REPORT ON THE THIRD COASTAL PROTECTION MEETING

Rarotonga, Cook Islands
22–29 March 1995

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SOPAC Secretariat

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SOPAC Miscellaneous Report 192

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INTRODUCTION

The August 1994 South Pacific Forum Meeting received and accepted a report and recommendations from the first two coastal protection meetings held in early 1994 (available from SOPAC Secretariat as SOPAC Miscellaneous Report 177).

The recommendations from the report contained fifteen resolutions and the Forum requested SOPAC and SPREP to draw up an Action Plan in respect of these and report back to the 1995 Forum Meeting.

The Third Coastal Protection Meeting was convened for a small group, predominantly of engineers, to specifically address two of the resolutions:

- The Forum endorses the establishment of guidelines for sound engineering practice in the region,

- The Forum endorses the need for detailed engineering assessment, including economic evaluations of new coastal protection systems.

The support of the Cook Islands Government in offering to host this meeting was gratefully acknowledged.

The financial assistance of the Australian and New Zealand governments provided to support the meeting was gratefully acknowledged.

Upon request, the National Committee on Coastal and Ocean Engineering of the Institution of Engineers Australia agreed to assist by way of recommending two engineers to participate.

THIRD COASTAL PROTECTION MEETING

The Third Coastal Protection Meeting was convened as a small meeting in Rarotonga, Cook Islands, 22-29 March 1995. The meeting, predominantly of engineers, was attended by 21 individuals (Appendix 1).

Participants were from Australia, Cook Islands, Fiji, New Zealand and Tuvalu as well as the SOPAC Secretariat. Invited engineers from Solomon Islands and Tonga were unable to attend.

Mr George Cowan, Technical Consultant to the Cook Islands Government and former Secretary of Public Works, was appointed to chair the Meeting. Dr Russell Howorth, a SOPAC representative, with assistance from others was rapporteur.

Following a welcome statement on behalf of SPREP and SOPAC by the Director of SOPAC, Mr Philipp Muller, the Meeting was officially opened by the Minister of Works, Honourable Tom Marsters and closed by the Minister of Marine Resources, Honourable Tepure Tapaitau (Appendix 2).

The Meeting program (Appendix 3) permitted comprehensive discussion and consideration of the issues. In addition two presentations were given by Dr Michael Gourlay of the University of Queensland on coastal engineering in the Great Barrier Reef region of Australia. The topics were, “Historical Engineering Structures of Reefs and Cays", and "The Impact of Heron Island Boat Harbour upon its Adjoining Reef and Cay”. Various protection systems on Rarotonga were also visited. In the latter context the venue for this Meeting was particularly appropriate since the Forum specifically requested “examination of various systems both existing and in the process of development”. In Rarotonga one new system is in place and another is in the process of development.

The Meeting was briefed by Mr Don Dorrel, representative of Coastal Environmental International Ltd, developers of the Coastal Protection Unit (CPU) and Coastal Protection and Energy Dissipater (COPED) systems prior to visiting the Rarotongan Hotel where CPUs have been in place since May 1991 and the western end of the airport where COPED units are to be installed shortly (Government has set aside funds for this project in the 1995 Budget). The Meeting was briefed by the Chairman at the Avarua Harbour, Avatiu Harbour and adjacent coastal area where extensive rock revetments and associated reclamation have been constructed and rock breakwaters removed.

SUMMARY STATEMENTS AND CONCLUSIONS

The **Meeting requested** that SOPAC in conjunction with SPREP facilitate the reporting of the output from the Meeting to the 1995 Forum. This was in recognition that if strong endorsement was given by the Forum then finance to carry out the required work might be forthcoming.

The **Meeting endorsed** the statements, needs and priorities of the previous two coastal protection meetings.

The **Meeting agreed** that a manual for coastal engineering practice in Pacific Island Countries (PICs) was urgently needed and that this manual would be likely to have application to all tropical island situations. In order to accomplish this, a project terms of reference, timeframe and budget estimate of F$727,250 was developed by the Meeting.

The Meeting agreed that in addition to the current system of technical advice through the ministries and cabinet, other methods of raising the awareness of the broader island leadership need to be activated such as:

- large professional engineering institutions such as the Institution of Engineers Australia and the Institution of Professional Engineers New Zealand being asked to take an active role in supporting their PIC counterparts,
- professional engineering institutions organising and sponsoring incountry technical meetings to gain public support,
- technical sessions in the PICs being held to contribute to greater public awareness, aid organisations playing an important supporting role in communicating technical issues to national leaders.

The **Meeting agreed** that there remain two urgent requirements for the engineers and allied professions in the Pacific:

- organisational support at a professional level where they can meet regularly, discuss technical matters and provide each other with support. This is where the PIC engineers must develop their own ethics, their methods for transfer of expertise and the confidence to judge their own abilities.
- professional training in addition to that required to promote the manual.

The **Meeting agreed** on a series of steps to be followed by a developer/designer in order to ensure that the following information is readily available before a proprietary system can be considered by an engineer:

- specific recommended uses,

- design data in the form of empirical formulae, charts, or constants to insert into other standard formulae,
- conditions imposed by patent rights on owner or user,
- costs of installation, inclusive of any royalty or costs of conditions under patent.

The design data given for use by the profession must be established and verified by recognised institutions accepted as having the skills and equipment to do this.

The **Meeting was unable to endorse** the design claim that the cessation of coastal erosion and promotion of sand accumulation at the Rarotongan Hotel site was caused solely or predominantly by the CPUs placed at the site in 1991.

The **Meeting strongly recommended** the Forum promote the development of integrated coastal management (ICM) for the nations in the region and give priority to calling on its development partners to resource coastal management.

PART A: GUIDELINES FOR SOUND COASTAL ENGINEERING PRACTICE IN THE REGION

Engineers in most parts of the English-speaking world commonly use the Shore Protection Manual published by the United States Corps of Engineers as their guidelines for coastal engineering practice. The current issue of this publication is ten years old, very extensive in content but does not address many matters relevant to engineers working in PICs and tropical regions generally.

In noting several different types of manuals or educational material used by coastal engineers and in particular some relevant to tropical coral regions, the Meeting agreed that none of these documents provide a relevant, updated and practical statement of guidelines for sound coastal engineering practice by engineers working in PICs.

In order to facilitate sound engineering practice in the region, the Meeting agreed that a manual for coastal engineering practice in the PICs was urgently needed and that this manual was to have application in tropical islands generally.

The Meeting discussed the contents of such a manual, the necessary training to facilitate its use, the necessary promotion to ensure its use, and a mechanism and cost estimate for ensuring its early production.

The contents of the manual should cover at least the following:

Manual for Coastal Engineering Practice in the Tropical Islands

1 Introduction

2 Applicability of Manual

3 Planning and Statutory Processes
Desirable processes, environmental assessment, integrated coastal management (ICM), national environmental management strategies (NEMS), engineering projects, relevant agencies (SOPAC, SPREP, specific agencies in each nation)

4 Tropical Island Coastal Processes

4.1 Geology and Geomorphology
Volcanic islands, coral reefs and atolls, seismicity, specific islands

4.2 Marine Ecology
Coral Reefs, atoll lagoons, estuaries and sheltered coasts

4.3 Meteorology
General and specific climatic conditions, ENSO, cyclones (frequency and intensity, impacts of winds, waves, surge and wind forces, examples

4.4 Climatic Change
Global warming, sea level rise, cyclone intensity and frequency

4.5 Tides and Currents
Generation, prediction, specific sites, ocean currents,

4.6 Ocean Waves and Surges
Ocean wave characteristics, normal wave conditions and their prediction, cyclonic waves, prediction, storm waves and swell, design waves, storm surges and their prediction, design surge levels, tsunamis

4.7 Waves on Shoaling Shorelines
Shoaling, refraction, diffraction, reflection, breaking, set-up and run-up

4.8 Waves and Currents in Coral Reef and Lagoon Environments
Depth-limited conditions including water levels on reefs, wave transformation and breaking, wave set-up, design wave conditions, wave-generated currents and reef-flat circulation systems, storm surge and wind- induced circulations

4.9 Coastal Processes
Coastal, estuarine and reefal systems, sediment sources and sinks, sediment budgets, sediment transport onshore/offshore, littoral drift, scour at obstructions, coastal and reefal sediments, coastal landforms

5 Investigation Methods

5.1 Historical
Previous studies, surveys, charts, maps, air and satellite imagery, local knowledge

5.2 Field
Geotechnical (foundations, reef structure, sources of materials), wave, tides, and currents, sedimentological, environmental

5.3 Modelling
Physical, mathematical

5.4 Data Sources
Meteorological, tides, waves, charts and maps, air and satellite imagery, reports and other literature

6 Design Processes

6.1 Problem Definition

6.2 Data Collection

6.3 Options Available
Types of solutions available, costs, effects and benefits

6.4 Design Criteria

6.5 Design Aids
Accepted approaches, theoretical and empirical formulae, product specifications, case histories, worked examples

6.6 Risk Analysis

6.7 Assessment of Environmental Effects

7 Construction

7.1 Type of construction
Contractor, government labour, community labour, voluntary labour

7.2 Contract Documentation
Specific conditions for each country

7.3 Construction Methods

7.4 Construction Quality Control
Enforcing and understanding specifications, ensuring site conditions are as assumed in design, controlling material quality, supervising local labour

7.5 Monitoring and Maintenance
Regular inspection, annual finance for repairs, urgent repairs to structures, additional work required to combat end effects

7.6 Construction Costs
Estimates and control

8 Properties of Materials used in Pacific Island Countries

8.1 Coral

8.2 Beach Sands

8.3 Concrete using locally available materials

8.4 Timber
Coconut, ironwood, others

8.5 Environmental Effects on Standard Engineering Materials
Concrete, steel, aluminium, treated timbers, others

9 Coastal Engineering Projects

9.1 Coastal Protection
Determination of need for protection and desired outcome, options for coastal protection (planning controls, nourishment, Structures including revetments, groynes, offshore breakwaters etc), environmental impacts, mitigation and monitoring, examples

9.2 Harbours
Purpose and size, location, layout for optimum protection, breakwaters, wharves and piling, environmental impacts, mitigation and monitoring, examples

9.3 Dredging and Reclamation
Purpose (sand mining, harbour construction, channel maintenance), methods and equipment, spoil dumping, compaction and consolidation of fill, reef blasting, environmental impacts, mitigation and monitoring, examples

9.4 Pipelines and Outfalls
Design, construction, effluent dispersion and plume analysis, environmental impacts, mitigation and monitoring, examples

9.5 Structures on reefs and reef top islands (motus and cays)
Navigation aids and weather stations, foundations, materials, construction, environmental impacts, mitigation and monitoring, examples

10 References and Appendices

For a manual on coastal engineering practice to be of use to engineers working in PICs, it needs to have the imprimatur and active support of the appropriate Institutions of Engineers. These include for example, the Institution of Engineers Australia, Institution of Professional Engineers New Zealand, Fiji Institution of Engineers, Institution of Professional Engineers Western Samoa, and the Society of Professional Engineers Papua New Guinea.

The biennial Australasian Conference on Coastal Engineering and Port Engineering will be held in Melbourne in May-June 1995. The Meeting recommended that the support for the manual from those relevant institutions be sought at this conference. The succeeding conference will be held in Christchurch in September 1997. This would provide an appropriate opportunity to launch the manual.

In considering the project to produce the manual, the Meeting agreed on an outline of the timetable for the production of the manual in this timeframe, a draft terms of reference and estimated the cost to be F$727,250 (Appendix 4).

PART B: TRAINING AND SUPPORT

Science and technology graduates in PICs are not plentiful, whereas there are many Pacific Islanders who have very high arts and law degrees. Sound engineering principles are sometimes not appreciated by the public and often difficult to raise in the area of public awareness.

The geography of PICs often means that local engineers rarely have the opportunity to obtain good practical engineering experience following graduation. Many local engineers are given management and policy roles without the experience, normally considered to be an essential prerequisite for the job. At a relatively young age many have to cope with making technical decisions without relevant professional experience. Few countries have sufficient numbers of engineers to allow their assignment to projects outside the country to gain this experience.

The Meeting agreed it is essential that the PICs have professional engineers in key roles so that all technical proposals can be assessed and managed adequately.

Status of science and engineering within the education system and the community

PICs are under pressure from population increases and the paucity of resources. Traditional utilisation of resources seldom overtaxed the natural resources available. With increased demands communities find that the need for technological advancement is essential. Elements that make the process more difficult include; the lack of science in the school curricula and the lack of general public awareness of coastal processes.

The Meeting agreed the most important concept to introduce at this base level is that the coast is an asset and it requires care, nourishment, protection and regeneration. The major mechanism for this has to be through the small number of PIC nationals involved in technology who are already in the engineering profession together with support from professional institutions, aid donors and other NGOs.

Communication

The Pacific tradition is oral communication. A manual, a paper or a book may or may not go further than the library shelf without complementary training and presentation.

The Meeting agreed that the introduction of the proposed manual would need to be accompanied by an oral and practical training program. Such a training program would have the advantage that concepts which are not yet popular (for example ICM) could be introduced in a Pacific context.

The Meeting also agreed that a major frustration and pressure on PIC engineers is the difference between the technical correctness and outcome. A major way to support the PICs is to find a way of introducing into the cultures the technical concepts necessary for the adoption of sound coastal engineering practices.

Communication with Leadership

For many reasons which could include the culture and tradition of the people, the state of development, the size of a country and the relatively low standing of science and technology in the community, communication from engineers and scientists to national leaders has generally been poor and considerable improvement is needed.

Apart from the current system of technical advice through the ministries and cabinet, other methods of raising the awareness of the broader island leadership need to be activated.

The Meeting agreed such mechanisms might include:

- large professional engineering institutions such as the Institution of Engineers Australia and the Institution of Professional Engineers New Zealand being asked to take an active role in supporting their PIC counterparts,
- professional engineering institutions organising and sponsoring incountry technical meetings to gain public support,
- technical sessions in the PICs being held to contribute to greater public awareness,
- aid organisations playing an important supporting role in communication of technical issues to national leaders.

Providing for further support and education of PIC engineers and allied professionals

The diverse nature of their work means that PIC engineers are general practitioners responsible for all stages of a project from research until its completion. Design and construction in the coastal zone are inseparably bound together and should continue that way. It will be some time before the region will not need to import specialists and this will depend on the qualification and retention of national professionals.

The Meeting agreed that there remain two urgent requirements for the engineers and allied professions in the Pacific;

- organisational support at a professional level where they can meet regularly, discuss technical matters and provide each other with support. Some PICs already have their own professional body but a combined organisation is necessary to ensure that the appropriate numbers are available to generate the support necessary for their needs. This is where the PIC engineers must develop their own ethics, their methods for transfer of expertise and the confidence to judge their own abilities.
- professional training in addition to that required to promote the manual includes; site investigations, materials investigations and quality control, asset management and maintenance, project analysis and management, construction management and quality assurance, preparation and management of contracts and contract law.

PART C: DETAILED ENGINEERING ASSESSMENT, INCLUDING ECONOMIC EVALUATIONS OF NEW COASTAL PROTECTION SYSTEMS IN THE REGION

Proprietary Systems

With the complex nature of coastal protection a number of proprietary systems with varying attributes and claimed attributes are available. Proprietary systems add to the range of sound

solutions which may be available for a given problem and lateral thinking in coastal management must be encouraged.

It is very necessary that when an engineer includes one of these systems within the problem solution that the engineer goes through the accepted procedures of project analysis.

Information Required to be available to the Engineer

The Meeting agreed that for any site, having completed an extensive investigation and having defined the problem the engineer will require the following information to be readily available if a proprietary system is going to be considered in the solution options:

- specific recommended uses,
- design data in the form of empirical formulae, charts, or constants to insert into other standard formulae,
- conditions imposed by patent rights on owner or user,
- costs of installation, inclusive of any royalty or costs of conditions under patent.

The design data given for use by the profession must be established and verified by recognised institutions accepted as having the skills and equipment to do this. Because of the nature of coastal engineering this will most likely be a recognised research institution with a suitable hydraulic laboratory.

Development of a Proprietary System

A new system is developed when a need is recognised. This need may be brought about by a lack of local materials, the high cost of standard materials, apparent failures of earlier solutions or because there needs to be a better way to achieve a certain outcome. The engineer who uses the system must be confident that the new system will fulfill the purpose it was designed for.

The Meeting considered the process of the development of a system and agreed on the following necessary steps so that all parties could be confident of the system.

Step1 Recognise the need for a desired result

Step 2 Obtain an understanding of the processes involved

Step 3 Investigate current practices and devices

Step 4 Decide which physical attributes, if any, need to be modified and how best to do it

Step 5 Develop prototype ideas

Step 6 Develop the hydraulic design criteria using appropriate means including physical model testing

Step 7 Develop prototypes, quantify design data, check forces induced on the structure and check forces induced within the structure

Step 8 Independently check the derived data

Step 9 Produce required design data to be available to those that use units

Step 10 Prototype full size trial for system. This will include baseline studies of the site to establish the coastal processes occurring prior to the installation of the system and an independently conducted and/or reviewed monitoring during and after the installation for the duration of a trial period of at least three years depending on the recurrence interval of the intended design conditions

Step 11 Set royalties and other conditions of use in sufficient detail for costs of an installation to be estimated.

Coastal Protection Units in the Cook Islands

The Meeting considered the two units being developed in the Cook Islands, the CPUs that have been installed offshore of the Rarotongan Hotel, and the COPED units that are proposed for use near the west end of the airport runway.

Where further work is suggested it is in the context of what a professional engineer would require before that individual could responsibly recommend that the units be installed at another site.

Coastal Protection Units (CPUs) at the Rarotongan Hotel

These are basically pre-cast, high-strength concrete structures with a series of apertures which channel water and suspended sediment through them. The units are 1.7 metres in length, 1.3 metres high with a depth of 2 metres at the base tapering to 0.5 metres at the top. The total weight of each unit is 2.9 tonnes and uses 1.2 cubic metres of concrete. The units are designed to be placed along a receding/eroding beach frontage to induce sediment build-up along the beach front.

The Meeting was informed by Mr Dorrel, that the overall design objectives of the CPUs had been to reduce erosive wave energies impacting the shore, reduce wave run-up and backshore inundation, induce natural accretion of the beach with a predominantly coarse grain sand both shorewards and seawards of the units until eventually the units themselves were buried. The sediments trapped for replenishment would largely be taken during heavy seas, these sediments would otherwise be swept down the lagoon by strong longshore currents that prevail at such times and would thus have been lost to the beach environment. At no stage of the replenishment period was littoral drift to be interrupted to any degree, so no detrimental effects would be expected to the surrounding environment. The under-water shoaling profile developed seaward of the units would assist to counter the erosive effects of close longshore currents.

The Meeting inspected the coastal protection system at the Rarotongan Hotel where CPUs had been placed along a 200-metre stretch of the foreshore. Mr Dorrel provided sequential photographs of the shoreline prior to and after installation of the CPUs, a video of their operation, and grain size data which he believed to show that the design objectives of the CPUs had been achieved. The Meeting agreed that there had been accretion behind and in the vicinity of the CPUs. However, in subsequent discussion Mr Dorrel stated that the overall coastal protection system to stop erosion and promote sand accumulation on the beach at the Rarotongan Hotel site included the rebuilding and extension of the stream-training gabion walls.

The Meeting was unable to endorse the design claim that the cessation of erosion and promotion of sand accumulation at this site was caused solely or predominantly by the CPUs. Hence the Meeting could not agree with Mr Dorrel that the field test clearly demonstrated that the design objectives of the CPUs had been achieved.

If the CPUs are to be accepted by the engineering fraternity for other projects as a viable alternative to the very many existing foreshore protection and sand accretion devices, further information is needed, including hydraulic and numerical data. This includes:

- determination of the limiting factors for the use of the units in different types of foreshores, wave heights, periods and water depths,
- acceptable design data in relation to the energy dissipated as a function of the incoming wave energy,

- the costs of the system including royalty and other conditions imposed by the patent holder,
- any restrictions that might make it difficult to construct them in certain countries.

The first two of the above points need to be verified in a recognised hydraulic laboratory using standard test procedures.

The prototype testing that has been undertaken at the Rarotongan Hotel is impressive. However the particular section of coast is complex and there may be several other factors that have influenced the amount of sand that was on the beach at the time of the inspection (24 March 1995). There was an indication that the build up of sand near the stream entrance immediately east of the CPUs might have been caused by the stream-training walls rather than the CPU's. The Meeting recognised that at least the entire section of coast and contiguous reef area of southwest Rarotonga must be treated as one system in regard to the natural sediment movements.

Because of the unavailability of all baseline coastal processes studies, the lack of a complete and continuous independently assessed monitoring program, the field trial does not provide conclusive evidence of the effectiveness of the CPUs to promote sand accumulation on the beach.

Coastal Protection and Energy Dissipater (COPED) Units

The COPED units are at a less-developed stage and with the information that was made available, no engineering assessment could be made of their effectiveness.

As with the CPUs, information is required on stability versus wave height and period for different water depths, energy dissipation versus wave height, and royalty arrangements.

In addition to the above, there are a number of general concerns that would need to be addressed. Some of these are:

- unless the units are tied to each other and into the seabed, they appear to be inherently unstable under wave attack. It is difficult at any time to mobilise, in a reef environment, the tensile forces that would probably be required of the foundations,
- the units would be subject to high cyclical wave force loading. Considerable doubt exists as to the ability of the interconnecting dowels between the units to resist such cyclical loading without pulling out,
- the units were described as requiring high-strength concrete (70 Mpa was quoted). Such concrete is unusual and expensive. If it is necessary to use high-strength concrete over about 30 Mpa, it would severely restrict the PICs in which the units could be used,
- the units are large and of unreinforced concrete. The stresses would be complex and exhaustive mathematical and physical testing of their structural integrity would be required before they could be used (After the experience in Sines, Portugal where very large unreinforced Dolosse units broke up under their own weight with catastrophic results, no experienced engineer could recommend their use without such testing),
- because of the weight of the units (1 tonne upwards), placing them will be difficult and will only be possible in those countries that have suitable heavy lifting equipment,

- any field experiments would need previous baseline studies of the site to establish the coastal processes and would require independent monitoring during and after the installation for the duration of a trial period of at least three years depending on the occurrence of the intended design conditions.

The Meeting was informed by the developer that the primary objective of the COPED units to be placed at the west end of the runway is to prevent the destruction of the foreshore and associated services and airport infrastructure during hurricane-force seas. A secondary objective is to prevent the infilling of the airport V-drain with rubble and coral boulders normally experienced during such events. In addition the build-up of sediments on the shoreward side of the COPEDs will restore the recreation area washed away by past cyclones.

APPENDIX 1

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APPENDIX 2

Opening and Closing Speeches

Welcome Remarks by Director of SOPAC, Philipp Muller

KiaOrana

Mr Minister, Honourable Tom Marsters, Mr Utanga and gentlemen.

I am pleased to be here, as always in the Cook Islands I have been welcomed so hospitably.

My association with the Cook Islands goes back some 15 years when I was first welcomed as Director of Forum Fisheries Agency by you Mr Minister.

On behalf of SPREP as well as SOPAC and the overseas participants I would like to thank the Government of the Cook Islands through you, Mr Minister, for making the Meeting possible, and thank the officials for all their hard work. Some have been up half the night, meeting us and tending to our needs.

I would like to thank the specialists gathered here for giving this Meeting their time. I think what is wanted of us is practical outcomes that can be used by our countries. It should not be a call for more work although by the nature of development, work must continue.

In a weeks time we should be able to go away with a sense of achievement possibly on the first chapter of coastal protection systems.

We are happy to be here for this Meeting, and also for the opportunity to see on Rarotonga, examples of coastal protection systems some of which are innovative and could have application elsewhere in the islands.

Once again, thank you for the welcome and hospitality, and so far and above all else it is great to be back among friends.

Thank you.

Opening Address by Minister of Works, Honourable Tom J Marsters

Greetings Ladies and Gentlemen, and special greetings to participants at this workshop, from overseas.

A considerable attention has been given to coastal areas, of Pacific Islands, over the past decade by SOPAC.

Numerous expert surveys have been conducted into natural coastal processes, especially where erosion by the seas has been a problem, and possible solutions have also been advanced.

Many such solutions have assisted to reduce the effects of coastal erosion and damages and yet, some have, to a large extent, added to the demise of coastal areas.

On the initiative of our own Prime Minister, three years ago, through the South Pacific Forum, SPREP and SOPAC were asked to initiate projects of solution finding.

Since that time, two workshops, one each in Western Samoa and Fiji, have taken place to look into this very important matter. They have indeed reported back their finding to the Forum.

This workshop, is a direct result of those earlier meetings, and you are now charged with the responsibility of looking into the engineering aspects of the various systems being used at present in combating coastal erosion. A viewpoint from an engineering perspective rather than from a scientific is your brief.

We ourselves here in the Cook Islands have an invention which we feel may, in some way, answer some of the questions regarding this very important issue.

We invite you to take time to investigate the applicability and viability of this invention.

Gathered here today are leading coastal engineers from Australia and New Zealand, as well as your counterparts from some of our neighbours in the Pacific.

You will be sharing experiences over the next few days, finding out how some things work - how some don't work, and I guess, whether in the long term, nature itself is the best healer,

In the past, things were left to nature, that was the norm.

However, in recent years, on many Pacific Islands, development has rapidly taken over the coastal, low-lying areas.

Areas which have been periodically affected by sea surges resulting from hurricanes, or large sea swells generated by distant extreme weather patterns.

Development, mainly for hotels or other tourism-oriented businesses, have accentuated the problem of erosion with the removal of large quantities of beach sand for construction purposes. So where do we draw the line?

On the one hand, tourism in the islands is inevitable, and related development must forge ahead. Whilst at the same time, we need our attractive white sandy beaches to enhance our tourism.

I guess, your role, is to find ways of protecting what nature gave, in the face of accelerating development. Whilst we, the law makers, are to ensure that what nature has given us, is somehow, not abused.

I leave you then to ponder over this important issue and wish you well in your deliberations.

It is my pleasure now to declare this workshop opened.

Closing Address by the Minister of Marine Resources, Honourable Tepure Tapaitau

Distinguished delegates in particular our visiting colleagues and young local professionals, gentlemen.

I am sorry that I had not been present at the opening of this Meeting as I had been overseas. However, I now have the privilege of speaking to you on this occasion of the closing of this Meeting.

You were given your assignment at the start and there is no one who can deny that you applied every effort and energy in fulfilling this task.

We had hoped that you would have been able to assess our innovations against others that are being applied in the Pacific. I understand that while your consideration of the field trials of the CPU could not be taken to conclusion, I believe you were able to personally see the build up of sand that has saved the Rarotongan Hotel from serious destructive damage.

However I have been told that your discussions on the needs of the Pacific Islands in coastal protection has been thorough and our engineers especially the younger ones were able to benefit by being involved in these discussions. I therefore would like to thank SOPAC and SPREP for organising the workshop in Rarotonga which has allowed the maximum exposure to our engineers.

I would like to acknowledge SOPACs support to Cook Islands which can be typified by the ATLAS that I received on Friday night. I would like to thank Philipp Muller and those of his team for their continued support of the Cook Islands. In particular I would like to thank Russell Howorth who has been involved in the technical training of many Cook Islanders. I hope that SOPAC is able to find a solution to the predicament with the lack of funding for the training programme.

Training for all of us in the Pacific is of the highest priority and SOPAC has contributed so practically in this regard. We cannot afford to let this program be allowed to lapse.

Over the years Cook Islands has had a lot of support from SOPAC and I ask you Philipp, to try your best to continue SOPAC's programmes that support us in areas that we need help. I know you have to balance the needs of all the member countries but I ask you to call on all your experience and skills to continue supporting all the countries in the region even against all the negativeness of the donor community.

In bidding you best wishes on your departure I am mindful of the achievements of this Meeting.

You came with open minds and a willingness to contribute and now you leave with having successfully completed the assignment and have produced a recipe for dealing with assessing the emerging new systems needed for coastal protection in the future.

On behalf of the Government I want to thank you all for a job well done and wish you a speedy and safe journey home to your loved ones.

KiaManuia.

Response to Closing Address by the Minister of Marine Resources from Filipo Taulima

Minister of Marine Resources, Honourable Tepure Tapaitau, Director of SOPAC Secretariat, Mr Philipp Muller, professional engineers from around the Pacific region, members of SOPAC Secretariat, my good engineers and friends from the Cook Islands.

I am indeed delighted to be given the opportunity to respond and address the closing remarks of the Minister.

As one of the participants to this very important meeting, I would like on behalf of the other participants to thank the Governments of Australia and New Zealand for the financial assistance they provided for this meeting. Most importantly I would like to convey my appreciation and sincere gratitude to the Government and people of the Cook Islands for their hospitality, support and of course for agreeing to host this Meeting.

I wish to admit that we finally engineered our way to a resolution after six days of serious and sometimes tense discussion.

I was made to believe before visiting the Rarotongan Hotel that the coastal protection units there were serving their purpose. However the Meeting agreed that in order to promote the use of the CPUs elsewhere in the region there has to be sufficient technical detail to support them.

Fakafetai Lasi
Tofa

APPENDIX 3

Program for the Third Coastal Protection Meeting (A Small Meeting of Experts)

Rarotonga, Cook Islands 22-29 March 1995

Chairman, George Cowan
Technical Consultant to Government, Cook Islands

Tuesday, 21 March	23.10	Arrive from Fiji NZ 46
Wednesday, 22 March	AM	Free
	PM	Opening (MC Tony Utanga) Prayer Takamoa Theological College Address Director of SOPAC Address Minister of Works Afternoon Tea State of the Art and Current Practices in the Island Countries
Thursday, 23 March	AM	Consideration of guidelines for sound engineering practice Presentations by individuals on general, thematic and case study issues
	PM	Consideration of guidelines for sound engineering practice (continued)
Friday, 24 March	AM	Procedures for engineering assessment and economic evaluation of new protection systems Presentations by individuals on general, thematic and case study issues
	PM	Field Trip: Rarotongan Hotel
	Even	Cocktail hosted by Minister of Works and Minister of Marine Resources
Saturday, 25 March	AM	Procedures for engineering assessment and economic evaluation of new protection systems (continued)
	PM	Field Trip: Avarua - Avatiu Harbours, Airport
	Even	Presentation on Great Barrier Reef Lighthouse Structures
Sunday, 26 March	Preparation of Draft Report	
Monday, 27 March	AM	Drafting Committee Report: Discussion
	PM	Drafting Committee Report: Discussion Continued
	Even	Presentation on Heron Island
Tuesday, 28 March	AM	Consideration of Draft Final Record
	PM	Consideration of Draft Final Record Adoption of Record of Meeting Closing
	Even	Feast hosted by Cook Islands participants
Wednesday, 29 March	Free	
	19.25	Depart for Fiji NZ 47

APPENDIX 4

Coastal Engineering in the Tropical Island Regions a Manual for Engineering Practice

Project Title

Coastal Engineering in Tropical Island Regions, a Manual for Engineering Practice

Draft Terms of Reference

SCOPE: The project is for the development of a manual for engineering practice for coastal projects in tropical island regions. The manual will contain best accepted current practices and will include practical examples from the Pacific Islands.

PATRONAGE: The project is to be completed under the patronage of the South Pacific Forum with the technical guidance of SOPAC in collaboration with SPREP.

METHODOLOGY: It is proposed that the project will be overseen by a Steering Committee with members drawn from The Institution of Engineers Australia, The Institution of Professional Engineers New Zealand and from other Pacific Island Engineering Organisations. The Steering Committee will be responsible for:

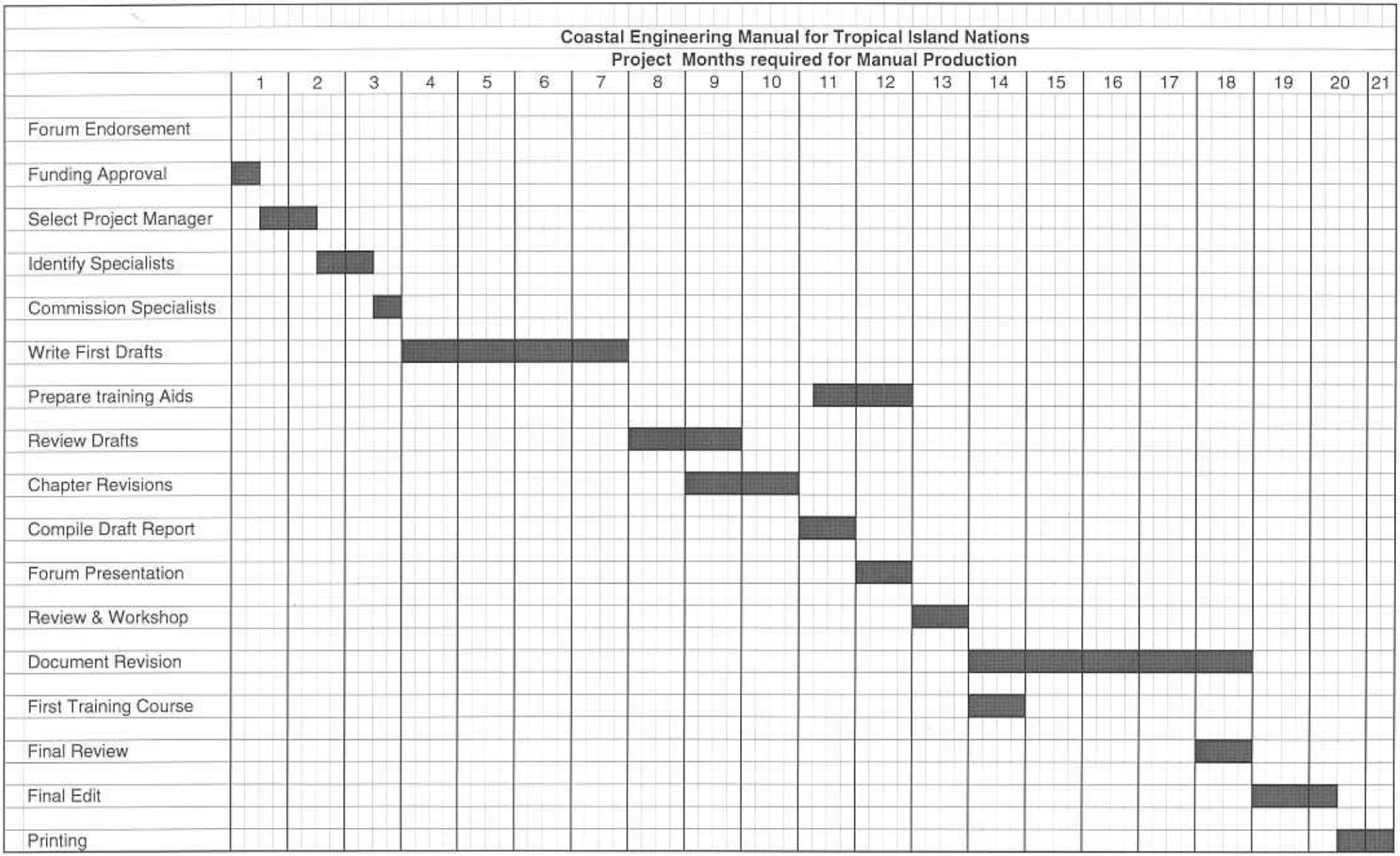
- recruiting a project manager to manage the compilation of the document;
- appointing the appropriate professionals to contribute to and review the manual;
- ensuring training programs for the manual users are developed in parallel with the manual;
- ensuring the manual contents are developed along the guidelines proposed by the Third Coastal Protection Meeting held in Cook Islands, March 1995, and making such changes as necessary to make the manual a practical working document;
- ensuring that the manual has the requisite professional endorsement.

TIMING: The project will commence as soon as funding is confirmed. A progress report and if possible a first draft will be made available for the following South Pacific Forum Meeting.

It would be desirable if the final document were available for release before the Australasian Coastal and Ocean Engineering Conference to be held in Christcurch, New Zealand in September 1997.

FUNDING: Funding should be sought from donor organisations involved in assisting with environmental and development programs.

ATTACHMENTS: Manual Outline, proposed timetable and estimate of costs.


Coastal Engineering Manual for Tropical Island Nations
Project Months required for Manual Production
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
Forum Endorsement
Funding Approval
Select Project Manager
Identify Specialists
Commission Specialists
Write First Drafts
Prepare training Aids
Review Drafts
Chapter Revisions
Compile Draft Report
Forum Presentation
Review & Workshop
Document Revision
First Training Course
Final Review
Final Edit
Printing

Cost Estimate for Manual Production							
	Time	Unit	Rate	Amount	Travel	Expenses	Total
Forum Approval							
Select Project Manager	10	person days	$500	$5,000	$1,500		$6,500
Identify Specialists	50	person days	$500	$25,000	$12,000	$500	$37,500
Commission Specialists	10	person days	$500	$5,000		$500	$5,500
Write First Drafts	550	person days	$500	$275,000	$5,000		$280,000
Prepare training Aids	80	person days	$500	$40,000		$10,000	$50,000
Review Drafts	120	person days	$500	$60,000		$1,000	$61,000
Chapter Revisions	66	person days	$500	$33,000		$1,000	$34,000
Compile Draft Report	30	person days	$500	$15,000		$10,000	$25,000
Forum Presentation				$0			$0
Review Workshop	50	person days	$500	$25,000	$20,000	$5,000	$50,000
Document Revision	40	person days	$500	$20,000		$5,000	$25,000
First Training Course	50	person days	$500	$25,000	$60,000	$5,000	$90,000
Final Review	30	person days	$500	$15,000		$250	$15,250
Final Edit	20	person days	$500	$10,000		$2,500	$12,500
Printing	10	person days	$500	$5,000		$30,000	$35,000
							$727,250