## Appendix 6. Estimation of Offshore Wave

As there is no observation facility in Solomon Islands, no observation data were available. Consequenty, we estimated wave characteristics based on winds and other weather statistics data.

(1) Sea Area Generating Waves and Effective Fetch

Waves in the vicinity of Honiara are mainly generated in a relatively narrow sea area surrounded by Malaita Island to the northeast, Florida Island to the north and St. Isabela to the northwest. (See the following figure.) In order to get fetches necessary for estimation of waves, effective fetches are determined according to the marine chart taking the topography into account. As illustrated below, the longest effective fetch is approximately 200 km in the direction of the NW and the shortest fetch is approximately 80 km in the direction of the NNE and ENE.

**Table Effective Fetch in Honiara**

| Direction | NW | NNW | N | NNE | NE | ENE |
|---|---|---|---|---|---|---|
| Blowing Distance (km) | 200 | 170 | 120 | 85 | 80 | 85 |

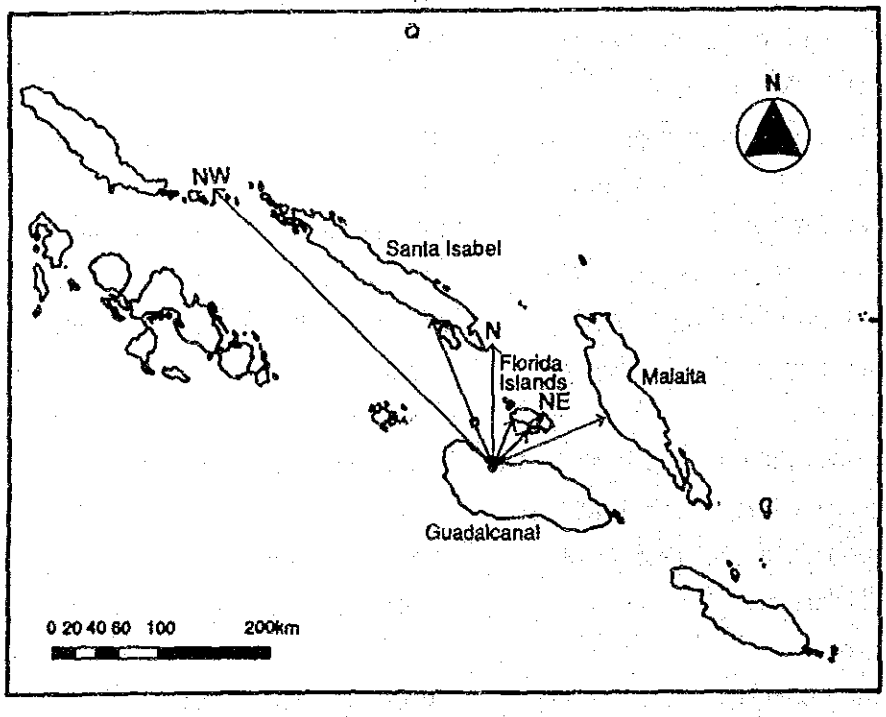



**Figure Effective Fetch in Honiara**

(2) Offshore Wave Expected at Honiara, the Capital

In estimating waves, we assumed that the wind area did not move, and wind blew evenly over the wind area. S.M.B. method was used to estimate the wave generated by the wind observed at Honiara and an assumed cyclone situation.

1) Estimation of Waves Generated by Observed Wind

The following table shows the maximum wind velocity per direction observed at Honiara from 1950 through 1974. The maximum velocity was 13.8 m/sec.

**Table Maximum Wind Velocity and Direction**

Unit: m/sec.

| Direction | NW | N | NE | E | SE | S | SW | W |
|---|---|---|---|---|---|---|---|---|
| Wind Force | 6 | 6 | 6 | 5 | 5 | 4 | 5 | 6 |
| Wind Velocity | 10.8~ 13.8 | 10.8~ 13.8 | 10.8~ 13.8 | 8.0~ 10.7 | 8.0~ 10.7 | 5.5~ 7.9 | 8.0~ 10.7 | 10.8~ 13.8 |

The above land wind velocity is converted into the maximum velocity of 11.2 ~ 14.4 m/sec NW ~ NE sea wind. In estimating waves, we assumed the maximum wind velocity to be 15 m/s, and reference value to be 10 m/s and 5 m/s. The values are estimated on the assumption that wind keeps blowing not less than the time "t" (minimum blowing time). If wind blows for a period less than this value, both values of wave heights and periods will be smaller. The following table shows the estimated offshore wave estimated from observed wind records at Honiara.

**Table Estimated Results of Offshore Waves by Observed Wind**

Unit H: m, T: second, t: hour

| Wave Direction | NW | | | NNW | | | N | | | NNE | | | NE | | | ENE | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind Velocity m/sec. | H | T | t | H | T | t | H | T | t | H | T | t | H | T | t | H | T | t |
| 5 | 0.6 | 3.4 | 25 | 0.6 | 3.3 | 22 | 0.6 | 3.1 | 17 | 0.5 | 2.9 | 13 | 0.5 | 2.9 | 13 | 0.5 | 2.9 | 13 |
| 10 | 1.8 | 5.5 | 17 | 1.7 | 5.3 | 15 | 1.6 | 5.0 | 12 | 1.4 | 4.6 | 9 | 1.4 | 4.6 | 9 | 1.4 | 4.6 | 9 |
| 15 | 3.2 | 7.0 | 14 | 3.1 | 6.6 | 12 | 2.8 | 6.3 | 10 | 2.3 | 5.7 | 7 | 2.3 | 5.7 | 7 | 2.3 | 5.7 | 7 |

The estimated results show that wind with the velocity of 5 m/s blowing for one half to full day will generate waves with height of 0.5 ~ 0.6 m and period of

approximately 3 seconds regardless of direction, though the values vary depending on minimum blowing time. Considering the frequency of the wind, the waves are considered to have less value than the above for more than 90% a year.

At 10 m/s of wind the estimation result indicates that waves from NW have height of 1.8 m and periods of 5.5 s which are the biggest value. As the wind direction turns toward the east, the values will become smaller, and with NE wind, the height will be 1.4 m and period 4.6 s.

At the velocity of 15 m/s, the following values are estimated: with NW waves, height 3.2 m, period 7.0 s; with N waves, height 2.8 m, period 6.3 s; and with NE waves, height 2.3 m, periods 5.7 s.

2) Estimation of Waves from Model Cyclone

A cyclone with a probability of once in 25 years to hit the area will have an average wind velocity of 30 m/s (36 m/s at limited area close to the center). Maximum possible waves generated from each direction were estimated as shown below.

**Table Estimated Results of Offshore Waves by Model Cyclone**

Unit H: m, T: second

| Wave Direction | NW | NNW | N | NNE | NE | ENE |
|---|---|---|---|---|---|---|
| Wave Height (H) | 8.0 | 7.5 | 6.7 | 5.5 | 5.5 | 5.5 |
| Period (T) | 10.3 | 9.7 | 9.1 | 8.2 | 8.2 | 8.2 |

3) The Wave Values in the Vicinity of Honiara

From the above estimations 1) and 2), wave values in the vicinity of Honiara are shown in the following table. The values of wind velocity of 15 m/s was actually observed at Honiara, and the value of 30 m/s is estimated under the worst condition of Model cyclone.

**Table Estimated Results of Offshore Waves in Honiara**

Unit H: m, T: second, t: hour

| Wave Direction | NW | | | NNW | | | N | | | NNE | | | NE | | | ENE | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind Velocity m/sec. | H | T | t | H | T | t | H | T | t | H | T | t | H | T | t | H | T | t |
| 15 | 3.2 | 7.0 | 14 | 3.1 | 6.6 | 12 | 2.8 | 6.3 | 10 | 2.3 | 5.7 | 7 | 2.3 | 5.7 | 7 | 2.3 | 5.7 | 7 |
| 30 | 3.0 | 10.3 | 9.5 | 7.5 | 9.7 | 8.5 | 6.7 | 9.1 | 6.8 | 5.5 | 8.2 | 5 | 5.5 | 8.2 | 5 | 5.5 | 8.2 | 5 |

(3) Wave Conditions at Project Site

The estimated offshore waves are transformed through diffraction and refraction due to topographical conditions in the vicinity before reaching the project site. The transformed offshore waves described above in the vicinity of the site with depth of -10 m are shown in the following table. The height reaches the maximum at the N direction, and transformed observed wind generated waves have a height of 2.4 m and period of 6.3 s, and cyclone generated waves a height of 5.5 m, and period of 9.1 s.

**Table Details of Converted Offshore Waves (Depth near -10m)**

| Wave Direction | NW | | NNW | | N | | NNE | | NE | | ENE | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Period | 7.0 | 10.3 | 6.6 | 9.7 | 6.3 | 9.1 | 5.7 | 8.2 | 5.7 | 8.2 | 5.7 | 8.2 |
| Wave Height (Ho) | 3.2 | 8.0 | 3.1 | 7.5 | | | 2.3 | 5.5 | 2.3 | 5.5 | 2.3 | 5.5 |
| Diffraction Coefficient | 0.5 | 0.5 | 0.71 | 0.71 | 0.87 | 0.8 | 0.95 | 0.95 | 0.95 | 5.5 | 0.92 | 0.92 |
| Refraction Coefficient | | | | | 0.98 | 0.9 | 0.97 | 0.95 | 0.93 | 0.90 | 0.89 | 0.83 |
| Converted Offshore Wave Height (Ho) | - | - | - | - | 2.4 | 5.5 | 2.1 | 5.0 | 2.0 | 4.7 | 1.9 | 4.2 |
| Incident Wave Angle* | - | | - | | 0 | 0 | 8 | 6 | 14 | 10 | 18 | 13 |

Notes: 1) * Angles at the project site facilities.
2) In all the columns of wind directions, figures on the left show waves computed through observed winds, and on the right through cyclone.

Wave heights in front of the project site (C.D.L.-0.5 m) is taken as the height (critical design wave height) of the converted offshore waves after breaking and transformation. The result is shown below based on the assumption of 1/30 sea bottom slope and a depth 1.5 m. (0.5 m depth + 1 m tide level ).

## Table Wave Heights in Front of Project Facilities

| | N. Direction Waves | NNE~ENE Direction Waves | N~ENE Direction Waves |
|---|---|---|---|
| Period of Converted Offshore Waves (second) | 9.1 | 8.2 | 6.3 |
| Height of converted Offshore Waves (m) | 5.5 | 5.0 | 2.4 |
| Length of Converted Offshore Waves (m) | 130 | 105 | 55 |
| Wave Heights in Front of Project Facilities | 1.5 m | 1.6 m | 1.4 m |

# APPENDIX TABLE · APPENDIX FIGURE

Appendix Table 1 Wind Frequency Analysis

(1950~1974 April-December) Unit : %

| W.V. / W.D. | 0 ~ 0.2 | 0.3 ~ 1.5 | 1.6 ~ 3.3 | 3.4 ~ 5.4 | 5.5 ~ 7.9 | 8.0 ~ 10.7 | 10.8~ 13.8 | 13.9~ 17.1 | 17.2~ 20.7 | 20.8~ 24.4 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CALM | 25.2 | | | | | | | | | | 25.2 |
| NE | | 1.8 | 5.1 | 4.0 | 1.4 | 0.2 | 0.0 | | | | 12.5 |
| E | | 0.5 | 1.8 | 1.8 | 0.7 | 0.2 | | | | | 5.0 |
| SE | | 1.2 | 3.1 | 2.1 | 0.6 | 0.2 | | | | | 7.2 |
| S | | 7.7 | 18.3 | 6.2 | 0.7 | | | | | | 32.9 |
| SW | | 1.0 | 2.6 | 1.6 | 0.2 | | | | | | 5.4 |
| W | | 0.7 | 0.4 | 0.1 | 0.1 | 0.0 | | | | | 1.3 |
| NW | | 0.7 | 1.5 | 0.5 | 0.1 | 0.0 | 0.0 | | | | 2.8 |
| N | | 2.3 | 4.6 | 1.4 | 0.2 | 0.0 | | | | | 8.5 |
| Total | 25.2 | 15.9 | 37.4 | 17.7 | 4.0 | 0.6 | 0.0 | | | | 100.8 |

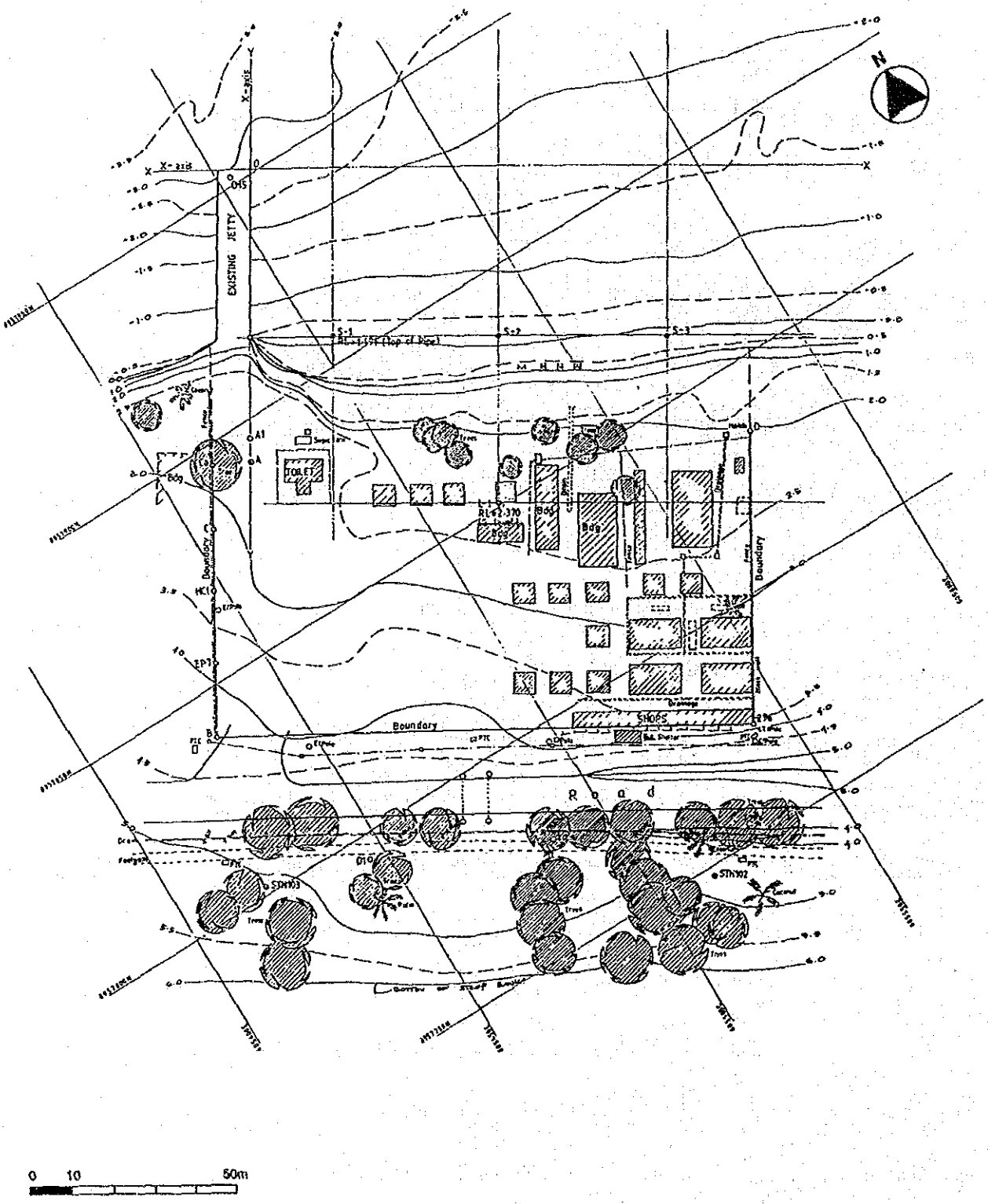
(1950~1974 January-May) Unit : %

| W.V. / W.D. | 0 ~ 0.2 | 0.3 ~ 1.5 | 1.6 ~ 3.3 | 3.4 ~ 5.4 | 5.5 ~ 7.9 | 8.0 ~ 10.7 | 10.8~ 13.8 | 13.9~ 17.1 | 17.2~ 20.7 | 20.8~ 24.4 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CALM | 33.5 | | | | | | | | | | 33.5 |
| NE | | 1.4 | 2.2 | 1.0 | 0.2 | | | | | | 4.8 |
| E | | 0.3 | 0.5 | 0.1 | 0.2 | | | | | | 1.1 |
| SE | | 0.3 | 0.5 | 0.2 | 0.2 | | | | | | 1.2 |
| S | | 7.2 | 16.3 | 5.2 | 0.2 | | | | | | 28.9 |
| SW | | 3.2 | 5.4 | 2.9 | 0.4 | 0.1 | | | | | 12.0 |
| W | | 1.0 | 1.9 | 1.3 | 0.3 | 0.1 | 0.1 | | | | 4.7 |
| NW | | 1.3 | 2.9 | 1.8 | 0.5 | 0.1 | | | | | 6.6 |
| N | | 1.8 | 3.3 | 1.7 | 0.2 | 0.2 | 0.1 | | | | 7.3 |
| Total | 33.5 | 16.5 | 33.0 | 14.2 | 2.2 | 0.5 | 0.2 | | | | 100.1 |

(1950~1974 January-December) Unit : %

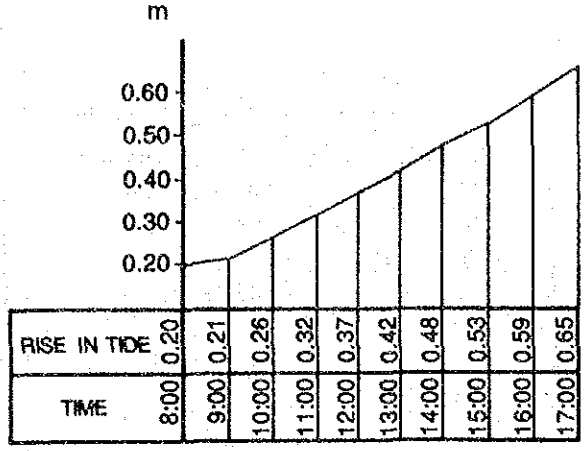
| W.V. / W.D | 0 ~ 0.2 | 0.3 ~ 1.5 | 1.6 ~ 3.3 | 3.4 ~ 5.4 | 5.5 ~ 7.9 | 8.0 ~ 10.7 | 10.8~ 13.8 | 13.9~ 17.1 | 17.2~ 20.7 | 20.8~ 24.4 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CALM | 27.3 | | | | | | | | | | 27.3 |
| NE | | 1.7 | 4.4 | 3.2 | 1.1 | 0.2 | 0.0 | | | | 10.6 |
| E | | 0.4 | 1.5 | 1.4 | 0.6 | 0.1 | | | | | 4.0 |
| SE | | 1.0 | 2.4 | 1.6 | 0.5 | 0.1 | | | | | 5.6 |
| S | | 7.6 | 17.8 | 5.9 | 0.5 | | | | | | 31.8 |
| SW | | 1.6 | 3.3 | 1.9 | 0.4 | 0.0 | | | | | 7.2 |
| W | | 0.5 | 0.8 | 0.4 | 0.1 | 0.0 | 0.0 | | | | 1.8 |
| NW | | 0.8 | 1.9 | 0.8 | 0.2 | 0.0 | | | | | 3.7 |
| N | | 2.2 | 4.3 | 1.5 | 0.2 | 0.1 | 0.0 | | | | 8.3 |
| Total | 27.3 | 15.8 | 36.4 | 16.7 | 3.6 | 0.5 | 0.0 | | | | 100.3 |

W.V. : Wind Velocity (m/sec.) W.D. : Wind Direction
Source : Solomon Islands Meteorological Service



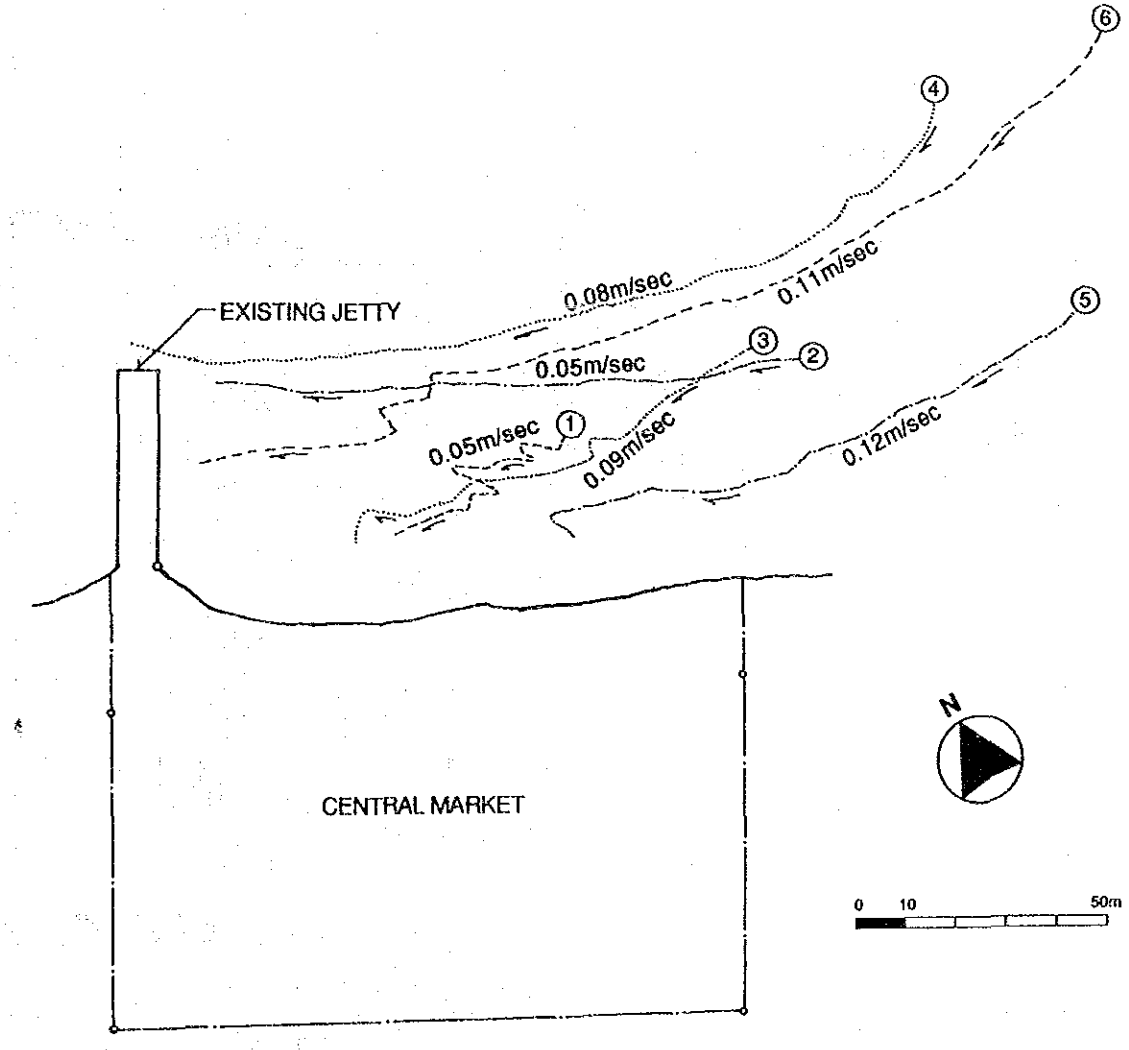

Appendix Figure 1.
Topographical and Bathymetric Plan

THE PROJECT FOR
THE HONIARA FISH MARKET DEVELOPMENT
IN SOLOMON ISLANDS



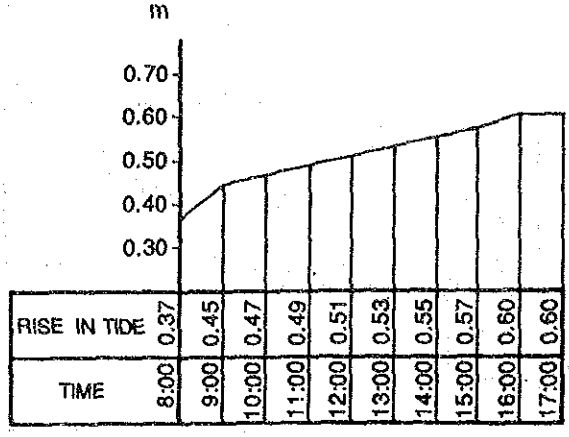

RISE IN TIDE AS AT 23,10,93

| FLOAT NO. | DURATION OF TRACKING |
|---|---|
| ① | 9.49 — 10.05 |
| ② | 10.10 — 10.55 |
| ③ | 10.57 — 11.15 |
| ④ | 11.22 — 12.01 |
| ⑤ | 13.27 — 13.46 |
| ⑥ | 13.53 — 14.26 |



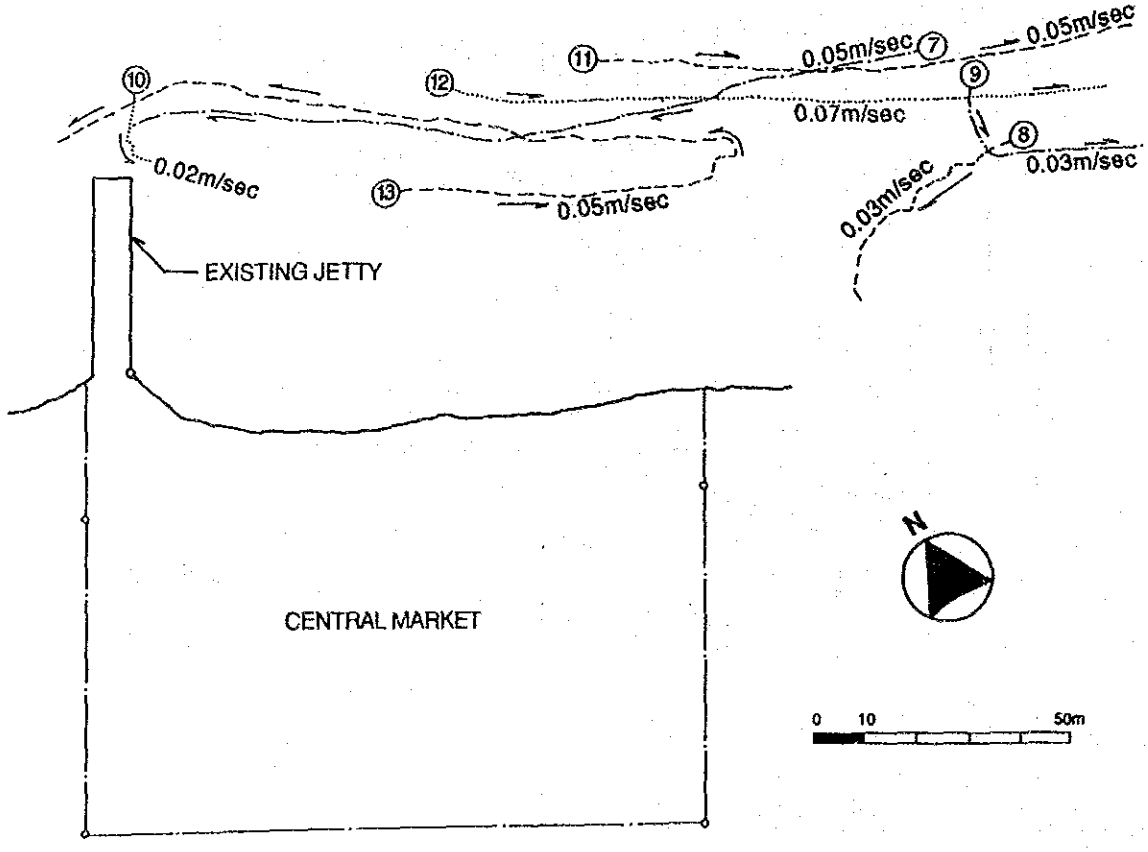

Appendix Figure 2.
Current Information Plan (1)

THE PROJECT FOR
THE HONIARA FISH MARKET DEVELOPMENT
IN SOLOMON ISLANDS



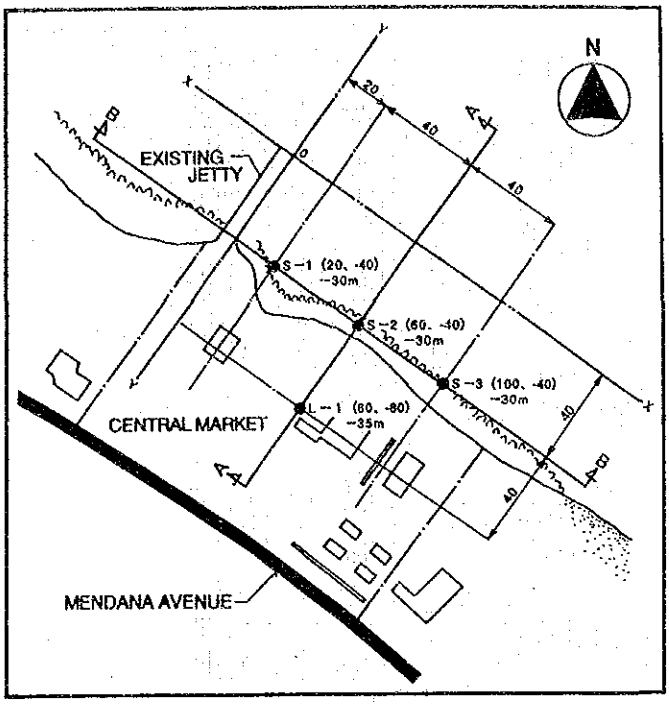

| FLOAT NO. | DURATION OF TRACKING |
|---|---|
| ⑦ | 9.05 — 9.54 |
| ⑧ | 9.57 — 10.27 |
| ⑨ | 10.31 — 11.35 |
| ⑩ | 13.39 — 13.53 |
| ⑪ | 13.56 — 14.31 |
| ⑫ | 14.40 — 15.10 |
| ⑬ | 15.16 — 16.23 |

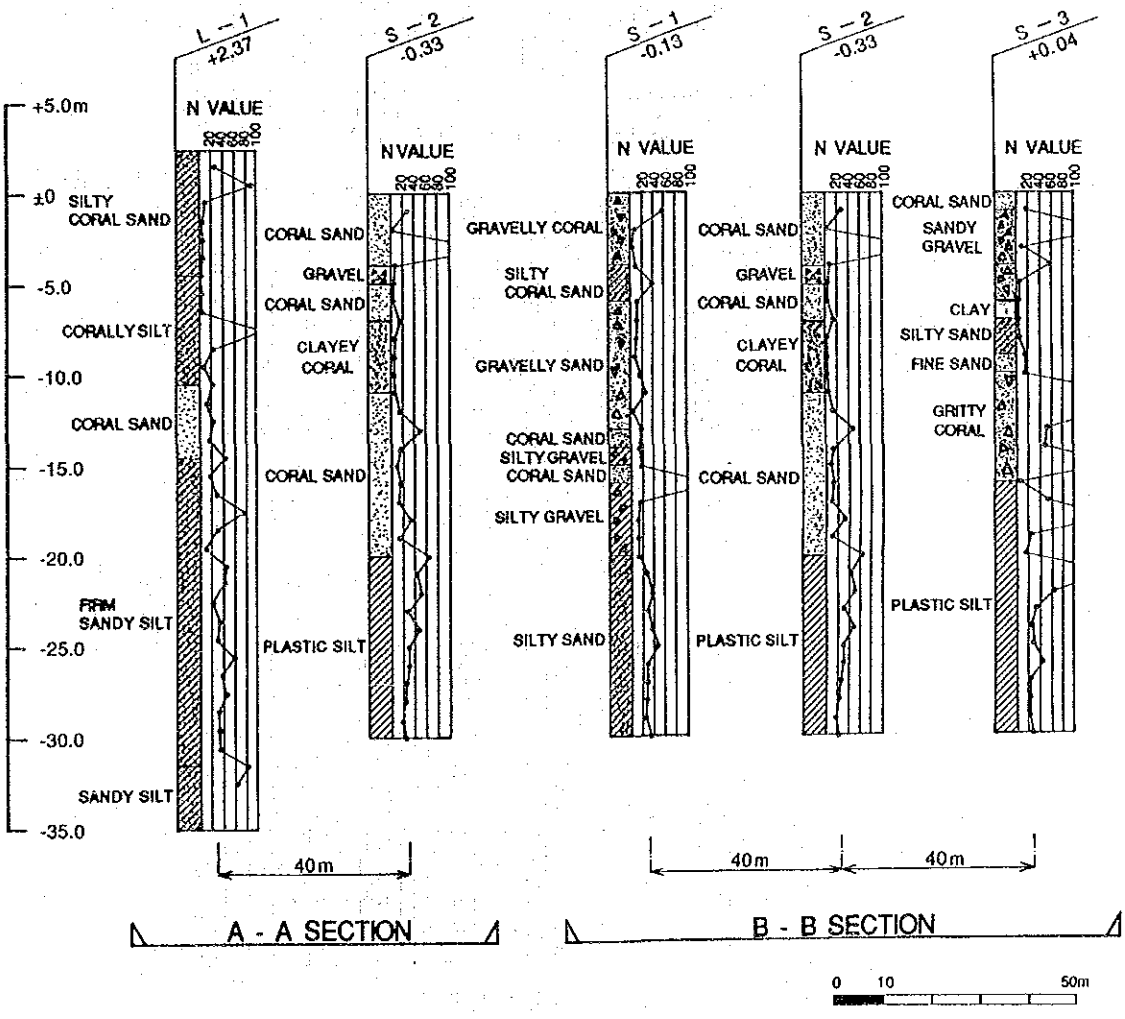
RISE IN TIDE AS AT 25,10,93




Appendix Figure 2.
Current Information Plan (2)

THE PROJECT FOR
THE HONIARA FISH MARKET DEVELOPMENT
IN SOLOMON ISLANDS

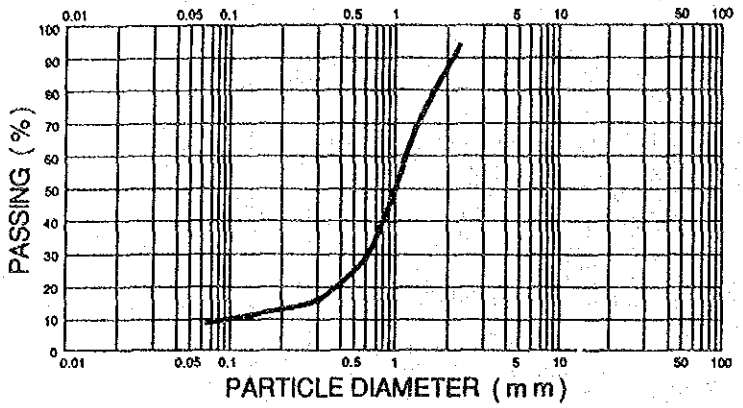


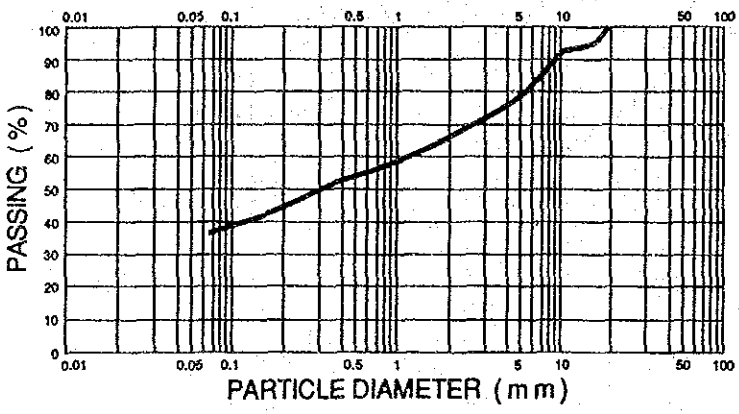

Appendix Figure 3.
Boring Log

THE PROJECT FOR
THE HONIARA FISH MARKET DEVELOPMENT
IN SOLOMON ISLANDS

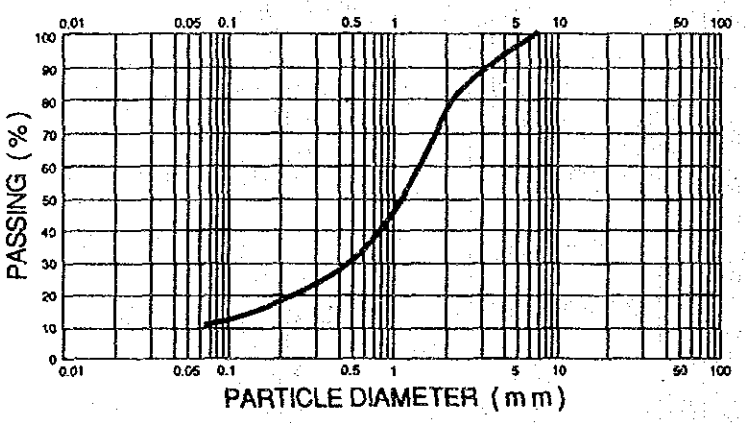
DEPTH 2.0 m



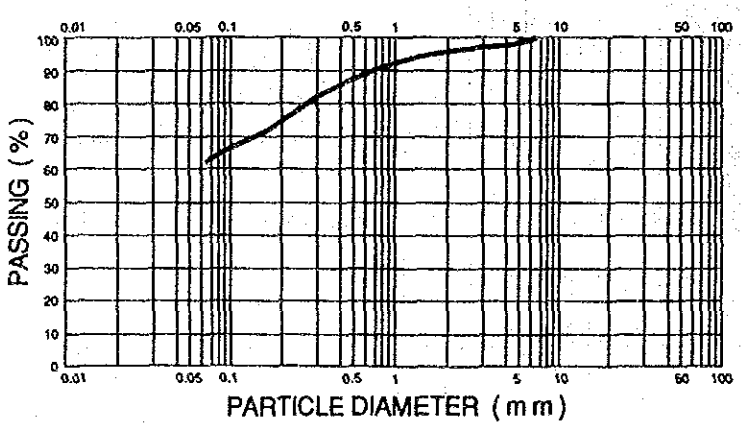

DEPTH 5.0 m




DEPTH 18.0 m

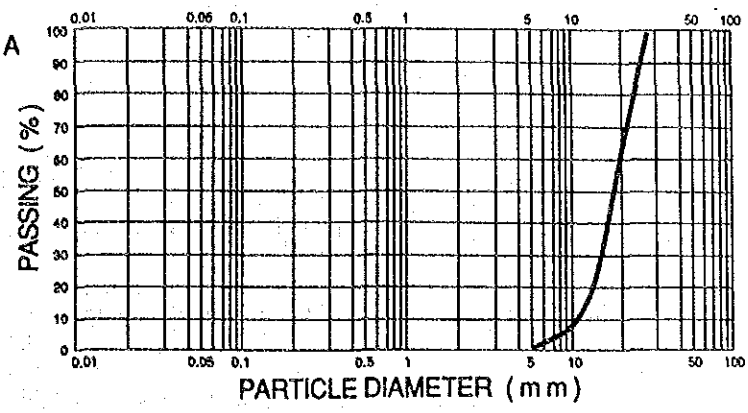



DEPTH 25.0 m

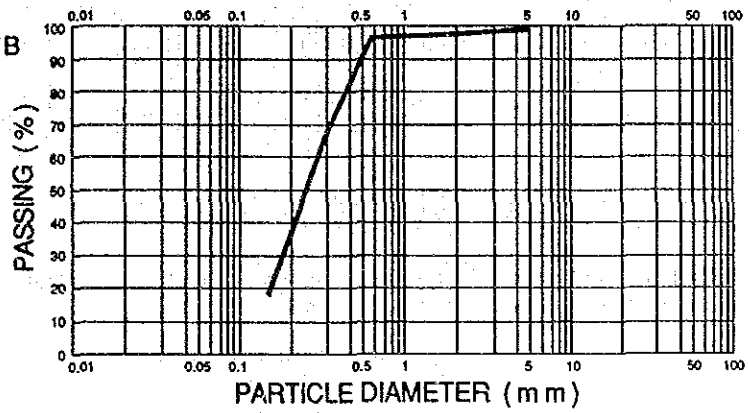



| Appendix Figure 4.<br>Particle Size Accumulation Curve | THE PROJECT FOR<br>THE HONIARA FISH MARKET DEVELOPMENT<br>IN SOLOMON ISLANDS |
|---|---|

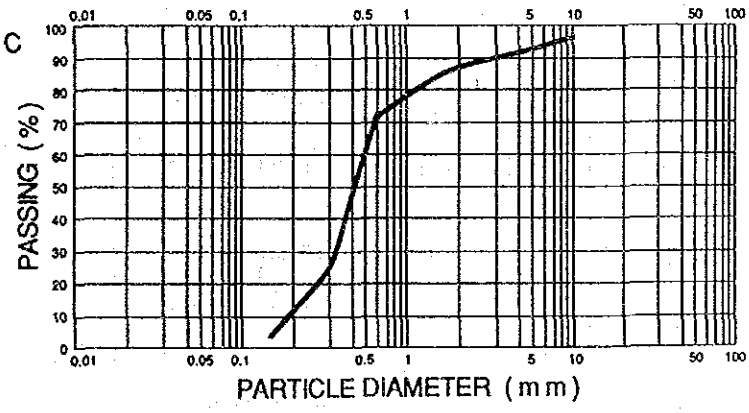
SAMPLING LOCATION POINT A



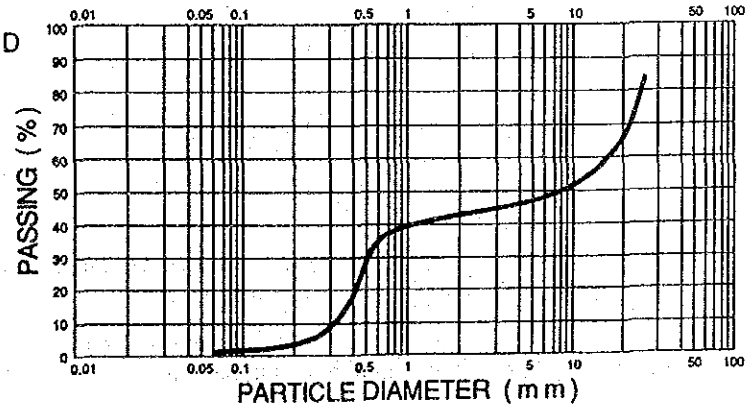

SAMPLING LOCATION POINT B




SAMPLING LOCATION POINT C




SAMPLING LOCATION POINT D




Appendix Figure 5.
Bottom Sediment Particle Size Accumulation Curve

THE PROJECT FOR
THE HONIARA FISH MARKET DEVELOPMENT
IN SOLOMON ISLANDS

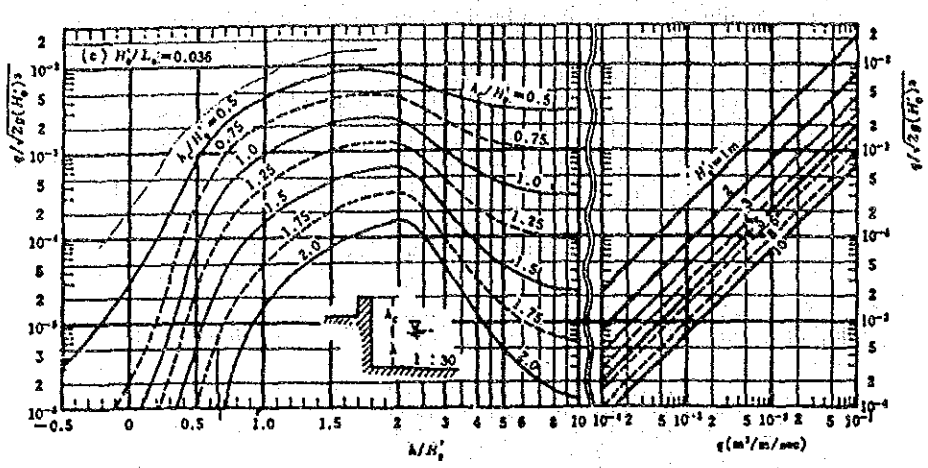



FIGURE WAVE OVERTOPPING RATE VERTICAL SEA DIKE ( SEABED SLOPE 1/30 )

SOURCE : "SHORE PROTECTION FACILITIES CONSTRUCTION STANDARD MANUAL" 1972 CONFERENCE OF SHORE PROTECTION FACILITIES CONSTRUCTION STANDARD

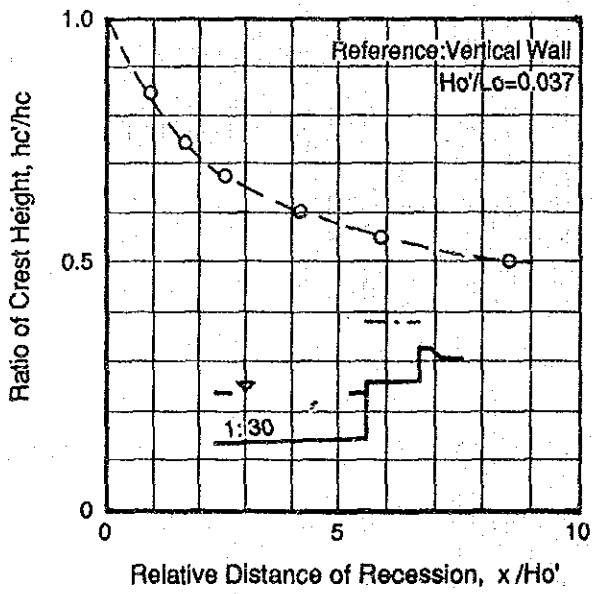



FIGURE THE CHANGE OF CROWN HEIGHT RATE BY RETREATED DISTANCE OF PARAPET

SOURCE : Dr YOSHIMI GOUDA - WAVE OVERFLOW EXPERIMENT OF LOW CREST REVETMENT FOR IRREGULAR WAVES, No242, 1976 THE PORT AND HARBOUR RESEARCH INSTITUTE

| | |
|---|---|
| Appendix Figure 6.<br>Wave Overtopping Rate For Vertical Sea Dike | THE PROJECT FOR<br>THE HONIARA FISH MARKET DEVELOPMENT<br>IN SOLOMON ISLANDS |