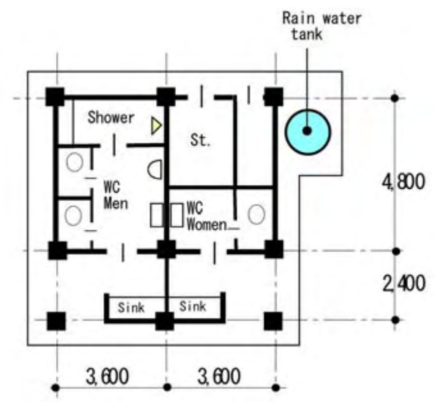


Figure 2.2.12 Floor plan of fishermen's toilet

(b) Garbage disposal area

Because there is a garbage collection service on Barbuda island, the garbage disposal area will be located to facilitate pickup and hauling off by garbage trucks, as well as causing no adverse impact on the internal environment. The garbage disposal area will be walled off and divided into three divisions, for fisheries oriented remains, general garbage, empty bottles and cans.

(c) Wastewater treatment tank

Wastewater flowing into the wastewater treatment tank comprises both contaminated and general wastewater generated at the administration and fish handling building and fishermen's toilet, as well as drainage from the workshop. Specifically in the case of wastewater from the workshop, drainage from the outboard motor test operation tank first flows from the grease trap to a settling tank where oil and grease is separated prior to the water then being conveyed to the wastewater treatment tank.

(3) Cross-section plan

Cross-section plan is based on a comprehensive study of the environment in an around the site, the status of the ground bearing layer, ceiling height in line with respective room functions, system piping within the ceiling, achieving natural ventilation to the extent possible, and preventing salt damage inside buildings.

1) Design ground level and first floor level

The landing jetty and mooring sea wall level is set at D.L.＋0.9m, which is the reference level for the lagoon side edge. The site design ground level slopes at a gentle 1/200 gradient from the sea side towards the road side. Both good rainwater drainage as well as convenient vehicle access to the complex can be achieved.

Design ground level for buildings is determined as follows, from the standpoint of preventing damage from rising sea level and ensuring convenience of daily access by fishermen.

・Reference level for fishermen support building:
GL-1=D.L.+1600mm、[FL=GL-1+600mm (D.L.+2200mm)]
・Reference level for administration and fish handling building:
GL-2=D.L.+1900mm、[FL=GL-2+600mm（D.L.+2500mm）]
・Reference level for fishermen's toilet, workshop:
GL-2=D.L.+1900mm、[FL=GL-2+300mm（D.L.+2200mm）]

In the case of the differential between the complex road elevation and the respective reference levels, steps will be constructed to accommodate persons using the facilities and slope ways will be established to enable push carts to negotiate this differential. Slope way width will be enough for easy push cart passage, and gradient will be 1/10.

2) Stories and floor height

Given the nature of work activities within the complex and to ensure the best continuity of work flow lines, all structures will be single story with the exception of the two-story portion of the administration and fish handling building. Also, with the exception of the administration and fish handling building, facilities will have no ceilings (roof framing will be exposed as is).

Main structure type, roof framing and roofing specifications, etc. are indicated in the Table 2.2.22 below.

Table 2.2.22 Respective facility main structure, walls, roof framing, roofing, etc.

Facility	Stories	Design Ground Level	First Floor Level	Floor Height (Structure)
Administration and fish handling building	2 stories	GL-2=D.L.+1900	GL-2+600<1	1F: 3,500 <2 2F: 3,300<3
Fishermen support building	1 story	GL-1=D.L.+1600	GL-1+600	1F: 3,100
Fishermen's toilet	1 story	GL-2=D.L.+1900	GL-2+300	1F: 3,100
Workshop	1 story	GL-2=D.L.+1900	GL-2+300	1F: 3,100

Note 1* First floor level will be GL-2+600 in general. First floor level of sanitary control area will be considered the structure slab level reason from the necessity of floor trench and floor inclination.

Note 2* Floor height of the rooms located in sanitary control area such as treatment room, fish handling room and departure room will be approx. 5,800mm. Because the apace of ducting of air supply, piping space are installed inside the ceiling space.

Note 3* Floor height of the ice making machine room will be located in the second floor above the the ice storage.

3) Energy saving engineering with consideration to local conditions

All buildings will be equipped with window eaves to block direct sunlight and rain intrusion through open windows, thereby enabling windows to remain open at all times (except for violent rainstorms) for natural ventilation. This precludes the need for mechanical ventilation by fan, etc.

(4) Structural plan

1) Ground bearing capacity and foundation type

Ground surface from the hinterland behind the Project site and extending to the lagoon tilts at a gentle 1.5%. The underlying limestone layer tilts at a slightly higher gradient. Specifically, the limestone layer at the lagoon water line is at a depth of around -3 m. There is a partial depression in the layer at the lagoon side fence of the existing restaurant, with the limestone layer at around -4 m depth. In terms of soil properties, the ground between the surface and the underlying limestone layer is a soft clayey layer with an N value of almost 0. Even in the case of light building structures, ground subsidence can be expected over the long term in the case of this layer. On the other hand, the underlying limestone layer exhibits an N value of 50 or more with a bearing capacity posing no problems even in the case of heavy buildings.

Under present ground conditions, it is not even possible to construct a stable on-site road, and the soft clayey surface layer is therefore to be replaced with crushed rock and sand at sites where a design facility foundation will rest on the surface layer. Approximately 60 m inland away from the lagoon waterline, the limestone layer at the site is just below the surface and in some cases partially exposed at the surface.

Given these geological conditions, the heaviest building structure (the administration and fish handling building) will be located slightly away from the lagoon edge and employ a spread footer type foundation resting on rubble concrete reaching to the limestone layer. Foundation bearing capacity will be 300kN/m^2. In the case of other buildings, these will adopt a slab foundation resting directly on a surface layer comprising crushed stone and sand used to replace the original soft clayey layer. Foundation bearing capacity will be 70kN/m^2. Since the workshop locates inner area of the site with shallow layer of foundation, its foundation type will be applied footing type foundation using rubble concrete up to limestone layer, foundation bearing capacity is calculated using 300kN/m^2.

Since there is concern for subsidence over the long term that would lead to floor cracking in the case of slab on grade, floor support will be applied structural slab type for floors of fishermen support building and of rooms inside sanitary control area of administration and fish handling building.

2) Earthquake and wind

(Earthquake)

As discussed earlier, Barbuda island lies within an earthquake zone. Based on past earthquake history, a lateral shear coefficient of 0.2 is adopted. Design seismic force (Vi) is calculated according to the following formula:

$$Vi = I \times Ki \times Rt \times Ai \times Co \times W$$

Vi	:	Seismic force (kN)
I	:	Importance factor (standard facility: 1.0)
Ki	:	Building coefficient（1.0）
Rt	:	Vibration characterisitic coefficient （1.0≦）
Ai	:	Height distribution coefficient（1.0≧）
Co	:	Shear coefficient（0.20）
W	:	Building weight（kN)

(Wind)

As discussed earlier, design standard wind speed is determined at 46 m/sec based on past hurricane data, and design wind load (Pi) is calculated according to the following formula:

$$Pi = I \times E \times Qo \times Cf \times A$$

Pi	:	Design wind load (kN)
I	:	Importance factor (standard facility: 1.0)
E	:	Environmental impact factor (1.0)
Qo	:	Velocity pressure (0.6*E*Vo: Vo=46m/sec)
Cf	:	Wind force coefficient
A	:	Pressure receiving surface area (m^2)

3) Building structure

Building foundations, beams and columns are to be RC rigid frame structure. In light of the need for hurricane resilience, building roofing is to comprise RC beams and RC roof slab. Walls will be mainly concrete block masonry. Nevertheless, RC earthquake resistant walls will be constructed at critical design locations where needed to ensure structural integrity.

Respective building structure criteria are summarized in Table 2.2.23.

Table 2.2.23 Overview of building structure

Facility	Foundation	Structural type	Walls	Slab frame	Roof
Administration and fish handling building	RC spread footer ＋rubble concrete	RC rigid frame	Concrete block masonry coated with mortar and painted	RC beam ＋ RC slab	RC slab + water proofing
Fishermen support building	RC footer	RC rigid frame	Concrete block masonry coated with mortar and painted	RC beam ＋ RC slab	RC slab + water proofing
Fishermen's toilet	RC footer	RC rigid frame	Concrete block masonry coated with mortar and painted	RC beam ＋ RC slab	RC slab + water proofing
Workshop	RC spread footer ＋rubble concrete	RC rigid frame	Concrete block masonry coated with mortar and painted	RC beam ＋ RC slab	RC slab + water proofing

(5) Building materials plan

1) Main structural materials

Building materials to be used are materials that generally can be procured in country. Nevertheless, these will be materials in compliance with locally specified standards (at present, US, UK and CUBiC standards are variously applied in Antigua and Barbuda). Types of building materials will be kept to a minimum. Main structural materials and procurement source are indicated in Table 2.2.24.

Table 2.2.24 Main structural materials and procurement source (common civil works and building construction items)

Application	Procurement source
・Replacement of soft clayey surface layer	-Limestone and sand that can be procured on Barbuda
・Low-strength concrete	-Crushed limestone and sand that can be procured on Barbuda
・Mass concrete structural components	-Crushed limestone and sand that can be quarried in the Project site vicinity
・RC super structural components of building with strength of 20 N/m^2 or more	-Coarse aggregate is to comprise basalt procured from Antigua (or other neighbouring island) and fine aggregate is to be sand that can be procured on Barbuda island
・Perimeter earth-retaining seawall	-Main wall structure is to comprise mass concrete, reinforced with appropriately sized limestone riprap procurable on Barbuda
・Landing jetty, mooring seawall (paving of on-land area butting against the lagoon)	-Concrete pavement
・On-site road and parking lot	-Interlocking block pavement

2) Finishing plan

In the same manner as described above, finishing materials are to be those generally procurable locally. Types of material are to be kept to a minimum.

(a) Exterior finishing

With the exception of the administration and fish handling building which has different roofing specifications, the exterior finishing for other buildings is to be the same (see Table 2.2.25).

Table 2.2.25 Exterior finishing

Facility	Specification	Reason
・On site road	・Interlocking block	・There are increasing examples of this material use in the country, due to the fact that it can be produced locally, and maintenance is easy.
・Berm / building periphery	・Concrete paving coated with hardener	・This is a common construction method locally, and has proved effective under previous grant-aid projects.
・Exterior surface finishing	・Mortar application overlaid with acrylic paint	・This is a common construction method locally, and has proved effective under previous grant-aid projects.
・Exterior wall	・Mortar application overlaid with acrylic paint	・This is a common construction method locally, and has proved effective under previous grant-aid projects.
・Roofing (administration and fish handling building)	・Area not accessed on foot: asphalt water proofing and exterior thermal insulation ・Area accessed on foot: asphalt water proofing overlaid with protective mortar (no thermal insulation)	・This is a common construction method locally (to be adopted for the sanitary control area and meeting room, etc.). ・This is a common construction method locally.
・Roofing (other buildings)	・Asphalt water-proofing	・This is a common construction method locally.

(b) Interior finishing

It is necessary that the administration and fish handling building be finished in a manner conducive to the sanitary handling of fish. Rooms related to Project operation are to be finished to a level comparable with the present Ministry of Fisheries home office. The fishermen's support building, fishermen's toilet and workshop are to be finished in line with general standards prevailing in the country, as well as standards achieved under past Japanese grant-aid projects.

(Administration and fish handling building)

Interior finishing is outlined in Table 2.2.26 as (i) sanitary control related rooms within the administration and fish handling building, and (ii) rooms related to Project operation and maintenance.

Table 2.2.26 Room interior finishing (administration and fish handling building)

	Room	Floor	Base board	Skirt / wall	Ceiling	Reason
Sanitary control area	・Fish receiving area	Ceramic Tile & Urethane paint	Tiling or Stone	Mortar with VP paint coating	Cement board; VP paint	Facilitates cleaning in conjunction with fish handling
	・Service room ・Fish handling area ・Shipping room	Urethane paint	Urethane paint; rounded corners	Mortar with VP paint coating	Cement board; VP paint	Facilitates cleaning in conjunction with fish handling
	・Locker room ・Ante-room ・Storage /preparation room ・Laboratory ・Control room	Urethane paint	Urethane paint; rounded corners	Mortar with VP paint coating	Cement board; VP paint	Facilitates cleaning in conjunction with fish handling
Operation and maintenance	・Office ・Meeting room ・Accommodation	Ceramic tile	Tiling	Mortar with acrylic paint coating	Rock wool sound insulation	General construction practice locally; no special finishing necessary

	・Washing room ・Toilet ・Tea kitchen	Ceramic tile		Skirt: tile Wall: acrylic paint	Cement board; VP paint	General construction practice locally; no special finishing necessary
	・Mechanical room ・Storage	Mortar substrate overlaid with hardener		Mortar with acrylic paint coating	Bare concrete	General construction practice locally; no special finishing necessary

(Other)

Interior finishing for the farmer's support building, the farmer's toilet and workshop are indicated in Table 2.2.27.

Table 2.2.27 Room interior finishing (fishermen support building, etc.)

	Room	Floor	Base board	Skirt / wall	Ceiling	Reason
Fishermen support building	・Multipurpose space	Ceramic tile	Acrylic paint	Mortar with acrylic paint coating	Bare concrete	To facilitate cleaning in light of the multipurpose nature of the building
	・Kiosk	Ceramic tile	Acrylic paint	Mortar with acrylic paint coating	Concrete with acrylic paint coating	Standard finishing for local kiosks
	・Fishing gear locker ・Storage	Concrete with acrylic paint coating	Acrylic paint	Mortar with acrylic paint coating	Bare concrete	Standard finishing for local kiosks
Fishermen's toilet	・Toilet interior	Ceramic tile	Tiling	Skirt: tile Wall: vinyl paint	Concrete with acrylic paint coating	Standard finishing for local toilets
Workshop	・Work room ・Storage ・Electrical room ・Generator room	Concrete with acrylic paint coating	Acrylic paint	Mortar with acrylic paint coating	Bare concrete	Standard local finishing

(c) Building fittings

Building fittings under the Project will be required to ensure the durability of externally facing windows and doors against salt damage, as well as damage from flying objects when a hurricane strikes. Accordingly, window and door fittings will be of aluminium fabrication, which is the general type adopted locally for this purpose. Door fittings within the sanitary control area rooms for fish handling will also be of aluminium fabrication to facilitate cleaning. The grilled gate to the outdoor garbage disposal area will be standard steel fabrication coated with rust-proofing paint.

(Externally facing windows and doors)

・ In preparation against hurricanes, aluminium sash windows are to be fitted with outer wooden shutters to protect glass panes from flying objects. During normal weather conditions, the shutters will remain open, and only the windows themselves will be opened and closed.

・Building entranceway doors will be glass panelled to facilitate natural lighting inside, likewise will be fitted with outer wooden shutters to protect glass panes from flying objects in the case of hurricane. Doors that are not glass panelled will not be fitted with hurricane-protective wooden shutters. Also, transoms fitted above doors to enhance natural illumination will not be glass, but rather fabricated of double-layered polycarbonate panels to eliminate the need for wooden-shuttered protection against hurricanes.

(Interior windows and doors)

・Windows and doors within the sanitation control area of the administration and fish handling building will be in line with HACCP specifications to ensure the sanitary handling of fresh fish. Window and door fittings not requiring special sanitary specifications will be fabricated of either aluminium or wood as is the general practice locally (for offices, etc.).

・Doors within the sanitary control area will be in principle aluminium sliding doors, designed with either a spring or balancer for automatic closure without the need for electric motor assist. In order to maximize the aperture for sliding doors through which bin carts loaded with fish pass, doors are to be fabricated of polycarbonate instead of glass. This will lighten the door weight, facilitating opening and closing. Also, in the part of the ante-room (within the sanitary control area) through which bin carts pass, sliding doors will be equipped with a movable silicon screen. Doors within other general rooms, will be either of aluminium or wooden fabrication, which is the general practice locally.

・Other building window and door fittings will be either aluminium or wood.

2-2-2-4 Utilities plan

(1) Water supply plan

City water supply to the site will be provided by the Antigua Public Utilities Authority (APUA). Two systems are planned for water supply: city water and rainwater. In the case of existing city water supply, viable count, calcium concentration (hardness), salinity, and turbidity all exceed standard values. Accordingly, depending on intended water use, appropriate pretreatment will be necessary (see Table 2.2.28).

Table 2.2.28 City water analysis data

Sampling date 2009	Sampling time	Bacillus coli CFU/ml	General bacteria CFU/ml	Iron (Fe^{2+}) (ppm)	Total dissolved impurities TDS (ppm)	Hardness (Ca^{2+}) (ppm)
Jan.9	1:05 AM	Not detectable	150	-	1753.8	-
Supplemental testing						
Feb. 5	6:45 AM	-	-	Not detectable	1782.0	575
Feb. 5	3:00 PM	-	-	Not detectable	1760.0	625

Note: Based on the water quality test results of January 9, supplemental study was carried out by the study team after its return to Japan

Because there are times when city water supply is cut off, city water will be firstly conveyed to an on-site reservoir tank. In the case of water supply to the ice making machine, city water will be filtered and then disinfected by sodium hypochlorite titration. Also, because water is slightly saline, a salt-resistant pump system will be applied.

In terms of water supply system operation and maintenance, the following regular inspection will be necessary.

(a) In conjunction with start of work operations, the disinfectant equipment is to be visually checked and valve positioning confirmed. Remaining amount of disinfectant agent (sodium hypochlorite) is likewise to be confirmed and salinity is to be checked by reagent. (Disinfectant agent is to be stored in a cool, dark place.)

(b) In advance of work operations, reservoir tank interior is to be visually checked as well as the operation of ball valves. From a sanitary standpoint including prevention of algae growth, the reservoir tank is two be emptied and cleaned at least once every six months.

Furthermore, because the hardness of city water is a high 575~625 Ca^{2+} ppm, it is necessary to reduce this to prevent calcium buildup on the ice making machine freezing plates. Due to the excessively high calcium value, the ion-exchange resin method for reducing hardness is not suitable. The alternative would be an evaporation type distiller facility. This approach, however, entails an excessive equipment and operating cost.

Accordingly, it is concluded that water pretreatment to reduce hardness will not be performed, and instead the frequency of freezing plate cleaning will be increased. Also from a machine maintenance standpoint, it is planned that raw water circulating to the freezing plates be periodically drained in order to reduce the calcium concentration (since only the water itself freezes at the ice making stage, impurities remain within the circulating water). Furthermore, a machine design will be adopted that facilitates freezing plate cleaning.

Water supply to toilets and showers will be primarily un-chlorinated rainwater delivered by pipe from a rainwater reservoir tank. However, water will be diverted from the city water reservoir tank during dry spells when rainwater is lacking.

(2) Wastewater drainage plan

Specifically with concern for wastewater from the fish handling area, separate drainage systems for each area are to be established to prevent contamination between areas. In addition, a basket type strainer is to be installed in each area to prevent solid waste such as scales, etc. from entering the wastewater pipeline. The terminus for the drainage pipeline is a purification tank where wastewater is treated. Amount of wastewater to be treated at the purification tank is indicated in the Table 2.2.29 below.

Table 2.2.29 Wastewater breakdown and quantities (maximum)

Location	Breakdown		Wastewater quantity / day
Work area	Floor area Insulated boxes Fish trays Fish washing	74.8m2 × 10L 5 boxes × 20L 65 boxes × 2L 65L	1.0 ton
Toilet / shower	Shower Toilet Wash basin, etc.	18 persons: 900L 16 person-times: 400L 100 L	1.4 tons
Office tea kitchen, etc.	100L		0.1 ton
Total			2.5 tons

Notes: Fish trays: 5 trays × 9 boxes = 45 boxes for work area; 20 boxes for cold storage use
Shower: 9 boats per day (Codrington only) × 2 persons × 50L
Toilet: 10 fishermen ＋ 6 staff × 40L

Antigua and Barbuda has not promulgated any independent wastewater standards of its own, and instead applies standards used throughout the Eastern Caribbean states (see the Table 2.2.30).

Table 2.2.30 Standards for wastewater released to the sea

Item	Upper limit
BOD	30 mg/L
SS	30 mg/L
pH	5.8-9.5
Chlorine	0.2-0.5 mg/L
Bacillus coli	300 organisms/100ml (average)
Enterococci	30 organisms/100ml (average)

Source: Ministry of Health

Wastewater treatment tank specifications are planned identical to the concrete, aerated tank type treatment system currently in use at the Point Wharf center, which has proven performance. Because ground at the Project site is a clayey layer, wastewater after treatment cannot be filtrated into the ground. Accordingly, wastewater will pass from the purification tank to either an evapo-transpiration tank, or a settling basin after which the supernatant portion would then be released to the lagoon.

(3) Power supply plan

Power supply to the site will be provided by the Antigua Public Utilities Authority (APUA). An existing trunk transmission line is strung on poles along the main road adjacent to the site. Transmission voltage is 11,000 V. Supply voltage is 240 V (general lighting, electrical socket circuitry) and 415 V (mechanical power). Frequency is 60 Hz. Power feed to the Project site will be from this existing overhead main transmission cable to a power pole and step-down transformer situated at the outer perimeter of the site. Power will flow from this transformer to the receiving panel within the electrical panel room attached to the workshop building.

However, unpredictable blackouts occur (for about 20 minutes when generator switch-over takes place, for 2~3 hours when power line maintenance works are carried out, and for a day or more when parts must be obtained for power system repair). In light of this situation, an emergency generator is planned under the Project to ensure a constant power source for water supply and purification tank pumps, and the cold storage facility.

Overall electricity load for the Project is summarized below.

Main electricity load areas	(KVA)
- Administration and fish handling building	36.3
- Cold storage and air conditioning	32.0
- Workshop	3.5
- Fishermen support building	2.2
- Fishermen's toilet	1.0
- Water supply and wastewater treatment facilities	11.0
- Other (outdoor lighting, pump equipment, etc.)	6.0
Overall electricity load total	92.0

Based on the above, overall electricity load total is calculated as approx. 92 KVA and operational electricity load total will be approx. 60KVA at the project site.

Emergency power will service the facilities indicated below in order to preserve fish freshness, normal wastewater treatment operation and minimal complex lighting.

Emergency electrical load sectors	Circuit load（KVA）
- Water supply	7.5
- Wastewater treatment (bilge and blower)	3.5
- Cold storage	11.0
- Ice storage	5.5
- Office electrical outlets, etc.	10.0
(Total load of emergency generator)	37.5

Considering in addition the necessary cold storage start up current of 11.0 KVA, a generator capable of producing (37.5KVA ＋11.0 KVA＝48.5 KVA) of power is necessary. 60 KVA class unit will be selected. Furthermore, because a school is located adjacent to the site, a quite type generator will be adopted 60Hz/60 KVA type.

(4) Ice making machine

The object for icing is only fishes. Lobsters are handled live and accordingly do not require icing. The required ice quantity is set up as follows.

(a) Average daily required ice quantity

Ice will be used both for fishing operation and for icing of fish for shipment to Antigua (exportable fish). The fish quantity for icing inside the sanitary control area is set up in the section 2-2-1 (1) 3) (c) (Fisheries related basic value for setting up of the Project scale).

- Estimation object : Fish catch quantity in the tourist season
- Facility operating days: 6 days/week, 4 weeks/month, 12 months/yr.
- Average daily fish catch quantity: 482 lbs/day (218kg/day)
- Average daily quantity of fish for shipment
  received into the sanitary control area: 144 lbs/day (65kg/day)
- Fish quantity shipped to Antigua per time:

  There are 3 transport vessels that are operating once a week respectively but their operating schedules are not regular. Accordingly, the average shipment frequency is set up at three (3) times/week. Based on this assumption, fish shipment quantity per time is estimated at the quantity equivalent to 2days quantity fish handled in sanitary control area. Accordingly, Fish quantity shipped to Antigua per time is set up as :

  = 144lbs/day x 2days/time = 288lbs/time≒290lbs/time (131kg/time)

Based on the above preconditions, average daily required ice quantity is calculated as shown in the Table 2.2.31 below. That is 369kg/day.

Table 2.2.31 Daily average quantity of ice necessary

Purpose of ice use	Conditions of use	Required quantity of ice (kg/day)
For fishing operation	Fish : ice ＝ 1 : 1	218
For sanitary processing	Fish quantity processed within the sanitary control area: 65kg/day	
Ice packing within the sanitary control area	Fish × 10%	7
Water ice for cooling (fish body cooling: 28℃→±0℃)	65kg ×1000 g/kg {(28-0℃) ÷ 80cal/g} ÷ (1000g/kg) × 3 times* (*water change 1 time every 2 hours)	66
Ice packing for temporary storage in cold storage	65kg × 20%	13
For fish shipping to Antigua	Fish : ice ＝ 1 : 1	65
Total		369

Remarks: 80 cal/g; the heat of fusion of ice

(b) Set up of ice making machine capacity

As assumed in (a) above, average daily required ice quantity is 369kg/day, and annual facility operating day is (6days x 48 weeks/yr.). Accordingly, annual required ice quantity is 369kgkg/day x (6days x 48 weeks/yr.) = 106,272kg/yr. Since it is desirable for ice making machine to operate continuously from standpoint of its heat efficiency, daily ice production of ice making machine is calculated as:

Daily ice production of ice making machine = annual required ice quantity÷365 days

= 106,272kg/yr.÷365days/yr. = 291.1kg/day≒291kg/day.

It means that envisioned ice making machine is required to produce ice at least 291kg/day.

However, because fish are shipped to Antigua three times per week in an unscheduled manner, it is necessary to prepare a maximum three days worth of fish for shipment (in the case where a Sunday falls between shipping days). If the quantity (V) of ice for this is considered as well, then calculation is as follows.

V = (ice for Monday fishing)+(ice for Monday processing)+(ice for one time shipment)

= 218kg for fishing + (7+66+13)kg for processing + 131kg for shipment = 435kg

Accordingly, an ice making machine capable of producing 435 kg of ice per day is necessary, and the smallest commercial type machine (1 ton class) is planned under the Project. Any ice produced in excess will be marketed locally.

(c) Ice configuration

Ice is to be plate ice, which is the type of ice generally used for fishing operations in Antigua and Barbuda. Plate ice to be used within the sanitary control area will then be broken up by crusher into a form that will pose as little danger as possible of damaging whole fish.

(d) Operation and maintenance method

Constant monitoring of the ice machine is necessary. Also, because city water on Barbuda island is high in calcium content, particular attention must be given to calcium buildup within the water supply system and the ice making machine freezing plates. In order to prevent calcium buildup, the following daily inspection and cleaning are necessary.

- Inspection at the time of operation start up:
  The water supply system is to be checked for possible clogging.
- Before stopping operations:
  In order to limit the concentration of calcium within the circulating water, the ice making machine is to be temporarily shut down, the circulating water drained, and the machine then restarted 30 minutes later.
- Regular cleaning:
  Even if equipment does not appear unclean, freezing plates are to be brushed and the water supply pipeline cleaned once a week. Sharp edged instruments are not to be used for cleaning. After cleaning, circulating water within the machine is always to be drained.

(5) Ice storage

A two day supply of ice is to be stored so that daily fishing operations can continue even in the case of power blackout or maintenance operations which temporarily suspend ice production. The ice storage facility is planned to have a floor area of 3.3 m^2, a stacking height of around 1.0 m and 1.0 ton storage capacity. From a sanitary standpoint, ice removal from ice storage is not to be done by workers entering the facility itself. Instead, the ice storage floor will be raised 40~50 cm to allow ice to be removed by scooping. In the case of ice at the back of the facility, this will be pulled forward by raking. Ice storage will be equipped with a refrigerating system in light of the fact that ice from the ice storage facility will be used when ice production is not carried out during power blackouts.

At the time of electric interruption, back-up generator will not operate ice making machine to save electric consumption but operate ice storage to prevent ice melting. Accordingly, a cooling machine is to be installed to the ice storage.

(6) Cold storage

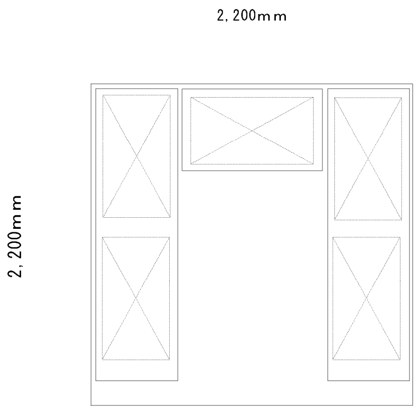
Live lobster and fresh fish will be handled in the sanitary control area. After being received into the area, live lobster will receive sanitary inspection and is promptly packed and exported from Barbuda island by air.

Fish, on the other hand, is shipped by sea to Antigua island three times a week. Accordingly, it is necessary to store a maximum three day supply of fish when shipping days straddle a weekend. During the period until actual shipping, fish are placed on trays, packed in ice and stored. At the time of shipping, fish are then packed in insulated fish boxes. Whole fish are carefully placed on trays so that no injury occurs to the fish body.

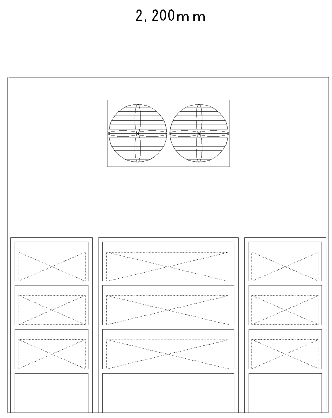
As calculated in the above mentioned section (4)[ice making machine], average shipped quantity per one time is 131 kg. Shipping schedule is not fixed, and it is conceivable that maximum 4 shipping days may occur in a row. On a given shipping day, it is possible that two days worth of fish for subsequent shipping would be stored. Accordingly, a cold storage facility is planned that can temporarily store two times of fish to be shipped (262 kg) including the quantity to be stored that day and the shipping quantity for the following day.

In order to have proper heat conduction in the cold storage, fish is to be subdivided. Fish trays are to be used for temporary storage. A tray is to have a 20 kg storage capacity including 18 kg of fish plus 3.6kg of packing ice. Accordingly, 15 nos. of tray are planned: 262kg ÷ 18 kg/unit ＝15 units. Space within the cold storage facility is to be sufficient to accommodate five tray cabinets, each three compartments in height. Floor area would be 2.2m × 2.2ｍ (Figure 2.2.13).

Furthermore, ice temperature will be controlled to prevent fish freezing.



Planar view



Cross section

Figure 2.2.13 Cold storage interior layout

The above discussed ice making machine, ice storage and cold storage require careful maintenance management. Accordingly, equipment and tools used in the course of Project construction for these facilities will be handed over to the executing agency upon completion of construction. These will include: general tools, tools for refrigerant piping, vacuum pump, stepladder, clamp meter, pipe vice, electric welder, gas torch (for brazing), welding masks, gas gauge for refrigerant charging, gas leakage detector, etc.

(7) Air conditioning system

Filtered fresh air is to be delivered to the fish handling area and service room for sanitary purposes. Because air filter clogging greatly reduces the amount of air delivery, this is to be checked prior to starting up operations. The air filter should be cleaned twice a month, depending on status of dust buildup.

.Furthermore, minimum required air-conditioning will be implemented in the fish handling room to maintain fish freshness given the fact that outside temperature is a high ± 30°. As for other rooms in the sanitary control area, the spaces for air-conditioning unit and air duct will be secured within the Japanese assistance to enable future increase of cooling units.

As for rooms for office, etc., air conditioning units are not installed by the Japanese assistance but done by Antigua and Barbuda side according to local needs. In stead, ceiling funs will be installed to the office of 1st floor, class room and sleeping quarters of 2nd floor, and fishing gear shop in fishermen supporting building.

2-2-2-5 Equipment plan

(1) Overall plan

Equipment content will comprise equipment necessary to carry out the primary functions of the Project facilities. Equipment will comprise items that can be maintained and repaired with local resources after being supplied under the Project.

(2) Specific equipment plan

Components of the equipment by the Japanese assistance are classified for fish handling, for engine repair tools and for education/training and administration. On the basis of local conditions of usage of the equipment, procurement and maintenance system, following equipment contents and quantity have been planned.

(a) Fish handling equipment

These equipment are composed of contents that will be used for works from fish landing, processing in the sanitary area, and up to shipment. Relation of work flow and the equipment needed is indicated below:

	Outside		Fish handling shed						
Flow of fish	Landing	Movement	Receiving room	Ante room	Preparation/ice making/cold storage	Inspection room	Fish handling room	Shipment room	Others
Equipment needed	Overhead crane	Bin cart	Platform balance, Handling table	Fish tray	Bin cart, Handling table, Fish tray	Test kit	Insulated box	Trolley jack	Pressure washer

(i) Overhead crane

Purpose : To lift heavy items including insulated fish boxes, outboard motors, etc.

Specification: Material : Stainless steel

Capacity : Capable of lifting 500 kg

Appurtenant items : Wooden pulley; ne 200 mm double pulley

Pulley with tackle; ne single pulley

Rope: Plastic, 20 mm dia., 100 m length

Other appropriate fittings and hardware

Quantity : One (1) set

Maintenance : Put grease once a year. To use water proof grease not containing chloride

(ii) Bin cart

Purpose : To transport catches from the landing jetty to the fish handling facility, as well as move ice and ice water within the fish handling facility.

O&M : No problem as this item is to be used only within the facility.

Required quantities: Outdoor cart

The distance from the landing jetty to the fish receiving room at the front of the sanitary control area is about 100 m. The outdoor cart will be used to transport fish catches over this distance. Because there may be three boats simultaneously off-loading over a one hour period during peak landing times, it is planned to provide 2 bin carts to be used in alternation (to reduce bin cart waiting time on the jetty).

Indoor cart

A total of 4 carts are planned: 1 cart to transport ice; 2 carts containing water ice for fish cooling; and 1 cart for transporting lobster.

Specification :Outdoor cart

Type: Dolly type

Construction: Main body = stainless steel; casters = stainless steel; wheels = urethane

Weight: 300 kg

Load capacity: 300 kg

Dimensions: L 750mm × W 900 mm

Indoor cart

Type Large-wheeled, container type dolly

Construction: PP

Capacity: 200 L

Dimensions: L 800 mm × W 640 mm × H 515 mm (external)

Other: Wheels, faucet

(iii) Platform scale

Purpose : To weigh incoming fish and outgoing fish

Required no. : Two units. One unit for fish receiving with weight indicator in pounds (which local fishermen are familiar with) and one unit for weighing shipped fish with weight indicator in kilograms, which is the unit of measure used on the French territories of nearby Martinique and Guadalupe.

Specification : Platform type and balance scale type (loaded weight type); maximum 300 lbs capacity for received catches, and maximum 150 kg for shipped fish

(iv) Fish tray

Purpose : For moving and washing fish within the fish handling facility; and temporary storage within the cold storage facility

O&M : No problem as this item is to be used only within the facility.

Required quantities:

For fish handling

One tray is to be capable of holding 20 kg of tightly packed fish in light of the fact that fish handling work will be done manually. Trays will be used to transport fish from the fish receiving room to the sanitary control area ante-room.

The average design landed catch at Codrington is 32 lbs (14 kg) of lobster and 44 lbs (20 kg) of fish per boat. Fish separating at the receiving room will not require that fish be laid out in lines for sorting by fish type and size, and instead fish will simply be randomly lumped together. There will be three trays for lobster (each tray holding around 5 kg, or about 5 individual lobsters) and two trays for fish (randomly lumped together) each tray holding around 10 kg. Lobster will then be transferred to a bin cart in the sanitary control area ante-room, and transported to the packing area. The two trays containing fish will be transferred to bin carts containing water ice in the sanitary control area ante-room, and after fish body temperature is appropriately lowered, fish are then arranged on trays for placement in cold storage. Also, because the average landed catch transported from the River mooring quay exceeds 100 lbs per large boat, this will be divided into a number of smaller portions for processing.

Because as many as two boats will be landing catches at the jetty over a one-hour period during peak landing times. Accordingly, a sufficient number of trays to accommodate two boats at one time is to be provided under the Project. This equates to: 5 trays/boat × 2 boats = 10 trays for fish handling.

It will not be possible to wash trays at such time, and then additional 5 tray are to be secured for rotation purposes including washing spare.

For cold storage

Fifteen trays are planned as discussed under the cold storage facility plan.

Specification: Stainless steel 304; equipped with handles;
Dimensions = L 810 mm × W 465 mm × H 200 mm
O&M : Washing with chlorine-based detergent is to be avoided.

(v) Tables for separating, inspecting and packing fish catches

a) Fish receiving table

This table is installed in the fish receiving room and is used to remove fish and lobster from the insulated fish boxes used for fishing operations, separate catches and conduct quality control inspection. The table size is to be L1800mm x W900mmm x H800mmm, and will have a raised edge along its sides to prevent fish from slipping off the table.

b) Tray packing tables

These tables are placed in front of the cold storage facility. There will be two tables. One table is used as a temporary placement area for trays, while the other table is used to remove cooled fish from the 200 L indoor bin carts and pack these in trays for cold storage.

Material : Stainless steel 304
Dimensions: L 1800 × W 600 × H 800
Other : Equipped with middle layer drain board
Quantity : 2 units
O&M : Washing with chlorine-based detergent is to be avoided.

c) Lobster bagging tables

Bagging lobsters is done in the fish handling room within the closed sanitary area. This work is carried out by 4 persons. Two tables with 2 persons per table is planned. In order that catches do not get mixed up, counter tops will be equipped with partitions. In addition to lobster bagging, fish packing in insulated boxes will also be carried out at the tables.

Material: Stainless steel 304
Dimensions: L 1800 × W 600 × H 800 (height excludes partition height)
Quantity: 2 units
O&M: Washing with chlorine-based detergent is to be avoided.

d) Pallets for insulated fish boxes

Pallets will serve to prevent insulated fish box contact with the floor at the time of shipping. One pallet can accommodate 2 fish boxes. Because it is planned to ship 5 boxes at a time, 3 pallets will be provided under the Project. Pallets will be constructed of easy to wash, salt-resistant aluminum.

Material : Aluminum

Dimensions: L 1100 × W 1100 × H 140

O&M : Washing with chlorine-based detergent is to be avoided.

(vi) Insulated fish boxes

Purpose : For preserving fish freshness (icing), and for fish storage. To be used for shipping fish to the Point Wharf fishery center.

O&M : Although it would be conceivable that fish boxes could be lost or stolen, the Point Wharf fishery center is directly under the jurisdiction of the Department of Fisheries and this likelihood is considered small. However, fish transport would be carried out by private sector distributors, and a fish box safety deposit would accordingly be required. Deposit amount per box would be equivalent to the cost of replacing a box.

Required quantities:

Because insulated fish boxes will be loaded and unloaded manually, they will be 120 L capacity boxes that can be carried by two persons. Each box will be capable of holding 30 kg of fresh fish and 30 kg of ice. Because the average amount of fish to be shipped per time is 131 kg, five boxes will be required per shipment.

Because the three ships traveling from Barbuda island to Antigua island each week follow no set schedule, it is possible that shipments will be sent out on consecutive days. In order that shipment is still possible during the period that one set of fish boxes has not yet returned, a total of 15 boxes is planned under the Project. This would comprise 5 boxes for shipment on a specific day, 5 boxes in reserve in the case where shipment occurs consecutively on the following day, and 5 boxes that would be waiting on Antigua island for return to Barbuda island.

Specification:

Material : Plastic (UV light protective), Heat-proofing; Urethane coating on both lid and box body

Capacity : 120 L

Dimensions: L 1090 mm × W 480 mm × H 540 mm

Other : Equipped with handles, drain plug

(vii) Trolley jack

Purpose : For moving insulated fish box pallets within the fish handling facility

Specification: Main body; Stainless steel
Wheels; Hardened urethane or plastic
Max. loading capacity;1000 kg

Quantity : 1 unit

O&M : Washing with chlorine-based detergent is to be avoided.

(viii) High pressure water floor washer

Purpose : For cleaning facility floor (as well as fish trays and insulated fish boxes)

O&M : No problem as this item is to be used only within the facility.

Specification: Electric motor type : Single phase 120 V or triple phase 415 V
Water pressure : 10 Mpa (maximum)
Nozzle and hand lever: Water jet can be stopped by hand
High pressure hose : At least 5 m length
Hose can be stored by hose reel
Continuous use possible

Quantity : 1 unit

(ix) Testing equipment

Purpose : For testing city water delivered to the facility, and analyzing the water quality of lobster stock cage. To comprise a rapid water quality checker kit.

O&M : Because a commonly used testing agent is applied, no special training in equipment use is necessary. Testing can be carried out by local Fisheries Division staff. Chemical reagent and other consumables can be procured within Antigua and Barbuda.

Specification: Visually confirmable, colorimetrical testing agent

Measurement items: Chlorine concentration, pH, DO

(b) Repair equipment

(i) Outboard motor repair tools

Purpose: For repairing engines of fishing boats targeted under the Project

O&M : The Department of Fisheries plans to sponsor the participation of interested fishermen in a technical training course in Trinidad, and then lease the repair workshop to the graduates of the training course. The leasees would be responsible for the daily management of repair tools, and supervision of equipment use would be overseen by the center director.

Tool content and required quantities:

Normal daily boat maintenance is performed by the individual fishermen themselves. Accordingly, it is planned to provide under the Project such tools as necessary for overhauling gear components, bearings, etc. that otherwise cannot be repaired by the fishermen on their own. Outboard motors targeted for repair using provided tools are engines in the 25~40 hp class. Large engines in excess of 40 hp (at present this applies to 6 boats) have a large number of cylinders, require complicated works for crankshaft setting as well as specialized tools for each engine type. Accordingly, engines in excess of 40 hp will be excluded from repair consideration under the Project. Planned equipment is indicated in the Table 2.2.32 below.

Table 2.2.32 List or repair tools for outboard engine

・Tabletop drill press chuck 13 mm, with vice stand	1 unit
・Disc grinder 200 mm, whetstone: both sides	1 unit
・Manual press for crank disassembly	1 unit
・Crank removal pin	1 set
・Micrometer stand and micrometer	1 set
・Bearing remover (from outside)	1 set
・Bearing remover (from inside)	1 set
・Bearing insertion rod	1 set
・Hydraulic hand jib crane (shop crane) max. lifting capacity: 1000 kg	1 unit
・Flywheel remover	1 set
・Timing light	1 unit
・Multi-tester	1 unit
・Outboard motor repair stand	1 unit
・Outboard motor carrier, load capacity: 130 kg	2units
・Air compressor 0.75 kW, ejection: 60 l/min, both continuous and on/off operation, air cable length: 5 m, with blow gun	1 unit
・Tabletop vice vice width: 200 mm	1 unit
・Lower unit bearing jigs	1 set

Note: It is expected that individual fishermen possess their own standard tools for daily maintenance, and these have accordingly been eliminated from consideration under the grant request. A piston internal pressure gauge was requested, but this was eliminated in light of the fact that conventional piston and liner measurement can address this issue. There was likewise a request for a diesel nozzle tester; however, there is currently only one boat with a diesel engine that will access the Project facilities. It was accordingly concluded that it would be appropriate that engine repairs for this boat be carried out on Antigua island where this type of repair is generally carried out. Accordingly, this item was also eliminated from consideration under the request.

(ii) Chain hoist

With reference to previous cases under similar type projects, "U" type hooks are to be installed at appropriate ceiling locations in the ice making machine room and the workshop space area to which a chain block can be attached. A chain block is planned given the need to raise and lower items such as the ice making machine, etc.

(c) Equipment for fishermen training and administrative purposes

(i) Audio-visual equipment

Purpose: For fishermen training. This will comprise a projector and screen to enable instructors dispatched by the Department of Fisheries to show pictures, illustrations, etc. from their laptop computers while conducting training sessions. This equipment is expected to be effective in extension activities directed at fishermen, among whom literacy rate is generally low.

O&M : No problem as this item is to be used only within the facility. Also, equipment bulbs and other consumables can be procured on Antigua island.

Projector

Specification: Pixels : 786432 (1024 × 768 pixels)
Brightness : At least 2000 lumens
Number of colors: 16,770,000
Input plugs : Computer: mini D-sub 15 pin; RCA video 9: mini DIN 4 pin
Spare parts : 2 lamps in reserve

Screen

Specification: Type ; floor rolling type; folding legs
Dimensions; 1720 mm × H 1080 mm (projection screen size)

(ii) Meeting room desks and chairs

Purpose: For meetings and fishermen training sessions

Specification: Desk ; steel legs; fitted with casters; melamine desktop
Dimensions; 1500 mm × W 500 mm × H 700 mm
Chair ; steel; urethane seat cushion; can be stacked when stored

Quantity : 12 desk and chair sets (2 persons per desk; can accommodate 24 persons)

(iii) VHF radio

Purpose : The Fisheries Division mandates that fishing vessels operating beyond outer reefs be equipped with VHF radios. This requirement is waived, however, in the case of fishing boats operating out of Barbuda island in light of the fact that no government base station has been established on the island. Nevertheless, in the interest of fishing boat safety, radio equipment will be installed at the Fisheries Division Barbuda branch public watch station facility to promote the equipping of fishing boats with VHF radios.

Specification: VHF; Marine frequency band
Output; 1/25W switch-over
Power source; C120V, single phase
Antenna; Rod type
Antenna mast; Fixed to facility wall

Accessories: Microphone, antenna cable (50 m), antenna connecting terminal

O&M : In order to prevent fire or equipment damage as a result of lightning strike, equipment power is to be turned off and the antenna cable disconnected during electrical storms.

2-2-3 Basic design drawings

The following basic design drawings have been prepared based on the Basic Plan as described in the previous Section 2-2-2.

(1) Project layout drawing

(2) Civil facilities

(a) Mooring type sea wall (general drawing)
(b) Landing jetty/slipway (general drawing)
(c) Landing jetty/Mooring sea wall (section drawing)
(d) Slipway (section drawing)
(e) Retaining wall (general drawing)

(3) Buildings

(a) Administration and fish handling building
(b) Fishermen support building / Workshop / Fishermen's toilet
(c) Wastewater treatment facility / Blower house / Garbage depot

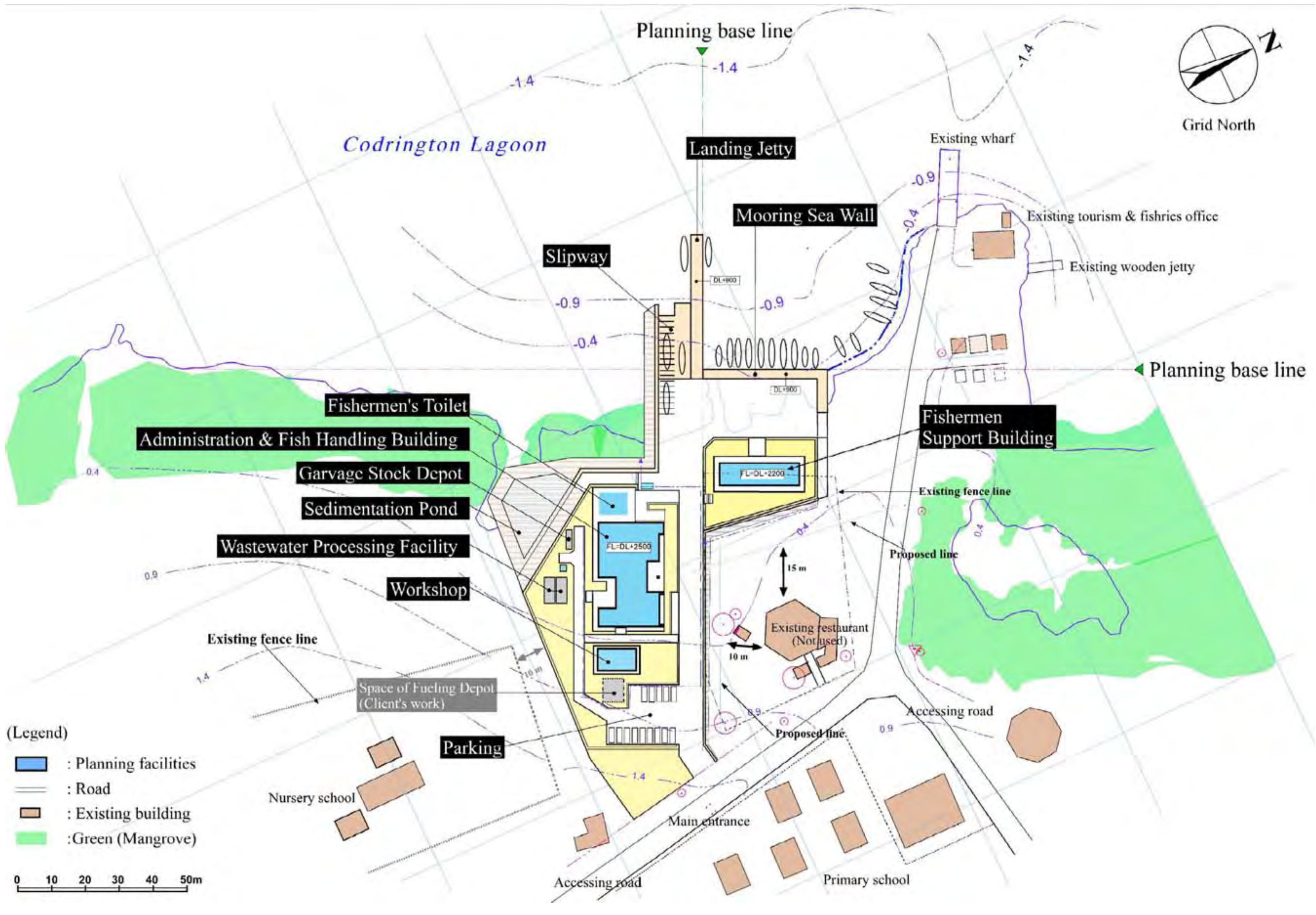


Figure : Project layout

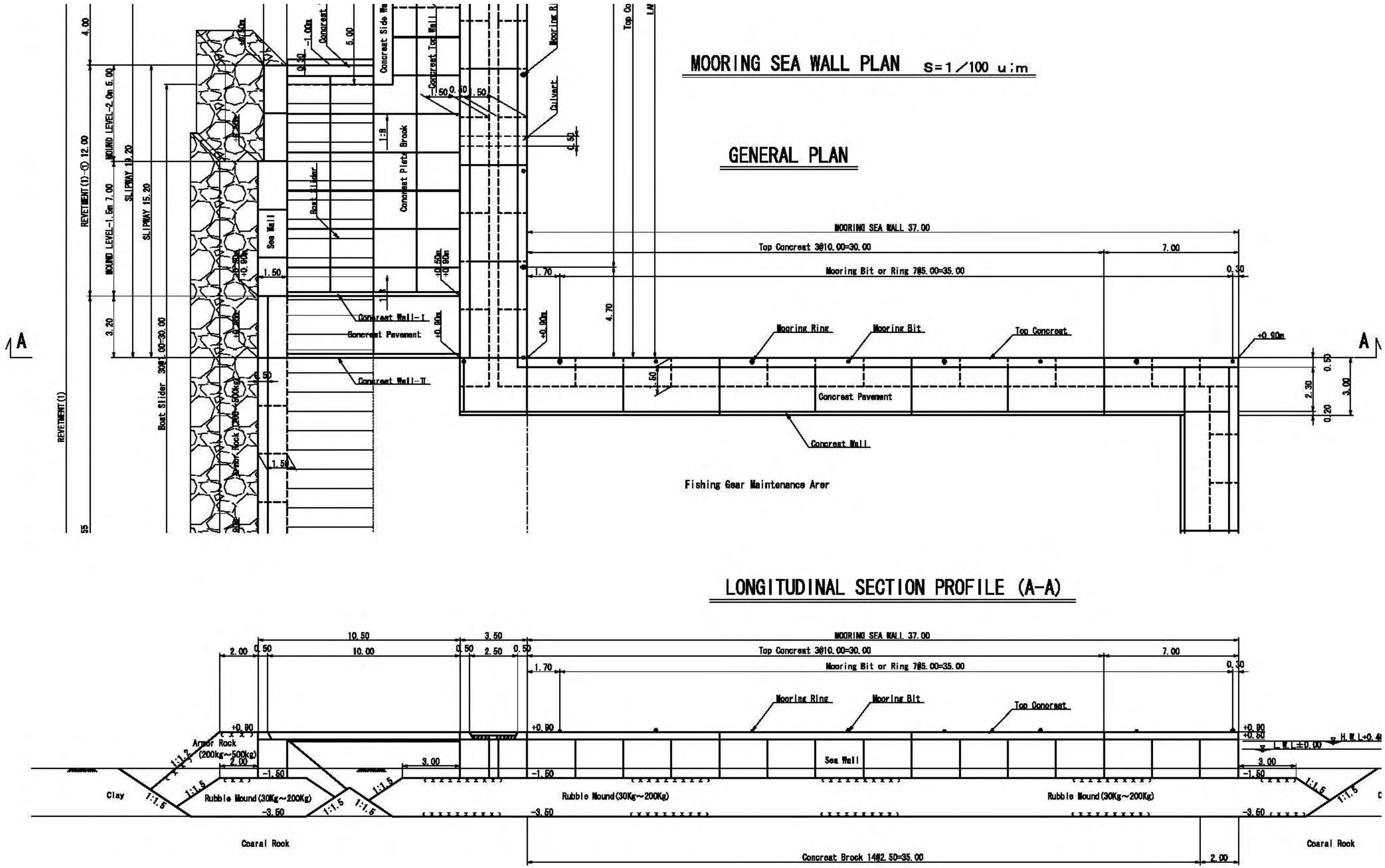


Figure : Mooring sea wall (general drawing)

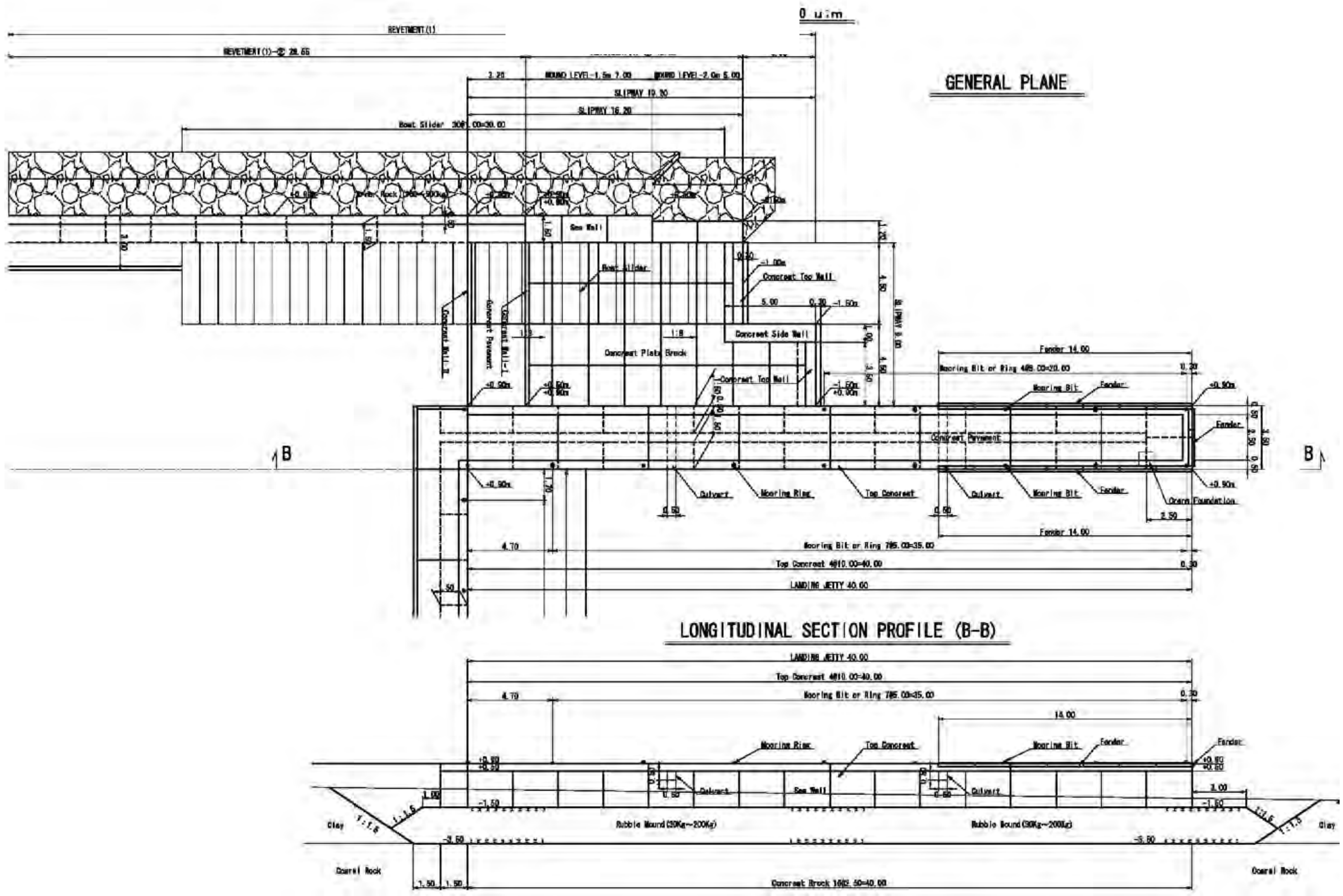
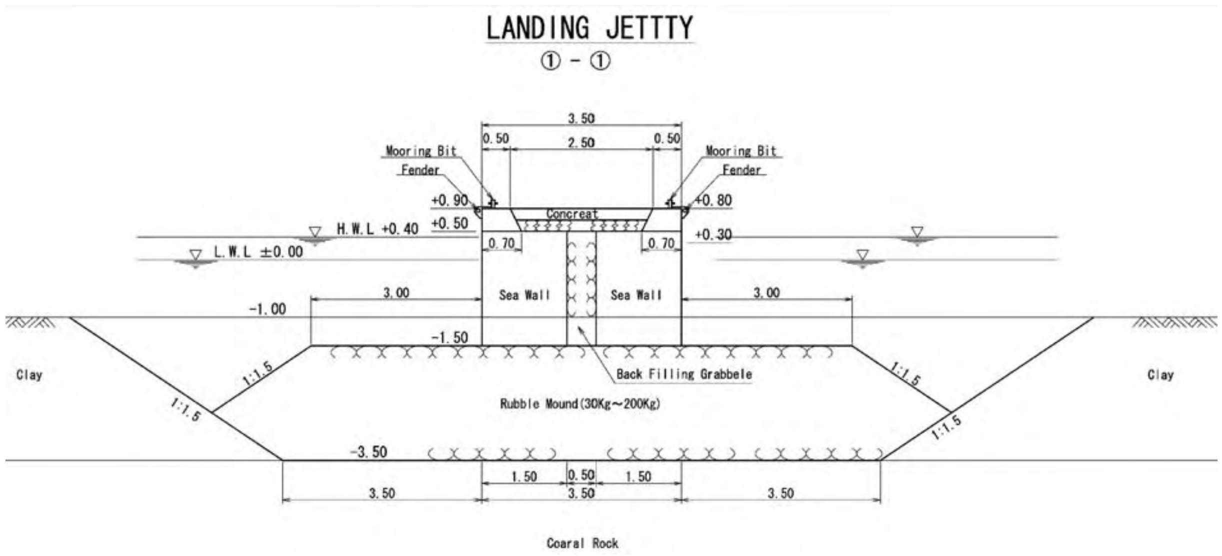


Figure : Landing jetty, Slipway (general drawing)



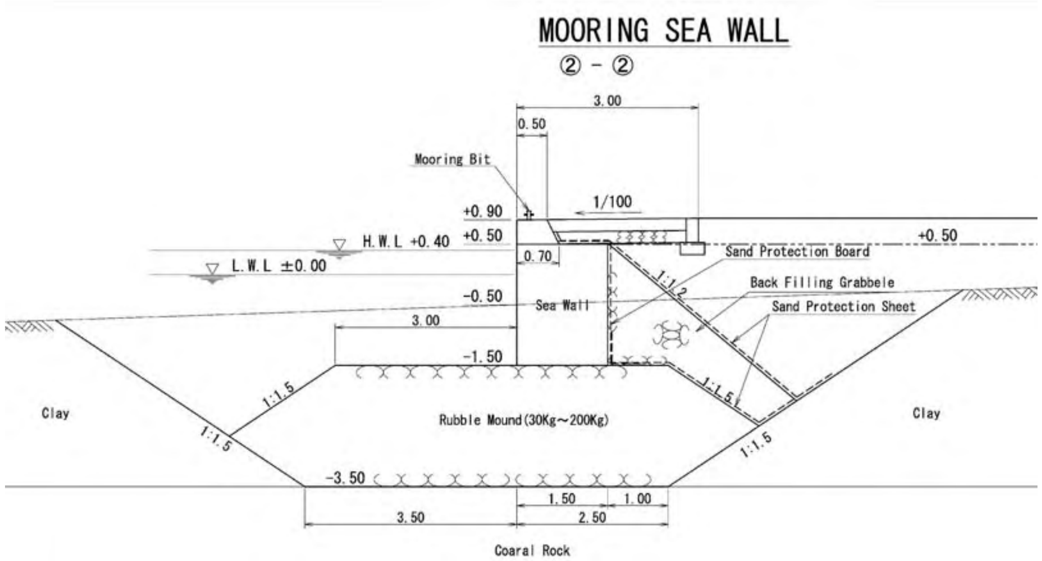


Figure : Mooring sea wall, Landing jetty (section)

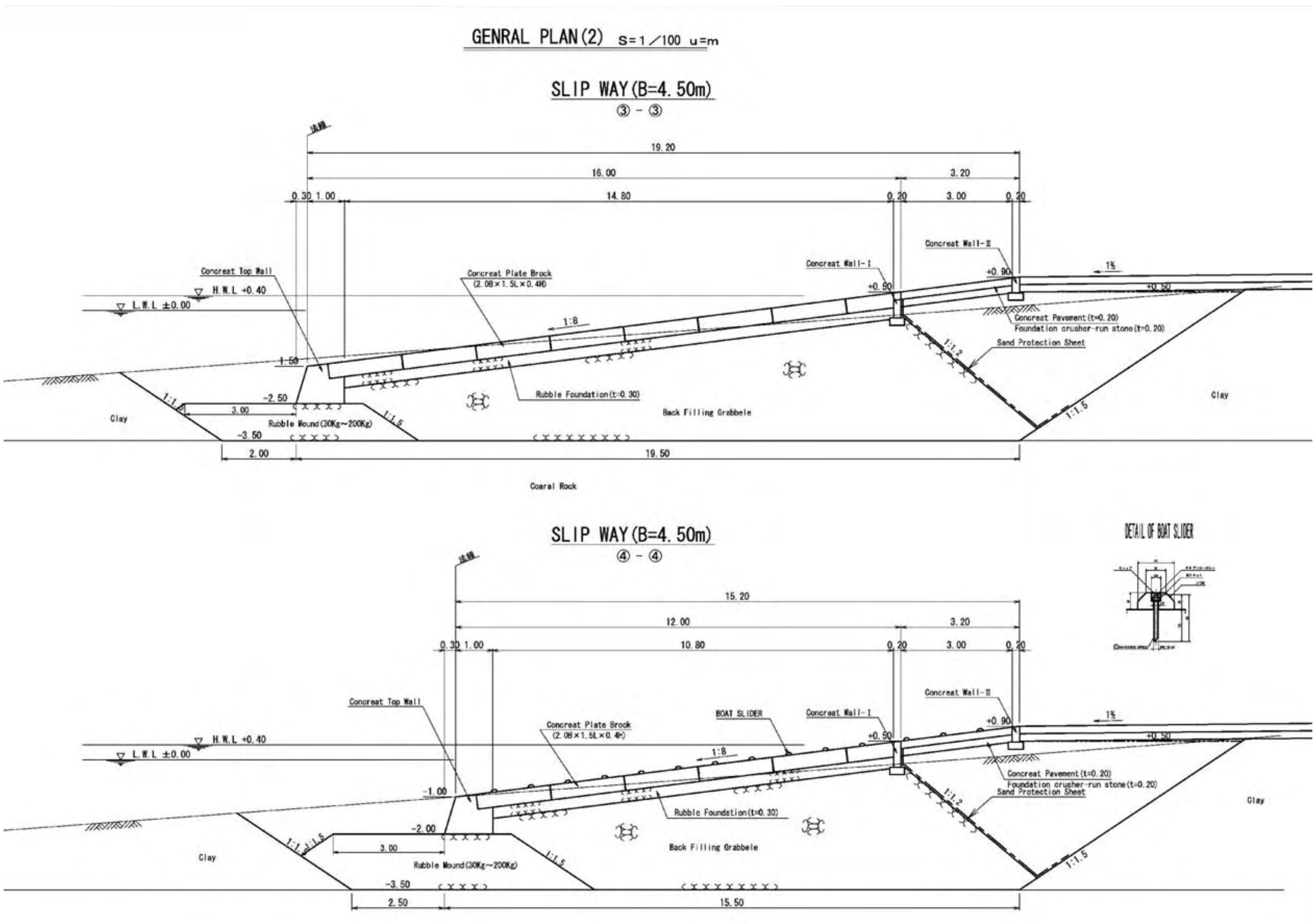


Figure : Slipway (section)

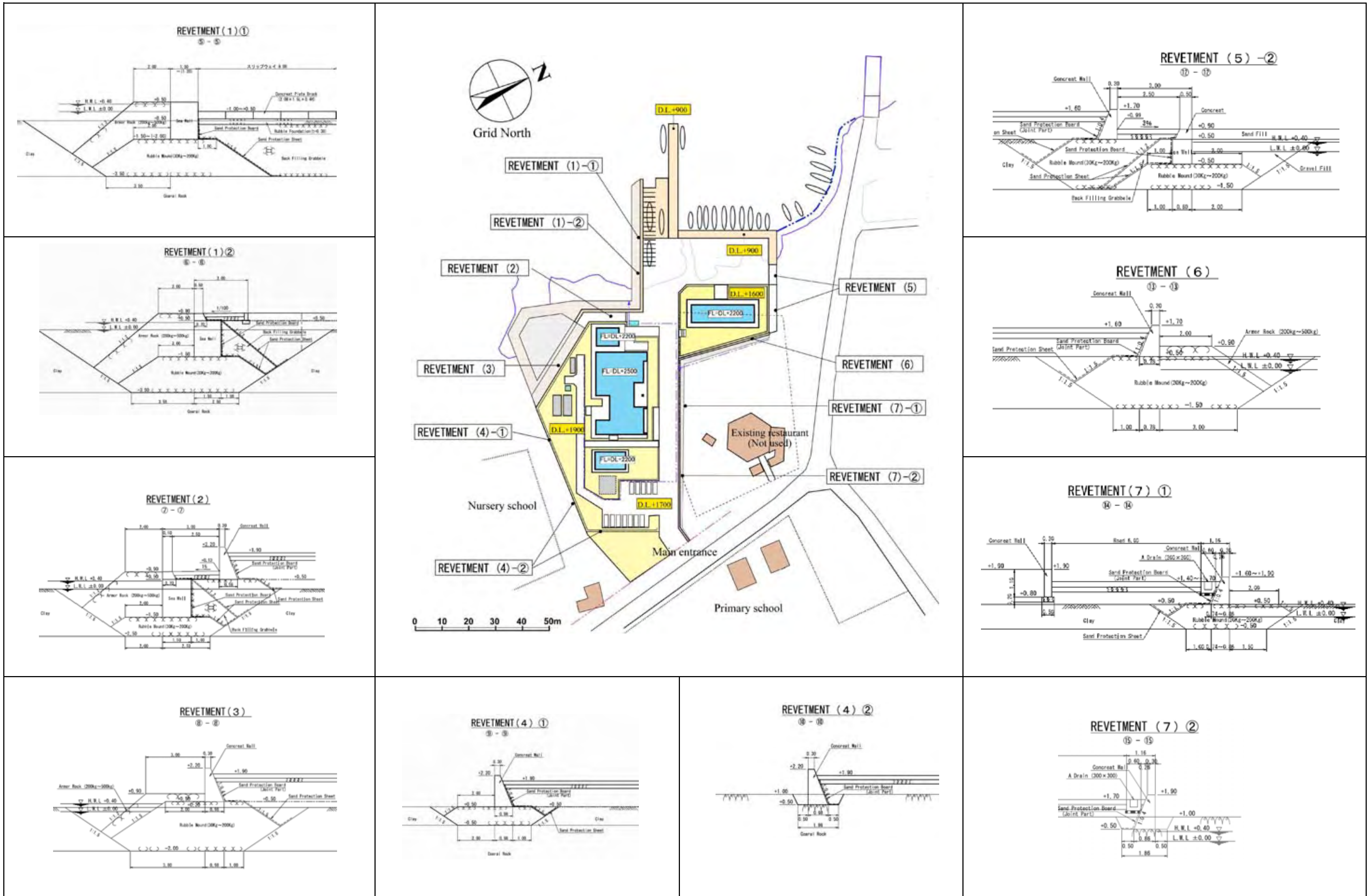


Figure : Retaining wall (general drawing)

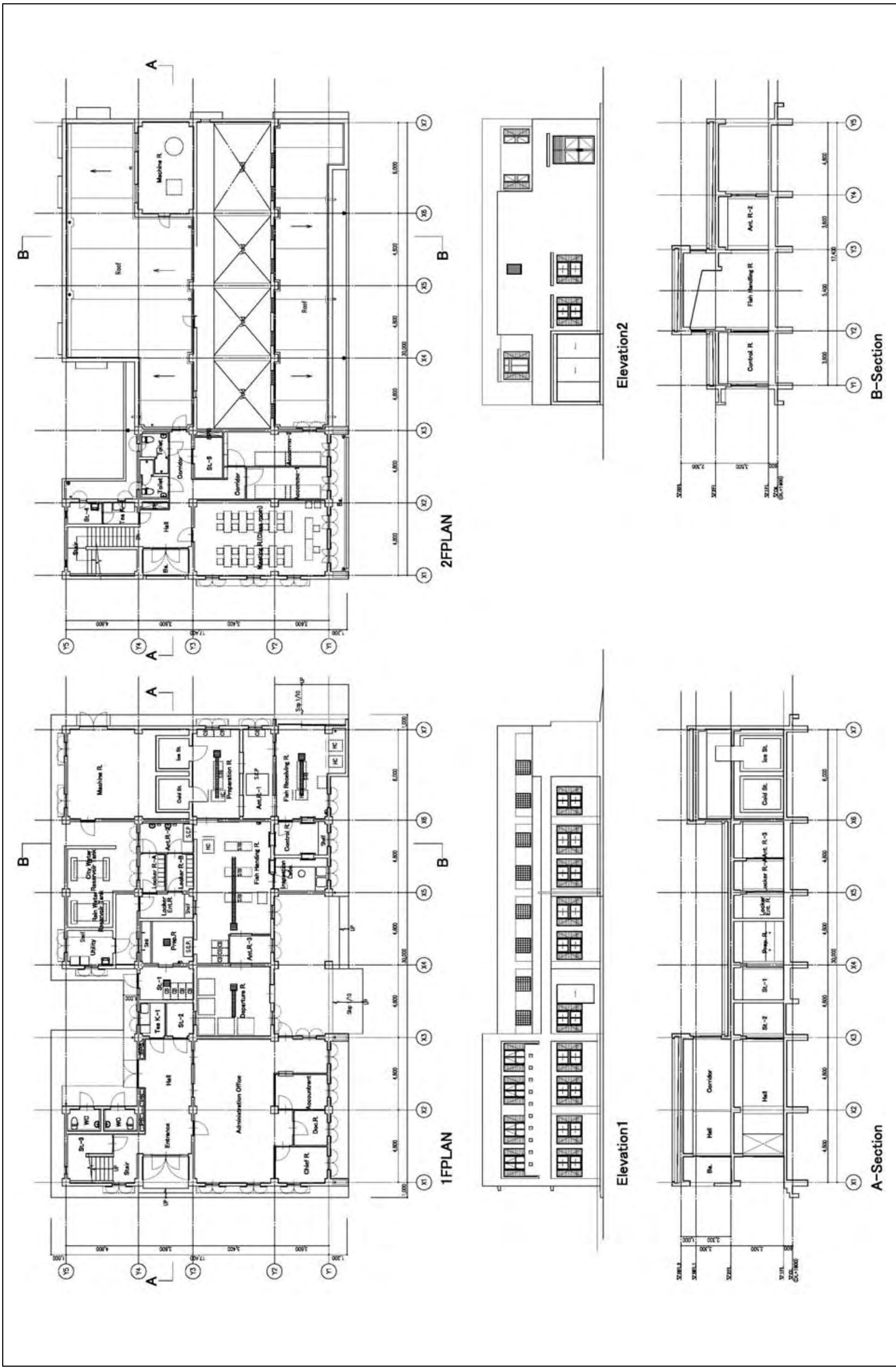


Figure : Administration and fish handling building

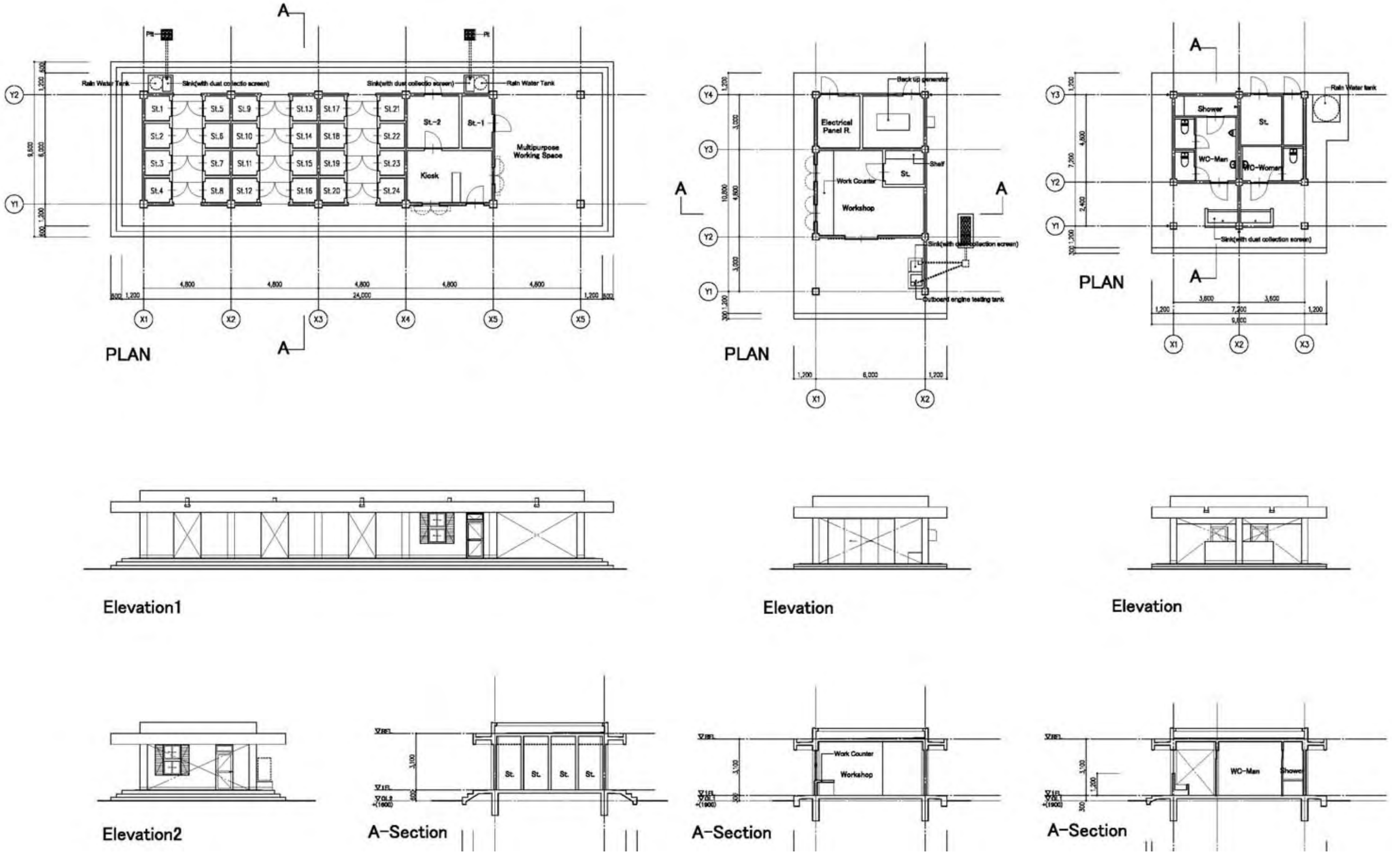
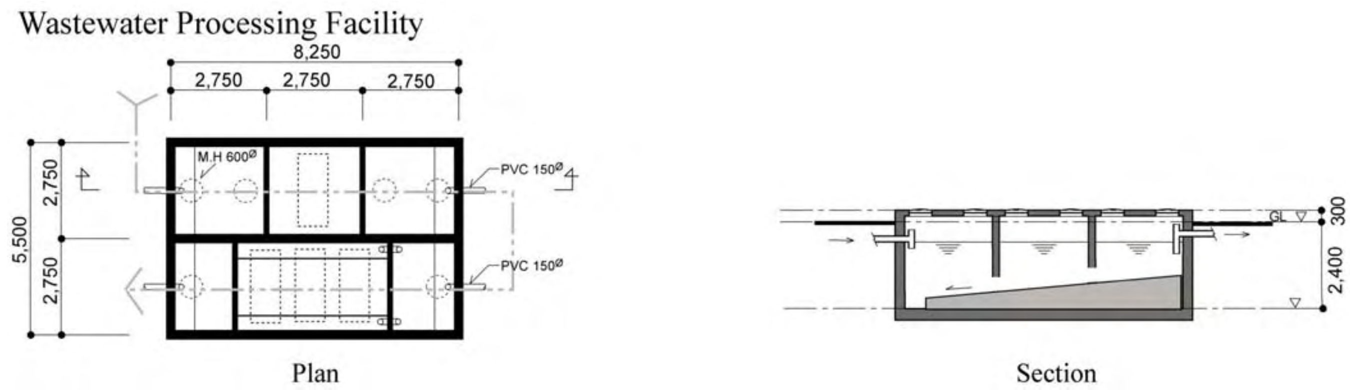
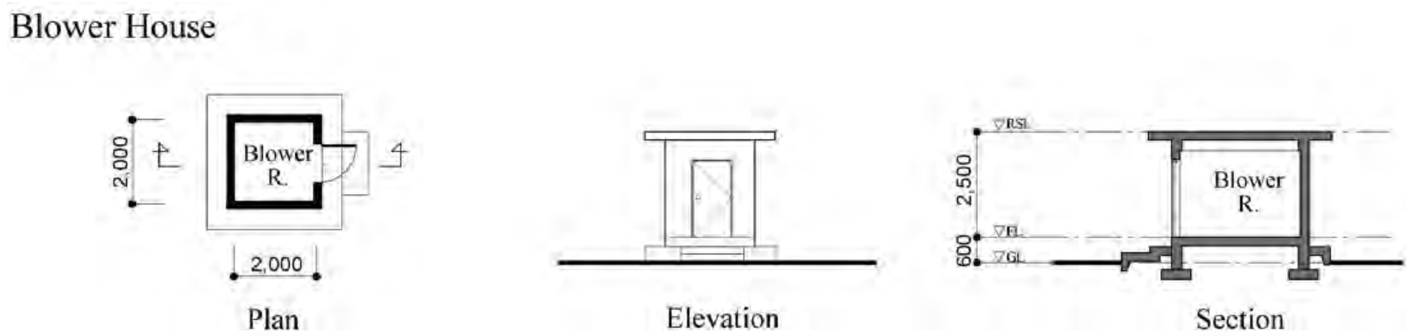


Figure : Fishermen support building, Workshop, Fishermen’s toilet





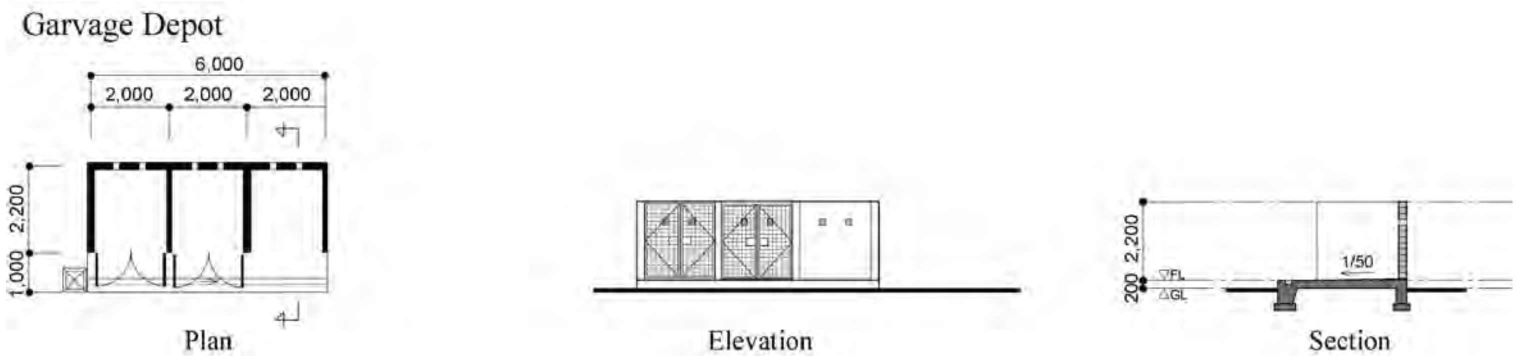


Figure : Wastewater treatment facility, Blower house, Garbage deposit

2-2-4 Implementation Plan

2-2-4-1 Implementation Policy

(1) Project implementation structure

The executing agency for the Project is the Fisheries Division under the Ministry of Agriculture, Lands, Marine Resources and Agro Industries. This Ministry is thus the responsible agency for Project implementation.

After signing of the Exchange of Notes between the Japanese government and the Antigua and Barbuda government, a Japanese consultant will then enter into contract with the Antigua and Barbuda government to carry out detailed design and construction supervision. Furthermore, construction works, equipment procurement and equipment installation will be carried out by a Japanese contractor who enters into contract with the Antigua and Barbuda government, under the supervision of the engaged consultant. After Project completion, the executing agency will then assume responsibility for facility operation and maintenance.

(2) Approach to construction

1) Remote island characteristics

(a) Labor

Barbuda island on which the Project site is located lacks skilled construction workers due to low construction demand on the island. Accordingly, it will be necessary to procure labor from the main island of Antigua or from neighboring territories and countries.

In the case of local construction works, it is a general practice to set up temporary lodging facilities for the duration of the construction period. In the case of this Project as well, temporary living quarters for workers will be constructed adjacent to the Project site. In the case of workers from Antigua island, they will be able to return to Antigua on weekends.

(b) Construction materials

Because a ready mix concrete plant is not available on Barbuda island, a concrete mixer will be installed in the temporary construction yard for concrete production and pouring. In the interest of adequate quality control based on local specifications, good fine aggregate will be quarried in the vicinity of the site, while coarse aggregate and cement will be procured from Antigua island.

Brick and secondary concrete products such as concrete block, precast concrete and concrete hume pipe are produced on Antigua island and will accordingly be procured locally.

Although rebar and steel in accordance with US standards can be imported either directly from third countries, Japanese products will be procured due to lower import cost.

Electrical, water supply and drainage, as well as air conditioning materials will be procured locally. These are products that have already been imported into the country from the US and Europe.

(c) Construction machinery

Although various road and hotel construction is currently being carried out on Barbuda island, and consequently local contractors possess construction machinery, types and numbers of equipment are limited. Furthermore, when this equipment is being used on other projects, it is difficult to procure the equipment for a specific construction period. Accordingly, depending on circumstances, construction machinery will either be procured from local subcontractors or from Japan.

(d) Transportation

Although there are both regularly scheduled cargo and passenger boats traveling between Antigua and Barbuda islands, it will be necessary to specially charter cargo ships or barges given the large and heavy quantity of construction material and machinery to be transported.

2) Determining approach to construction

This Project takes into consideration both the fact that the Project will be implemented under the Japanese government grant-aid program, as well as conditions affecting the local construction sector. In implementing project construction, the following issues apply.

(a) The Antigua and Barbuda government, Japanese engineering consultant and Japanese subcontractor are to maintain close coordination and liaison, with detailed consultation to ensure smooth construction implementation.

(b) Although general construction materials can normally be procured locally, the fact that very little construction work is being carried out within the country means that construction material stockpiles are low. Accordingly, in the case of materials such as steel, metal, ceramic products for sanitary use, etc. which require a certain amount of time from order to delivery, the construction contractor will be strongly advised of the need to maintain the planned construction schedule. The construction plan will also be formulated taking into consideration existing material and equipment stocks as well as procurement period with regard to special materials and equipment. A flexible construction management plan will accordingly be adopted to reflect these insitu conditions and promote the smooth implementation of construction works.

(c) Construction schedule will be formulated to effectively coordinate both facility construction works and equipment installation during the final stage of the construction schedule.

(d) Measures will be formulated to prevent adverse impact of sea breeze given the need for safe (protection from salt damage) storage of construction materials during construction in light of the proximity of the Project site to the coast.

(e) Construction is to be planned so that areas with regard to utility subcontractors (electricity, water supply and drainage, etc.) are clearly delineated, implementation is efficient, and there is no interference between construction works in this regard.

(f) Temporary fencing as well as safety signs must be setup around the site given the fact that the construction area fronts on both a school and private facility. These measures are further necessary to contain noise, prevent vandalism and ensure the safety of third parties on the site. The construction supervision structure will also include regular coordinating guidance with regard to ensuring safety during the course of the construction works.

2-2-4-2 Implementation Conditions

Attention is to be given to the following items in implementing the Project.

(1) Items of note in construction

1) Construction permits

It is necessary to incorporate the time required for application for building and construction permits into the overall schedule.

2) Weather conditions

The construction schedule will take into account the fact that rainfall is relatively small from January to August and then exceeds a monthly average of 100 mm from September to December. Also, the period from June to November experiences the most frequency of hurricane occurrence. These weather factors will accordingly be reflected in construction plan formulation.

3) Construction quality control

In addition to existing standards for the quality of construction works, a mechanism will be put in place for quality control that fully reflects specific insitu conditions.

4) Strict construction schedule management

Emphasis will be given to execution based on confirming and coordinating construction layout, as well as subcontracting that reflects the overall Project schedule. In order to prevent construction modifications or redoing, a construction management supervisor is to be deployed to the Project site from the preparatory stage.

5) Local customs and practices

Personnel deployment and work schedule planning will take into consideration holidays celebrated locally including Christmas, etc.

6) Finishing schedule and equipment installation

Because it is anticipated that the timing for the finishing stage for construction works and equipment installation works will overlap, an insitu construction management structure will be established that effectively coordinates the equipment installation plan and finishing works procedures.

7) Environment

In case that the existing mangroves would be cut off during the construction stage, the Fisheries Division would try to rehabilitate the mangroves by replanting during the operation stage.

A contaminant protective screen is to be erected on the site to prevent outflow into the lagoon of sediment as a result of marine structure construction. Also, soil excavated in the course of foundation improvement works will be transported to a properly designated on-land disposal site. In this manner, temporary facility preparation and main construction works will minimize to the extent possible impact on the environment.

(2) Items of note in equipment procurement

1) Shipping pre-inspection

Pre-inspection at the time of cargo loading will be done by a third party organization.

2) Transportation

Equipment transport will be done by container to avoid salt damage. It is planned to charter cargo ships from ports on Antigua for equipment transport to Barbuda. When equipment shipments arrive, heavy construction equipment will be diverted from the Project for off-loading operations.

3) Installation works

Almost all equipment to be supplied under the Project will require installation works. In this regard, on-site delivery time for equipment requiring installation works will be coordinated with the progress of facility construction works.

4) Test operation guidance

To promote technology transfer, recipient side equipment operation and maintenance personnel will be encouraged to witness equipment test operation under the Project. In this regard, an appropriate test operation instructional period will be set to best promote technology transfer in terms of characteristics of equipment operation and maintenance.

2-2-4-3 Scope of Works

A breakdown of tasks to be borne by the Japanese side and tasks to be borne by the Antigua and Barbuda side under the Project is shown in Table 2.2.33.

Table 2.2.33 Respective task responsibility

Task content	Japan	A&B
1. Land acquisition		○
2. Delineating site area, preparing construction sites (levelling, etc.)		○
3. Construction of site perimeter fence and gate facility		○
4. Parking lot construction	○	○
5. Road construction		
・On-site	○	
・Off-site		○
6. Construction of design facilities	○	
7. Construction works to extend public utilities onto the site		
1) Electricity		
・Extending trunk transmission cable onto the site		○
・On-site distribution cable works		○
・Receiving panel and transformer works	○	
2) City water supply		
・Extending main city water supply trunk pipeline onto the site		○
・Water supply system (receiving tank, elevated storage tank)	○	
3) Drainage		
・Main drainage channel (to handle rain runoff to the site, etc.)		○
・On site drainage system (contaminated water, general waste water, rain runoff, etc.)	○	
4) Gas		
・Extending main gas supply trunk pipeline onto the site		○
・On-site gas supply system	○	
5) Phone		
・Extending the phone trunk line to building internal MDF (main distribution frame)		○
・MDF and extension lines	○	
6) Furniture and equipment		
・General furniture		○
・Design equipment	○	
8. Following commissions to a Japanese foreign exchange bank based on banking arrangement		
・Advisement commission for payment authorization		○
・Payment commission		○

9.	Import and customs procedures		
	1) Surface transport cost to Antigua and Barbuda	○	
	2) Duty exemption and customs procedures at the off-loading port		○
	3) Inland transport and off-loading at Project site	○	○
10.	Expediting procedures for Japanese experts to enter Antigua and Barbuda to carry out Project duties		○
11.	Exemptions for Japanese experts entering Antigua and Barbuda with regards to customs duties, domestic taxes		○
12.	Formulating and funding a structure for effective operation and maintenance of facilities and equipment under the Project		○
13.	All costs relevant to the construction of facilities, transport of equipment and installation of equipment not covered under the grand-aid cooperation package.		○

2-2-4-4 Consultant Supervision

Basic approach and points of special note with regard to construction supervision and procurement plans under the Project are set out below.

(a) The project consultant will maintain close liaison with the executing agency in order to ensure smooth execution of construction works, as well as transport and installation of equipment. Because there is a need to coordinate infrastructure works by the Antigua and Barbuda side (to bring utilities on-site) along with Japanese side facility construction works, construction work timing is of prime importance and in-depth discussion and agreement on construction schedule and specifications are to be reached beforehand.

(b) Prior to construction, implementation plan documentation and construction drawings submitted by the construction contractor are to be carefully studied, and temporary facility plan, construction schedule, quality of proposed materials and appropriateness of construction method are reviewed.

(c) Upon completion of construction and handing over of Project facilities and equipment, inspection is carried out for construction quality, and whether or not delivered equipment meets design specifications. In the case that any repair or refurbishment is required, advisory to this effect is made.

(d) Construction supervision will be carried out by a combination of permanently assigned construction engineers, as well as spot deployment of facility and equipment engineers as required.

2-2-4-5 Quality Control Plan

(1) Facility plan

Basic approach and items of special note with regard to quality control of Project facilities are set out below.

(a) Design criteria

Materials and structures, etc. under the Project are in principle in line with the following standards: (i) Common Specifications for Fishing Harbor Construction (Japan Port and Harbor Association), (ii) Common Specifications for Port and Harbor Construction (Ministry of Land, Infrastructure and Transport), (iii) Standard Specifications for Building Construction – Commentary JASS 5 (Architectural Institute of Japan), (iv) Common Specifications for Building Construction (Ministry of Land, Infrastructure and Transport), (v) Building Construction Supervision Guidelines (Ministry of Land, Infrastructure and Transport), and Japanese Industrial Standards (JIS). However, locally available sands and gravels for concreting and local tap water contain salt. Accordingly, concreting works would follow the local standard and apply unti-saline measures such as adding a rustproof material and or rust proofing treatment for reinforcing bar.

(b) Detailed confirmation of foundation characteristics

Spread foundation will be adopted for Project structures. Because the site comprises soft ground, soil improvement is required. in situ testing method will be established for quickly assessing site foundation conditions for adequate bearing capacity of the foundation excavation face and to prevent uneven settlement.

(c) Confirming main construction methods and main construction materials

Particularly in the case of concrete, thorough testing is to be carried out with regard to aggregate, cement, water, placing method, temperature, and curing method prior to the start of construction. In situ construction supervision structure will ensure the appropriate and homogeneous placement of concrete. In the case of other main materials as well, efficient inspection methods will be adopted that enable local engineers as well to ensure consistent quality from the beginning of construction works.

(d) Recording ledger for consistent quality control

Priority is to be placed on consistent control of construction quality. In this regard, a quality control ledger is to be drafted to enable cross-checking achievement at the procurement, placement, concrete curing and completion stages of construction with the results of preliminary testing, mix proportion testing and other various material testing.

(2) Equipment plan

Relatively simple equipment will be the main type under the Project to support operations such as catch landing, fish handling, as well as facility operation and maintenance. Most equipment will be general-purpose in function, and selected with attention to salt-resistance specifications.

2-2-4-6 Procurement Plan

(1) Construction material and equipment

Construction materials and equipment necessary under the Project, including imported items, can be procured in Antigua and Barbuda. Accordingly, these items will be procured within Antigua and Barbuda unless delivery time adversely impacts on construction schedule, or otherwise from a cost perspective it would be advantageous to procure from Japan.

(2) Equipment

Various types of equipment are imported into Antigua and Barbuda from Japan, Europe, North America and China. These imports arrive at St. John's on Antigua Island. In the case of equipment to be procured which entails a detailed study of performance and detailed coordination of facility construction and equipment installation, this is to be selected and procured from Japan. In the case of equipment which could be procured locally, those will accordingly be procured locally.

Main facility and equipment components are set out in Table 2.2.34.

Table 2.2.34 Main facility and equipment components

Facilities	Equipment
Civil works	-
- Landing jetty	Overhead crane
- Mooring type sea wall	-
- Slipway	-
- Retaining wall	-
On-land facilities	-
- Administration and fish handling building	1) Bin-cart, Platform scale, Fish tray, Table for fishing handling and inspection, Insulated fish box, Trolley jack, High pressure water floor washer, Water testing equipment 2) Audio-visual equipment, Meeting room chairs and desks, VHF radio
- Fishermen support building	-
- Workshop	Equipment for repair tools, Chain hoist
- Fishermen toilet	-

2-2-4-7 Operational Guidance Plan

The Project includes facilities for fishermen support including ice making plant and cold storage. In light of the fact that these are core facilities, Japanese engineers are to be dispatched for guidance in initial equipment startup and subsequent operation. At the same time, a contact list of accessible agents will be provided at the time of arising operating troubles.

- Ice making machine and cold storage: to conduct operation training of ice making machine, explain its operation manual and method of daily / periodical inspection on mechanical facilities such as compressor, outdoor machines.
- Emergency generator: to conduct operation training on the manual method of

changeover switching between city current and generator and to explain the maintenance manuals.

- Water supply facility: to conduct training on chlorinating sterilization of city water and explain the maintenance manual of daily / periodical inspection of filters.
- Wastewater treatment facility: to conduct training on daily / periodical inspection of machines such as air blowers and water pumps and explain the maintenance manuals. Also to explain the method of periodical cleaning of precipitated sludge in the treatment tank and periodical inspection / cleaning of the seepage pond of primarily treated wastewater.

2-2-4-8 Soft Component (Technical Assistance) Plan

There will be no soft component input under the Project since the Fisheries Division has sufficient experiences of operation through having been operating three (3) fisheries complexes similar to the planned fisheries facilities.

2-2-4-9 Implementation Schedule

In the case where the Project is implemented under the Japanese government grant-aid program, implementation schedule will sequentially include (i) exchange of notes between the two governments, followed by (ii) detailed design, (iii) preparation of tender documents and drawings, (iv) tendering and contract award for construction works and equipment procurement, (v) construction works, equipment procurement and installation, and (vi) construction completion and complex handing over.

(1) Detail design works

Detailed design will be carried out on the basis of this Basic Design Report, and tender documents subsequently prepared. An estimated 4.0 months will be necessary from the signing of the Exchange of Notes to approval of tender documents (including preparation of tender documents and drawings, as well as obtaining authorization for these).

Specifically, the procedure for local government authorization of tender documents as required in the case of this type of Project is normally estimated at 2.0 months. This includes document and drawing preparation, coordination with other related projects and evaluation of project content. Consultations with the Antigua and Barbuda government side will be carried out during the detailed design period to ensure timely authorization of tender documentation by the time of tendering.

However, the authorizing authority lies with the Antigua and Barbuda government, and it is thus requested that the Antigua and Barbuda government act in a timely manner in this regard in order to maintain the envisioned project schedule. In addition, it should be noted that any costs incurred due to additions or modifications of the detailed design content as a result of the authorization application process will be wholly borne by the Antigua and Barbuda government.

(2) Tendering

Following the completion of detailed design, a newspaper announcement of tender will be issued in Japan calling for tenderers for construction works and equipment procurement under the Project. After a prequalification procedure for interested tenderers based on requirements under the Japanese grant-aid program, a shortlist of qualified tenderers will be determined. On the basis of this shortlisting, the executing agency then invites participants to convene for tender opening to be performed in Tokyo in the presence of all concerned parties. The successful tenderer then enters into contract for the Project. The time from newspaper announcement of tender to briefing on the Project and distributing tender documents is roughly 0.5 months. Time from distributing tender documents, to completing tendering and contract signing with the successful tendering contractor is estimated at around 1.5 months.

(3) Construction and material/equipment procurement stage

After signing of contract with the designated contractor, and contract approval by the Japanese government, construction works, and equipment procurement and manufacture then begin. Total construction schedule from signing of the Exchange of Notes until completion of construction is estimated at 24.0months. (See Table 2 2.35)

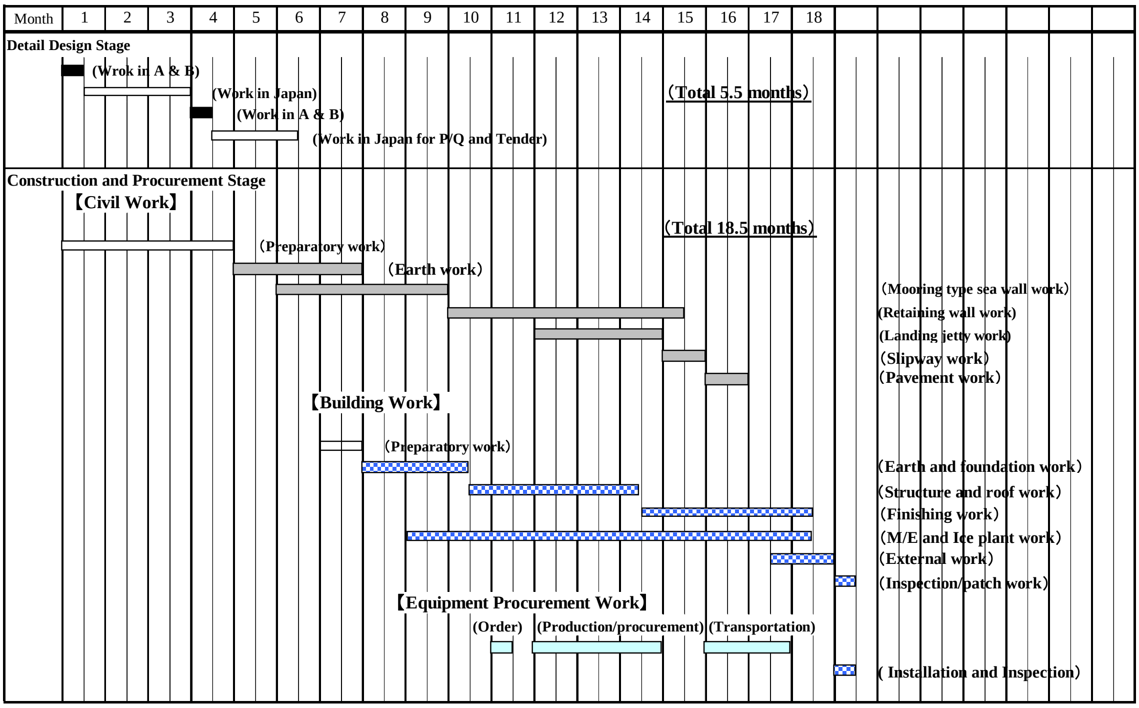


Table 2 2.35 Project implementation schedule

2-3 Obligation of Recipient Country

In implementing the Project, the Antigua and Barbuda executing agency shall carry out the following in the course of the project construction schedule.

(1) Procedures for all construction and building permits: This is to be done prior to distributing tender documents

(2) Issuance of bank arrangement (B/A) and authorization to pay (A/P) to a Japanese foreign exchange bank: B/A is to be promptly issued following the signing of the Exchange of Notes. A/P is to be promptly issued after signing of consultant and contractor contracts.

(3) Extending utility infrastructure (water supply, electricity, phone, etc.) into the site area: This is to be done before the completion of Project construction.

(4) Constructing protective fencing and gate, and planting lawn and shrubbery within the site area: This is to be done prior to startup of Project operation.

(5) Installing office materials, equipment and furniture in on-land facilities, as well as other facility furnishings and fixtures: This to be done prior to startup of Project operation.

(6) Measures to exempt the nominated contractor from domestic taxes with regard to payments for materials, equipment and services procured inside Antigua and Barbuda.

(7) Expediting customs procedures for material and equipment procured under the Project. Measures to exempt material and equipment procured under the authorized contract, as well as Japanese experts assigned to the Project, from customs duties, domestic taxes, value added taxes (VAT) and any other local tax levies.

(8) Expediting country entry, exit and residence procedures for Japanese experts assigned to the Project.

(9) Budgetary measures, personnel deployment and operational plan execution for facility operation after Project construction completion.

(10) Appropriate provision of materials, equipment, services, etc. that may be required under the Project but are not including under the grant-aid cooperation package.

2-4 Project Operation Plan

2-4-1 Operation plan

(1) Operational structure

1) Objective of the Barbuda fishery complex

The Barbuda fishery complex to be established under the Project will be the first facility of its kind on Barbuda island encompassing catch landing, product distribution and fishermen support functions. The objective of the envisioned complex operations is to promote the livelihood of local small fishermen by making the best use of the above functions to realize an efficient and sanitary fish catch landing, processing and marketing system.

2) Operational format

The Project facilities will comprise the fourth fishery complex established in Antigua and Barbuda. The previous three complexes are under the jurisdiction of the Department of Fisheries, and the Project complex will assume the same operational format. A fishery complex coordination officer is assigned within the Department of Fisheries to integrate the operations of the respective complexes. In the case of the Project facilities as well a dedicated operational structure is included but this will still remain under the higher jurisdiction of the fishery complex coordination officer at the Department of Fisheries. Budget allocation for Project operation is to be made by the Department of Fisheries.

3) Operational structure

Although the Project complex will be unique compared with other fisheries complexes except Point Wharf fisheries center, in its strong emphasis on sanitized processing, storage and shipping of fish products, its other functions will be the same as the other fisheries complexes in the country. Accordingly, a similar type of operational structure is possible except the division that wills mange the sanitary control function.

Although persons availing of the services offered by the fishery complex facilities are charged for these services, fish purchasing transactions are carried out directly between the fishermen and distributors, with distributors then taking responsibility for produce marketing.

After fish sorting and transaction within the Project complex, lobster for export and fresh fish destined for Antigua are moved to the sanitary control area, where sanitation inspection and freshness preservation processing are carried out and the produce then shipped. At such time health certificates for export designated produce, and handling certificates for fresh fish destined for Antigua, are issued by the Department of Fisheries.

The Project complex will have a fishermen support function including a fishing gear shop and work shop, and operation in this regard will be the same as other fishery complexes. These facilities will be leased to a local fishermen cooperative or to a private sector enterprise.

The Project complex will be operated under a structure including a facility director under which will be an operations department staff and administrative department staff (See Figure 2.4.1).

Respective activities by the operations department and the administrative department will be as follows.

- Operations department: Technical staff will carry out the following services under the direction of the facility director:
  - Produce flow control of fish catches brought into the fish reception room
  - Produce flow control within the sanitary control area
  - Issuing health certificates and handling certificates
  - Supply services management (ice supply to fishermen and the sanitary control area)
  - Facility and equipment operation and maintenance
- Administrative department: Administrative personnel will carry out the following services under the direction of the facility director:
  - Accounting and records management (facility use fee collection)
  - Supervision of the workshop and fishing gear shop
  - Facility and equipment operation and maintenance
  - On-site management (on-site security and on-site janitorial works)

(Operations department) (Administrative department)

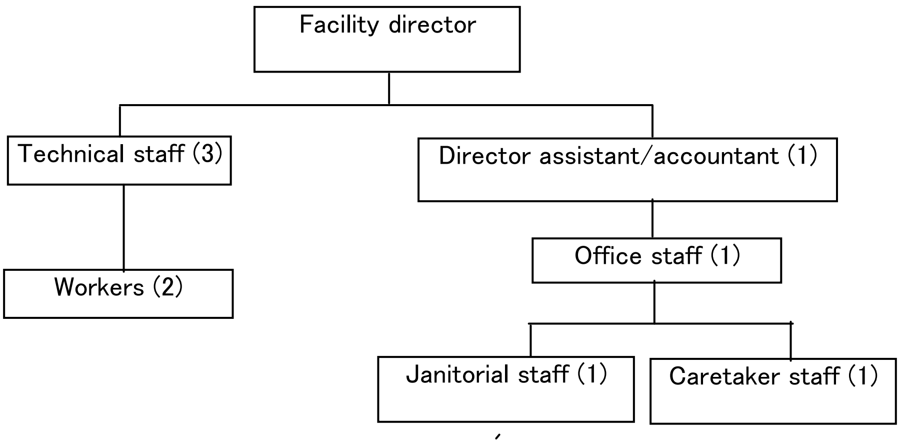


Figure 2.4.1 Staffing organization for the Barbuda fishery complex

(2) Staffing plan

Staff task responsibilities and number of staff (proposed) are indicated in the Table 2.4.1 below.

Table 2.4.1 Staff task responsibilities and number of staff (proposed)

Assignment	No. of staff	Task content
1) Facility director	1	Acting as well as the Department of Fisheries branch director, carrying out overall operations management, and issuance of health certificates and handling certificates in line with the directive of the director of the Department of Fisheries.
2) Facility director assistant/accountant	1	Assistance to the facility director; managing disbursement under facility activities; managing digitalized data.
3) Office staff	1	Calculating and collecting facility use fees, and preparing administrative documents.
4) Caretaker staff	1	Facility and equipment operation and maintenance; and site security.
5) Janitorial staff	1	Facility cleaning, and trash disposal.
6) Technical staff	3	1) Produce flow control and record keeping for fish catches brought to the fish receiving room; moving lobster for export and fresh fish destined for Antigua to the sanitary control area, and issuing vouchers. 2) Produce flow control for fish catches within the sanitary control area (sanitary inspection, freshness preservation processing, temporary storage, shipment packaging); keeping records and issuing health certificates and handling certificates for each inspection lot; regular water quality testing. 3) Collecting fishery statistics and data Note: Because tasks in 1) and 2) above entail long hours, these are to be carried out in shifts by 3 persons.
7) Workers	1～2	Supply of ice to fishermen and the sanitary control area; moving fish to the cold storage facility for temporary storage.

2-4-2 Operation and maintenance plan

Under the operation plan for Project facilities, initial year startup funding under Japanese grant-aid is not necessary. In addition, the recipient government will bear the cost for personnel, electricity, water, communications and storage management. Revenue from operation of the Project facilities will be allocated to purchasing consumables, replacement parts and repair parts for facilities and equipment.

Below, stand-alone capability of facility operation is verified on the basis of revenue and expenditure balance.

(1) Operational revenue

Operational revenue is broadly categorized into income from ice sales, facility use fees (locker fees, mooring fees, slipway utilization fees and income from leasing the fishing gear shop), as well as fees in conjunction with issuance of health certificates and handling certificates.

Although the Fisheries Division itself does not charge for the issuance of health certificates and handling certificates, the fishing complex is rightfully in a position to collect a levy in some form in line with the amount of fish catch inspected and handled at the sanitary control area. This translates into the issuance fee for health certificates and handling certificates.

(2) Operation and maintenance

Management outlay for facilities under the Project can be broadly divided into operational cost and maintenance cost. Operational cost comprises costs incurred during everyday operation of Project facilities (this includes costs for personnel, utilities, cleaning service, water treatment, and office consumables). Maintenance cost comprises costs for regular facility repair, renovation and equipment/parts replacement (painting, electrical bulb and florescent light replacement, repair of on-site paving, parts replacement or entire replacement of equipment).

2-5 Project Cost Estimation

2-5-1 Initial Cost Estimation

The breakdown of respective costs to be borne by the government of Antigua and Barbuda is estimated in the Table 2.5.1. However, the cost estimate is provisional and would be further examined by the Government of Japan in approving the Grant.

(1) Cost to be borne by Antigua and Barbuda

Project cost (Portion borne by Antigua and Barbuda side) is Approx. EC$320,000 (approx. 12.0 million yen) as indicated in the table below.

Table 2.5.1 Project Cost borne by Antigua and Barbuda side

Cost item	Cost (EC$)	Cost ('000 yen)	Remarks
1) Constructing perimeter fence, gate, etc.	Approx.70,000	2,600	Fence of approx. 250m, and gates
2) Extending power supply, city water and phone line onto the site	Approx.188,000	7,100	Transformer (1), water gauge (1), electric gauge (1)
3) Procuring office equipment and furniture	Approx.20,000	750	Computer (2), furniture (10), calculator (4), shelf (10), etc.
4) On-site cleaning equipment, garbage containers, etc.	Approx.5,000	190	Cleaning equipment, garbage containers, etc.
5) Grass, shrubbery and tree planting	Approx.1,000	40	Replanting of mangrove (200m²)
6) Banking arrangement （B/A）	Approx.36,000	1,350	
Total	Approx.320,000	12,030	

(2) Calculation criteria

・Calculated costs apply prices as of , 2009

・Exchange rate: US$1.00 = JPY100.4
US$1.00 = EC$2.67
EC$1.00 = JPY37.6

・Construction period: Implementation is to be divided into one phase. Respective time periods required for the detailed design phase and the construction phase are indicated within the Project Implementation Schedule.

・Other: The Project is to be implemented under the grant-aid program of the Japanese government.

2-5-2 Operation and Maintenance Cost

(1) Funding status

Trend in budget status of the responsible agency (Ministry of Agriculture, Lands, Marine Resources and Agro Industries) and the executing agency (Fisheries Division) is shown in Table 2.5.2. The years 2005~2007 show actual budget data. Figures for 2008 and 2009 are projected performance. During the period 2005~2007, the ministry budget accounted for roughly 2.5% of the national budget. In 2008 and 2009, this percentage further increased.

In 2007, the budget for the Fisheries Division increased significantly. In 2008, the department restructured, and a new fishery complex management section was established. This resulted in an internal shift of budget from the general administrative section to the fishery complex management section.

Table 2.5.2 Budget trend for the Ministry of Agriculture, Lands, Marine Resources and Agro Industries, and the Fisheries Division

(Unit: EC$ '000)

Years	2009	2008	2007	2006	2005
National budget	974,769	971,705	531,255	642,320	565,611
Budget for the Ministry of Agriculture Lands, Marine Resources and Agro Industries	33,897 (3.5)	34,638 (3.6)	13,546 (2.6)	13,754 (2.1)	15,622 (2.8)
Allocation to the Fisheries Division	1,305	1,409	1,496	954	775
Management section within the department (allocation specifically for operation and maintenance)		964 56	1,164 21	614 83	521 (-)
Maintenance budget within the complex management section	736 91				

Source: Ministry of Finance and the Economy

Note: Fiscal year is January~December. Figure in parentheses is the proportion of national budget allocated to the Ministry of Agriculture, Lands, Marine Resources and Agro Industries.

(2) Operational revenue and expenditure

1) Revenue

Source of operational income is broadly categorized into (i) sale of ice, (ii) facility use fees (vessel mooring, locker use and slipway access), (iii) leasing fees (workshop and fishing gear sales outlet), and (iv) issuance of health and handling certificates. An overview of operational revenue is shown in Table 2.5.3.

Table 2.5.3 Annual operating revenue at the Barbuda Fishery Complex

Revenue item	Breakdown	Amount (EC$/year)
Selling ice for fishing operations	EC$0.3/kg (unit cost for ice) × 218 kg/day (quantity of ice sold)[1] × 312 days/year (no. of days of facility operation)	20,404
Selling ice for fresh fish shipment	EC$0.3/kg (unit cost for ice) × 651 kg/week (quantity of ice consumed)[1] × 48 weeks/year (no. of shipments)	9,374
Locker rental	EC$50/unit/month (rental unit cost) × 24 units[1] × 12 months/year	14,400
Mooring fees[2]	EC$40/boat/month (mooring fee unit cost) × 14 boats/month (mooring capacity) [2]× 12 months/year	6,720
Slipway use fees	EC$10/vessel-day (utilization unit cost) × 12 vessel-days (monthly average of utilization days)[3] × 12 months/year	1,440
Workshop lease fee	EC$7,200/year (lease unit cost)	7,200
Lease fee for fishing gear shop	EC$10,000/year (lease unit cost)	10,000
Health certificate issuance fees	EC$1/kg (certificate issuance unit cost) × 50,000 kg/year (annual exported quantity of lobster)[4]	50,000
Handling certificate issuance fees	EC$0.5/kg (certificate issuance unit cost) × 19,000 kg/year (annual shipped quantity of fresh fish)[5]	9,500
Total	—	129,038

Note:
[1] = Quantity is adopted from the design value.
[2] = Number of boats out of the currently active fishing vessels anchoring at Codrington, minus the number of boats less than 16 feet in length.
[3] = Monthly maintenance frequency for fishing boats based on the baseline survey (approx. 4 boats/month; 3 days for each boat)
[4] = Average annual export quantity for 2006~2008.
[5] = Design quantity of fresh fish to be shipped.

2) Operational expenditure

Operational expenditure broadly includes both operation and maintenance costs. Operational cost comprises daily expenditure, including primarily personnel costs, etc. Maintenance cost comprises facility repair and equipment renewal cost. Operation and maintenance costs are summarized in Table 2.5.4 {for details on each item, see Appendices 5 (7)}.

Table 2.5.4 Summary of operational expenditure

Expenditure item	Breakdown	Amount (EC$/year)
Personnel cost	1 person × EC$42,400/year (complex director) 1 person × EC$32,500/year (assistant director / accountant) 1 person × EC$18,950/year (office staff) 1 person × EC$18,950/year (maintenance staff) 1 person × EC$16,500/year (janitorial staff) 3 persons × EC$30,500/year (technical staff) 2 persons × EC$15,600/year (general laborer staff)	42,400 32,500 18,950 18,950 16,500 90,000 31,200 Total 250,500
Office consumables (copy machine paper, etc.)	EC$135/month (monthly consumed quantity) × 12 months	1,620
Fuel (for pickup truck)	EC$0.48/km (fuel unit cost) × 20 km/trip × 12 times/month × 12 months/year	1,382
Electricity	EC$0.6/kwh × 182,458kwh/year	109,474
Purification tank maintenance	EC$1,200/year (personnel cost / chemical cost) EC$2,600/year (roundtrip travel expenses from Antigua to Barbuda) EC$800/year (sludge removal cost)	4,600
Water purification	EC$2,000/year (10 packs per year of 6% sodium hypochlorite) EC$3,200/year (filter replacement 4 times per year)	5,200
Reserve fund for equipment renewal	EC$8,100/year (ice making machine: EC$105,300 ÷ 13 years) EC$8,370/year (refrigerator: EC$108,810 ÷ 13 years) EC$3,510/year (emergency generator: EC$54,000 ÷ 15 years) EC$675/year (radio: EC$6,750 ÷ 10 years) EC$567/year (crane: EC$4,050 ÷ 7 years) EC$540/year (weighing scale: EC$2,700 ÷ 5 years)	21,762
Other operation and maintenance costs		21,000
Expenditure total		4415,538

3) Operational independence

Among the above operational expenditures, given the fact that (i) staff of the Barbuda branch office of the Department of Fisheries will simultaneously be assigned to Project facility operation and (ii) government policy covers expenses for electricity and city water on Barbuda island, these costs (EC$73,474/year) can be deducted from Project operational expenditure. As a result, the Project is deemed operationally independent.

2-6 Other Relevant Issues

It will be necessary for the executing agency (Fisheries Division) to establish a consensus with other concerned agencies to ensure that operation and maintenance costs, etc. are continuously funded, in light of the degree to which promotion of small fishery on Barbuda under the Project will contribute to the nation's socio-economy.

CHAPTER 3

PROJECT EVALUATION AND RECOMMENDATION

Chapter 3 Project Evaluation and Recommendation

3-1 Project Effect

Impacts anticipated as a result of Project implementation are indicated in Table 3.1.

Table 3.1 Project impacts

Current status and problems	Measures under the cooperation project	Direct impacts / degree of enhancement	Indirect impacts / degree of enhancement
①The Project site is located at Codrington, which is the center of fishing activity on Barbuda. Nevertheless, fishing infrastructure remains underdeveloped. In addition, hurricanes are frequent, causing boat and fishing gear loss. Fishermen are faced with time loss and inconvenience when preparing for fishing departure, landing catches, repairing boats or securing fishing gear. Also, fishermen must travel to Antigua island to purchase fishing gear or have outboard motors repaired. ②There are no ice-making or cold storage facilities on Barbuda necessary to maintain the freshness of fish catches. Accordingly, it is not possible to sanitarily ship fish produce from Barbuda to Antigua (even though a potentially robust market is present). As a result, fishing operations comprise mainly trap harvesting of live lobster which requires no icing to preserve freshness. Fish catch marketing is limited to local consumption on Barbuda.	①Fishing infrastructure will be established under the Project at Codrington on Barbuda to include catch landing, mooring, resupply, and engine repair functions, as well as sanitary management of offloaded catches. Target number of fishing boats to access ice supply and sanitary control of fish catches is 44 boats. Target number of boats to access the catch landing facility is 35 boats (approximately 72 fishermen).	①Construction of the landing jetty will reduce the time for catch landing by about 9 min/boat. Since there are 35 target boats, this comes to an annual total reduction of 380 hours for catch landing. ②Construction of the mooring seawall will enable 14 out of the 23 target boats anchoring in the site area to directly moor. Preparations for fishing departure will be reduced around two minutes per boat, totaling an annual reduction of up to 36 hours ③Constructing a slipway will facilitate the beaching and launching of fishing boats. It will further make easy boat evacuation in the case of direct hurricane strike.	
③Domestic fishery production in Antigua and Barbuda does not meet local demand. As a result, the country relies on imports to meet 35% of domestic fishery product demand. The major portion of fishery production in the country is based out of Antigua. Fishery production on Barbuda is sufficient only to meet local demand on the island. Barbuda island has promising fishing grounds with ample potential for fishing resources development. Nevertheless, present catch quantity is less than one tenth of that for fishing operations out of Antigua.		④Constructing an administration and fish handling building will enable the supply of sanitary ice, and control of fish catch freshness. This in turn will make possible a stable shipment of fish catches to Antigua. An annual 19 tons of fresh fish will be shipped to Antigua.	①Because fresh fish will be distributed from Barbuda, the present fishermen over-reliance on lobster harvesting should shift towards harvesting a broader variety of fish. As a result, the harvesting pressure on lobster will be reduced, promoting a more balanced and effective exploitation of fishery resources. ②Supply of fresh fish from Barbuda will alleviate the shortage of fishery products available for consumption on Antigua.

④The reliability of fishery statistical data gathered from Barbuda is low. Accordingly, this data is not reflected in officially released information by the Fisheries Division. Furthermore, extension activities directed at fishermen are not being carried out in a thorough and structured manner. Additionally, Barbuda fishermen are not receiving adequate administrative support due to geographical, political and funding allocation issues. ⑤The Fisheries Division generally oversees fishery administration in the country. Nevertheless, there is a fisheries office directly under the jurisdiction of the Barbuda Council, the staff for which are selected by the council. As a result, the technical level of nominated staff may sometimes not meet the standards set by the Fisheries Division itself.	②Function of education and training to local fisheries office staff and fishermen to be included to envisioned facilities.	⑤Operation of Project facilities will enable the keeping of accurate records on the size of fish catches at Barbuda. ⑥Utilization of the administration and fish handling building will promote fishermen educational and extension activities.	③The Fisheries Division will be better able to identify fisheries status on Barbuda, and to carry out fishery administration in line with maximum sustainable exploitation of resources as targeted by the Fisheries Division. ④Promoting fishermen extension activities is aimed at promoting small fishery on Barbuda by upgrading fishing technology, improving marine resource management, and enhancing fishing safety.

3-2 Recommendations

3-2-1 Issues to be addressed by the recipient country

The fishery infrastructure to be established under the Project will include catch landing, mooring, sanitary fish handling, fishermen support, as well as operating and administrative functions. It will be the first such fishery complex on Barbuda island. Accordingly, it is incumbent upon the Department of Fisheries to fully apply the experience and lessons learned from its operation of existing fishery complexes in other parts of the country, in order to create a personnel and financial structure enabling sustainable operation of Project facilities. From the standpoint of facility operation, the most salient issues and recommendations are as follows:

① In most cases, staff at the Barbuda branch office of the Department of Fisheries will simultaneously assume responsibilities for Project operation. It is necessary that these personnel be thoroughly educated and trained in the significance of the Project, and methods for sustainable operation and maintenance.

② Among facility operational expenses, personnel cost, electricity cost and city water cost will be allocated from the national budget via the Barbuda Council. The Department of Fisheries must liaise closely with related agencies (Office of Prime Minister, Ministry of Public Works, etc.) to ensure a sustained funding outlay for the above costs, as well as work closely with the Barbuda Council in establishing a shared understanding of the significance and benefit of Project implementation.

③ The success or failure of the Project will depend on whether or not fish catches can be sanitarily processed and shipped to Antigua. Because actual fish distribution will be carried out by private sector distributing agents, it is necessary that the Department of Fisheries carry out a sustained collaborative effort to ensure thorough understanding on the part of distributing agents regarding the mechanism for sanitary fish distribution centering on the activities within the sanitary control area.

④ Implementing the Project will create a venue for educating and training fishermen. The Department of Fisheries must avail of this opportunity to strengthen its extension activities targeting the more backward fishermen on Barbados, aiming at more diversified fishing operations and sustainable exploitation of marine resources.

⑤ Project facilities front on Codrington lagoon which is a designated national park. The Department of Fisheries must give extremely careful attention to preserving the lagoon environment and ecosystem, and should carry out regular monitoring of Project wastewater quality to ensure that wastewater from Project facilities discharged to the lagoon does not adversely impact the lagoon environment.

3-2-2 Linkage between Japanese technical cooperation and other donors

There are HACCP specified catch processing facilities at the Point Wharf fishery center where JICA technical expert work in facility operation. It is recommended that the Department of Fisheries look to technical cooperation from these expert with regard to sanitary processing methods and technical training.

3-3 Project justification

A summary of Project preliminary planning (at the time of basic design) has been included as Attached Material 5. The Antigua and Barbuda economy currently relies heavily on the tourist industry. Economic development through diversification of industries is a pressing issue, and in addressing this fisheries sector is posited as an important industry that will promote national independence by exploiting domestic resources. Specifically, the Project will establish fishing infrastructure on Barbuda island where economic development is lagging, and create a structure for fish catch distribution to Antigua. These are aimed at promoting Barbuda fishery in particular, and the island's overall economy in general. As indicated in Table 3.2, Project implementation is deemed both important and urgent. In light of the fact that significant positive effect is anticipated by the envisioned fishery complex serving as a base for area fishing operations, it is concluded that implementation of the proposed cooperation project under Japanese grant-aid is justified.

Table 3.2 Criteria for justification as a cooperation project

Justification indicator	Project consistency with indicator
①Targeted beneficiaries: General citizenry, including the impoverished segment of society. Targeted beneficiaries are numerous.	Facility beneficiaries: 44 boats; approx. 70 fishermen Local beneficiaries: Barbuda's population of 1,400 Indirect beneficiaries: Resident population (approx. 50,000 persons) of the capital St. John's on Antigua who will have access to fresh fish supply from Barbuda as a result of Project implementation.
②Project objectives: Consistent with human safety and security. Project is highly urgent in terms of improving and stabilizing the livelihood of the general population.	Barbuda has rich fishery resources, ranking highest among the islands various sector resources. Nevertheless, development of the fishery sector on Barbuda has lagged, and the island produces less than 1/10 the fish catch generated by Antigua. In addition, education levels among fishermen on Barbuda are low, making it highly urgent that economic development be accompanied by educational and extension activities.
③ Operation and maintenance capacity: In principle, the project can be sustained independently by local funding, human resources and technology. Project operation does not require an excessive technological level.	An excessive technological input is not required for Project facility operation. Although staff at the Barbuda branch of the Department of Fisheries have no direct experience in operating the types of facilities under the Project, the Department of Fisheries headquarters itself is staffed with personnel who have operational experience on similar types of fishery complexes. Through short, effective technical training sessions with these personnel as instructors, it will be possible for the minimum required operating technology to be transferred to Barbuda staff.
④National planning: Whether or not the Project is consistent with national development strategy.	Under national development strategy, the importance of developing the fishery sector has been given clear emphasis. Furthermore, Project targets are consistent with fishery sector development strategy regarding establishing fishery infrastructure, energizing small fishery operations and increasing the supply of animal protein through fish harvesting.
⑤Profit-earning requirement: In principal, not high.	Required Project profitability is at a modest level that could operate envisioned facilities and replace equipment without an additional input by the government.
⑥ Environmental and social aspects: Impacts are either none, or appropriately mitigated.	Negative impacts are not anticipated in environmental and social aspects. With regard to land use, the full support of the Barbuda Council (agent with land rights) has been obtained. Furthermore, area residents look forward to Project implementation.
⑦ Constraints on consideration under the Japanese grant-aid system: No particular issues are present.	No particular issues are present.

3-4 Conclusion

As described in 3-1~3-3, the Project conforms to the objectives set out under national level planning (Manifesto 2004, and Fisheries Development Plan 2006~2010 (Draft)), and will promote small fishery on Barbuda island. The Project will also contribute to a better balance in fishery product demand within the country, and enable distribution of fish catches that meet international sanitary standards. On this basis, the Project exhibits the necessity, appropriateness and urgency for implementation under the Japanese grant-aid program.