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No. 42

THE STUDY ON COASTAL PROTECTION AND PORT IMPROVEMENT IN THE COOK ISLANDS

FINAL REPORT

(APPENDIX)

August 1992

JAPAN INTERNATIONAL COOPERATION AGENCY
(JICA)

THE STUDY
ON
COASTAL PROTECTION AND PORT IMPROVEMENT
IN
THE COOK ISLANDS

FINAL REPORT

(APPENDIX)

August 1992

JAPAN INTERNATIONAL COOPERATION AGENCY
(JICA)

Final Report for the Study on
Coastal Protection and Port Improvement

APPENDIX

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Appendix A-1 Scope of Work (April 17, 1991)

SCOPE OF WORK
FOR
THE STUDY
ON
COASTAL PROTECTION AND PORT IMPROVEMENT
IN
THE COOK ISLANDS

AGREED UPON BETWEEN
MINISTRY OF PLANNING AND ECONOMIC DEVELOPMENT
AND
JAPAN INTERNATIONAL COOPERATION AGENCY

APRIL 17, 1991
Rarotonga
THE COOK ISLANDS

Mr Richard C Chapman
Acting Secretary
MINISTRY OF PLANNING AND
ECONOMIC DEVELOPMENT

Dr. Tadahiko Yagyu
Leader of the
Preliminary Study Team
JAPAN INTERNATIONAL
COOPERATION AGENCY

I. INTRODUCTION

In response to the request of the Government of the Cook Islands, the Government of Japan has decided to implement the Study on Coastal Protection and Port Improvement in the Cook Islands (hereinafter referred as "the Study") in accordance with the relevant laws and regulations in force in Japan.

Accordingly, the Japan International Cooperation Agency (hereinafter referred to as "JICA"), the official agency responsible for the implementation of the technical cooperation programs of the Government of Japan, will undertake the Study in close cooperation with the authorities concerned of the Government of the Cook Islands.

The present document sets forth the Scope of Work with regard to the Study.

II. OBJECTIVE OF THE STUDY

The objective of the Study is to carry out the study on coastal protection and port improvement at Rarotonga Island in the Cook Islands from technical and economic point of view.

III. STUDY AREA

The Study shall cover the whole area of Rarotonga Island.

IV. SCOPE OF THE STUDY

In order to achieve the objective mentioned above, the Study shall cover the following items:

1. Collection, review, and analysis of the existing data, information, and reports relevant to the Study.

2. Site surveys for the Study, if necessary.

1) topographical data
2) geological and geophysical data
3) hydrological and hydraulical data
4) hydrographical data
5) meteorological data
6) port activity, facilities and equipment
7) land use

8)coastal erosion

3.Master Plan for the period up to the year 2010.

A Master Plan for the port improvement of the Avarua-Avatiu port area(hereinafter referred to as "the Port Area")
1)port traffic forecast
2)projection of land requirement
3)basic layout plan of the major port facilities
4)land use plan
5)rough design and cost estimate
6)phased development plan

B Coastal conservation plan for the Rarotonga Island.
1)setting up area for the conservation plan
2)clarification of mechanism of erosion
3)selection of suitable countermeasures

4.Feasibility Study for the period up to the year 1997.

A Feasibility Study on the short term port improvement plan of the Port Area.
1)detailed layout plan of the major port facilities
2)preliminary design and cost estimate
3)economic analysis
4)implementation program
5)recommendation on port management and operation system

B Coastal protection plan from disaster.
1)basic layout plan of coastal protection facilities
2)preliminary design
3)cost estimate for construction, operation and maintenance
4)economic analysis
5)construction, operation and maintenance program

5.Conclusion and recommendation.

V.STUDY SCHEDULE

The Study shall be carried out in accordance with the attached tentative schedule.

VI.REPORTS

JICA shall prepare and submit the following reports in English to the Government of the Cook Islands.

1.Inception report
Twenty(20)copies within one(1)month after the commencement of the Study.

2.Interim Report
Twenty(20)copies within four(4)months after the commencement of the Study.

3.Draft Final Report
.Twenty(20)copies within six(6)months after the commencement of the Study. The Government of Cook Islands will submit its commments on the report to JICA within thirty(30)days after receipt of the Draft Final Report.

4.Final Report
Fourty(40)copies within one(1)month after receipt of the comments on the Draft Final Report.

VII.UNDERTAKINGS OF THE GOVERNMENT OF THE COOK ISLANDS

1.To facilitate smooth conduct of the Study, the Government of the Cook Islands shall take necessary measures;
1)to secure the safety of the Japanese study team (hereinafter referred to as "the Team").
2)to permit the members of the Team to enter, leave, and sojourn in the Cook Islands for the duration of their assignment therein, and exempt them from alien registration requirements and consular fees.

3) to exempt the members of the Team from taxes, duties, fees, and other charges on equipment, machinery, and other materials brought into the Cook Islands for the conduct of the Study.
4) to exempt the members of the Team from income tax and other charges of any kind imposed on or in connection with any emoluments or allowances paid to the members of the Team for their services in connection with the implementation of the Study.
5) to provide necessary facilities to the Team for remittances as well as utilization of the funds introduced into the Cook Islands from Japan in connection with the implementation of the Study.
6) to secure permission for entry into private properties or restricted areas for the conduct of the Study.
7) to secure permission for the Team to take all data and documents(including photographs)related to the Study out of the Cook Islands to Japan.
8) to provide medical services as needed. Its expenses will be chargeable to the members of the Team.

3. The Government of the Cook Islands shall bear claims, if any arises, against the members of the Team resulting from, occurring in the course of or otherwise connected with the discharge of their duties in the implementation of the Study, except when such claims arise from gross negligence or wilful misconduct on the part of the members of the Team.

4. Ministry of Planning and Economic Development shall act as a counterpart agency to the Team and also as a coordinating body in relation with other Governmental and non-governmental organizations concerned for the smooth implementation of the Study.

5. Ministry of Planning and Economic Development shall provide the Team with the followings in cooperation with other organizations concerned;
1) available data and information related to the Study.
2) counterpart personnel.
3) suitable office with necessary office equipment in Rarotonga.

4)credentials or identification cards
5)available vehicles with drivers necessary for the implementation of the Study.

VIII.UNDERTAKINGS OF JICA

For the implementation of the Study, JICA shall take the following measures:

1.to dispatch, at its own expense, the Team to the Cook Islands.

2.to pursue technology transfer to the Cook Islands conterpart personnel in the course of the Study.

IX.CONSULTATION

JICA and Ministry of Planning and Economic Development shall consult with each other in respect of any matter that may arise from or in connection with the Study.

TENTATIVE SCHEDULE

Months	1	2	3	4	5	6	7	8	9
Work in Cook Is.		▭	▭	▭	▭		▭		
Work in Japan	▭		▭	▭	▭	▭	▭		▭
Reports	△ IC/R				△ IT/R		△ DF/R		△ F/R

Remarks: IC/R··· Inception Report
IT/R··· Interim Report
DF/R··· Draft Final Report
F/R··· Final Report

Appendix A-2 Minutes of Meeting (April 17, 1991)

MINUTES OF MEETING ON
SCOPE OF WORK
FOR
THE STUDY
ON
COASTAL PROTECTION AND PORT IMPROVEMENT
IN
THE COOK ISLANDS

AGREED UPON BETWEEN

MINISTRY OF PLANNING AND ECONOMIC DEVELOPMENT

AND

JAPAN INTERNATIONAL COOPERATION AGENCY

APRIL 17, 1991
Rarotonga
THE COOK ISLANDS

Mr Richard C Chapman
Acting Secretary
MINISTRY OF PLANNING AND
ECONOMIC DEVELOPMENT

Dr. Tadahiko Yagyu
Leader of the
Preliminary Study Team
JAPAN INTERNATIONAL
COOPERATION AGENCY

The Japanese Preliminary Study Team headed by Dr. Tadahiko YAGYU visited the Cook Islands for the purpose of discussing the Scope of Work for the Study on Coastal Protection and Port Improvement, from April 9th to April 17th, 1991.

The Team had a series of discussions with the representatives of the Ministry of Planning and Economic Development and other agencies concerned for exchanging the views and opinions, and conducted field surveys in the study area.

The list of attendants of the meeting is attached hereto.

As the results of the above, the both sides have confirmed the following points.

Aerial Photographs

The available information referred to in the Section IV 5 (1) will include aerial photographs.

Steering Committee

The Cook Islands Government will organise a Steering Committee which will be chaired by the Acting Secretary of the Ministry of Planning and Economic Development to co-ordinate all matters related to the Study.

Definition of the Port Area

The Port Area defined under the Section IV.3A includes both Avarua and Avatiu ports and an area between the two ports.

Area to be formulated the coastal protection plan

The coastal protection plan from disaster under the Section IV.4B will be formulated for coasts adjacent to the Avarua-Avatiu town which are considered to be important for Rarotonga island.

The abovementioned coasts may include a coast line up to the airport.

Financial Analysis

Since financial analysis is required for obtaining a financial assistance from international financing institutes, the feasibility study on the short term port improvement plan of the Port Area under the Section IV.4A will include a preliminary financial analysis.

Schedule of the Full Scale Study Team

The Government of the Cook Islands requested the visiting Team that a Full Scale Study Team commence the work on the Study as soon as possible.

ATTENDANTS LIST

1 JAPANESE SIDE:

Dr. Tadahiko Yagyu	Leader
Mr Tadayoshi Kawazoe	Member
Mr Yutaka Matsubara	Member
Mr Ken-ichi Torii	Member
Mr Masahiro Yokokawa	Member
Mr Masayuki Koike	Member

2 COOK ISLANDS SIDE:

1	Mr Richard C Chapman (Chairman)	Acting Secretary Ministry of Planning and Economic Development (MOPED)
2	Mr Aukino Tairea	Secretary Ministry of Foreign Affairs
3	Mr George Cowan	Secretary Ministry of Works (MOW)
4	Mr Oliver Peyroux	Chief Surveyor Survey Department
5	Mr Don Dorrell	Consultant to the Prime Minister on Coastal Protection
6	Mr Poko Tutaka	Deputy Secretary Ministry of Trade Labour and Transport (TLT)
7	Mr Ben Parakoti	Engineering Officer Ministry of Trade Labour and Transport (TLT)
8	Mr Teariki Rongo	Director Conservation Service
9	Mr Vaitoti Tupa	Conservation Officer Conservation Service
10	Mr Stuart Kingan	Scientific Officer/Consultant
11	Dr Charito Chapman	Senior Research Economist Ministry of Planning and Economic Development (MOPED)

12	Mr Brent Dark	Development Economist Ministry of Planning and Economic Development (MOPED)
13	Mr Tai Manuela	Director of Programmes/Planning Ministry of Planning and Economic Development (MOPED)

MEMBERS LIST OF JICA STUDY TEAM

FOR

THE STUDY ON COASTAL PROTECTION AND PORT IMPROVEMENT

IN

THE COOK ISLANDS

1.	Mamoru AMEMIYA	Leader	Pacific Consultants International (PCI)
2.	Tomoo AMANO	Port Planning	Overseas Coastal Area Development Institute of Japan (OCDI)
3.	Eiji KAWABATA	Coastal Planning	PCI
4.	Hiroshi KAYUKAWA	Demand Forecast/ Economic Analysis	OCDI
5.	Masato SUZUKI	Design/Construction/ Estimation	PCI
6.	Mitsuhiko HASEGAWA	Natural Condition	PCI

JAPAN INTERNATIONAL COOPERATION AGENCY

(JICA)

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SHINJUKU MITSUI BLDG.,
1-1, NISHI-SHINJUKU 2-CHOME, TEL. 03 (3346) 5428
SHINJUKU-KU, TOKYO, 163 JAPAN FAX. 03 (3346) 5439

Appendix A-3 Minutes of Meeting (October 18, 1991)

MINUTES OF MEETING
FOR
THE INCEPTION REPORT FOR THE STUDY
ON
COASTAL PROTECTION AND PORT IMPROVEMENT
IN
THE COOK ISLANDS

AGREED UPON BETWEEN THE STEERING COMMITTEE FOR THE CAPTIONED PROJECT CHAIRED BY THE MINISTRY OF PLANNING AND ECONOMIC DEVELOPMENT (MOPED)
AND
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

RAROTONGA
THE COOK ISLANDS
OCTOBER 18 1991

Mr Richard Chapman
Acting Secretary
MOPED

Mr Mamoru Amemiya
Leader
JICA STUDY TEAM

The Government of Japan, in accordance with the Scope of Work agreed on April 17th 1991, has dispatched through JICA, a study team (hereinafter referred to as "The Team") headed by Mr. Mamoru Amemiya together with the JICA advisory committee (hereinafter referred to as "The JICA Committee") chaired by Dr. Katsuyoshi Ishizaki to the Cook Islands for the captioned project.

They arrived in the Cook Islands on October 15th 1991 to present the methodology of study as stipulated in the Inception Report (hereinafter referred to as "The Report").

The team submitted to the Steering Committee of the Cook Islands (hereinafter referred to as the Steering Committee) thirty (30) copies of the Report. The Report was presented at the meeting between the Steering Committee and the Team held on October 16th at Rarotonga.

From October 16th to 18th 1991, both parties held a series of meeting on the Report. The following are major topics concluded by both parties.

1. The Report was in principle accepted by the Government of the Cook Islands represented by the Steering Committee

2. The Steering Committee requested to increase sounding lines at the Eastern Coast of Avarua Harbour up to the Health Department. The team agreed on the request subject to maintaining total number of lines as shown in the Report.

ANNEX 1

ATTENDANTS LIST

COOK ISLANDS SIDE:

Steering Committee

Mr. Richard Chapman CHAIRMAN	Acting Secretary Ministry of Planning and Economic Development (MOPED)
Mr. Tap Pryor	Chief Project Officer Ministry of Planning and Economic Development (MOPED)
Mr. Tai Manuela	Director of Planning and Programmes Ministry of Planning and Economic Development (MOPED)
Mr. Brent Dark	Development Economist Ministry of Planning and Economic Development (MOPED)
Mr. Henry Puna	Secretary Department of Trade, Labour and Transport (TLT)
Mr. Ata Herman	Harbour Engineer Department of Trade Labour and Transport (TLT)
Mr. Oliver Peyroux	Chief Surveyor Survey Department
Mr. Don Dorrell	Coastal Consultant to the Prime Minister on Coastal Protection

Working Group

Dr. Charito Chapman	Chief Economist Ministry of Planning and Economic Development (MOPED)
Mr. Vaitoti Tupa	Deputy Director of Conservation Conservation Service
Mr. Nooroa Parakoti	Engineering Officer Department of Trade Labour and Transport (TLT)
Mr. V Nantheeswarar	Deputy Secretary of Works (CIVIL) Ministry of Works (MOW)
Mr. Terii Tipokoroa	Building Inspector Ministry of Works (MOW)
Mr. David Ngatupuna	Civil Engineering Officer Ministry of Works (MOW)
Mr. George Cowan	Secretary Ministry of Works (MOW)

ANNEX 2

JAPANESE SIDE:

Study Team

Mr. Mamoru Amemiya	Team Leader
Mr. Tomoo Amano	Port Planner
Mr. Eiji Kawabata	Coastal Planner
Mr. Hiroshi Kayukawa	Demand Forecast/Economist Analyst
Mr. Mitsuhiko Hasegawa	Topographic and Geotechnical Engineer

JICA ADVISORY COMMITTEE

Dr. Katsuyoshi Ishizaki CHAIRMAN	Executive Director Japan Institute of Construction Engineering (JICE)
Mr. Seiji Matsumoto	Deputy Director International Affairs Office Ports and Harbours Bureau Ministry of Transport

JICA COORDINATOR

Mr. Masayuki Koike	Project Officer First Development Study Division Social Development Study Department, JICA

Appendix A-4 Minutes of Meeting (February 7, 1992)

MINUTES OF MEETING
FOR
THE INTERIM REPORT FOR THE STUDY
ON
COASTAL PROTECTION AND PORT IMPROVEMENT
IN
THE COOK ISLANDS

AGREED UPON BETWEEN THE STEERING COMMITTEE FOR THE CAPTIONED PROJECT CHAIRED BY THE MINISTRY OF PLANNING AND ECONOMIC DEVELOPMENT (MOPED)
AND
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

RAROTONGA
THE COOK ISLANDS
FEBRUARY 7 1992

Mr Richard Chapman
Acting Secretary
MOPED

Mr Mamoru Amemiya
Leader
JICA STUDY TEAM

The Government of Japan, in accordance with the scope of work agreed on April 17th 1991, has dispatched through JICA, a study team (hereinafter referred to as "The Team") headed by Mr. Mamoru Amemiya to the Cook Islands for the captioned project.

They arrived in the Cook Islands on January 30th 1992 to present the Masterplan and Phased Development Plan as stipulated in the Interim Report (hereinafter referred to as "The Report").

The team submitted to the Steering Committee of the Cook Islands (hereinafter referred to as the Steering Committee) thirty (30) copies of the Report. The Report was presented at the meeting between the Steering Committee and the Team held on January 31st 1992 at Rarotonga.

From January 31st to February 6th 1992, both parties held a series of meeting on the Report. The following are major topics concluded by both parties.

1. The Report was in principle accepted by the Government of the Cook Islands represented by the Steering Committee.

2. The Steering Committee requested to

   (a) consider the cyclone disasters by Val and Wasa December, 1991 in the short-term coastal protection plan, especially for the areas, the West of existing Airport and the Northern coast of Department of Health.

   (b) ensure the safety vessel manoeuvring in the approach channel and inner turning basin. It is also requested to add a tug boat capable to the maximum vessel in the short-term port improvement plan.

   (c) prepare recommendation in the environmental consideration in seawater quality.

ANNEX 1 — ATTENDANTS LIST

COOK ISLANDS SIDE:

Steering Committee

Mr. Richard Chapman CHAIRMAN	Acting Secretary Ministry of Planning and Economic Development (MOPED)
Mr. Tai Manuela	Director of Planning & Programmes Ministry of Planning and Economic Development (MOPED)
Mr. Tep Pryor	Chief Project Officer Ministry of Planning and Economic Development (MOPED)
Mr. Brent Dark	Development Economist Ministry of Planning and Economic Development (MOPED)
Mr. George Cowan	Secretary Ministry of Works (MOW)
Mr. V Nantheeswarar	Deputy Secretary of Works (CIVIL) Ministry of Works (MOW)
Mr. Henry Puna	Secretary Department of Trade, Labour and Transport. (TLT)
Mr. Ata Herman	Harbour Engineer Department of Trade Labour and Transport. (TLT)
Mr. Vaitoti Tupa	Deputy Director of Conservation Service
Mr. Oliver Peyroux	Chief Surveyor Survey Department
Mr. Don Dorrell	Coastal Consultant to the Prime Minister on Coastal Protection.

Working Group

Dr. Charito Chapman	Chief Economist Ministry of Planning and Economic Development (MOPED)
Mr. Noorea Parakoti	Engineering Officer Department of Trade Labour and Transport (TLT)
Mr. Terii Tipokoroa	Building Inspector Ministry of Works (MOW)
Mr. David Ngatupuna	Civil Engineering Officer Ministry of Works (MOW)

ANNEX 2

JAPANESE SIDE:

Study Team

Mr. Memoru Amemiya	Team Leader
Mr. Tomoo Ameno	Port Planner
Mr. Yutaka Yoshimori	Operation, Management and Financial Anelysis

Appendix A-5 Minutes of Meeting (March 20, 1992)

MINUTES OF MEETING

FOR

THE DRAFT FINAL REPORT FOR THE STUDY

ON

COASTAL PROTECTION AND PORT IMPROVEMENT

IN

THE COOK ISLANDS

AGREED UPON BETWEEN THE STEERING COMMITTEE FOR THE CAPTIONED PROJECT CHAIRED BY THE MINISTRY OF PLANNING AND ECONOMIC DEVELOPMENT (MOPED)

AND

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

RAROTONGA
THE COOK ISLANDS
MARCH 20 1992

Mr Richard C Chapman
Acting Secretary
MOPED

Mr Mamoru Amemiya
Leader
JICA STUDY TEAM

The Government of Japan, in accordance with the scope of work agreed on April 17th 1991, has dispatched through JICA, a study team (hereinafter referred to as "The Team") headed by Mr Mamoru. Amemiya to the Cook Islands for the captioned project.

They arrived in the Cook Islands on March 12th 1992 to present the short-term Development Plan as stipulated in the Draft final Report (hereinafter referred to as "The Report").

The team submitted to the Steering Committee of the Cook Islands (hereinafter referred to as the Steering Committee) twenty (20) copies of the Report. The Report was presented at the meeting between the Steering Committee and the Team held on March 13th 1992 at Rarotonga.

From March 13th to March 20th 1992, both parties held a series of meeting on the Report. The following are major topics concluded by both parties.

1. The report was in principle accepted by the Government of the Cook Islands represented by the Steering Committee.

2. The Steering Committee was requested to submit their comments on the report by April 10th, 1992.

3. Based on the Cook Government request, JICA advisory Committee members provided an explanation that the first action to be taken by the Cook side should be through the diplomatic channel when they want to proceed to Implementation of the Study.

ANNEX 1

ATTENDANTS LIST

COOK ISLANDS SIDE:

Steering Committee

Mr. Richard Chapman CHAIRMAN	Acting Secretary Ministry of Planning and Economic Development(MOPED)
Mr. Tai Manuela	Director of Planning and Programmes Ministry of Planning and Economic Development
Mr. Tap Pryor	Chief Project Officer Ministry of Planning and Economic Development(MOPED)
Mr. Brent Dark	Development Economist Ministry of Planning and Economic Development
Mr. George Cowan	Secretary Ministry of Works
Mr. Henry Puna	Secretary Ministry of Trade Labour and Transpsort (TLT)
Mr. Ata Herman	Harbour Engineer Department of Trade, Labour and Transport (TLT)
Mr. Vaitoti Tupa	Deputy Director of Conservation Service
Mr. Oliver Peyroux	Chief Surveyor Survey Department
Mr. Don Dorrell	Coastal Consultant to the Prime Minister on Coastal Protection.
Mr. Patana Yala	Chief Resident Engineer Ministry of Works

Working Group

Mr Nooroa Parakoti	Engineering Officer Department of Trade, Labour and Transport (TLT)

JAPANESE SIDE

JICA ADVISORY COMMITTEE

Mr. Seiji Matsumoto	
Mr. ~~Uniaka~~ Kenichi Torii	

JICA TOKYO HEADQUARTER

MR. Masayuki Koike	

Study Team

Mr. Mamoru Amemiya	Team Leader
Mr. Tomoo Amano	Port Planning
Mr. Eiji Kawabata	Coastal Planning

Appendix B-1 Cost Estimation for Short-term Development Plan

Appendix B - 1 : Cost Estimation for Short-term Development Plan

Cost Summary

(1/23)

Site	Location	Coastal Protection	Port Improvement	Total Cost
Site - 1 "Health Department"		$747,000	-	$747,000
Site - 2 "Avarua Coast"	I Avarua East Coast	$833,000	-	$833,000
	II Avarua Harbour	-	$2,639,000	$2,639,000
	III Avarua Central Coast	$3,179,000		$3,179,000
	IV Avatiu Harbour	-	$6,704,000	$6,704,000
	Sub-total	($4,012,000)	($9,343,000)	($13,355,000)
Site - 3 "Airport East"		$1,157,000	-	$1,157,000
Site - 4 "Airport West"		$1,102,000	-	$1,102,000
A. Direct Cost		$7,018,000	$9,343,000	$16,361,000
B. Indirect Cost	20.5% of A	$1,439,000	$1,915,000	$3,354,000
C. Grand Total Cost (A+B)	A plus B	$8,457,000	$11,258,000	$19,715,000

Breakdown of Cost : Site - 1 "Health Department"

(2/23)

Works	Specifications	Quantity of Works	Unit Price	Cost
		L = 300.0 m		
A. Rock Mound Wall				
1. Armour Rock	1 ~ 2 ton	16.19 m² x 300.0 m = 4,857 m³	x 60.0	= $291,400
2. Core Rock	100 ~ 200 kg	9.12 m² x 300.0 m = 2,736 m³	x 48.0	= $131,400
2'. Excavation/Filling		6.12 m² to be included in item 8.		
8. Filling	General earth	21.20 m² x 300.0 m = 6,360 m³	x 10.0	= $63,600
10. Concrete	Type 1	0.08 m² x 300.0 m = 240 m³	x 960.0	= $230,400
15. Others	Step etc.,	300.0 m	x 100.0	= $30,000
		Total		$746,800
		Unit Cost:		
		$746,800 ÷ 300 m = 2,389 $/m		
		= 2,400 $/m		

List of Works : Site - 2 "Avarua Coast"

(3/23)

Works	Specifications	Quantities	Total cost
I Avarua East Coast			
A. Seawall/Reclamation	Section 2-1A	125 m (20,880 m³)	$833,000
		Subtotal	$833,000
II Avarua Harbour			
B. East Breakwater	sec. 2-1B, 2-1C	90 m	$535,000
B'. West Breakwater	sec. 2-4C	30 m	$414,000
C. Avarua East wharf/Stream	sec. 2-2A	155 m	$474,000
D. Repair Work for existing wharf	sec. 2-2B	155 m	$495,000
E. Dredging		9,938 m³	$350,000
F. Temporary Quay	sec. 2-3	120 m	$311,000
G. Berthing Jetty	sec. 2-4	LS	$60,000
		Subtotal	$2,639,000
III Avarua Central Coast			
H. Additional works to existing wall by MOW	sec. 2-5	130 m	$392,000
I. Seawall/Reclamation	sec. 2-6	220 m (55,053 m³)	$1,703,000
I'. Seawall/Reclamation	sec. 2-7	195 m (24,398 m³)	$1,084,000
		Subtotal	$3,179,000
IV Avatiu Harbour			
J. Reclamation		13,000 m³	$154,000
K. East Breakwater	sec. 2-8A ~ 2-8D	280 m	$3,250,000
L. Inner Breakwater	sec. 2-1	100 m	$57,000
M. Quay Repair	Commercial	130 m	$218,000

List of Works : Site - 2 "Avarua Coast"

(4/23)

Works	Specifications	Quantities	Total Cost
N. TLT Slipway/marine police (Repair)		30 m	$51,000
O. Quay wall, Fisheries		145 m	$437,000
P. West Breakwater protection	sec. 2-11A	65 m	$99,000
Q. West Breakwater	sec. 2-11B, 2-11C	225 m	$538,000
R. Fish Market (shed)		300 m²	$150,000
S. Utilities		LS	$350,000
T. Dredging		30,000 m³	$1,400,000
		Subtotal	$6,704,000
		Site - 2, Total Cost	$13,355,000

Breakdown of Cost : Site - 2 "Avarua Coast"

(5/23)

Works	Specifications	Quantity of Works	Unit Price	Cost
I. Avarua East Coast				
A. Seawall and Reclamation	Section 2-1A	Length 125.0 m		
1. Armour Rock	1 ~ 2 ton*	14.86 m² x 125.0 m = 1,858 m³	x 60 =	$111,500
2. Armour Rock	1 ~ 2 ton*	10.20 m² x 125.0 m = 1,275 m³	x 60 =	$76,500
2'. Cone Rock	100 ~ 200 kg	6.26 m² x 125.0 m = 783 m³	x 48 =	$37,600
3. Reclamation	General earth	167.04 m² x 125.0 m = 20,880 m³	x 10 =	$208,800
4. Concrete parapet		0.88 m² x 125.0 m = 110 m³	x 960 =	$105,600
5. Concrete Apron		2.25 m² x 125.0 m = 281 m³	x 720 =	$202,500
6. Filter sheet		10.7 m x 125.0 m = 1,338 m²	x 30 =	$40,100
7. Planting		20.0 m x 125.0 m = 2,500 m²	x 20 =	$50,000
		Total		$832,600
		Unit Cost: $832,600 ÷ 125 m = 6,660 $/m		
II. Avarua Harbour				
B. Breakwater	90 m			
B-1 East Breakwater (Lagoon) Section 2-1B	60 m(Lagoon)			
1. Armour Rock	2 ton Replace	36.86 m² x 60.0 m = 2,212 m³	x 24.0 =	$53,100

Note: Armour rock size at Avarua East can be reduced to 400 ~ 700 kg.

(6/23)

Works	Specifications	Quantity of Works	Unit Price	Cost
B-2 East Breakwater (Head) Section 2-1C	30 m (Head)			
1. Concrete Block	8 ton	23.3 m² x 30.0 m = 699 m³	x $\frac{1}{2}$ (600+720) =	$461,200
2. Core Rock	400 ~ 700 kg	13.00 m² x 30.0 m = 390 m³	x 54 =	$21,100
		Total of B-1 and B-2		$535,200
		Unit Cost, $4,535,200 ÷ 90 m = 5,950 $/m		
B' West Breakwater (Head) Section 2-4C	30 m			
1. Concrete Block	8 ton	23.20 m² x 30.0 m = 690 m³	x 600 =	$414,000
		Unit Cost: $414,000 ÷ 30 m = 13,800 $/m		
		Total of B		$949,200

Works	Specifications	Quantity of Works	Unit Price	Cost
C. Avarua East wharf/stream				
C-1 Marina Wharf	Avarua East			
Wharf	L=85 m			
1. Front wall, Rock	100 ~ 200 kg	35.00 m² x 85 m = 2,975 m³	x 48.0 =	$142,800
2. Front wall, Rock	10 ~ 100 kg	6.30 m² x 85 m = 536 m³	x 48.0 =	$25,700
3. Reclamation	by sec. 2-1A	-	- =	-
4. Gravel		6.10 m² x 85 m = 519 m³	x 10.0 =	$5,200
5. Apron Concrete		1.50 m² x 85 m = 128 m³	x 720.0 =	$91,800
6. Filter sheet		7.00 m x 85 m = 595 m²	x 30.0 =	$17,900
		Total of wharf		$283,400
Jetty				
1. Concrete	Reinforced	60.00 m³ x 5 units = 300 m³	x 960 =	$288,000
2. Gravel Filling				
3. Fitings	Tender etc.	100.00 m³ x 5 units = 500 m³	x 10 =	$5,000
		= 85 m	x 200$/m =	$17,000
		Total of Jetty		$310,000

Works	Specifications	Quantity of Works	Unit Price	Cost
C.2 Stream Wall	East L=70 m			
2. Armour Rock	400 ~ 700 kg	5.25 m² x 70 m = 368 m³ (Replace)	x 22.0 =	$8,100
2'. Cone Rock	100 ~ 200 kg	3.63 m² x 70 m = 254 m³ (Replace)	x 22.0 =	$5,600
3. Gravel		3.85 m² x 70 m = 270 m³	x 10.0 =	$2,700
4. Filter Sheet		6.50 m x 70 m = 455 m²	x 30.0 =	$13,700
5. Concrete Parapet		0.65 m² x 70 m = 45.5 m³	x 960 =	$43,700
6. Concrete Apron		1.65 m² x 70 m = 115.5 m³	x 720 =	$83,200
7. Reclamation		(by section 2-1A)		-
8. Planting		5.0 m x 70 m = 350 m²	x 20 =	$7,000
			Total	$164,000
			Total of C1 + C2	$474,000
		Unit Cost 474,000 + (85 + 70) = 3,060 $/m		

Works	Specifications	Quantity of Works	Unit Price	Cost
D. Repair Work and Reclamation for the Existing Wharf	Section 2-2B L=155 m (35 + 80 + 40)			
Seawall and River Dike	L=155 m -1.0 m			
1. Front Wall, Rock	100 ~ 200 kg	9.98 m² x 155 m = 1,547 m³	x 48.0 =	$74,300
2. Front Wall, Rock	10 ~ 100 kg	6.30 m² x 155 m = 986 m³	x 48.0 =	$46,900
3. Reclamation		35.00 m² x 155 m = 5,425 m³	x 10.0 =	$54,300
4. Gravel		6.10 m² x 155 m = 482 m³	x 10.0 =	$4,800
5. Apron Concrete		1.50 m² x 155 m = 233 m³	x 720.0 =	$167,400
6. Parapetwall		0.88 m² x 155 m = 136 m³	x 960.0 =	$130,900
7. Filter sheet		3.50 m x 155 m = 543 m²	x 30.0 =	$16,300
			Total	$494,900
		Unit Cost: $494,900 ÷ 155 m = 3,190 $/m		
E. Dredging				
E1. Marina Wharf (90 m x 60 m x 1.5 m)	MSL - 2.5 m	1.5 m x 5,400 m² = 8,100 m³	x $\frac{1}{2}$ (50+25)=	$303,800
E2. Dredging (Temporary Wharf) (75 m x 35 m x 0.7 m)	MSL-1.0 m	0.7 m x 2,625 m² = 1,838 m³	x 25 =	$45,900
			Total Dredging	$349,700

Works	Specifications	Quantity of Works	Unit Price	Cost
F. Temporary Quay Section 2-3	-1.0 m	L = 120 m Equivalent		
1. Front wall, Rock	100 ~ 200 kg	9.98 m² x 120 m = 1,198 m³	x 48.0 =	$57,500
2. Front wall, Rock	10 ~ 100 kg	6.30 m² x 120 m = 756 m³	x 48.0 =	$36,300
3. Reclamation	General earth	56.10 m² x 120 m = 6,732 m³	x 10.0 =	$67,300
4. Gravel		6.10 m² x 120 m = 732 m³	x 10.0 =	$7,300
5. Apron Concrete		1.50 m² x 120 m = 180 m³	x 720.0 =	$129,600
6. Filter sheet		3.50 m x 120 m = 420 m²	x 30.0 =	$12,600
		Total		$310,600
		Unit Cost: $310,600 ÷ 120 = 2,590 $/m		
G. Berthing Jetty (Temporary Quay)				
1. Concrete	Reinforced	29.44 m³ x 2 units = 59	x 960 =	$56,600
2. Gravel Filling		51.56 m³ x 2 units = 103	x 10 =	$1,100
3. Fitings	Tender etc.,	250 $/m x 120 m = 120 m	x 100$/m =	$12,000
		Total		$59,700
		Unit Cost: $59,700 ÷ 120 m = 500 $/m		
		$59,700 ÷ 2 units = 30,000 $/unit		

Works	Specifications	Quantity of Works	Unit Price	Cost
III. Avarua Central Coast				
H. Additional work to Existing wall by MOW	Section 2-5	L = 130 m		
1. Armour Rock	1 ~ 2 ton*	20.4 m³ x 130 m = 2,652 m³	x 60.0 =	$159,100
2. Concrete Parapet		0.93 m³ x (130+25) m = 144 m³	x 960 =	$138,400
3. U-shapes drainage		0.60 m³ x 130 m = 78 m³	x 960 =	$74,900
4. Others		130 m	x 150$/m =	$19,500
		Total		$391,900
		Unit Cost: 391,900 ÷ 130 = 3,015 $/m		
I. Seawall/Reclamation	Section 2-6			
1. Armour Rock	1 ~ 2 ton*	14.86 m² x 220 m = 3,270 m³	x 60 =	$196,200
2. Armour Rock	1 ~ 2 ton*	15.00 m² x 220 m = 3,299 m³	x 60 =	$198,000
3'. Core Rock	100 ~ 200 kg	15.04 m² x 220 m = 3,309 m³	x 48 =	$158,800
3. Reclamation	General earth	125.12 m² + 50 x 100 x 220 = 55,053 m³	x 10 =	$550,530
4. Filter Sheet		13.8 m x 220 m = 3,036 m²	x 30 =	$91,100
5. Concrete Parapet		0.93 m² x 220 m = 205 m³	x 960 =	$196,800
6. Concrete Apron		0.90 m² x 220 m = 198 m³	x 720 =	$142,600
7. Concrete Drainage	U shaped	0.54 m² x 220 m = 119 m³	x 960 =	$114,000
8. Others	incl. planting	= 220 m	x 250$/m =	$55,000
		Total		$1,703,030
		Unit Cost: 1,703,030 ÷ 220 m = 7,741 $/m		

Note: Armour rock can be reduced to 400 ~ 700 kg.

Works	Specifications	Quantity of Works	Unit Price	Cost
I'. Seawall/Reclamation	Section 2-7	L = 195 m		
1. Armour Rock	1 ~ 2 ton*	14.86 m² x 195 m = 2,898 m³	x 60 =	$173,900
2. Armour Rock	1 ~ 2 ton*	Replace 15.00 x 195 m = 2,925 m³	x 24 =	$70,200
2'. Core rock	100 ~ 200 kg	15.04 m² x 195 m = 2,933 m³	x 22 =	$64,500
3. Reclamation	General earth	125.12 m² x 195 m = 24,398 m³	x 10 =	$244,000
4. Filter Sheet		13.8 m x 195 m = 2,691 m²	x 30 =	$80,700
5. Concrete Parapet		0.93 m² x 195 m = 181 m³	x 960 =	$174,100
6. Concrete Apron		0.90 m² x 195 m = 176 m³	x 720 =	$126,400
7. Concrete Drainage	U shaped	0.54 m² x 195 m = 105 m³	x 960 =	$101,100
8. Others	incl. planting	195 m	x 250$/m =	$48,800
		Total	=	$1,083,700
		Unit Cost: $1,083,700 ÷ 195 m = 5,560 $/m		

Note: Armour rock can be reduced to 400 ~ 700 kg.

Works	Specifications	Quantity of Works		Unit Price	Cost
IV. Avatiu Harbour					
J. Reclamation					
1. Reclamation	General earth	260m x 100m x $\frac{1}{2}$ x 1.0m =	13,000 m³	x 10 =	$130,000
2. Wall, Avatiu Stream	Repair	200 m³ x 260 m =	520 m³	x 22.0 =	$11,400
3. Others			260 m	x 50 $/m =	$13,000
			Total		$154,400
K. East Breakwater	L = 280 m				
K-1 Lagoon Section	L = 130 m				
1. Armour Rock	1 ~ 2 ton	38.0 m² x 130 m = 4,940 m³		x $\frac{1}{2}$ (60+24) =	$207,500
2. Stream month	Replace		20 m	x 5,000 $/m =	$100,000
3. Others			310 m	x 150 $/m =	$46,500
			Total	=	$354,000
K-2 Lagoon Section	L = 50 m				
1. Concrete Block	3.2 ton	16.5 m³ x 50 m = 825 m³		x 600 =	$495,000
2. Core Rock	100 ~ 200 kg	11.5 m² x 50 m = 575 m³		x 48 =	$27,600
			Total	=	$522,600
K-3 Reef Front Section	L = 70 m				
1. Concrete Block	10.0 ton	23.9 m³ x 70 m = 1,673 m³		x $\frac{1}{2}$ (600+720) =	$1,104,000
2. Core Rock	400 ~ 700 kg	17.0 m² x 70 m 1,170 m³		x 54 =	$64,300
			Total	=	$1,168,300
K-4 Head 30 m Section	L = 30 m				
1. Concrete Block	16 ton	53.00 m² x 30 m = 1,590 m³		x 720 =	$1,144,800
2. Core Rock	1 ~ 2 ton	48.40 m² x 30 m = 1,452 m³		x $\frac{1}{2}$ (60+24) =	$61,000
			Total		$1,205,800
			Total of K		$3,250,700
		Unit Cost: $3,250,700 ÷ 280 m = 11,600 $/m			

Works	Specifications	Quantity of Works		Unit Price	Cost
L. Inner Breakwater	Section 2-1	L = 100 m			
1. Armour Rock	400 ~ 700 kg	23.63 m² x 100 m = 2,363 m³		x 24 =	$56,700
M. Quay Repair	Commercial				
1. Front wall		130 m x 25 % = 32.5 m		x 2,500 =	$82,300
2. Pavement		(5.0m x 10.0m) x 4 places = 200 m²		x 200 =	$40,000
3. Others		260 m		x 100 =	$26,000
4. Pavement		7 m x 100 m = 700 m		x 100 =	$70,000
			Total	=	$218,300
N. TLT Slipway/Marine Police					
1. Dike		30 m		x 500 =	$15,000
2. Pavement		30 m x 5m = 150 m²		x 200 =	$30,000
3. Other		30 m		x 200 =	$6,000
			Total		$51,000

Works	Specifications	Quantity of Works	Unit Price	Cost
Q Quay wall (Fisheries Sector)	Section 2-10	L = 145 m		
1. Armour Rock	1 ~ 2 ton*	- - -	- =	-
2. Armour Rock	400 ~ 700 kg	9.72 m² x 145 m = 1,409 m³	x 54 =	$76,100
3. Armour Rock	100 ~ 200 kg	4.66 m² x 145 m = 676 m³	x 48 =	$32,400
4. Filter sheet		3.00 m x 145 m = 435 m²	x 30 =	$13,100
5. Reclamation	General earth	45 m x 145 m x 1.70 m = 11,093 m³	x 10 =	$110,100
6. Gravel Pavement		45 m x 140 m x 0.4 m = 2,520 m³	x 10 =	$25,200
7. Berthing Jetty	Same with Item G	6 units	x 30,000 =	$180,000
		Total		$436,900
		Unit Cost: $436,900 + 145 m = $3,000 $/m		
P. West Breakwater Protection	Section 2-11A			
1. Drainage by Core Rock	< 10 kg	8.20 m² x 65 m = 533 m³	x 48.0 =	$25,600
2. Pavement concrete		1.50 m² x 65 m = 98 m³	x 720 =	$70,600
3. Gravel Pavement		4.2 m² x 65 m = 273 m³	x 10 =	$2,700
		Total		$98,900
		Unit Cost: $98,900 + 65 m = 1,520 $/m		

Note: Armour rock for fishery quay wall can be reduced to 400 ~ 700 kg.

Works	Specifications	Quantity of Works	Unit Price	Cost
Q West Breakwater	L = 225 m			
Q-1 Middle Section 2-11B	L = 195 m			
1. Armour Rock (Relocation)	1 ~ 2 ton	40.0 m³ x 195 m x 1/2 = 3,900 m³	x 24 =	$93,600
1'. Armour Rock (New)	2 ton	40.0 m³ x 195 m x 1/2 = 3,900 m³	x 60 =	$234,000
2. Parapet wall		0.8 m³ x 70 m = 56 m³	x 960 =	$53,800
		Total		$381,400
Q-2 Head 30 m Section 2-11C	L = 30 m			
1. Concrete Block	4 ton	18.0 m³ x 30 m = 240 m³	x 600 =	$144,000
2. Core Rock	400 ~ 700kg	10.5 m² x 30 m = 315 m³	x $\frac{1}{2}$ (54 + 24) =	$12,300
		Total of Q-2		$156,300
		Total of Q (West Breakwater)		$537,700
		Unit Cost: 537,700 + 225 m = 2,400 $/m		
R. Fish market				
1. Shelter		12 m x 25 m = 300 m²	x 500 =	$150,000

(17/23)

Works	Specifications	Quantity of Works	Unit Price	Cost
S. Utilities				
S-1 Commercial Sector	East			
1. Water Supply		LS	=	$15,000
2. Lighting		LS	=	$30,000
3. Incinerator		1 unit	x 7,500 =	$7,500
		Commercial Sector Total		$52,500
S-2 Fisheries Sector				
1. Water Supply		LS	=	$35,000
2. Lighting		LS	=	$50,000
3. Power Supply		LS	=	$75,000
4. Incinerator		1 unit	x 7,500 =	$7,500
5. Septic Tank		1 unit	x 30,000 =	$30,000
6. Ice Plant	0.5 t/day	1 set	x 100,000 =	$100,000
		Fisheries Sector Total		$297,500
		Total Utilities		$350,000
T. Dredging				
1. Dredging	Blasting	22,000 m³	x 50.0 =	$1,100,000
2. Dredging	Clamshell	8,000 m³	x 25.0 =	$200,000
3. Other		LS	=	100,000
		Total		$1,400,000

List of Works : Site - 3 "Airport East"

(18/23)

Works	Locatoin	Total Cost
A. Auxiliary side dike	Both ends	$97,000
B. Rock Mound Wall	West	$433,000
C. Rock Mound Wall	Middle	$322,000
D. Rock Mound Wall	East	$305,000
		Site-3, Total $1,157,000

Breakdown of Cost : Site - 3 "Airport East"

(19/23)

Works	Specifications	Quantity of Wroks	Units Price	Cost
A. Auxiliary Dike				
1. Armour Rock	400 ~ 700 kg	15 m² x 120 m 1,800 m³ x	54.0 =	$97,200
		Total Length	120 m	
		Unit Cost: 97,200 + 120 m =	810 $/m	
B. Rock Mound Wall (Main Seawall)	Section 3-4 West end			
1. Armour Rock	1~2 ton*	17.83 m² x 130 m		
2. Armour Rock	1~2 ton*	16.46 m² x 130 m = 4,458 m³ x	60.0 =	$267,500
2'. Lone Rock	100 ~ 200 kg	10.50 m² x 130 m = 1,365 m³ x	48.0 =	$65,500
3. General Earth		- x 130 m - x	10.0 =	-
10. Concrete		0.80 m² x 130 m = 104 m³ x	960.0 =	$99,800
		Total		$433,000
		Unit Cost: $433,000 + 130 m =	3,330 $/m	

Note: Armour rock for the main seawall can be reduced to 400 kg ~ 700 kg.

(20/23)

Works	Specifications	Quantity of Wroks	Units Price	Cost
C. Rock mound Wall (Main Seawall)	Section 3-3 Middle			
1. Armour Rock	1 ~ 2 ton*	16.68 m² x 90 m = 1.500 m³ x	60.0 =	$90.000
2. Armour Rock	1 ~ 2 ton*	15.04 m² x 90 m = 1.355 m³ x	60.0 =	$81,300
2'. Core Rock	100 ~ 200 kg	13.84 m² x 90 m = 1.246 m³ x	48.0 =	$59,800
3. General Earth		23.79 m² x 90 m = 2.141 m³ x	10.0 =	$21,400
10. Concrete		0.80 m² x 90 m = 72 m³ x	960.0 =	$69,100
		Total		$321,600
		Unit Cost: $321,600 + 90 m =	3,573 $/m	
		=	3,500 $/m	
D. Rock Mound Wall (Main Seawall)	Section 3-2 East end			
1. Armour Rock	1 ~ 2 ton*	22.48 m² x 80 m = 1.800 m³ x	60.0 =	$108,000
2. Armour Rock	1 ~ 2 ton*	16.29 m² x 80 m = 1.302 m³ x	60.0 =	$78,100
2'. Core Rock	100 ~ 200 kg	14.95 m² x 80 m = 1.106 m³ x	48.0 =	$57,400
3. General Earth		- x 80 m = -	=	-
10. Concrete		0.80 m² x 80 m = 64 m³ x	960 =	$61,500
		Total		$305,000
		Unit Cost: $305,000 + 80 m =	3,810 $/m	

Note: Armour rock can be reduced to 400 kg ~ 700 kg.

List of Works : Site - 4 "Airport West"

(21/23)

Works	Location	Section	Total Cost
A. Seawall	Near the MET	Section 4-1	$308,000.-
B. Lagoon Breakwater	North-west Corner	Section 4-2	$304,000.-
C. Leading Jetty	For Airport Drain	Section 4-3	$16,000.-
D. Seawall, Right Bank	Airport West	Section 4-4	$268,000.-
E. Seawall, Left Bank	Airport West	Section 4-4	$206,000 -
		Site - 4 Total	1,102,000.-

Breakdown of Cost : Site - 4 "Airport West"

(22/23)

Works	Specifications	Quantity of Works					Unit Price			Cost
A. Seawall	Met site Section 4-1									
1. Armour Rock	1 ~ 2 ton*	15.20 m²	x	80.0 m	=	$1,216	x	60.0	=	$73,000
2. Armour Rock	1 ~ 2 ton*	10.58 m²	x	80.0 m	=	$846	x	60.0	=	$50,700
3. Core Rock	100 ~ 200 kg	6.93 m²	x	80.0 m	=	$554	x	48.0	=	$26,600
3'. Excavation and Rock fill		4.55 m²	x	80.0 m	=	$364	x	(48.0 + 5.0)	=	$19,300
4. Gravel		3.63 m²	x	80.0 m	=	$290	x	10.0	=	$2,900
5. Filter sheet		13.00 m	x	80.0 m	=	$1,040	x	30.0	=	$31,200
6. Concrete wall	parapet wall	0.80 m²	x	80.0 m	=	$64	x	960.0	=	$61,400
7. Concrete apron		0.75 m²	x	80.0 m	=	$60	x	720.0	=	$43,200
								Total		$308,300
		Unit Cost:		308,300	+	80.0 m	=	3,855 $/m		

Note: Armour rock size can be reduced to 400 kg ~ 700 kg.

Works	Specifications	Quantity of Works					Unit Price			Cost
B. Lagoon Breakwater	Section 4-2									
1. Armour Rock	1 ~ 2 ton	21.56 m²	x	150.0 m	=	3,234 m³	x	60.0	=	$194,000
2. Core Rock	100 ~ 200 kg	15.30 m²	x	150.0 m	=	2,295 m³	x	80.0	=	$110,200
								Total		$304,200
		Unit Cost:		304,200	÷	150 m	=	2,028 $/m		
C. Leading Jetty : Airport Drain	Section 4-3	1 unit	x	20 meters						
1. Armour Rock	400 ~ 700 kg	14.49 m²	x	20.0 m	=	289 m³	x	54.0	=	$15,600
		Unit Cost:		$15,600	÷	20m	=	780 $/m		
D. Seawall : Airport West	Right Bank	Section 4-4								
1. Armour Rock	1 ~ 2 ton*	19.35 m²	x	65.0 m	=	1,258 m³	x	60.0	=	$75,500
2. Armour Rock	1 ~ 2 ton*	9.90 m²	x	65.0 m	=	643 m³	x	60.0	=	$38,600
3. Core Rock	100 ~ 200 kg	5.10 m²	x	65.0 m	=	332 m³	x	48.0	=	$15,900
3'. General Earth		32.25 m²	x	65.0 m	=	2,096 m³	x	10.0	=	$21,000
4. Gravel/Lawn		6.25 m²	x	65.0 m	=	407 m³	x	(10 + 5)	=	$6,400
5. Filter sheet		13.00 m	x	65.0 m	=	845 m²	x	30.0	=	$25,400
6. Concrete wall	parapet wall	0.8 m²	x	65.0 m	=	52 m³	x	960.0	=	$49,900
7. Concrete apron		0.75 m²	x	65.0 m	=	49 m³	x	720.0	=	$35,100
								Total		$267,800
		Unit Cost:		$267,800	÷	65 m	=	4,120 $/m		
E. Seawall : Airport West	Left Bank					50 m	x	4,120 $/m	=	$206,000

Note: Armour rock for airport west seawall can be reduced to 400 kg ~ 700 kg.

Appendix C-1 Coast File

Appendix C1 "Coast File"; Present Coast Conditions by Village

General Notes

1. Constituency and village divisions are based on the available map. Number for classification are given to these two. Refer to Fig. C1-1.

2. Coast Section

   Length of village are measureed at the center of beach road. This length has been divided by unit length in 200 meters. Measurement is started from the village boundary to unti-clockwise direction.

   "Coast Unit" is also numbered.

3. Shore length is tentatively substituted by the length of beach road as it runs parallel to the shoreline.

4. "Sea Side" column may show landmarks, passage, island etc., existing on the shoreline or seaward.

5. Existing land use representing by population (Pp) major facilities and plant are shown in two classification by depth of land.

   "First 100" means data in the nearest 100 meter to the beach top.

   "Next 200" means another 200 meter behind the First 100 meter ares.

6. "Pp" means the population in number of house marks on the map. It is assumed that one house mark is equivalent to five villagers.

7. "Plant" means rate of plantation area indicating in the map. This data should be confirmed.

8. Columns "Profile"

   Data in this column show physical characteristics of coastal areas.

   "Lg" means the width of lagoon in meter. Refer to Fig. C1-2.
   "Sl" means average gradient of beach slope.

"El" means the elevation of beach top above Mean Sea Level (MSL) in meter. Refer to Fig. C1-2.

"Sd" shows the type of structure, if there is any artificial construction.

"Dr" Distance in meter between the beach top and the beach road, Ara Tapu.

9. Columns "Damage"

Data in this column show record of damage and damage forecasts in the coastal area.

"B·Er" shows beach erosion, fine particles.

"N·Er" shows combined erosion both beach and coast, fine particles and coarse particles.

"Dw" shows the design wave or wave intensity for wave run-up estimation. Refer to Fig. C1-3.

"Ru" shows the estimated run-up elevation in meter by design wave above MSL. Refer to Fig. C1-4.

"Bl" shows balance between the beach top elevation (El) and run-up elevation (Ru). Refer to Fig. C1-4.
Thus, Bl = El - Ru
If wave is overtopping, Bl is in minus, otherwise in plus.

"-1M" shows wave height which may run up to beach top minus one meter. Refer to Fig. C1-5.

"±0M" shows wave height which will run up just top of beach. Refer to Fig. C1-5.

"+1M" shows wave height which may overtop the beach top by one meter. Refer to Fig. C1-5.

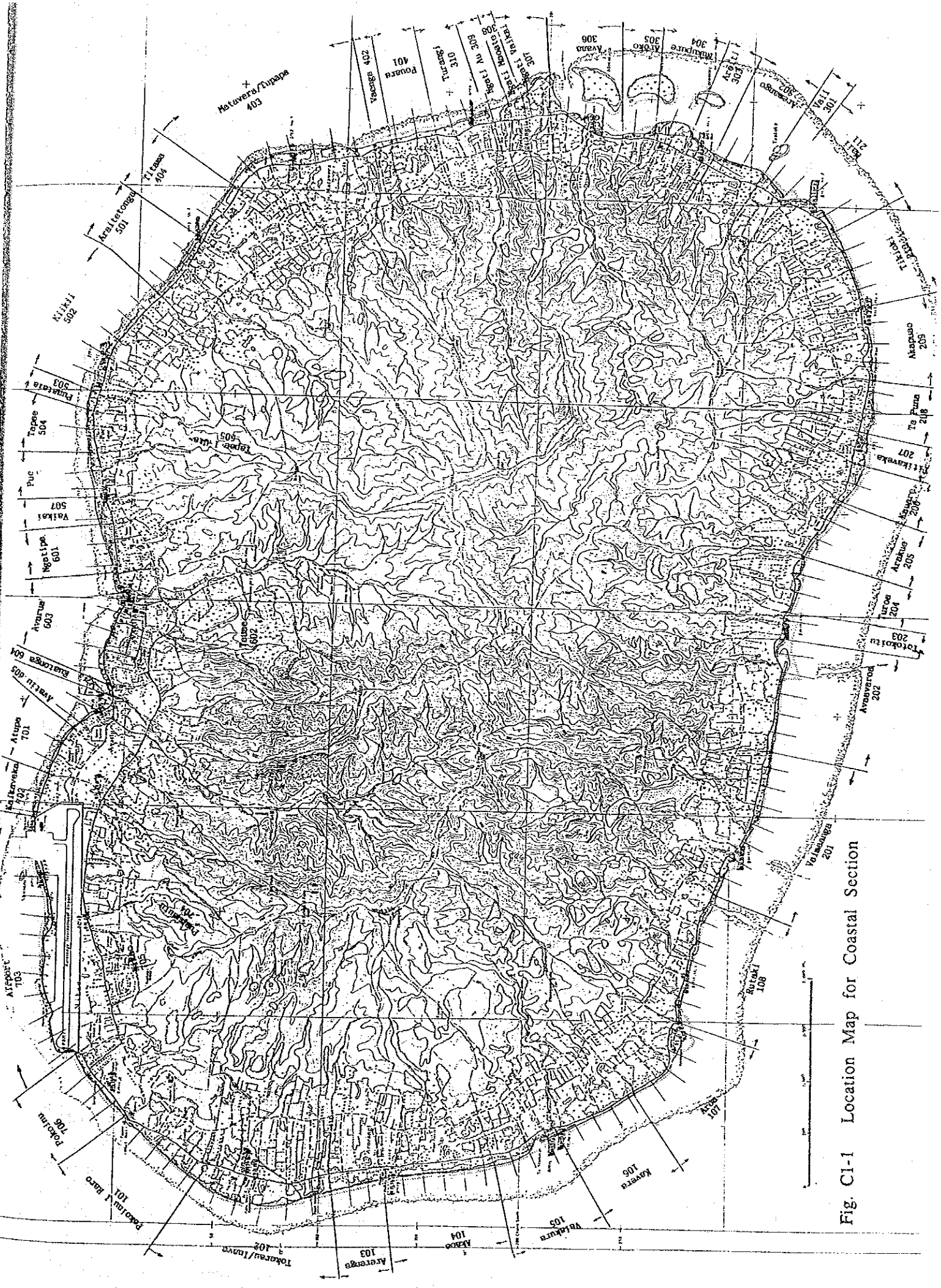


Fig. C1-1 Location Map for Coastal Section

Fig. C1-2 Lagoon Width and Ground Height of Beach Top

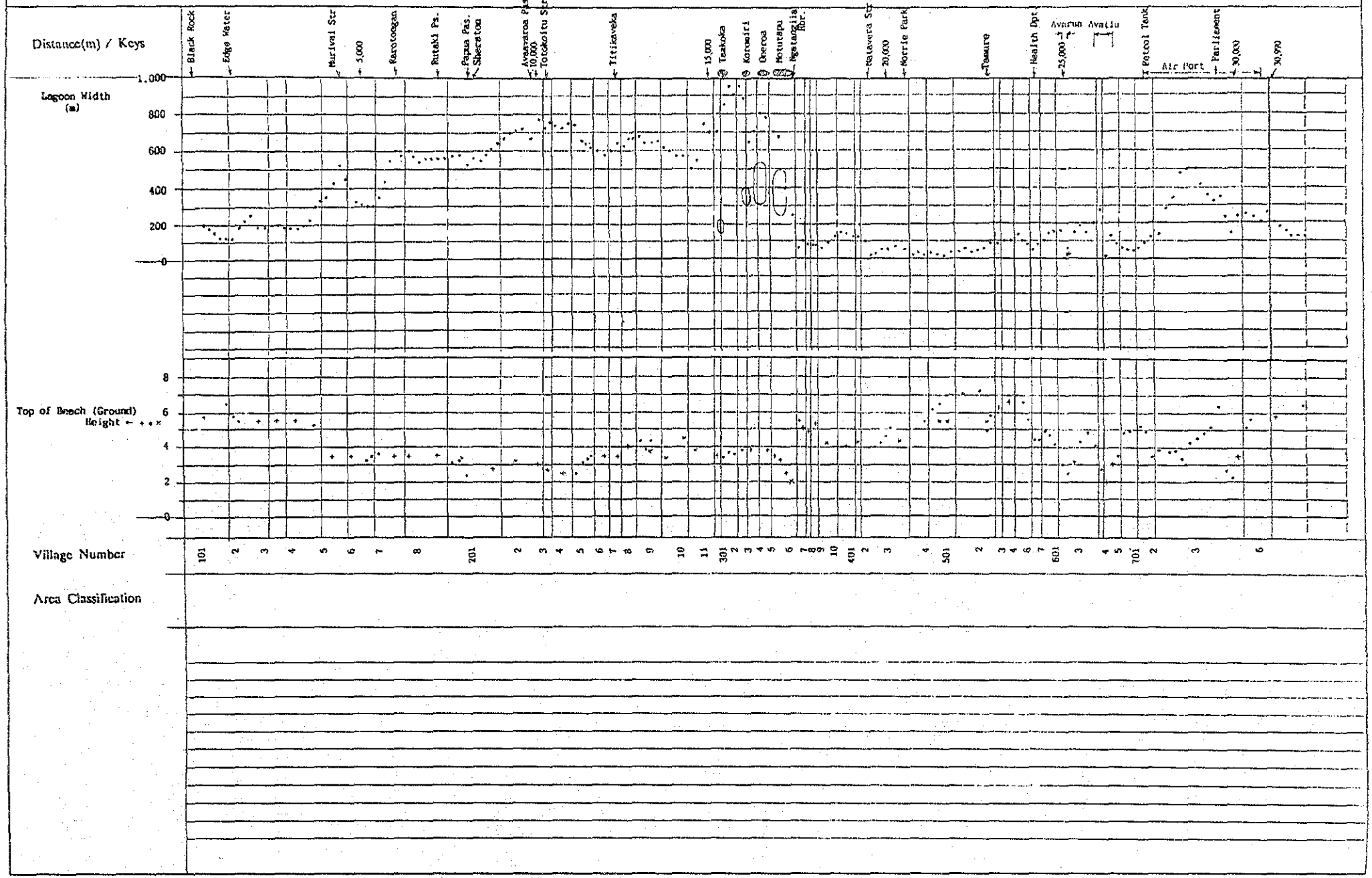


Fig. C1-3 Equivalent Offshore Waves by Village

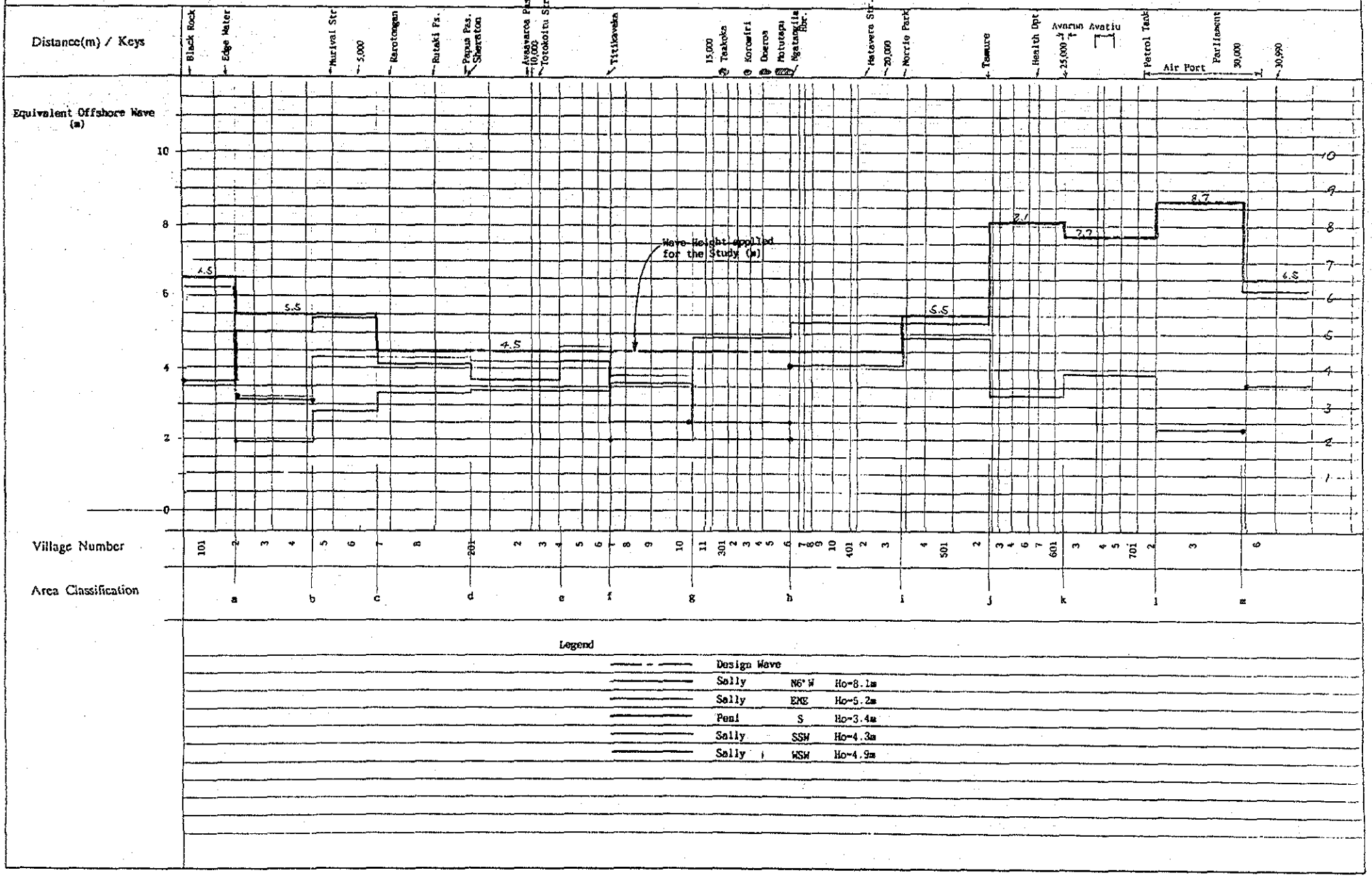


Fig. C1-4 Wave Run-up and Overtopping Elevation by Design Waves

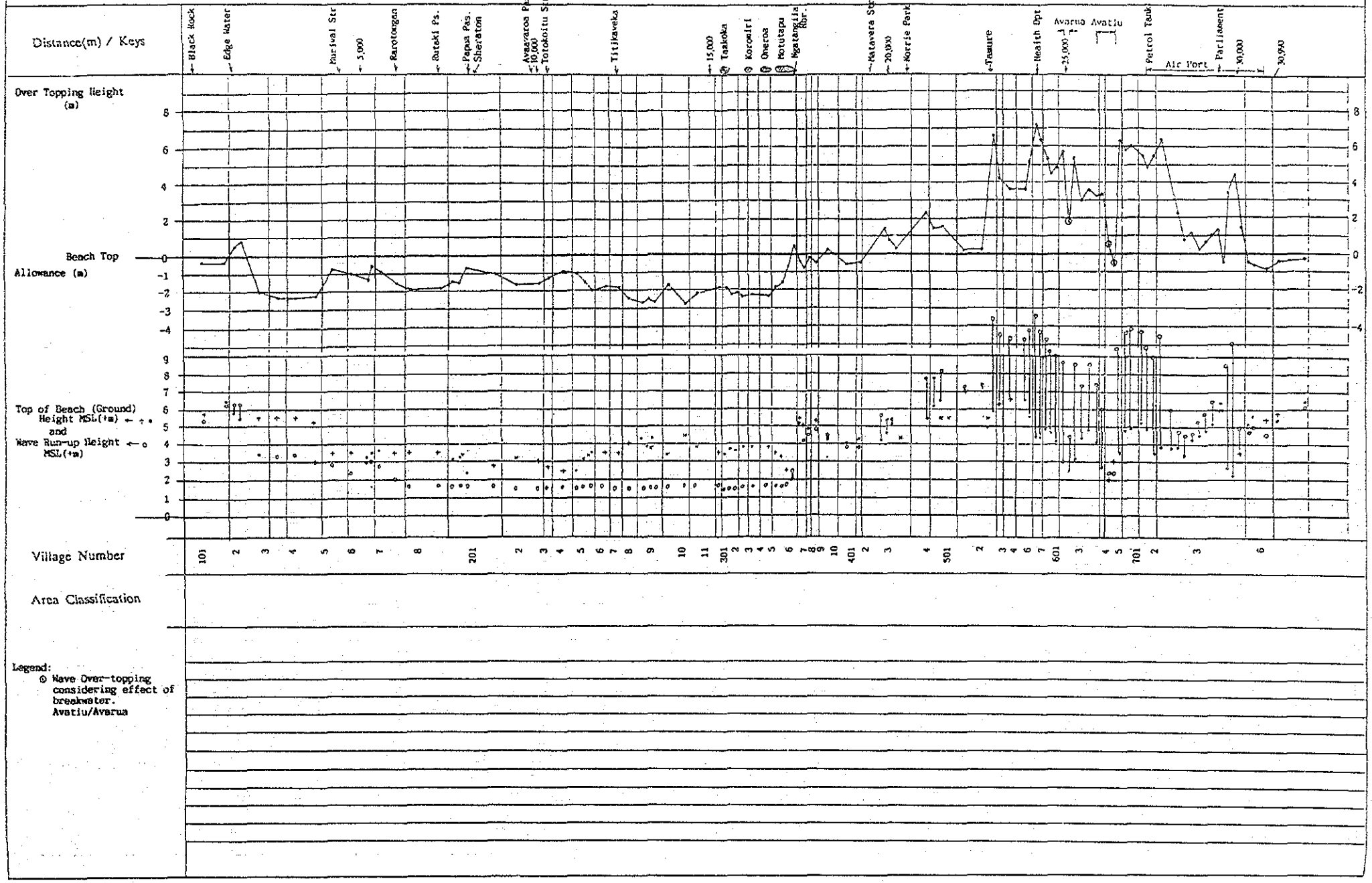
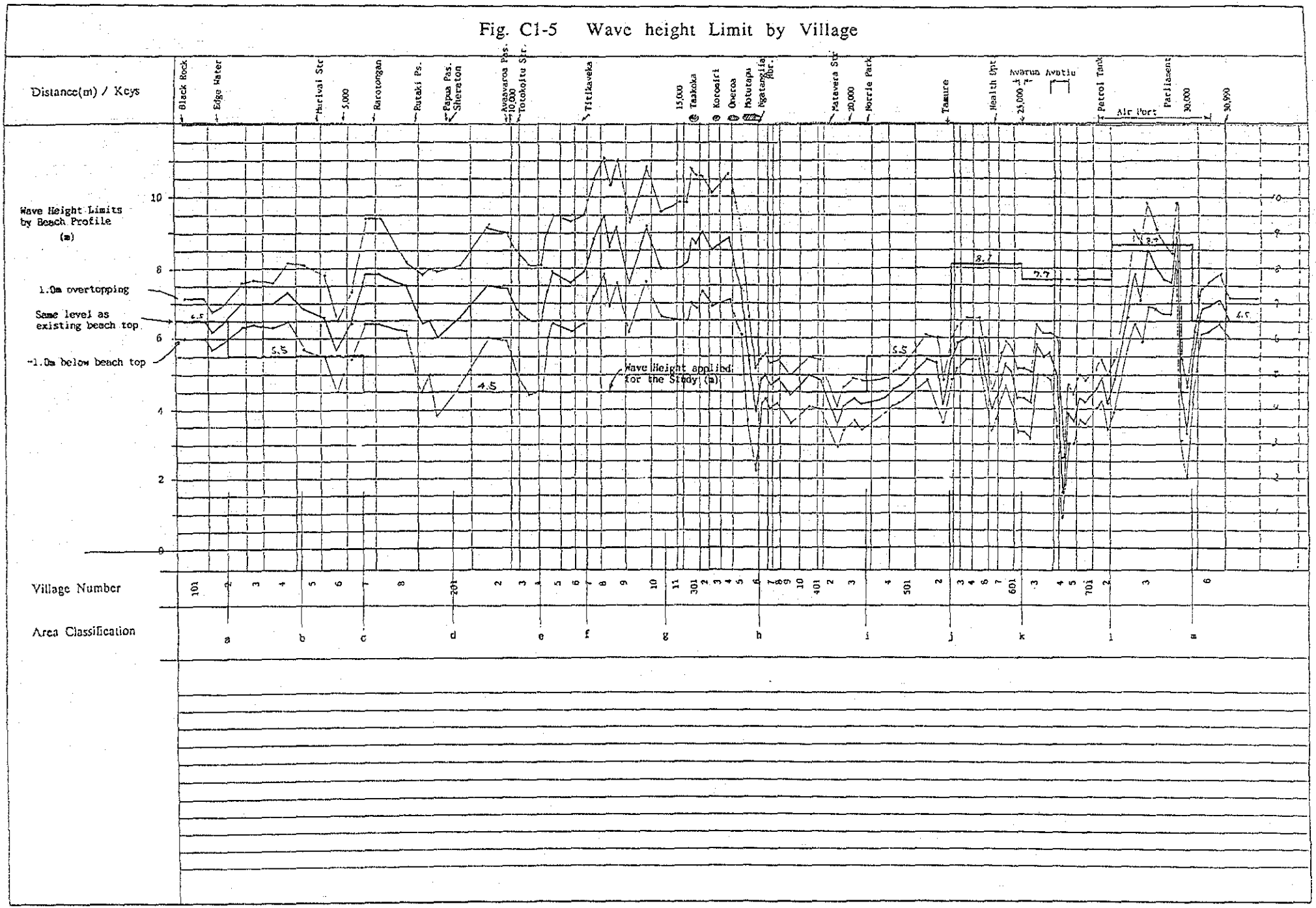


Fig. C1-5 Wave height Limit by Village



Appendix C1. "Coast File"

Present Coast Conditions by Village

Constituency village	Coast Unit	Shore length	Seaside	First 100M			Next 200M		Profiles					Damage						
				Pp	Facilities	Plant	Pp	Facilities	Lg	Sl	El	Sd	Dr	B.Er	N.Er	(Dw) Ru	Bl	-1m	±0n	+1m
1. Arorangi																				
101 Pokoinu I.R.	1011	200	Black Rock	0	Quarry	FC 10	0	Quarry	200		**5.7		50			(6.5) 5.5	+ 0.2	6.0	6.5	7.2
	1012	200	-	3	-	F 60	3	-	180				110							
	1013	200	-	4	-	FC 70	1	-	170				150							
	1014	200	-	2	-	FC 50	2	-	160				160							
	1015	100	-	0	-	FC 70	2	-	160		6.5		160			6.3	+ 0.2	6.0	6.5	7.2
Sub Total (Average)		900		9(2.0)		260 (52)	8 (1.8)	No.6	870(174)		6.1		630(126)							
102 Tokerau/Inave	1021	200	-	4	-	FC 80	3	- No.6	160		5.8		230			6.3	- 0.5	5.7	6.2	6.8
	1022	200	-	1+	Edge WaterTamure Tovern	FT 50	2+	Edge Water Tamure Tovern No.6	190		5.5		260			6.3	- 0.8	5.8	6.4	6.9
	1023	200	-	+	MOW	F 50	+	BM 15+90 No.6	220				280			(6.5)				
	1024	200	-	0	-	F 40	2	-	260				230			(5.5)				
	1025	200	-	2	Stream ( )	F 60	5	Bridge	240		**5.5		180			3.5	+ 2.0	6.3	7.0	7.6
	1026	200	-	1+	Beach Hotel	F 50	4+	Theatre	240				170							
Sub Total (Average)		1,200		8+(1.3)		330 (55)	16+(2.7)		1,310(218)		5.6		1,116(186)							
103 Averenga	1031	200	-	1	R.C.	FC 70	16	-	250				160							
	1032	200	-	3	-	FC 40	8	-	250		**5.5		140			3.3	+ 2.3	6.4	7.0	7.7
	1033	130	-	10	-	FC 40	7	-	240				130							
Sub Total (Average)		530		14(5.3)		150 (50)	31(11.7)		740(245)		5.5		430(143)							
104 Akaoa	1041	200	-	0	Packing Shed BM14+19 School, Stream ( ) Bridge	FT 10	4	Sport Ground, C.I.C.C. Sec. School	240				100							
	1042	200	-	9	-	FT 70	9	-	240		**5.5		100			3.5	+ 2.3	6.3	7.0	7.6
	1043	200	-	5	-	F 30	6	-	250				100							
	1044	200	-	8	-	F 40	8	-	270				120							
	1045	200	-	2	S.D.A	FC 30	6	-	300		**5.2		110			3.0	+ 2.2	6.5	7.3	8.2
	1046	70	-	0	-	FC 30	1	-	330				110							
Sub Total (Average)		1,070		24(4.5)		210 (35)	34 (6.4)		1,630(272)		5.4		640(107)							

Present Coast Conditions by Village

Constituency village	Coast Unit	Shore length	Seaside	First 100M			Next 200M		Profiles					Damage						
				Pp	Facilities	Plant	Pp	Facilities	Lg	Sl	El	Sd	Dr	B.Er	N.Er	(Dw) Ru	Bl	-1m	±0h	+1m
105 Vaiakura	1051	200	-	1	-	FC 50	2	I.D.S	350				100			(5.5)				
	1052	200	-	3	-	F 60	3	-	430		**3.5		100			2.8	+ 0.7	5.7	6.8	8.1
	1053	200	Te Muriavai	6	Stream Muriavai	FC 30	5	-	520				40							
	1054	100	-	1	-	FC 40	3	Bridge BM 13-1+80	450				80							
Subtotal (Average)		700		11(3.1)		180 (45)	13 (3.7)		1,795(449)		3.5		320 (80)							
106 Kavera	1061	200	-	3	BM 13-2+50	F 30	5	-	400		**3.5		40			2.5	+ 1.0	5.5	6.6	7.8
	1062	200	-	1	-	F 50	0	-	320				30							
	1063	200	-	4	-	F 20	0	-	310				20							
	1064	200	-	1	-	F 30	0	- No.7	300		3.2		30			3.0	+ 1.2	4.5	5.7	6.5
	1065	50	-	0	-	F 60	0	- No.7	300		3.5		20			3.0	+ 0.5	5.0	6.0	6.8
Subtotal (Average)		850		6(1.4)		190 (38)	5 (1.2)	- No.7	1,630(326)		3.4		140 (28)							
107 Aroa	1071	200	-	6	-	FT 10	1	- No.7	350		3.6		20			2.7	+ 0.9	5.4	6.4	7.3
	1072	200	-	6	-	F 30	1	-	430				20							
	1073	200	-	2	-	F 30	2	-	550				30							
	1074	200	-	0+	Rarotongan H.	-	1+	Rarotongan H.	600		**3.6		140			(5.5) 2.0	+ 1.5	6.4	7.8	9.4
	1075	80	-	0+	Rarotongan H.	-	0+	Rarotongan H.	570				100			(4.5)				
Subtotal (Average)		880		14+2(3.2)		70 (14)	5+2(1.1)		2,500(500)		3.6		310 (62)							
108 Rutaki	1081	200	-	2	Bridge Stream ( )	FC 60	2	-	600		**3.5		50			1.6	+ 1.9	6.4	7.8	9.4
	1082	200	-	3	-	FC 10	1	-	570				30							
	1083	200	-	2	BM 12--1+50 BM 12--2+110 School	FC 10	6	-	450				30							
	1084	200	-	5	Bridge Stream Rutaki	FC 20	5	-	550				60							
	1085	200	-	3	-	FC 30	4	-	550				30							
	1086	200	-	1	-	FC 40	0	-	550		**3.5		50			1.7	+ 1.8	6.2	7.5	8.2
	1087	130	Rutaki Pass.	1	-	FTC 10	0	-	550				40							
Subtotal (Average)		1,330		17(2.6)		180 (26)	18 (2.7)		3,910(559)		3.5		290 (41)							
Total (Average)																				

Present Coast Conditions by Village

Constituency village	Coast Unit	Shore length	Seaside	First 100M			Next 200M		Profiles					Damage						
				Pp	Facilities	Plant	Pp	Facilities	Lg	Sl	El	Sd	Dr	B.Er	N.Er	(Dw).Ru	Bl	-1m	±0m	+1m
2. Titikaveka																				
201 Vaimaanga	2011	200	-	0	-	F 90	1	- No.8	570		3.1		50			(4.5)				
	2012	200	-	2	Stream Ngatoe	FC 80	2	- No.8	580		3.2		70			1.7	+ 1.4	4.5	6.4	7.8
	2013	200	-	1	Bridge BM 11-2+120	F 40	2	- No.8	530		2.4		30			1.7	+ 1.5	5.0	6.5	8.0
	2014	200	Papua Pass	0	Bridge, Sheraton Stream Papua	FC 80	0	Sheraton	560				30			1.7	+ 0.7	3.8	6.0	7.9
	2015	200	-	3	-	FC 60	3	-	550				50							
	2016	200	-	3	-	FTC 60	2	-	580				70							
	2017	200	-	5	-	FTC 40	3	-	610		**2.7		70			1.7	+ 1.0	4.7	6.6	8.1
	2018	130	-	4	-	FC 70	2	-	640				50							
Subtotal (Average)		1,530		18(2.4)		520 (65)	15 (2.0)		4,620 (578)		2.9		420 (53)							
202 Avaavaroa	2021	200	-	5	-	FC 50	0	-	670				60							
	2022	200	-	4	-	FTC 80	2	-	700				30							
	2023	200	-	7	-	FC 60	5	-	710		*3.2		30			1.6	+ 1.6	6.0	7.5	9.2
	2024	200	-	1	-	FC 80	0	-	720				30							
	2025	200	Avaavaroa Pass	2	Bridge Stream Taipara	FC 30	0	-	670				100							
	2026	150	-	0	-	FC 30	0	-	770		**3.0		50			1.5	+ 1.5	5.9	7.4	9.0
Subtotal (Average)		1,150		19(3.3)		330 (55)	7 (1.2)		4,240 (707)		3.1		300 (50)							
203 Totokoitu	2031	200	-	4	Bridge Stream Totokoitu	FTC 30	2	-	720				40							
	2032	100	-	4	BM 10-2+30	FC 20	1	-	750		**2.7		30			1.5	+ 1.2	5.0	6.8	8.5
		300		8(5.3)		50 (25)	3 (2.0)		1,470 (735)		2.7		70 (35)							
204 Turoa	2041	200	-	6	-	FTC 50	4	-	730				20							
	2042	200	-	3	-	FC 40	3	-	720		**2.5		50			1.6	+ 0.9	4.4	6.5	8.1
	2043	200	-	0	Bridge Stream ( )	FC 70	3	-	750				70							
Subtotal (Average)		600		9(3.0)		160 (53)	10 (3.3)		2,200 (733)		2.5		140 (47)							

Present Coast Conditions by Village

Constituency village	Coast Unit	Shore length	Seaside	First 100M			Next 200M		Profiles					Damage						
				Pp	Facilities	Plant	Pp	Facilities	Lg	Si	El	Sd	Dr	B.Er	N.Er	(Dw) Ru	Bl	-1m	±0n	+1m
205 Arakue	2051	200	-	8	-	FC 20	3	- No.9	740		2.5		20			(4.5) 1.5	+ 1.0	4.5	6.5	8.1
	2052	200	-	5	Church Hall	F 30	1	- No.9	660		3.1		40			1.6	+ 1.5	6.0	7.3	9.0
	2053	200	-	6	S.D.A. School and Compound	FC 60	3	- No.9	640		3.5		40			1.6	+ 2.0	6.4	7.9	9.5
	2054	30	-	1	-	FC 40	0	-	610				50							
Subtotal (Average)		630		20 (6.3)		150 (38)	7 (2.2)		2,560 (663)		3.0		150 (38)							
206 Kauare	2061	200	-	6	-	F 30	6	-	600				50							
	2062	200	-	8	Theatre	F 30	4	-	570		*3.5		100			1.7	+ 1.8	6.2	7.6	9.3
Subtotal (Average)		400		14 (8.0)		60 (30)	10 (5.0)		1,170 (585)		3.5		150 (75)							
207 Titikaveka	2071	200	-	8	-	FT 20	5	School Sport Ground	600				110							
	2072	100	-	3	BM 9+80	F 10	4	Kend Hall	640		**3.5		100			1.6	+ 1.9	6.4	7.9	9.5
Subtotal (Average)		300		11 (7.3)		30 (15)	9 (6.0)		1,240 (620)		3.5		210 (105)							
208 Te Puna	2081	200	-	13	C.I.C.C.	FT 20	16	-	620				120							
	2082	200	-	9	S.D.A.	F 10	5	-	670		*4.0		70			1.6	+ 2.4	7.2	8.8	10.5
	2083	100	-	3	-	FC 40	2	-	670				60							
Subtotal (Average)		500		25 (10.0)		70 (23)	23 (9.2)	- No.10	1,960 (653)		4.0		250 (83)							
208 Akapuao	2091	700	-	1+	-	FC 30	0	- No.10	680		4.3		40			1.6	+ 2.7	7.8	9.5	11.1
	2092	200	-	4+	Polynesian Motel	FTC 70	1	- No.10	650		3.9		30			1.6	+ 2.5	6.9	8.6	10.3
	2093	200	-	8	-	F 40	1		650		4.3		30			1.6	+ 2.7	7.6	9.2	11.0
	2094	170	-	2	BM 8-2+20 Packing Shed	FC 10	5	-	660				50							
Subtotal (Average)		770		15+2(3.9)		150 (38)	7 (1.8)		2,640 (660)		4.2		150 (38)							
210 Tikioki	2101	200	-	1	R.C.	FC 30	2	-	610		*3.4		30			1.6	+ 1.7	6.2	7.6	9.3
	2102	200	-	3	-	FC 30	1	-	600				20							
	2103	200	-	2	-	FC 30	4	-	570				20							
	2104	200	-	3	-	FC 30	3	-	570		*4.5		60			1.7	+ 2.8	7.6	9.2	10.8
Subtotal (Average)		800		9 (2.3)		120 (30)	10 (2.5)		2,350 (588)		4.0		130 (33)							

Present Coast Conditions by Village

Constituency village	Coast Unit	Shore length	Seaside	First 100M			Next 200M		Profiles					Damage						
				Pp	Facilities	Plant	Pp	Facilities	Lg	Sl	El	Sd	Dr	B.Er	N.Er	(Dw) Ru	Bl	-1m	±0m	+1m
211 Maii	2111	200	-	2	-	FC 20	1	-	500				40			(4.5)				
	2112	200	-	2	BM 7-3+80	FC 20	1	-	550		*3.8		80			1.7	+2.1	6.6	8.0	9.6
	2113	200	-	4	-	F 30	0	-	750				60							
	2114	100	-	1	-	FC 20	0	-	700				80							
Sub Total (Average)		700		9 (2.6)		140 (35)	2 (0.6)		2,500 (625)		3.8		260 (65)							
Total (Average)																				
3. Ngatangiia																				
301 Vaii	3011	170	-	1	-	FC 30	1	-	700		**3.5		100			1.6	+1.9	6.5	8.0	9.8
Sub Total (Average)		170		1 (1.2)		20 (30)	1 (1.2)		700 (700)		3.5		100 (100)							
302 Aremango	3021	200	-	1	-	FC 30	2	- No.11	850		3.4		150			1.5	+1.9	6.5	8.2	9.8
	3022	200	-	3	-	FC 30	2	- No.11	950		3.7		130			1.5	+2.2	7.0	8.8	10.3
	3023	100	-	3	-	F 10	4	- No.11	900		3.6		140			1.5	+2.1	6.8	8.7	10.2
Sub Total (Average)		500		7 (2.8)		70 (23)	8 (3.2)	- No.11	2,700 (900)		3.6		420 (140)							
303 Areiti	3031	200	Koromiri Is.	8	Sailing Club BM 6-2+150	FC 40	3	- No.11	950		3.8		140			1.5	+2.3	7.3	9.0	10.6
	3032	100	Koromiri Is.	0	Stream ( )	FC 40	2	-	880				180							
Sub Total (Average)		300		8 (5.3)		100 (40)	5 (3.2)		1,830 (915)		3.8		300 (160)							
304 Nukopure	3041	200	Koromiri Is.	3	-	FC 20	8	Bridge	*		**3.8		250			1.6	+2.2	6.9	8.5	10.1
	3042	110	One Is.	0	-	FC 30	4	Sport Ground	*				180							
Sub Total (Average)		310		3 (1.9)		50 (25)	12 (7.7)				3.8		430 (215)							
305 Aroko	3051	200	One Is.	1	-	FTC 40	2	-	*				50							
	3052	110	One Is.	0	-	FC 40	2	-	*		**3.8		50			1.5	+2.3	7.1	8.8	10.7
Sub Total (Average)		310		1 (0.6)		80 (40)	4 (2.6)				3.8		50 (50)							

Present Coast Conditions by Village

Constituency village	Coast Unit	Shore length	Seaside	First 100M			Next 200M		Profiles					Damage						
				Pp	Facilities	Plant	Pp	Facilities	Lg	Sl	El	Sd	Dr	B.Er	N.Er	(Dw) Ru	Bl	-1m	±0n	+1m
306 Avana	3061	200	Mo Is.	2	-		2	-	*		**3.5		30			(4.5) 1.6	+ 1.9	6.5	8.0	9.8
	3062	200	Mo Is.	2	Packing Shed Bridge, Stream Avana	F 10	3	-	*		**3.2		150			1.6	+ 1.6	6.1	7.4	9.1
	3063	200	Mo Is.	4		F 10	3	-	*		**2.5		80			1.8	+ 0.7	3.7	5.5	6.6
	3064	170	Nagatongua Pass.	6	Stream Turangi C.I.C.C	F 30	2	-	*		*2.0		150			2.4	- 0.4	2.2	3.9	5.2
Subtotal (Average)		770		14 (13.6)		50 (17)	10 (2.5)				2.8		410(103)							
307 Ngati Vaikai	3071	200	-	2	Bridge	FC 30	6	-	600		**5.5		320			5.1	+ 0.4	4.2	4.8	5.4
	3072	30	-	2	-	FC 70	2	-	100		**5.0		350			4.2	+ 0.8	4.3	5.0	5.6
Subtotal (Average)		230		4 (3.5)		100(50)	8 (7.0)		160 (80)		5.3		570(285)							
308 Ngati Macate	3081	150	-	2	-	FC 50	10	-	80		**4.8		200			4.6	+ 0.2	4.0	4.7	5.3
Subtotal (Average)		150	-	2 (2.7)		50 (50)	10 (3.3)		80 (80)		4.8		200(200)							
309 Ngati Au	3091	200		3	-	F 30	6	-	70				130							
	3092	30	-	0	School	0	0	-	70		**5.3		120			4.8	+ 0.5	4.2	4.8	5.4
Subtotal (Average)		230	-	3 (2.6)		30 (15)	6 (5.2)		140 (70)		5.3		350(125)							
310 Ngati Vaikai	3101	200	-	0	School	F 20	4	-	60				110							
	3102	200		2	-	FC 70	3	-	90		*4.2		110			4.4	- 0.2	3.6	4.4	5.0
	3103	170	-	0	-	FC 70	2	-	120				80							
Subtotal (Average)		570	-	2 (0.7)		160 (53)	9 (3.2)		270 (90)		4.2		300(100)							
Total (Average)			-																	
4. Matavera			-																	
401 Pouara	4011	200		2	-	FC 70	6	-	150				50							
	4012	200	-	2	-	FC 70	4	-	140		**4.0		40			3.4	+ 0.6	4.1	5.0	5.5
	4013	30	-	1	-	FC 70	2	-	120				40							
Subtotal (Average)		430	-	5 (2.3)		210 (70)	12 (5.6)		410 (137)		4.0		130 (43)							
			-																	

Present Coast Conditions by Village

Constituency village	Coast Unit	Shore length	Seaside	First 100M			Next 200M		Profiles					Damage						
				Pp	Facilities	Plant	Pp	Facilities	Lg	Sl	El	Sd	Dr	B.Er	N.Er	(Dw) Ru	Bl	-1m	=0m	+1m
402 Vaenga	4021	180	-	2	-	F 60	4	-	120		*4.2		50			(4.5) 3.7	+ 0.5	4.0	4.8	5.4
Sub Total (Average)		180		2 (2.2)		60 (60)	4 (4.4)		120 (120)		4.2		50 (50)							
403 Matevera/Tupapa	4031	200	-	2	Bridge Stream Matavera	F 10	7	-	100				60							
	4032	200	-	5	S.D.A.	FC 30	7	-	20				100							
	4033	200	-	3	R.C.	F 40	2	- No.12	30		4.2		110			5.7	- 1.5	2.9	3.6	4.1
	4034	200	-	5	-	F 70	12	- No.12	50		4.6		130			5.3	- 0.7	3.4	4.1	4.7
	4035	200	-	4	BM 13-2+10 Packing Shed	F 70	3	- No.12	50		5.1		110			(4.3) 5.3	- 0.2	3.7	4.3	4.9
	4036	200	-	1	Norrie Park	0	0	School	70		*4.3		80			(5.5)		3.4	4.2	4.8
	4037	200	-	1	-	C 20	2	-	50				80							
Sub Total (Average)		1,400		21 (3.0)		240 (34)	33 (4.7)	-	370 (53)		4.6		680 (97)							
404 Titama	4041	200	-	0	-	F 40	5	-	20				80							
	4042	200	-	1	Bridge Stream ( )	FC 30	1	-	30				70							
	4043	200	-	4	-	F 30	1	- No.13	30		5.4		40			7.7	- 2.3	3.8	4.3	4.9
Sub Total (Average)		600		5 (1.7)		100 (33)	7 (2.3)	- No.13	80 (27)		5.4		190 (63)							
Total (Average)																				
5. Araitetonga																				
501 Araitetonga	5011	200	-	7	BM 2-2+130	F 30	4	- No.13	30		6.2		70			7.7	- 1.5	4.1	4.6	5.1
	5012	200	-	3	Bridge TStream Tupapa	FC 30	4	- No.13	20		6.5		90			8.1	- 1.6	4.2	4.7	5.2
	5013	200	-	3	-	FC 30	2		10				70							
	5014	100	-	2	-	FC 30	1	-	30				70							
Sub Total (Average)		700		15 (4.3)		120 (30)	11 (3.2)		90 (23)		6.4		300 (75)							

Present Coast Conditions by Village

Constituency village	Coast Unit	Shore length	Seaside	First 100M			Next 200M		Profiles					Damage						
				Pp	Facilities	Plant	Pp	Facilities	Lg	Sl	El	Sd	Dr	B.Er	N.Er	(Dw) Ru	Bl	-1m	±0m	+1m
502 Kiikii	5021	200	-	3	-	FC 60	6	-	30				70			(5.5)				
	5022	200	-	2	Bridge Stream ( )	FC 50	1	-	50		**7.0		60			7.1	- 0.1	4.8	5.4	6.1
	5023	200	-	2	-	FC 50	2	-	30				60							
	5024	200	-	7+	(Kiikii) Motel	FC 20	5	- No.14	40		7.2		60			(5.5) 7.3	- 0.1	4.8	5.3	6.0
	5025	200	-	2	BM 2A + 110	0	4+	Punanala Motel No.14	50		4.9		80			(8.1) 11.5	- 6.6	3.6	4.2	4.8
	5026	160	-	0+	Tamure Sesort	FC 20	2	- No.14	90		5.9		80					4.8	5.4	6.0
Subtotal (Average)		1,160		16+2 (2.9)		220 (37)	20+ (3.6)		290 (48)		6.3		410 (68)							
503 Punatala	5031	160	-	6	-	FC 60	5	-	90		**6.4		80			10.5	- 4.1	5.2	5.8	6.3
Subtotal (Average)		160		6 (7.5)		60 (60)	5 (6.3)		90 (90)		6.4		80 (80)							
504 Tapae	5041	200	-	8	-	FC 40	4	-	100				60							
	5042	190	-	5	-	FC 40	3	-	100		**6.6		60			10.2	- 3.6	5.4	6.0	6.6
Subtotal (Average)		390		13 (6.7)		80 (40)	7 (3.6)		200 (100)		6.6		120 (60)							
505 Tapae I. Uta		0	-	0	-		0	-												
506 Pue	5061	200	-	5	Bridge Stream Pue	FC 40	18	-	130				110							
	5062	200	-	15	-	F 30	11	- No.1	100		6.6		100			10.2	- 3.6	5.4	6.0	6.6
	5063	70	-	0+	Conservation Dep. Health Dep.	0	2	- No.1	80		5.6		80			10.7	- 5.1	4.5	5.1	5.7
Subtotal (Average)		470		20+ (8.5)		70 (23)	31 (26.4)	- No.1	310 (103)		6.1		290 (97)							
507 Vaikai	5071	200	-	6	Health Dep.	FC 30	15	- No.1	50		4.4		130			11.5	- 7.1	3.3	4.0	4.6
	5072	50	-	2	-	0	3	- No.1	80		4.4		130			10.7	- 6.3	3.7	4.3	5.1
Subtotal (Average)		250		8 (6.4)		40 (20)	18 (14.4)	- No.1	130 (65)		4.4		260 (130)							
Total (Average)																				

Present Coast Conditions by Village

Constituency village	Coast Unit	Shore length	Seaside	First 100M			Next 200M		Profiles					Damage						
				Pp	Facilities	Plant	Pp	Facilities	Lg	Sl	El	Sd	Or	B.Er	N.Er	(Dw) Ru	Bl	-1m	±0m	+1m
6. Avarua																(8.1)				
601 Ngatipa	6011	200	-	18	( )	F 20	15	( ) Sport Ground No.1	100		(4.6) (5.2) 4.9		110			10.2	-5.3	4.3	5.0	5.6
	6012	200	Wreck Yankee	25	( )	F 10	5	( )No.1	140		(4.8) (4.6) 4.7		60			9.2	-4.5	4.7	5.3	5.9
	6013	80	-	5	( )	0	5	( ) C.I.C.C. No.1	150		4.1		40			9.0	-4.9	4.2	5.1	5.7
Subtotal (Average)		480	-	48 (20.0)		30 (10)	25(10.4)	No.1	390 (130)		4.6		210 (70)							
602 Tavae		0	-	0	-	0	0	No.1	-				-							
Subtotal (Average)					( )			( )												
603 Avarua	6031	200	Breakwater	15	( )	0	10	( )No.1	160		(3.3) (2.6) 3.0		40			8.7	-5.7	3.3	4.3	5.2
	6032	200	Ancharage Berth	5	Bridge Stream Takovaaine	0	15	- No.2	* 5		*2.5		70			(3.5) 4.3	-1.8	3.3	4.3	5.2
			Avarua Pass.		BM 1 + 80 Government Offices			Government offices												
	6033	200	Breakwater	10	Shopping Center	0	20	- No.2	150		3.1		20			(7.7) 8.4	-5.3	3.2	4.2	5.1
			Wreck Maitai		( )			-												
	6034	200	-	10	Shopping Center	0	20	- No.2	190		4.3		20			7.3	-3.0	5.0	5.8	6.4
			-		( )			-												
	6035	200	-	10	Bridge Stream ( )	0	20	- No.2	150		4.8		60			8.4	-3.6	5.0	5.5	6.2
			-		Shopping center Park			-												
	6036	170	-	5	Park	F 20	10	- No.2	200		4.1		70			7.3	-3.2	4.8	5.6	6.2
					( )			-												
Subtotal (Average)		1,170		55 (9.4)		20 (3)	95 (16.2)	- No.2	910 (152)		3.6		280 (47)							
604 Ruatonga	6041	130	Breakwater	5	Park, Bridge Stream Avatiu	F 20	15	- No.2	270		2.7		20			6.0	-3.3	3.5	5.0	6.0
Subtotal (Average)		130		5 (7.7)		20 (20)	15 (15)		270 (270)		2.7		20 (20)							
605 Avatiu	6051	200		10	Port area BM 18 + 190	F 20	15	-	* 5		**2.0		60			(2.0) 2.5	-0.5	0.8	1.6	2.6
	6052	200	Ancharage Berth	10	Port area	F 20	15	L.D.S. Sport Ground	* 5		**3.0		20			(2.0) 2.5	-0.5	3.0	3.8	4.7
	6053	70	Avatiu Pass. Breakwater	5	-	F 20	10	-	80		**3.5		20			(7.7) 9.8	-6.3	3.0	3.7	4.4
Subtotal (Average)		470	-	25 (10.6)		60 (20)	55 (23.4)		205(68)		2.8		100 (33)							
Total (Average)																				

Present Coast Conditions by Village

Constituency village	Coast Unit	Shore length	Seaside	First 100M			Next 200M		Profiles					Damage					
				Pp	Facilities	Plant	Pp	Facilities	Lg	Sl	El	Sd	Dr	B.Er	N.Er	(Dw) Ru	Bl	-1m	±0m	+1m
7. Nikao																(7.7)				
701 Atupa	7011	200	-	3	( )	F 30	5	Petro. Tanks	60		4.8		20			10.7	-5.9	3.7	4.3	5.0
	7012	200	-	3	-	FC 40	5	Rubbish Dump	50		4.9		40			10.9	-6.0	3.6	4.2	4.8
	7013	120	-	2	-	FC 30	5		40				30							
Subtotal (Average)		520		8 (3.1)		100 (33)	15 (5.8)		150 (50)		4.9		90 (30)							
702 Kaikaveka	7021	200	-	2		FC 30	5	BM 23 + 50 M.O.J. works	60		5.2		40			10.7	-5.5	4.0	4.6	5.2
	7022	200	-	5	R.C. Cemetery	FC 30	5	Airport	90		4.9		50			9.8	-4.9	4.2	4.9	5.4
	7023	50	-	0	Laundry Airport	FC 30	0	Airport	120		3.5		40			9.0	-5.5	3.4	4.2	5.0
Subtotal (Average)		450		7 (3.1)		100 (33)	10 (4.4)		270 (90)		4.5		130 (43)							
703 Airport	7031	200	-	0	Petro. Tnaks Airport	F 20	0	Airport Term	130		3.9		80			(8.7) 10.3	-6.4	3.9	4.8	5.4
	7032	200	-	0	Airport	F 20	0	Airport	290				60							
	7033	200	Motutoa Is.	0	Airport BM 17 + 160	F 20	0	Airport	340		(3.7) (3.8) 3.8		60			6.0	-2.2	5.7	6.6	7.5
	7034	200	Motutoa Is.	3	-	F 20	0	Airport	480		3.9		20			4.6	-0.7	6.4	7.8	9.1
	7035	200	-	3	Airport	F 20	0	Airport	500		3.4		30			4.5	-1.1	5.8	7.1	8.7
	7036	200	-	7	Parliament	F 20	0	Airport	500		4.3		50			4.5	-0.2	6.9	8.5	9.8
	7037	200	-	3	-	F 20	0	Airport	410		4.6		20			5.2	-0.6	6.8	8.0	9.1
	7038	200	-	5	-	F 20	0	Airport	360		4.8		40			5.8	-1.0	6.7	7.7	8.7
	7039	200	-	3	-	F 20	0	Airport	320		(5.2) (5.1) 5.2		30			6.4	-1.2	6.7	7.6	8.4
	70310	200	-	0	Meteorolotical C. Airport	0	0	Airport	340		(6.4) (6.5) 6.5		40			6.0	0.5	8.2	9.0	9.8
	70311	200	-	0	Airport	0	0	Airport	220		*4.0		20			8.5	-4.5	3.1	4.5	5.4
	70312	200	-	0	Airport	0	0	Airport	140		*4.5		10			10.0	-5.5	2.0	3.3	4.2
	70313	160	-	0	Bridge, Stream ( ) Airport	0	0	Airport	230		**3.5		10			(6.5) 5.0	-1.5	4.4	5.5	6.2
Subtotal (Average)		2,560		24 (1.9)		180 (14)	0 (0)		4,260 (378)		4.1		470 (36)							

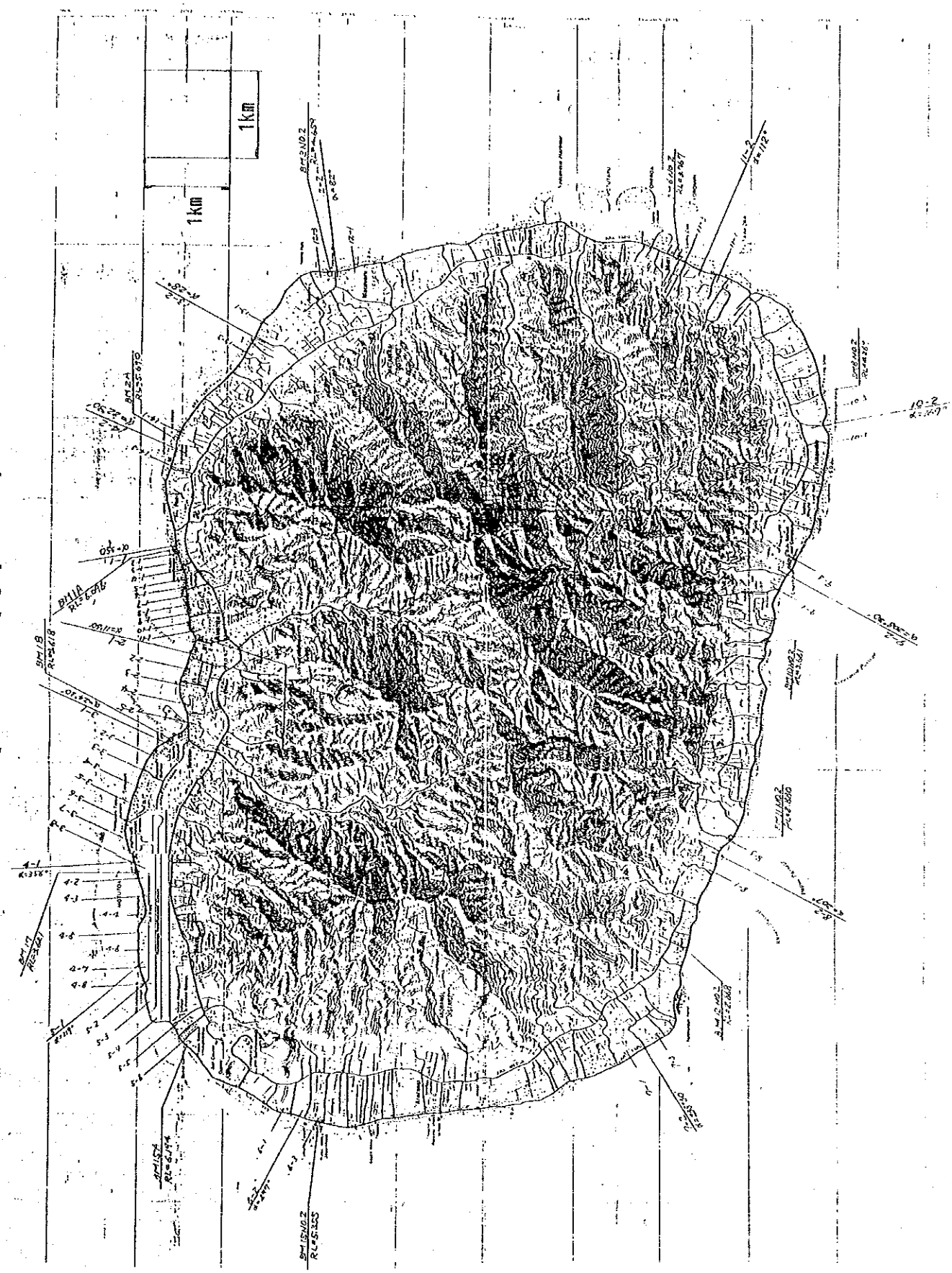
Present Coast Conditions by Village

Constituency village	Coast Unit	Shore length	Seaside	First 100M			Next 200M		Profiles					Damage						
				Pp	Facilities	Plant	Pp	Facilities	Lg	Sl	El	Sd	Dr	B.Er	N.Er	(Dw) Ru	Bl	-1m	±0n	+1m
704 Puapuautu		0	-	-	-	-	-	-												
705 Nikao		0	-	-	-	-	-	-								(6.5)				
706 Pokoinu	7061	200	-	4	-	FC 30	9	Mikao M. School	250		5.1		50			4.7	+0.4	6.1	6.8	7.4
	7062	200	-	5	Social Centre	F 40	20	Golf Course ( ) Station	230		5.6		40			5.0	+0.6	6.2	6.9	7.6
	7063	200	-	0	BM 15A + 30	F 30	0	Golf Course	200				50							
	7064	190	-	0	Quarry	F 10	0	Quarry	260		**5.4		30			4.5	+0.9	6.4	7.1	7.8
Subtotal (Average)		790		9 (2.3)		110 (28)	29 (7.3)		940 (235)		5.4		170 (43)							
Total (Average)																				
Grand Total (Average)		30,990 M		597			698													

Appendix C-2 Topographic Survey (Nov. 1991 by the team)

Appendix C-2 Topographic Survey (Nov. 1991 by the team)

Location Map : Sections Topographic Survey Conducted



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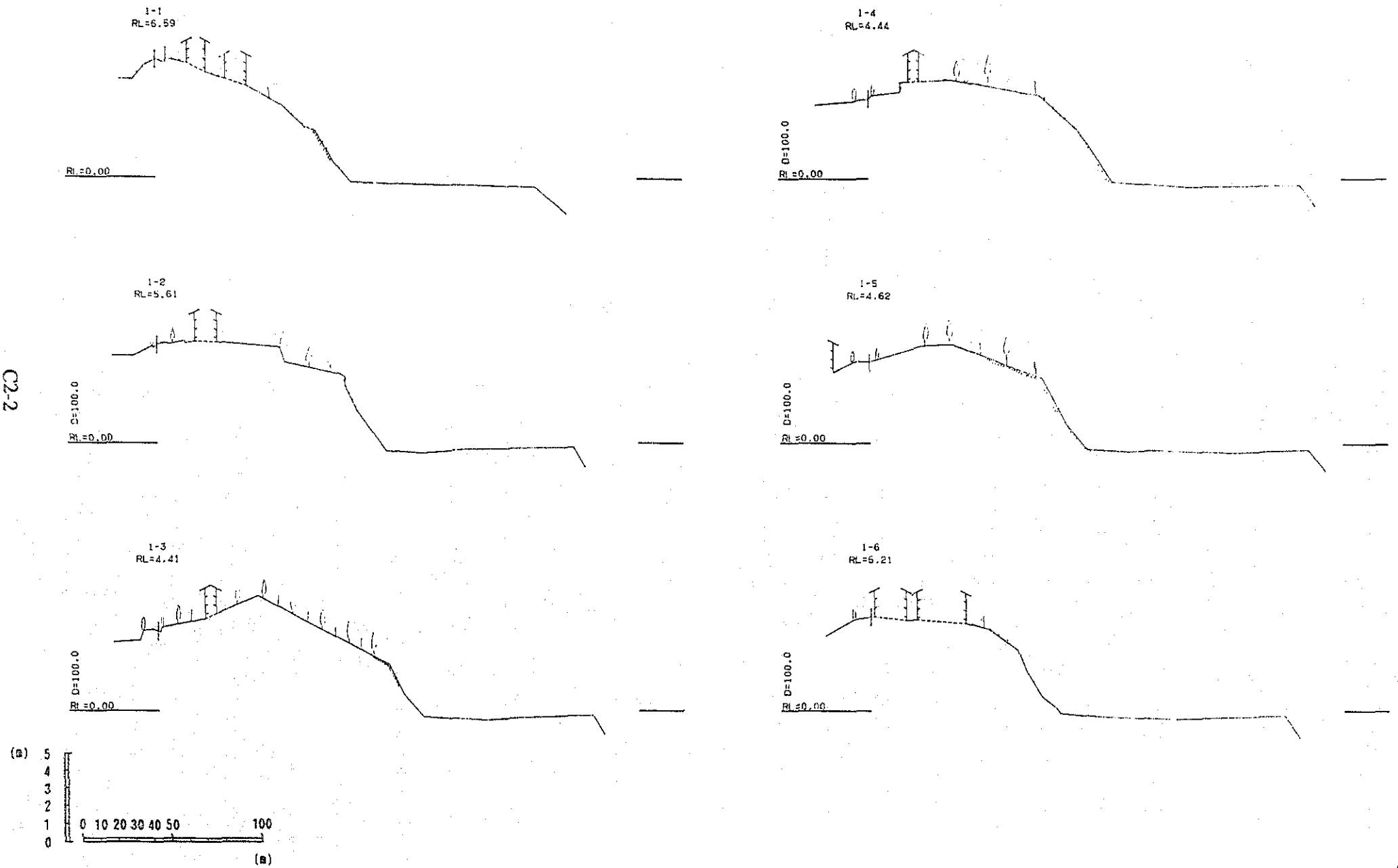
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1-5
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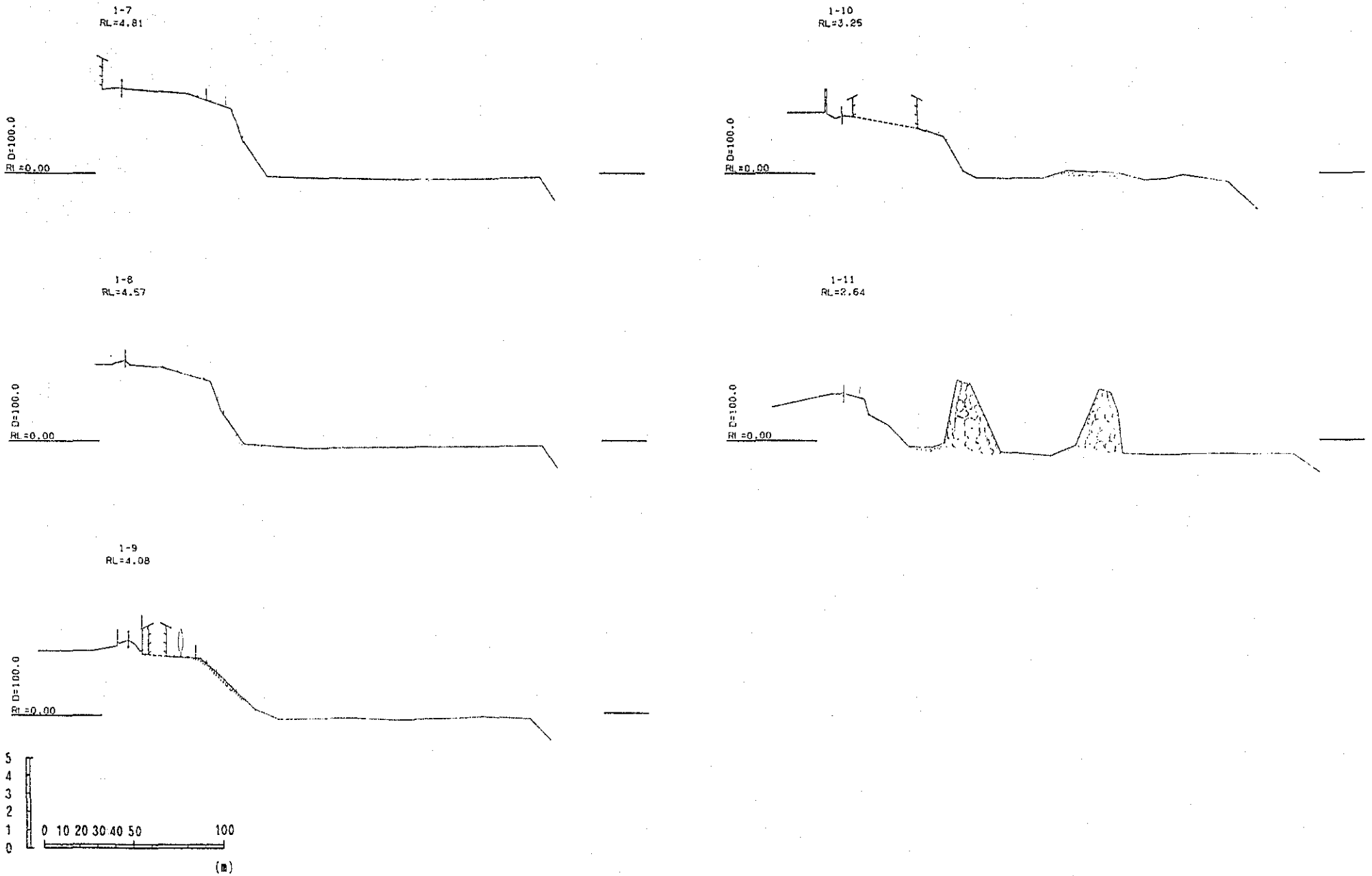
(m)

C2-3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0 10 20 30 40 50 100
(m)

C2-4

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2-3
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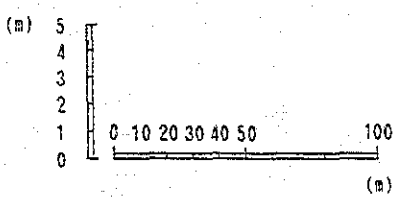
RL=0.00



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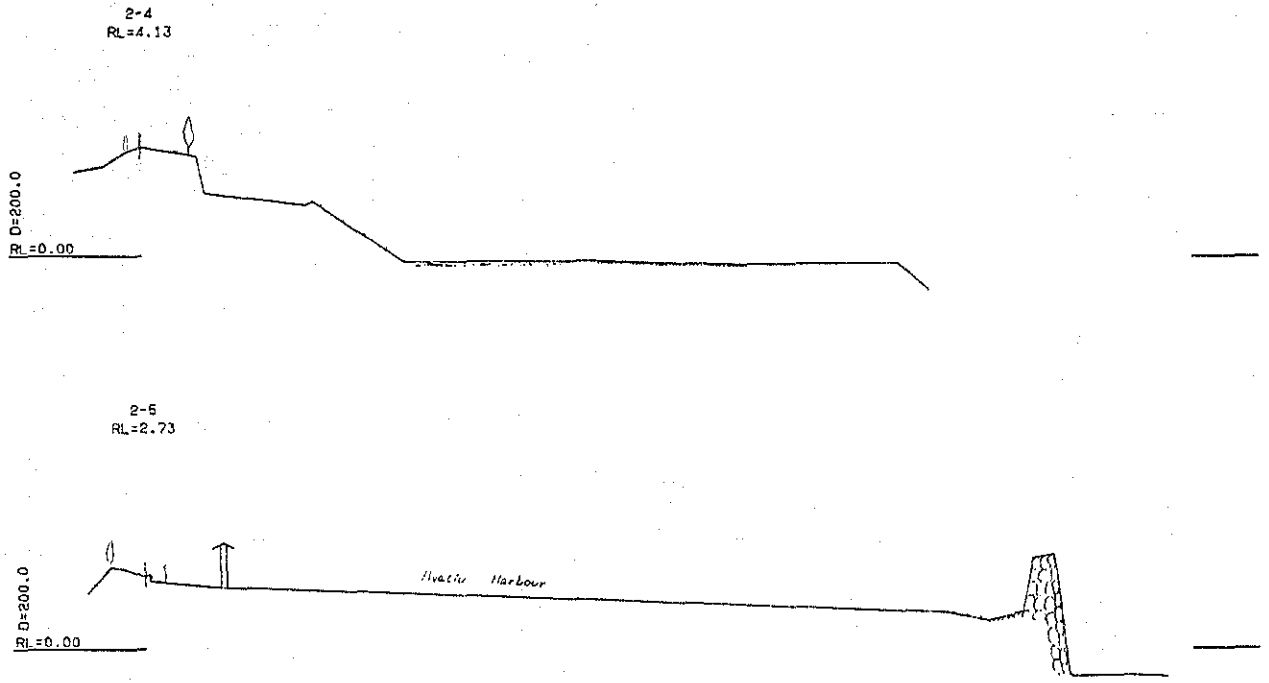
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2-5
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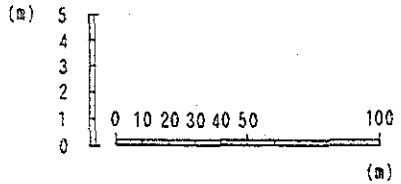
Ilvatiu Harbour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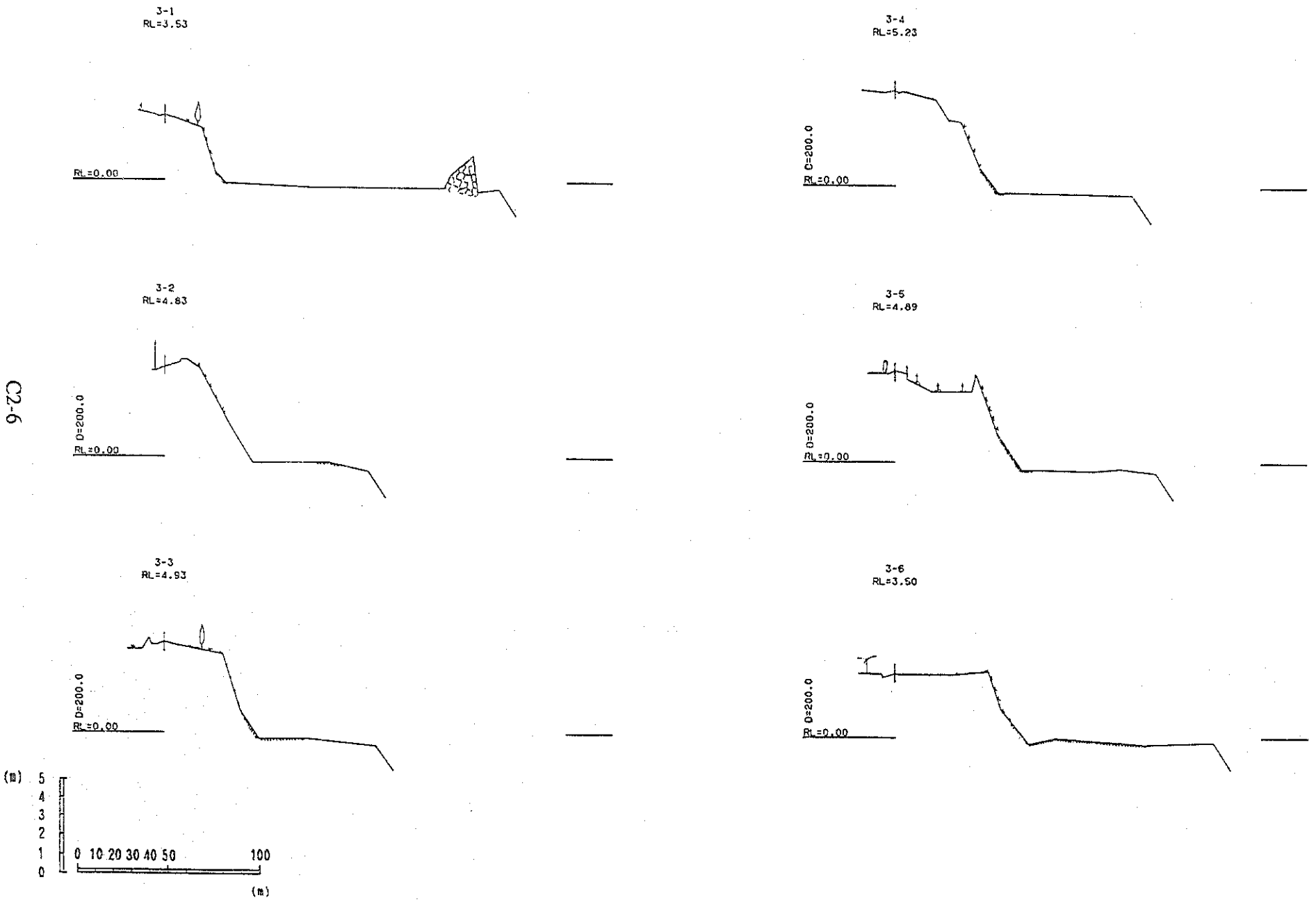
(m)

C2-6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3-6
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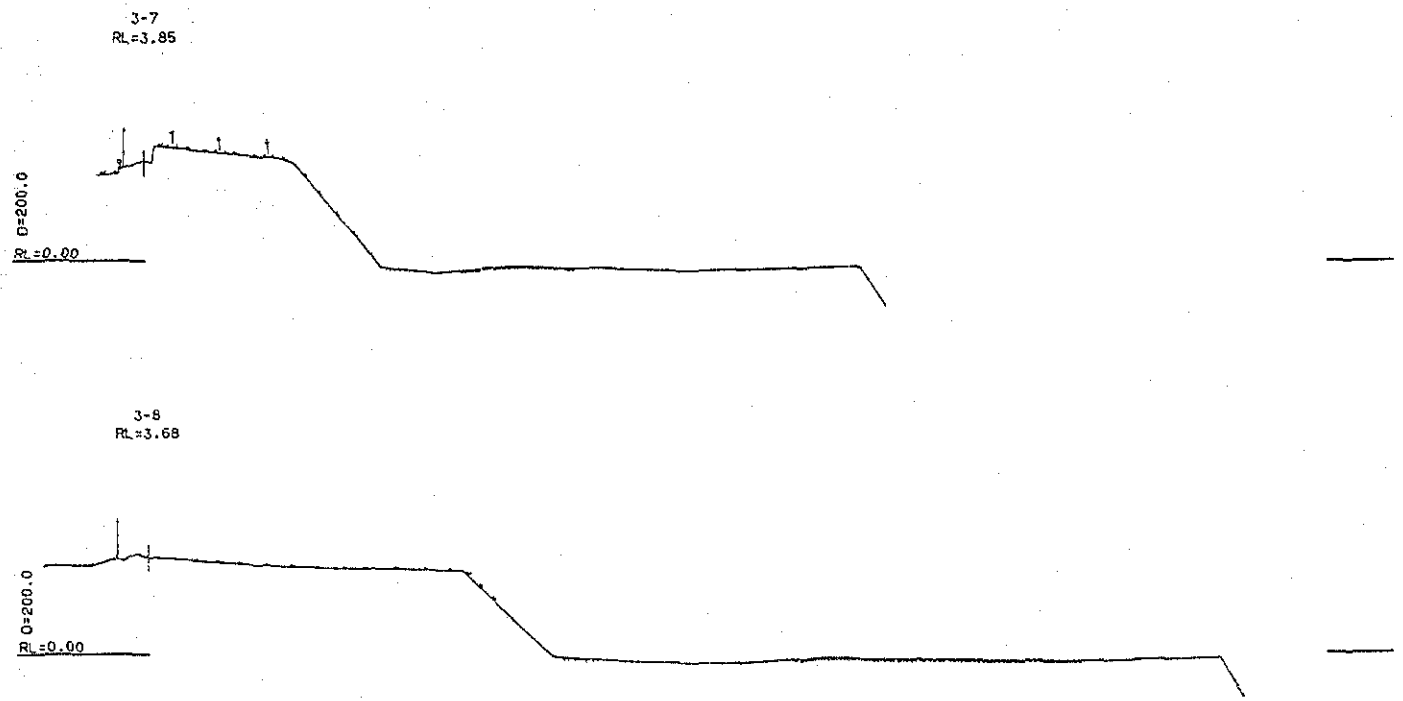
5
4
3
2
1
0
0 10 20 30 40 50 100
(m)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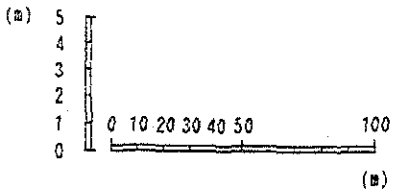
C2-7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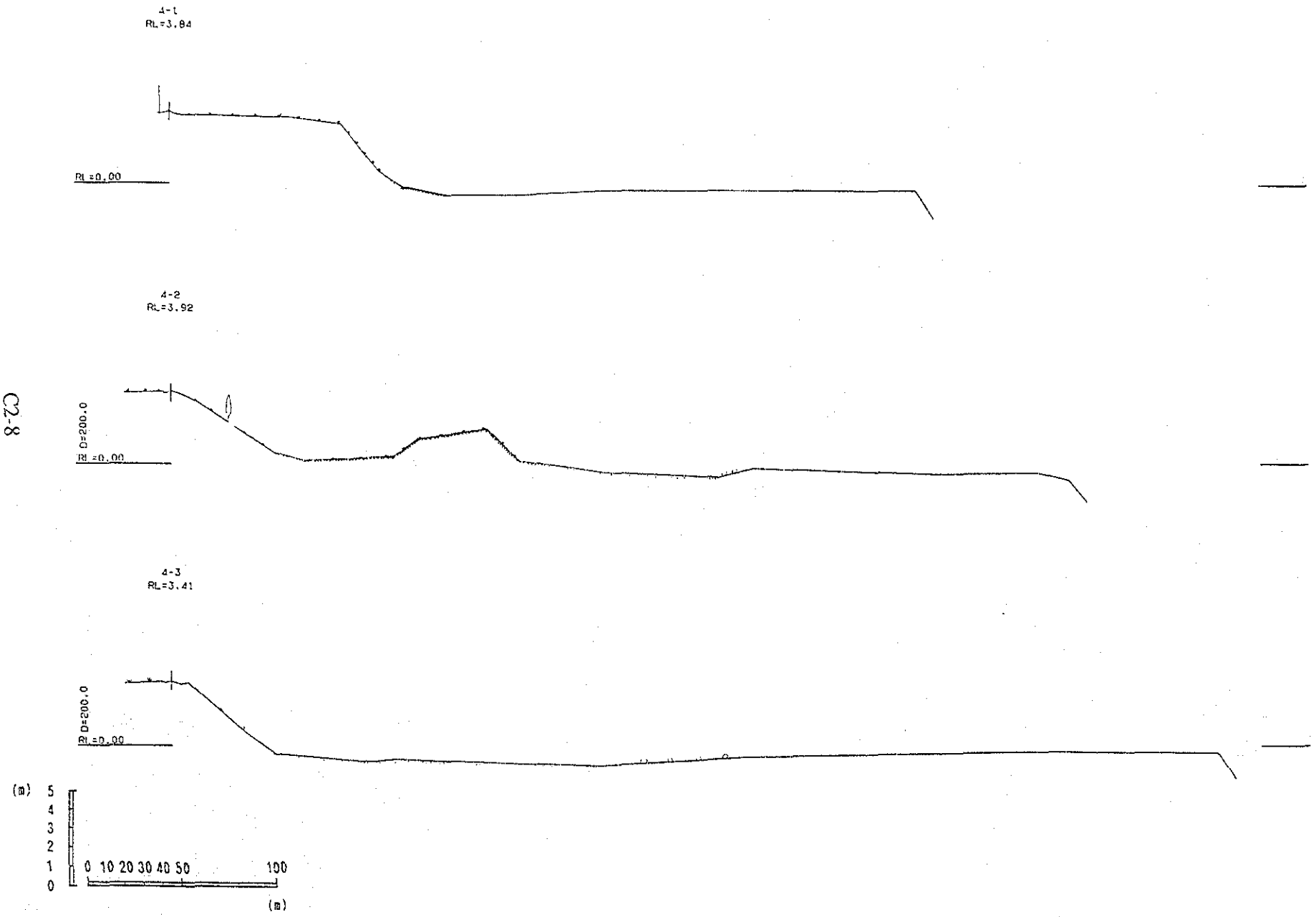
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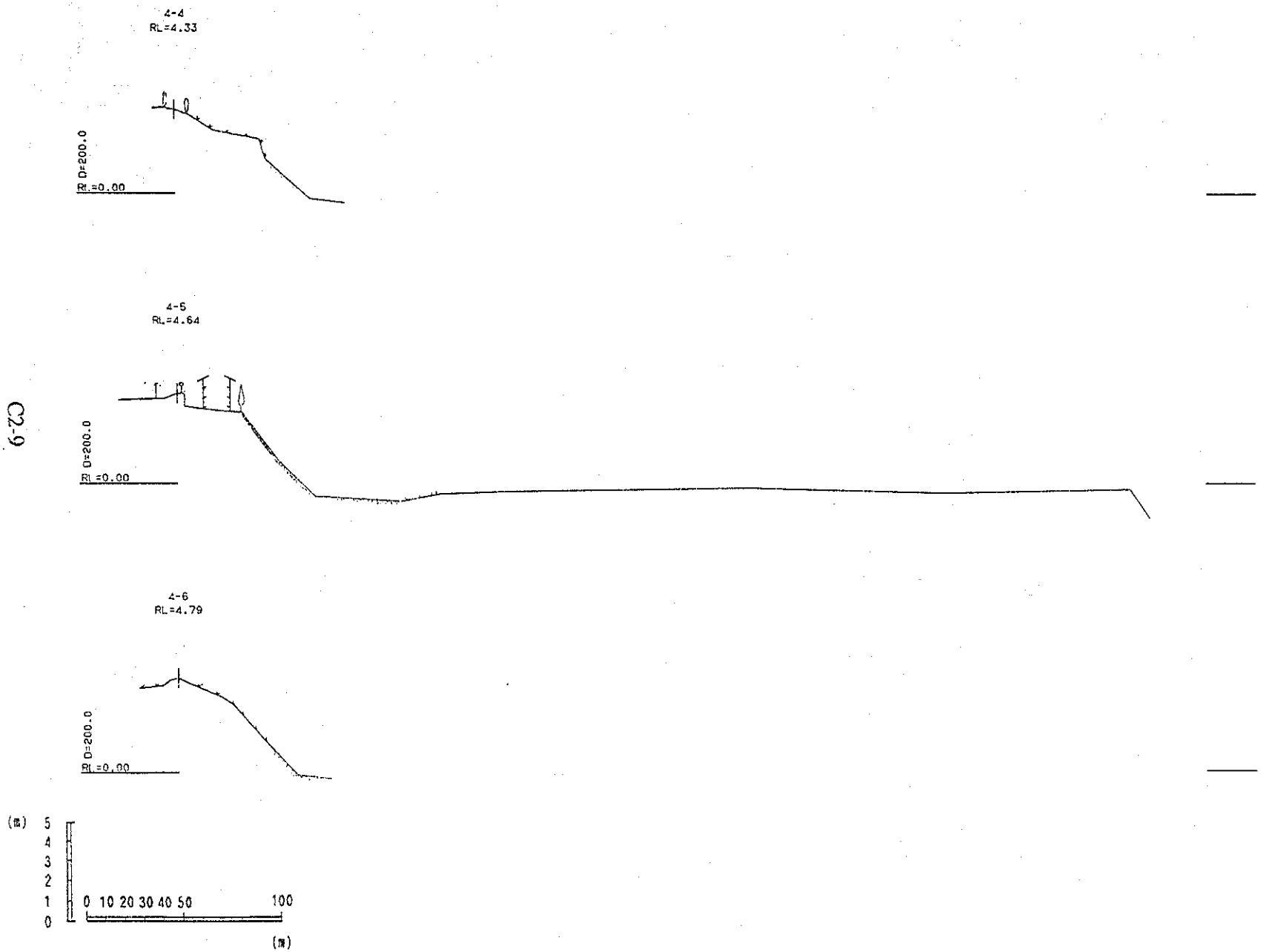
0 10 20 30 40 50 100
(m)

C2-8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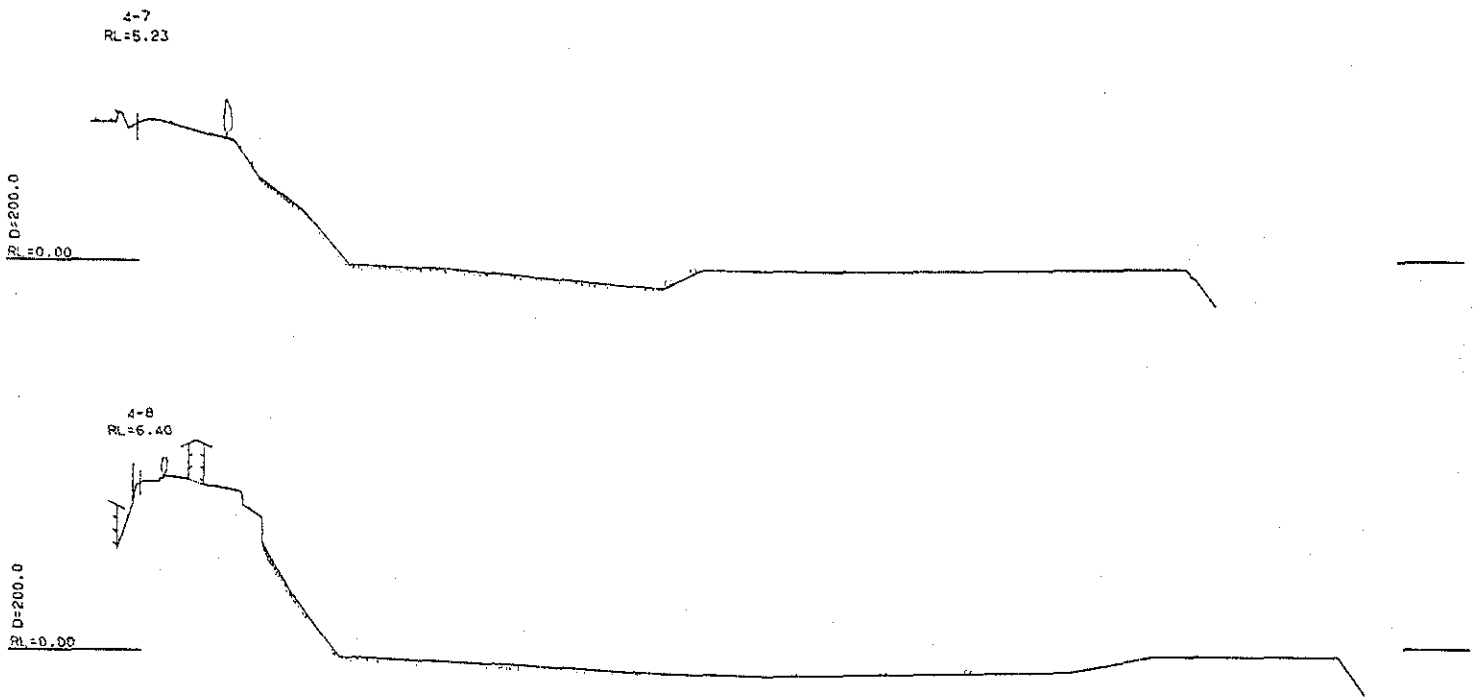
(m)

C2-9

C2-10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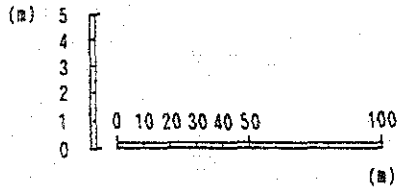
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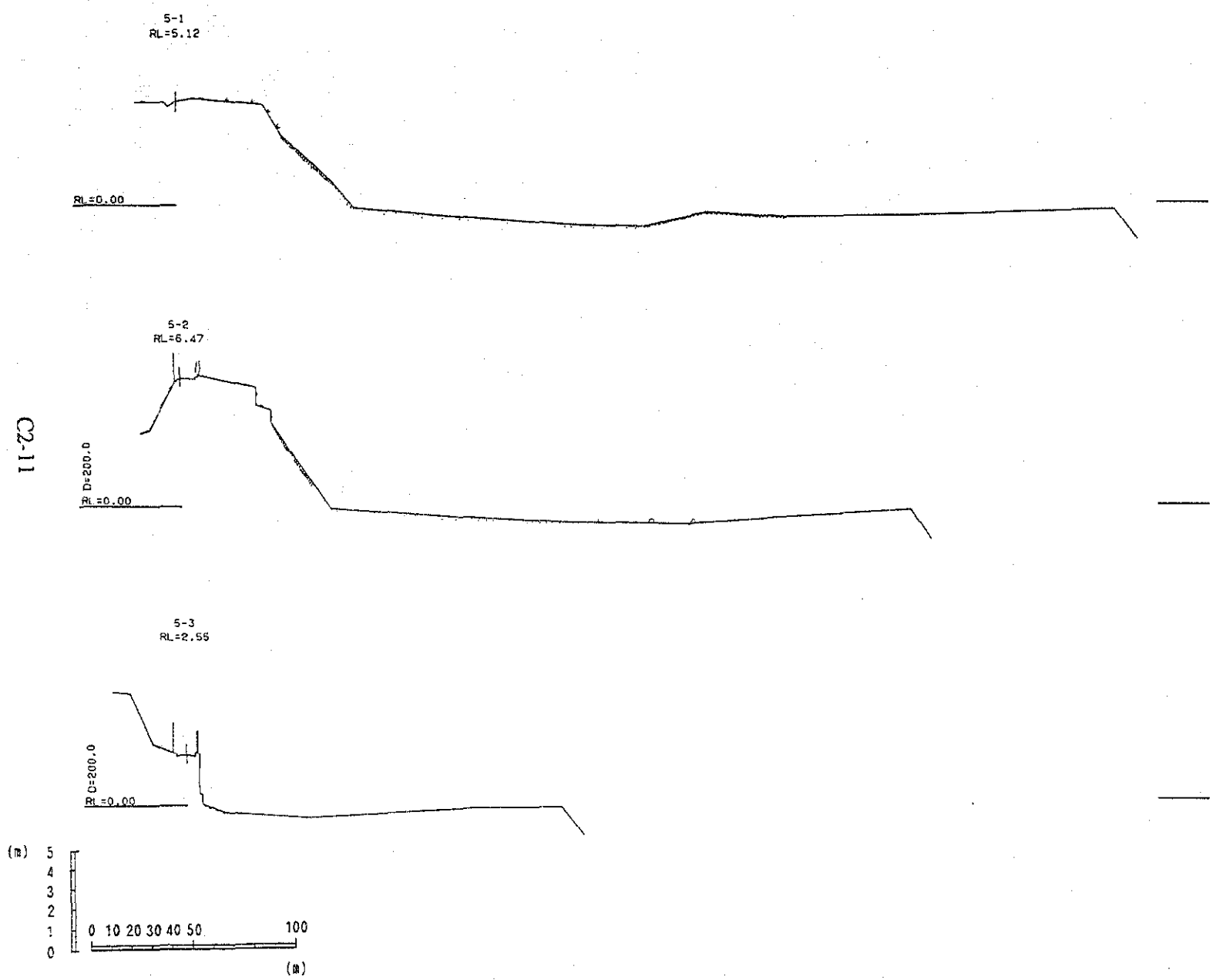
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S-3
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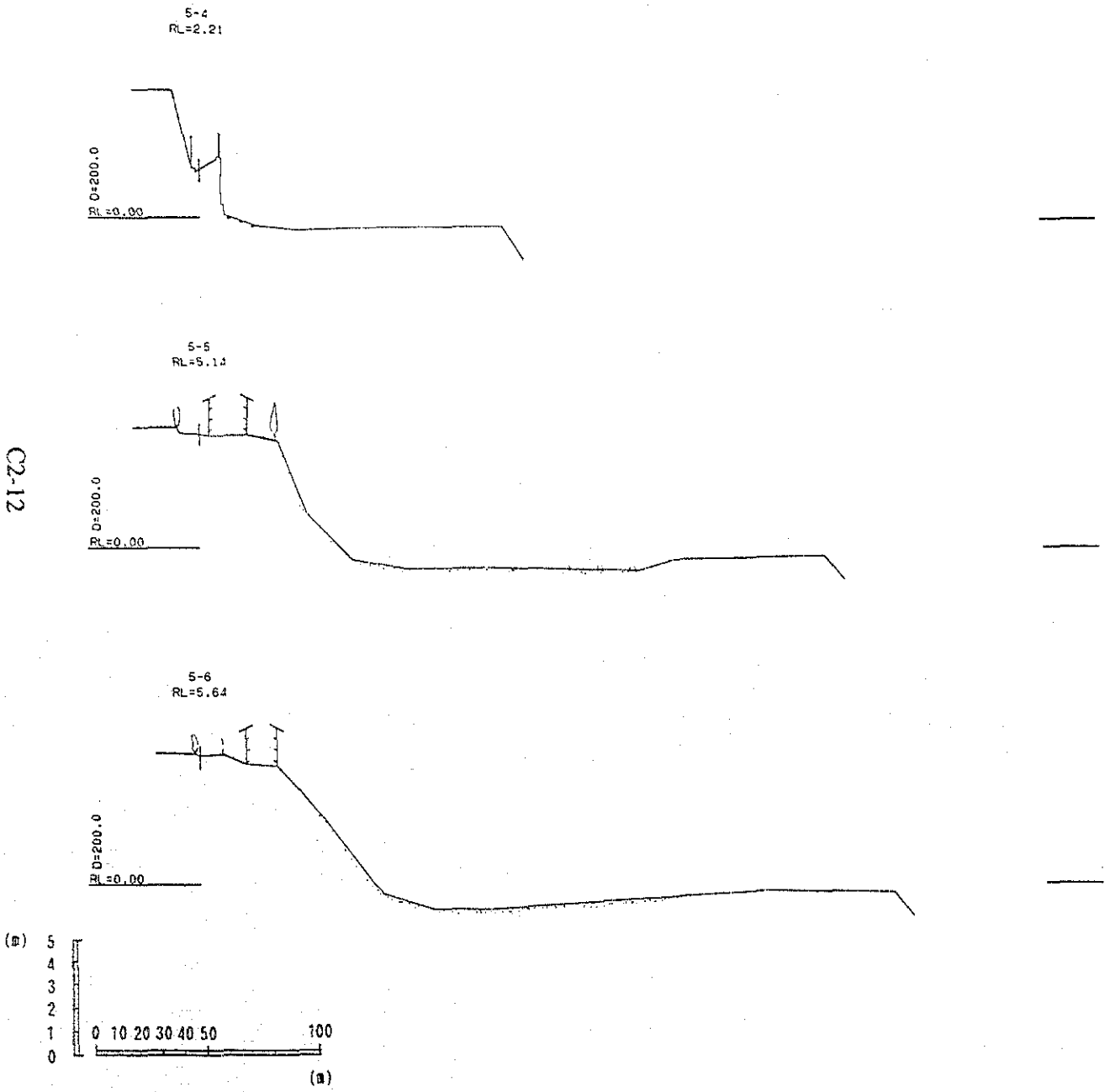
3
2
1
0
0 10 20 30 40 50
100
(m)

C2-11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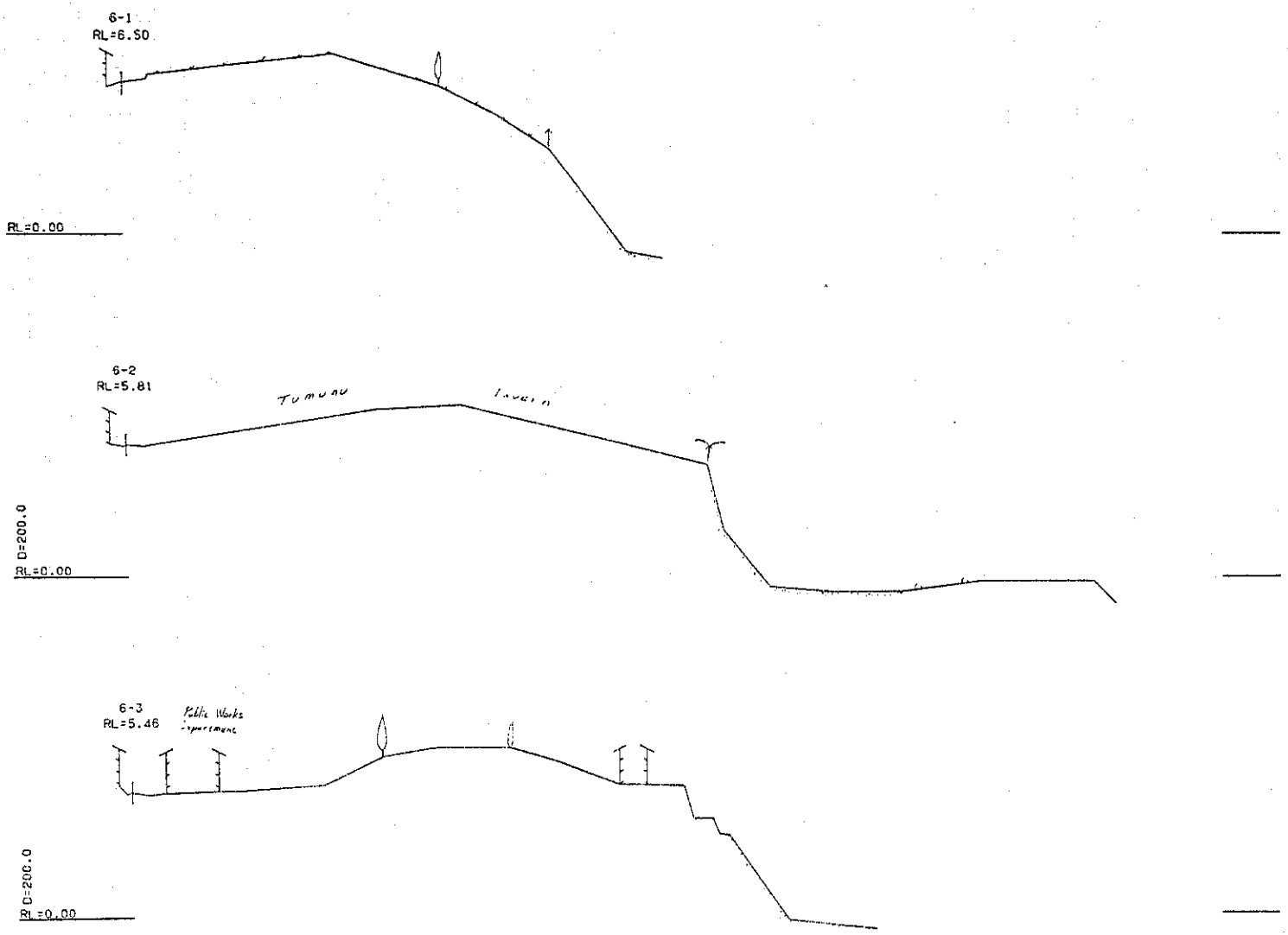
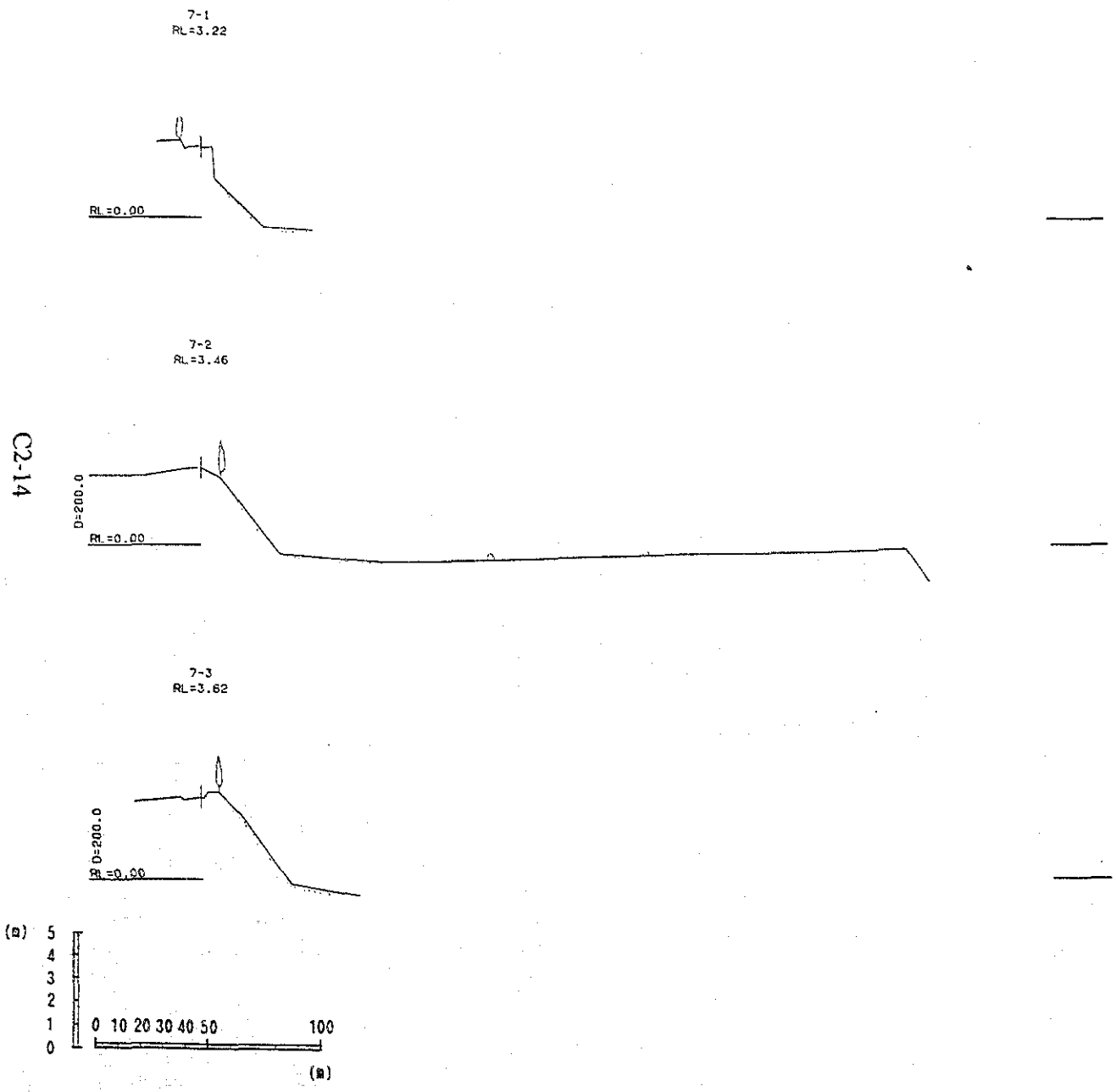
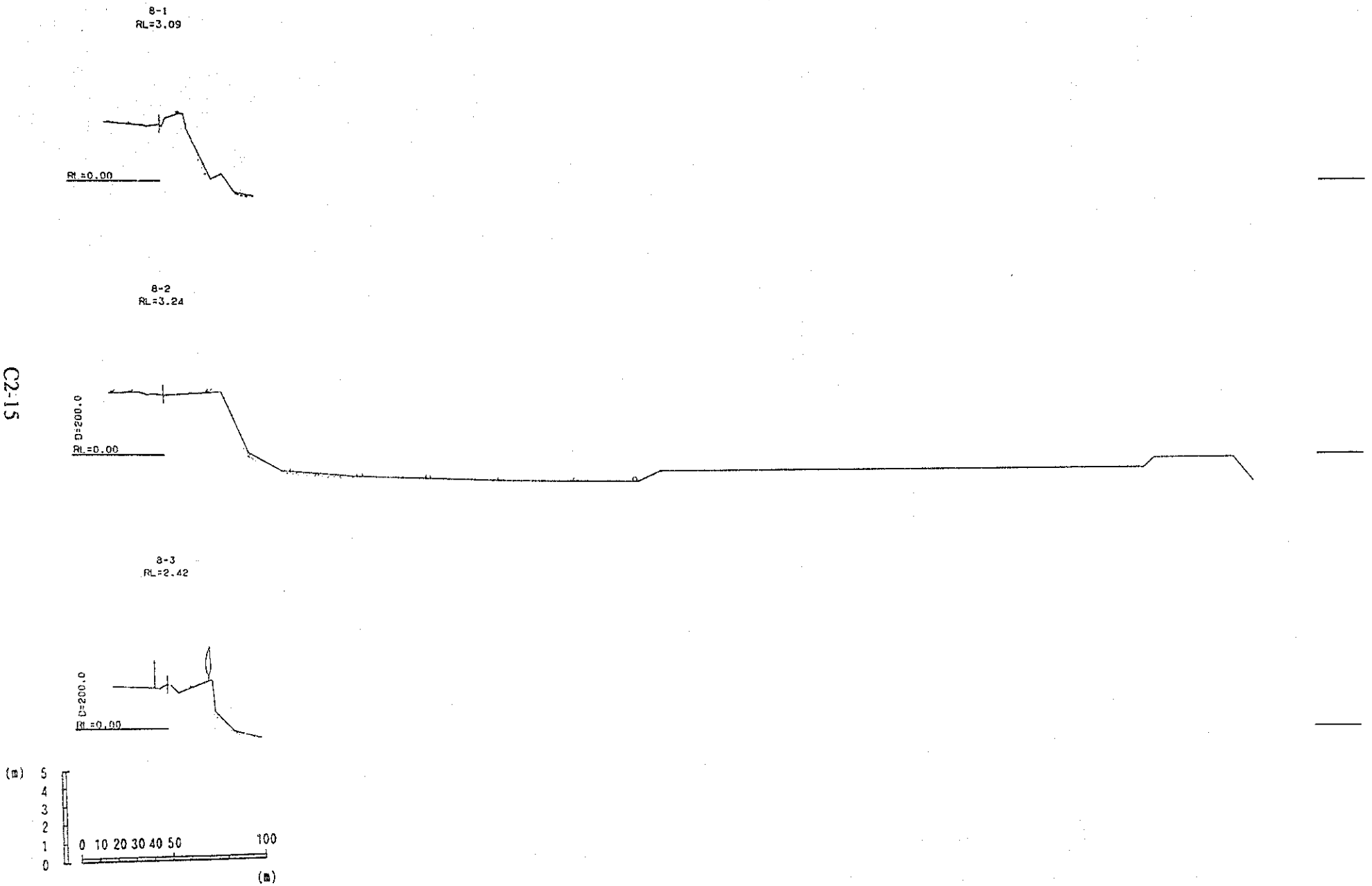
RL=0.00
5-6
RL=5.64
D=200.0
RL=0.00
(m)
5
4
3
2
1
0
0 10 20 30 40 50 100
(m)

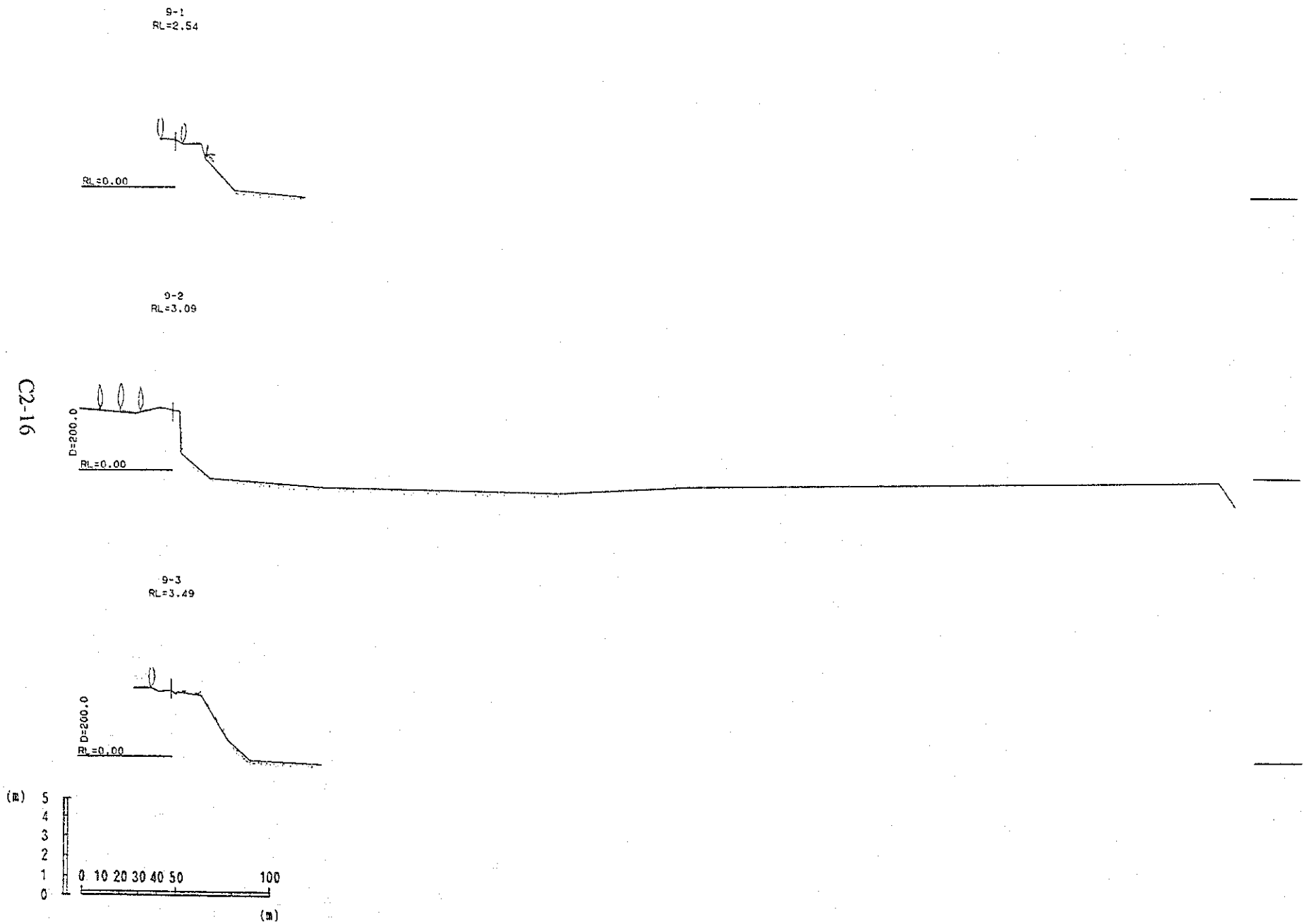
C2-13

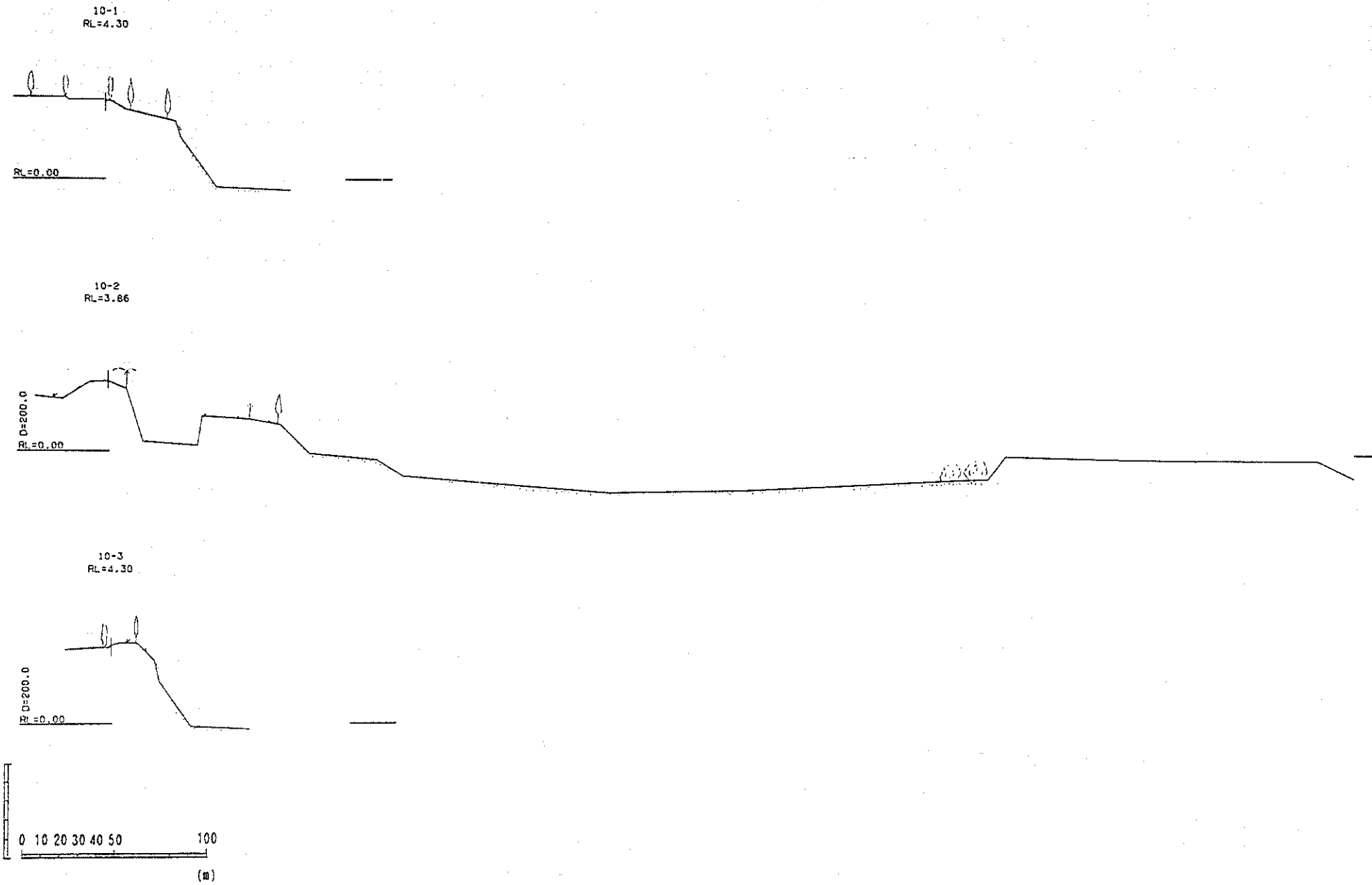

6-1
RL=6.50
RL=0.00
6-2
RL=5.81
D=200.0
RL=0.00
6-3
RL=5.46
Public Works Department
D=200.0
RL=0.00
(m) 5 4 3 2 1 0
0 10 20 30 40 50 100
(m)

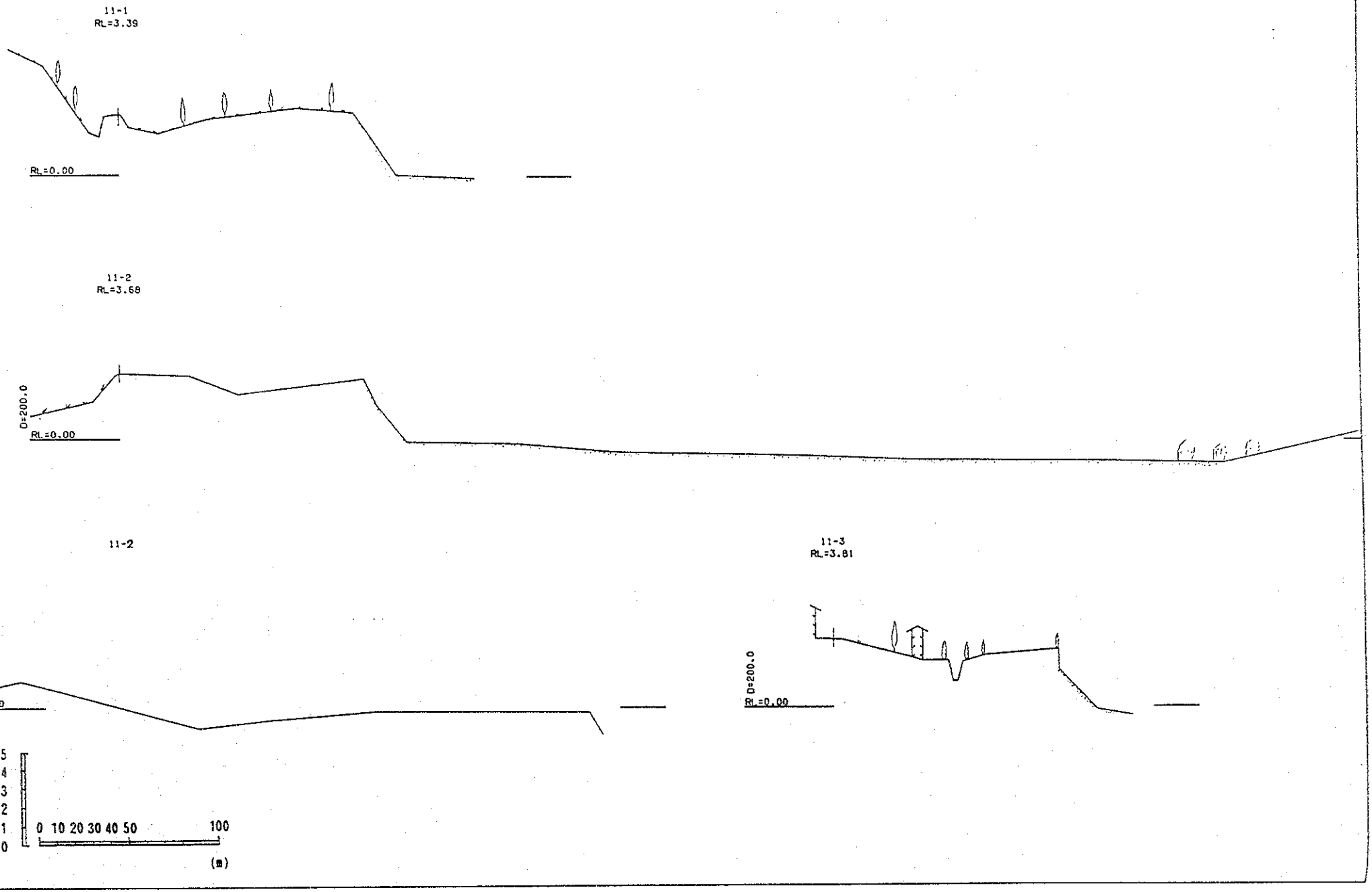

7-1
RL=3.22
RL=0.00
7-2
RL=3.46
D=200.0
RL=0.00
7-3
RL=3.62
D=200.0
RL=0.00
(m)
5
4
3
2
1
0
0 10 20 30 40 50 100
(m)


8-1
RL=3.09
RL=0.00
8-2
RL=3.24
D=200.0
RL=0.00
8-3
RL=2.42
D=200.0
RL=0.00
(m) 5 4 3 2 1 0
0 10 20 30 40 50 100
(m)

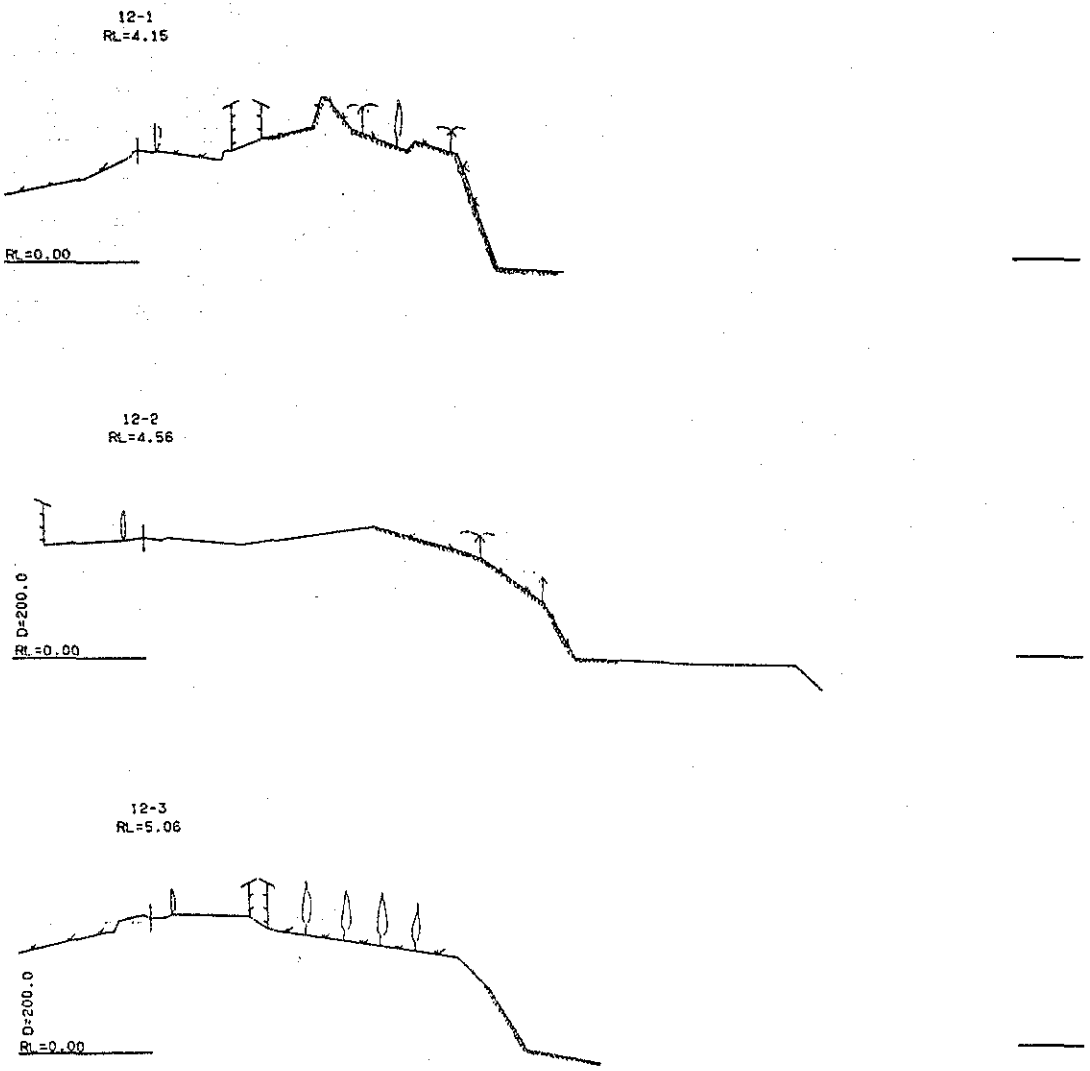
C2-15

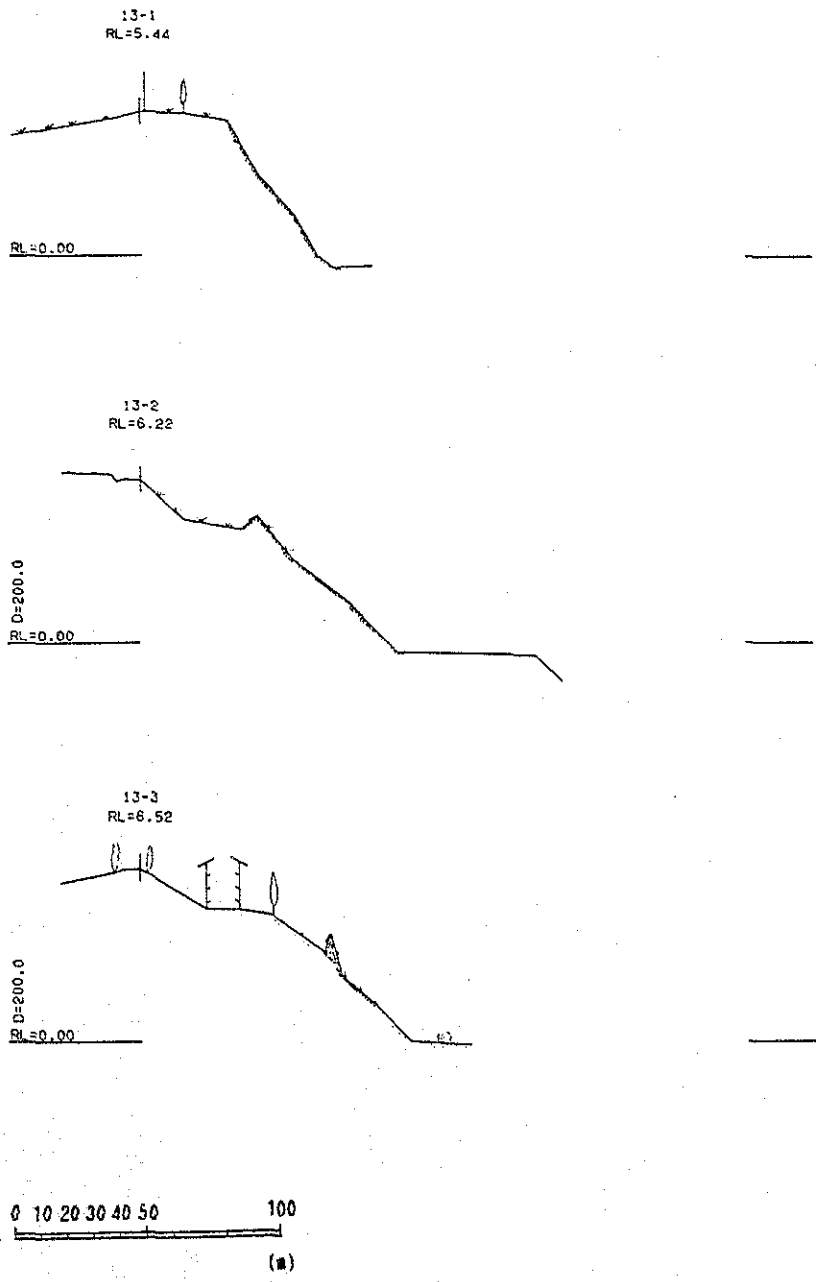

9-1
RL=2.54
RL=0.00
9-2
RL=3.09
D=200.0
RL=0.00
9-3
RL=3.49
D=200.0
RL=0.00
(m) 5
4
3
2
1
0
0 10 20 30 40 50 100
(m)


10-1
RL=4.30
RL=0.00
10-2
RL=3.86
D=200.0
RL=0.00
10-3
RL=4.30
D=200.0
RL=0.00
(m) 5 4 3 2 1 0
0 10 20 30 40 50 100
(m)

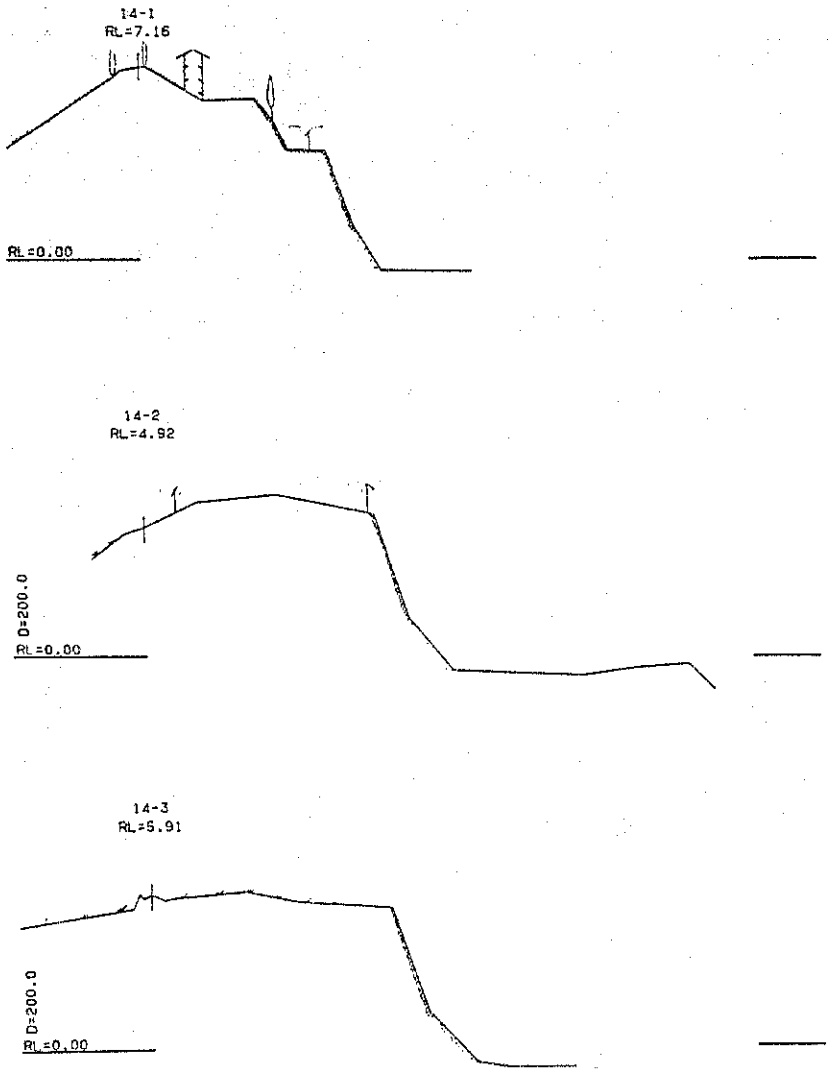

11-1
RL=3.39
RL=0.00
11-2
RL=3.68
D=200.0
RL=0.00
11-2
11-3
RL=3.81
D=200.0
RL=0.00
RL=0.00
(m) 5 4 3 2 1 0
0 10 20 30 40 50 100
(m)

C2-18


12-1
RL=4.15
RL=0.00
12-2
RL=4.56
D=200.0
RL=0.00
12-3
RL=5.06
D=200.0
RL=0.00
(m) 5 4 3 2 1 0
0 10 20 30 40 50 100
(m)


13-1
RL=5.44
RL=0.00
13-2
RL=6.22
D=200.0
RL=0.00
13-3
RL=6.52
D=200.0
RL=0.00
(m) 5
4
3
2
1
0
0 10 20 30 40 50 100
(m)

C2-20


14-1
RL=7.16
RL=0.00
14-2
RL=4.92
D=200.0
RL=0.00
14-3
RL=5.91
D=200.0
RL=0.00
(m) 5 4 3 2 1 0
0 10 20 30 40 50 100
(m)

C2-21