

REPUBLIC OF THE MARSHALL ISLANDS

WATER & SANITATION SECTOR STRATEGY AND ACTION PLAN

ACTION PLAN

August 1996

SOPAC TECHNICAL REPORT 236

Kevin D. Doig
(SOPAC Consultant)

TABLE OF CONTENTS

<u>EXECUTIVE SUMMARY</u>		ES/1
ES 1	<u>INTRODUCTION</u>	ES/1
ES 2	<u>POPULATION GROWTH</u>	ES/1
ES 3	<u>PUBLIC HEALTH</u>	ES/2
ES 4	<u>WATER RESOURCES</u>	ES/2
ES 5	<u>WATER SUPPLY</u>	ES/2
ES 6	<u>SANITATION</u>	ES/4
ES 7	<u>SOLID WASTE DISPOSAL</u>	ES/4
ES 8	<u>STORMWATER DISPOSAL</u>	ES/5
ES 9	<u>THE ECONOMY</u>	ES/5
ES 10	<u>FINANCE</u>	ES/5
ES 11	<u>UTILITY COMPANY ORGANISATION</u>	ES/6
ES 12	<u>RECOMMENDED ACTIONS</u>	ES/7
ES 12.1	Government Actions	ES/8
ES 12.2	Technical Assistance	ES/11
ES 12.3	Project Assistance	ES/19
CHAPTER 1	<u>INTRODUCTION</u>	1/1
1.1	Preamble	1/1
1.2	Terms of Reference	1/1
1.3	Country Background	1/2
1.4	Documents Used For Reference	1/3

CHAPTER	2	<u>POPULATION</u>	2/1
	2.1	Population Growth	2/1
	2.2	Migration to Urban Centres	2/2
CHAPTER	3	<u>PUBLIC HEALTH</u>	3/1
	3.1	Introduction	3/1
	3.2	Morbidity Statistics	3/1
	3.2.1	Gastrointestinal Diseases	3/1
	3.2.2	Skin And Eye Diseases	3/2
	3.2.3	Typhoid And Paratyphoid	3/2
	3.3	Mortality Statistics	3/2
	3.4	Health Conclusions	3/3
	3.5	Recommended Actions	3/3
	3.5.1	Government Actions	3/3
CHAPTER	4	<u>WATER RESOURCES</u>	4/1
	4.1	Introduction	4/1
	4.2	Rainwater Harvesting	4/1
	4.3	Groundwater	4/2
	4.4	Seawater	4/2
CHAPTER	5	<u>WATER SUPPLY</u>	5/1
	5.1	Freshwater Supply	5/1
	5.1.1	Majuro Atoll	5/1
	5.1.2	Ebeye Island, Kwajalein Atoll	5/2
	5.1.3	Outer Islands	5/2

	5.2	Saltwater Supply	5/3
	5.2.1	Majuro	5/3
	5.2.2	Ebeye Island, Kwajalein	5/3
	5.2.3	Outer Islands	5/3
	5.3	Water Demand	5/4
	5.3.1	General	5/4
	5.3.2	Demand Management	5/4
	5.4	Unaccounted for Water in Urban Systems	5/5
	5.4.1	Freshwater	5/5
	5.4.2	Seawater	5/5
	5.5	Majuro Water Supply and Sanitation Project	5/6
	5.6	Recommended Actions	5/7
	5.6.1	Government Actions	5/7
	5.6.2	Technical Assistance	5/8
	5.6.3	Project Actions	5/8
CHAPTER	6	<u>SANITATION</u>	6/1
	6.1	Introduction	6/1
	6.2	Urban Systems	6/1
	6.2.1	Saltwater Reticulation	6/1
	6.2.2	Sewer Reticulation	6/1
	6.2.3	Sewage Outfalls	6/2
	6.2.4	Premises Not Served	6/2
	6.3	Rural Systems	6/3

	6.4	Recommended Actions	6/4
	6.4.1	Technical Assistance	6/4
	6.4.2	Project Assistance	6/5
CHAPTER	7	<u>SOLID WASTE DISPOSAL</u>	7/1
	7.1	Introduction	7/1
	7.2	Garbage Collection & Disposal	7/1
	7.3	Recycling	7/1
	7.3.1	Aluminium Cans	7/1
	7.3.2	Steel Scrap	7/2
	7.3.3	Storage Batteries	7/2
	7.3.4	Waste Oil & Solvents	7/2
	7.3.5	Cyclogen Emulsifier	7/3
	7.3.6	Hospital Wastes	7/3
	7.3.7	Organic Wastes/Composting	7/3
	7.4	Future Municipal Landfill	7/4
	7.5	Recommended Actions	7/4
	7.5.1	Technical Assistance	7/4
	7.5.2	Project Assistance	7/4
CHAPTER	8	<u>STORMWATER DISPOSAL</u>	8/1
	8.1	Introduction	8/1
	8.2	Flooding & Silt Control	8/1
	8.3	Development Clearing & Surface Erosion	8/1
	8.4	Groundwater Recharge	8/1
	8.5	Recommended Actions	8/2
	8.5.1	Technical Assistance	8/2
	8.5.2	Project Assistance	8/2

CHAPTER	9	<u>THE ECONOMY</u>	9/1
	9.1	Dependency	9/1
	9.2	Balance of Trade	9/1
	9.3	Subsidies	9/1
CHAPTER	10	<u>FINANCE</u>	10/1
	10.1	Introduction	10/1
	10.2	Tariffs	10/1
	10.2.1	General Principles	10/1
	10.2.2	Majuro Water & Sewer Company	10/1
	10.2.3	Kwajalein Atoll Joint Utility Resources	10/3
	10.3	Government Accounts	10/4
	10.4	Recommended Actions	10/4
	10.4.1	Government Actions	10/4
CHAPTER	11	<u>UTILITY COMPANY ORGANISATION</u>	11/1
	11.1	Management	11/1
	11.2	Organisation	11/1
	11.2.1	Administration	11/1
	11.2.2	Technical	11/2
	11.2.3	Institutional Memory	11/2
	11.3	Training	11/2
	11.3.1	Majuro	11/2
	11.3.2	Ebeye	11/3
	11.4	Recommended Actions	11/4
	11.4.1	Government Actions	11/4
	11.4.2	Technical Assistance	11/4

ACRONYMS USED IN THIS REPORT

ADB	Asian Development Bank
ASLR	Accelerated Sea Level Rise
AusAID	Australian Assistance for International Development
DUD	Delap, Uliga, Jenrok & Darritt (Rita)
EPA	Environmental Protection Agency
GDP	Gross Domestic Product
JICA	Japanese International Cooperation Agency
KALGOV	Kwajalein Atoll Local Government
KAJUR	Kwajalein Atoll Joint Utility Resources
MALGOV	Majuro Local Government
MEC	Marshalls Energy Company
MIDB	Marshall Islands Development Bank
MIMRA	Marshall Islands Marine Resource Authority
MPW	Ministry of Public Works
MWSC	Majuro Water and Sewer Company
NEMS	National Environment Management Strategy
OPS	Office of Planning and Statistics
O & M	Operations and Maintenance
PWD	Public Works Department
RMI	Republic of the Marshall Islands
SSAP	Sector Strategy and Action Plan
SOPAC	South Pacific Applied Geoscience Commission
UNDDSMS	United Nations Department of Development Support and Management Services
USA	United States of America
WHO	World Health Organisation

CONVERSION TABLES

<u>FROM</u>		<u>TO</u>
Temperature		
degree Fahrenheit (°F)	$5/9 \times (°F - 32)$	= °C
Length		
inch (in.)	x 25.4	= millimeter (mm)
foot (ft.)	x 0.3048	= meter (m)
mile (mi.)	x 1.609	= kilometer (km)
Area		
acre (ac)	x 4,047	= square meter (m ²)
square foot (ft ²)	x 0.09294	= square meter (m ²)
square mile (mi ²)	x 2.590	= square kilometer (km ²)
Volume		
acre-foot (acre-foot)	x 1,233	= cubic meter (m ³)
U.S. Gallon (gal)	x 3.78	= litre
millions gallons (Mgal)	x 3,785	= cubic meter (m ³)
Cu. Meter (m ³)	=	= 35.3 cu. feet
Cu. Foot (cf)	=	= 0.0283 cu. meter
Volume Per Unit Time		
gallon per minute (gpm)	x 0.20700	= litre per second (l/s)
million gallons per day (Mgal/d)	x 0.04381	= cubic meter per sec (m ³ /s)

NOTE : ALL DOLLAR (\$) AMOUNTS SHOWN IN THIS REPORT ARE IN
US DOLLARS (\$)

EXECUTIVE SUMMARY

ES 1 INTRODUCTION

The Marshall Islands are a widespread group of low lying atolls and islands situated just north of the Equator in the central part of the Pacific Ocean. Total land area is some 70 square miles (110 sq.km) in an Exclusive Economic Zone of some 750,000 square miles (1.2 mill.sq.km).

The average surface level of the land areas is about 7 feet (2.1m) above mean sea level, and soils are generally poor and overlying coral sand, limiting the Republic's agricultural base.

The climate is moist and tropical, with rainfall varying from an annual mean of about 130 inches (3,300mm) in the southern part of the group down to about 60 inches (1,500mm) in the northern atolls. The 'dry' season extends from December through April, and there have been drought years in which no significant rainfall has fallen for up to three months.

Politically the Marshall Islands in this century were under German influence until 1914, under Japanese influence from 1914 until 1944, and since then under the influence of the USA, initially as part of the Trust Territory of the Pacific Islands until 1986, and latterly as a sovereign nation associated with the USA under a Compact of Free Association which defines political, military and economic relationships between the two nations. The Compact agreement also includes the provision of US funding for development in the RMI through to Year 2001., together with special compensation for Marshallese detrimentally affected by US nuclear testing.

ES 2 POPULATION GROWTH

Total population enumerated in the 1988 census was 43,380 which represented a 4.2% growth rate from the results of an earlier census in 1980. No census has been carried out since 1988, but statistics on fertility and mortality suggest that the growth rate has declined significantly since then and that if this trend continues, could be as low as 2.8% by Year 2005. Even so, from an estimated base of about 55,000 persons in 1995, the population could double to 110,000 by Year 2020.

Population distribution is approximately 45% in the Majuro urban area, 22% in the Ebeye urban area on Kwajalein atoll, and the balance 33% in the Outer Islands. To lessen in-migration pressure on the urban area there is a need to increase economic and employment opportunities in the Outer Islands, as well as improving the transportation and communication infrastructure, but indicators suggest that Outer Island development is not receiving the level of support necessary to achieve these goals.

ES 3 PUBLIC HEALTH

Health statistics present an interesting picture in that the incidence of sanitation related and preventable diseases is higher in the urban areas of the RMI, with their piped water supplies and sewage disposal, than in the rural Outer Islands where there are no community water supplies or sanitation facilities. Overall, the health profile of Majuro is typical of a developing country, whereas that of the Outer Islands is typical of a country of moderate economic development.

The perception of health professionals is that the main causes of morbidity are behavioural in character and that health education will have to be improved if the existing high rates of morbidity are to be reduced to an acceptable level.

ES 4 WATER RESOURCES

The primary source of freshwater is rain which, because of the low elevation of the atolls and islands, soaks directly into the soil and disperses into the saltwater which permeates atoll subsoils. In some favourable locations some of the freshwater may accumulate in a lens which floats on the saltwater below and can be accessed with wells.

Rainwater collection systems, widely used in most water-short countries, are not well developed in the RMI. Existing legislation which requires new buildings to be provided with rainwater collection and storage facilities is not enforced.

Seawater provides a limitless resource for either direct substitution of freshwater for certain uses, or as a base for the production of freshwater by desalination.

ES 5 WATER SUPPLY

On Majuro Atoll, the average daily quantity available for distribution to the community is about 1 million gallons (3,700 m³) produced both from a groundwater lens at Laura and from rainwater harvested from part of the paved area of the international airport. Some 71% of households rely entirely on the community supply, 27% on rainwater catchments and storage supplemented with community water, and 2% on groundwater wells.

Ebeye Island on Kwajalein Atoll utilises freshwater from a desalination plant producing about 118,000 gallons (450 m³) per day. Some 93% of households rely entirely on the community system, and 7% on rainwater catchments and storage supplemented with community water.

On the Outer Islands rainwater is preferred by 76% of households supplemented when necessary by groundwater. 24% of households rely entirely on groundwater.

In spite of the fact that the naturally-occurring freshwater resources of the RMI are limited, the rainwater resource is considerably under-exploited, and supplies to individual consumers could be considerably enhanced if more attention was given to rainwater harvesting and storage.

The urban areas of Majuro and Ebeye are both supplied with seawater for toilet flushing and for firefighting.

Unrestricted water demand levels on Majuro are extravagantly high and would probably be similar on Ebeye if it were not for the fact that the output of the desalination plant limits freshwater use. Allowing for basic water requirements, 10 gallons per person per day (38 lppd) of freshwater should be a reasonable target to provide for drinking, cooking, laundry, and ablutions, with a further 20 gppd (75 lppd) of seawater for toilet flushing.

However, to achieve these demand targets, actions to promote economy of water use will need to be taken on a broad front including:

- education to increase public awareness of the need to economise on water use, and to promote the use of water-efficient plumbing and sanitary fittings.
- promotion of rainwater collection and storage from all buildings throughout the RMI.
- universal metering of all premises receiving potable water from a public water supply system.
- reduction of unaccounted-for water through a comprehensive leak detection survey and system rehabilitation.
- adjustment of tariffs for water supply to reflect the actual cost of the utility, to recognise the efforts of those consumers who do use rainwater harvesting and so reduce system demand, and to progressively penalise extravagant water use.
- under extreme conditions, the utility companies may have to adopt policies and refuse to supply water to potentially high demand users such as hotels and fish processing premises, and to leave them to develop their own supply systems.

There is also a perception that much of the apparent high individual use of water is due to over-estimations of water production and to leaks in the reticulation pipework. Reliable bulk metering and a comprehensive leak detection survey is therefore required in both freshwater and seawater urban systems.

An ADB project for Majuro has recently been let for the upgrading of some water production and treatment facilities, additional freshwater reticulation, upgrading and extension of the seawater supply system and an upgrading of sewage pumping stations and facilities. The project does not include complete bulk metering, or a leak detection survey, or any rehabilitation of existing water supply or sewerage networks.

ES 6 SANITATION

Saltwater is reticulated on both Majuro and Ebeye for the flushing of toilets, and both urban areas have a piped sewerage system terminating in an outfall to the sea. Even so, a number of urban households are not connected to the sewerage system and, in some cases, have no sanitation facilities at all.

The condition of the saltwater reticulation and sewerage systems is not known, and should be investigated and rehabilitated where necessary. The ADB project on Majuro provides for a major extension to the saltwater supply system, but no corresponding sewerage reticulation is included to collect and dispose of the wastewater which will be generated.

Of the sewage outfalls, both have been storm-damaged or affected by land development so that sewage solids float to the surface and contaminate adjacent shorelines.

Families living on the Outer Islands are being encouraged to construct proper latrines rather than using the natural environment or the lagoon. With pit latrines, these tend to be dug as deep as possible to avoid frequent relocation, so most pits penetrate the groundwater table, and thereby pollute adjacent wells. Composting toilets as an alternative to pit latrines have been researched in other island nations, but to date little effort has been focussed on the RMI to establish either the economic feasibility or the user-acceptability of such alternative sanitation systems.

ES 7 SOLID WASTE DISPOSAL

Because of a shortage of land area, municipal landfill sites are operated as reclamation areas adjacent to the urban areas. The landfills are general poorly managed with no control on access and the mechanical equipment for spreading compacting and covering the garbage is frequently out of service. In rural areas, each household makes its own arrangements for garbage disposal, sometimes in pits, but more frequently in the ocean.

Garbage collection in the urban areas is not regular and needs proper closed compacting trucks to keep streets and adjoining properties clean.

The volume of garbage could be reduced by the recycling of recoverable materials, but distances from markets have seriously constrained the economics of recycling in the conventional sense. A project set up by MRIEPA for the crushing and recycling of aluminium cans has been affected by this problem.

Scrap steel in all forms from old car bodies to unserviceable earthmoving machinery litters the urban areas of the RMI and, even if the material has no commercial value, it should be removed, especially if the community is serious about the promotion of tourism. One possibility would be for the scrap to be dumped in a remote part of the lagoon to form the base of an artificial reef for the attraction of fish.

Waste oil and solvents could be removed by the oil importing companies for re-refining, but otherwise would require an incinerator for disposal. Waste bituminous materials could also be incinerated if such a facility was available.

An existing project to promote household-based composting of organic waste could be expanded to include municipal wastes if suitable buildings, plant, and financial support was available.

ES 8 STORMWATER DISPOSAL

Lack of effective stormwater drainage and subsequent pollution of stagnant water presents a real health risk to young children who will play in the water. In the urban areas poor drainage also leads to surface erosion, flooding of roads, and uncontrolled silt-laden discharges to the lagoon or the ocean.

Relatively clean run-off water from roofs and paved areas adds to surface flooding problems but could be used for the recharge of groundwater systems.

ES 9 THE ECONOMY

The economy is heavily dependent upon annual grants from the US Government as part of the Compact of Free Association agreement. Of total RMI budget of \$90.9 million in the 1995/96 fiscal year, \$55.3 million is US grants being \$42.5 million of Compact funds and \$12.8 million of US Federal Grants to specific ministries of the RMI Government. Compact funding is due to be terminated after Year 2001, but may be renegotiated before that date.

The balance of trade is also of concern, with, in 1995 for example a negative balance of exports over imports of nearly \$52 million. The trade deficit has been of this order since 1990, and has not in fact been in credit at least since 1979.

Subsidies, made possible by US funding, have been a significant part of the RMI economy, but the Government is slowly moving towards reducing these.

ES 10 FINANCE

This section refers only to the operations of the water and sanitation utility companies on Majuro (MWSC) and Ebeye (KAJUR).

In view of the need to manage the use of the limited natural freshwater resource, and of high-cost electricity for seawater and sewage pumping, a stepped tariff has been suggested to make service cost modest and affordable for low-demand consumers but to increasingly penalise high-demand consumers.

The applicability of the system will require all water consumers to be metered and MWSC is moving towards this goal with a positive effect on operating revenues. However, the incidence of bad debts and so-called 'doubtful' accounts is increasing for both MWSC and KAJUR, and Government action to make the Attorney General responsible for the provision of legal services to the utility companies has resulted in a cessation of debt

recovery activities due to the unavailability of legal staff and an apparent reluctance to delegate the work to an attorney in private practice.

In the sanitation sector present tariffs are on a 'per connection' basis, regardless of how many toilets are serviced from the connection. A change to a 'per toilet pan' tariff is therefore recommended to bring revenue more in line with actual demand levels.

As noted earlier, subsidy levels are under review, but this may not be possible for the water supply on Ebeye where all freshwater is produced by a desalination plant and some subsidy is desirable to reduce the cost of water to an affordable level. It would however be appropriate for the subsidy to be paid on the basis of actual water quantities produced rather than as a bulk grant as at present.

Although Government premises are billed individually for services provided, the utility companies have some difficulty in reconciling payments with accounts because the Ministry of Finance, when making payments, does not provide a dissection of the make-up of the payments. Some action needs to be taken to make the payment process more transparent.

ES 11 UTILITY COMPANY ORGANISATION

The MWSC is currently benefitting in its financial management activities through its association with the Marshalls Energy Company, the General Manager of which is also Acting General Manager of MWSC. On the technical side however, both MWSC and KAJUR suffer from a lack of local qualified staff and have had to rely on expatriate assistance. KAJUR in particular has leaned heavily on the financial and technical resources of the US Army without adding to its own institutional resources.

Both utility companies should consider joining the Pacific Water Association and to employ technically educated Marshallese to work alongside expatriate staff to take advantage of this counterpart training opportunity, and also to participate in training courses offered by organisations such as SOPAC. The utility companies should also be supporting local initiatives to provide trade and technical training in the education system, and should consider 'twinning' with water and sanitation organisations in Hawaii or in the Federated States of Micronesia to expand their experiences of other systems which operate in a similar geographic and cultural environment.

ES 12 RECOMMENDED ACTIONS

Recommended actions are presented in three categories as follows:

A graphical presentation of these actions is given at the end of this section.

GA - Government Actions:

The recommended actions in this category include matters which may require legislation, or a particular emphasis in Government policy, either directly through its Ministries or through its appointees to the Boards of the individual utility companies.

The recommended actions are seen as a prerequisite to proposed Technical Assistance and Project Assistance recommendations to ensure that the political climate is supportive of the various elements required to be implemented for the sustainable development of the Water and Sanitation sectors.

It is therefore desirable that these recommendations be implemented or at least be under action prior to donors being sought to support Technical Assistance or Project Assistance actions.

TA - Technical Assistance:

Matters recommended in this category include research and pilot projects together with feasibility studies, any or all of which may lead to full scale project activity at a later date.

Technical assistance recommendations have been listed in order of assessed priority and of the fiscal year in which they might be implemented, having due regard for the urgency or otherwise of the action, and of the financial inputs which would be required to maintain the programme.

Wherever possible projects should include maximum opportunity for training and transfer of technology to RMI agencies.

PA - Project Assistance:

Items included in this category are those which can be clearly identified as infrastructure development within the Water and Sanitation sector.

As for Technical Assistance, items have been listed in order of assessed priority, but implementation times with one exception have been aligned with the 5-year planning periods of the RMI Government because of the generally larger inputs of capital which would be required. The exception is Project PA 1, Bulk Metering of Water Supply, which should receive immediate attention.

Wherever possible, projects should include maximum opportunity for training and transfer of technology.

GA 1 - Health Education

To instruct the Ministry of Health to ensure that its health education programme emphasises the importance of personal and family behaviour and hygiene in reducing the incidence of morbidity due to notifiable diseases, especially those which may be sanitation related such as gastrointestinal diseases, skin and eye diseases, typhoid and paratyphoid. Also to ensure that programme staff should themselves participate in regular staff training and education to maintain their technical skills at an acceptable level.

To instruct the RMIEPA to ensure that its Sanitarians (health inspectors) collaborate with the Ministry of Health in promoting the health education programme throughout the community. Also to ensure that these Sanitarians participate in the staff training and education programmes organised by the Ministry of Health.

Explanatory Text - Chapter 3, 3.4

Time For Action - Immediate.

GA 2 - Housing Act

To review and strengthen that part of the Housing Act that requires the construction of water catchments on all new buildings, and authorise the utility companies to refuse to supply services to premises which do not comply with the Act. (May require amendments to other legislation.)

Explanatory Text - Chapter 5

Time for Action - As soon as possible.

GA 3 - Water-Efficient Appliances

Through the water utility companies, to promote the use of water-efficient plumbing and sanitary fittings and initiate regulatory and/or legislative action to ban the importation of appliances and fittings which are not economical in terms of water use, and, in the case of sanitary fittings, appliances which are not satisfactory for use with saltwater.

Explanatory Text - Chapter 5, 5.3.2

Time For Action - As soon as possible.

GA 4 - Universal Metering

To support the installation of water meters on all consumer suppliers, already in progress by MWSC, but yet to be implemented by KAJUR.

Explanatory Text - Chapter 5, 5.3.2, & Chapter 10, 10.2.2

Time for Action - Immediate.

GA 5 - Tariffs for Potable Water Supply

To support the adoption of a system of progressive tariffs in accord with the principles set out in 10.2.1. The tariffs included in Table 10.2 are believed to present a reasonable basis on which to proceed for both MWSC and KAJUR.

To offset the effect of the costs of production of desalinated water, the Government and KAJUR should negotiate a unit rate subsidy, per 1000 gals. (3.78 m³) of production, to be met for the time being out of Compact funds.

Explanatory Text - Chapter 5, 5.3.2 & Chapter 10, 10.2.1, 10.2.2

Time For Action - Immediate

GA 6 - Tariffs for Sanitation Services

To support the adoption of a system of tariffs based on the actual number of toilet pans in customer's premises. The suggested level of tariff is \$3.00 per toilet pan per month, with a minimum charge of \$6.00 per month per premises.

Explanatory Text - Chapter 10, 10.2.2

Time For Action - Immediate

GA 7 - Government Accounts

To instruct the Ministry of Finance to provide a complete dissection of the make-up of all payments made for the provision of water, sanitation and electricity services to Government premises.

Explanatory Text - Chapter 10, 10.3

Time For Action - Immediate

GA 8 - Recovery of Bad Debts

To instruct the Attorney General to appoint two attorneys, one each to MWSC and KAJUR, for the express purpose of pursuing long-standing delinquent debtors. It is suggested that payments to these attorneys should be negotiated in terms of a fixed percentage of debts recovered.

Explanatory Text - Chapter 10, 10.2.2

Time For Action - Immediate

GA 9 - KAJUR Dependency

Although it is recognised KAJUR may not be able to provide utility services at affordable prices, nevertheless the Government should require KAJUR to increase its self-reliance and overall level of service. The Government for its part, should cease payments of lump sum subsidies and should negotiate future support on the basis of unit rate payments on the quantity of services actually supplied.

Explanatory Text Chapter 10, 10.2.3

Time For Action - Immediate

TA 1 - Building Code

Terms of Reference: To provide funding and support for a suitable person to produce a Building Code for the direction and regulation of all development and construction works within the RMI. (Note that the implementation of such a Code, as with any other regulatory action, necessarily requires that staff and facilities will be put in place to manage such implementation.)

Explanatory Text - Chapter 8, 8.3

Project Duration - 4 months

Personnel - Expatriate - 4 man months

Equipment - Nil

Office Support - By RMI Government

Local transport - Rental Vehicle

Estimated cost of assistance - \$100,000

Time for Action - Fiscal Year 1996/97

TA 2 - Municipal Landfill

Terms of Reference: To investigate and report on alternative future landfill sites on Majuro and Kwajalein Atolls having regard to environmental considerations and economic feasibility.

Explanatory Text - Chapter 7, 7.4

Project duration - 4 months

Personnel - Expatriate - 4 man months

- Local - 8 man months

Equipment - Nil

Office Support - By RMI Government

Local transport - Rental Vehicle

Estimated cost of assistance - \$120,000

Time For Action - Fiscal Year 1996/97

TA 3 - Laura Leases

Terms of Reference: To investigate the effects of land use on the quality of groundwater and to propose a culturally acceptable means of ensuring landowner cooperation in not compromising the groundwater resource. (It is believed that lease values do not reflect the actual value of the land in that payments are not related to the value of possible alternative uses of the land. Payments should also be related to actual water production and purity to persuade owners not to use the land for purposes incompatible with water production for community use.)

Explanatory Text - Chapter 4, 4.3

Project duration - 3 months

Personnel - Local expert - 3 man months

Equipment - Nil

Office support - By RMI Government

Local transport - Rental vehicle

Estimated cost of assistance - \$60,000

Time For Action - Fiscal Year 1996/97

TA 4 - Composting of Organic Wastes

Terms of Reference: In collaboration with the Agriculture Division of the Ministry of Research and Development to investigate the feasibility of municipal composting on Majuro by conducting a pilot project to include the provision of a suitable covered area, a public awareness survey, and manpower resources for the operation and management of the project.

Explanatory Text - Chapter 7, 7.3.7

Project duration - 12 months

Personnel - Expatriate - 12 man months

- Local - 24 man months

Equipment - 60' (18m) x 30' (9m) covered area

Tractor loader (small)

Office Support - By RMI Government

Local transport - Included in equipment above

Estimated cost of assistance - \$450,000

Time For Action - Fiscal year 1997/98

TA 5 - KAJUR Institutional Strengthening

Terms of Reference: To investigate and report on the need for organisational, operation and physical improvements to the water supply and sanitation systems on Ebeye Island, Kwajalein Atoll.

Explanatory Text - Chapter 11

Project duration - 3 months

Personnel - Expatriate - 6 man months

Local - 6 man months

Equipment - Nil

Office Support - By RMI Government

Local transport - Rental Vehicle

Estimated cost of assistance - \$180,000

Time For Action - Fiscal year 1997/98

TA 6 - Urban Sewage Collection & Disposal

Terms of Reference: To review the condition and performance of sewerage networks on Ebeye and Majuro, to investigate the installation of new sewerage reticulation in the additional area of Majuro to be supplied with seawater, to review the condition and performance of existing sewage outfalls including oceanographic studies, and to prepare a design report covering rehabilitation, reconstruction, new construction, and all such works required to provide effective and hygienic sanitation for the urban areas over a design period of, say 20 years, having due regard for likely population, economic, and environmental developments within such a period.

Explanatory Text - Chapter 6, 6.2.2, 6.2.3

	<u>Reticulation</u>	<u>Oceanography</u>
Project duration	6 months	2 x 3 months
Personnel - Expatriate	12 man months	18 man months
- Local	12 man months	12 man months
Equipment	P.C. Hardware	Dive gear etc by Contractor
Office support	by RMI Government	
Local transport - Purchase pickup	1	1
Estimated Cost of assistance	\$330,000	\$470,000
Time For Action	Fiscal year 1998/99	

TA 7 - Pit Latrines

Terms of Reference: To review available literature on pit latrines and to develop and conduct a pilot project to test the cultural, economic, and practical suitability of alternative designs, including composting latrines, in the Marshallese environment. Such a review will include wide community participation and education in all phases of the work including the potential for the pollution of groundwater resources, as well as the preparation of a promotional and funding option to support latrine construction throughout the islands.

Explanatory Text - Chapter 6, 6.3

Project duration - 6 months

Personnel - Expatriate - Sociologist/Educator - 6 man months
Sanitation expert - 4 man months

Local - 12 man months

Equipment - Building materials

Local transport - Rental Vehicle and interisland air transport

Office support - by RMI Government

Estimated cost of assistance - \$250,000

Time For Action - Fiscal year 1999/2000

TA 8 - Well Protection

Terms of Reference: Pilot project to demonstrate protection of groundwater wells with concrete aprons and the use of hand pumps to extract groundwater.

Explanatory Text - Chapter 4, 4.3

Project duration - 4 months

Personnel - Expatriate - 4 man months
Local - 8 man months

Equipment - Material for demonstration wells

Office support - By RMI Government

Local transport - Rental vehicle and interisland air transport

Estimated cost of assistance - \$140,000

Time For Action - Fiscal year 1999/2000

TA 9 - Rainwater Storage

Terms of Reference: Research project to test economic and technical feasibility of constructing household rainwater storage tanks out of unreinforced concrete, with or without a butynol liner.

Explanatory Text - Chapter 5, 5.1.3

Project duration - 2 months
Personnel - Expatriate - 2 man months
 Local - 4 man months
Equipment - Building materials
Office support - By RMI Government
Local transport - Rental Vehicle
Estimated cost of assistance - \$60,000

Time For Action - Fiscal Year 1999/2000

TA 10 - Laura Groundwater

Terms of Reference: Research project to assess the production capacity of the Laura groundwater lens by setting up a programme to monitor rainfall, evaporation, transpiration, draw-off, and profile of potable water, and expert analysis of these factors.

Explanatory Text - Chapter 5, 5.1.1

Project duration - 2 years, but monitoring to be continued by RMIEPA on a permanent basis.
Personnel - Expatriate - Set up - 1 man month
 Oversight - 1 man month
 Assessment - 2 man months
 Local (RMIEPA) - 48 man months
Equipment - Compact meteorological station
 Salinity recorder
Office support - By RMI Government
Local transport - Purchase pickup
Estimated cost of assistance - \$220,000

Time For Action - Fiscal Year 1999/2000

TA 11 - Uliga Rainwater Catchment System, Majuro

Terms of Reference: To investigate the Uliga rainwater catchment system and its associated water treatment plant to determine the feasibility of rehabilitating the system for the purposes of public water supply. To prepare a design report for rehabilitation works if such works are economically feasible.

Explanatory Text - Chapter 5, 5.1.1

Project duration - 3 months
 Personnel - Expatriate - 3 man months
 Equipment - Nil
 Office Support - By RMI Government
 Local transport - Rental vehicle
 Estimated cost of assistance - \$70,000

Time For Action - Fiscal Year 2000/2001

TA 12 - Artificial Catchments vs. Desalination

Terms of Reference: To investigate the relative feasibilities of artificial catchments, other than the roofs of buildings, and the desalination of seawater for the production of freshwater. Project to include the potential application of small scale desalination, possibly solar powered, as a source of emergency freshwater on the Outer Islands in drought conditions.

Explanatory Text - Chapters 4 & 5

Project duration - 3 months
 Personnel - Expatriate - 3 man months
 Local - 3 man months
 Equipment US Navy emergency stills x 5
 Office Support - By RMI Government
 Local transport - Rental vehicle
 Estimated cost of assistance - \$80,000

Time For Action - Fiscal Year 2000/2001

TA 13 - Groundwater Recharge

Terms of Reference: To conduct a research project to investigate the feasibility of utilising silt-free yard and roof water for groundwater recharge.

Explanatory Text - Chapter 8, 8.4

Project duration - 2 months

Personnel - Expatriate - 3 man months

Local - 3 man months

Equipment - Building materials for 4 wells

Office support - By RMI Government

Local transport - Rental Vehicle

Estimated cost of assistance - \$60,000

Time For Action - Fiscal Year 2000/2001

TA 14 - Review of Water Supply & Sanitation Sector

Terms of Reference: To conduct a review of progress and development within the water supply and sanitation sector over the two 5-year planning periods 1997/2001 and 2002/2006, and to bring forward recommendations for the further development of the sector up to Fiscal Year 2021.

Explanatory Text - None. Need for future review should be self evident.

Project duration - 4 months

Personnel - Expatriate - 4 man months

Local counterpart - 4 man months

Equipment - Nil

Office support - By RMI Government

Local transport - Rental vehicle & interisland air transport

Estimated cost of assistance - \$100,000

Time For Action - Fiscal Year 2007

PA 1 - Bulk Metering of Water Supply

Terms of Reference: To rehabilitate or replace existing bulk meters and to supply and install new meters as necessary in both freshwater and seawater systems at Majuro and Ebeye to provide accurate information on water production. Also, in the new ADB-sponsored Majuro freshwater transmission system, to relocate bulk meters from the cross connections into the new transmission main to minimise the effects of turbulent flow on meter accuracy.

Explanatory Text - Chapter 5, 5.5

Estimated Contract value - \$30,000

Time For Action - Immediate, possibly as an extension to the current ADB project on Majuro.

PA 2 - Consumer Water Metering

Terms of Reference: To supply and install water meters at all consumer premises connected to the public water supply systems of Majuro and Ebeye.

Explanatory Text - Chapter 5, 5.3.2

Estimated Contract value - \$500,000

Time For Action - 1997/2001 Planning period.

PA 3 - Garbage Collection Vehicles

Terms of Reference: To supply three custom-built, diesel powered, garbage collecting and compaction vehicles, two for Majuro and one for Ebeye. Vehicles shall be supplied with a range of consumable spare parts, and shall be of a make for which service and mechanical parts are readily available in the RMI.

Explanatory Text - Chapter 7, 7.2

Estimated Contract value - \$900,000

Time For Action - 1997/2001 Planning period.

PA 4 - Port & Septic Tank Servicing

Terms of Reference: To design and construct sewage holding tanks, each of some 5000 gals. (19 m³), at the port facilities of Majuro and Ebeye to receive sewage discharges from ships using the ports, and from other services at the ports which may be lower in elevation than the community sewerage reticulation. Also to supply 2 suction tankers, of not less than 2000 gals. (7.5 m³) liquid capacity and equipped with high displacement vacuum pumps to service the port holding tanks and other septic tanks. These diesel-engined vehicles shall be supplied with a range of spare parts, and shall be of a make for which service and mechanical parts are readily available in the RMI.
To design and construct two tanker-emptying stations, one each on Majuro and Ebeye, so that tankered waste can be discharged into an existing sanitary sewer in a hygienic and aesthetically acceptable manner.

Explanatory Text - Chapter 6, 6.2.4

Estimated Contract value - \$700,000

Time For Action - 1997/2001 Planning period.

PA 5 - Reservoir Pipework, Majuro

Terms of Reference: To design and construct new inlet pipework for raw and treated water reservoirs at Treatment Plant 'C', and to reconstruct existing inlet/outlet pipework to operate as outlet-only to supply the treatment plant. To separate treated water pumping pipework and relocate chlorination dosing points as necessary.

Explanatory Text - Chapter 5, 5.5

Estimated Contract value - \$350,000

Time For Action - 1997/2001 Planning period.

PA 6 - Leak Detection Surveys

Terms of Reference: To supply two complete sets of leak detection equipment, including listening and ultrasonic flow measurement devices, to be handed over to MWSC and KAJUR at the conclusion of the project, and to train utility staff in the operation of such equipment. To conduct leak detection surveys on both freshwater and seawater supply systems at Majuro and Ebeye. To provide all materials and repair identified faults and leaks and disconnect unauthorised connections, including consumer pumping connections.

Explanatory Text - Chapter 5, 5.4.1, 5.4.2

Estimated Contract value - \$900,000

Time For Action - 1997/2001 Planning period.

PA 7 - Urban Sewage Collection & Disposal

Terms of Reference: To design and construct all rehabilitation, new construction and outfall works identified in the review of urban facilities conducted under TA 6 of the Technical Assistance Programme.

Explanatory Text - Chapter 6, 6.2.2

Estimated Contract value - \$3,000,000

Time For Action - 2002/2006 Planning period

PA 8 - Roothing Rehabilitation

Terms of Reference: To reconstruction of some 16 miles (26 km) of urban roads, including arterial roads, to drain road margins and to provide controlled drainage outlets into the lagoon or the ocean.

Explanatory Text - Chapter 8, 8.2

Estimated Contract value - Majuro \$9,000,000/Ebeye \$4,000,000

Time For Action - 1997/2001 Planning period.

Note: Such a project on Majuro is already the subject of JICA interest.

PA 9 - Steel Scrap Collection & Disposal

Terms of Reference: To collect all existing scrap steel, including construction machinery and other derelict plant, to transport collected material to a suitable shallow site in the lagoon or the ocean, and to dump the material to form an artificial reef. The project would include the draining and flushing out of all fuels, lubricants, and other hydrocarbons from plant and machinery prior to placement in the sea.

Explanatory Text - Chapter 7, 7.3.2

Estimated Contract value - \$500,000

Time For Action - 2002/2006 Planning period.

PA 10 - Water Supply, Ebeye

Terms of Reference:

To the turn-key construction of a new stand-alone desalination plant with a production capacity of some 500,000 gpd (1,900 m³/d) to completely replace the existing facility.

The plant shall be supplied complete with its own electricity generating equipment, and a minimum 1-year's supply of treatment chemicals and normal spare parts.

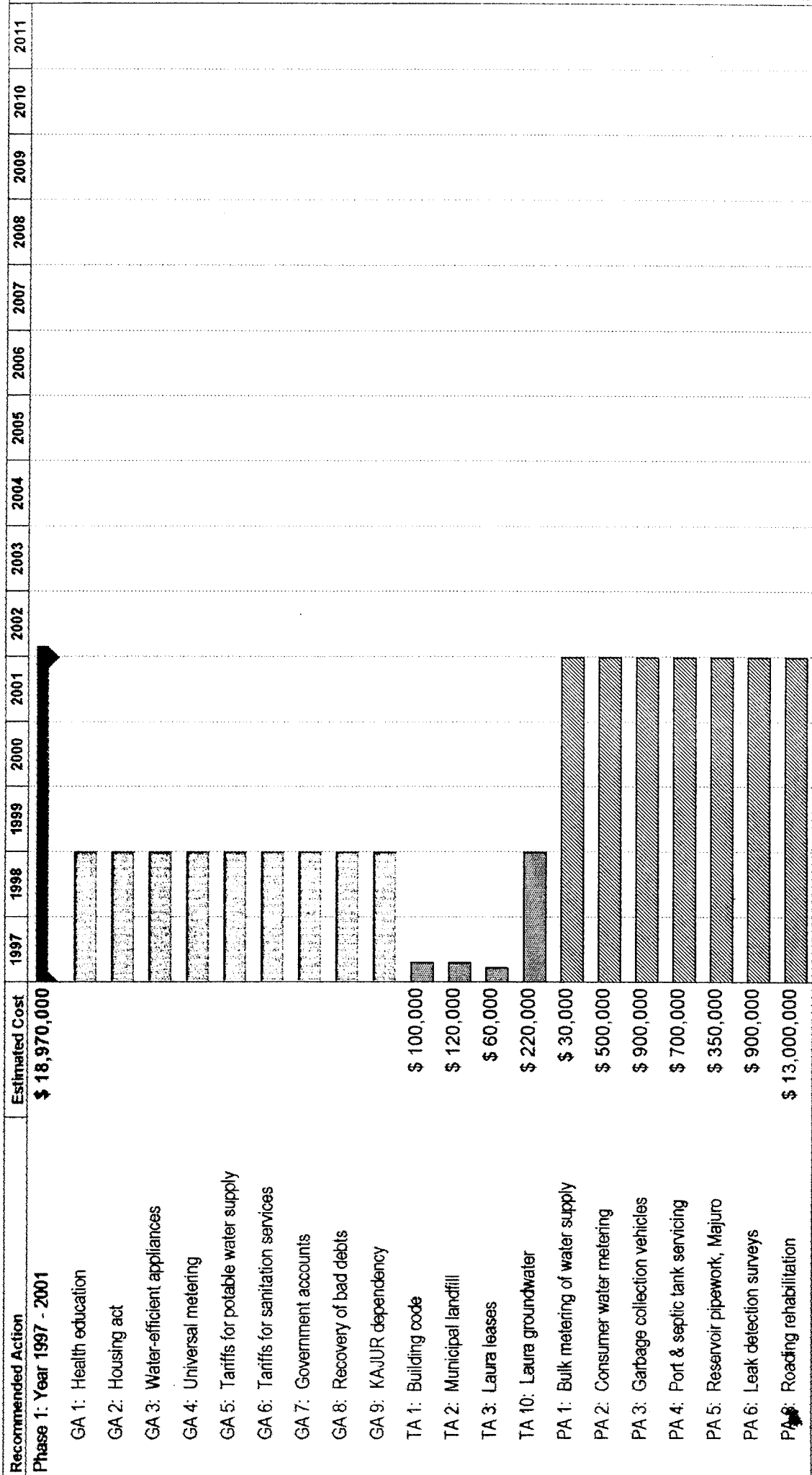
The contract shall include not less than 3 months production supervision and training of KAJUR staff in the operation of the plant.

Explanatory Text - Chapter 5, 5.2.2

Estimated Contract value - \$4,000,000

Time For Action - 2007/2011 Planning period

Recommended Actions, Time Schedule and Estimated Costs



Action Plan The Republic of Marshall Islands SOPAC Water and Sanitation	Government Action Technical Assistance	Project Assistance Summary
---	---	-------------------------------

Chapter 1

INTRODUCTION

1.0 INTRODUCTION

1.1 Preamble

This report comprises Phase 4, Action Plan, of a National Water Policy and Strategy Statement, a study aimed at the development and formulation of a water and sanitation sector strategy and action plan (SSAP) for the Republic of the Marshall Islands.

Phases 1 and 2 of the study, relating to the identification of the present situation and to the sector issues are contained in a Draft Position Statement published in June 1994. Phase 3 of the study, relating to the preparation of a draft strategy and the prioritisation of activities and projects are contained in a National Water Policy And Strategy Statement published in September 1994, and an associated Addendum, Assessment of Priorities, published in October, 1994.

Phases 1, 2 & 3 reports were prepared under the auspices of the UNDP Water Supply and Sanitation Programme. Phase 4 has been conducted under the auspices of the South Pacific Applied Geoscience Commission (SOPAC), UNDP funded Pacific Water and Sanitation Programme.

To provide a complete background, the 1994 reports should be read in conjunction with this Phase 4 report, but where necessary, particular information will be repeated here to provide a 'stand-alone' document.

All activities in the Republic of the Marshall Islands have been supported by the RMI Environmental Protection Agency (RMIEPA) as the lead agency for the RMI Government.

1.2 Terms of Reference

The Terms of Reference for this Phase 4 report are as follows:

Using the existing RMI National Water Policy and Strategy Statement (September 1994) and its addendum, Assessment of Priorities (October 1994) the consultant shall verify in the field the content of documents and prepare an Action Plan based on current information and circumstances.

The Action Plan implements the strategy developed for the water and sanitation sector of RMI. The Action Plan shall be nationwide including all sector requirements, studies, actions, works activities, institutional strengthening, legislative requirements, financial management, demand management, training requirements, critical constraints, evaluations and these shall be designated as projects.

The Action Plan shall address the needs for a 20 year period but compile them into actions that are necessary in a 5 to 10 year implementation period.

All existing and/or proposed projects identified in the field during this consultancy and those identified in the National Water Policy and Strategy documentation shall be included in the Action Plan.

The Action Plan shall be prioritised and costed in a user friendly manner so that the document may be used to seek donor funding for various projects detailed in the Plan.

1.3

Country Background

The Republic of the Marshall Islands (RMI) is comprised of 29 atolls and 5 low elevation islands located in the northern part of the Pacific Ocean some 2,200 miles (3500 km.) west of Hawaii and some 1,600 miles (2600 km.) east of Guam. The atolls of the Republic form an archipelago which extends from 4° to 19° North Latitude and from 160° to 175° East Longitude.

The Republic has a total land area of only some 70 square miles (180 sq.km.), and a mean height above sea level of about 7 feet (2.1 m). On the other hand, the Republic's marine resource is large, with combined lagoon areas totalling over 4000 square miles (10,400 sq.km.), and with an Exclusive Economic Zone including some 750,000 square miles (1.94 million sq.km.) of the Pacific Ocean.

The population of the Republic in 1994 was estimated to be some 50,000 persons, so by now, allowing for a known high growth rate in excess of 4%, the population could be closer to 55,000 persons. Some 45% of the total live on Majuro Atoll, site of the capital and principal town of the RMI, 22% live on Ebeye in the Kwajalein Atoll, and the 33% balance on the other islands and atolls. Of the 27 other atolls, 9 are uninhabited and the other 18 have populations ranging from about 100 to 1800 persons. Of the 5 islands, 2 are uninhabited and the others range from 100 to 600 persons.

The climate of the Republic has a fairly uniform temperature less than 2° from a mean of 81° Fahrenheit. Rainfall however, varies considerably with annual means ranging from some 160 inches (4,000 mm) on Jaluit Atoll in the south

down to about 60 inches (1,500 mm) on Eniwetak Atoll in the north west. Periods of drought are common, and those of 1970, 1983, and 1992 were particularly severe, resulting in drastic water rationing.

The wind regime is characterised from the end of December until the end of April by the northeast trade winds which blow quite strongly with an average speed of some 13 miles per hour (21 km/h.). For the rest of the year winds are mainly light and variable, although tropical storms occur during this period. Major storms such as typhoons do not often affect the Marshall Islands, but when they do they can cause considerable damage, especially due to storm surge causing flooding and salination of groundwater at a time when wind damage to roofs and rainwater catchments may render those unusable.

1.4 Documents Used For Reference

The principal reference documents used in the preparation of this Report are listed as follows:

- RMI National Environmental Management Strategy, Parts A & B; South Pacific Regional Environmental Programme, 1993.
- RMI Rural and Urban Water and Sanitation Review; Draft Position Statement; UNDP Water Supply and Sanitation Programme, June 1994.
- Pacific Water Sector Planning, Research and Training; Proceedings of UNESCO/SOPAC/UNDDSMS Workshop; UNESCO, June 1994.
- Review of Human Settlements in Pacific Atoll Nations, Republic of the Marshall Islands/Republics of Kiribati and Tuvalu; UN Centre for Human Settlements (Habitat), October 1994.
- RMI Water & Sanitation Sector Strategy and Action Plan; National Water Policy And Strategy Statement; UNDP Department of Development Support And Management Services, September 1994.
- RMI Water & Sanitation Sector Strategy and Action Plan; National Water Policy And Strategy Statement, Addendum - Assessment of Priorities; UNDP.DDSMS, October 1994.
- Institutional Strengthening Of The Majuro Water and Sewer Company, Republic of the Marshall Islands; Final Project Report; Asian Development Bank Technical Assistance Project No. 1946-RMI; May 1995.
- Majuro Water Supply And Sanitation Project, Tender Documents; RMI Ministry of Public Works, September 1995.

- RMI Regulations, Various; RMI Environmental Protection Agency.
- Marshall Islands Vital And Health Statistics Abstract 1989-1993; Bureau of Health Planning and Statistics Ministry of Health and Environment.
- Report On The Republic of The Marshall Islands Fertility and Family Planning Survey, November - December 1994: Ministry of Health and Environment.
- Marshall Islands Statistical Abstract, 1993 and 1994: Office of Planning and Statistics.
- Marshall Islands Statistical Abstract, 1995: Office of Planning and Statistics.
- Report on the Proceedings of National Seminar on Population and Development, Majuro, July 10-12, 1995: Office of Planning and Statistics.
- Population and Development Policy: RMI National Population Council, November 1995.
- Bill No 23 N.D.2, An Act to amend Public Law 1995-126, the Appropriations Act, as an Interim Budget Bill: Nitijela of the Marshall Islands, March 1996.

Chapter 2

POPULATION

2.0 POPULATION

2.1 Population Growth

According to the 1988 Census of Population and Housing, the national population was 43,380, an increase of just over 40% in the 8-year period following the 1980 census, or an equivalent annual growth rate of some 4.2%.

In recognition of the difficulties associated with maintaining long-term sustainable development in the face of such a high growth rate, the Government has sought to implement policies to reduce the rate of population increase.

One of these policies has placed strong emphasis on the Family Planning Programme operated through the Ministry of Health Services. Although it is widely acknowledged that there are shortcomings in the national system of registering births and deaths, there are indications that the crude birth rate has declined from 34.55/1000 in 1989 to 23.93/1000 in 1993. The crude death rate remained nearly constant over the same period.

The general decline in fertility was confirmed in the 1994 Fertility and Family Planning Survey when it was found that 37% of females were managing their fertility by use of family planning methods promoted by the Ministry of Health Services, and that perceptions of the ideal family size for both males and females included only from two to four children.

Although the Family Planning Programme is having a positive impact on population growth, it is accepted that a continuing effort is needed to ensure that all Marshallese citizens are correctly informed about family planning and have the means to manage the number and spacing of children in achieving their ideal family size.

Overall it is estimated that the population growth rate has fallen from 4.2% in 1988 to about 3.6% at the end of 1994, and there is an expectation that this rate will reduce further to about 3.2% at Year 2000 and to 2.8% by Year 2005. Extrapolating these targets, and excluding any allowance for external emigration, it is possible that an annual growth rate of about 2.3% might be achieved by Year 2115.

Table 2.1 below is based on these population growth rate assumptions, starting from a 1995 population of 55,575 which is consistent with a 3.6% annual growth rate from the 1988 Census value of 43,380, and with the assumptions included in the RMI Population and Development Policy, 1995. The Medium and Low growth predictions from this latter report are also included in the table.

Table 2.1

Population Projections

<u>Year</u>	<u>Population</u>		
	<u>This Report</u>	<u>Policy-Medium</u>	<u>Policy - Low</u>
1995	55,575	55,575	55,575
2000	65,560	64,981	64,551
2005	75,855	76,189	74,532
2010	86,450	<u>89,323</u>	<u>85,500</u>
2015	97,340	(Table ends at 2010)	
2020	109,000		

2.2 Migration to Urban Centres

Of the total population it is estimated that some 45% reside on Majuro, some 22% on Kwajalein (Ebeye), and the balance 33% on the Outer Islands.

To mitigate the effects of in-migration to the urban areas the Government, in its Second Five Year Development Plan, 1992-96, emphasised the need for outer island development projects aimed at increasing economic and employment opportunities and at improving access to educational, health, and social amenities. A key objective stressed was for the establishment of an efficient transportation and communication infrastructure to link local, regional, and international markets.

However, of the \$55 million programmed to be allocated to such development, indications are that actual expenditures were considerably below the programmed level. In the current Budget, for instance, identifiable allocations include \$819,071 in the Health Services sector for dispensaries, \$300,098 under Resources and Development, \$99,840 under Finance for the Outer Islands Development Authority, and \$600,000 as a Special Appropriation for Copra Subsidy, a total of some \$1.82 million for the year. Part of the \$1.4 million set aside as a Special Appropriation for loan guarantees and subsidy to Air Marshall Islands could also be directed to Outer Island air services. There is no indication in the Budget as to how much of the \$13,434,900 of Compact Capital Account funds appropriated to the Marshall Islands Development Authority are to be directed to the Outer Islands, but physical indications do not reveal heavy spending in this sector.

Taken together, the indicators suggest that Outer Island development is not receiving the level of support required to stop or reverse in-migration to the urban areas, so that urban infrastructure can be expected to be put under increasing population-generated pressure for the foreseeable future.

Chapter 3

PUBLIC HEALTH

3 PUBLIC HEALTH

3.1 Introduction

Base data for this chapter has been taken from the Marshall Islands Vital And Health Statistics Abstract, 1989-1993, published by the Bureau of Health Planning and Statistics, Ministry of Health and Environment, and from the Marshall Islands Statistical Abstract(s) 1993 and 1994, (1 volume), and 1995. There are acknowledged shortcomings of long standing in the registrations of births and deaths, so that vital statistics tend to be indicative rather than definitive, revealing trends and patterns rather than absolute data. Health statistics are compiled from returns from Majuro and Ebeye hospitals and from outer islands health service centres.

3.2 Morbidity Statistics

3.2.1 Gastrointestinal Diseases

The generally accepted epidemiological scenario in a developing country is one typified by a high proportion of diseases which are vaccine preventable or which could be sanitation related.

The unusual feature revealed over the period 1989-93 by the statistics is, however, that Majuro, the centre with the most abundant supply of treated water, has the highest average incidence of gastrointestinal diseases in the RMI, some 116.8 episodes/1000 persons, and the lowest incidence of respiratory diseases mainly influenza, of 27.20/1000. Annual incidences of gastrointestinal diseases ranged from a high of 142.4/1000 in 1993 to a low of 85.55/1000 in 1990.

On Ebeye, with limited quantities of desalinated water, and a very high population density, (40,000 sq. mile), gastrointestinal disease averaged 99.5/1000 in 1991 to a low of 71.7/1000 in 1993. Respiratory diseases, possibly aggravated by the crowded living conditions, averaged 65.4/1000, about 2.4 times the rate on Majuro.

In the outer islands, without formal water supply systems, and where the disease profile typical of a developing country would be expected to be found, the rate of gastrointestinal disease is in fact, much lower than in the urban areas, averaging 30.5/1000 over the 5 year period, from a high of 57.6/1000 in 1993 to a low of 10.6/1000 in 1989. On the other hand, respiratory diseases are the most common, averaging 35.9/1000 over the 5 year period, about half of the Ebeye rate, but some 1.3 times higher than on Majuro.

The statistics for gastrointestinal diseases certainly suggest that these health problems are not related to the actual supply of water, but rather to the use, or non-use of water for personal hygiene. If it is true that the main causes of morbidity are behavioural in character, the emphasis on health education will

have to be considerably increased to have any impact on the high incidence of disease.

3.2.2 Skin And Eye Diseases

Although not included in health statistics as sanitation related, there are two diseases listed as infections which are commonly associated with polluted surface water, for example, pools of stormwater which accumulate in poorly drained situations. These two, scabies and bacterial conjunctivitis (red eye), can be spread by direct contact or through water and are most commonly found amongst young children who enjoy playing in pools of water. Note, however, that the skin-burrowing mite which causes scabies usually has a primary association with domestic pets, especially dogs, so that direct transfer of the mite from animal to human is common. Also note that conjunctivitis can be easily spread through a family when infected and non-infected members share wash cloths and towels.

Average incidence rates for these diseases are fairly constant throughout the Marshalls with scabies in the 15 to 20/1000 range and conjunctivitis a little higher in the 17 to 22/1000 range. As with gastroenteric diseases, public health education may have the most impact on the incidence of these diseases.

3.2.3 Typhoid And Paratyphoid

These diseases can also be associated with sanitation, but the statistics indicate a constant low level of infection confined entirely to the urban areas. It is reasonable from the figures to assume that there are a small number of carriers of these diseases in each community and that transfer is occurring through poor hygiene practices rather than through polluted water.

However, these unidentified carriers do carry the threat of infecting large numbers of people, so the communicable disease section of the Ministry of Health should be searching out these carriers as a primary target.

3.3 Mortality Statistics

As with morbidity statistics, the mortality figures display unusual trends for a developing country, where infants (less than 1 year old) and young children (1 to 5 years) are usually the most vulnerable to sanitation-related diseases.

Taking 1993 statistics for example, of 33 infant deaths, or some 15.61/1000 live births, 21 of these deaths occurred less than one month after birth and none were sanitation related. There were 2 deaths from severe hydration secondary to diarrhoea which could be related to sanitation or poor hygiene or both.

Amongst young children, none of the 7 deaths was due to a sanitation related disease.

3.4 Health Conclusions

Available statistics do not indicate that there are substantial health problems within the community as a result of poor sanitation or of the quality of water supplies. A close association can however be developed to lack of hygiene on both a personal and a community basis, and this lack must be addressed by the Ministry of Health in its public education and awareness programmes.

Sanitarians (Health Inspectors) employed through the RMIEPA must also be included in such programmes to take advantage of their frequent contacts in food-handling and similar premises.

3.5 Recommended Actions

3.5.1 Government Actions

- Health Education

To support and encourage the Ministry of Health to ensure that its health education programme emphasises the importance of personal and family behaviour and hygiene in reducing the incidence of morbidity due to notifiable diseases, especially those which may be sanitation related such as gastrointestinal disease, skin and eye diseases, typhoid and paratyphoid. Also to instruct the Sanitarians of the RMIEPA to collaborate with the Ministry of Health in promoting the health education programme throughout the community.

It is emphasised that programme staff should themselves participate in regular staff training and education to maintain their technical skills at an acceptable level.

Chapter 4

WATER RESOURCES

4.0 WATER RESOURCES

4.1 Introduction

As in all hydrological systems, the primary source of freshwater is rain, but since low-lying atolls have no uplands where water may be retained in the plants, soils and rocks and released only slowly into the environment, the rainwater that soaks into the soil may immediately disperse into the saltwater which inevitably permeates atoll subsoils, or if conditions are favourable, may accumulate in a lens which virtually floats on the saltwater below, separated from it by a thin brackish layer.

4.2 Rainwater Harvesting

Rainwater collection systems are widely used in most water-short countries for domestic, commercial and municipal use and, in the Marshall Islands, examples of such systems can be found, the largest utilising some 3.2 million sq.ft. (30 ha.) of the paved area of the Majuro International Airport. Note that there are several conflicting figures in use as to the actual area of airport collection surface. The 3.2 million sq.ft. (30 ha.) assumed here is consistent with a total annual capture of some 210 million gallons (794,000 m³) a mean annual rainfall of 133 inches (3380 mm.) and at a loss of 20% due to evaporation.

Overall, however, the rainwater resource is not well exploited in the Republic and although Government spokesmen espouse a policy of encouraging the installation of roof catchment and storage systems, few practical steps appear to have been taken to implement this policy. An exception was an initiative promoted by the Marshall Islands Development Bank (MIDB) for the provision of low interest loans to low income families for the construction or repair of residential sanitary water and waste disposal systems, together with the plumbing and gutters and downpipes for roofwater catchments. A pilot scheme, the Housing Preservation Grant Revolving Loan Programme, provided finance direct to families for them to arrange and pay for the work, but when it was found that the finance was being diverted in many cases into household extensions and the like, the scheme was restructured in late 1994 to focus more closely on the original goals. Since then some \$200,000 has been made available to 225 applicants, mostly from the Outer Islands, with MIDB paying suppliers and builders directly for materials, labour and transportation in order to minimise the opportunities for the misdirection of funds.

Nevertheless there is a decided lack of effort to increase public awareness of the need, in all parts of the Republic, to make maximum use of the rainwater resource, nor does there appear to be any willingness to enforce existing legislation to ensure that every new building is provided with rainwater collection and storage facilities.

4.3

Groundwater

Groundwater lenses can be expected to be found on most atoll islands, but if the land area is small, only brackish water may accumulate. The larger the land area, the more chance there will be that a freshwater lens will form, so that, for instance, on an island 300 yards (275m) in width there would be a strong possibility of finding freshwater at the centre of the lens.

Note again that the existence of a freshwater lens is dependent upon rainfall, as is the quantity of water which can be taken from the lens - it is not an inexhaustible supply. It is also essential to remember that groundwater is easily polluted by almost any substance placed in or on the ground. Such substances include agricultural chemicals, animal wastes and human wastes from privies, septic tank effluent, and the like.

In a large groundwater system, such as the Laura lens, water can be collected through infiltration galleries laid to central pumping wells. However, a wellfield can extend across several traditional land ownerships for which separate leases are required, and, even though lease documents may state that certain land uses may not be permitted, such clauses are largely ignored by the landowners on cultural grounds. It may be that lease payments do not truly reflect the value of the land for alternative uses, and if they did, that the landowners might be more amenable to adhering to lease conditions.

In Outer Atoll situations where there is no community water supply system, dug wells would be required to gain access to the water. Such wells should be constructed with a free-draining concrete apron to prevent contaminated water from flowing directly into the well, and preferably with a handpump to draw water from the well. If a bucket or dipper is used to draw water, it should be used only to fill other containers and then stored inside the well to minimise contamination.

4.4

Seawater

Since no part of the Marshall Islands is more than a few hundred yards from the sea, seawater provides a virtually limitless resource for either direct substitution of freshwater for certain uses, or as the base fluid for the production of freshwater by desalination.

In the urban areas of both Majuro and Kwajalein seawater is being used in the sewerage system to flush toilets, but the benefit of any reduction in freshwater demand is partly offset by the need to have separate supply systems for potable water and sanitation water.

Desalination processes for the production of freshwater from seawater range from distillation/condensation methods to reverse osmosis systems. Existing installations in the Marshalls include a distillation plant on Ebeye Island, Kwajalein, initially rated at 350,000 gpd. (1,300 m³), but now down to less than 120,000 gpd (450 m³) due to lack of tube descaling and general maintenance, a new low-pressure/low temperature 26,000 gpd (100 m³) distillation unit at the Majuro Hospital and yet to be commissioned, and two smaller units operated by companies producing bottled drinking water. Water production costs at the Ebeye plant are estimated to be between \$8 and \$10 per 1000 gallons (\$2.10 to \$2.65/m³), at the Hospital plant about \$5.50 per 1000 gallons (\$3.20/m³) for electricity alone and probably over \$12 per 1000 gallons (\$3.20/m³) when wages, chemicals and loan repayments are included. Production costs at the drinking water plants are unavailable.

Conventional wisdom suggests that, except for emergency survival conditions, desalination should not be considered for water supply purposes until all other possible sources have been fully committed. For survival conditions, small portable solar stills were developed in World War II, and produced about one third of a gallon (1.3 l) of drinking water per day from a unit which cost little to make and nothing to operate. A reverse osmosis unit powered by solar electricity and capable of producing about 100 gpd (0.4 m³/d) of clean water could cost, including solar panels up to \$15,000, with operating costs of about \$1200 per year, mostly for the replacement of rechargeable heavy-duty automotive-type batteries every second or third year.

For a saltwater fed reverse osmosis plant with a capacity of 80,000 gpd (300 m³/d), the installed capital cost could be expected to be of the order of \$400,000 to \$500,000, and the total cost of production about \$12 per 1000 gal (\$3.20/m³). A distillation plant of similar capacity could be about twice the capital cost noted above, although production costs could be of the same order.

Nevertheless, the production of freshwater by desalination is well established, and the process continues to be the subject of vigorous research. The resource is limitless, so the time may yet come when the economic constraint on the use of desalinated water may reduce to a level that makes it an acceptable alternative to naturally occurring freshwater.

Chapter 5

WATER SUPPLY

5. WATER SUPPLY

5.1 Freshwater Supply

5.1.1 Majuro Atoll

From an estimated total annual capture at the airport of 210 million gallons (794,000 m³) the average daily quantity would be some 575,000 gals. (2175 m³). Adding to this the estimated daily production from the Laura lens of 400,000 gals. (1510 m³), the average daily quantity available for distribution to the community is therefore slightly less than 1 million gals. (3,700 m³).

A small system, serviced by Treatment Plant A, at Delap, is dedicated to the supply of freshwater to the Hospital and the Capitol building, and can produce about 50,000//gpd (190 m³/pd) from roofwater collected from those buildings, and supplemented with groundwater. Another small system, serviced by Treatment Plant B, collected roofwater from schools and government buildings at Uliga, but the system has largely fallen into disrepair and is no longer functional. The Delap system is included in the current ADB project for rehabilitation, but the Uliga system has been ignored.

Since the production from the Laura lens is believed to be close to its optimum extraction rate, the only means of increasing the quantity of naturally occurring freshwater to the community system would be by increasing the area of artificial surface available for rainwater harvesting. In this regard it can be noted that a proposed 15 acre (6 hectare) addition to the airport catchment has been deleted from the ADB funded 'Majuro Water Supply and Sanitation Project' for which contract works are expected to commence before the end of 1996. The proposed addition would have increased the available catchment area by about 20% and lifted average daily production by some 115,000 gals. (435 m³). to a total of 1,090,000 gals.(4120 m³).

The reasons behind this deletion of this item, which was specifically mentioned in the Terms of Reference for the ADB Technical Assistance Project No. 1946 RMI, are not discussed in the Project Report, but it must be presumed that the omission had the approval of ADB. One possible explanation could be that the estimated capital cost of such an artificial catchment was too high to justify construction. An estimate prepared for this Action Plan suggests that a desalination plant of similar capacity would require less than 20% of the capital input required for an artificial catchment, and that total production costs, including loan repayments, would also be less. Nevertheless, it is desirable that ADB be asked to supply an official statement as to why the artificial catchment proposal was deleted from the Project.

Also, the situation suggests that a detailed examination of the relative economic feasibilities of freshwater production from artificial catchments and desalination is warranted under technical assistance.

For domestic supplies some 71% of households rely entirely on the community water supply system, some 27% on rainwater catchments (most without sufficient storage) supplemented by community water, and the balance 2% on groundwater wells.

5.1.2 Ebeye Island, Kwajalein Atoll

The community water supply system on Ebeye utilises water from a desalination plant which has been producing only about 118,000/gpd, but which it is hoped can be increased to some 300,000/gpd when maintenance works are carried out.

For domestic purposes about 93% of households rely on the community supply, and 7% on rainwater catchment supplemented from the community system. Again, rainwater storage facilities are not of sufficient volume to support a household over more than a few days.

5.1.3 Outer Islands

Except for Jaluit, where a small freshwater distribution system has occasionally provided water to the high school and to student teacher housing, water requirements must be met by individual households. The preferred source of water is rainwater collected from roofs of buildings and some 76% of households rely on this source, supplemented when necessary by groundwater in times of drought. The balance 24% of households rely on groundwater wells all the time.

The distribution of rainwater catchments throughout the Outer Islands is, however, not uniform due to certain islands such as Maloelap, Arno, and Ailinglaplap having been favoured by UNDP and USEPA projects in the late 1980's.

Overall, there are still many public buildings, churches, and the like from which rainwater is not being harvested, and, considering that the World War II Japanese Army garrison on Mili numbered in excess of 5,000 men, and was almost entirely supported by rainwater harvesting, it is clear that the rainwater resource is considerably under-exploited.

Regarding the construction of rainwater storage tanks in the Outer Islands, it has to be noted that transportation of materials adds considerable cost to tank construction. Also since local aggregates and sand are impregnated with salt, expensive additives have to be used for the production of good quality concrete and cement plaster, and even then the product is aggressive to steel reinforcing materials.

Ready-made tanks of high density polyethylene (hdpe) are available on Majuro at \$2000 for 1500 gal.(5.7 m³) capacity, and timber tanks of the same capacity with a butynol or hdpe liner retail for \$2200. Fibreglass tanks of 660 gal. (2.5 m³) capacity could be made available in Majuro for about \$900. These costs are all of the order of \$1.30 to \$1.50 per gal. (35c to 40c per litre) stored, without allowing for transportation costs.

Ferrocement tanks, built on site, should be able to be manufactured for less than half the cost of ready made tanks but expert tankmakers are required, and the potential corrosion problem would have to be addressed. It is of interest to note that storage tanks built by the Japanese in World War II were of unreinforced concrete and some of those which were not damaged by US bombardment appear to be still in useable condition.

It therefore seems reasonable to conduct a pilot/research project on the feasibility of building unreinforced tanks with or without a butynol liner, in an effort to develop a water storage system which is affordable to those people living a subsistence lifestyle. If the research project is successful, it should be followed up with active promotion of tank construction.

5.2 Saltwater Supply

5.2.1 Majuro

The seawater supply system for flushing toilets and firefighting currently has a production capacity of some 1 million /gpd and services about 900 connections. Production capacity is to be expanded in the 'Majuro Water Supply and Sanitation Project', and the service area is to be extended to cover all of the urban area from the airport to Rita. Improvements and additions to the saltwater pumping system should increase production capacity to about 2 million /gpd.

5.2.2 Ebeye Island, Kwajalein

This seawater supply system, also for flushing toilets and firefighting has a production capacity of some 300,000 /gpd and services some 850 connections. Average daily production is about 220,000 gals.

Maintenance costs on this plant can be expected to rise as the plant gets older, and complete replacement could be required by about Year 2010. An increase in production capacity could also be required by that time.

5.2.3 Outer Islands

There are no formal seawater supply systems in the Outer Islands.

5.3 Water Demand

5.3.1 General

Unrestricted demand levels on Majuro are estimated at 45 gals. (170 litres) per person day (gppd) of freshwater plus 30/gppd (113/lppd) of seawater making 75/gppd (280/lppd) in total. On Ebeye, the capacity of the desalination plant limits freshwater demand to about 20/gppd (76/lppd), and with saltwater demand also estimated to be about 20/gppd(76/lppd), the total of 40/gppd (152/lppd) is just over half of the Majuro figure. There are no official data on Outer Island water consumption.

Considering basic water requirements, 10/gppd (38/lppd) of freshwater should be a reasonable target figure to provide for drinking, cooking, laundry, and ablutions. Water for toilet flushing, should not exceed 20/gppd (76/lppd). The total of 30/ gppd (114/lppd) may be compared with current European targets of 32/gppd (120/lppd) for households without automatic washing machines or dishwashers.

Relating these basic requirements to the quantities of freshwater currently available, the 1,000,000/gpd (3,700 m³) on Majuro could support the population of 50,000 persons estimated to be reached by Year 2020. The 118,000/gpd (446 m³/pd) available on Ebeye is only about half of the optimum for the estimated population of 12,000 persons, but the projected 300,000/gpd (1130 m³/pd) from the rehabilitated desalination plant should support 15,000 persons, estimated to be reached by Year 2002.

5.3.2 Demand Management

It has to be understood that the natural freshwater resources of the RMI are severely limited, and, given these limitations, and in the face of an increasing population, actions to promote economy of water use will need to be made on a broad front which should include the following:

- education to increase public awareness of the need to economise on water use, and to promote the use of water-efficient plumbing and sanitary fittings.

- promotion of rainwater collection and storage from all buildings throughout the RMI.

- universal metering of all premises receiving potable water from a public water supply system.

-reduction of unaccounted for water through a comprehensive leak detection survey and system rehabilitation. (See 5.4.1 below).

-adjustment of tariffs for water supply to reflect the actual cost of the utility, to recognise the efforts of those consumers who do use rainwater harvesting and so reduce system demand, and to progressively penalise extravagant water use. (This will be considered further in Section 10, Finance).

-Under extreme conditions, the utility companies may have to adopt policies and refuse to supply water to potentially high demand users such as hotels and fish processing premises, and to leave them to develop their own supply systems.

5.4 Unaccounted for Water in Urban Systems

5.4.1 Freshwater

There is a general perception that much of the apparent high individual use of water is due to over-estimations of water production and from leaks in the reticulation pipework. However, until reliable bulk metering of the supply is installed, and all consumer connections are metered, it will be difficult to conduct a comprehensive leak detection survey.

Further, until the reticulation system can be operated so as to ensure that pipelines remain full of water, meter readings, especially of propeller-driven meters, could be grossly unreliable. In this regard it is important to ensure that consumers who are pumping water directly from the water mains should be identified during meter installation and made to stop this practice which can drain the mains and encourage the infiltration of groundwater.

Where a leak detection survey does identify faults, leaks, or unauthorised connections, the system should be rehabilitated as necessary to eliminate such deficiencies.

5.4.2 Seawater

As with the freshwater system, there are believed to be substantial losses in the seawater reticulation system. This system should have bulk meters installed at the seawater pumping stations, but individual consumer metering is considered impracticable due to potential corrosion problems and possible confusion between freshwater and saltwater meters at the consumer's premises.

As with the freshwater system, the saltwater system should be subjected to a leak detection survey, but, in the absence of consumer metering, this survey should include an inspection of sanitary appliances to detect those fittings which require repair or replacement. In the event of non-compliance by the

consumer, the supply to the premises could be disconnected as for non-payment of rates.

Deficiencies identified in the leak detection survey should be repaired or rehabilitated as necessary.

5.5 Majuro Water Supply and Sanitation Project

This ADB-funded project is considered here because it incorporates certain works which would otherwise be included in actions still to be implemented for improvements on Majuro Atoll.

Such incorporated works include the following:

- Laura groundwater: upgrading of the pumping facility and provision for chlorination.

- Treatment Plant 'C' at Airport: Upgrading of treatment plant including increase of filter capacity, revised chlorination arrangements, increase in storage volume of existing raw and fresh water reservoirs and construction of one additional raw water reservoir, and construction of a storage building for chemicals and fittings.

- Treatment Plant 'A' near Hospital: Upgrading of plant including provision of new sand filter, raw water pumps and chlorination facility.

- Freshwater Reticulation: Construction of a new transmission pipeline parallel to the existing transmission pipeline from Treatment Plant 'C' for some 45,500 feet, (13.9 km) to Rita at the eastern end of the island. The two mains will be cross-connected at five locations to provide an equitable distribution of water to consumers. Bulk meters are to be provided at each cross-connection.

- Seawater Supply System: Upgrading of seawater pumping facilities, including the construction of two new pumping stations. Extend transmission pipeline by 27,400 feet (8.4 km) to the airport, construct 13,500 feet (4.1 km) of distribution pipelines, and 20,600 feet (6.3 km) of consumer service connections.

- Sewerage System Rehabilitation: Upgrade four sewage pumping stations including new pumps, valves, and electrics, together with new buildings.

Regarding the freshwater reticulation and provisions for bulk metering, it should be noted that there is no provision for the separate metering of the existing and new distribution mains at the Treatment Plant 'C', and that the placing of meters in the actual cross-connections between the mains is contrary to recommended meter installation practice. For accurate measurement a meter should be placed in a section of pipeline unaffected by turbulence, so at least should be placed in the main transmission pipeline upstream of the cross-connection Tee, and, if a valve is located on the upstream side and close to the meter, it should be kept wide open under normal operating conditions.

Also at the raw water and treated water reservoirs associated with Treatment Plant 'C', inlet and outlet functions are combined in the same pipeline so that it is not possible to isolate and fill one reservoir while another is being drawn down to supply the treatment plant or for maintenance works. For treated water the direction of flow will depend upon the combination of pumps running at any particular time making accurate chlorine dosing difficult if not impossible.

Although the project includes provisions to extend the seawater supply system to the airport, there is no corresponding provision for the collection of sewage from this extended supply area. (See 6.2.2 below).

5.6 Recommended Actions

5.6.1 Government Actions

-Housing Act: To review and strengthen that part of the Housing Act that requires the construction of rainwater collection and storage facilities on all new buildings, and to support the urban water utility companies in refusing to supply water to premises which do not comply with the Act.

-Water Efficient Appliances: Through the water utility companies, to promote the use of water-efficient plumbing and sanitary fittings and to initiate regulatory and/or legislative action to ban the importation of appliances and fittings which are not economical in terms of water use, and, in the case of sanitary fittings, appliances which are not satisfactory for use with salt water. Again, the water utility companies should be supported in refusing to supply water and/or sanitation services to premises which are not fitted with approved appliances.

5.6.2 Technical Assistance

Technical assistance is required in the following areas of concern:

-Well Protection: Project to demonstrate protection of rural groundwater wells with concrete aprons and of the use of hand pumps to extract groundwater. A Construction Manual For A Ferrocement Well prepared by Appropriate Technology Enterprises of Truk in the Federated States of Micronesia could be a useful guide for this proposed programme.

-Uliga Rainwater Catchment Systems, Majuro: To investigate the Uliga rainwater catchment system and its associated water treatment plant to determine the feasibility of rehabilitating the system for the purposes of public water supply.

-Laura Groundwater: To assess the production capacity of the Laura groundwater lens by setting up a long term continuing programme to monitor rainfall, evaporation, transpiration, draw-off, and profile of potable water and expert analysis of these factors.

-Laura Leases: To investigate the effects of land use on the quality of groundwater and to propose a culturally acceptable means of ensuring landowner cooperation in not compromising the groundwater resource. It is believed that lease values do not reflect the actual value of the land in that payments are not related to the value of possible alternative uses of the land. Payments should also be related to actual water production and purity to persuade owners not to use the land for purposes incompatible with water production for community use.

-Rainwater Storage: To test economic and technical feasibility of constructing household rainwater storage tanks out of unreinforced concrete, with or without a butynol liner.

5.6.3 Project Actions

-Consumer water metering: Complete the installation of water meters at all premises connected to the public freshwater supply systems at both Majuro and Ebeye.

-Bulk metering: Rehabilitate/replace existing bulk meters and install new meters as necessary in both freshwater and seawater supply systems at Majuro and Ebeye, to provide accurate information on water production.

-Bulk meter relocation: At cross-connections in new Majuro freshwater transmission system, relocate bulk meters into new transmission main to minimise effects of turbulent flow on meter accuracy.

-Leak detection: Conduct leak detection surveys on freshwater and seawater supply systems at Majuro and Ebeye. Repair identified faults and leaks, and disconnect unauthorised connections, including consumer pumping connections.

-Reservoir pipework, Majuro: Construction of new inlet pipework for raw and treated water reservoirs. Revise existing inlet/outlet pipework to operate as outlet only supplying Water Treatment Plant 'C'. Resite chlorination dosing points as necessary. Note that the treated water pumping pipework at the treatment plant will also have to be separated in this project.

-Water Supply, Ebeye: Construction of a new stand-alone desalination plant with production capacity of some 500,000/gpd (1,900 m³/d) to completely replace the existing facility in due course.

Chapter 6

SANITATION

6. SANITATION

6.1 Introduction

In the urban environment, excessive water use is reflected in excessive quantities of wastewater, both sewage and ‘grey’ water, so that any improvement in the management of demand for water supply should relieve some of the load on piped sanitation systems.

However, there are concerns about the number of urban households which are not connected to a sewerage system and, in some cases, have no sanitation facilities at all. In the latter case the ocean or the lagoon becomes the waste disposal area, often resulting in undesirable nutrient pollution.

Rural areas have this problem also, but with a much lower polluting effect due to low population concentrations. Of more concern is the potential for cross-pollution between pit latrines and groundwater resources.

6.2 Urban Systems

6.2.1 Saltwater Reticulation

The supply and reticulation of saltwater for sanitation purposes has been included in Chapter 5, Water Supply, and the opportunities for demand management appear to be limited to minimising leakage in the reticulation and from faulty sanitary fittings, and in restricting the availability and use of sanitary fittings which are not economical in terms of water use and/or are not suitable for use with saltwater flushing.

Remedial measures for these items are also included in Chapter 5.

6.2.2 Sewer Reticulation

The sewerage networks on Ebeye and Majuro do not appear to have been reviewed in recent years in terms of condition or of capacity to deal with expected increases in population. The current ADB project for Majuro does include provision for the rehabilitation of pumping stations but not for the sewer reticulation system.

The ADB project also includes provisions to extend the seawater supply system to the airport, but there is no corresponding provision for the collection of sewage from this extended supply area. It may be that the Majuro Water & Sewer Company (MWSC) has agreed to construct the collection system with other funding, but there has not been any indication from MWSC that this was to be the case.

There would therefore seem to be a need to review the condition and performance of the sewerage networks on both Ebeye and Majuro and from that review to prepare a design report for the rehabilitation and upgrading of those networks, and for the extension of the Majuro system to cover the entire area to which seawater will be supplied for sanitation purposes.

A contract would then need to be prepared for the performance of rehabilitation works and for new construction.

6.2.3 Sewage Outfalls

On Majuro, untreated sewage is discharged into the ocean from an outfall which discharges close to the reef in a water depth of about 45 ft (13.7 m). At most times sewage solids float to the surface and, on occasions, are deposited on the adjacent shoreline. Coliform and enterococci tests taken by RMIEPA consistently exceed the pollution standards set for these coastal waters.

The Ebeye outfall discharges raw sewage into the Kwajalein lagoon in an area in which natural seawater circulation has been inhibited by the construction of an access causeway. As at Majuro, sewage solids float to the surface and contaminate the adjacent shoreline. Pollution levels are also in excess of acceptable standards.

Both outfalls appear to have been sited without adequate research and this, together with the fact that both have been affected by either storm damage or land development suggests that a complete review of outfall location and performance should be undertaken and that this review should lead to the renovation or reconstruction of both outfalls, to provide hygienic disposal of sewage to the ocean environment.

Such reviews should include detailed oceanographic surveys of the existing and possible alternative outfall sites together with the preparation of an environmental assessment of the possible impact of any proposal. The works could well be included in an overall review of the conditions and performance of the sewerage systems, and are so included in the proposed Actions for the sanitation sector.

6.2.4 Premises Not Served

Such premises should be identified in the leak detection survey, and existing legislation should be enforced to ensure that these premises are serviced.

There are however some sites which are not of sufficient elevation to gain gravity access to the existing sewers, the Port areas being examples of these. In such cases pumping stations could be constructed to lift the wastewater to the level of the sewers, but, considering the probable intermittent duty of such stations, especially at the port where visiting ships could discharge their wastes, it is probable that holding tanks of an appropriate size would be more

practicable, serviced by a suction tanker as required. Suction tankers would also serve the dual purpose of also being able to empty the several septic tanks which exist in unsewered areas.

Two 2000 gal. (7.5 m³) tankers, one each on Majuro and Ebeye, should have sufficient capacity to meet the demands of those urban areas. Such tanker trucks should be equipped with reinforced tanks to withstand the vacuum conditions and with high-volume displacement vacuum pumps to minimise hose blockages and provide rapid removal of wastes from the holding tanks.

6.3 Rural Systems

Families living on the outer islands are being encouraged to construct proper sanitary facilities and many pit latrines, some with waterseal, have been installed. A large number of families do, however, continue to use the natural environment, including the lagoon or ocean.

Although an environmental purist might object strongly to the use of the natural environment for such purposes, the practice is not necessarily unhygienic provided that on-shore users follow biblical instructions (Deut 23, vs 13) to dig a hole for their use and cover it over immediately afterwards, and that lagoon/ocean users go into deep enough water to ensure that their wastes are dispersed and not stranded on the beach. As noted earlier in this report, the problems which do arise in the use of the natural environment are generally the result of concentrations of people using one particular area : health implications for isolated rural families are negligible.

In the use to pit latrines it is noted that the tendency is to dig the pit as deep as possible, probably to avoid frequent relocation. The practice does, however, mean that most pits penetrate the groundwater table, allowing pathogenic bacteria from the pits direct access to the groundwater and thereby to pollute adjacent wells. It would be preferable to construct latrine superstructures on runners like a sledge to facilitate relocation, and then to encourage users to accept pits of a lesser depth, no more than 1 metre, to avoid direct contact with groundwater. Shallower pits, covered over the sand or earth when full, would form reservoirs of high fertility upon which food crops or trees should thrive.

The use of a shallow pit can be regarded as a form of composting toilet except that the decomposing waste is in direct contact with the ground, leaving some risk of pathogen migration into groundwater.

The use of conventional composting latrines, sealed from ground contact, has not been explored in the RMI, but a 1995 AusAID project on Kiritimati Island in Kiribati concludes that composting latrines should be considered as an effective sanitation device provided that they can be demonstrated to be acceptable in a cultural, socio-economic, and ecological context in any particular location. A Greenpeace project investigating the feasibility of using

composting latrines in the Federated States of Micronesia might also provide useful information.

It is clearly desirable that the Government of the RMI continues to promote, by education, training, and financial assistance, the provision of every rural/outer island household with a safe, hygienic, and affordable sanitation facility. It is also clear that the form of that sanitation facility requires further research and investigation to identify an environmentally friendly system which minimises groundwater pollution and can add to soil fertility without compromising the cultural and socio-economic norms of the potential users. On the latter point, any excreta disposal system which does not receive user approval has little chance of being successfully implemented. A recent SOPAC-organised workshop on Appropriate and Affordable Sanitation in Small Islands emphasised this particular requirement.

6.4 Recommended Actions

6.4.1 Technical Assistance

Technical assistance is required in the following areas of concern:

- Urban Sewage Collection & Disposal: To review the condition and performance of sewerage networks on Ebeye and Majuro, to investigate the installation of new sewerage reticulation in the additional area of Majuro to be supplied with seawater, to review the condition and performance of existing sewage outfalls including oceanographic studies, and to prepare a design report covering rehabilitation, reconstruction, new construction, and all such works required to provide effective and hygienic sanitation for the urban areas over a design period of, say 20 years, having due regard for likely population, economic, and environmental developments within such a period.

- Pit Latrines : To review available literature on pit latrines and to develop and conduct a pilot project to test the cultural, economic, and practical suitability of alternative designs, including composting latrines, in the Marshallese environment. Such a review will include wide community participation and education in all phases of the work, including the potential for the pollution of groundwater resources, as well as the preparation of a promotional and funding option to support latrine construction throughout the islands.

6.4.3

Project Assistance

Project assistance for the funding and performance of equipment purchase and construction works is required as follows:

- Port & Septic Tank Servicing : To design and construction of sewage holding tanks at port facilities to receive discharges from ships using the port and from other services at the port which are lower in elevation than the community sewerage reticulation. Also to purchase 2 suction tankers, one for Majuro and one for Ebeye, of not less than 2000 gal. (7.5 m³) liquid capacity and equipped with high-volumetric displacement vacuum pumps to service sewage holding tanks and septic tanks, and to design and construct a tanker-emptying station so that tankered wastes can be discharged into an existing sanitary sewer in a hygienic and aesthetically acceptable manner.

- Urban Sewage Collection & Disposal : To design and construct all rehabilitation, reconstruction, new construction and outfall works identified in the review of urban facilities conducted in the Technical Assistance programme.

Chapter 7

SOLID WASTE DISPOSAL

7 SOLID WASTE DISPOSAL

7.1 Introduction

Only the urban areas of Majuro and Ebeye have a garbage collection service, and the municipal landfills are operated as reclamation areas on the coasts of these islands. Mechanical equipment for spreading, compacting, and covering the garbage is frequently out of service so that the landfills cannot be managed in an acceptable way.

Access to the landfills is not controlled allowing children and animals to scavenge amongst the trash.

In the outer islands, each household has to make its own arrangements, frequently by using the ocean or lagoon as a dumping area.

7.2 Garbage Collection & Disposal

Collection of garbage by the municipal authorities is not regular, and is accomplished with open trucks rather than closed compacting trucks. Garbage is therefore prone to fall off or be blown off the collecting vehicles, adding to problems of keeping streets and adjoining properties clean.

A regular collection of garbage on a twice weekly basis would require a minimum of two trucks on Majuro (2400 households) and one on Ebeye (1000 households) together with regular availability of dump maintenance plant.

Existing dumps need to be fenced off and access controlled to prevent human and animal scavenging.

7.3 Recycling

Some efforts have been made to recycle recoverable materials, particularly aluminium cans, but distances from markets for scrap seriously constrain the economics of recycling in the conventional sense.

7.3.1 Aluminium Cans

With some 7 million cans being imported into the RMI annually, there is considerable scope for the recycling of this material. Commercial can-crushing equipment has been set up by the RMI Environmental Protection Agency (RMIEPA) which is now seeking the support of private enterprise to operate a can recycling programme.

Distance from the nearest market remains a problem in making can recycling a viable economic proposition. However, even if the cans have to be dumped, crushing and baling would be advantageous in reducing garbage volume.

7.3.2 Steel Scrap

Majuro in particular is littered with scrap steel in various guises, from old car bodies and broken-down earthmoving machinery to derelict landing craft. Whilst there does not appear to be any move to dispose of this scrap in the municipal landfill, the cleaning-up of the urban environment must be of some advantage to the community, especially if it is serious about the promotion of tourism.

Considering the success of sunken World War II ships in attracting fish, one possible solution would be to collect all the scrap, load it on to an old landing barge, tow it to an identified sea mount in the lagoon or the ocean, and there sink it to provide an artificial reef to attract fish. The complete flushing out of hydrocarbons from engines, fuel tanks, and the like would be an essential requirement for such a proposal.

An oceanographic survey of the RMI, soon to be undertaken as part of a mineral resources study, should identify high points on the sea floor suitable for development as artificial reef sites.

7.3.3 Storage Batteries

Storage batteries containing lead or cadmium should be removed from the natural environment when they have reached the end of their useful life. The poisonous nature of the battery components makes them a hazard if disposed of in a dump, but, as with cans, removal to a distant market is economically difficult.

7.3.4 Waste Oil & Solvents

The simplest means of disposal of waste oil and solvents would be to require the oil importing companies to remove them for reprocessing, but informal approaches to achieve this have been refused. It would seem that a formal approach from the RMI Government will be required for this suggestion to have any chance of success.

In the absence of being able to export these waste materials, an incinerator will have to be purchased to achieve effective disposal, trading off the polluting effects of hydrocarbons in the land environment for the emission of carbon dioxide into the air.

The Marshall Energy Company, probably the largest producer of waste oil, remixes its own waste with fuel oil and uses the mixture as part of its fuel supply to its electricity generating units. The Company is however not willing to accept other waste oil for this use because of the uncertainty of its constituents and the potential therefore of damaging its generating units. It is believed that the Company would be prepared to operate an incinerator at its premises to dispose of other hydrocarbons provided that the equipment was paid for by others and that it could make free use of the heat output of the incinerator.

7.3.5 Cyclogen Emulsifier

There were several drums of this bitumen emulsifier left in the RMI in 1986, and because of perceived health risks in handling this material, little of the emulsifier has been used since. Since the potential hazard to humans lies in prolonged skin contact, judicious use of protective clothing should enable this material also to be incinerated with waste oil and other hydrocarbons. The protective clothing itself should also be incinerated in due course.

7.3.6 Hospital Wastes

Ministry of Health staff report that the Hospital incinerator, which had not been functioning properly for some considerable time, has now been restored to its normal function and is being used, on an intermittent basis, for the disposal of dressings, biological specimens, 'sharps', and minor body parts. Major body parts, such as amputated limbs, are normally returned to the family of the patient for storage and later burial with the rest of the body when death finally occurs.

7.3.7 Organic Wastes/Composting

UNICEF, as a part of its Family Food Production and Nutrition Programme is sponsoring a Department of Agriculture project to promote household-based composting for the improvement of soil fertility and stimulation of home gardening.

As an extension of this basic principle, officers of the Department would be interested in conducting a pilot project to test the feasibility of municipal composting, but would require assistance in the provision of a covered area of a suitable size and of additional staff resources to operate and manage the project, preferably on Majuro in the first instance.

The project would depend upon the establishment of regular collections of organic material only, possible only with public support and participation. An extensive public awareness and education programme would therefore be an integral part of any municipal composting project.

7.4 Future Municipal Landfill Sites

Existing landfill sites on Ebeye and Majuro are close to residential areas and frequently give rise to complaints regarding odours, wind-blown trash, rats, and similar problems.

Since it is acknowledged that there is only limited scope for expanding the existing landfill areas, it is necessary that other coastal areas, and possibly uninhabited islands, be investigated for use as future municipal landfill sites. Selection would have to give due regard to environmental considerations as well as the economic feasibility of transporting garbage to any potential site.

7.5 Recommended Actions

7.5.1 Technical Assistance

Technical assistance is required in the following areas of concern:

- Composting of Organic Wastes : To investigate the feasibility of municipal composting on Majuro by conducting a pilot project to include the provision of a suitable covered area, a public awareness survey, and manpower resources for the operation and management of the project.

- Municipal Landfill Sites : To investigate alternative future landfill sites on Majuro and Kwajalein Atolls having regard to environmental considerations and economic feasibility.

7.5.2 Project Assistance

Project assistance for the funding of equipment purchase, including spare parts, and construction works is required as follows:

- Garbage Collection Vehicles : To supply three custom-built garbage collecting and compacting vehicles, two for Majuro and one for Ebeye.

- Steel Scrap Collection & Disposal : To fund the collection of existing scrap steel, including construction machinery, for the purchase of derelict craft, for the loading of all scrap onto the landing craft(s), and for towing and scuttling the laden vessel at a location suitable for development as an artificial reef.

Chapter 8

STORM WATER DISPOSAL

8 STORMWATER DISPOSAL

8.1 Introduction

Concerns have been expressed about the lack of effective stormwater drainage in the urban areas, the health risks to children playing in polluted water, surface erosion, flooding of roads, and uncontrolled silt-laden discharges to the lagoon and the ocean.

8.2 Flooding & Silt Control

Much of the urban flooding problems on Majuro can be related to the need to reshape area and arterial roads, to drain the margins of the roads, and to rehabilitate or construct new drainage outlets.

The remedial works necessary to eliminate roadside stormwater flooding and to provide controlled drainage outlets should be included in the road reconstruction project now being discussed between the RMI Government and the Japanese International Cooperation Agency (JICA). The proposed project, still tentative as to the final scope of the works, is hoped to provide for the complete rehabilitation of all area and arterial roading between the airport and Rita, some 9 miles, as a minimum.

At a household level, the public should be encouraged to fill in and/or drain off any areas of ponding within their residential areas, not only for their own comfort and ease of access, but to remove potential health risks to themselves and their children.

8.3 Development Clearing & Surface Erosion

Development clearing typically leaves large areas of bare coral sand which readily erodes to add large amounts of silt to the drainage channels. Also, the removal of vegetation decreases the ability of the land surface to absorb water which is essential for the recharge of groundwater resources.

It would be desirable for some site clearing controls to be included in an RMI Building Code which has now been in the proposal stage for some years. Assistance could be required to fund one person for the sole purpose of compiling the Building Code as a matter of urgency.

8.4 Groundwater Recharge

Urban development, with its buildings, paved roads, and areas stripped of vegetation, produces a great deal of run-off to add to surface flooding problems, but which is largely unavailable for groundwater recharge. Some research would be useful to investigate the feasibility of the disposal of silt-free

yard water and surplus roof water into soakage pits to achieve some recharge of groundwater systems.

8.5 Recommended Actions

8.5.1 Technical Assistance

Technical assistance is required in the following areas of concern:

- Building Code : To provide funding and support for a suitable person to produce a Building Code for the direction and regulation of all development and construction works within the RMI. Note that the implementation of such a Code, as with any other regulatory action, necessarily requires that staff and facilities will be put in place to manage such implementation.

- Groundwater Recharge : To support a pilot project to investigate the feasibility of utilising silt-free yard and roof water for groundwater recharge.

8.5.2 Project Assistance

Project assistance for the funding of design and construction works is required as follows:

- Roading Rehabilitation: To reconstruct urban roads, including arterial roads, to drain road margins and to provide controlled drainage outlets into the lagoon or the ocean. (Note that such a project on Majuro is already the subject of JICA interest.)

Chapter 9

THE ECONOMY

9 THE ECONOMY

9.1 Dependency

The economy continues to be heavily dependent upon annual grants from the US Government, comprising some \$55.3 million in a total RMI budget of \$90.9 million in the 1995/96 fiscal year. Of the grants, \$12.8 million is in US Federal Grants made direct to specific Government ministries, and the balance of \$42.5 million is made available through a Compact of Free Association for capital investment and technical assistance. The amounts noted above do not include compensation payments to Marshallese victims of the US nuclear testing programme carried out between 1946 and 1958.

9.2 Balance of Trade

In the period 1979/1995 inclusive, the value of imports rose steadily from some \$14 million to \$75 million, an increase of about 536%. Over the same period, the value of exports rose from \$3.4 million to \$23.0 million, an increase of 676%.

Exports showed a dramatic increase over 1994 and 1995 from trade in chilled fish, but the gains were offset by large increases in the value of mineral fuels and oils over the same two years, the trade deficit in 1995 being \$52 million, marginally less than the 1990 high of \$54.2 million.

The scope for import substitution seems to be limited to foodstuffs such as fish, fruit, and vegetables which overall would not make any significant impact on the import bill. In the export sector, the growth in the sales of chilled fish is encouraging, but the market for copra cake and coconut oil seems fairly static.

Considering the size of the RMI Exclusive Protection Zone, further increases in fishing related income should be possible, and the encouragement of tourist-related activities could also bring foreign exchange earnings.

9.3 Subsidies

Subsidies have a distorting effect on the economy, but the Government is slowly moving towards reducing these, particularly for utility services on Majuro. The Kwajalein Atoll Joint Utility Resources (KAJUR) which controls electricity, water, and sanitation services to the Ebeye community nevertheless continues to receive subsidies, possibly to offset the high costs of desalinated water production. The need to keep this subsidy in place to make the cost of potable water affordable needs to be carefully taken into account by those advocates for desalination on Majuro.

Chapter 10

FINANCE

10 FINANCE

10.1 Introduction

This chapter refers only to the operations of the water and sanitation utility companies on Majuro (MWSC) and Ebeye (KAJUR).

10.2 Tariffs

10.2.1 General Principles

In view of the need to manage the use of the limited freshwater resource, and of high-cost electricity for the pumping of seawater and sewage, the adoption of progressive (stepped) tariffs which are modest and affordable for low-demand consumers would seem appropriate.

A brief tariff study is included in the ADB Technical Assistance Project 1946-RMI for Institutional Strengthening of the Majuro Water and Sewer Company, but the study appears to be based wholly on financial assumptions rather than on balancing resource conservation with financial considerations. The study says the “impact of these tariffs would be a general reduction in monthly charges for consumers in the average or lower consumption ranges, and minimal increases for most other consumers.” The first part of the statement supports the policy of rewarding careful users, but, if larger users are to be persuaded to modify their use of water, increases in their monthly charges need to be substantial. If, for instance, a desalination plant had to be installed on Majuro to meet the demand for public water supply, it would be quite reasonable to expect that the upper levels of progressive tariffs should at least cover the production costs from such a plant.

The same philosophy should be applied to commercial tariffs, although cross-subsidisation between the commercial and residential sectors is not recommended because of the distorting effect of this practice on the economics of utility operation.

In the case of Ebeye, considering its special situation where all potable water is produced by desalination, it would be reasonable to apply similar tariffs to Majuro, with the difference between actual tariffs and the real charges which would have to be applied to meet production costs being met out of Compact funds.

10.2.2 Majuro Water & Sewer Company

The Company, although wholly owned by the RMI Government is being encouraged to manage its affairs in a subsidy-free environment, and with this in

mind its tariffs for water supply were drastically reviewed in 1994 as shown below in Table 10.1. (1000 US gal. is equivalent to some 3.8 m³)

TABLE 10.1

<u>Class of Consumer</u>	<u>Unit</u>	<u>Old Tariff</u>	<u>New Tariff</u>
Unmetered	Flat Rate/mth	\$8.00	\$8.00
Metered-Commercial	1000 US gal.	\$1.00	\$10.00
Metered-Laura(untreated)	1000 US gal.	\$0.80	\$5.00
Metered-Residential(treated)	1000 US gal.	\$0.80	\$6.00

The Company has also adopted a universal metering policy and is progressively extending its metered coverage. In the process it is discovering many unauthorised connections and these too have been metered. The effect on operating revenues has been marked, but so has the increase in bad debts and so-called 'doubtful accounts', bad debts in 1995 totalling \$366,192, and doubtful accounts \$940,912. The recovery of outstanding monies has been hindered by a Government policy to have all legal action for the utility companies handled through the Office of the Attorney-General, an office which is already short staffed and does not therefore appear to be able to handle these additional duties or even to delegate them to attorneys in private practice.

Another problem for MWSC is it is paying for contractual services, \$646,000 in 1995, directly from revenue rather than arranging loan finance for services which involve major expenditure.

In 1995, with alternative financing for contractual services and with active debt recovery, MWSC should have broken even or even made a modest profit on its operations, and a reduction in the level of 'doubtful accounts' would have been similarly reflected in the Assets and Liabilities balance sheet.

As to the level of water tariffs, it will be seen that these have been substantially increased, but do not reward the modest user or penalise the extravagant user if the principles set out in 10.2.1 above are to be followed.

To set the simplest form of progressive tariff, a base rate and a basic consumption block needs to be established, and then the rate for each higher block of consumption is increased by a fixed percentage. Table 10.2 below illustrates the result of adopting a base residential rate of \$4.00/1000 gals. (\$1.06/m³) for a basic consumption block of 3000 gals.(11.3 m³), and a base commercial rate of \$7.00/1000 gals.(\$1.85/m³) for a consumption block of 10,000 gals.(37.8 m³), and increasing the tariff by 15% for each block.

TABLE 10.2

Residential		Commercial	
Consumption block (gallons)	Tariff (\$/1000 gals.)	Consumption block (gallons)	Tariff (\$/1000 gals.)
0 - 3000	4.00	0-10,000	7.00
3000 - 6000	4.60	10,000-20,000	8.05
6000 - 9000	5.29	20,000-30,000	9.26
9000-12000	6.08	30,000-40,000	10.65
12000-15000	7.00	40,000-50,000	12.24
etc	etc	etc	etc

On the basis of this table, the charge for unmetered water could be set at the equivalent of one consumption block at the minimum tariff, that is \$12.00 for residential customers and \$70 for commercial customers.

It is recommended that this form of tariff structure be adopted and implemented at the earliest opportunity.

In the sanitation sector it is believed that the present tariff of \$7.00 per connection per month does not allow for actual demand levels. It is recommended that the sewerage tariff be amended to, say, \$3.00 per toilet per month with a minimum levy of \$6.00 per connection per month. At this level, a hotel such as the RRE would be required to pay about \$90.00 per month, and the new government hotel about \$300.00 per month. Allowing for all commercial premises, including office complexes, the contributions for sanitation services should be more in proportion to the demands placed on the sewerage system.

10.2.3 Kwajalein Atoll Joint Utility Resources

This utility company, also wholly owned by the RMI Government, is still being heavily subsidised - \$400,000 in the 1995/96 Budget.

As noted in Chapter 9, Economy, there may be some justification for some form of subsidy, particularly to reduce the cost of water supply from the desalination plant to an affordable level. However, the lump sum appropriation now being made does not give KAJUR any incentive to improve the efficiency of its service. If a subsidy is to be paid at all, it should be paid on the basis of actual service supplied to the consumer, that is, as a contribution per 1000 gals. (3.78 m³) to make up the difference between consumer tariffs and actual operating costs. It is therefore recommended that consumer tariffs for water and sanitation services be adjusted to the level of actual and proposed Majuro

tariffs and that any subsidy be calculated on a unit rate for the metered quantity of services supplied. The recommendation presupposes that all water consumers will be metered as soon as is practicable.

The current amount of outstanding accounts for KAJUR in 1994 was said to be \$2.6 million so the need for an effective debt recovery programme here is even more pressing than on Majuro.

10.3 Government Accounts

Although it was earlier believed that government Ministries were not paying metered accounts, it now appears that such an assumption was incorrect. The actual process is that each agency certifies its account for payment and then forwards it to the Ministry of Finance for payment. The certified amount is deducted from the agency budget, but, when payments are made to the utility Company, they are made as a lump sum without any supporting documentation to indicate the actual dissection of the payment.

In the absence of such a dissection, the utility company cannot reconcile its accounts with payments, and it is recommended that some appropriate action be implemented within the Ministry of Finance to make the payment process more transparent.

10.4 Recommended Actions

10.4.1 Government Actions

It is recommended that the following policy suggestions are adopted and implemented:

- Universal Metering : That the installation of water meters on all consumer supplies, already in progress by MWSC, should be completed by both utility companies.

-Tariffs for Potable Water Supply : That a system of progressive tariffs be adopted in accord with the principles set out in 10.2.1. The tariffs included in Table 10.2 are believed to present a reasonable basis on which to proceed for both MWSC and KAJUR.

To offset the effect of the costs of production of desalinated water, the Government and KAJUR should negotiate a unit rate subsidy, per 1000 gals. of production, to be met for the time being out of Compact funds.

- Tariffs for Sanitation Services : That a system of tariffs based on the actual number of toilet pans in the customers premises be implemented. The

suggested level of tariff is \$3.00 per toilet pan per month, with a minimum charge of \$6.00 per month per premises.

-Government Accounts: That the Ministry of Finance be instructed to provide a complete dissection of the make-up of all payments made for the provision of water, sanitation, and electricity services.

-Recovery of Bad Debts: That the Attorney General be instructed to appoint two attorneys, one each to MWSC and KAJUR, for the express purpose of pursuing long-standing delinquent debtors. It is suggested that payments to these attorneys should be negotiated in terms of a fixed percentage of debts recovered.

Chapter 11

UTILITY COMPANY ORGANISATION

11 UTILITY COMPANY ORGANISATION

11.1 Management

The utility Companies on both Majuro (MWSC) and Ebeye (KAJUR) are wholly Government owned and their Boards of Directors are predominantly Government appointees. Each utility would normally have its own General Manager, but, in order to strengthen the financial and technical management of MWSC, the General Manager of the Marshalls Energy Company has been appointed to also serve as Acting General Manager of MWSC.

This appointment was seen in some quarters as the first step in merging MWSC with MEC, but Government is not yet convinced that such a merger should take place. However, the MEC billing, collection, and accounting systems are being implemented in MWSC and have resulted in better cost recovery and stronger financial management.

Given the limited customer base of both Majuro utility companies, it would seem reasonable to at least combine the top management of these companies and possibly their administrative support units even if a complete merger does not take place.

On Ebeye, KAJUR is already responsible for electricity, water, and sanitation services, but, as was the case with MWSC, there are considerable shortcomings in its billing and collection systems, and some technical assistance may be required to strengthen this organisation also. Much of the lack of performance by KAJUR appears to have been smoothed over with the practical assistance of the US Army and with Compact funds channelled through the Kwajalein Atoll Development Authority. However, with the continuing reduction, and possible cessation of Compact funding, a more self-reliant attitude should be required of KAJUR to avoid future insolvency and the complete collapse of its utility functions.

11.2 Organisation

11.2.1 Administration

Both companies have a poor record in terms of accounting procedures, including metering, billing, and collections, with bad debts and doubtful accounts being prominent in their balance sheets, (See Chapter 10, Finance).

MWSC procedures are being turned around due to the application of MEC practices introduced by the Acting General Manager. KAJUR does not appear to be showing the same progress, and this may be due to its reliance on Compact and US Army handouts and assistance. With the decline and possible cessation of Compact funding, it would seem appropriate for the RMI Government to seek technical assistance for the review of the administration and operation of KAJUR, including recommendations as to the strengthening

of these functions, in an effort to improve the self-reliance of the utility and so reduce its state of dependency.

11.2.2 Technical

In intermediate management, there has been a lack of technical expertise in both MWSC and KAJUR. For the time being, an expatriate engineer is providing some technical guidance in MWSC, but he has no Marshallese counterpart to take over when his contract term expires.

KAJUR have recently employed a new Operations Manager, formerly an expatriate but now resident in the RMI, who is determined to make progress on remedying long-standing maintenance problems affecting all operations of the utility Company. However, on the financial side, KAJUR is heavily dependent on US assistance, the latest being a \$1.3 million grant from the US Department of the Interior to repair and upgrade the power system. (Marshall Islands Journal:June 21, 1996).

11.2.3 Institutional Memory

As with many developing countries where management staff change frequently and expatriates are employed to support the organisation, most institutional memory lies in the minds of the longer serving operations and maintenance staff. The information held is seen to be of economic importance to the staff, particularly in the retention of employment, so they are often reluctant to share their knowledge with outsiders or short term managers.

This particular problem needs to be addressed by improving the skills of the O & M staff to replace the negative effect of suppressing information with the positive effect of upgraded work skills. Supervisory staff who resist such a change may have to be replaced, but the end result will be beneficial to the organisation, and to the community.

Work habits may also be subject to institutional memory in the form of outdated practices and an unwillingness to adopt more modern O & M procedures. Here again training and education provide the means of overcoming such difficulties.

11.3 Training

11.3.1 Majuro

Since the appointment of the Acting General Manager, training has been focussed mainly on MWSC accounting and administrative staff for their familiarisation with and implementation of accounting, metering, and billing procedures practised within MEC. The Acting General Manager has also

promoted moves to have MWSC join the Pacific Water Association, (now in its establishment phase), to introduce a Training Within Industry course related to the organising of work functions, and to establish an Apprentice School in Majuro to provide training opportunities for the development of basic skills.

Technical training within MWSC has been hampered by the lack of technical expertise within the organisation. An expatriate Water and Sanitation Engineer is presently contracted to MWSC, but a brief observation of his work suggested that he was fully occupied in trying to find solutions to long-standing operational problems and had little spare time to direct towards transfer of technology. In any case, he did not appear to have been provided with a counterpart to whom such a transfer could be made.

In the longer term, MWSC has to accept that it will have to employ technically-oriented staff if it is to benefit from operation and maintenance training opportunities. If the Company is prepared to do this, it should also establish a 'twinned' arrangement with another water and sanitation utility either in Hawaii or the Federated States of Micronesia, or in both, so that, by exchanging staff, it can have access to 'in-country' and 'out-of-country' practical training in a similar operating environment. Suitably oriented staff will also be able to benefit from exchange, seminars, and training workshops which will become available through the Pacific Water Association.

It has been noted that SOPAC provides a certificate course in Earth Science and Marine Geology which includes water resources, but that to date no Marshellese has participated in this programme.

The costs of training should be borne by the Company as a part of its operational expenses.

11.3.2 Ebeye

The newly appointed Operations Manager should be able to achieve some training within KAJUR, but basically he is restricted in this role by the demands of his job responsibilities. As with MWSC, KAJUR could attract many benefits from 'twinning' with an outside utility company and with joining the Pacific Water Association. At the present time it would do well to study the administrative and accounting procedures being adopted by MWSC, and a closer liaison between the companies should be encouraged.

However, until KAJUR adopts a fundamental policy of increasing its level of self-reliance, and takes steps to strengthen its institutional performance, training of itself may not be of any substantial benefit to the utility.

The cost of the training should be borne by KAJUR as a part of its normal operational expenses.

11.4 Recommended Actions

11.4.1 Government Actions

- KAJUR Dependency : Although it is recognised that KAJUR may not be able to provide utility services at affordable prices, nevertheless the Government should require KAJUR to increase its self-reliance and overall level of service. The Government, for its part, should cease payments of lump sum subsidies and should negotiate future support on the basis of unit rate payments on the quantity of services actually supplied.

11.4.2 Technical Assistance

- KAJUR Institutional Strengthening : To investigate and report on the need for organisational, operational and physical improvements to the water supply and sanitation systems on Ebeye Island, Kwajalein Atoll.