(2) Explanation on the Draft Report

Minutes of Discussions
on the Basic Design Study
on the Project for Improvement of Port Vila Main Wharf
in the Republic of Vanuatu
(Explanation on the Draft Report)

In June 2007 and also in September 2007, the Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched the Basic Design Study Team on the Project for Improvement of Port Vila Main Wharf (hereinafter referred to as "the Project"). Through a series of discussion, field survey and technical examination of the results, JICA prepared a draft report of the study.

In order to explain and consult with the officials concerned of the Republic of Vanuatu (hereinafter referred to as "Vanuatu") on the components of the draft report, JICA sent to Vanuatu the Basic Design Explanation Team (hereinafter referred to as "the Team"), headed by Mr. Yoshinori Ebata, Resident Representative of JICA Vanuatu Office, from 4th to 8th November, 2007.

In the course of the discussions, both sides confirmed the main items described in the attached sheets.

Port Vila
7th November, 2007

Yoshinori Ebata
Leader
Basic Design Study Team
Japan International Cooperation Agency

Wilson Tari Vuti
Director General
Ministry of Infrastructure and Public Utilities
Republic of Vanuatu

Simeon Athy
Director General
Ministry of Finance and Economic Management
Republic of Vanuatu

ATTACHMENT

1. Contents of the Draft Report

The Vanuatu side agreed and accepted in principle the contents of the Draft Report explained by the Team.

2. Japan's Grant Aid Scheme

The Vanuatu side reconfirmed the Japan's Grant Aid scheme and the necessary measures to be taken by the Government of Vanuatu explained by the Team as described in Annex-5 and Annex-6 of the Minutes of Discussions (M/D) signed by both sides on 19th September, 2007.

3. Schedule of the Study

JICA will complete the Final Report in accordance with the confirmed items and send it to the Vanuatu side by January 2008.

4. Cost Estimation

Both sides agreed that the Project Cost Estimation, as attached in Annex-1 should never be duplicated or released to any outside parties before the signing of all the Contract(s) for the Project.

5. Other Relevant Issues

(1) The Vanuatu side shall demolish the existing administration office, toilet which is located in the western side of the port, and superstructure of the shed, on a timely manner. However, regarding the superstructure of the shed, eastern side portion, which is approximately one third of existing size and will be renovated and continued to use, is not necessary to be demolished by the Vanuatu side.

(2) The Team confirmed that the road drainage facility in the hinterland of the port is not necessary, but the Vanuatu side shall assure the appropriate drainage outlet around the area outside of the east boundary of the port.

(3) The Vanuatu side shall secure the necessary space for temporary yard. The Team informed that the specific size of the yard is not less than 2,500 m^2.

(4) The Vanuatu side shall relocate the surveillance cameras to the appropriate locations on a timely manner.

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Appendix-5 References

Appendix-5-1 Cargos handled at Port Vola

【Data on cargoes handled at the port】

While Vanuatu has organized statistics on the exports and imports of the entire country on a monetary value basis and cargo statistics on a weight basis, PHD, the custodian of Port Vila, where this project will be implemented, does not even keep primary data, not to mention statistical data, on the statistics and details of the contents of the cargoes handled at the port. Because of this absence of organized statistical data on the trends in cargo volume at the port, the basic design study team attempted to estimate the cargo volume from the bills of lading and Customs applications submitted by the import and export agents, with the aim of grasping the trends in cargo volume at the port at the time of formulating the plan for Port Vila. Although we requested data on imported cargoes from the cargo handler, IFIRA, and from import and export agents and the Customs office, we were unable to obtain sufficient data for the estimation from anywhere on the cargoes handled at the port, because of misplacement of data prior to 2006 and protection of privacy. Under such circumstances, we managed to obtain the details of individual cargoes by vessel from import and export agents as data on cargoes handled at the port. The data thus obtained are summarized in Tables 1 and 2. Table 1 summarizes the number of containers (number of FCL/LCL, number of exported empty containers and loose cargoes, number of LCL and items in the cargoes) by vessel during the six month period from January to June 2007. We also collected data on the imported cargo volume (FCL, LCL and loose cargoes) of all but major freighters per entry to the port during the same period to complement the data in the above-mentioned tables. To cross-check these data, we obtained copies of the work records of pilots from the PHD, from which the mooring time of each vessel which entered the port could be estimated.

During this project study, the current conditions of Port Vila will be estimated by utilizing the above-mentioned data on trends in cargo handling at the port and data on the entry/exit of vessels, and the optimal facility plan within the framework of Grant Aid Cooperation will be formulated.

Table-1 Number of exported and imported containers (FCL and LCL) by vessel

Month	Name of Vessel	Voyage No.	No. of Containers Discharge									No. of Containers Loaded					Export	Trans shipment
			LCL				FCL				Total (TEU)	Empty Containers				Total (TEU)		
			20 feet	40 feet		Reefer	20 feet	40 feet		Reefer		20 feet	40 feet		Reefer			
March	Kiribati Chief	91	17				174			8	199	102	7	14		116	2	
May	Kiribati Chief	93	12				138	11	22	10	182					0	3	
January	Kiribati Chief	90	16			1	131	3	6	6	160	48			9.0	57	4	3
June	Kiribati Chief	94	7				130	9	18	9	164					0	2	
March	Kiribati Chief	92	9	3	6	1	122	10	20	7	165							
May	Kiribati Chief	93S									0	166			3.0	169		
	Subtotal		61	3	6	2	695	33	66	40	870	316	7	14	9	342		
April	Southern Moana	138	5	3	6	1	76	28	56	5	149	82	13	26	4.0	112	2	
April	Southern Moana	139	5	4	8	1	72	16	32	4	122					0		
January	Southern Moana	135	6	1	2	1	68	12	24	1	102	95			2.0	97	2	13
February	Southern Moana	136	6	2	4	1	63	12	24	4	102	19	2	4		23	3	
March	Southern Moana	137	10	2	4		60	9	18	6	98	11			5.0	16		10
May	Southern Tiare	47	6				45			3	54	49			10.0	59	2	
May	Southern Moana	140	1	1	2		32	5	10	2	47					0		
	Subtotal		39	13	26	4	416	82	164	25	674	256	15	30	21	307		
April	Sofina Magellan	108	1	0		0	53	1	2		56	61	0		0.0	61	1	
January	Sofina Magellan	106	0	0		0	50	1	2		52	19	0		0.0	19		
April	Sofina Magellan	109	1	0		0	48				49	35	0		0.0	35	2	
June	Sofina Magellan	110	0	0		2	34	1	2		38	23	0		0.0	23	3	
February	Sofina Magellan	107	0	0		0	26	0	0	1	27	52	3			55	1	
	Subtotal		2	0		2	211	3	6	1	222	190	3	0	0	193		
June	Coral Islander	28	3	0		0	37	3	6		46	24	0		0.0	24	10	
March	Pacific Islander	25	3				25	9	18		46	13	0		0.0	13	5	
January	Pacific Islander	24	2	0		0	20	13	26		48	18	1	2		20	1	
April	Pacific Islander	26	2	0		0	27		0		29					0	3	
February	Coral Islander	26	2	0		0	18	4	8		28	28	12	24		52	4	
April	Coral Islander	27	3	0		0	20	2	4		27	25	0		0.0	25	3	
	Subtotal		15	0		0	147	31	62	0	224							
February	Pacific Explorer	8					37	2	4	2	43					0		10
June	Pacific Voyager	9	1				39	8	16		56	137			13.0	150		10
April	Pacific Voyager	8					31	2	4		35	149			7.0	156		
May	Pacific Explorer	9	1				45	1	2		48							
January	Pacific Voyager	7					18	1	2		20	80				80		13
	Subtotal		2	0		0	170	14	28	2	202							
February	Mahina Bank	207	3				13	5	10	3	29					0		1
January	Gazelle Bank	206	2				5		0		7					0		
May	Gazelle Bank	211	2				10	1	2	4	18					0		
	Subtatal		7				28	6	12	7	54							
February	Caledonie Express	43					7	2	4		11	97	16		4.0	117		
	TOTAL		126	16	32	8	1,674	171	342	75	2,257	859	41		87.0	959	53	60

Table-2 Weight of loose cargoes and LCL cargoes by vessel (in 2007)

Month	Name of Vessel	Voyage No.	Bulk		LCL							Total		
					20 feet		40 feet		reefer		Sub total			
			ton	FT	nos.	ton	nos.	FT	nos.	ton	TEU	ton		FT
January	Kiribati Chief	90			16	244.3			1	10.3	17	254.6		0.0
March	Kiribati Chief	91			17	260.1			1	9.3	18	269.4		0.0
March	Kiribati Chief	92			9	135.9	3	147.4			15	135.9		147.4
April	Kiribati Chief	93	16.4		12	120.6					12	137.0		0.0
May	Kiribati Chief	93S	No Discharge								0			0.0
June	Kiribati Chief	94	15.2		7	93.7	2	28.6			9	109.0		28.6
	Subtotal		31.6	0	61	854.6	5	175.952	2	19.6	71	905.7		176.0
January	Southern Moana	135	62.2	71.5	6	137.8	1	51.2	1	12.7	9	212.7		122.7
February	Southern Moana	136	87.8	55.6	6	167.5	2	49.0	1	9.6	11	264.9		104.7
March	Southern Moana	137	213.0	153.1	10	210.0	2	98.7			14	423.1		251.8
April	Southern Moana	138	82.6	135.8	5	130.5	3	137.0	1	5.4	12	218.6		272.8
April	Southern Moana	139	333.9	170.5	5	100.4	4	198.7	1	4.5	14	438.8		369.3
May	Southern Moana	140			1	6.1	1	49.5			3	6.1		49.5
May	Southern Tiare	47	753.5	767.4	6	43.6					6	797.1		767.4
	Subtotal		1533.0	1,353.9	39	796.0	13	584.171	4	32.2	69	2,361.2		1,938.1
January	Sofina Magellan	106	1.8								0	1.8		0.0
February	Sofina Magellan	107									0	0.0		0.0
April	Sofina Magellan	108	126.5		1	10.5					0	137.0		0
April	Sofina Magellan	109	100.2		1	13.4					0	113.6		0
June	Sofina Magellan	110	315.1								0	315.1		0
	Subtotal		543.5	0.0	2	23.9	0	0	0	0	0	567.4		
January	Pacific Islander	24	14.3		2	30.6					2	44.9		0.0
February	Coral Islander	26	104.3		2	32.6					2	136.9		0.0
March	Pacific Islander	25	20.9		3	63.4					3	84.3		0.0
April	Coral Islander	27	45.7		3	54.9					3	100.6		0.0
April	Pacific Islander	26			2	34.4					2	34.4		0.0
June	Coral Islander	28	12.1		3	58.5					3	70.6		0.0
	Subtotal		197.4	0.0	15	274.4	0	0	0	0	15	471.8		
January	Pacific Voyager	7	863.6								0	863.6		0.0
February	Pacific Explorer	8	854.5								0	854.5		0.0
April	Pacific Voyager	8	310.0								0	310.0		0.0
May	Pacific Explorer	9	576.4		1	6.7					6	583.1		0.0
June	Pacific Voyager	9	862.0		1	8.7					1	870.7		0.0
	Subtotal		3466.5	0.0	2	15.4	0	0	0	0	7	3,481.9		0.0
January	Gazelle Bank	206	43.3		2	16.8					2	60.2		0.0
February	Mahina Bank	207	161.0		3	30.1					3	191.1		0.0
May	Gazelle Bank	211	34.1		2	22.7					2	56.8		0.0
	Subtotal		238.4	0.0	7	69.6	0	0	0	0	7	308.0		0.0
	TOTAL		6,010.4	1,353.9	126.0	2,033.9	18.0	760.1	6.0	51.7	169.0	8,096.1		2,114.1

The actual data on port entries at Port Vila in 2006 show that, of the vessels that called at the port, only a limited number of container and semi-container vessels called at the port on a regular or semi-regular basis. By country (or route), imported cargoes can be roughly divided into cargoes from Australia, New Zealand, Japan, New Caledonia and Indonesia/Singapore. Table 3 shows the number of entries to the port and the names of the vessels. In this table, vessels using identical routes are considered collectively.

Table-3 Number of entries to the port by freighters (in 2006).

Name of vessel	Number of entries	Ports of call
Kiribati Chief	17	Melbourne, Sydney, Port Vila, Tarawa and Majuro
Southern Moana	14	Auckland, Noumea, Port Vila, Suva and Funafuti
Pacific Islander, Pacific Islander II & Coral Islander, Coral Islander II	12	Pusan, Kobe, Yokohama, Majuro, Tarawa, Port Vila, Suva, Papeete, Nuku'alofa, Santo and Noro
Sofrana Magellan & Sofrana Kermadec	10	Melbourne, Sydney, Port Moresby, Rabaul, Honiara, Port Vila and Brisbane
Gazelle Bank etc.	8	Auckland, Noumea, Port Vila, Santo, Honiara, Rabaul and Medan
Pacific Explorer & Pacific Voyager	7	Jakarta, Singapore, Port Vila and Santo

【Current status of number of imported containers by vessel】

Of the freighters included in the table above, Kiribati Chief, Southern Moana and Pacific Islander and her sister ships are regular services and they entered the port approximately once a month. The rest are semi-regular services which entered the port at intervals of one to less than two months.

As shown above, the vessels entering Port Vila operate regular or semi-regular services to fixed ports of call and it is quite rare to see the entry of non-regular freighters. As each freighter serving a specific route shows characteristic tendencies in the quantity of imported cargoes, the average number of containers imported by each at present is described in the following.

The existing data on cargoes imported into Vanuatu show that cargoes imported from Australia comprise almost 40% of the total. The number of containers imported by Kiribati Chief, which serves on the Australian route, at 175 TEU per entry, is much larger than the corresponding number for the other freighters, as shown in the table below. For the other freighters (on their respective routes), the table below shows that the average number of imported containers (in TEU) is 91, 44, 38, 37 and 18, respectively, for Southern Moana, Sofrana Magellan, Pacific Islander and her sister vessels, Pacific Explorer and her sister ships, and Gazelle Bank and her sister ships.

Table-4 Average number of imported containers by vessel entering the port (in the first half of 2007)

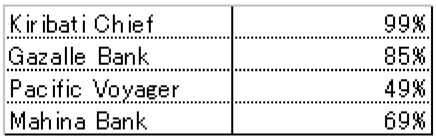
Name of vessel	Interval between entries	Average number of containers (TEU)	Ports of call
Kiribati Chief	33~36	174	Melbourne, Sydney, Port Vila, Tarawa and Majuro
Southern Moana	24~25	91	Auckland, Noumea, Port Vila, Suva and Funafuti
Sofrana Magellan	15~52	44	Melbourne, Sydney, Port Moresby, Rabaul, Honiara, Port Vila and Brisbane
Pacific Islander II & Coral Islander II	26~31	38	Pusan, Kobe, Yokohama, Majuro, Tarawa, Port Vila, Suva, Papeete, Nuku'alofa, Santo and Noro
Pacific Explorer & Pacific Voyager	43~54	37	Jakarta, Singapore, Port Vila and Santo
Gazelle Bank etc.	13~49	18	Auckland, Noumea, Port Vila, Santo, Honiara, Rabaul and Medan

【Imported cargoes by vessel】

The actual status of the imported cargoes is analyzed using the data for the six-month period (from January to June) in 2007, which are considered reliable. Although even these data presumably lacked some of the cargo volume carried by non-regular freighters, we concluded that analysis of these data would reveal a trend not much different from the actual trend as the great majority of the cargoes are handled by regular and semi-regular vessels at present, as mentioned above.

♦ Proportion of container freight

While container freight comprised 79% of the above-mentioned total volume of cargoes handled at the port, the proportion of container freight differs among the vessels entering the port (or origin of imported goods), as shown in the table below, and a summary of the characteristics of the proportion of container freight of the freighters entering the port is described in the table below. Only the data of freighters with confirmed cargo volumes and number of containers are listed in the table below.



Kiribati Chief	99%
Gazalle Bank	85%
Pacific Voyager	49%
Mahina Bank	69%

— Kiribati Chief has a proportion of container freight of 99%.

— The proportion of container freight varies among the other vessels from 50% to 85%, depending on the contents of the cargoes.

－ The average weight per TEU for FCL is approximately 15t.

－ 20ft and 40ft containers comprise 91% and 9%, respectively, of the total number of imported containers.

♦ Proportion of FCL and weight of LCL

The quantities of FCL and LCL in the six-month period in 2007 were 2,300 TEU and 177 TEU, respectively, implying that FCL accounted for approximately 93% of the total number of containers. The weight of LCL during the same period was a little less than 2,500t, consisting mostly of personal effects and small consignments of several tons.

♦ Loose cargoes

The main items in loose cargoes are construction materials, such as cement and reinforcement bars, reflecting the recent construction boom. In particular, import of a large number of bags of cement, amounting to 800t in 2t packages, was confirmed three times in 2006 and three times already in 2007 by the time of the study. By the time of the site study in 2007, the total amount of cement imports stood at approximately 4,700t, accounting for 78%, on a weight basis, of the loose cargoes imported during the same period.

【Cargoes for export】

♦ Empty containers

In the first half of 2007, the number of exported empty containers handled at the port was 1,479 TEU, which corresponds to approximately 60% of 2,477 TEU of imported containers. The data provided by the cargo handler at the port, IFIRA, indicate that a total of 4,077 containers were imported and a total of 2,534 empty containers were exported during 2006. Assuming that the proportion of 40t containers in 2006 was the same as in 2007, the former translates into 4,855 TEU and the latter into 2,787 TEU. These two figures give the proportion of the number of exported empty containers to the number of imported containers as 57%.

As the two estimates of the proportion of empty containers differ little, we assume the proportion of exported empty containers to imported containers to be 59%, the average of the two figures.

In the following, this figure will be used to estimate the number of empty containers loaded onto freighters while they are at the port.

♦ Export cargoes

As mentioned above, the statistics for the year 2005 show that 83% and 17% of the cargoes handled at Port Vila are imports and exports, respectively, on a monetary value basis. The collected data for the year 2007 indicate that, by the time of the study, the number of transshipped containers was 60, which corresponded to approximately 3% of the total number of imported containers.

The container handling records of IFIRA in 2006 show that the numbers of exported and transshipped containers were 84 and 102, respectively, both of which corresponded approximately to 2% of the total number of imported containers, which was 4077.

- ♦ On a case-by-case basis, Coral Islander, at the time of calling at the port in January 2007, had a high proportion of export containers, namely 10 containers for export to 46 TEU of imported containers. However, as it is evident that not all the freighters leave the port loaded with containers for export or transshipment, it is assumed that the number of containers for export and transshipment correspond to 2% of the number of imported containers, based on reference to the actual data of IFIRA.

1. Container yard plan

The quality of service at Port Vila is far below international standards because underdevelopment of the container yard has led to extremely inefficient cargo handling and, consequently, longer mooring time for vessels entering the port. This project aims to improve the efficiency of cargo handling at the port through the development of a container yard behind the main wharf.

As the container yard in this project will be developed with the aim of eliminating existing bottlenecks, the facilities will be designed on a scale sufficient to handle the current cargo volume.

【Design number of containers to be handled】

The container cargoes handled at the port consist of imported containers, empty containers to be exported, loaded containers for export and containers to be transshipped. In this section, the number of containers in each of the four categories handled at the port will be used for consideration of the design number of containers stored in the container yard and the design scale of the container yard.

a) Trend in container imports

As shown in Table-4 in the preceding section, import of cargoes to this port depends heavily on specific freighters (container and semi-container ships). Therefore, the number of containers unloaded from these vessels and the frequency of their entry to the port are considered to be major factors in defining the area of the container yard required for cargo works and storage of imported containers.

Verification of the entry of Kiribati Chief, Southern Moana and Sofrana Magellan, the top three vessels in the list of number of imported containers, within a period of five days, which is said to be the number of days required for customs clearance at present, has revealed that such frequency was observed four times in 2006 and twice in the first half of 2007. It has been confirmed that the top two vessels in the same list entered the port within a five-day period on seven and five occasions, respectively, in 2006 and 2007. In addition, there have been a few cases in which they entered the port on consecutive days. The results of the verification are shown in the table below.

Table-5. Frequency of concentrated entry of freighters (including container vessels)

	Combination of vessels entering port	2006	2007 (Jan – Jun)
Case 1	Kiribati Chief + Southern Moana + Sofrana Magellan (total 3 vessels)	4 times	2 times
Case 2	Kiribati Chief + Southern Moana (2 vessels)	7 times	5 times

As shown in Table-6, the frequency of cases in which the top three vessels in the list of number of imported containers entered the port within a five-day period was not necessarily low. When the cases in which the top two vessels in the same list entered the port within five days are included, entry of more than one of these vessels to the port within a five-day period is estimated to happen more frequently than once in two months. Almost all the freighters entering the port are regular or semi-regular services. As expected from Table-1, the majority of the imported containers handled at the port are container cargoes unloaded from various vessels on regular service. In addition, if the empty containers are excluded, the volume of export cargo is extremely small. All these facts collectively depict a condition in which the majority of the containers handled at the container yard planned in this project will be imported containers from the vessels listed in Table-6 and empty containers for export, with a small number of loaded containers for export.

b) Estimation of the number of containers stored in the yard

When designing the number of containers stored in a container yard on the basis of the current scale of container handling, the number is usually calculated using the peak rate estimated from the number of containers handled in a year, the number of days that the containers stayed in the yard and the number of working days at the yard per year. However, for a port at which a relatively small number of vessels on regular service handle a great majority of the cargoes, like this port, it is considered that estimating the number in storage on the basis of a rough estimate of the largest number of TEU, obtained from the pattern of entry of the respective vessels and the average number of imported TEU, reflects the actual condition of cargo handling more accurately. Therefore, the latter method has been adopted for estimation of the number of containers in storage in this project.

As the pattern of entry of the freighters on regular service, the entry of two or three of the above-mentioned vessels at an interval of one to two days has been confirmed several times. Therefore, the number of containers stored in the container yard will be estimated on the basis of this entry pattern. To obtain the conditions in which the number of TEU in the container yard is at its largest, cases of a different order of entry of these vessels were examined. The case in which the number of TEU in the yard was largest in the examination is shown in Table-7. This particular entry pattern has been observed in the entry record several times since 2006. In the examination, the number of imported containers from the respective vessels was assumed to be the average TEU shown in Table-5 and the number of containers cleared by the Customs was assumed to be approximately 25 TEU per day. It was also assumed that the customs clearance process for the containers from the second vessel begins when the process for the containers from the first vessel has been completed. In addition, the number of empty and loaded containers for export was set at the values shown below, using the above-mentioned assumption on the ratio of these types of containers to the number of imported containers.

＊ Number of empty containers for export: 59% of the number of imported containers

＊ Number of loaded containers for export and containers for transshipment: 2% of the number of imported containers

In the case in which Southern Moana, Kiribati Chief and Sofrana Magellan entered the port on three consecutive days in this order, the number of containers in the container yard is expected to reach the maximum of 350 TEU on the day Kiribati Chief enters the port.

Therefore, the design number of containers stored in the container yard is set at 350 TEU in this project.

【Area required for the container yard】

A 10,500m^2 piece of land behind the existing pier in the port has been set aside for the planned container yard. Excluding the area for the cargo shed and Administration Office, the effective area available for the container storage yard is limited to approximately 9,000m^2. Allocation of storage slots will be designed allowing a working space for forklift trucks of 12m and 14m, respectively, for 20ft and 40ft containers. Designing the area of the container yard will require coordination with the design of the cargo shed mentioned below. However, as efficient handling of all imported containers is required at the port, the container yard will have priority over the cargo shed in the project in terms of area requirement.

In accordance with this policy, various allocation plans were examined in the search for a plan that would provide the maximum number of storage slots. As a result, it was revealed that a maximum number of 96 ground slots can be secured when part of the existing cargo shed is used as the cargo shed in this project.

The three types of containers, 20ft, 40ft and reefer containers, will be handled in the yard. Bearing this fact in mind, the following were taken into particular consideration with regard to slot allocation in the yard.

＊ In order to secure working space for the forklift trucks required for 40ft containers, their storage will be located on the western side of the yard and near the gate on the eastern side.

＊ Twenty-foot containers will be stored mainly in the central area.

＊ Not enough definite information on the import of reefer containers is available. A record of the unloading of 10 or 13 TEU of reefer containers from Kiribati Chief has been confirmed in the data for 2006 – 2007. However, as the area available for the container yard is limited, it will be impossible to offer adequate service to reefer containers in this project. Nevertheless, to meet part of the demand for the storage of reefer containers, storage slots for 6 TEU adjacent to the Administration Office will be set aside for reefer containers and power sources will be provided with a capacity corresponding to the storage capacity of the slots.

In consideration of the very limited effective yard area, a design of three tiers per slot will be adopted. The design will bring the total storage TEU to 288 with the 96 ground slots. As the design number of containers in storage is 350 TEU, as mentioned in the preceding section, there will be a shortage equivalent to 62 TEU in the storage yard.

There is no means to increase the amount of storage if the project implementation is to be restricted within the port area. As a practical measure to deal with this problem, the following two options can be considered.

＊ All 62 TEU in shortage will be allocated to empty containers. By making effective use of the concrete decks to be developed between the existing pier and the access bridges, the empty containers will be stored on the decks near the boundary with the yard on the land the day before the vessel onto which they will be loaded enters the port.

＊ While partly adopting the method mentioned above, storage space outside the port area will be secured, as currently practiced. This option should be investigated as a measure in case containers that exceed the storage capacity of the container yard are imported.

In this project, keeping these measures in mind, a container yard with a storage capacity of 288 TEU will be designed.

2. Cargo shed

【Location of the cargo shed】

The container yard and the cargo shed to be developed in the port area should be properly located within the limited area. As the existing cargo shed is located close to the pier, the policy of removing the existing cargo shed has been confirmed, in consideration of the flow of cargo traffic in the yard after it has been developed.

On the other hand, as it is difficult to ensure sufficient container storage space in the planned container yard, various options for the location of the planned cargo shed should be investigated. In such investigation, the following conditions must be considered.

＊ Selection of a location which will guarantee the largest container storage area

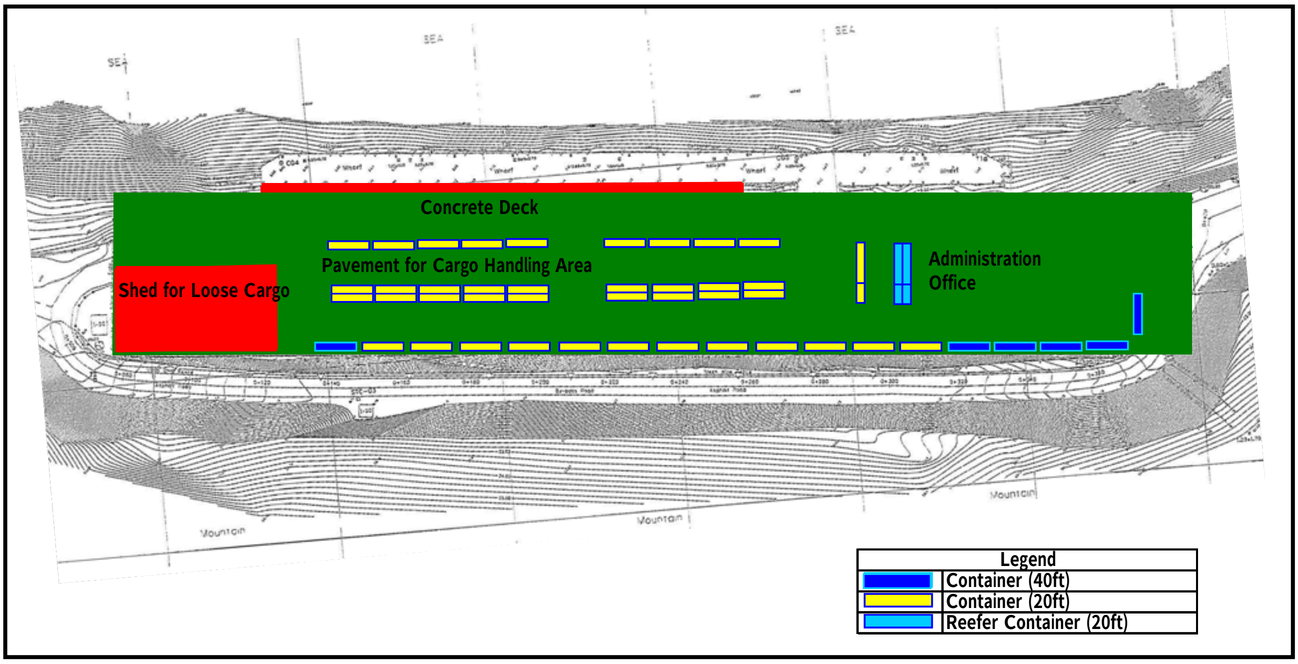
＊ Consideration of traffic flow of loose cargoes and LCL to the cargo shed after unloading

＊ Consideration of traffic flow of transport vehicles inside and outside the yard

＊ Selection of a location which will not affect the traffic flow even after extension of the existing pier, which is likely to be considered in future

＊ Minimal construction cost

Taking the above conditions into consideration, the two alternatives shown in the figures below were chosen for a comparative examination.



The characteristics of the two options shown above are summarized in the table below.

Table-6 Comparative examination of the cargo shed locations

	Option 1	Option 2
Characteristics of the location	Part of the existing cargo shed will be reused.	A new cargo shed will be built at the western end of the yard.
Container yard area (Convenience of the yard))	＊A larger area can be secured than Option 2. ＊At least 36 TEU of 40ft container storage can be secured.	＊There will remain a piece of land around the cargo shed which cannot be used as container yard. ＊Only 12 TEU of 40ft container storage can be secured.
Flow of cargo traffic	Part of the access between the pier and the yard will be restricted.	Sufficient access will be guaranteed between the pier and the yard.
Response to future plans (Flexibility to the plans)	＊Although it will not obstruct the traffic flow between the extended part of the pier and the yard, the number of storage slots for 40ft containers will be reduced by 4 TEU.	Part of the traffic flow between the extended part of the pier and the yard will be restricted.
Construction cost	Lower than Option 2	Higher than Option 1.
Overall assessment	○	△

As the results of the above examination confirmed the advantage of Option 1, taking the convenience of the container yard into consideration at the same time, it has been decided that the cargo shed in this project will be constructed by reusing part of the existing cargo shed (the steel frames in particular).

【Cargoes using the shed】

Among the loose cargoes and LCL going through the cargo shed in Port Vila, import of 800 tons (2 tons/package x 400 packages) of cement stands out as a unique trend in cargo transport. As mentioned above, the import of cement in units of 800 tons was observed three times in the first six months of 2007. Considering that the prosperity of the construction sector is expected to continue with economic cooperation from the US (in the form of the Millennium Challenge Account), the volume of imports of construction materials, such as cement and reinforcement bars, is expected to remain at the current level or increase slightly. Particular consideration will be given to the current situation of construction materials being imported as loose cargo when designing the cargo shed area.

Meanwhile, as the total area of the planned site of approximately 9,000m^2 is not particularly large, priority should be given to guaranteeing storage space for containers for export and import. Therefore, the cargo shed area will be considered under this constraint.

The cargo shed should be designed so that it has sufficient space for temporary storage of loose and LCL cargoes. However, the current situation does not allow the cargo shed to have sufficient area to accommodate these cargoes. Therefore, the highest priority in the design of the cargo shed area will be given to temporary storage of loose cargoes which must be kept out of the rain.

Under these circumstances, the design of the cargo shed in this project will give priority to temporary storage of cement and reinforcement bars.

a) Area required for loose cargo storage

i) Cement

As cement is being imported in units of 800 tons, the floor area required for storage of this amount of cement will be estimated.

Estimation conditions

① Bags of cement: 2tons/pck x 400pcks = 800tons
② Area of base of package: 2m x 1.5m = 3 m^2
③ Stowage height: two tiers (1 lot: 4tons)
④ Number of lots: 800tons ÷ 4tons = 200 lots

Therefore, the area required for 800 tons of cement bags is:
3 m^2 x 200 lots = 600 m^2

ii) Reinforcement bars

There have been four confirmed cases each of the import of 150 tons and 170 tons of reinforcement bars in the records. Thus, the required storage area will be estimated for the actual import of 170 tons of reinforcement bars.

Estimation conditions

① One bundle (with a length of 12m): 2 tons

② Area required for one bundle: 6.24 m2

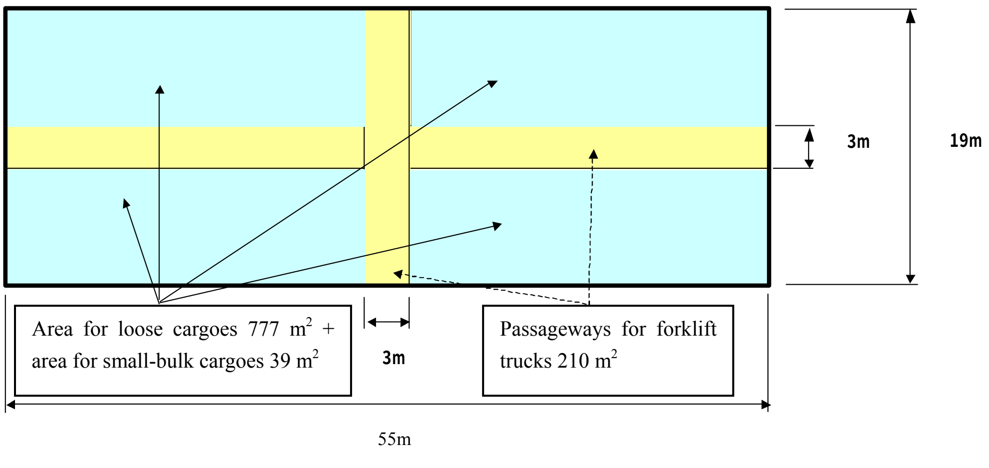
③ Stowage height: three tiers with sleepers

Therefore, the floor area required for the storage of reinforcement bars is:
$6.24\ m^2$/bundle x (170tons ÷ 2tons/bundle) ÷ 3 tiers = $176.8\ m^2$

【Design cargo shed floor area】

The floor area required for temporary storage of the two above-mentioned materials is approximately $777m^2$ in total. In addition, working space for the movement of forklift trucks will have to be secured for transport of the stored cargoes in the cargo shed. In consideration of the fact that each of the cargoes of a relatively large volume, such as cement and reinforcement bars, was consigned to a single company, only a minimal area required for the movement of forklift trucks with a width of 3m will be set aside. Allocation of one passageway each in the lengthwise and widthwise directions will require an area of approximately 210 m^2. As the planned cargo shed will reuse part of the existing cargo shed, the span of the existing steel frame structure must be taken into consideration in the design. Thus, an available floor area of 1,045 m^2 (= 19m x 55m) is established for further consideration.

As shown in the preceding section, the area for loose cargo storage will be 600 m^2 + 177 m^2 = 777 m^2. Addition of the passageways for forklift trucks as shown in the figure below makes a required cargo shed floor area of approximately 777 m^2 + 210 m^2 = 987 m^2. As the cargo shed in this project will make use of the structure of the existing cargo shed, the area corresponding to the difference of 58 m^2 between the available cargo shed floor area of 1,045 m^2 and the required area for loose cargo storage of 987 m^2 will be used as floor area for small bulk cargoes and the offices of IFIRA and others.



Summary of the calculation of the required floor area of the cargo shed

Appendix-5-2 Detailed Building Criteria

〔Bearing capacity of soil〕

Boring surveys were conducted at two locations in the ground in this project. One is on the southwestern side of the existing Cargo Shed and the other is between the existing Administration Office and the existing Cargo Shed near the wharf. The boring data of the site near the existing Administration Office show that the N value at ground level is 14 and at 4m below ground level is 50. Meanwhile, at the site southwest of the shed, even at 14m below ground level, the N value does not reach 50, implying an absence of bearing ground at depth. These data, as well as the plan of the existing Cargo Shed, suggest differences in elevation of strata. Taking into consideration the distance from the point very close to the existing Administration Office to the farthest part of the planned Administration Office, the elevation of the bearing ground of the Administration Office is set at GL -5.0m.

The following standards will be followed for the architectural design, structural design and related matters.

- Building Standard Law
- Standard for Structural Design of Reinforced Concrete, Architectural Institute of Japan
- Structural Design Standard for Special Concrete, Architectural Institute of Japan
- Design Standard for Steel Structures, Architectural Institute of Japan
- Recommendation for the Design of Building Foundations, Architectural Institute of Japan
- Japanese Industrial Standards, Japanese Standards Association
- ASTM

〔Electric facilities〕

As a power supply substation is situated on the southern side of the planned site in Port Vila, the plan is to extend three-phase main lines to the power receiving room on the first floor of the Administration Office and to distribute the power to the Administration Office, Cargo Shed and septic tank from the power receiving room.

The required electric energy of each facility is shown below.

Required electric energy -1

Name of facility	Required electric energy	
	Single-phase	Three-phase
1F Administration Office	16.10	9.30
2F Administration Office	21.80	
Cargo shed	7.80	2.10
Septic tank		2.40
Total	45.70	13.80
Three-phase equivalent	26.38	13.80
Total	40.18 KVA	

From interviews with UNELCO and observation of the power supply conditions at the site, we consider that there is no need for an emergency generator. As the substation very close to Port

Vila has the capacity to supply 50kVA of electric power at present, it is expected to be able to meet the above-mentioned required electric energy.

Meanwhile, the electric energy required for the outdoor lights in the port premises and as the power source for reefer containers was examined according to the following estimations.

Required electric energy - 2

Name of facility	Required electric energy	
	Single-phase	Three-phase
Outdoor lights	12.20	
Power source for reefer containers		66.00
Total		
Three-phase equivalent	7.10	66.00
Total	73.10 KVA	

To meet this requirement, a substation facility with a capacity of 75kVA will be required. Therefore, the plan is to construct a new substation on the site adjacent to the existing substation.

The table below shows the standard illuminance and requirements for receptacles, electric appliances, air conditioning facilities and equipment in each room in the Administration Office and the Cargo Shed.

Standard illuminance and facilities/equipment in each room

Building	Floor	Personnel and name of room	Illuminance	Receptacles	Telephone	LAN	Air conditioning/ ventilation
Administration Office	First	Manager of Border Customs	500	○	○	○	A/C
		Principal Compliance Officer	500	○	○	○	A/C
		Senior Compliance Officer	500	○	○	○	A/C
		Examination Border Officer					
		Examination Officer					
		Immigration Office	500	○	○		A/C
		Library & Store	150	○			Vent
		Storage for Dangerous Materials	200	○			Vent
		Small Kitchen	150	○			Vent
		Conference Room	400	○	○		A/C
		Toilets	100				Vent
		Entrance Hall	200				
		Corridor	150				
		Power Receiving Room	150				
	Second	Director		○	○	○	A/C
		Clerical Support Officer		○	○	○	A/C
		Harbor Master		○	○	○	A/C
		Assistant Harbor Master		○	○	○	A/C
		Manager of Operations		○	○	○	A/C
		Senior Finance Officer		○	○	○	A/C
		Finance Officer		○	○	○	A/C
		Captain & Boson		○	○		A/C
		Conference Room		○	○		A/C
		Small Kitchen		○			Vent
		Library		○			Vent
		Storage					
		Toilets					Vent
Cargo Shed	First	Storage Space					Vent
		Customs Office					
		IFIRA Office					
		Toilet					Vent

〔**Water supply and drainage facilities**〕

① Water supply

According to UNELCO, water supply mains (φ150) with a water pressure of 7 – 10 bars pass the planned site and the pier is equipped with fire hydrants. The water supply capacity of the mains is considered sufficient for the ordinary water supply. As a measure against reduction in water pressure and for an emergency water supply, a water tank will be installed in the Cargo Shed. The existing water supply pipe (φ25) branching from the mains will be used to supply water to the tank, from which water will be supplied to each building. The pipe which supplies water from the Cargo Shed to the Administration Office will be buried underground between the two buildings. Riser pipes connected to the underground pipe will be used to supply water to the water supply points on the first floor of the Administration Office. Water will be supplied to the water supply points on the second floor through horizontal extension from the pipe coming up through the PS. The water supply points are listed in the table below.

Building	Floor	Water supply point	Stool	Urinal	Wash basin	Sink	Number of stopcocks
Administration Office	First floor	Lavatory for male customs workers	1	2	2		5
		Lavatory for female customs workers	1		1		2
		Hot water supply room				1	1
	Second floor	Lavatory for male PHD workers	1	2	2		5
		Lavatory for female PHD workers	1		1		2
		Hot water supply room				1	1
Cargo Shed	First floor	Men's outdoor lavatory	2	2	2		6
		Women's outdoor lavatory	2		2		4

The result of investigation into the required water supply amount is described below.

Consumption of supplied water by approximately 30 permanent staff members working in the Administration Office is

30 x 100L = 3,000L/day.

Assuming that each use of four stools, two urinals and four wash basins in the lavatories of the Cargo Shed consumes

4 x 10L + 2 x 6L + 4 x 2L = 60L

of water and that each one is used 30 times a day, the total water supply amount becomes 30 x 60L = 1,800 L/day.

Thus, the total water supply volume will be 4,800 L /day.

Assuming the actual capacity of the water tank as approximately 80% of its capacity, installation of a 6.0m^3 (= 4.8m^3/0.8) water tank will be planned.

② Drainage:

Three major categories of wastewater are involved in this project. The first is wastewater with little pollution, represented by rainwater. The second is grey water, for example, from the hot water supply rooms. The last is wastewater from lavatories which requires artificial treatment. It is possible to discharge wastewater in the first category into the sea after collecting it in gutters. As the planned site is adjacent to the sea, simple treatment of wastewater in the third category by an inlet may not be enough to prevent it from polluting the seawater as mentioned above. Therefore, an aeration septic tank should be included in the design. The required processing capacity of the septic tank will be estimated on the basis of the number of users. As it is unlikely that wastewater in the second category, grey water or household wastewater, will receive general treatment in the planned buildings, it will be mixed with wastewater in the third category, processed in the septic tank and discharged into the sea.

1) Estimation of the capacity of the septic tank:

With regard to the required processing capacity of the septic tank, the pollutants in the wastewater were calculated in accordance with the Operational Guidelines for Estimation of Population for Waste Water Purifiers of Buildings (supervised by the former Ministry of Construction). The following are the calculations.

Influent concentration:	BOD	216mg/L
Daily average water volume:	15.0m^3/day	
Effluent concentration after treatment:	BOD	20mg/L

The bases for obtaining these design conditions are as follows:

1. Estimation of population:

a) Administration Office

n = 0.06 A (where A = total floor area: 560m^2.) ※ no kitchen

n = 0.06 × 560 = 34 people …(1)

b) Lavatories in the Cargo Shed

n = 16 C (where C = total number of toilets: 6)

As the frequency of usage is expected to be 50% of the estimate for the public lavatories, half of the coefficient, 16, was used in the estimation.

n = 16 ÷ 2 x 6 = 48 people …(2)

(1)＋(2) = 82 people

2) Estimate of the volume of polluted water:

a) Administration Office

34 people× 200L = 6,800L …(3)

b) Lavatories in the Cargo Shed

Same as above, considering the frequency of usage as half of that of the public lavatories, a volume of 1,200L / unit (= 2,400L x 1/2) was obtained.

For the six toilets, the volume was estimated at

1,200L/unit x 6units = 7,200L …(4).

(3) + (4) ≈ 15,000L = 15.0 m^3/day

3） Estimate of influent concentration:

a) Administration Office

6,800L × 200mg/L = 1.36kg …(5)

b) Lavatories in the Cargo Shed

7,200L × 260mg/L = 1.872kg …(6)

(5) + (6) = 3.232kg

3.232 kg ÷ 15.0 m^3 x 1,000 = 216mg/L

As the installation site of the septic tank is adjacent to the Administration Office, an effort is to be made to keep the spread of bad odor to the minimum by air blower as an anti-odor measure.

Appendix-5-3 Examination of Equipment Performance

(1) Tugboat

The basic design of the tugboat will be made on the principle of consideration for movement performance to speedily support large ships entering and leaving the port, safety in ship operations such as steering and turning, installation and arrangement of the equipment necessary for tugging work, and search and rescue and disaster prevention functions, with reference to a similar type of tugboat which is provided in Japanese ports.

	Requested Tugboat	Standard Tugboat in Japanese Ports
Total length Loa	Approx. 31.8 m	Approx. 31 – 34 m
Width Bmld	Approx. 8.8 m	Approx. 8.6 – 9.2 m
Depth Dmld	Approx. 3.8 m	Approx. 3.5 – 3.9 m
Draft Dmld	Approx. 2.9 m	Approx. 2.6 – 2.8 m
Trial run speed Knots	Approx. 14 knots	Approx. 12 – 14 knots (max.)
Main engine horsepower PS	Approx. 1,550 PS x 2 units	Approx. 1,500－1,700 PS x 2 units
Towing power Ton	Approx. 42 tons	Approx. 40 – 43 tons
Other functions	Search and rescue	Ship firefighting equipment, sea-surface oil treatment equipment, search and rescue

1) Examination of Ship Operation System

Conventional tugboat operations included escort operation aft of a ship entering the port to prevent the ship from grounding in the narrow, curved channel indicated by the entrance lighting buoy (168°1717', 17°44'8). As the tugboat was not equipped with a winch on its bow, it was unable to take the tug line and it supported only the work of pushing the ship in the event of an emergency.

In berthing operation, the tugboat was able to push the ship with its bow, but it had to use a stern hook in tug work and had to turn and do stern tugging work by taking the tug line. Therefore, it was impossible for the tugboat to do any speedy thrusting or tugging work in the event of an emergency and it was difficult to support the smooth berthing of ships.

The planned tugboat will take the tug line from the entrance lighting buoy position through the stern of the ship entering the port to the winch on the tugboat bow in order to enable escort operation by backward tugging work and bow thrusting work. When turning the ship in front of the jetty, the turning radius will be about 1 to 1.5 times the hull length in the thrusting and tugging work in order to secure safe and steady berthing of the ship. In berthing operation, it is very important to adjust the ship’s position and berthing speed in front of the pier. As the berthing speed is 15cm/s in the pier design, it is necessary for smooth berthing to reduce the berthing speed to the utmost as the approach distance between the ship and the jetty becomes smaller. Operation to enable the safe and steady berthing of the ship will be made by parallel thrusting using the bow of the planned tugboat, taking the wind direction and tidal drift into account and adjusting the ship’s berthing direction and speed by backward tugging work using the tug line from the bow winch.

2) Examination of tugging assistance power

i) Tugging assistance power necessary for berthing operation

The tugging assistance power necessary for berthing of large ships calling at Port Vila harbor at present was examined. In berthing operation, the ship is berthed by keeping it almost parallel to the mooring facility. In this case, the tugging assistance power (Te) required for the ship's cross movement is assumed: Te≧ship's cross movement resistance + reaction against external forces such as wind and currents.

$$Te \geqq {}^{1}/{}_{2}\, \text{Þ}_{w}\, L\, d\, C_{w90}\, (U_0+V_c)^2 + {}^{1}/{}_{2}\, \text{Þ}_{a}\; B_a\, C_{a90}\, V_a^2$$

Te	Tugging assistance power (kN)		
Þw , Þa	Water (1.025x10^{3}kg/m^3) and air (1.225kg/m^3) density		
L	Hull length of ship		
d	Draft		
Ba	Cross wind-exposed area		
Cw90	Cross movement resistance coefficient of ship	3.5	(Based on shallow water impact coefficient)
Ca90	Positive cross wind pressure resistance coefficient	1.00	
U0	Cross movement speed of ship	0.15m/s	
Vc	Current velocity (positive cross direction)	0.10m/s	
Va	Wind velocity (positive cross direction)	10m/s, 15m/s	
Required tug power (PS)	kW=6.92kN	85% constant power	

Source: "Reference Materials for Ship Operations" by Japan Captains' Association

a) 17,000GRT container/multi-purpose ship

17,500GRT (total length 161m) container/ multi-purpose ship Loa x B x d : 161m x 25m x 8.4m/6.4m "Coral Islander"	Wind velocity 10m/s		Wind velocity 15m/s	
	Full-load	Half-load	Full-load	Half-load
Cross movement resistance (kN)	122	93	122	93
Wind pressure resistance (kN)	152	144	343	325
Total resistance (kN)	274	237	465	418
Required tug thrust (kN)	274	237	465	418
Required tug power kW (PS)	1,900 (2,580)	1,640 (2,235)	3,210 (4,370)	2,890 (3,930)

b) 18,400GRT container/cargo ship

18,400GRT (total length 185m) container/ cargo ship Loa x B x d: 184m x 27.5m x 10.14m/7.4m "Pacific Voyager"	Wind velocity 10m/s		Wind velocity 15m/s	
	Full-load	Half-load	Full-load	Half-load
Cross movement resistance (kN)	168	123	168	123
Wind pressure resistance (kN)	215	191	484	430
Total resistance (kN)	383	314	652	553
Required tug thrust (kN)	383	314	652	553
Required tug power kW (PS)	2,650 (3,600)	2,170 (2,960)	4,510 (6,140)	3,830 (5,200)

c) 30,000GRT tanker (Total length 183m) MAOHI

30,000GRT (total length 183m) Petroleum product tanker Loa x B x d : 183m x 32.2m x 8m "MAOHI"	Wind velocity 10m/s		Wind velocity 15m/s	
	No full load	Half-load	No full load	Half-load
Cross movement resistance (kN)		134		134
Wind pressure resistance (kN)		194		436
Total resistance (kN)		328		569
Required tug thrust (kN)		328		569
Required tug power kW (PS)		2,265 (3,080)		3,940 (5,360)

d) 48,000GRT Cruiser

48,000GRT (total length 240m) cruiser Loa x B x d : 223m x 27m x 7.6m "Pacific Sun"	Wind velocity 10m/s	Wind velocity 15m/s
	Full load	Full load
Cross movement resistance (kN)	152	152
Wind pressure resistance (kN)	353	794
Total resistance (kN)	505	946
Required tug thrust (kN)	505	946
Require tug power kW (PS)	3,490 (4,750)	6,550 (8,900)

The required total horsepower of the main engines of the tugboat as a result of calculation of the maximum berthing assistance power by ship type for the ships calling at Port Vila is as follows:

Ship calling at Port Vila harbor	Wind velocity 10m/s Required main engine horsepower kW (PS)	Wind velocity 15m/s Required main engine horsepower kW (PS)
17,500GRT (total length 161m) container/multi-purpose ship (fully loaded)	1,900 (2,580)	3,210 (4,370)
17,500GRT (total length 161m) container/multi-purpose ship (half-loaded)	1,640 (2,235)	2,890 (3,930)
18,400GRT (total length 185m) container/cargo ship (fully loaded)	2,650 (3,600)	4,510 (6,140)
18,400GRT (total length 185m) container/cargo ship (half-loaded)	2,170 (2,960)	3,830 (5,200)
30,000GRT (total length 183m) tanker (half-loaded)	2,265 (3,080)	3,940 (5,360)
48,000GRT (total length 240m) cruiser	3,490 (4,750)	6,550 (8,900)

In regard to bow-thruster equipped ships, general cargo/container ships are equipped with a bow-thruster with a power of 0.3 to 0.5kW per 1m^2 of the hull area below the waterline and their propelling power is approximately 1.5 ton/100kW (approx. 1.0 ton/100 PS).

Assuming that a 17,500GRT container/multi-purpose ship calling at the port is equipped with a bow thruster, the bow thruster is estimated to have a thrust power of 380kW (517 PS and a propelling power of 5.7 ton) to 634kW (862 PS and a propelling power of 9.5 ton) because the hull area below the waterline is 1,268 m^2, and the propelling power of the bow thruster can be reduced from the total required propelling power as examined above.

The cruiser “Pacific Sun” is equipped with a bow thruster and a stern thruster with a total thrust power of 2,000kW (2,720 PS) and the required assistance horsepower at a wind velocity of 10m/s and 15m/s is 1,446kW (1,966 PS) and 4,458kW (6,062 PS) respectively. All the cruisers calling at Port Vila harbor are equipped with bow and stern thrusters, thereby needing no tugging assistance. Therefore, those cruisers are excluded from this examination.

If the constant wind velocity as the work limit and the tugboat’s main engine horsepower are 10m/s and 3,000 to 3,200 PS respectively from the above results, it is necessary to limit the berthing speed of 18,400GRT container ships (fully loaded).

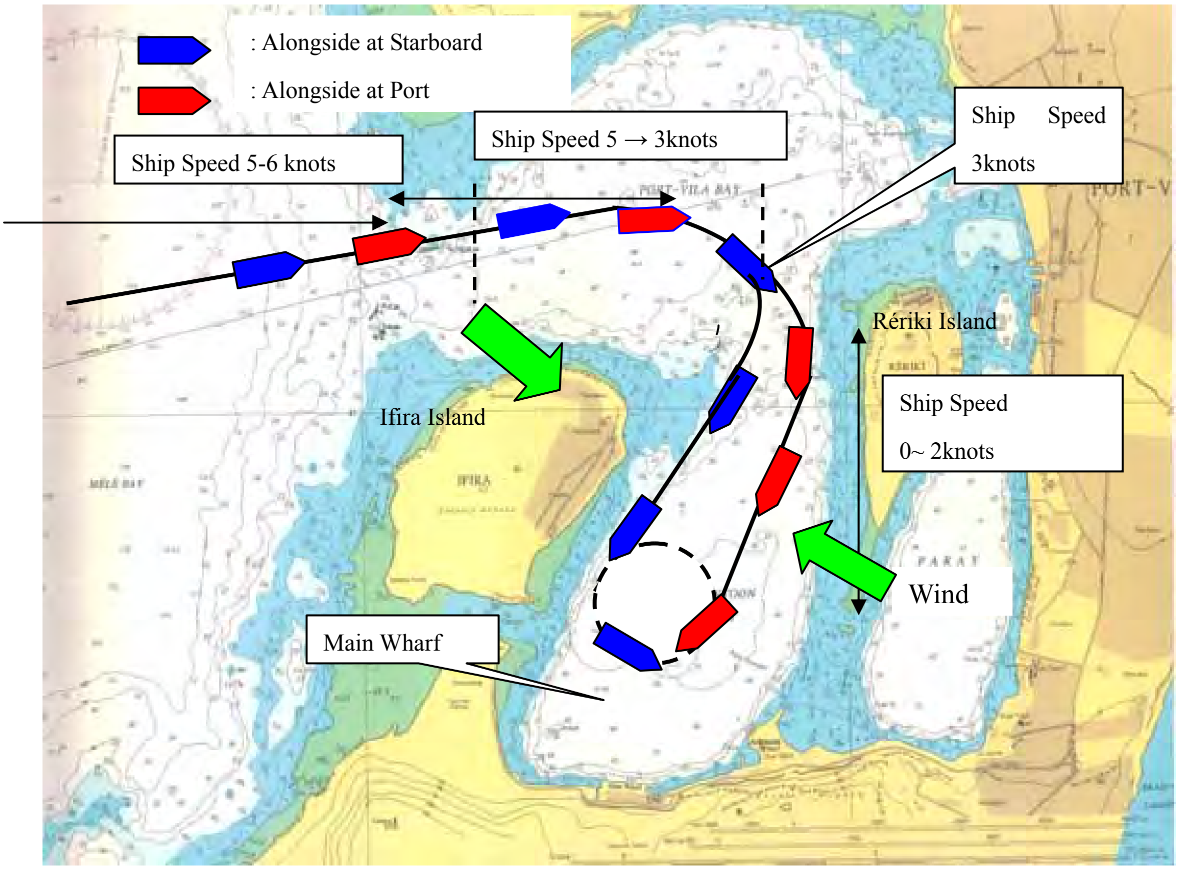
In the case of a berthing speed of 15cm/s or less in the pier design, it is necessary to reduce the berthing speed to the utmost within the range for smooth berthing as the distance between the jetty and the ship becomes smaller.

The results of calculating the maximum wind velocity values in the case of a berthing speed of 0m/s (capable of holding the position) and 0.05m/s are shown in the table below. The maximum wind velocity in the case of a berthing speed of 0m/s which is capable of holding the ship’s position is 10m/s or more, and if the berthing speed is limited to 0.05m/s or less, an 18,400GRT container ship (fully loaded) can move to the jetty at a wind velocity of 10m/s. In the case of the 3,200PS tugboat, the wind velocity approximates to the variable wind velocity (at which the gust ratio is generally about 1.3 times the constant wind velocity).

	3,000PS Tugboat		3,200PS Tugboat	
Ships calling at Port Vila port	Berthing Speed 0m/s	Berthing Speed 0.05m/s	Berthing Speed 0m/s	Berthing Speed 0.05m/s
17,500GRT (total length 161m) container/ multipurpose ship (fully loaded)	14.0m/s	12.3m/s	14.5m/s	12.8m/s
17,500GRT (total length 161m) container/multi-purpose ship (half-loaded)	14.5m/s	12.9m/s	15.0m/s	13.5m/s
18,400GRT (total length 185m) container/cargo ship (fully loaded)	11.7m/s	9.5m/s	12.1m/s	10.0m/s
18,400GRT (total length 185m) container/cargo ship (half-loaded)	12.5m/s	10.6m/s	12.9m/s	11.2m/s
30,000GRT (total length 183m) tanker (half-loaded)	12.4m/s	10.5m/s	12.8m/s	11.0m/s

ii) Tugging assistance power necessary for channel control operation

A ship calling at the port enters by the entrance lighting buoy into Port Vila Bay and turns 180 degrees between Ifira Island and Rériki Island. The ship navigates toward the Main Wharf at a speed of 2 knots or less past Ifira Island when berthing at starboard and past Rériki Island when berthing at port. Wind from a south-easterly or north-westerly direction blows against the hull of the ship as it approaches under adverse steering conditions at a speed of 2 knots or less, thereby making control of the ship in the channel difficult. The ship enters Port Vila Bay under a wind speed of 10m/s or less. The tugging (thrusting) assistance power necessary for channel control (holding the channel) under wind speeds of 10m/s and 15m/s was verified by simulation and the verification results were as follows:



<Simulation Conditions>

Ship type: 18,400GRT container/cargo ship

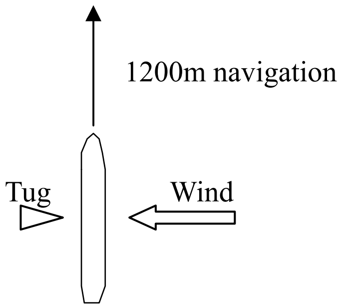
Total length = 185.0m

Width = 27.6m

Draft = 9.0m

Wind-pressured side area = 3510m^2

The wind conditions are 10m/s and 15m/s against the ship's side.



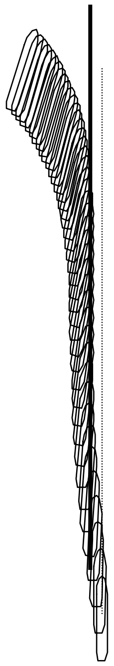
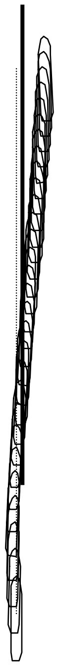
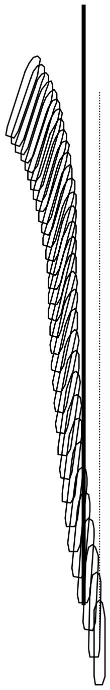
The tugboat pushed the hull center of the ship in the opposite direction to the wind pressure (with no propelling control).

The propelling power of the tugboat was 15t and 20t at a wind velocity of 10m/s and 35t and 40t at a wind velocity of 15m/s, and the ship navigated at an initial speed of 2 knots for 1200m through the channel.

In this simulation, the propeller's rotation was set to a value equivalent to 1.5 knots at a wind velocity of 10m/s and to 2.6 knots at 15m/s. (The minimum revolutions are ignored.)

Extracted Indices: Deviation from the channel at the 1200m point, remaining speed, and maximum and average rudder angles

Wind velocity	10m/s	10m/s	15m/s	15m/s
Tug propelling power	15t	20t	35t	40t
Deviation	170m	78m	163m	16m
Remaining speed	0.2 knot	1.1 knot	0.4 knot	1.2 knot
Maximum rudder angle	25 degrees	16 degrees	22 degrees	20 degrees
Average rudder angle	16 degrees	11 degrees	14 degrees	13 degrees

Ship's Track				

The constant wind velocity at the working limit was set to 10m/s and the variable wind velocity (gust ratio of 1.3) was set to 13m/s to obtain the tugboat propelling power of about 34 tons necessary to offset the deviation from the channel (the horsepower of the main engines was 3,180PS).

iii) Cruising distance

Vanuatu is an archipelago extending 1,200km from north to south. The planned tugboat will provide berthing assistance to ships calling at Port Vila harbor. Assistance to be provided at the islands of Vanuatu in the event of disaster and the cruising distance of about 1,800km for ships navigating to Australia from the port will be examined.

North-south distance of Vanuatu	648 nm (1,200km)
Port Vila – Luganville distance (tug aid and repair dock)	135 nm (250km)
Port Vila – Australia distance (repair dock)	972 nm (1,800km)

(1) Pilot boat

To design the optimum pilot boat, it is necessary to examine in detail various conditions including the navigation conditions, natural conditions and the maintenance capacity of the implementing agency. However, the basic conditions for dispatching a pilot to a ship calling at the port and designing a pilot boat with good surge resistance, high maneuvering performance and sufficient seaworthiness to ensure that the pilot can board and leave the ship and do line handling work safely, quickly and steadily have been examined as follows:

		Requested Pilot Boat	Standard Pilot Boat in Japanese Ports
Total length	Loa	Approx. 12.0m	Approx. 13－17m
Width	Bmld	Approx. 3.80m	Approx.
Depth	Dmld	Approx. 1.50m	Approx.
Main engines		Approx. 220PS x 2	Approx. 220PS ~ 550PS x 2
Maximum speed		Approx. 12 knots	Approx. 18－23 knots
Crew		3 members	3 ~ 5 members

1) Design study

The hull of small craft is made of FRP, steel, high-tension steel or aluminum alloy.

As a pilot boat must be able to approach the hull of a ship when going to and returning from the ship in rough seas, it must have high rigidity and consideration must be given to easy repair of damaged parts. The required ship speed is 12 knots and high-tension steel or aluminum alloy construction is not needed to reduce the hull weight. The repair shops in Port Vila have no experience in the repair of high-tension steel or aluminum alloy boats. An FRP boat, if badly damaged, could not be repaired and would be difficult to dispose of and would have a high impact on the environment. Therefore, the planned pilot boat will be made of steel like the other pilot boats possessed by the implementation agency.

Material	Weight	Rigidity	Ease of Repair	Price
FRP	Light	Low	Easy, but serious damage is unrepairable.	Medium Cost of manufacturing mold is high.
Steel	Heavy	High	Easy	Medium
High-tension steel	Heavy	Excellent	Difficult	High
Aluminum alloy	Light	Good	Difficult	High

Appendix-5-4 Basic Data for Wind and Wave Analyses

(1) Winds

The average wind distribution (source: Meteorological Agency database) in the Southwestern Pacific Ocean in which the country of Vanuatu is located is shown in Figure A.1 and Table A.1.

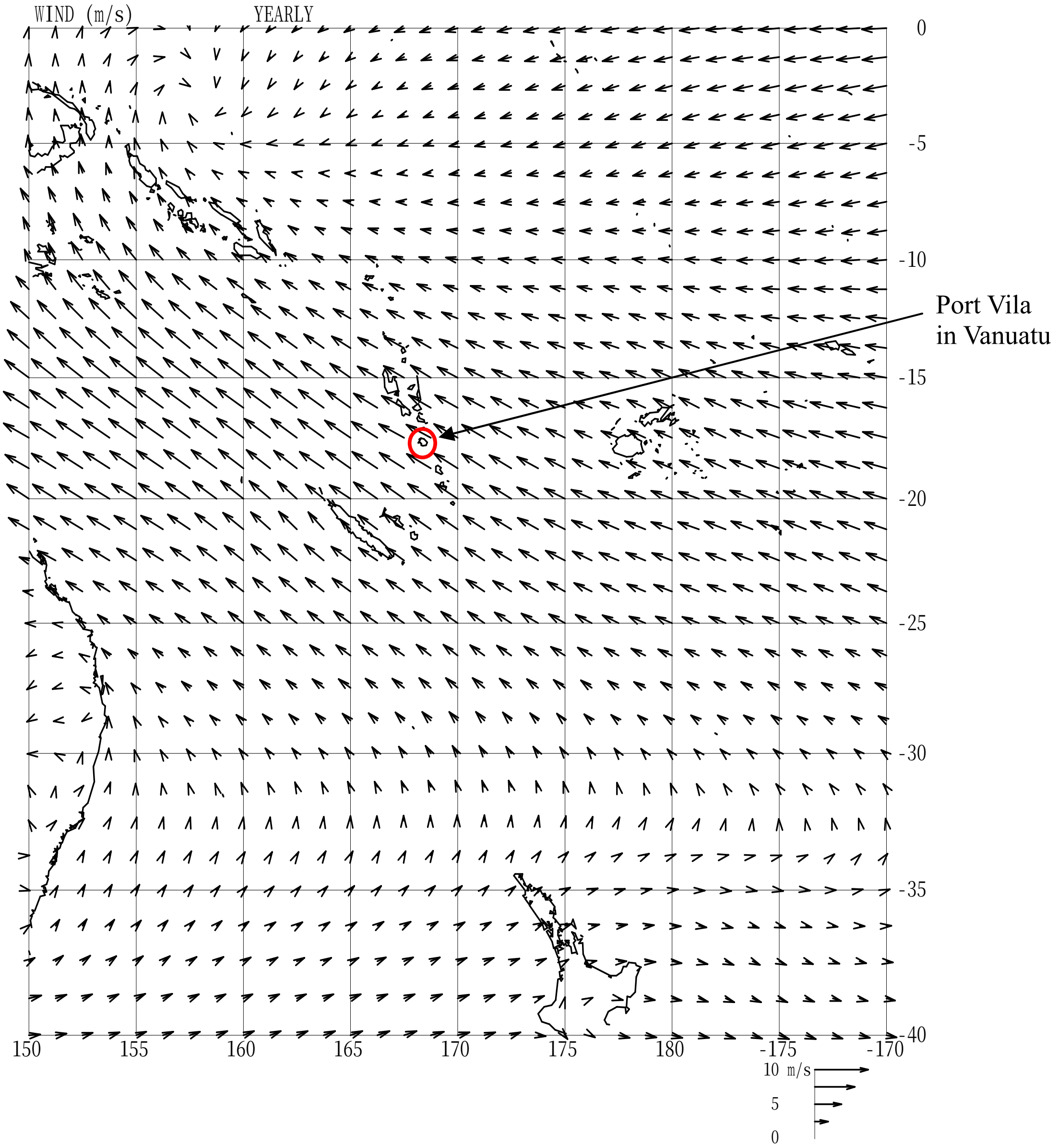


Figure A.1 Average wind distribution in the southwest of the Pacific Ocean
(March 2001 to February 2004: Data by Meteorological Agency)

Table A.1 Frequency table of wind direction and wind velocity
(March 2001 to February 2004: Data by Meteorological Agency)

YEARLY

Direction U(m/s)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW		Total
0.0 - 0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.1 - 2.5	19	16	20	34	43	36	41	31	22	18	13	11	10	12	10	16	0	352
	0.43	0.36	0.46	0.78	0.98	0.82	0.94	0.71	0.50	0.41	0.30	0.25	0.23	0.27	0.23	0.36	0.00	8.03
2.5 - 5.0	39	40	62	95	235	226	171	73	62	18	18	17	13	20	24	26	0	1139
	0.89	0.91	1.41	2.17	5.36	5.16	3.90	1.67	1.41	0.41	0.41	0.39	0.30	0.46	0.55	0.59	0.00	25.98
5.0 - 7.5	10	28	23	67	263	481	369	107	33	14	7	1	3	7	15	19	0	1447
	0.23	0.64	0.52	1.53	6.00	10.97	8.42	2.44	0.75	0.32	0.16	0.02	0.07	0.16	0.34	0.43	0.00	33.01
7.5 - 10.0	2	5	5	20	114	380	369	79	25	2	4	0	1	2	4	2	0	1014
	0.05	0.11	0.11	0.46	2.60	8.67	8.42	1.80	0.57	0.05	0.09	0.00	0.02	0.05	0.09	0.05	0.00	23.13
10.0 - 12.5	1	0	3	5	18	127	128	22	5	2	2	1	0	1	3	2	0	320
	0.02	0.00	0.07	0.11	0.41	2.90	2.92	0.50	0.11	0.05	0.05	0.02	0.00	0.02	0.07	0.05	0.00	7.30
12.5 - 15.0	0	2	1	1	0	46	31	5	0	1	0	0	0	0	3	2	0	92
	0.00	0.05	0.02	0.02	0.00	1.05	0.71	0.11	0.00	0.02	0.00	0.00	0.00	0.00	0.07	0.05	0.00	2.10
15.0 - 17.5	1	0	0	1	0	8	6	1	0	0	0	0	0	0	0	0	0	17
	0.02	0.00	0.00	0.02	0.00	0.18	0.14	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.39
17.5 - 20.0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2
	0.00	0.02	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05
20.0 - 22.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22.5 - 25.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25.0 - 27.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
27.5 - 30.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.02
30.0 - 100.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	72	92	114	223	673	1305	1115	318	147	55	44	30	27	42	60	67	0	4384
	1.6	2.1	2.6	5.1	15.4	29.8	25.4	7.3	3.4	1.3	1.0	0.7	0.6	1.0	1.4	1.5	0.0	100.0

Upper : Number of contents
Lower : Percentage of occurrence

(2) Waves

1) Offshore wave data

a) Waves at normal time

The waves at normal time in Vanuatu were estimated by the condition of offshore waves (disregarding Efate Island located in Port Vila Bay) using the "single-point spectrum method" based on the horizontal data of winds in the southwestern Pacific Ocean. The "single-point spectrum method" is a wave estimation method using a simple calculation program to make the estimation at a single point, taking into account wave irregularity in generation, development and propagation of waves and swells due to wind. This method makes it possible to estimate the waves for a long period of more than one year and obtain the wave characteristics (wave frequency table) at normal time in the sea area in this study by outputting the time-series data (wave height, wave period and wave direction) of the waves approaching the study point. Table A.2 shows the wave frequency table which was obtained by calculation of the waves at an offshore point as planned.

(b) Waves in time of emergency

On the other hand, the sea waters surrounding Vanuatu are in an area through which pass cyclones generated in the South Pacific Ocean that impact the waves. Figure A.3 shows the route of some of the cyclones that passed through this sea area in the last 60 years (1945 – 2003), which brought high waves to Vanuatu (the cyclones which meet three (3) conditions as described below). The cyclones in the South Pacific Ocean are generated in an area around latitude 10 degrees south and move to a higher latitude area. However, their routes vary: some move in a southwesterly direction and some in a southeasterly direction. This characteristic is in contrast with the typhoons that have a clear pattern of movement in the Northwestern Pacific Ocean in which Japan is located.

The scale of past cyclones was then examined using the parameter K_t as indicated below. Cyclone No. 9323 that hit Vanuatu in March 1993 was the largest scale of cyclone with a parameter K_t value of 64. (The second largest cyclone was No. 9225 that hit in March 1992 and its K_t value was 44, and the third largest one was cyclone No. 8813 in February to March 1988 and its K_t value was 42.)

The conditions for selecting cyclones were:

i) The shortest distance between the planned point and the cyclone center was 300km or less.
ii) The maximum momentary wind velocity of the cyclone was 20m/s or more.
iii) The maximum value of the parameter (K_t) in the following formula is 20 or more:
$K_t = U^2/D$,

Where U: Maximum momentary wind velocity (m/s)
D: Distance (km) from the cyclone center to the planned point (minimum: 50km)

Figure A.4 shows the results of calculating the offshore waves generated by the largest cyclone (9323) using the “single-point spectrum method”. In this figure, the largest wave data during this period were a wave height of 12.7m, wave period of 13.6s and NE wave direction. On the other hand, the third largest cyclone (8813) was calculated and the results are shown in Figure A.5. The data for the largest wave (significant wave) were a wave height of 10.7m, wave period of 12.2s and WSW wave direction. In considering the topographic conditions around the planned point, it is thought that this wave had a large impact on the planned point.

2) Waves in the vicinity of the planned point

The planned point was located within Mele Bay on Efate Island and at the deepest part of Port Vila Bay, the entrance of which is located at the easternmost part of Mele Bay. Therefore, the offshore waves as calculated in the preceding section do not reach the planned point. Then, the calculations of wave deformation within Mele Bay and within Port Vila Bay were made to obtain the data on the waves reaching the planned point.

In the calculations of wave deformation, the method to solve the energy balance equation which is deemed to be the most common method of irregular wave deformation calculation was used. The field of calculation (large field) in the surrounding area of Mele Bay is shown in Figure A.6. The small field in this figure is the field for calculation of waves intruding into Port Vila Bay. Figure A.7

shows the field of calculation within Port Vila Bay. In the calculation of wave deformation in the small field, the data for waves in the offshore boundary of the small field were obtained from the results of calculation in the large field in order to use the results for the calculation of wave deformation within Port Vila Bay.

Figure A.8 shows the results of wave deformation calculations within Mele Bay for the waves generated by the cyclone (8813). In this figure, the deflection factor in the entrance area of Port Vila Bay is about 0.7. The incoming wave direction at the entrance area is around S85°W. Figure A.8 also shows the results of wave deformation calculations for the waves intruding into Port Vila Bay based on the above calculation results. In this figure, the deflection factor around the planned point decreased to about 0.07 assuming that the deflection factor at the entrance of Port Vila Bay is 1. The incoming wave direction is almost the N-direction. In overlaying these data, the deflection factor around the planned point to the offshore waves is about 0.05, and even if the waves approach due to the cyclone (8813), the offshore waves at the planned point are reduced to about 0.5m high.

As described above, the impact of the waves generated in the open sea on the waves at the planned point is small, but it is thought that strong winds due to the cyclones passing through the surrounding area of Port Vila harbor have an impact on the waves generated within the bay.

Figure A.10 shows the results of calculations of the effective blowing distance within Port Vila Bay. In this figure, the maximum value of effective blowing distance was about 1.3km in the NNE direction. According to the calculation results of the waves due to the cyclone as mentioned above, the maximum wind velocity around the Port Vila point is about 40m/s. Thus, the wind velocity was set to 50m/s at the planned point, allowing for a margin of risk.

In calculating the waves generated at the planned point within the bay based on these results, the maximum wave height is 1.4m in a wave period of about 3 seconds and it is higher than the incoming waves from the open sea.

Table A.2 Frequency table of wave height by direction and by level

(Offshore waves at planned point in Vanuatu, March 2001 to February 2004)

WAVE DIRECTION WAVE HEIGHT(M)	U.K.	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0
0.00 - 0.50	0 .0	0 .0	0 .0	7 .0	25 .1	1 .0	54 .2	165 .6	0 .0	30 .1	0 .0	0 .0	45 .2	0 .0	0 .0	0 .0	0 .0	327 1.2
0.50 - 1.00	0 .0	5 .0	4 .0	38 .1	175 .7	9 .0	371 1.4	651 2.5	68 .3	427 1.6	6 .0	0 .0	92 .3	5 .0	3 .0	0 .0	34 .1	1888 7.2
1.00 - 1.50	0 .0	6 .0	11 .0	24 .1	145 .6	25 .1	1542 5.9	1382 5.3	114 .4	1041 4.0	10 .0	0 .0	8 .0	31 .1	19 .1	0 .0	11 .0	4369 16.6
1.50 - 2.00	0 .0	0 .0	13 .0	8 .0	134 .5	37 .1	1916 7.3	1442 5.5	310 1.2	1162 4.4	1 .0	1 .0	1 .0	33 .1	17 .1	0 .0	0 .0	5075 19.3
2.00 - 2.50	0 .0	1 .0	10 .0	3 .0	36 .1	52 .2	1734 6.6	1451 5.5	218 .8	845 3.2	1 .0	3 .0	10 .0	2 .0	16 .1	0 .0	0 .0	4382 16.7
2.50 - 3.00	0 .0	0 .0	0 .0	0 .0	19 .1	71 .3	1506 5.7	1130 4.3	128 .5	679 2.6	3 .0	8 .0	16 .1	0 .0	5 .0	0 .0	0 .0	3565 13.6
3.00 - 3.50	0 .0	0 .0	0 .0	0 .0	1 .0	52 .2	1154 4.4	1040 4.0	94 .4	509 1.9	0 .0	0 .0	0 .0	0 .0	6 .0	0 .0	0 .0	2856 10.9
3.50 - 4.00	0 .0	2 .0	0 .0	3 .0	3 .0	34 .1	620 2.4	679 2.6	98 .4	272 1.0	0 .0	0 .0	0 .0	0 .0	4 .0	0 .0	3 .0	1718 6.5
4.00 - 5.00	0 .0	15 .1	0 .0	0 .0	8 .0	24 .1	701 2.7	544 2.1	51 .2	139 .5	0 .0	0 .0	0 .0	0 .0	14 .1	4 .0	10 .0	1510 5.7
5.00 - 6.00	0 .0	15 .1	5 .0	2 .0	7 .0	0 .0	193 .7	112 .4	6 .0	22 .1	0 .0	0 .0	0 .0	0 .0	4 .0	0 .0	18 .1	384 1.5
6.00 - 7.00	0 .0	7 .0	3 .0	0 .0	0 .0	0 .0	93 .4	62 .2	0 .0	7 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	172 .7
7.00 -	0 .0	9 .0	0 .0	0 .0	0 .0	0 .0	28 .1	9 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	4 .0	1 .0	51 .2
TOTAL	0 .0	60 .2	46 .2	85 .3	553 2.1	305 1.2	9912 37.7	8667 33.0	1087 4.1	5133 19.5	21 .1	12 .0	172 .7	71 .3	88 .3	8 .0	77 .3	26297 100.0

Table A.3 Frequency table of wave height by wave period

(Offshore waves at planned point in Vanuatu, March 2001 to February 2004)

WAVE PERIOD(S) WAVE HEIGHT(M)	CALM	0- 1	1- 2	2- 3	3- 4	4- 5	5- 6	6- 7	7- 8	8- 9	9-10	10-11	11-12	12-13	13-14	14-15	15-	TOTAL
CALM	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0
0.00 - 0.50	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	15 .1	24 .1	12 .0	39 .1	50 .2	74 .3	49 .2	49 .2	15 .1	0 .0	0 .0	327 1.2
0.50 - 1.00	0 .0	0 .0	0 .0	0 .0	0 .0	35 .1	193 .7	166 .6	330 1.3	413 1.6	274 1.0	248 .9	129 .5	62 .2	20 .1	18 .1	0 .0	1888 7.2
1.00 - 1.50	0 .0	0 .0	0 .0	0 .0	0 .0	32 .1	453 1.7	692 2.6	609 2.3	565 2.1	628 2.4	758 2.9	425 1.6	116 .4	47 .2	44 .2	0 .0	4369 16.6
1.50 - 2.00	0 .0	0 .0	0 .0	0 .0	0 .0	2 .0	554 2.1	804 3.1	961 3.7	853 3.2	714 2.7	633 2.4	384 1.5	113 .4	28 .1	21 .1	8 .0	5075 19.3
2.00 - 2.50	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	397 1.5	993 3.8	894 3.4	552 2.1	543 2.1	507 1.9	283 1.1	120 .5	36 .1	57 .2	0 .0	4382 16.7
2.50 - 3.00	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	46 .2	1158 4.4	893 3.4	519 2.0	217 .8	197 .7	105 .4	24 .1	97 .4	262 1.0	47 .2	3565 13.6
3.00 - 3.50	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	687 2.6	789 3.0	526 2.0	248 .9	76 .3	43 .2	148 .6	110 .4	205 .8	24 .1	2856 10.9
3.50 - 4.00	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	124 .5	833 3.2	428 1.6	105 .4	38 .1	48 .2	38 .1	86 .3	18 .1	0 .0	1718 6.5
4.00 - 5.00	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	7 .0	926 3.5	316 1.2	43 .2	54 .2	57 .2	84 .3	14 .1	9 .0	0 .0	1510 5.7
5.00 - 6.00	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	101 .4	276 1.0	7 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	384 1.5
6.00 - 7.00	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	122 .5	50 .2	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	172 .7
7.00 -	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	0 .0	40 .2	10 .0	1 .0	0 .0	0 .0	0 .0	0 .0	51 .2
TOTAL	0 .0	0 .0	0 .0	0 .0	0 .0	69 .3	1658 6.3	4655 17.7	6348 24.1	4609 17.5	2919 11.1	2595 9.9	1524 5.8	754 2.9	453 1.7	634 2.4	79 .3	26297 100.0

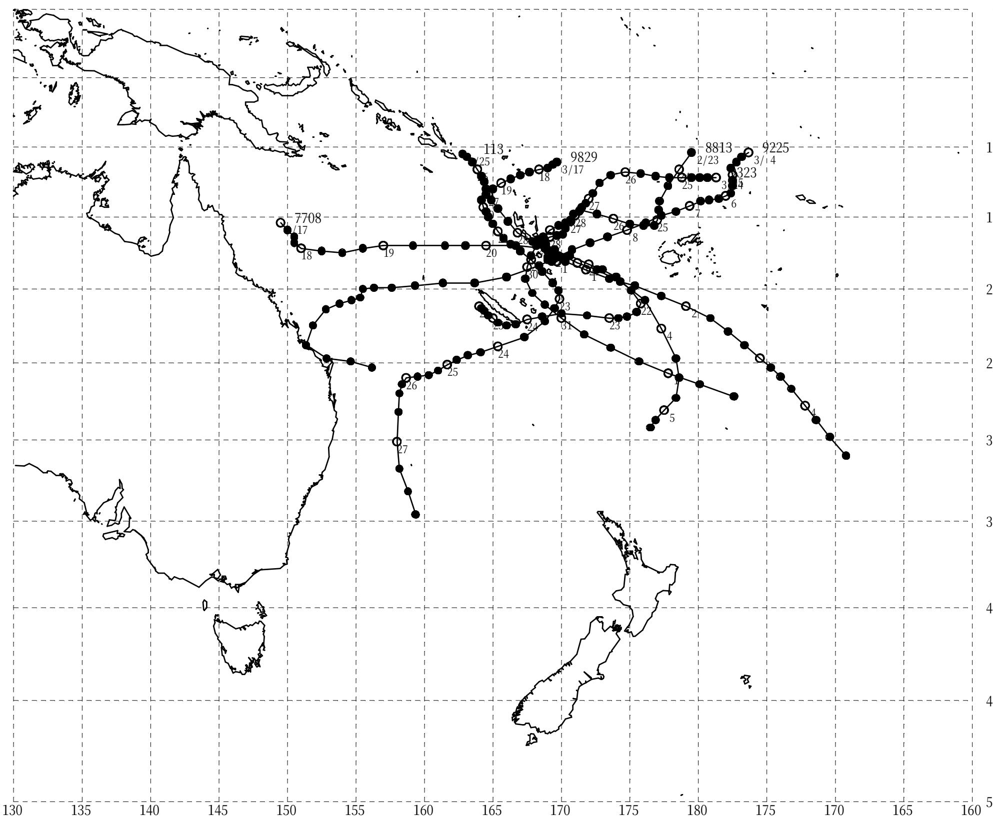


Figure A.3 Routes of large-scale cyclones (1945 – 2003)

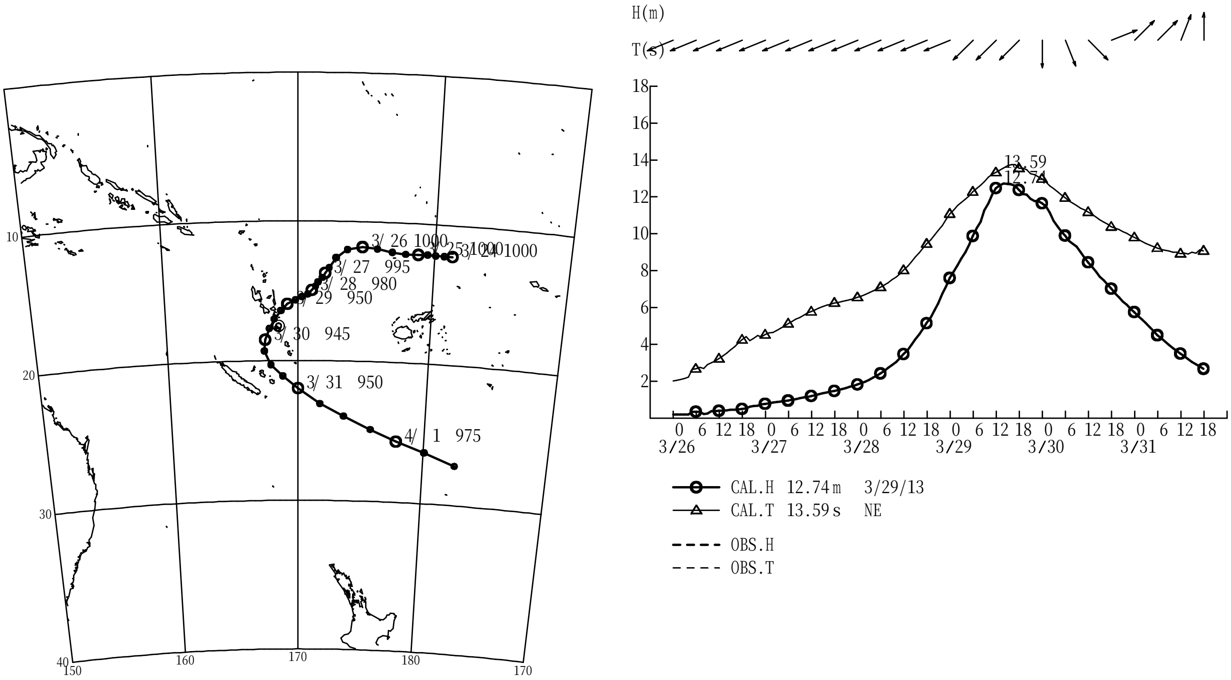


Figure A.4 Results of calculation of waves due to cyclone (9323)

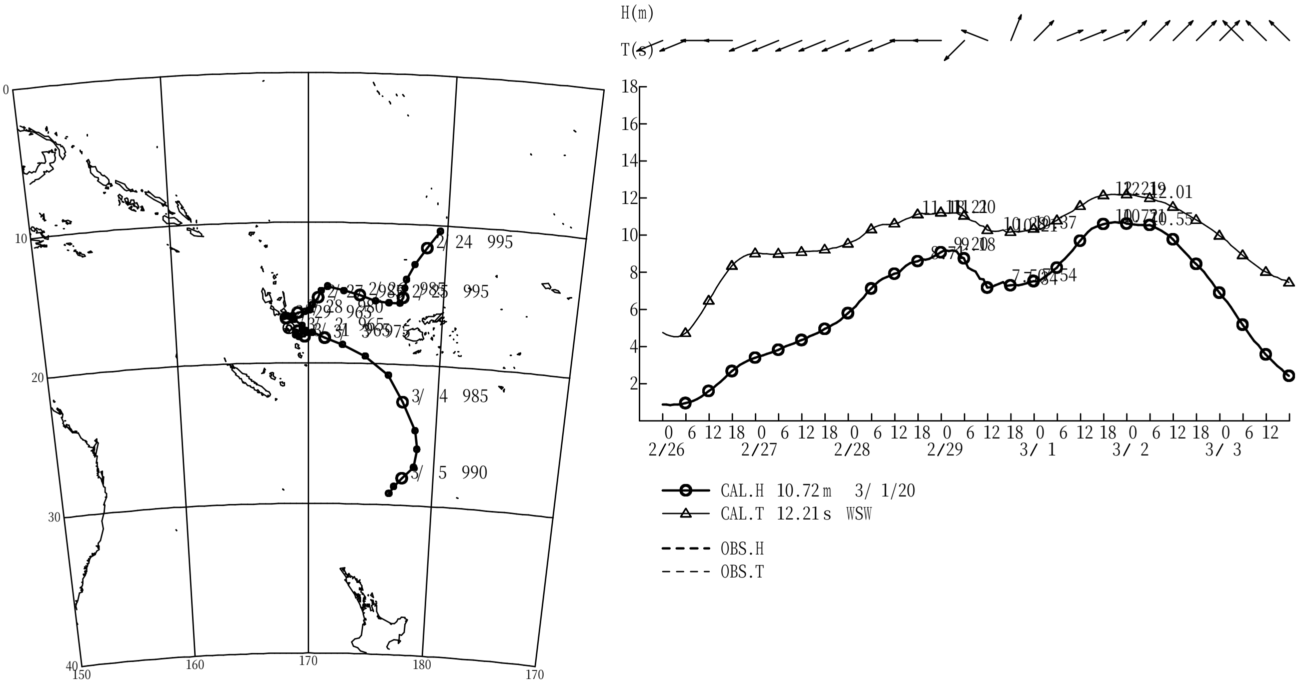


Figure A.5 Results of calculation of waves due to cyclone (8813)

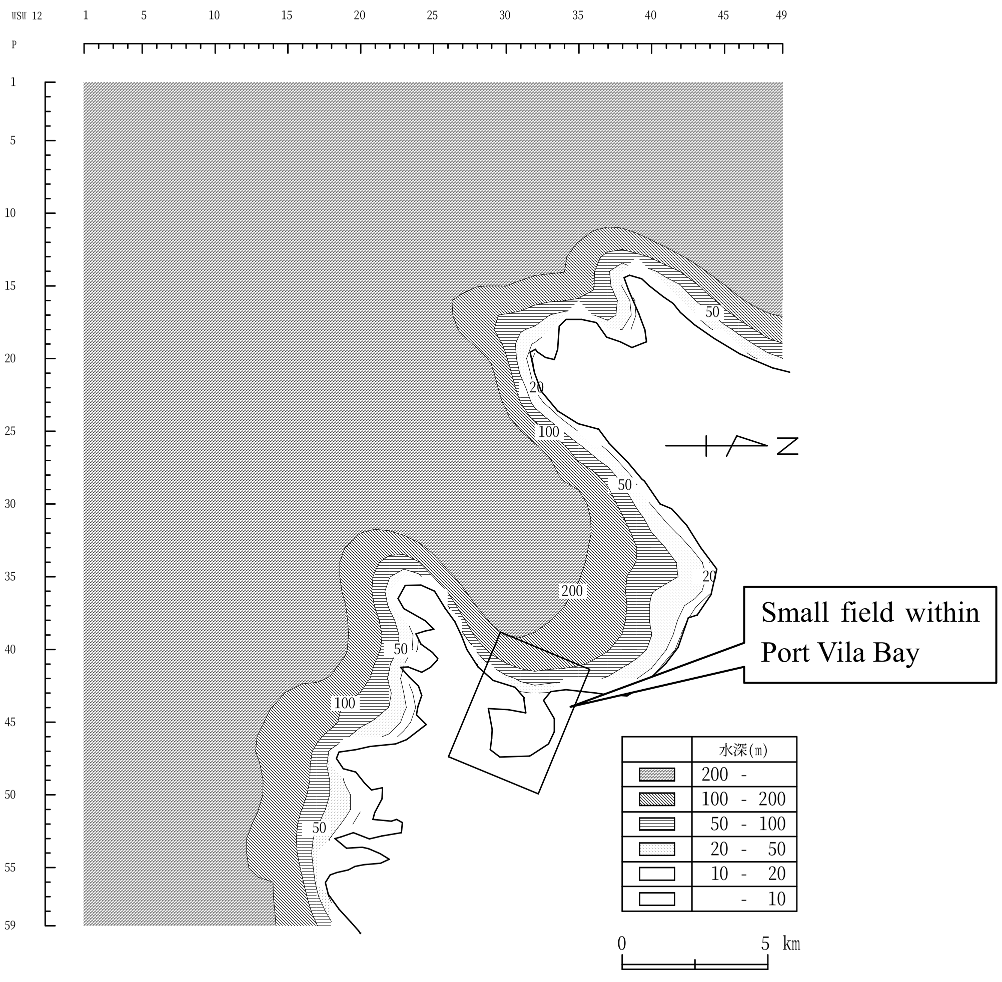


Figure A.6 Field of calculation of wave deformation (large field)

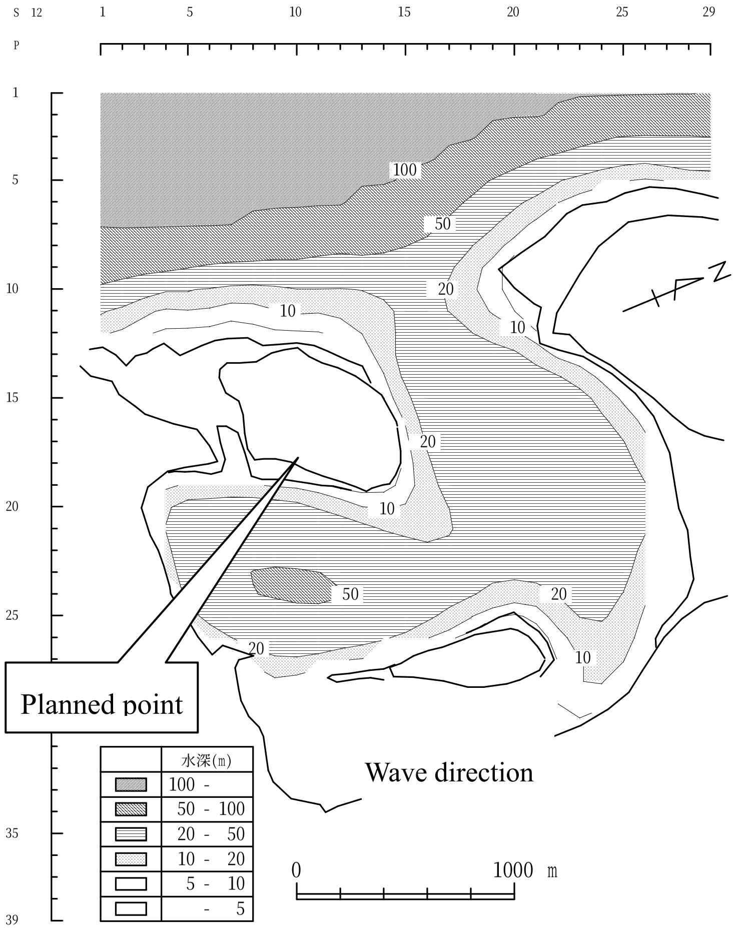


Figure A.7 Field of calculation of wave deformation (small field)

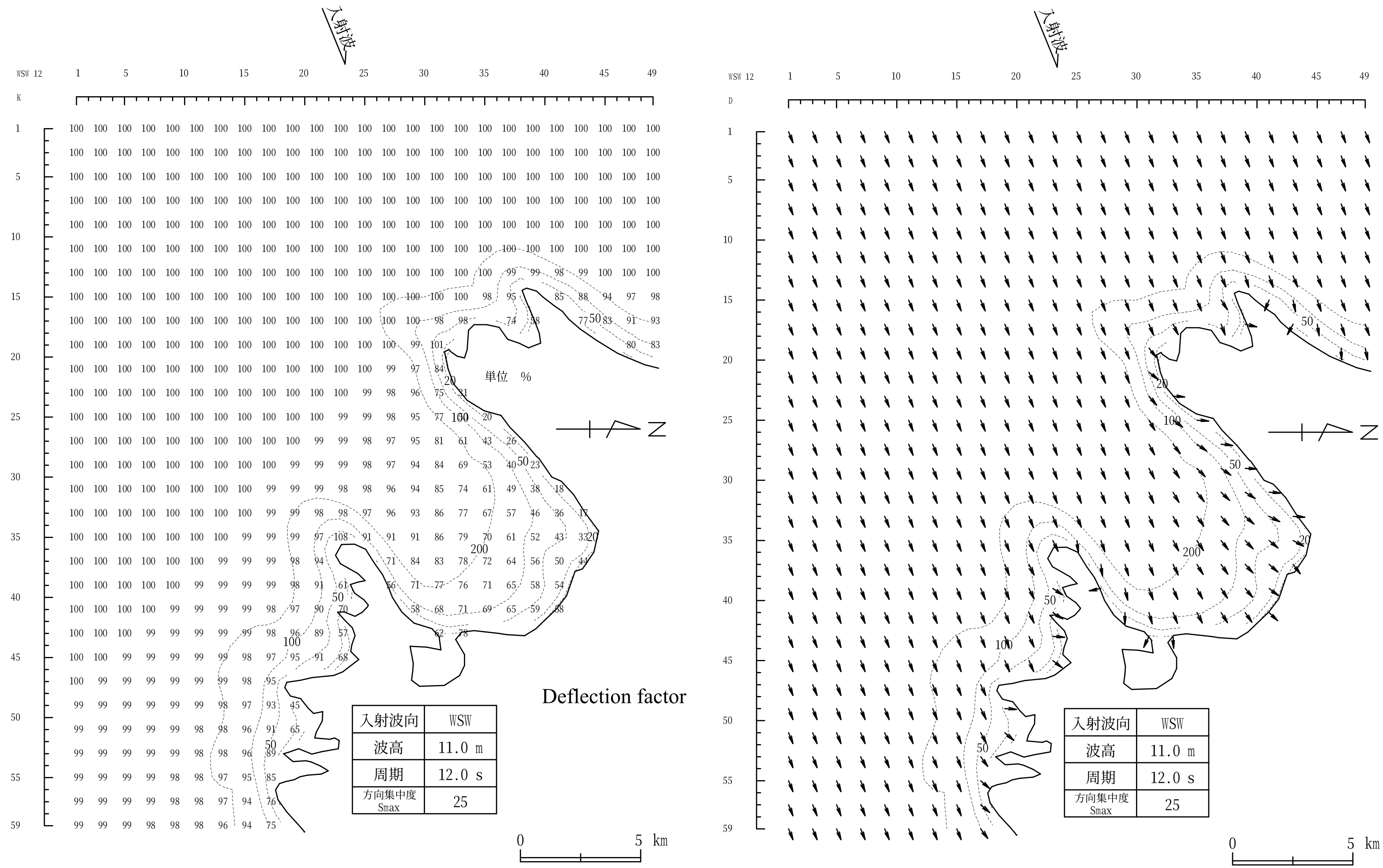


Figure A.8 Results of wave deformation calculations
(waves in time of emergency, open sea waves and large field)

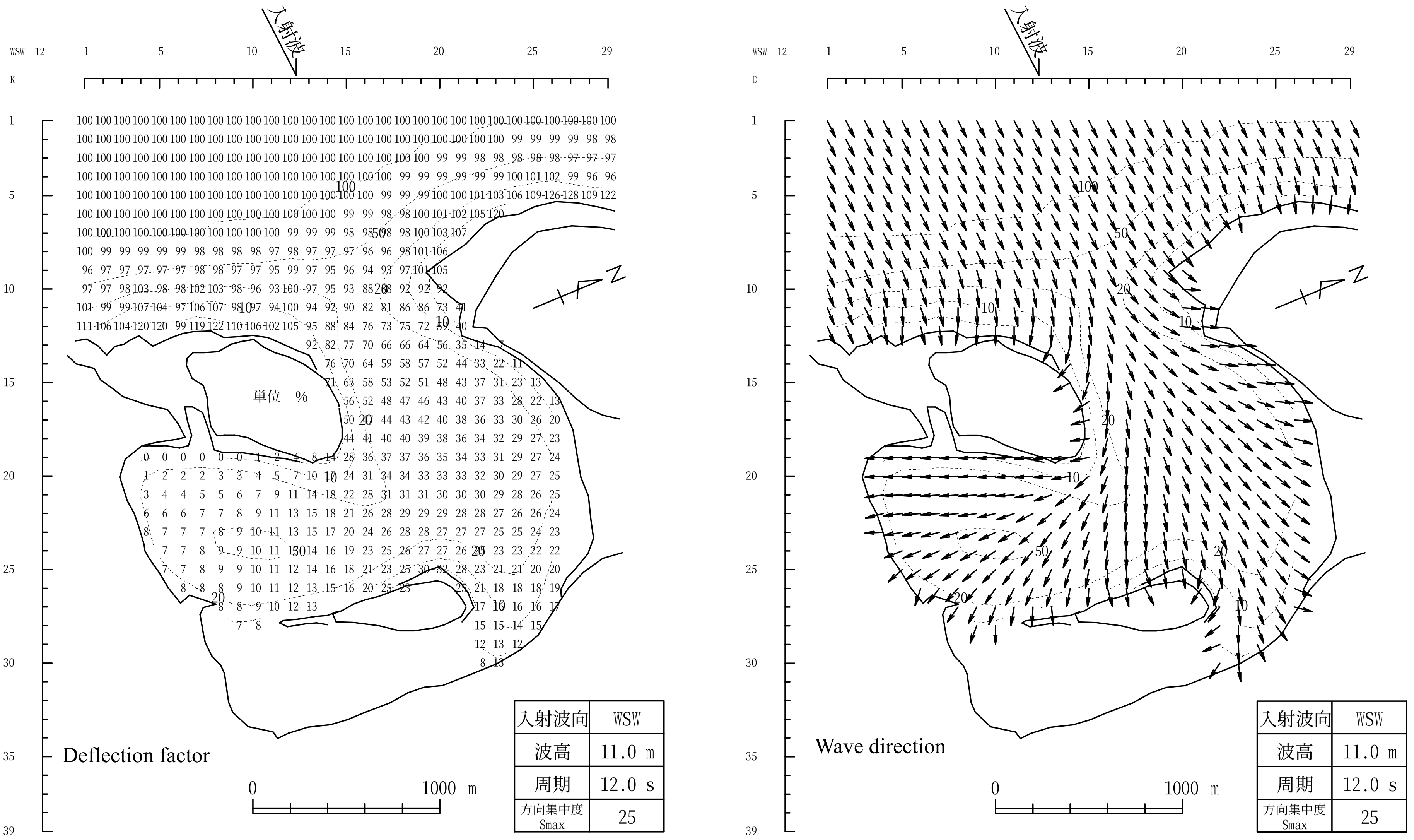


Figure A.9 Results of wave deformation calculations

(Waves in time of emergency, open sea waves, small field)

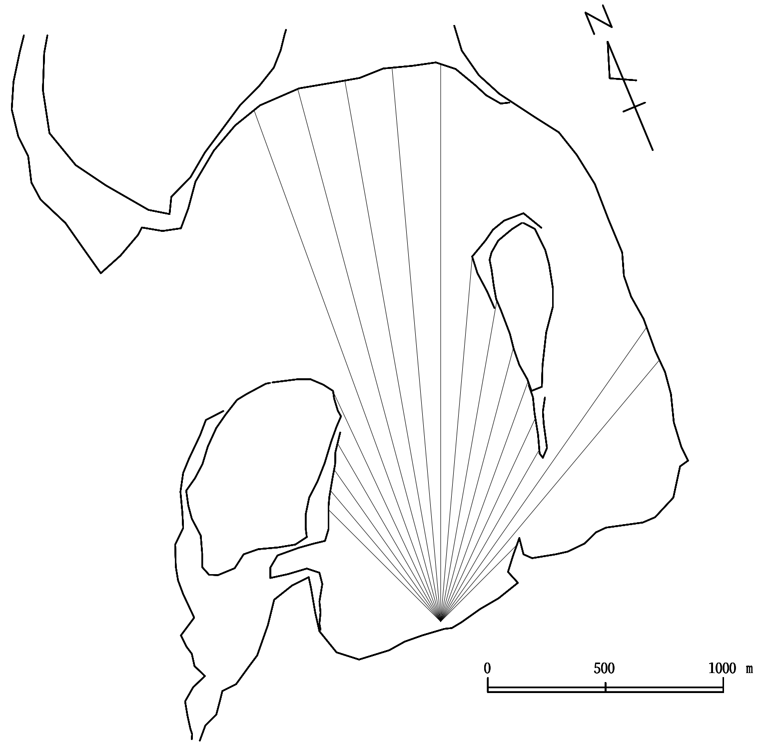
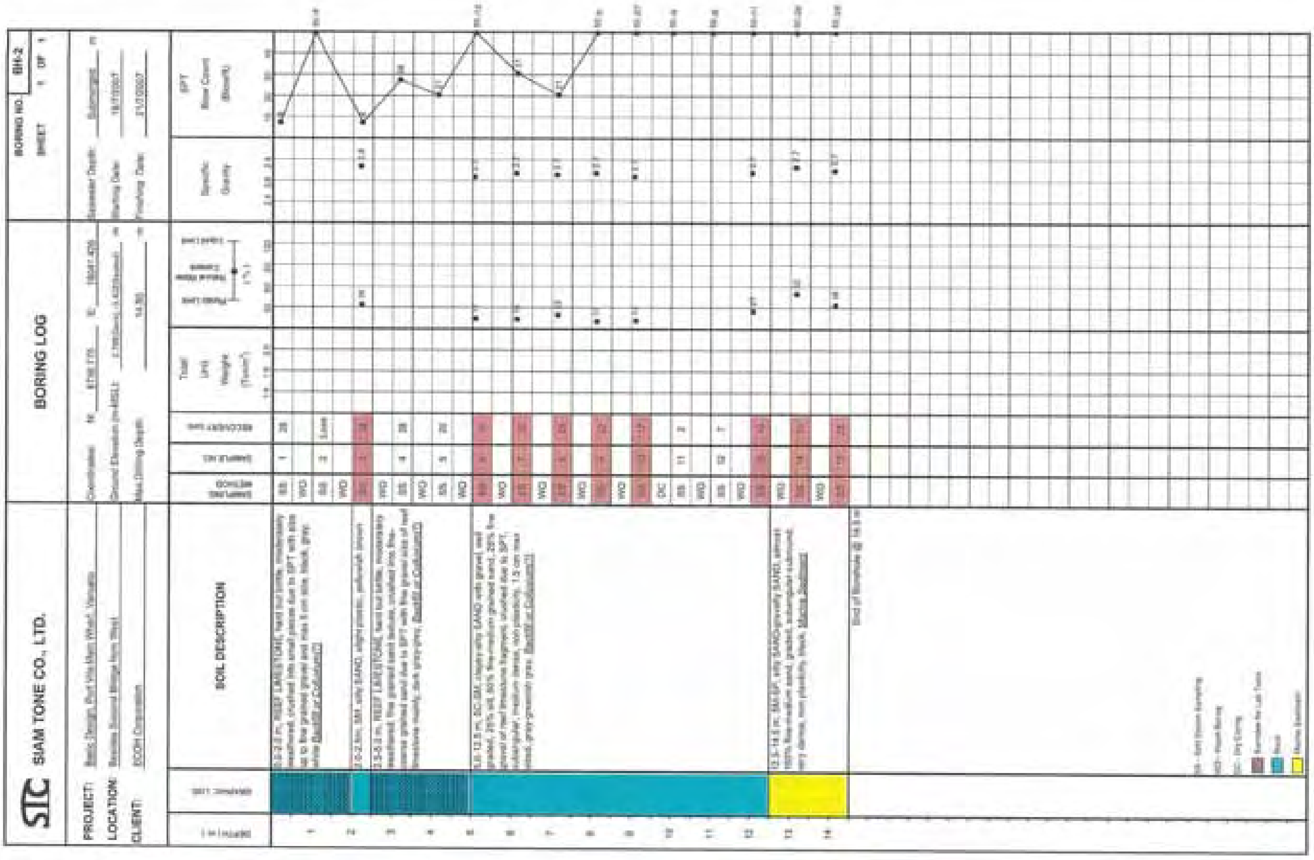


Figure A.10 Calculation of effective blowing direction

Appendix-5-5 Result of Soil Investigation and Topographic and Bathymetric Survey



SIAM TONE CO., LTD.

BORING LOG

BORING NO. BH-2

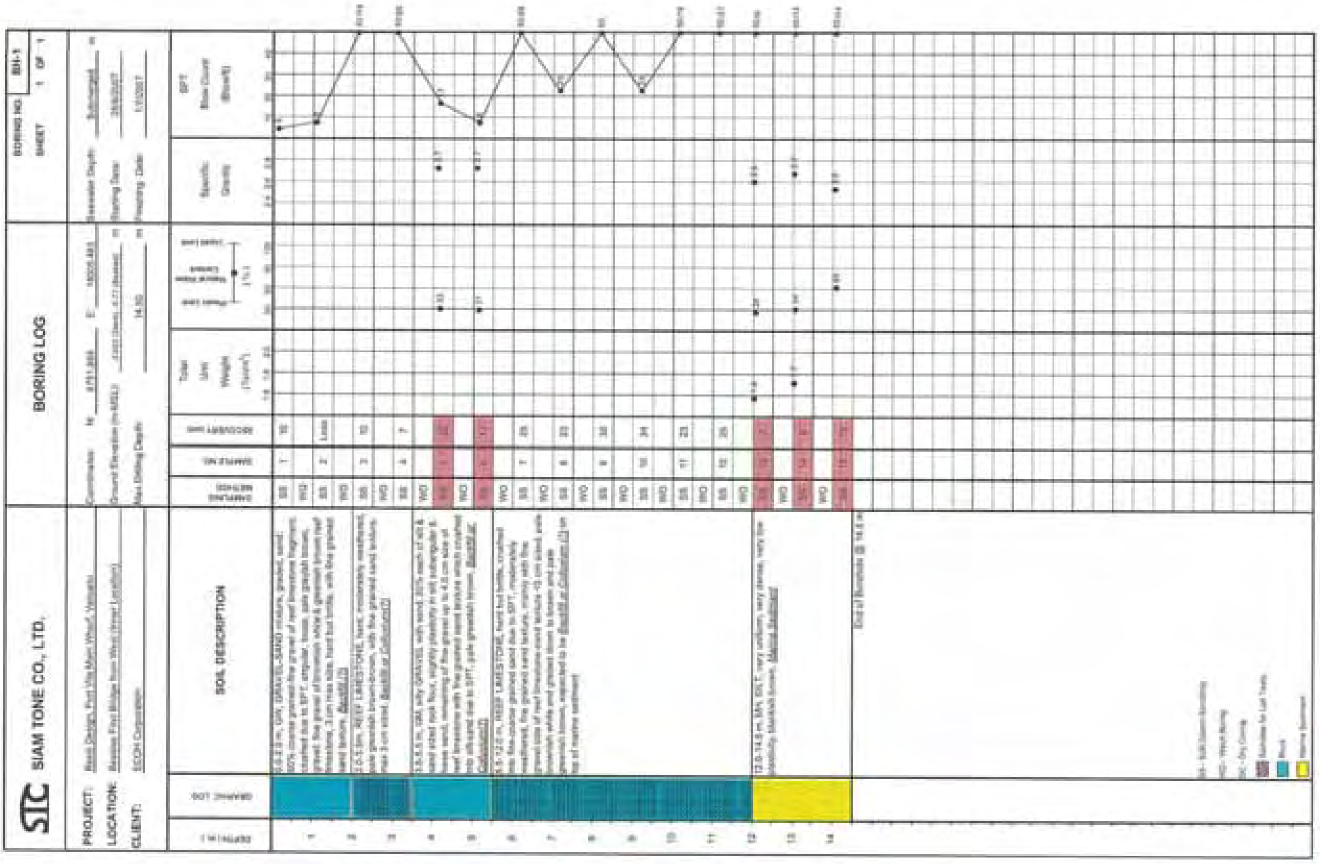
SHEET 1 OF 1

PROJECT:

LOCATION:

CLIENT:

SOIL DESCRIPTION



SIAM TONE CO., LTD.

BORING LOG

BORING NO. BH-1

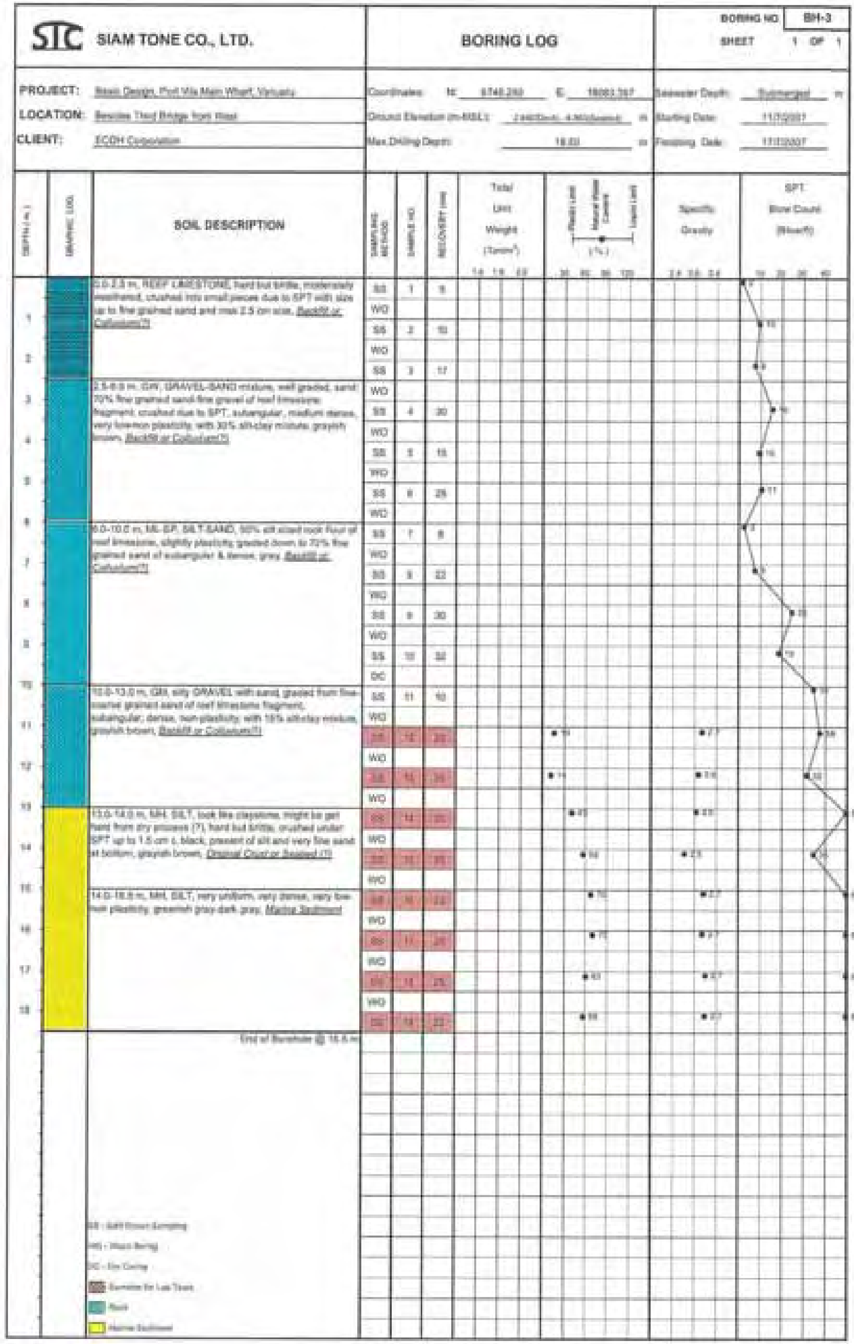
SHEET 1 OF 1

PROJECT:

LOCATION:

CLIENT:

SOIL DESCRIPTION



SIAM TONE CO., LTD. — BORING LOG — BORING NO. BH-3 — SHEET 1 OF 1

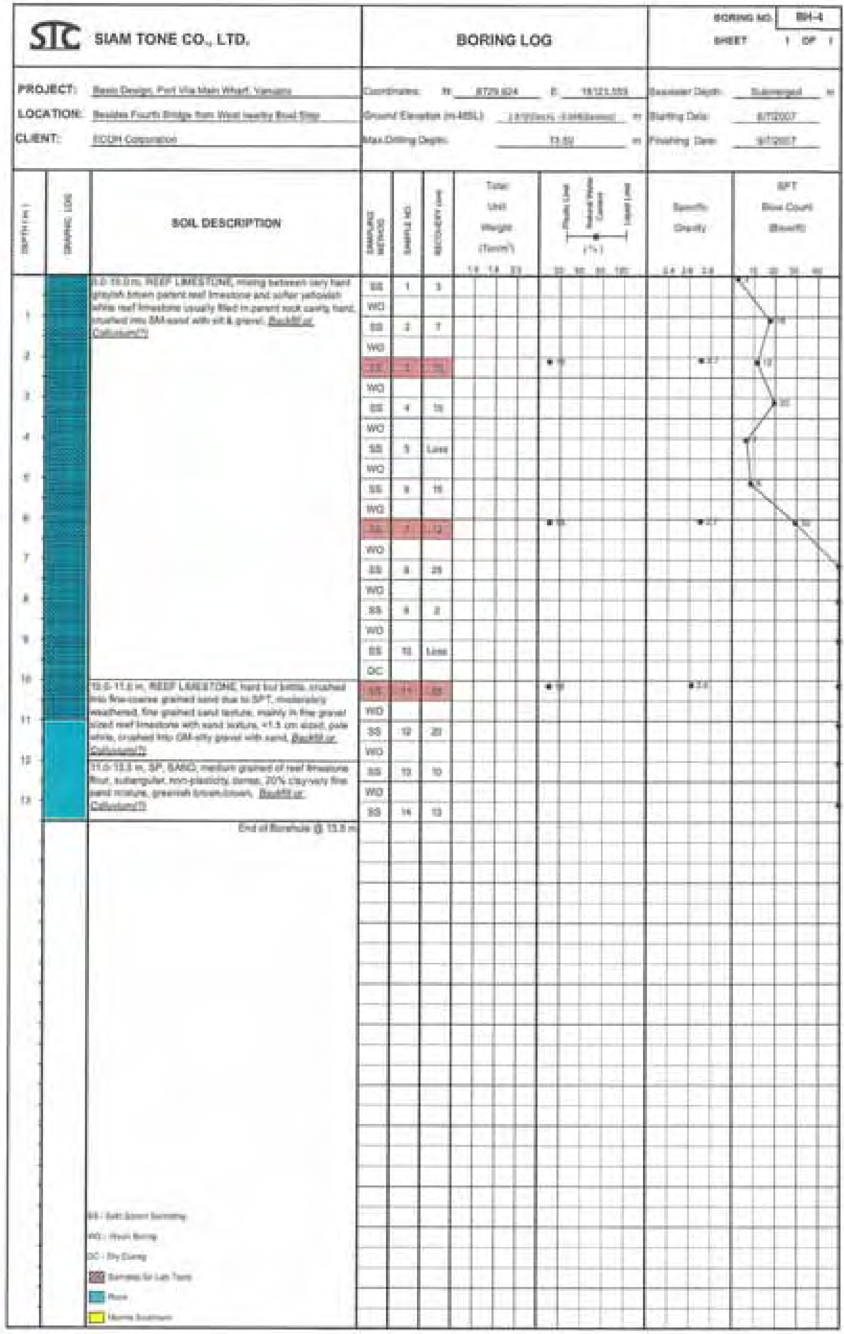
PROJECT: Basic Design, Port Vila Main Wharf, Vanuatu
LOCATION: Besides Third Bridge from West
CLIENT: ECOH Corporation
Coordinates: N: 8746.260 E: 18083.767
Ground Elevation (m-MSL): [illegible] m
Max Drilling Depth: 18.60 m
Seawater Depth: Submerged m
Starting Date: 11/7/2007
Finishing Date: 11/7/2007

DEPTH (m)	SOIL DESCRIPTION
0.0-2.5	0.0-2.5 m, REEF LIMESTONE, hard but brittle, moderately weathered, crushed into small pieces due to SPT with size up to fine grained sand and max 2.5 cm size, *Backfill or Colluvium(?)*
2.5-6.0	2.5-6.0 m, GW, GRAVEL-SAND mixture, well graded, sand 70% fine grained sand-fine gravel of reef limestone fragment, crushed due to SPT, subangular, medium dense, very low/non plasticity, with 30% silt-clay mixture, grayish brown, *Backfill or Colluvium(?)*
6.0-10.0	6.0-10.0 m, ML-SP, SILT-SAND, 50% silt sized rock flour of reef limestone, slightly plasticity, graded down to 70% fine grained sand of subangular & dense, gray, *Backfill or Colluvium(?)*
10.0-13.0	10.0-13.0 m, GM, silty GRAVEL with sand, graded from fine-coarse grained sand of reef limestone fragment, subangular, dense, non-plasticity, with 15% silt-clay mixture, grayish brown, *Backfill or Colluvium(?)*
13.0-14.0	13.0-14.0 m, MH, SILT, look like claystone, might be get hard from dry process (?), hard but brittle, crushed under SPT up to 1.5 cm ¢, black, present of silt and very fine sand at bottom, grayish brown, *Original Court or Seabed (?)*
14.0-18.6	14.0-18.6 m, MH, SILT, very uniform, very dense, very low-non plasticity, greenish gray-dark gray, *Marine Sediment*

End of Borehole @ 18.6 m

SAMPLING METHOD	SAMPLE NO.	RECOVERY (cm)
SS	1	9
WO		
SS	2	10
WO		
SS	3	17
WO		
SS	4	30
WO		
SS	5	15
WO		
SS	6	25
WO		
SS	7	8
WO		
SS	8	22
WO		
SS	9	30
WO		
SS	10	32
DC		
SS	11	10
WO		
SS	12	20
WO		
SS	13	30
WO		
SS	14	20
WO		
SS	15	35
WO		
SS	16	22
WO		
SS	17	28
WO		
SS	18	25
WO		
SS	19	22

SS - Split Spoon Sampling
WO - Wash Boring
DC - Dry Coring
▨ Samples for Lab Tests
🟦 Rock
🟨 Marine Sediment



SIAM TONE CO., LTD. — BORING LOG — BORING NO. BH-4 — SHEET 1 OF 1

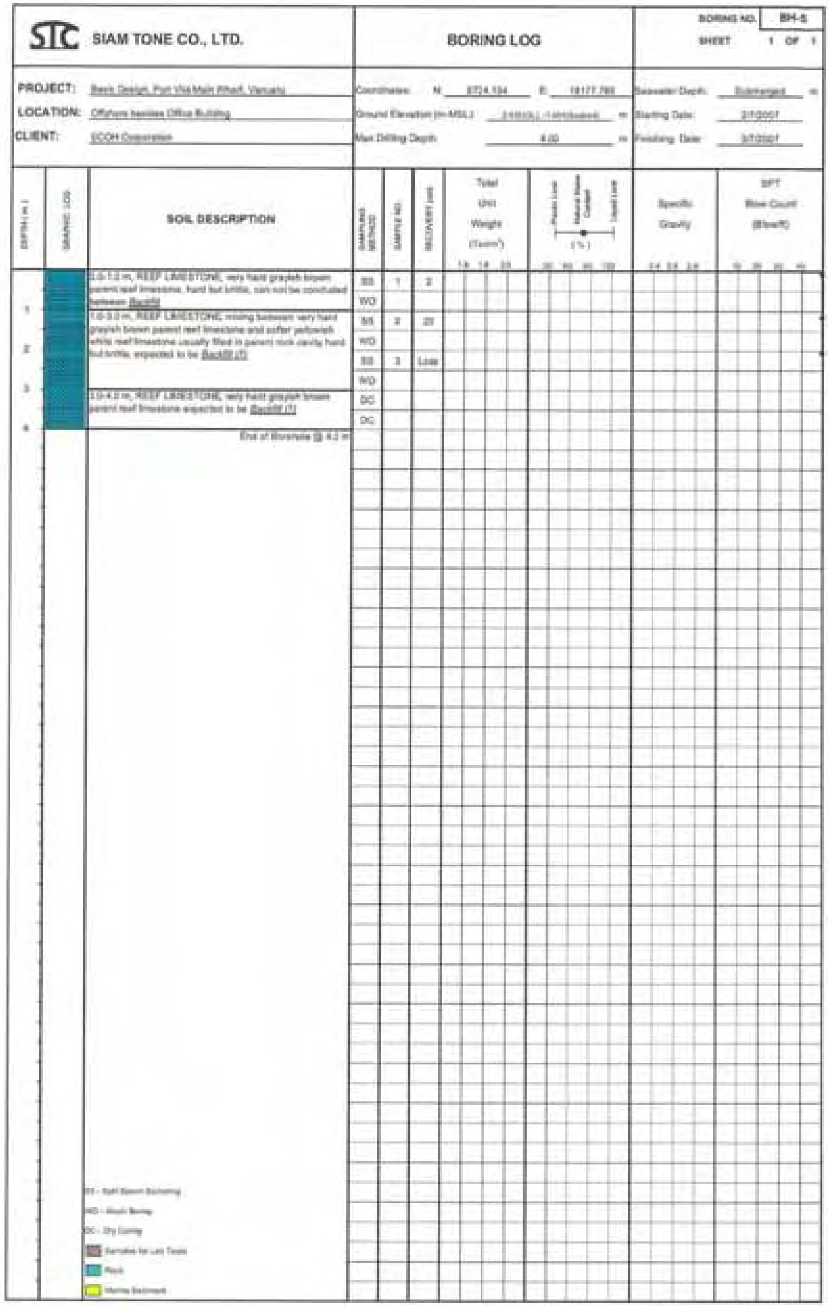
PROJECT: Basic Design, Port Vila Main Wharf, Vanuatu
LOCATION: Besides Fourth Bridge from West nearby Boat Slip
CLIENT: ECOH Corporation
Coordinates: N: 8729.824 E: 18123.553
Ground Elevation (m-MSL): [illegible] m
Max Drilling Depth: 13.80 m
Seawater Depth: Submerged m
Starting Date: 9/7/2007
Finishing Date: 9/7/2007

DEPTH (m)	SOIL DESCRIPTION
0.0-10.0	0.0-10.0 m, REEF LIMESTONE, mixing between very hard grayish brown parent reef limestone and softer yellowish white reef limestone usually filled in parent rock cavity, hard, crushed into SM-sand with silt & gravel, *Backfill or Colluvium(?)*
10.0-11.0	10.0-11.0 m, REEF LIMESTONE, hard but brittle, crushed into fine-coarse grained sand due to SPT, moderately weathered, fine grained sand texture, mainly in fine gravel sized reef limestone with sand texture, <1.5 cm sized, pale white, crushed into GM-silty gravel with sand, *Backfill or Colluvium(?)*
11.0-13.8	11.0-13.8 m, SP, SAND, medium grained of reef limestone flour, subangular, non-plasticity, dense, 20% clay-very fine sand mixture, greenish brown-brown, *Backfill or Colluvium(?)*

End of Borehole @ 13.8 m

SAMPLING METHOD	SAMPLE NO.	RECOVERY (cm)
SS	1	3
WO		
SS	2	7
WO		
SS	3	15
WO		
SS	4	15
WO		
SS	5	Loss
WO		
SS	6	15
WO		
SS	7	12
WO		
SS	8	25
WO		
SS	9	2
WO		
SS	10	Loss
DC		
SS	11	25
WO		
SS	12	20
WO		
SS	13	10
WO		
SS	14	13

SS - Split Spoon Sampling
WO - Wash Boring
DC - Dry Coring
▨ Samples for Lab Tests
🟦 Rock
🟨 Marine Sediment



SIAM TONE CO., LTD.

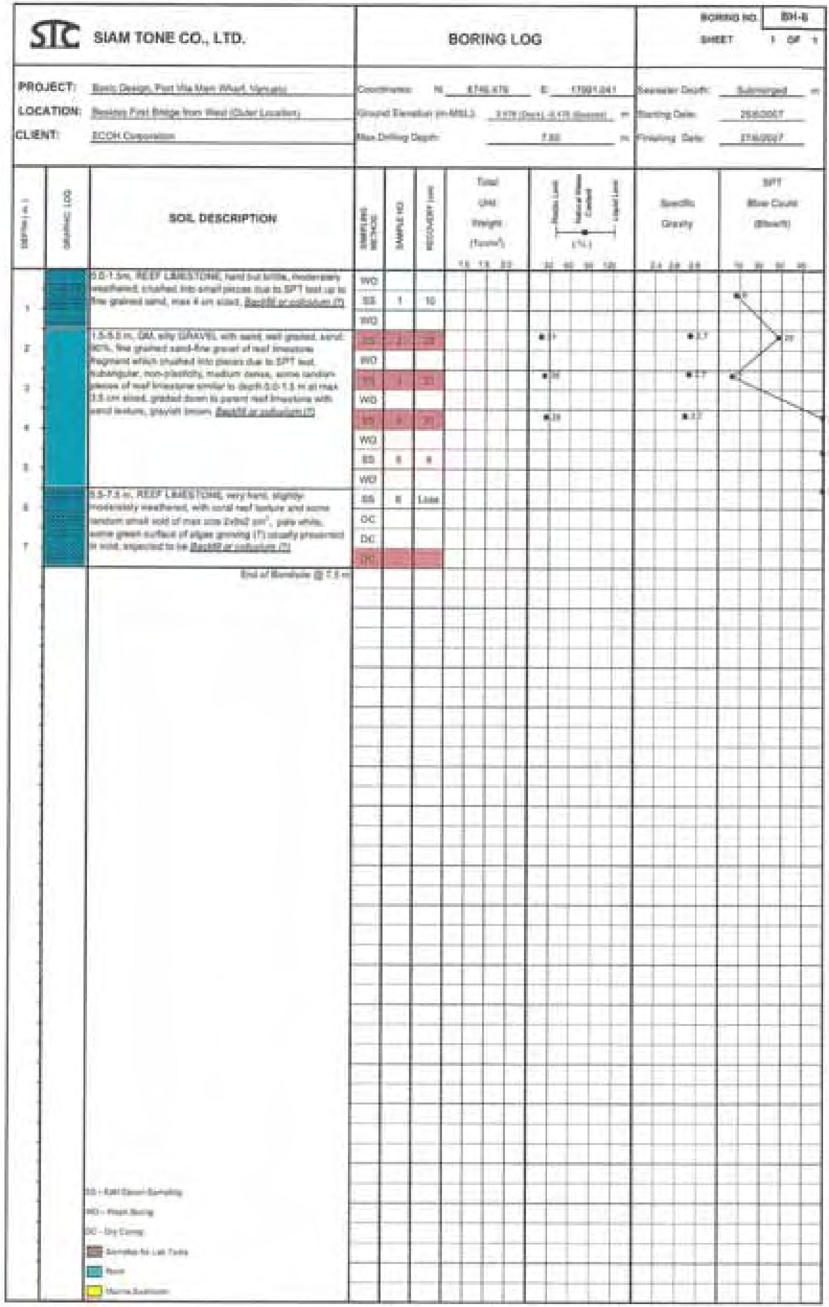
BORING LOG

BORING NO. BH-5
SHEET 1 OF 1

PROJECT: Basic Design, Port Vila Main Wharf, Vanuatu
LOCATION: Offshore facilities Office Building
CLIENT: ECOH Corporation
Coordinates: N [illegible] E [illegible]
Ground Elevation (m-MSL): [illegible] m
Max Drilling Depth: 4.00 m
Seawater Depth: Submerged m
Starting Date: 2/7/2007
Finishing Date: 3/7/2007

DEPTH (m)	SOIL DESCRIPTION	SAMPLING METHOD	SAMPLE NO.	RECOVERY (cm)
	0.0-1.0 m, REEF LIMESTONE, very hard grayish brown parent reef limestone, hard but brittle, can not be concluded between Backfill	SS	1	2
1		WO		
	1.0-3.0 m, REEF LIMESTONE, mixing between very hard grayish brown parent reef limestone and softer yellowish white reef limestone usually filled in parent rock cavity hard but brittle, expected to be Backfill (?)	SS	2	20
2		WO		
		SS	3	Lose
3		WO		
	3.0-4.0 m, REEF LIMESTONE, very hard grayish brown parent reef limestone expected to be Backfill (?)	DC		
4		DC		
	End of Borehole @ 4.2 m			

SS - Split Spoon Sampling
WO - Wash Boring
DC - Dry Coring
▨ Samples for Lab Tests
🟦 Rock
🟨 Marine Sediment



SIAM TONE CO., LTD.

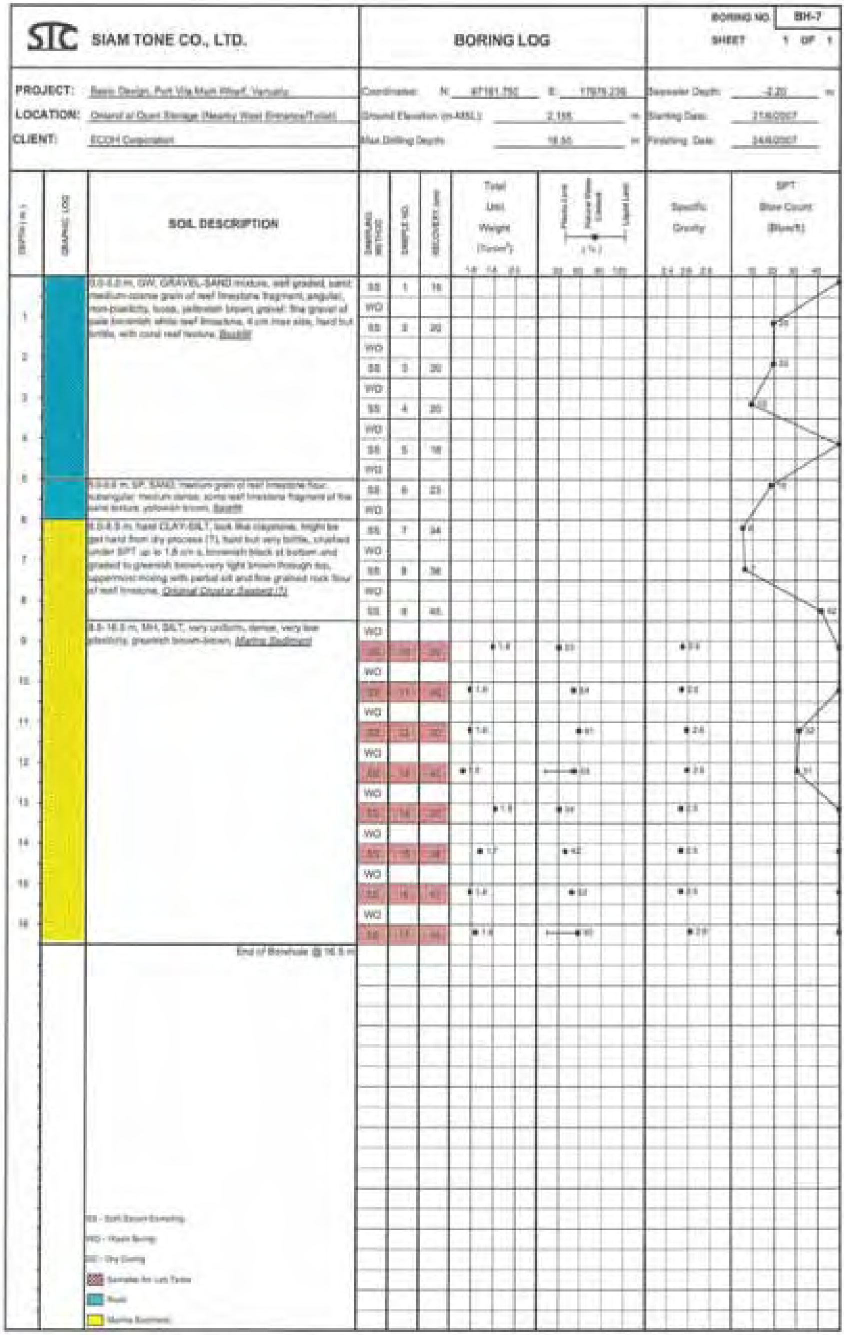
BORING LOG

BORING NO. BH-6
SHEET 1 OF 1

PROJECT: Basic Design, Port Vila Main Wharf, Vanuatu
LOCATION: Besides First Bridge from West (Outer Location)
CLIENT: ECOH Corporation
Coordinates: N [illegible] E [illegible]
Ground Elevation (m-MSL): [illegible] m
Max Drilling Depth: 7.50 m
Seawater Depth: Submerged m
Starting Date: 25/6/2007
Finishing Date: 27/6/2007

DEPTH (m)	SOIL DESCRIPTION	SAMPLING METHOD	SAMPLE NO.	RECOVERY (cm)
	0.0-1.5m, REEF LIMESTONE, hard but brittle, moderately weathered, crushed into small pieces due to SPT test up to fine grained sand, max 4 cm sized, Backfill or colluvium (?)	WO		
1		SS	1	10
		WO		
2	1.5-5.5 m, GM, silty GRAVEL with sand, well graded, sand: 30%, fine grained sand-fine gravel of reef limestone fragment which crushed into pieces due to SPT test, subangular, non-plasticity, medium dense, some random pieces of reef limestone similar to depth 0.0-1.5 m at max 3.5 cm sized, graded down to parent reef limestone with sand texture, grayish brown, Backfill or colluvium (?)	SS	2	[illegible]
		WO		
3		SS	3	[illegible]
		WO		
4		SS	4	[illegible]
		WO		
5		SS	5	8
		WO		
6	5.5-7.5 m, REEF LIMESTONE, very hard, slightly-moderately weathered, with coral reef texture and some random small void of max size 2x2x2 cm³, pale white, some green surface of algae growing (?) usually presented in void, expected to be Backfill or colluvium (?)	SS	6	Lose
		DC		
7		DC		
		DC		
	End of Borehole @ 7.5 m			

SS - Split Spoon Sampling
WO - Wash Boring
DC - Dry Coring
▨ Samples for Lab Tests
🟦 Rock
🟨 Marine Sediment



SIAM TONE CO., LTD.

BORING LOG

BORING NO. BH-7
SHEET 1 OF 1

PROJECT: Basic Design, Port Vila Main Wharf, Vanuatu
LOCATION: Onland at Open Storage (Nearby West Entrance/Toilet)
CLIENT: ECOH Corporation

Coordinates N: 47181.750 E: 17976.236
Ground Elevation (m-MSL): 2.155 m
Max Drilling Depth: 16.50 m

Seawater Depth: -2.20 m
Starting Date: 21/8/2007
Finishing Date: 24/8/2007

DEPTH (m)	GRAPHIC LOG	SOIL DESCRIPTION	SAMPLING METHOD	SAMPLE NO.	RECOVERY (cm)	Total Unit Weight (t/m³)	Plastic Limit / Natural Water Content / Liquid Limit (%)	Specific Gravity	SPT Blow Count (Blow/ft)

0.0-5.0 m, GW, GRAVEL-SAND mixture, well graded, sand: medium-coarse grain of reef limestone fragment, angular, non-plasticity, loose, yellowish brown, gravel: fine gravel of pale brownish white reef limestone, 4 cm max size, hard but brittle, with coral reef texture, Backfill

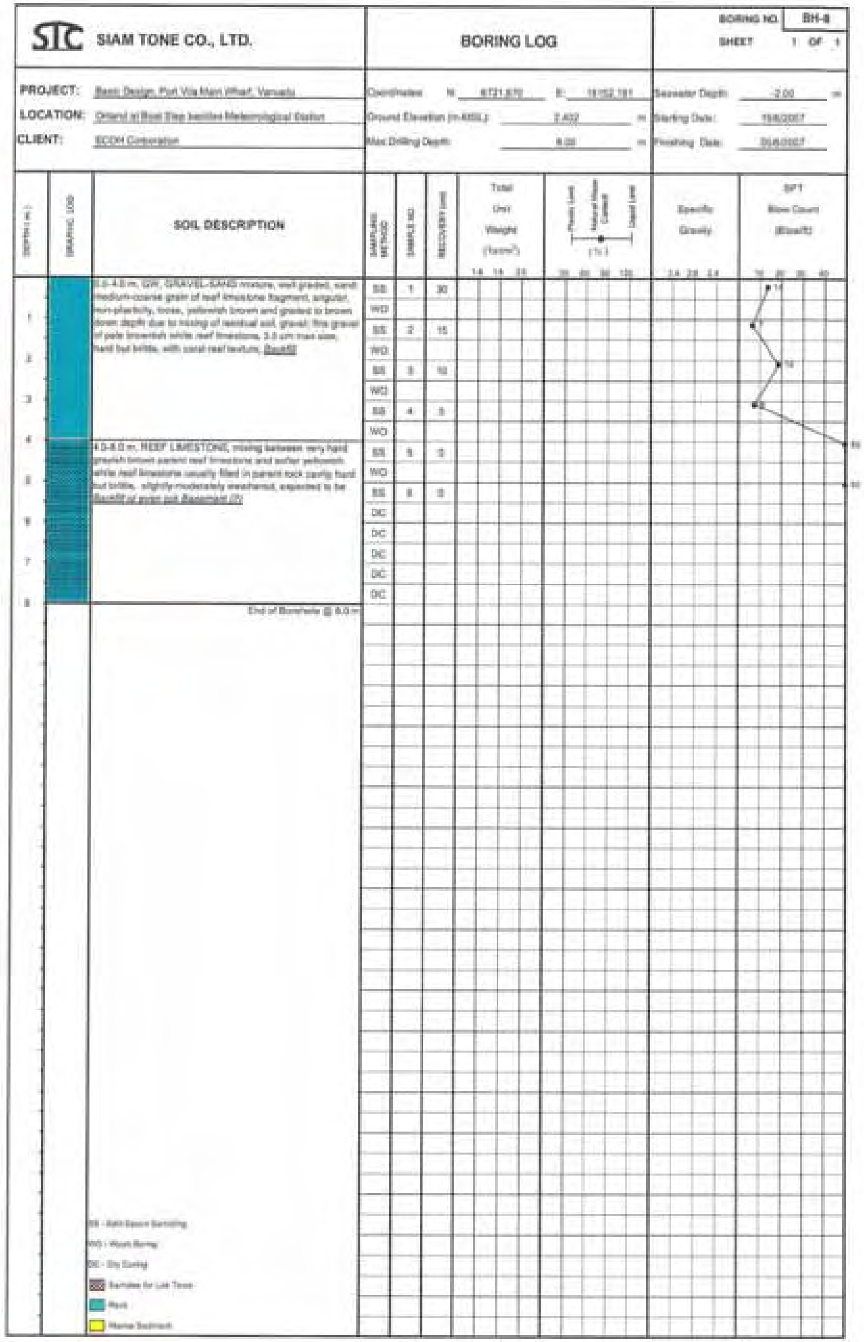
5.0-6.0 m, SP, SAND, medium grain of reef limestone flour, subangular, medium dense, some reef limestone fragment of the same texture, yellowish brown, Backfill

6.0-8.5 m, hard CLAY-SILT, look like claystone, might be get hard from dry process (?), hard but very brittle, crushed under SPT up to 1.8 cm s, brownish black at bottom and graded to greenish brown-very light brown through top, uppermost mixing with partial silt and fine grained rock flour of reef limestone, Original Cloud or Seabed (?)

8.5-16.5 m, MH, SILT, very uniform, dense, very low plasticity, greyish brown-brown, Marine Sediment

End of Borehole @ 16.5 m

SS - Split Spoon Sampling
WO - Wash Boring
DC - Dry Coring
▨ Samples for Lab Tests
🟦 Rock
🟨 Marine Sediment



SIAM TONE CO., LTD.

BORING LOG

BORING NO. BH-8
SHEET 1 OF 1

PROJECT: Basic Design, Port Vila Main Wharf, Vanuatu
LOCATION: Onland at Boat Slip beside Meteorological Station
CLIENT: ECOH Corporation

Coordinates N: 4721.870 E: 18152.181
Ground Elevation (m-MSL): 2.402 m
Max Drilling Depth: 8.00 m

Seawater Depth: -2.00 m
Starting Date: 15/8/2007
Finishing Date: 20/8/2007

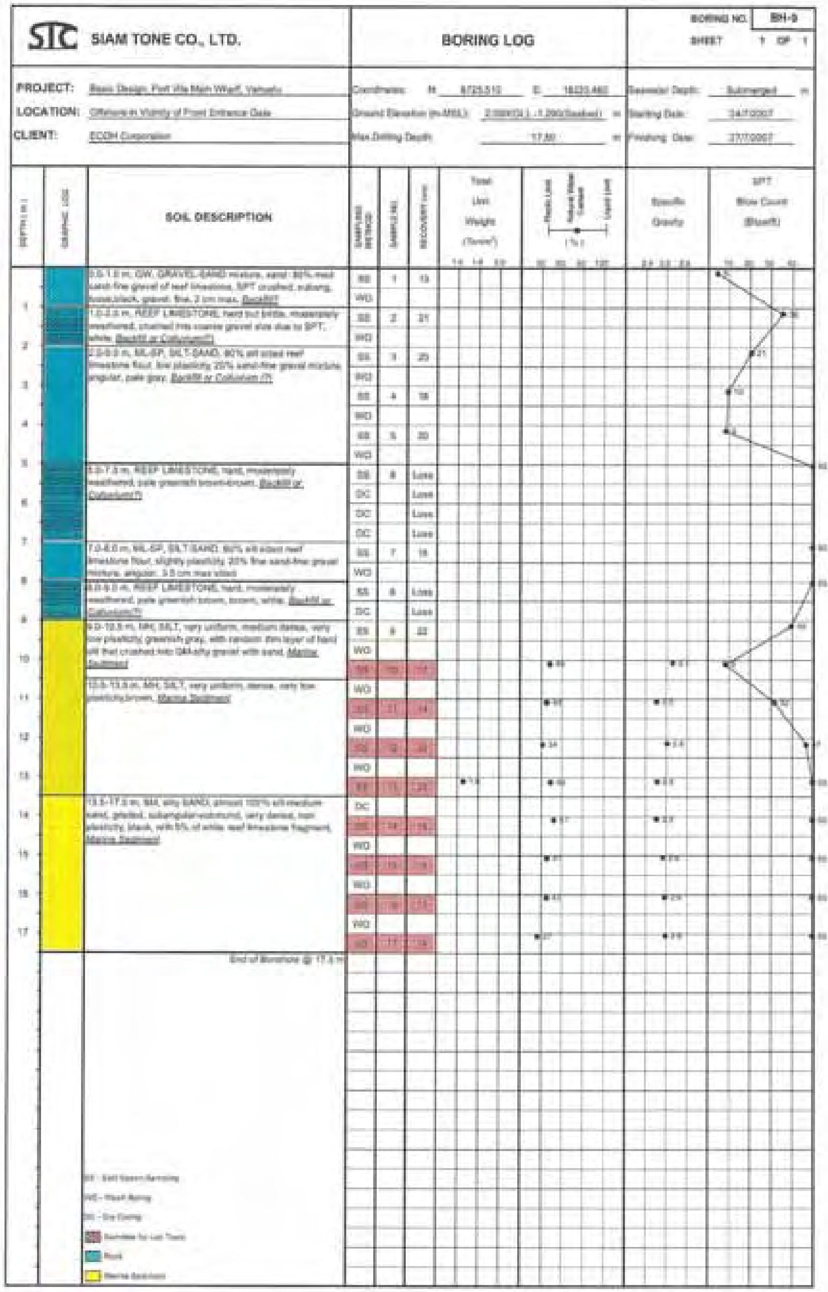
DEPTH (m)	GRAPHIC LOG	SOIL DESCRIPTION	SAMPLING METHOD	SAMPLE NO.	RECOVERY (cm)	Total Unit Weight (t/m³)	Plastic Limit / Natural Water Content / Liquid Limit (%)	Specific Gravity	SPT Blow Count (Blow/ft)

0.0-4.0 m, GW, GRAVEL-SAND mixture, well graded, sand: medium-coarse grain of reef limestone fragment, angular, non-plasticity, loose, yellowish brown and graded to brown down depth due to mixing of residual soil, gravel: fine gravel of pale brownish white reef limestone, 3.0 cm max size, hard but brittle, with coral reef texture, Backfill

4.0-8.0 m, REEF LIMESTONE, mixing between very hard greyish brown parent reef limestone and softer yellowish white reef limestone usually filled in parent rock cavity hard but brittle, slightly-moderately weathered, expected to be Backfill or given soil Basement (?)

End of Borehole @ 8.0 m

SS - Split Spoon Sampling
WO - Wash Boring
DC - Dry Coring
▨ Samples for Lab Tests
🟦 Rock
🟨 Marine Sediment



SIAM TONE CO., LTD.

BORING LOG

BORING NO. BH-9
SHEET 1 OF 1

PROJECT: Basic Design, Port Vila Main Wharf, Vanuatu
LOCATION: Offshore in Vicinity of Front Entrance Gate
CLIENT: ECOH Corporation

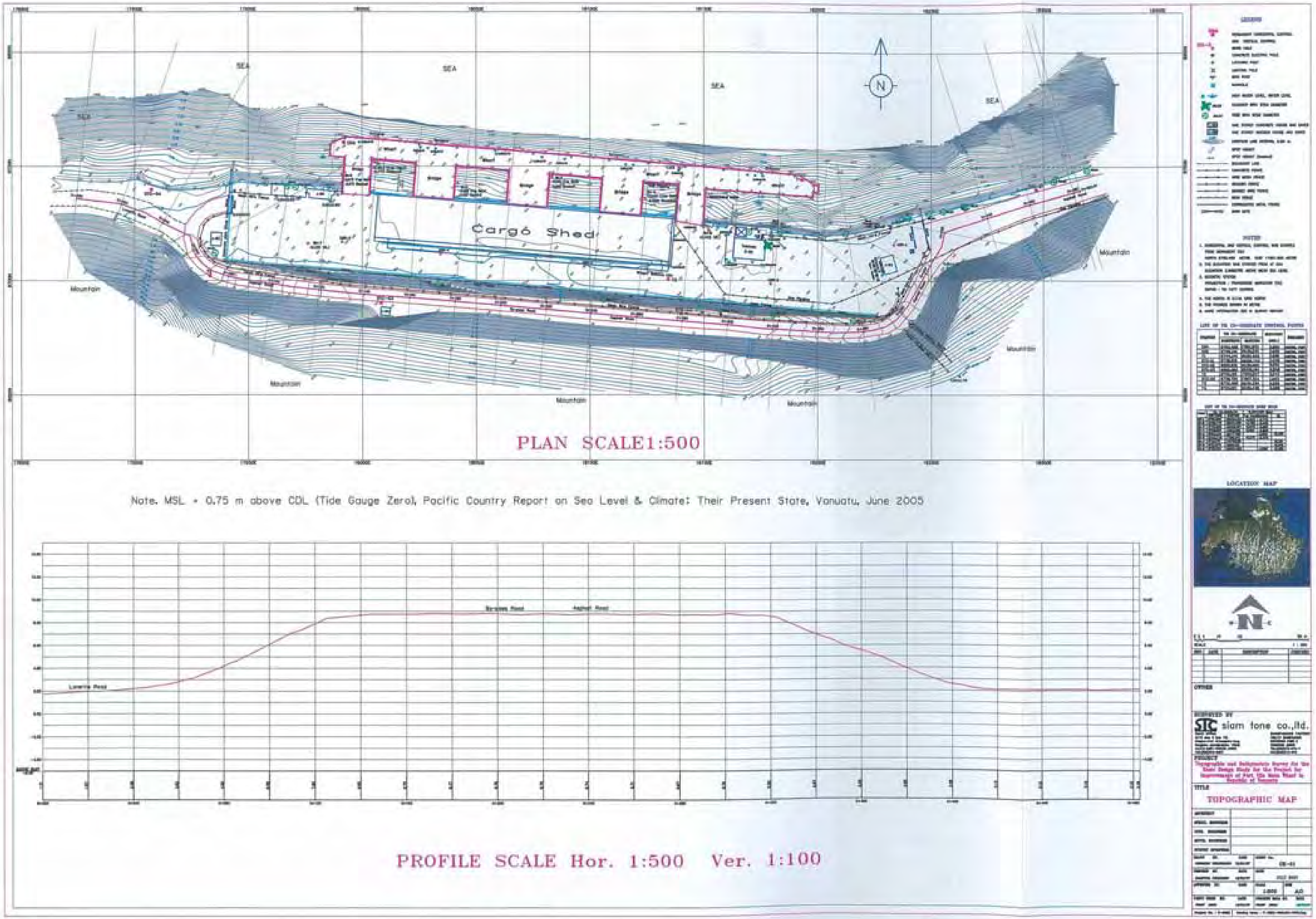
Coordinates: N 8725.510 E 16223.460
Ground Elevation (m-MSL): 2.000(O.L.) -1.200(Seabed) m
Max Drilling Depth: 17.50 m

Seabed Depth: Submerged m
Starting Date: 24/7/2007
Finishing Date: 27/7/2007

DEPTH (m)	SOIL DESCRIPTION	SAMPLING METHOD	SAMPLE NO.	RECOVERY (cm)
	0.0-1.0 m, GW, GRAVEL-SAND mixture, sand: 80% med sand-fine gravel of reef limestone, SPT crushed, subang, brown/black, gravel: fine, 2 cm max, Backfill?	SS	1	13
1		WO		
	1.0-2.0 m, REEF LIMESTONE, hard but brittle, moderately weathered, crushed into coarse gravel size due to SPT, white, Backfill or Colluvium(?)	SS	2	21
2		WO		
	2.0-5.0 m, ML-SP, SILT-SAND, 80% silt sized reef limestone flour, low plasticity, 20% sand-fine gravel mixture, angular, pale gray, Backfill or Colluvium (?)	SS	3	25
3		WO		
		SS	4	18
4		WO		
		SS	5	20
5		WO		
	5.0-7.0 m, REEF LIMESTONE, hard, moderately weathered, pale greenish brown-brown, Backfill or Colluvium(?)	SS	6	Loss
6		DC		Loss
		DC		Loss
7		DC		Loss
	7.0-8.0 m, ML-SP, SILT-SAND, 80% silt sized reef limestone flour, slightly plasticity, 20% fine sand-fine gravel mixture, angular, 3.5 cm max sized	SS	7	18
8		WO		
	8.0-9.0 m, REEF LIMESTONE, hard, moderately weathered, pale greenish brown, brown, white, Backfill or Colluvium(?)	SS	8	Loss
9		DC		Loss
	9.0-10.5 m, MH, SILT, very uniform, medium dense, very low plasticity, greenish gray, with random thin layer of hard silt that crushed into GM-silty gravel with sand, Marine Sediment	SS	9	22
10		WO		
		[illegible]	10	[illegible]
11	10.5-13.5 m, MH, SILT, very uniform, dense, very low plasticity, brown, Marine Sediment	WO		
		[illegible]	11	14
12		WO		
		[illegible]	12	[illegible]
13		WO		
		[illegible]	13	[illegible]
14	13.5-17.5 m, SM, silty SAND, almost 100% silt-medium sand, graded, subangular-subround, very dense, non plasticity, black, with 5% of white reef limestone fragment, Marine Sediment	DC		
		[illegible]	14	[illegible]
15		WO		
		[illegible]	15	[illegible]
16		WO		
		[illegible]	16	[illegible]
17		WO		
		[illegible]	17	[illegible]

End of Borehole @ 17.5 m

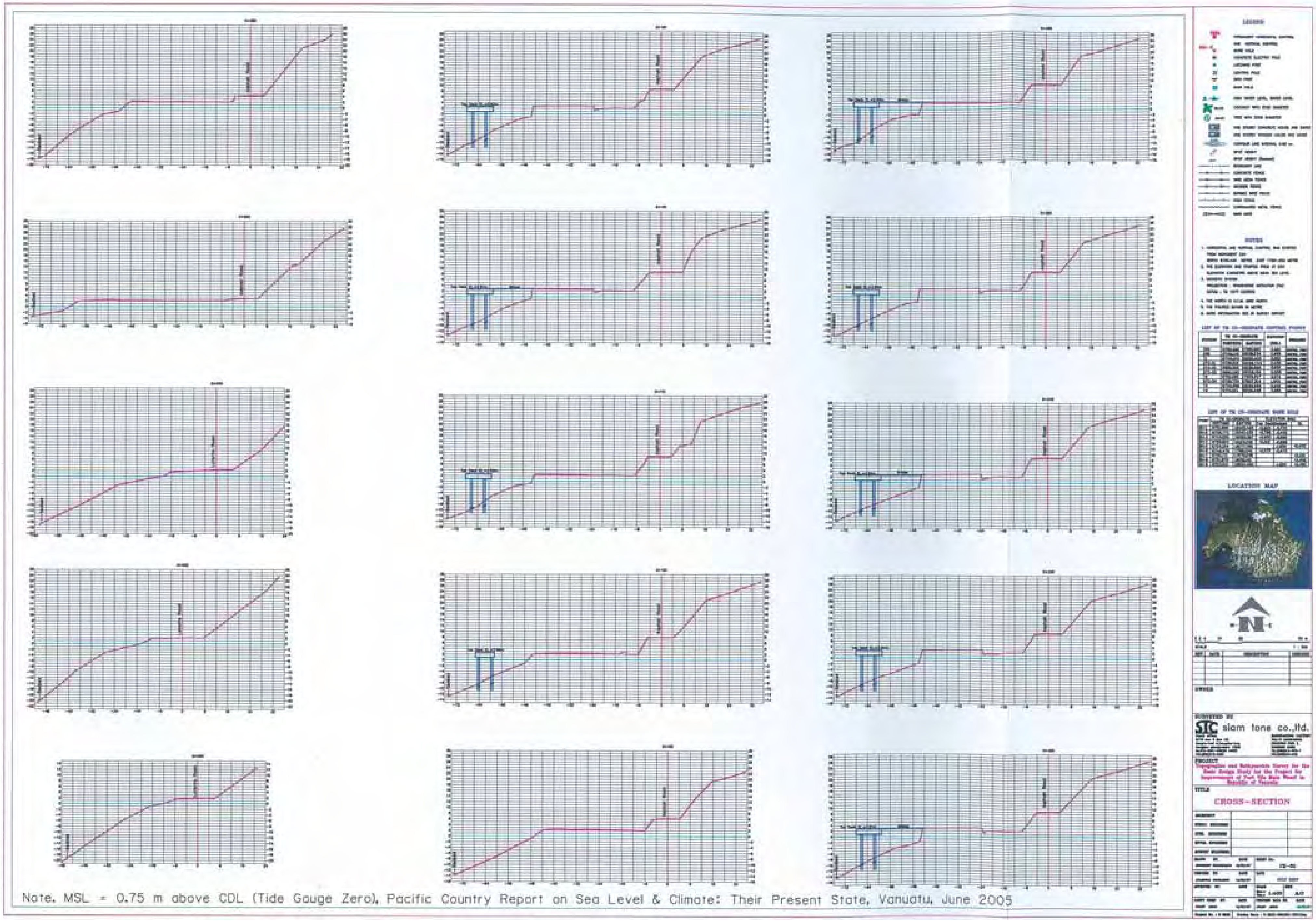
SS - Split Spoon Sampling
WO - Wash Boring
DC - Dry Coring
▨ Samples for Lab Tests
🟦 Rock
🟨 Marine Sediment



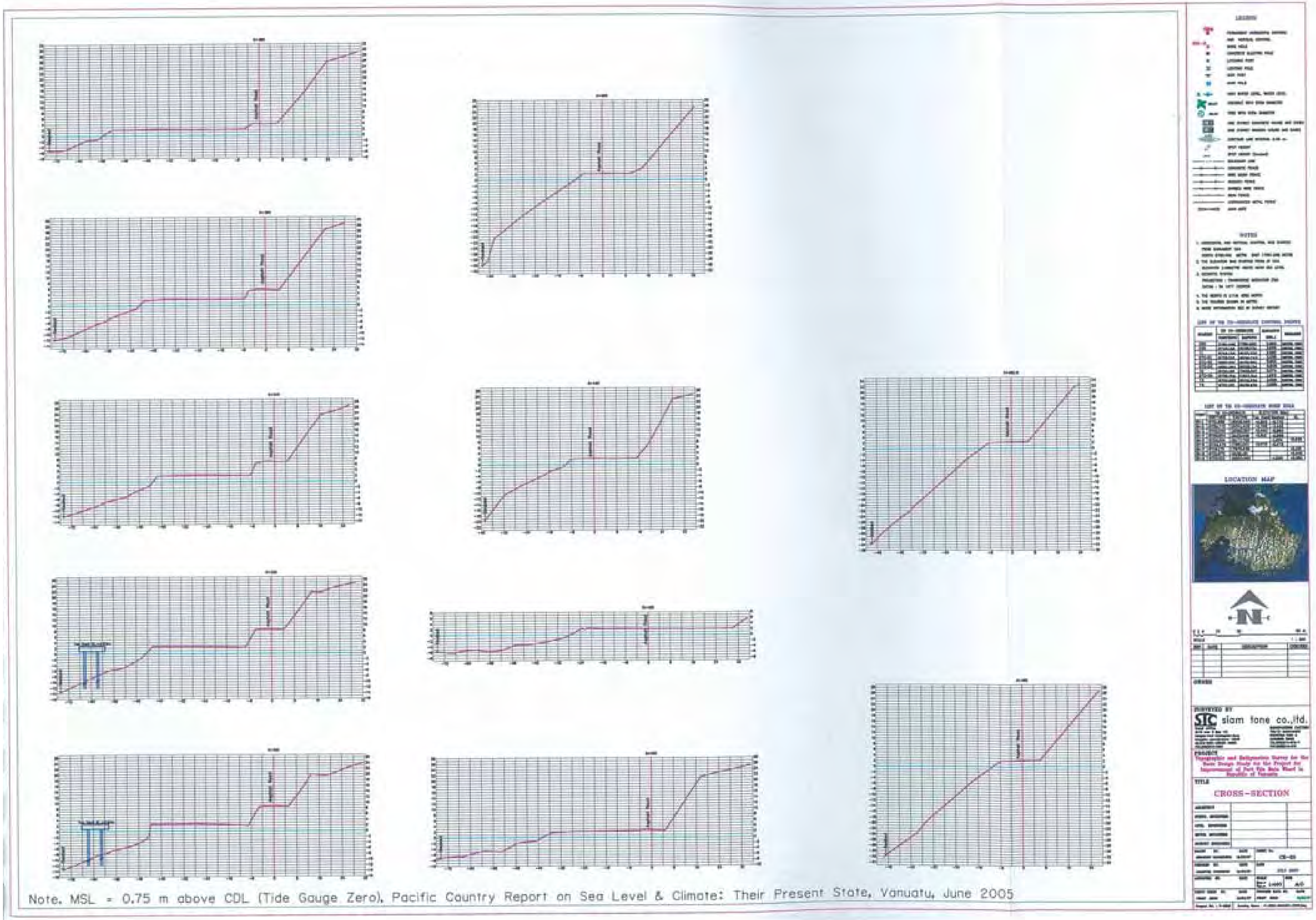
PLAN SCALE1:500

Note. MSL = 0.75 m above CDL (Tide Gauge Zero), Pacific Country Report on Sea Level & Climate: Their Present State, Vanuatu, June 2005

PROFILE SCALE Hor. 1:500 Ver. 1:100



Note. MSL = 0.75 m above CDL (Tide Gauge Zero), Pacific Country Report on Sea Level & Climate: Their Present State, Vanuatu, June 2005



Note. MSL = 0.75 m above CDL (Tide Gauge Zero), Pacific Country Report on Sea Level & Climate: Their Present State, Vanuatu, June 2005