

Strategies for preventing and mitigating land-based sources of pollution to trans-boundary water resources in the Pacific region

By Nancy S. Convard, Andrew Tomlinson
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Abbreviation and Acronyms

NPS	Non-Point sources of Pollution
WHO	World Health Organisation
GPA	Global Program Action
BMP	Best Management Practices
NGOs	Non Government Organisations
EIA	Environmental Impact Assessment
NEMs	National Environmental Management Strategy
DDT	Dichlorodiphenyltrichloroethane

1 Introduction

This paper presents a number of strategies for the prevention and mitigation of land-based sources of pollution to trans-boundary fresh and marine water resources in the Pacific Region. The South Pacific Regional Environmental Programme (SPREP) commissioned this paper as part of its Strategic Action Programme for International Waters in the Pacific Region (SAP), a project funded by the Global Environment Facility (GEF). The paper specifically focuses on the following land-based sources of pollution:

- domestic sewage;
- solid waste including litter, domestic and industrial wastes; and
- industrial wastewater and runoff: (nutrients, pesticides and herbicides).

It is important to note that “trans-boundary water resources” as related to international waters in the context of the GEF is defined as the oceans, large marine ecosystems, enclosed or semi-enclosed seas and estuaries as well as rivers, lakes, groundwater systems and wetlands with trans-boundary drainage basins or common borders.

The geographic focus for this study includes Cook Islands, Federated States of Micronesia (FSM), Fiji, Kiribati, Marshall Islands, Nauru, Niue, Papua New Guinea, Samoa, Solomon Islands, Tonga, Tuvalu and Vanuatu herein referred to as the “the region”.

1.1 Background to this Study

In December 1996, the GEF committed financial support from its Project Development Fund to facilitate the Strategic Action Programme (SAP) for International Waters (IW) Programme for the Pacific Region. SPREP is the principal implementing agency for the SAP with assistance also provided by South Pacific Commission (SPC), South Pacific Bureau for Applied Geosciences (SOPAC), and the South Pacific Forum Fisheries Agency (FFA).

The SAP will be developed by a regional task force (RTF). Input to the RTF is being provided by regional reviewers and others.

1.2 Terms of Reference

The terms of reference (ToR) for the study are summarized as follows:

- (i) Produce a paper that identifies and prioritizes in order of regional need a range of activities to address trans-boundary and collective needs of the Pacific Region to address the mitigation and prevention of degradation of trans-boundary fresh and marine water resources from the following sources of land-based pollution:
 - domestic sewage;
 - solid waste including litter, domestic and industrial wastes; and
 - industrial wastewater and runoff: (nutrients, pesticides and herbicides).

The requirements of the paper are outlined in the remaining ToR.

- (ii) Review of existing information is limited to a minimal summary and identification of current actions. The paper relies on previous work to provide an adequate review of the current situation including sources, impacts, and actions. The principal reference for this information is *Land-Based Pollutants Inventory for the South Pacific Region* (Convard, 1993).
- (iii) Recommended activities should include, where appropriate:
- identification of important knowledge gaps, policy distortions, and institutional deficiencies and possible actions to address these gaps, distortions, and deficiencies;
 - suggested national and regional interventions;
 - national and regional mechanisms necessary for the implementation of the activities;
 - comprehensive, cross-sectoral eco-system based approaches that integrate ecological and development needs;
 - ways to assist groups of countries to better understand the land-based sources of pollution concerns and of their international waters and work collaboratively address them;
 - ways to build the capacity of existing institutions to utilize a more comprehensive approach for addressing land-based pollution concerns;
 - suggestions for monitoring and analysis of shore-zone and near-shore environments to determine the vulnerability to environmental degradation by land-based sources of pollution; and
 - suggestions for location of the activities in two types of areas: where maximum demonstration/replication value can be achieved if it is an innovative activity; and areas where the pollution sources are - and therefore the need for mitigation/prevention is the greatest.
- (iv) Tailor the activities to the needs and priorities of the Pacific Region and as appropriate draw upon the United Nations Global Programme of Action (GPA) for the Protection of the Marine Environment from Land-Based Activities, adopted at the intergovernmental conference of 23 October - 3 November, 1995 in Washington D.C.
- (v) Develop the activities so that they are consistent with and advance the implementation of international instruments such as the GPA.

2 Regional Review of Land-Based Sources and Status

The principal reference for this study was the *Land-Based Pollutants Inventory for the South Pacific Region* (Convard, 1993). As indicated in the ToR and personal communications from SPREP little additional detailed information is available for the region and the situation, in general, is little changed from the date of the previous study. The referenced study identified and estimated quantities of several types of pollutants to the marine environment.

The categories of pollutants used in this present study correspond closely to those in Convard, 1993. These categories are different though not incompatible with those of the GPA. The following table

provides guidance for relating the category sets.

Pollution Source Categories		
This Study	Convard, 1993	GPA
Domestic - wastewater - solid waste	Domestic - wastewater - solid waste	Sewage Litter
Industrial - solid waste and hazardous waste - wastewater - tourism	Industrial Wastewater Solid Waste Mining	Persistent organic chemicals Radioactive substances* Heavy metals* Oils and Hydrocarbons
Agricultural - erosion and sedimentation** - nutrients and pesticides	Agricultural	Persistent organic chemicals Nutrients Sediment mobilization

* These pollutants are specifically excluded from this study; however, heavy metals will be discussed briefly in the context of industrial sources, including a brief reference to mining, for some countries.

** Sediment transport and up slope erosion are specifically excluded from this paper; however, it is addressed in a limited fashion as regards to agricultural sources.

*** The GPA category “physical alteration and destruction of habitats” is also excluded from the ToR of this paper.

The 1993 inventory noted several constraints to the quantification of pollutants and water quality. These constraints include lack of data, out-of-date data, lack of data management, and insufficient technical understanding of the fate and transport of some pollutants in the Pacific insular environment e.g. fate and transport of nutrients from individual near shore septic tanks to the marine environment. Rapid assessment techniques, such as the World Health Organization (WHO) approach used in the 1993 inventory offers an approach that would be very useful to the region provided that the requisite data is collected on a routine basis by local governments (WHO, 1989, Convard, 1993).

2.1 Domestic Contributions

Domestic contributions dominate the relatively un-industrialized Pacific Region. Domestic wastewater disposal (or sewerage) and disposal of domestic solid waste remain critical issues for the region. In most areas the current management of these results is not sufficient to prevent deleterious effects on public health, environmental quality, traditional lifestyles, and economic development. Marine water quality as well as fresh surface and ground water quality are affected. Based on the criteria for the establishment of priorities outlined in paragraph 22 et. seq. of the GPA this area, particularly wastewater disposal, should receive urgent attention on regional, national, and local levels.

2.1.1 Sewerage

Domestic wastewater or sewerage is managed in several ways ranging from non-existing physical facilities in rural and undeveloped urban areas to advanced secondary treatment plants in some of the large municipalities. A number of areas still lack adequate facilities as defined by the WHO (Convard, 1993, Guo, 1991, Naidu et al. 1991). A perennial problem in assessing

and monitoring this issue is the divergent national opinions of what constitutes adequate facilities.

Over-the-water latrines and direct use of the beach areas continue in many areas. This is due to a variety of causes including a lack of local financial resources and technical expertise, cultural preferences, or some combination thereof. A number of countries have reticulated systems (Kiribati, RMI, Solomon Islands, and Nauru) but no treatment. Where adequately functioning wastewater treatment and disposal systems exist, water quality may still be poor due to the large number of individual systems that still exist in the area. Pohnpei, FSM is one example of this situation. Sewerage outfall locations and depths also are inappropriate in some areas, resulting in the contamination of near shore waters or down-current areas.

Sewerage disposal also degrades groundwater quality. Though not documented on Pacific Islands, groundwater contamination is prevalent in densely populated areas that are served by individual sanitation systems. The population density and inappropriate designs of the systems combine to create this situation.

As with other pollutant sources, there is a problem with the availability and quality of data. This is associated with the number of agencies that are often involved in sanitation issues, e.g. health, environmental, and utility offices.

As a result of individual country priority setting and limited financial and technical resources, water quality monitoring is limited in most countries. To provide an adequate assessment of current effects of sewerage disposal as well as that of implemented mitigation activities, additional effort in this area is needed.

2.1.2 Solid Waste

Solid waste includes litter as well as collected wastes. Solid waste generation is increasing at a rapid rate in the region. In urban and rural areas per capita generation is still relatively low by industrialized standards; Ogawa (1992) estimated a range of 0.35 to 0.5 kg/person/day. Solid waste, however, is rarely managed in controlled landfills and usually is disposed directly in coastal areas. This situation presents serious hazards to the marine ecology and public health.

2.2 Industrial Contributions

Industrial contributions are a growing component of land-based pollution in the region. Both the quantity and the toxicity of the materials used in the region are increasing, while monitoring and regulation is minimal.

2.2.1 Solid and Hazardous Waste

Industrial solid waste is co-disposed with domestic waste. Industrial and commercial solid wastes often include process waste, solvents, cleaners, construction debris, metals, acids, petroleum products, etc. Household waste also may contain hazardous wastes from cleaners, pesticides, used oils, and infectious wastes. Thus, leachate generated from solid waste landfills may contain a number of toxic chemicals and infectious agents. The leachate can adversely affect local ecosystems and may be injurious or fatal to a number of aquatic species. Fish and shellfish may bioaccumulate such toxins. Persons consuming these fish and shellfish are at risk for cancer and a variety of chemical-induced diseases and organ failures.

2.2.2 Wastewater

Previously conducted water quality and marine environmental studies clearly have demonstrated the presence of metal, organic chemicals, and other toxics in the marine environment. Though the 1993 study (Convard, 1993) was unable to quantify industrial wastes in some cases, it does identify a number of industries that generate wastes that are harmful or potentially harmful to the marine environment. The effects of industrial discharges need to be urgently addressed in the more industrialized countries of the region: Fiji and Papua New Guinea. Countries with growing industrial activity are in a position to take proactive action toward the prevention of environmental degradation from industrial waste discharges.

Fish canneries, sugar refineries, breweries, edible oil production and mining operations are major sources of several pollutant constituents, including B.O.D., suspended solids, nitrogen, phosphorous, and oils and grease. Other industries including agrochemicals, metal plating, paint manufacturing, maintenance facilities, etc. generate heavy metal and persistent organic pollutants. Petroleum storage facilities and electrical utilities (power plants) also contribute to contamination of soils, groundwater, and marine waters. The contamination includes petroleum products, their constituents (e.g. benzene, toluene, ethylbenzene, etc.), and polychlorinated biphenyls.

These industries clearly have the potential to cause serious environmental impacts. Indeed, such environmental problems are evident in the countries with these types of industries. Several studies have documented the introduction into Suva Harbor of organic chemicals, heavy metals, and toxic substances that clearly are of industrial origin (Cripps, 1992; Morrison, 1992a; Morrison, 1992b; Naidu et al. 1991). Similar pollution has been observed in marine waters near other regional urban centers (Morrison, 1990; Gangaiya and Green, 1991).

The waste streams from most industrial facilities have little or no treatment. The most common type of treatment provided for almost all facility types is simple sedimentation. Where oils and grease are anticipated, oil-water separators are sometimes provided. As evidenced by Convard's (1993) visits to a number of facilities in the region and the reports of others (Cripps, 1992; Gangaiya and Green, 1991; Morrison, 1990; Maata, 1992; Chester, 1984; Stone, 1990), most of these treatment facilities are grossly undersized and provide inadequate treatment. In some cases secondary treatment was originally provided, but is no longer adequately maintained.

Few countries have permit systems for industrial activities or discharge of wastes. Known exceptions to this are Fiji, FSM, and the Marshall Islands. In Fiji, the permit system is not fully implemented. Lack of discharge and water quality data leaves the responsible government agencies with limited information on which to prioritize their pollution control, and more importantly, pollution prevention efforts. The lack of information also hinders responsible operators of industrial facilities who prefer to operate in an environmentally responsible manner. The previously mentioned WHO rapid assessment method relies on the use of production rates and raw material use. Raw material use should include quantities as well as types of materials.

2.2.3 Tourism

Much of the region has, or desires, tourism as a major economic component. Though the contributions of the tourism industry to marine pollution fall into the other established categories for the SAP, it is appropriate to mention some particular aspects of the industry's significance to the issues. Poorly managed solid wastes have a particularly negative effect on the tourism industry because of the resulting

water quality degradation and unsightly conditions. While improved management of wastewater and solid waste facilities may enhance tourism opportunities, an enhanced tourism also places greater stresses on these systems. Increased populations of visitors and local resort employees increase stresses on systems and local ecologies

2.3 Agricultural Contributions

Agricultural sources of pollutants other than sediments are minor compared to the other sources. Except for the potential of accidental spills, the environmental impact of agrochemicals is negligible. Erosion as a result of improper or inappropriate cultivation practices contributes substantial quantities of sediment to the marine environment. Nutrients and chemicals also are carried to marine areas with this runoff.

2.4 Non-Point Sources of Pollution

Non-point sources of pollution (NPS) are extremely difficult to identify and quantify, yet numerous studies have identified them as an important contributor to marine and fresh water quality degradation.

Non-point sources of pollution originate from residential, commercial, industrial, agricultural, and construction areas. The type of pollutants that are associated with these different sources are summarized below:

Non-Point Pollution Sources and Typical Constituents

Typical Constituents	Source
Urban	oil and grease, nutrients, organic chemicals, toxic metals, pathogens
Agricultural	nutrients, pesticides, sediments
Industrial	petroleum products, metals, organic compounds
Residential	household pesticides, nutrients, used oils, pathogens
Construction	sediment, oil and grease

It is very difficult to quantify the contribution to marine pollutant loadings without detailed hydrologic and water quality monitoring. The WHO methods provide some typical loadings that were developed for United States and European countries using the average concentration of pollutants in urban runoff and pollutant loadings per square kilometer for agricultural and urban runoff, however, the applicability of these loadings to the Pacific region is uncertain.

Data on urban and rural runoff quality in the region is very limited. This is the most critical issue affecting management of this source of pollutants to the marine environment. Management and mitigation of NPS pollution requires control of all the various sources.

3 Regional Strategies and Activities

The recommended regional strategies and activities reflect the commonalities of the individual national needs as well as the regional and trans-boundary needs. They provide for:

- promotion and implementation of regional cooperation;
- development of regional goals and objectives;
- establishment of common criteria for assessment of pollutants sources and measurement of environmental quality;
- development of technical information and facility designs;
- development of regional programs and clearinghouses for exchanging and sharing of technical information;
- development of educational and community awareness programs that are adaptable to the individual countries; and,
- development of regional databases for environmental quality information.

The GPA provides conceptual and practical guidance that can be drawn upon by the region and individual nations. The principles and aims of the activities recommended herein are consistent with, and in some cases, the same as the GPA. Where recommendations are similar to those of the GPA, the GPA paragraph number where the activity is found is included in brackets after the recommendation. The overall approach reflects principles of integrated coastal zone management that integrate waste management and sustainable development.

In recognition of the financial constraints of the small island states that exist in the region, recommendations that the GPA included on a national level are recommended for regional implementation. For example, paragraph 97 (d) of the GPA identifies a number of issues related to the development of environmentally sound sewerage facilities that may be appropriately studied on a regional level. The technological information can then be demonstrated in pilot projects or transferred directly to individual countries.

3.1 Overview of Recommended Strategies

The following sections present recommended strategies and activities organized by waste source and activity/strategy type. Activity and strategy types include: technical, policy and legislative, and educational and community-based. Though divided into activity type, it is still intended that management be integrated. The organization by activity type is only meant to facilitate the identification of potential principal implementers.

3.2 Technical Strategies and Activities

Technical strategies include facility design, operations, and maintenance as well as technical training, data management, and technical information exchange.

3.2.1 Domestic Contributions

Domestic sources remain the principal contributors of land-based pollution to trans-boundary waters. Because of their dominating importance to public health and environmental quality,

these activities are a high priority for action.

Wastewater

- Develop/adapt typical designs for individual wastewater treatment systems for distribution to the individual countries. The International Water and Sanitation Decade produced a large number of designs and evaluations that may be adapted for the region. [99, 97 (d)(xviii)]
- Provide capacity building assistance to individual nations to utilize typical designs that are developed on a regional basis. [98,99]

Suggested locations for demonstrating the typical designs:

Atolls: Kiribati, Tuvalu

High Islands: Pohnpei, Solomon Islands, Vanuatu

- Strengthen analytical ability and the capacity of national laboratories through the development of financial mechanisms for funding physical improvements as well as training of laboratory staff. [98,99]
- Training of technical staff can be enhanced by providing internships for national laboratory personnel at other national laboratories in the region. Laboratories in Fiji (e.g. University of the South Pacific) and Papua New Guinea (University of Papua New Guinea) have the capabilities to provide the technical hands-on training. [98,99]
- Conduct research on wastewater re-use for those countries with wastewater treatment systems, e.g. Fiji, FSM, Vanuatu, and Solomon Islands. [97(d) viii]
Suggested pilot project locations: Solomon Islands, Nauru
- Establish regional planning guidelines for tourist industry development. These guidelines would assist island country planners in projecting impacts from tourist developments on wastewater systems and coastal waters.

Solid Waste

Recommended activities for solid waste emphasize development of improved data collection, appropriate landfill designs, recycling and public awareness.

- A regional organization should develop or commission a project to develop typical designs for landfills (“dumps”). A practical and flexible approach that recognizes the financial, technical, environmental, and physical constraints of the different islands should be established. A phased approach, including the containment of waste, use of cover material, and fencing of disposal areas, should be considered for updating existing landfills. Typical designs should be developed for each of the atoll and high island types. [146(f) and (h)]
- Develop pilot projects for composting programs of organic wastes (e.g. yard waste, food waste). Again, the particular constraints for the atoll and high islands should be considered in selecting pilot project sites. This should be coordinated with regional agricultural organizations. Small-scale composting programs are underway in Kiribati and a recent Asian Development Bank

project provided recommendations for expanding these efforts (ADB TA No. 2199, 1996: *Institutional Strengthening of the Environment Unit*).

Recommended pilot project locations: Kiribati, Vanuatu, Samoa.

- It is to be noted that Kiribati has ongoing composting projects for small commercial farmers and individual homes. These primarily have been sponsored by the Pacific Regional Agricultural Program and the Foundation for the People of the South Pacific.
- Develop a database system that tracks the quantities and types of wastes being generated, as well as communities that are willing to participate in recycling programs. This can be developed on a regional basis and transferred to individual countries for their use. Some tailoring of the system may be required for individual countries.
- Conduct a feasibility study to determine the viability of sub-regional recycling centers for materials not financially feasible for individual nations, i.e. ferrous metals, used oil, batteries, plastic products, paper. These centers would take advantage of economies-of-scale created by sub-regional collection and marketing of materials. This should be done in consideration of other activities including: existing recycling operations of individual countries; the feasibility of recycling in the individual countries; and, the potential adverse effects of waste minimization and re-use activities. (Note this recommendation is directly linked to the same recommendations for industrial sources). [141, 124 (vi)]
- Establish “seed” projects for private or cooperative commercial end-users of recycled materials. These “seed” projects can be linked to sub-regional or national recycling collection centers. Possible projects include retreading of tires, artificial reef development, metal plating, used oil marketing, etc.

3.2.2 Industrial Sources

Recommendations for activities to address industrial sources emphasize improvement of data collection and recording, development of pollution prevention methods, and recycling.

- Develop consistent data collection requirements and methods among all the countries in the region [41]. The data requirements should be incorporated in standard national statistics collection systems, and be consistent with rapid assessment methods developed in the recommendations described below. [118 (b)]
- Modify and supplement the WHO rapid assessment methods to suit the industries in the region. [118 (b)]
- Once production data is available use the WHO method to quantify pollutant loadings throughout the region. [118]
- Train local officials in the rapid assessment methods. This can be accomplished through case studies and waste management surveys in specific countries/locales.

Recommended Case Study Locations: Suva, Fiji; Port Moresby, PNG; Port Vila, Vanuatu; Rarotonga; Cook Islands.

The above study locations together in series would provide effective coverage for the major industries in the region. They also have potential for immediate impact and reproducibility elsewhere.

- Assist national governments in developing permit systems that allow for monitoring of industrial discharges and the quality of the receiving water (surface or groundwater). [131, 118 (f), 104 (d)(vi)]
- Establish training programs for local Nongovernmental Organizations and community groups to participate with government agencies in the monitoring of local industries.
- Establish a pilot industrial discharge monitoring program that includes representatives from the government, industry, and the community or a NGO. Possible pilot project areas could be Suva, Fiji or Port Moresby, PNG.
- Compile available information on pollution prevention and waste minimization methods for regional industries. Modify the compilation methods as necessary for the region.
- Promote used oil recycling for urban areas through technical assistance and feasibility studies. The small commercial operation in Apia, Samoa serves as an excellent example of how used oil recycling can be established in a manner appropriate for the region. Technical assistance must be supported by policy, legislation, and public relations so that waste oil recycling remains financially viable. The government, commercial sector, and public should be encouraged to give their waste oil to these types of facilities. [124 (vi)]
- Conduct pilot projects to demonstrate simple remediation techniques for contaminated areas. For example, bioremediation of petroleum contaminated soils is a relatively low cost approach for areas where soils contaminated from petroleum products threaten marine waters. [124 (j)]
- Develop appropriate loading factors for pollutants in urban runoff to allow assessment of this source. [106 (h)]

3.2.3 Agricultural Sources

The high costs of agrochemicals provide an opportunity for agricultural professionals to encourage more environmentally sound pest management practices such as integrated pest management. While the use of fertilizers and pesticides is small compared to other regions, there is a need for improved management of their storage, use, and disposal. The following activities address these issues:

- Develop educational materials for national programs to train pesticide suppliers and users on the safe transport, storage, and use of pesticides.
- Develop informational materials to promote appropriate agriculture methods, including integrated pest management, soil conservation, and crop selection. Establish programs to encourage integrated agriculture and soil conservation programs. These activities are currently being conducted by some regional and national organizations. [130(h), 132]

- Develop regionally appropriate loading factors to modify the WHO method or other available methods (e.g. U.S. Soil Conservation Service's methods) to calculate pollutant loading in runoff from agricultural areas. [131 (h)]
- Circulate descriptions of Best Management Practices (BMPs) and establish pilot BMP demonstration projects. Possible project areas include Pohnpei, PNG, and Vanuatu.

3.3 Educational and Community-Based Strategies and Activities

Education and community-based activities are key components in pollution prevention and waste reduction throughout the region. As isolated island economies are brought into the market-based economy non-traditional products and wastes including pesticides, petroleum-based products, processed food products, and other industrial/manufactured products are proliferated and accumulated at the household level. Community-based activities particularly emphasize the integration of traditional practices, cultural values, and public participation for pollution prevention, waste reduction, and improved sanitation.

Churches and women's groups play an important role in the community and often serve a center for community life and information sharing. Involving these groups in pollution prevention will facilitate the development and utilization of educational materials and activities such as pamphlets and posters to complement the formal education programs. These groups can become actively involved in environmental management programs such as recycling, composting, re-use activities, and monitoring. The use of these groups in such activities will result in environmental management and awareness becoming a part of daily life rather than a special activity.

The continued involvement of other NGOs including specialized environmental, conservation, and resource management NGOs should be continued.

- SPREP should continue its existing program to assist in providing environmental educational materials to individual nations. [130 (h)(viii)]
- SPREP and other international organizations should continue to support the development of local NGOs.
 - Formulate awareness and information campaigns to promote appropriate agriculture methods including: integrated pest management, soil conservation and crop selection.
 - Involve churches and community groups in educational programs and community projects that promote overall environmental awareness, recycling, composting, sanitation, etc.
- Identify existing references and develop new educational materials that demonstrate material re-use in the home. The suggested re-use and recycling strategies and activities should focus on traditional or existing material re-use practices. It is important to emphasize the examples of existing local practices that reduce pollution in addition to the development of new technologies and ideas.
- Develop materials that provide instructions on how community groups can participate in cleaning up litter, preventing NPS pollution, improving water quality through "Adopt a Clean Stream/Beach/Road Programs". These programs involve a community group taking on the

responsibility of maintaining a portion of a stream, beach, road by picking up litter, educating users about the resource's value, and conducting other activities to minimize pollution of the area. These can be tailored to the cultural and traditional systems existing on the individual islands or atolls. [130 (h)(viii)]

- SPREP should continue to assist in the establishment of environmental curriculum for schools and community groups based on local conditions, customs, and traditions.
- A regional organization should assist national governments in establishing local presentations and capacity-building workshops on water and sanitation issues. Communities should be provided technical assistance, organizational support, financial support, and materials in the development of community-based water and sanitation projects. These can be developed through NGOs and church groups.
- Pacific Island countries and regional organizations should continue to seek support and resources for capacity-building from neighboring countries including Hawaii (USA), Australia, New Zealand, Japan, and China.

3.4 Policy and Legislation

Policy and legislative recommendations for the region focus on encouraging cooperation among countries in the region and provision of technical assistance to the region. In many cases, the regional assistance is necessary for the individual countries to develop improved policies and legislation in a timely manner.

- Provide assistance to countries for the development of industrial waste permit systems wherever possible. Permit systems are an effective method for legislating industrial waste monitoring efforts. The permit system need not be interpreted as a command and control approach, but also should be seen as a means of monitoring the effectiveness of different treatment methods. The systems serve not only to justify requiring increased treatment efficiency, but also to justify reduced treatment requirements. This will depend on the facility type, its location, and its in-house waste reduction efforts. Waste reduction, or pollution prevention, can easily be incorporated into the permit systems. Facilities that incorporate pollution prevention and waste reduction can be rewarded through tax incentives or other mechanisms developed per the recommendation above. The permit systems provide the government with a mechanism for monitoring the industrial waste output, and for working with the industries to reduce the deleterious impacts of the industry on the environment. [120 (d)]

Priority countries for permit systems are Papua New Guinea, Solomon Islands, and Vanuatu.

It is to be noted that full implementation of Fiji's permit system also represents an opportunity for mitigation of immediate marine water quality concerns as well as serve as an excellent demonstration project.

- Develop regional and sub-regional programs for preventing and responding to oil and chemical spills. [125]
- Provide assistance to individual countries for the development of "Green Business Programs" that encourages recycling, pollution prevention, and waste minimization with appropriate tax

benefits and loan assistance. In such programs, industry participation and financial support of water quality monitoring should be encouraged through tax and license incentives.

- Regional sponsored seminars for political and business leaders that stress the inter-relationship of the protection of the marine and fresh water resources and economic and community well-being should be provided. These seminars should include site visits to locations where (1) planning and management activities have improved environmental quality as well demonstrated economic benefits; and, (2) poor planning or environmental degradation has resulted in lost economic opportunities.
- Establish legislation and policy supporting NGO and community involvement in environmental monitoring, environmental impact assessment (EIA), permitting, and pollution prevention programs.

Country Recommendations

The following sections provide specific recommendations for strategies and activities to mitigate or prevent water resource pollution in the individual island countries of the Pacific region. The recommendations are based on the current conditions of the countries and their respective needs.

In general, most Pacific Island countries need enhanced capacity-building for protection of national and trans-boundary water resources, integrated coastal resource management, and environmental planning at the national and local levels. As more pressures are applied to island geographies from market-based economic activities, improved EIA and planning is necessary to reduce and mitigate the affects of development actions. Integrated planning at the local level can be used to promote appropriate economic development based on local land tenure systems, the needs of local communities, local customs and traditional practices, and the restrictions of local geographic conditions. This type of proactive planning forms the basis of sustainable development at the local level.

The recommended activities include references to legislative and policy tools, as well as BMP. Appendices 1 and 2 provide examples of such tools, respectively.

4 Cook Islands

4.1 Introduction

The 15 islands comprising the Cook Islands are located between 156° and 167° West longitude and 8° and 23° South latitude. The islands cover approximately 1.83 million square kilometers with Rarotonga (65 km²) and Mangaia (51 km²) being the two largest islands. Fifty-three percent (53%) of the population lives on Rarotonga, which contains the capital city of Avarau. Population growth is declining due to a trend of out-migration. The Cook Islands established some environmental legislation and management systems to address pressing environmental concerns.

4.1.1 Economy

The economy of the Cook Islands is dominated by agricultural production of banana, oranges, pineapple, copra, and papaya (pawpaw). There is light manufacturing including fruit processing, clothes production,

handicraft production, and the assembly of electronic components. The pearl farming industry also is growing in the lagoons of Manihiki. Tourism also has grown to become a primary revenue generators in the islands. It can be assumed that as tourism grows in the rest of the region it also will grow in the Cook Islands.

4.1.2 Social and Cultural

The Cook Islands Maori and culture dominate the cultural landscape in the islands. The traditional land tenure system provides for the retention of land and resources in the hands of the local population. Traditional lifestyles are maintained on the smaller islands with the traditional extended families and leaders retaining extensive control over land and resource management decisions. The traditional values of *ra'ui* are exercised in many areas.

The Christian Church, Roman Catholic Church, Seventh Day Adventist Church are the main denominations of the Christian religion in the islands.

4.1.3 Land-Based Sources of Marine Pollution

There are limited sources of land-based marine pollution in the Cook Islands. Rarotonga is served by septic tanks, while other island populations primarily use latrines. Some over-the-water latrines are probably in use in the smaller islands. The problem of domestic sewage and wastewater poses one of the most significant threats to water resources in a number of the Northern and Southern island groups. Shallow water tables on the atolls and the near shore areas near hotels directly contribute to water contamination. Water pollution from sewage threatens the growing tourism industry, pearl farming, and local fishing.

Because of the small manufacturing base in the islands, commercial and industrial sources of water pollution are limited. Fruit processing, printing, clothes manufacturing, and the agricultural industry do produce limited quantities of hazardous wastes that could threaten the marine environment if not stored or disposed of properly.

Agricultural runoff from pesticide use and erosion also poses a significant threat to marine and fresh water quality. Upland erosion resulting from poor agricultural practices and poor maintenance of drainage channels results in high suspended sediment loads in stream flow and overland flow. This results in the discharge of heavy sediment loads to the lagoon areas, which directly affects marine ecosystems. Poor pearl farming practices also are affecting conditions in Manihiki and other Northern islands that are expanding pearl production. The combined effects of domestic sewage and wastes from poor pearl farming threaten lagoons throughout the area.

Approximately 9,000 cubic meters of solid waste from the population of approximately 18,000 is disposed of inland from the coast in generally poorly managed garbage dumps. A continued rise in the amount of tourism activity and changing lifestyles also will increase the generation of solid wastes in coastal areas. Some recycling efforts exist and help to reduce the amount of solid waste being accumulated in the islands. It is assumed that this effort is centered on Rarotonga.

4.2 Overview of Recommended Strategies

Strategies for preventing or mitigating pollution of water resources in the Cook Islands should combine technical, educational, and policy initiatives. Particular emphasis should be placed on incorporating

traditional knowledge and management systems like *ra'ui* with new technologies and environmental awareness programs. Specific emphasis should be placed on promoting local decision-making and planning.

Efforts to prevent and mitigate pollution should focus on reducing impacts from domestic sewage or wastewater, agricultural industries, pearl farming, and the growing tourism sector. Consistent with recommendations from the GPA, the NEMS for the Cook islands, and regional requirements, general environmental monitoring and record keeping of the types and quantities of pollutants and local water quality need to be improved.

4.3 Technical Strategies

- Increase environmental monitoring of local light industry and manufacturing to determine the types and quantities of wastes generated.
- Collect production data, raw material usage and other data necessary to conduct rapid assessments of pollutants sources. Collect data as part of existing industrial statistics activities.
- Establish water quality monitoring of important water resources including those that have important economic value (i.e. Coastal areas used in tourism and pearl farming like Manihiki lagoon). [137 (j)]
- Develop administrative oversight for the storage and disposal of hazardous and non-hazardous wastes away from water resources. [104 (d)(iv)]
- Establish sewage treatment facilities for the tourism industry and growing “urban” areas.
- Establish a program for the development of composting toilets for households for rural areas on all the islands and atolls. [97 (d)(xviii)]
- Develop and implement spill prevention and response plans for petroleum and energy facilities. Emphasis should be placed on implementing low-tech prevention techniques like drip pans and automatic cut-off valves. [124 (d)(viii)]
- Establish programs to support existing commercial recycling activities.
- Develop composting programs for homes and small farms.
- Encourage BMPs for erosion and sediment control in agriculture and large building development. [137 (d), 130 (h)(iv)]
- Provide community solid waste disposal containers in communities at convenient locations with assurance of adequate pickup and disposal. [146 (d)]

4.4 Educational and Community-Based Strategies

- Establish basic environmental awareness projects in schools and government offices on littering and domestic sewage/sanitation problems. [97 (h)]

- Promote environmental awareness projects and networking in established local civic organization and church groups including the Cook Islands National Council of Women, Catholic Women's League, and the local business associations.
- Build expanded environmental awareness programs and groups based on existing campaigns like the recycling program. [146 (h)]
- Network traditional leaders from the smaller island groups through a program on environmental awareness.
- Document, preserve, and teach traditional knowledge systems with an emphasis on coastal resource management and preservation.

4.5 Policy and Legislative

- Mandate through legislation the development of monitoring and reporting for hazardous and non-hazardous wastes at manufacturing and light industrial facilities.
- Establish policies and protocols for storages and disposal of solid wastes. [104 (d)(ii)]
- Establish requirements for phasing out of inadequate latrines and over-the-water toilets.
- Establish requirements for wastewater treatment at tourist accommodations and service facilities. [97 (d)(ii)]
- Promote the development of island and village development and environmental management plans through local/traditional leaders. [146 (l)]
- Develop training for pesticide importers, retailers and users. [104 (d)(viii)]
- Establish requirements for BMPs for agricultural production and large building developments. [130 (h)(iv)]
- Establish a coastal management plan based on local conditions and experiences.

5 Federated States of Micronesia

5.1 Introduction

The Federated States of Micronesia (FSM) is located approximately 5,150 kilometers west-southwest of Honolulu in the North Pacific Ocean. The FSM is composed of four major island groups totaling 607 islands with a total land area of 702 square kilometers and 6,112 kilometers of coastline. There are four states, Pohnpei, Yap, Kosrae, and Chuuk. There are approximately 102,000 people residing in the FSM with a population growth rate of 2.8 percent.

FSM has a well developed regulatory framework established in the Environmental Protection Act of 1984, and administered by first the Environmental Protection Board and then the Secretary of the Department of Human Resources. The individual states have a wide variety of environmental administration and management policies and programs that have hampered the clear division of responsibilities between the state and national governments. Despite the existence of laws for resource conservation and permitting, there are no environmental regulations specifically related to tourism development.

5.1.1 Economy

FSM's natural resources include forests, marine products, and deep-sea based minerals. Fishing, limited manufacturing of clothes and handicrafts, and small scale agriculture are the main local economic activities. Other states have cold storage facilities, but no significant processing facilities exist. Canneries are planned for all states. The relatively small economic base of the country is heavily dependent on foreign aid.

5.1.2 Social and Cultural

The states of FSM, including Pohnpei, Chuuk, Kosrae, and Yap, are socially and culturally diverse. Traditional cultural values and lifestyles are dominant on most of the islands except in the larger population centers like Kolonia. Traditional land tenure systems of family and clan owned lands are prevalent in all areas. Western private property tenure systems are prevalent in Pohnpei.

5.1.3 Land-Based Sources of Marine Pollution

The primary land-based pollutant sources in the FSM are solid waste, domestic and commercial wastewater, and sedimentation from agriculture (particularly related to *sakau* cultivation on Pohnpei). Specific pollution sources impacting coastal water quality in the FSM are runoff and associated sedimentation, discharge of sewage, discharge from fish canneries, poor domestic waste management, and the increase of non-traditional land use. Though regulations exist, a lack of funding and training have resulted in little enforcement. These same problems result in poor operation and maintenance of waste water facilities.

- Untreated sewage is discharged into coastal waters from the urban areas of Pohnpei and Chuuk, though improvements to the treatment system have resulted in the less raw sewage discharge. Kosrae and Yap have small populations, and the wastewater treatment plants are believed to still provide reasonable treatment of sewage. In rural areas sewage is disposed in septic tanks and latrines, to include over-the-water latrines.
- Solid waste disposal is poorly managed and most disposal sites are located in mangrove areas. Some disposal sites are located near urban amenities (i.e. Pohnpei dump).

- Commercial activities that may contribute to marine pollution, but for which no data is available include laundries, auto shops, ship repair, and printers. Oil pollution from power plants and gas stations also are potential sources of pollution.
- No data on agrochemical use is readily available. Erosion as the result of poor agricultural practices, especially on the steep slopes of Pohnpei, is likely to result in loss of valuable topsoil and downstream sedimentation.

5.2 Overview of Recommended Strategies

Since the FSM has a developed regulatory framework emphasis should be placed on the implementation of mandated policies and regulations. In the urban areas more western forms of environmental protection and awareness programs should be implemented, while more traditional based programs should be emphasized in the rural areas.

Resources need to be devoted toward local capacity building and integration of the various government sectors involved in environmental protection and public health. The NEMS recommends an overhaul of the regulatory framework to create clear areas of responsibility between the states and the national government. While it is important to establish clear policies, it appears, however, that scarce resources should be directed toward capacity building at the local levels to obtain tangible results.

Since the major sources of pollution are from domestic wastewater technical efforts should be focused on reducing the population's reliance on latrines and reduce the use of important mangroves as waste dumps.

5.3 Technical Strategies

- Continue to improve and maintain domestic wastewater treatment efficiency. [97 (d)(iv)]
- Connect more households to existing sewage treatment systems. [97 (d)(x)]
- Implement a program to select and install improved individual sanitation systems, particularly in urban areas not yet accessible to the municipal system. [97 (d)(x), 97 (d)(xviii)]
- Establish oil spill prevention and response plans for the power plant, bulk fuel storage facilities, and port facilities. [124 (d)(viii)]
- Implement low-tech oil spill prevention technologies including drip pans and butterfly valves on loading hoses.
- Reduce/Eliminate solid waste disposal in mangrove areas through the development of alternative landfill sites. [146 (j)]
- Conduct a feasibility study for local recycling programs. [146 (j)]
- Provide training to local farmers and contractors on basic BMPs to reduce erosion and sedimentation from agriculture and building activities. [137 (d), 130 (h)(iv)]

- Conduct studies on the state of important resources including mangroves.
- Conduct a feasibility study on recycling of non-ferrous metals (i.e. aluminum cans), paper, and plastic. [146 (b)]
- Provide community solid waste disposal containers in communities at convenient locations with assurances of adequate pickup and disposal. [146 d]

5.4 Educational and Community-Based Strategies and Activities

- Establish environmental education on local radio programs.
- Encourage the development of environmental awareness in established civic organizations including women’s groups, business associations, and church groups.
- Develop educational materials on agricultural and construction Best Management Practices. [137 (d), 130 (h)(viii)]
- Include environmental education curriculum in schools and church schools.
- Promote the development of ocean-oriented groups (i.e. fishermen).
- Network local fishermen and resource owners and involve them in planning efforts.
- Develop a sanitation campaign for all islands using local terms of reference and languages.
- Train local village people in community organization and awareness.
- Document local knowledge systems related to environmental management and resource allocation.
- Involve business and government leaders in seminars and workshops on environmental impact assessment, “green business” opportunities, and sustainable development. Include positive and negative examples of the interrelationship of long-term economic success and good environmental management.

5.5 Policy and Legislative Strategies

- Focus policy efforts on local needs and environmental problems.
- Mandate oil pollution prevention plans for all petroleum facilities. [124 (d)]
- Establish policies for cross-sectoral tourism and development planning .
- Centralize environmental data management under one agency.
- Provide funding for training and enforcement of existing regulations.

6 Fiji

6.1 Introduction

Fiji is composed of 332 islands (approximately 110 are inhabited) with a total land area of 18,274 km² and 1,129 kilometers of coastline. There are four major islands which include Viti Levu, Vanua Levu, Taveuni, and Kadavu; the two largest islands, Viti Levu and Vanua Levu, have areas of 6,418 and 3,419 miles² respectively. In 1989, the Fijian population was estimated to be approximately 756,559, of which 61 per cent lived in rural areas. The population density is 39.7 persons per square kilometers. Suva, the capital city of Fiji has an estimated population of 157,980, and the urban growth rate is 3.4 per cent. The overall population growth rate for Fiji is 2.1 per cent. The majority of the Fijian population is found in the lowlands which consist of flatter land in the coastal areas near large deltas. Natural resources consist of timber, fish, copra, gold, and copper.

6.1.1 Social and Cultural

The Fiji Islands are inhabited by native Fijians of Melanesian and Polynesian stock, Europeans, mixed European-Fijians, Indians and Chinese. Most Fijians live in clan groups and maintain subsistence lifestyles on communally owned lands, and most Indians, Chinese, Europeans and other ethnic groups live in the more urban area of Suva.

Approximately 83% of the land is held communally under traditional Fijian custom, and is administered by the National Land Trust Board. Local lands are managed by the hereditary chief and the various family groups. The remaining land is privately held either by European farmers or Indian businessmen.

6.1.2 Economy

The Fijian economy is primarily agriculturally based and has a large subsistence sector, yet maintains a moderate industrial sector in the urban areas. Sugar is a major export product its processing accounting for a third of the industrial output. The industrial sector is among the largest in the region, but only small to medium on a worldwide scale. Tourism, garment manufacturing, gold mining, timber, commercial fishing and coconut products are key parts of the economy.

6.1.3 Land-Based Sources of Marine Pollution

Industrial, agricultural and domestic activities are the major sources of marine pollution in Fiji. These activities include mining, shipyards, slipways, moorages, sugar mills, timber mills, cement factory, litter refuse disposal sites, sewage, pesticides and herbicides, tourist developments, and changing land-use practices. Environmental problems in Fiji also arise from highly erosive rainfall in areas impacted by deforestation and agriculture. Suva Harbor is described as highly contaminated (Cripps, 1992; Morrison, 1992a).

Urban areas of Fiji are reasonably well-served by adequate sanitation facilities. The rural coverage is also reasonably well-served. Though the level of coverage appears acceptable, the present facility designs and conditions still result in sanitation problems. Numerous marine pollution problems are associated with domestic sewage.

Solid waste is collected in urban areas, however, nearly all dumps are poorly maintained and most are located in environmentally sensitive areas. Eleven of the 21 surveyed sites were located in mangrove or other coastal areas. Smoke, smell, insects, water pollution, and loss of natural beauty were the environmental problems noted by a previous study (Bronders, 1991).

Urban areas are served by both sewer and individual wastewater disposal/treatment systems. Secondary treatment is provided for the reticulated system and it discharges into Suva Harbor. Urban areas not served by sewers are often the older areas of the towns and thus also have inadequate septic tanks, cesspools, and latrines. These individual facilities are known to be undersized and often discharge overflows and or leachate directly to marine areas or streams and storm drains.

6.2 Overview of Recommended Activities

Fiji has a relatively well-developed economy, institutional structures, and technical capabilities that both provide great opportunities for addressing land-based sources of pollution and create challenges in the number and variety of sources to address. Central to all recommendations is the collection of adequate data to prioritize mitigation activities.

6.3 Technical Strategies and Activities

6.3.1 Domestic Wastes

- Expand urban sewer systems and phase-out individual systems in highly populated areas. Where individual systems can not be replaced develop programs to improve the design and operation of these facilities. [97 (d)(x)]
- Provide affordable wastewater pumping services for individual systems.
- Continue to enforce anti-littering ordinances. [146 (b)]
- Conduct feasibility study to re-use treated wastewater for agricultural purposes to avoid the release of heavy loads of nutrients into Suva Harbor. [97 (d)(viii)]
- Provide community solid waste disposal containers in communities at convenient locations with assurances of adequate pickup and disposal. [146 (d)]

6.3.2 Industrial Wastes

- Improve data collection for industrial sources so that it is consistent with rapid assessment methods and regional needs. Include raw material usage and unit production information.
- Conduct surveys of industrial sources to document location pollutant sources and types.
- Develop spill prevention and control plans for utility and fuel storage plants. [124 (d)(viii)]
- Conduct a feasibility study to identify and design a solid waste landfill suitable for acceptance of industrial wastes. [146 (f)]
- Develop a used oil, battery, and other hazardous material recycling facility. Business community cooperation to develop this as a commercial operation is preferred. [104 (d)(iv)]
- Conduct a feasibility study for recycling of other materials, including aluminum, paper and

plastics. The feasibility study should consider government and commercially run operations. Consider integration of recycling needs with waste collection operations. [146 (d)]

- Research opportunities for the re-use of brewery and sugar processing wastes for agricultural needs. [146 (d)]

6.3.3 Agricultural

- Develop improved agricultural techniques to limit erosion, particularly on up slope areas. [137]
- Implement integrated pest management techniques to minimize the use of agrochemicals, particularly on large commercial plantations.
- Implement BMP plans and techniques in construction, agriculture, and industry.

6.4 Educational and Community-Based Strategies

- Develop and implement “Adopt a Stream/Beach/Road” programs in urbanized areas.
- Integrate environmental awareness into the formal education process.
- Continue to promote anti-littering campaigns.
- Develop and distribute to agriculture industry educational materials on best management practices to avoid excessive erosion and runoff.

6.5 Policy and Legislative Strategies

- Fully implement the existing permit system in Suva and expand to other areas. [97 (d)(xiv)]
- Require environmental monitoring by permitted industrial facilities.
- Conduct independent monitoring of receiving water quality (including groundwater).
- Develop policies and mechanisms to encourage “green businesses” through tax and license incentives.
- Establish coordinating agency to coordinate environmental management activities.
- Involve coordinating agencies in development/economic planning activities. This includes development of integrated environmental impact assessment
- Conduct study to assess feasibility of community service as alternative to fines or prison terms for littering, permit violations, etc. [146 (b)]

7 Kiribati

7.1 Introduction

Kiribati is composed of 33 islands that are divided into three island groups; the Gilbert (contains 93 percent of the population), Phoenix, and Line Islands. Of total land area of 810.5 square kilometers, Christmas Island is the largest island with a total area of 388.4 square kilometers. Kiribati has 1,143 kilometers of coastline and a total marine area of 3.55 million square kilometers. The 1990 census reported the population of Kiribati to be 72,298 of which 47,144 (65%) people live in rural areas and 25,154 people (35%) live in the 15.8 square kilometers of urban area. Twenty of the 33 islands are inhabited. The growth rate is 2.24 percent and the population density of Kiribati is 89 people per square kilometers. South Tarawa, the capital, contains 34.8 percent of the total population. Natural resources on Kiribati consist of copra and pelagic fishing. Approximately three percent of Kiribati is forest land.

7.1.1 Economy

The economy is primarily based in subsistence fishing and agriculture with over 60% of the workforce found in this sector. There is a small commercial and service sector. Exports are primarily limited to fish and copra. Employment opportunities, primarily in government service and small private commerce, are found on South Tarawa.

7.1.2 Social and Cultural

The I-Kiribati have strong kinship ties and the family and traditional leadership systems remain strong. Status in the I-Kiribati society is characterized by acknowledging equality with others as opposed to a competitive approach. Land tenure is governed by British imposed legislation as well as the traditional system. Land is exchanged through a complex structure involving all aspects of customary social organization. The government owns no land and must lease property for government functions.

The social organization and traditional leadership is focused around the *Mwaneaba* where community meetings take place and decisions are made. The *Mwaneaba* holds a central place in the society in both a physical and a figurative sense.

7.1.3 Land-Based Sources of Marine Pollution

Land-based sources of pollution are principally from domestic sources with the lack of sanitation facilities being the greatest course of marine environmental degradation. Groundwater is also contaminated from sanitation facilities. Solid waste that is normally dumped without containment on coastal areas also represents a major threat to water resources. Industrial and agricultural sources are insignificant.

7.2 Overview of Recommended Strategies

The recommended strategies focus on the continued development of Kiribati's institutional capacity, inclusive of policy and legislative needs, as well as technical improvements to address urgent sanitation and waste management needs. As a result of the dominance of domestic sources, most recommendations focus on this area.

7.3 Technical Strategies and Activities

- Continue expansion of individual and small commercial farms composting.
- Develop a pilot project to compost organic materials from municipal wastes. Once a pilot project is established composting activities is expanded to other disposal sites. [97 (d)(xvi)]
- Construct containment facilities for beach dump sites, cover and secure as practicable.
- Study and select individual sanitation facilities that will be culturally and socially acceptable. [97 (d)(xviii)]
- Locate reticulated sewer system outfalls at greater depths to minimize contamination of near shore areas. The placement of outfalls at adequate depths for enhanced mixing is consistent with GPA recommendation found in paragraph [97(d)(vi)].
- Provide community solid waste disposal containers in communities at convenient locations with assurances of adequate pickup and disposal. [146 (d)]
- Continue to develop aluminum can recycling on a commercial level. [146 (d)]
- Used oil at the power plant should be properly contained and a spill prevention plan developed and implemented. [124 (d)(viii)]
- Existing contamination of soil around the plant should be remediated through simple bioremediation techniques.

7.4 Educational Strategies and Community-Based Activities

A strong traditional leadership system remains in Kiribati. Church groups and other community-based groups and activities have strong potential to affect improvement of environmental management.

- Utilize *Mwaneaba* system, church groups, and women's groups to integrate environmental education into the daily life of the community with an emphasis on sanitation and waste management. [97 (h)]
- Continue to develop environmental education materials in Kiribati.
- Use environmental awareness and formal educational materials to encourage recycling and re-use of materials. [146 (h)]

7.5 Policy and Legislative Strategies

A number of policy and legislative activities are currently underway to improve the institutional capacity Kiribati to address water resource concerns. These are noted below along with recommendations for additional activities.

- Continue to develop comprehensive environmental legislation that emphasizes planning and coordination.
- Through existing Business Names Act, develop “Green Business Program” that offers special tax benefits.
- Utilize Customs Act to prohibit import of hazardous wastes and encourage import of less hazardous materials. [104 (d)(ii)]

8 Marshall Islands

8.1 Introduction

The Republic of the Marshall Islands (RMI) is an island group consisting of 30 atolls and 1,152 islands. The major atolls are Kwajalein, Rongelap, Enewetak, and Maloelap. The RMI is located in the North Pacific Ocean, approximately 800 km southwest of Honolulu (approximately two-thirds of the way between Hawaii and Papua New Guinea) and has a total land area of 181.2 square kilometers with 370.4 kilometers of coastline. In July 1989, the population of the RMI was reported to be 46,188 with a population growth rate of 4.2 percent. The urban and rural population densities are 19,336 and 626 people per square respectively.

8.1.1 Economy

Approximately 60 percent of the land in the RMI is cultivated. The RMI's major natural resources are marine products. Deep-seabed mining is not economically viable at this time. The islands are raised coral islands with low elevations. The United States formerly used both Bikini and Eniwetak for nuclear testing. Kwajalein is a US military base and is used as missile-testing range.

The RMI economy is primarily based on foreign-aid from the U.S. and fishing. There are few local industries.

8.1.2 Social and Cultural

Traditional leadership centered around the extended family continues to play an important role in the Marshall Islands. Land tenure is still based on the traditional system that maintains land management within the extended family.

8.1.3 Land-Based Sources of Marine Pollution

The most serious environmental problems in the RMI are caused by overpopulation and poorly-planned development. The environmental quality of the urban area is impacted by increased demand on land and water resources due to over-exploitation of food resources, over use of water supplies, and contamination of marine and fresh water. Additionally, domestic waste water and solid waste disposal also pose a serious threat to the RMI environment.

Human and animal wastes and increased concentrations of nitrogen have been identified in extremely high concentrations in lagoon waters near densely populated areas. Coastal shoreline waters have also been found to be contaminated by human and animal wastes. Contamination of groundwater by benjos

and pit privies have impacted the quality and use of groundwater.

Domestic waste disposal in Majuro/Ebeye, including sewage and solid waste, is the major contributor to marine pollution. Industry is not present in the RMI, with the exception of some laundries and small print shops. A tuna cannery is planned for Majuro. Domestic wastewater disposal is achieved by a combination of piped sewerage and individual systems in urban areas and all individual facilities in rural areas. The piped sewerage is untreated but discharges to the ocean side of the atoll. The negative environmental and public health effects of these discharges, even though the outfalls are not at great depth, are less than the cumulative discharge of the individual facilities that discharge on the lagoon side. In addition to the individual land facilities, many persons still use the beaches below the high water mark.

All solid waste in the RMI is disposed of into the marine environment, either in very low lying areas or reef flats. This is true both for controlled facilities and litter, which are prevalent in both Majuro and Ebeye.

8.2 Overview of Recommended Strategies

The RMI has, through its Environmental Protection Authority, a strong regulatory framework for the management and control of land-based pollution. It provides for environmental assessments, permitting, and monitoring of all major activities. The need for major capital improvements and trained personnel to operate and maintain them are necessary before such a framework can be effective in managing domestic waste disposal.

Efforts to mitigate water resource degradation should be focused on implemented grassroots solid waste and sanitation programs within the established regulatory framework. Improved development planning should be fostered through the use of EIA and coastal zone planning. However, the focus should be on the development of local environmental awareness, and capacity-building to solve local water resource and sanitation problems.

8.3 Technical Strategies

- Develop a grassroots sanitation program to replace over-the-water latrines and poor septic system. [97 (d)(xviii)]
- Study feasibility of extending the reticulated sewerage system outfall further beyond the reef and to greater depths. [97 (d)(vi)]
- Develop improved designs for coastal solid waste disposal facilities with consideration of the future land uses of the area. [146 (j)]
- Provide community solid waste disposal containers in communities at convenient locations, with assurance of adequate pickup and disposal. [146 (d)]
- Continue and re-vitalize aluminum can recycling activities. [146 (b)]
- Establish oil spill pollution prevention plans and technologies, particularly for bulk fuel storage

facilities, port areas, and the power plant. [124 (d)(viii)]

- Establish BMP sediment controls for agriculture and construction. [137 (d)]

8.4 Educational and Community-Based Activities

- Continue to develop local environmental awareness programs at grassroots level and through the EPA and schools. [104 (d)]
- Involve church groups and other organizations in environmental awareness and action programs. [97 (h)]

8.5 Policy and Legislation

- Incorporate “Green Business” provisions into existing business registration and taxation legislation.
- Localize regulations for environmental planning and coastal management to emphasize local decision-making and capacity-building.

9 Nauru

9.1 Introduction

Nauru is a small coral island with a population of approximately 8,000. The island area is approximately 21 km², with phosphate bearing rock covering approximately three fifths of the surface. Approximately half of the people on the island are immigrants working in the phosphate industry. Government on the island is two tiered, with an island governing parliament, and a local government council.

9.1.1 Economy

Nauru is a small single island country with a monolithic industrial base. Mining for phosphate is the largest component of the economy, with most other economic activity supporting the mining industry. The island of Nauru supports a population of approximately 8,000.

9.1.2 Social and Cultural

Nauruan traditional leadership systems have been absorbed by the Island Council and national government. Land is individually held. The majority of Nauruan are Christian.

9.1.3 Land-Based Sources of Marine Pollution

The single greatest source of land based pollutant on Nauru comes from domestic sources. Domestic waste is collected and piped through a sewerage system, however the sewage receives no treatment prior to discharge. Waste, primarily phosphate based from the mining industry is controlled and remains on land, resulting in little or no impact to the marine environment. Its effects on groundwater have not been

ascertained.

9.2 Overview of Recommended Strategies

Nauru, with an advanced economy based upon a singular industry, and a relatively high standard of living, is amenable to engineered solutions to resolve the impacts of domestic wastewater to marine near shore waters. A policy based engineering approach, with strategic goals and objectives based upon recognized standards, should be implemented for long-term institutionalization of pollution prevention.

9.3 Technical Strategies and Activities

- Design and construct facilities for the treatment of wastewater. [97 (d)(iv), 97 (d)(x)]
- Provide water quality monitoring capabilities for use in near shore waters, and training on the use of monitoring equipment, with an emphasis on wastewater born pathogens. [97 (d)(xiv)]
- Provide community solid waste disposal containers in communities at convenient locations, with assurance of adequate pickup and disposal. [146 (d)]
- Monitor groundwater quality at or near solid waste disposal sites.

9.4 Educational and Community-Based Strategies and Activities

- Create awareness programs aimed at educating the community on the impact of human activity, particularly sewage discharge on the near shore environment. [97 (h)]
- Institute a scholarship program for environmental and engineering disciplines, with a stipulation for a commitment to work and train on Nauru following completion of education. [97 (f)]
- Orient a portion of the curricula in elementary, middle, and secondary schools toward environmental subject matter.

9.5 Policy and Legislative Strategies

- Appoint an inter-department commission to study and recommend approaches for upgrading the current sewerage system. [97 (d)(iv)]
- Implement strategic planning to detail a phased approach to implementation of treatment of wastewater with time tables, costs, and priorities. [97 (b)]
- Legislate a monitoring program, consistent with local customs, to detect and document the quality of near shore waters, fisheries, and littoral conditions, particularly near sewage outfalls. [97 (d)(xiv)]

- Establish water quality standards consistent with regional goals.
- Create a body for the collection, analysis, and dissemination of coastal water quality data.

10 Niue

10.1 Introduction

Niue is a small island state of 258 km² with a declining population of approximately 2,300. The island is a self governing Commonwealth in a contract of free association with New Zealand, as of 1974. Education is compulsory until the age of 14.

10.1.1 Economy

Over half the population is employed by the government, with the remaining population primarily in agricultural and tourism related employment. The agricultural base is both of a commercial and subsistence nature. The commercial agricultural industry is based upon fruit production and processing, with some animal husbandry. New Zealand supplies approximately two-thirds of the local budget through intergovernmental aid.

10.1.2 Social and Cultural

All land on the island is owned by families, with three quarters belonging to the Ekalesia Niue. The London Missionary Society, Catholics, and Mormons are the predominant religious organizations on the island. Island inhabitants live in villages throughout the island, with a slight concentration of population near the administrative center of Alofi.

10.1.3 Land-Based Sources of Marine Pollution

Domestic waste is the primary source of marine pollution. Other lesser sources of marine pollution include:

- soil erosion from unprotected alteration to upland areas;
- waste from agricultural production;
- pesticides from agriculture; and
- small boat harbor maintenance facilities.

10.2 Overview of Recommended Strategies

Due to the rural nature and small population of the island, strategies should focus on activities which easily integrate into the traditional lifestyle and which are not intensive in terms of human and capital resources. Because the island economy is supported in large part by New Zealand, institutionalization of environmental management strategies into the customs of the local population base will ensure long-term utilization.

10.3 Technical Strategies and Activities

- Provide a standard for individual and collective wastewater treatment systems, and implement a time sequenced approach to their integration based on need.[97 (b), 97 (d)(xii)]
- Establish management practices for the containment of wastes from agricultural production, to include capabilities for recycling or reusing organic residuals. [137 (d), 130 (h)(vi)]
- Establish BMPs that provide guidelines for activity specific approaches for the preservation of topsoil and prevention of erosion.
- Provide training to pesticide users on the proper use and disposal of chemicals and pesticides. Encourage integrated pest management. [104 (d)(viii)]
- Provide technical training on water quality monitoring and coastal environmental processes: water quality monitoring should focus on wastewater and agrochemical based residuals. [97 (d)(xiv)]

10.4 Educational and Community-Based Strategies and Activities

- Implement environmental education programs in public schools.
- Give scholarships for environmentally focused higher education with stipulations for in-kind provision of educational services to the local population on Niue. [97 (f)]
- Create an advisory organization composed of local business interests, religious organizations, and government agencies to establish standards for pollution control, consistent with regional goals.

10.5 Policy and Legislative Strategies

- Provide incentives for the use of integrated pest management strategies, such as tax breaks and loan programs, for the use of ecologically sound multi-cropping strategies.
- Utilize the local land regime to formulate land use controls that protect marine resources from land based pollutants.
- Establish a coordinating agency or commission to oversee implementation of monitoring programs.

11 Papua New Guinea

11.1 Introduction

.1 Introduction

Papua New Guinea (PNG) consists primarily of a large island land mass and several smaller islands that are populated by approximately 3,650,000 people, 2,600,000 of which live in the rural highlands. Urban areas include Port Moresby, with a population of 390,000, and the provincial centers.

11.1.1 Economy

Much of Papua New Guinea's economy is based the mining industry. In addition to mining, other export oriented activities include the production and processing of palm oil, coffee, tea, cocoa, and sugar. For domestic consumption economic output includes soft drink, beer, and paint production. The domestic economy also has substantial food processing capacity. Agricultural activity in PNG occurs from the coast to inner highlands. Subsistence agriculture is practiced throughout PNG.

11.1.2 Social and Cultural

Papua New Guinea is home to a number of ethnic groups. Life in the Capital of Port Moresby is becoming Westernized, while the rural areas remain somewhat traditional. Land in the rural areas is managed in a variety of methods including customary land management and ownership and in two freehold land systems. The land tenure system is designed to maintain customary land management and ownership and protect the rights of indigenous people.

The land tenure systems are mixed with the local government structure that is becoming more westernized. Traditional leadership in local areas is not based on heredity, but on achievement. Local traditional laws and systems of leadership are being replaced with western style elected councils.

11.1.3 Land-Based Sources of Marine Pollution

Significant sources of water resource and marine environment pollution include:

- Mining discharges (direct and erosion -related).
- Industrial waste from industries such as beer, palm oil, and sugar refineries.
- Agricultural waste, particularly pesticides.
- Domestic solid waste.
- Domestic wastewater; approximately 40% of the urban population has piped sewerage with wastewater discharged untreated to surface water systems. Most of the remaining population using septic systems (36%) or latrines (24%).

Mining waste has the most dramatic impact to the inland and coastal water resources of Papua New Guinea. The mining discharges contribute millions of tons of hazardous and non-hazardous solid wastes to the environment. Hazardous materials in the wastes include heavy metals, acids, cyanide, and other chemical used in the metal extraction process.

The industrial sector in PNG is among the more developed in the region. In addition to the large industries noted above, industrial activities include metal fabrication, food processing, paint

manufacturing, animal slaughtering and processing, equipment maintenance, petroleum storage and transfer facilities, etc. Except for the wastewater from larger facilities such as the palm oil factory and brewery, wastewater from facilities receive no treatment prior to discharge. It is believed that the large facilities receive at least primary treatment. The effectiveness of these treatment facilities is not monitored.

11.2 Overview of Recommended Strategies

Papua New Guinea's pollutants originate from both point sources (mining, industry, and domestic waste water) and non-point sources (solid waste, agricultural waste, and domestic wastewater. Currently regulations exist for the control of pesticides and industrial discharges into coastal areas, neither of which are widely enforced.

Due to the broad range of polluting activities over varying geographic, legal, and social/institutional settings, a multi-pronged strategy for reducing the marine pollutant load is recommended. In the commercial agriculture and industrial setting data is lacking to adequately provide specific recommendations on pollution prevention and mitigation methods. Enforcement of existing laws is needed. For domestic wastewater, a plan to upgrade deficient waste treatment systems needs to be instituted concomitantly with a campaign to incorporate inadequate individual waste systems. With a focus on urban centers, solid waste legislation needs to be passed, and rules promulgated and enforced. In addition, formal environmental education and environmental awareness programs concerning the impact of waste on the coastal environment and water resources need to be enhanced. A strategy of increased data collection, monitoring of pollutant discharge and impacts, and associated data management is required for the effective management and control of potential pollutants. A cooperative and integrated approach to monitoring and data collection that incorporates representatives from the government, industry, and the communities or NGOs should be established to utilize all available resources and improve local decision-making.

11.3 Technical Strategies and Activities

- Collect coverage, treatment types, and discharge data for urban sewerage systems to determine effectiveness and efficiencies of these systems. This data is lacking and represents a critical data gap. [97 (b)]
- Conduct survey of industrial facilities and collect rapid assessment data such as production rates, raw material usage, water usage, and discharge information, as available. [104 (b)]
- Provide community solid waste disposal containers in communities at convenient locations with assurances of adequate pickup and disposal. [146 (d)]
- Prioritize industries in need of pollution prevention and control measures, and identify appropriate control measures.
- Continue to improve environmental performance of industrial mining operations to conform with regional discharge standards.

- Monitor industrial operations, including mining, for compliance with effluent discharge standards. Monitoring groups should be established that include representatives from the local community, government, and industry.
- Working with the national universities, develop programs to increase the capacity of national laboratories, particularly in training staff on monitoring techniques and methods. A cooperative relationship should be formalized between the government, local industry, the university, and communities to utilize capabilities of the university laboratories and other services.
- Train the agricultural industry on the proper application and disposal of pesticides. Encourage integrated pest management. [104 (d)(viii)]
- Establish/upgrade wastewater treatment facilities for the sewerage system, to include the construction of an outfall which extends beyond coastal waters and allows for adequate mixing of wastewater prior to reaching other communities. [97 (d)(vi)]
- Incorporate/upgrade individual wastewater systems, particularly in shoreline areas, into the centralized sewerage system of urban areas. [97 (d)(x)]

11.4 Educational and Community-Based Strategies and Activities

- In rural areas, educate populations, to conform to local customs and tradition. Educate them on the public health and environmental effects of poor sanitation, haphazard waste disposal, and hazardous materials. In the case of highland localities, include information on the impact to down-gradient marine environments.
- In urban communities, create public health oriented education focusing on the impact that poor wastewater management has on local food sources and public health.
- Develop anti-littering campaigns. [146 (h)]
- Continue to support involvement of national universities in environmental data collection, monitoring, and research.

11.5 Policy and Legislative Strategies

- Enforce existing regulations on industrial discharges.
- Provide incentives in the form of technical training/reduced taxes to companies that institute environmentally sound practices, i.e. a “Green Business Program.”
- Develop comprehensive environmental legislation that includes impact assessment, discharge permits, integrated planning, and monitoring requirements and, enhance existing regulations.
- Create pesticide importers and user licensing programs with required training in the safe storage,

use, and disposal of pesticides. [104 (d)(iv)]

- Modify statistics collection requirements to include production (in units of material produced not monetary value) and raw material use data for all industries.
- Provide resources for the continuing collection, storage, and analysis of information regarding environmental impacts of domestic, agricultural, and industrial wastes.
- Create an institute, involving government, business, and local groups/organizations, for the national and regional exchange of environmentally oriented technical/engineering knowledge, with a primary focus on mining, agricultural, and industrial technology.

12 Solomon Islands

12.1 Introduction

The Solomon Islands consist of six main, 20 intermediate size, and many small islands. A majority of the population of 325,000 live in small rural villages spread across 347 islands. The Solomon Islands are a constitutional monarchy, with a legislature elected under universal suffrage. Local governance is by popularly elected councils. Eight councils, in four districts, currently exist.

12.1.1 Economy

The Solomon Islands economy is based primarily upon the utilization of natural resources. Exports provide the main source of income for the economy. Timber and fish are the primary exports followed by palm oil, cacao, and copra. A majority of people (84%) in the island nation rely upon subsistence agriculture for income. One-third of the employment base works in government related services.

12.1.2 Social and Cultural

Most of the population in the Solomon Island is located in coastal villages, and land ownership is held by village members. Approximately 87% of the land is held according to local traditional land tenure systems, and remains in family ownership through inheritance. Social status in the Solomon Islands is based on land ownership.

Solomon Islanders speak approximately 56 distinct languages. Education is not compulsory, and the illiteracy rate is estimated at 85%. Several NGOs exist in the Solomon Islands, and work with the local population on health issues, resource management, mineral development, and water issues. The most active organization is the Solomon Islands Development Trust.

12.1.3 Land-Based Sources of Marine Pollution

Pollution production in the Solomon Islands comes from both domestic and industrial sources. Domestic wastes, sewage, and solid waste constitute the main source of concern in the Solomon Islands. In Honiara 75% of sewage flows through a piped collection system directly into marine near shore waters. Groundwater and marine water resources are negatively affected by current sewage and solid waste management activities.

Solid waste in the Solomon Islands is poorly managed and disposed of haphazardly in unprotected solid waste sites. The solid waste problem is clearly evident in coastal waters. Industrial wastewater also is generally discharged into coastal waterways without treatment. Agriculturally based pollutants, principally sediment and pesticides, run into coastal waters. Due to a lack of monitoring, the overall impact of discharge activities is unknown.

12.2 Overview of Recommended Strategies

Due to the diversity of the society and cultural landscape, implementation of both traditional and western technologies and social conventions is needed. Integration of customary land use with pollution prevention and mitigation measures is best suited for the rural areas on a location specific basis. In the urban centers, an integrated environmental/engineering and educational approach is best suited.

12.3 Technical Strategies and Activities

- Upgrade the sewerage infrastructure in urban areas to include at least primary treatment, and locate outfalls to have minimal environmental and public health impact. [97 (d)(x), 97 (d)(vi)]
- Provide improved individual sanitation facility designs to homes and businesses not connected to the sewerage system. Institute a design review and approval process for new facilities. [97 (d)(xviii)]
- Establish BMPs for the mitigation of erosion in agricultural locations. [137 (d)]
- Provide training to agricultural workers on the safe application, storage, and disposal of pesticides. Encourage integrated pest management. (107 (d)(viii)]
- Conduct a feasibility study on recycling of solid wastes, particularly cans, plastics, paper, and used oil. [146 (b)]
- Provide community solid waste disposal containers in communities at convenient locations with assurances of adequate pickup and disposal. In rural areas, work to provide the local capacity for disposal of non-traditional wastes. [146 (d)]
- Re-locate coastal dumps to appropriate inland disposal sites that do not threaten groundwater. [146 (f)]
- Enhance the existing solid waste collection system to encourage its use. [146 (b)]
- Provide monitoring equipment and training for the monitoring of near shore waters with an emphasis on detection of wastewater related pathogens and industrial wastes. [97 (d)(xiv)]
- Encourage the commercial sector to treat effluent, and to appropriately discharge non-hazardous effluents to the municipal wastewater system.

12.4 Educational and Community-Based Strategies and Activities

- In urban areas, as appropriate, develop curricula in local schools that educate school age population on environmental issues with particular regard to the impact of sanitation on public health. [97 (h)]
- In rural areas, support the activities of NGOs, and use them as a conduit to relay information concerning public health and environmental issues.
- Provide scholarships for education in the environmental, engineering, and planning fields in exchange for a commitment to work in the Solomon Islands.
- Where possible, integrate information concerning human impact to the coastal environment with the formal education system.
- Develop and implement an anti-littering campaign. [146 (h)]

12.5 Policy and Legislative Strategies

- Consistent with the NEMS recommendations, EIA should be legislated and instituted as a mechanism for the review of development projects. An emphasis should be placed on the potential impact coastal resources.
- In conformance with traditional and customary practices, a land use system for the protection of coastal land and ocean resources should be designed and phased into the current land governance system. [97 (d)(ii)]
- “Green Business” programs, chiefly targeting the industrial and agricultural sectors, should be implemented to encourage environmentally friendly industrial and agricultural development.
- Legislate integrated solid waste management for urban areas. In rural areas provide funding for education on recycling, re-use, and composting. [146 (b)]

13 Tonga

13.1 Introduction

Tonga is comprised of 170 islands, 36 of which are inhabited by a population of approximately 95,000.

13.1.1 Economy

Tonga’s economy is evenly divided between the commercial and subsistence economies. The commercial sector is dominated by tourism, with additions from agriculture and telecommunications industry. Tonga’s agricultural industry is dominated by the export of pumpkins to Japan. The subsistence economy is based on traditional fishing and agricultural activities.

13.1.2 Social and Cultural

All of Tonga's land is held in common under a monarchy, and is administered by the noble class. Tongans generally reside in small villages. The social fabric of Tonga has been heavily influenced by the introduction of western religion. Nearly 100% of the population is Christian.

13.1.3 Land-Based Sources of Marine Pollution

Little quantitative information is available for land-based sources of marine pollution. In addition to domestic wastewater and solid waste, coconut processing, brewery, and food and beverage processing contribute to the wastewater stream. Most industrial and domestic liquid wastes are discharged in septic tanks, dry wells, or cesspools. Groundwater quality is potentially threatened in these areas. Small amounts of agricultural chemicals and pesticides are used on Tonga, however, no impact to marine environments has been quantified.

13.2 Overview of Recommended Strategies

Tonga's initial need is the collection of basic data and analysis with respect to waste generation and disposal activities. A main focus should be on the potential impact that domestic and industrial liquid waste collection systems have on groundwater quality and the marine environment. Another focus should be on the quantification of solid waste generation.

13.3 Technical Strategies and Activities

- Establish a coordinating organization for the collection of water quality data and implement a program for basic water quality data collection. This will require training and equipment acquisition by the implementing agency. [97 (d)(xiv), 137 (j)]
- Collect groundwater and marine water quality data, particularly in areas where discharges are known to occur. Pollutants associated with the local industries should be targeted as priority pollutants. Groundwater quality monitoring is of first priority. [104 (b)]
- Study the effectiveness of existing land-disposal system for each type of waste source.
- Develop a pilot project to compost food wastes and other green wastes. [146 (b)]
- Identify and develop solid waste disposal sites outside of wetlands areas. [146 (f)]
- Research opportunities for wastewater re-use in the agricultural sector.
- Develop composting programs.

13.4 Educational and Community-Based Strategies and Activities

- Train traditional users of coastal resources to recognize impacts caused by land based pollutants, and the proper channels and methods for reporting the information. [97 (h)]

- Create a campaign focused on the re-use of plastics and glass, and other solid waste in conjunction with government and religious institutions. [146 (h)]
- Develop training programs for pesticide users on safe practices for pesticide storage, use, and disposal.

13.5 Policy and Legislative Strategies

- Institute integrated solid waste management. [146 (b)]
- Fund and implement data collection and research regarding impacts to the coastal zone with particular emphasis on the growing tourist sector of the economy.
- Develop land use planning that integrates traditional and customary practices. This should be used to plan and manage coastal development.
- Implement “Green Business friendly” taxes or funding mechanisms as incentives to environmentally sustainable coastal development.

14 Tuvalu

14.1 Introduction

Tuvalu is an independent nation comprised of nine low lying atolls. Funafuti, the capital is made up of 30 islets and covers an area 20.8 kilometers long and 16 kilometers wide. The main island where most of the population lives, Fogafale, has a land area of just 2.8 square kilometers for its population of 4,000. There is a total land area of approximately 26 square kilometers and a marine area (EEZ) of 750,000 square kilometers. The population of the islands is approximately 11,000.

14.1.1 Economy

Tuvalu has a subsistence economy and there is no industry. Commercial activity is limited to small retail shops to serve the local population.

14.1.2 Social Cultural

Tuvalu retains a traditional lifestyle and traditional leadership still plays an important role in the management of community activities. This informal role is incorporated into the formal systems by the Chiefs’ membership on Island Councils and other government agencies. Churches also play an important role in community activities.

Land tenure is complex and the traditional system is maintained, although a western-style land registration system is in-place. Land transfer is through inheritance and gifts. Land tends to stay within the extended family.

14.1.3 Land-Based Sources of Pollution

The pollution of water resources primarily is the result of domestic waste disposal. There is inadequate sanitation and contamination of the lagoon and communal water supplies that has resulted in a prevalence of water-related diseases. Solid waste disposal sites are generally located on beaches or abandoned borrow pits. No controls are in place to prevent the waste material from entering the marine area or from being dispersed on land by winds or pests. Petroleum storage and transfer operations and port operations represent the major sources of industrial pollutants.

14.2 Overview of Recommended Activities and Strategies

For Tuvalu, recommended activities center on improved sanitation and solid waste disposal practices. This will require review of available options and identification of the most culturally acceptable and affordable alternatives.

14.3 Technical Strategies

- Study and select individual sanitation facilities that will be culturally and socially acceptable (e.g composting toilets). [97 (f)]
- Develop projects to promote composting for individual households and small farms. [146 (b)]
- Conduct a study to determine feasibility of composting organic materials from municipal wastes. [146 (b)]
- Construct containment facilities for beach dump sites that cover and secure materials.
- Continue (or re-institute as appropriate) aluminum can recycling efforts.
- Seek out training for local personnel in simple water quality monitoring programs. [137]
- Provide community solid waste disposal containers in communities at convenient locations with assurances of adequate pickup and disposal. [146 (d)]
- Establish a water quality monitoring program. [137]

14.4 Educational Strategies and Community-Based Activities

- Implement a public awareness campaign to promote environmental awareness, discourage littering, and encourage recycling and re-use of material. [146 (h)]

14.5 Policy and Legislation Activities

- Develop spill prevention and control plans for all operations that use or store petroleum products.

[124 (d)(viii)]

- Develop and implement a program for conducting EIA.
- Identify an appropriate government department to monitor environmental quality.
- Develop a coastal resource management plan together with the lagoon management plan.
- Establish “Green Business” program that encourages commercial recycling and use of non-hazardous materials.
- Incorporate collection of data on hazardous material import and use in national statistics gathering.

15 Vanuatu

15.1 Introduction

The Republic of Vanuatu is an archipelago comprised of some 80 islands scattered over a distance of 900 kilometers from north to south, and lies west of Fiji and north of New Caledonia. Most of the islands are mountainous and are relatively young geologically. There is an abundance of rainfall with an average of about 2200 millimeters per year. There are, however, few perennial streams. This is probably the result of the islands small size and rugged topography. Eighty percent of the 142,944 population lives in rural areas.

15.1.1 Economy

The economy is primarily agricultural based and beef, copra, and fish remain the primary exports. Industrial scale logging also occurs as well as a small industrial sector that is found in Port Vila. A brewery, soft drink manufacturer, canned meat manufacturer, biscuit factory, and a number of manufacturers and commercial operations also contribute to the economy.

15.1.2 Social and Cultural

The area of Port Vila on Efate is heavily influenced by both British and French culture. To a lesser extent the island of Espiritu Santo maintains many vestiges of European colonial life. The outer islands retain strong aspects of traditional life or *kastom* mixed with the influences of the missionaries. In the northern islands, women’s roles are stronger and more dominant because of the traditional matrilineal culture. On the southern islands males dominate society.

15.1.3 Land-Based Sources of Marine Pollution

Environmental problems in Vanuatu are present in both rural and urban areas. In the rural areas, the main issue is marine degradation from erosion and sedimentation. In urban locations, sewage is the primary problem, particularly in lagoons near Port Vila. In 1990, the level of coverage with adequate sanitation in Vanuatu was 86 percent for urban areas and 34 percent in rural.

Vanuatu's industrial sector is relatively small but is approaching medium scale on a regional level. Waste

management in the industrial sector is minimal. The exception to this is the abattoir at Port Vila (Santo abattoir was not visited). Numerous small wastewater producing activities such as laundries, printers, restaurants, and photo shops discharge their wastes to overflowing septic tanks or directly to storm drains.

Solid waste disposal, as elsewhere throughout the region, is poor in the urban centers of Vanuatu. The Port Vila dump at Fres Wata is of particular concern as it is located over a groundwater supply.

As a result of the Agriculture Department's encouragement, agrochemical use in Vanuatu is small considering the large agricultural sector. Only small quantities of fertilizers and pesticides are imported each year. The heavy use of DDT and other mosquito-control pesticides, sprayed as part of a malaria prevention program, likely contributes greater quantities of pesticides to the environment than agriculture. Information concerning industrial discharge and sedimentation is lacking.

15.2 Overview of Recommended Strategies

Domestic sources are the primary target of recommended activities. The principal activity for industrial sources is additional data collection to allow further evaluation of these sources.

15.3 Technical Strategies

- Upgrade and improve individual sewage systems taking into account the varying economic conditions through urban and rural areas. [97 (d)]
- Require advance sewage treatment at tourist areas and hotels. [97 (d)(iv)]
- Study and evaluate wastewater re-use opportunities. Possibilities include agriculture, landscaping, etc. [97 (d)(viii)(b.)]
- Increase monitoring in Port Vila for water contamination, particularly nutrients and sewage related pollutants. [97 (d)(xiv)]
- Collect a survey of industrial facilities using rapid assessment methods. Facilities must be required to maintain production data and raw materials use information.
- Identify improved designs for individual wastewater facilities for smaller industries, e.g. laundries. Alternatively, have these facilities connected to a reticulated system as soon as possible.
- Develop a recycling program for all areas based on locally conducted feasibility studies. [146 (b)]
- Provide community solid waste disposal containers in communities at convenient locations with assurances of adequate pickup and disposal. [146 (d)]
- Conduct a sitting study to identify appropriate locations and designs for solid waste disposal sites in Port Vila and other urban centers. [146 (f)]
- Continue to support integrated pest management (which can potentially be used as a model for

other island countries).

- Implement additional mosquito-control methods that do not include long-term DDT use, e.g. control and eliminate as possible breeding areas.

15.4 Educational Strategies and Community-Based Activities

- Promote environmental awareness regarding sanitation and solid waste through school curriculum and informally through local civic organizations. [97 (h)]
- Establish an environmental education program for local government officials.
- Use traditional knowledge systems and local knowledge to promote improved local decision-making on resource management.

15.5 Policy and Legislation

- Mandate water quality monitoring to determine the effectiveness of treatment and septic systems. [97 (d)(xiv), 130 (f)]
- Develop a coastal zone management policy to plan for coastal development and tourism.
- Conduct feasibility for recycling of non-ferrous metals, paper, plastics, used oil, etc. [146 (b)]
- Incorporate production data and other information for rapid assessment methods into standard statistics gathering.
- Establish policies and legislation to promote “Green Businesses” and reduce the importation of hazardous materials.
- Pass legislation requiring environmental impact assessment for development.

16 Samoa

16.1 Introduction

Western Samoa consists of 2 major islands and several smaller islands including a total land area of approximately 2,934 km². The main islands are Upolu and Savai'i. Western Samoa has a population of around 165,000 with over seventy percent of the population living on Upolu. Apia has a population of approximately 33,000 is the capital and urban center. It has no official status as a municipality and is made up of number of traditional villages.

16.1.1 Economy

Employment is generally based around a subsistence economy. Apia also has a more urban economy with

government employment and a number of small industries and manufacturers. Small industries include paint manufacturing, wire harness manufacturing, printing shops, equipment repair and maintenance, soft drink bottling shops, and small-scale food packaging. There is also a brewery in Apia.

16.1.2 Social and Cultural

Traditional leadership maintains an important role in Samoa. Churches also play an important role in directing community activities. Land tenure is principally within the traditional system that keeps land management within the extended family.

16.1.3 Land-Based Sources of Pollution

Domestic wastewater is the primary contributor of wastes to the marine environment. Groundwater also is degraded by domestic sewage disposal. Industrial and manufacturing contributions, while small in quantity are of concern because of the increasing quantities and the chemical and toxic nature of the waste.

16.2 Overview of Recommended Strategies and Activities

Recommended strategies focus on domestic issues and known industrial concerns, such as petroleum spills and lack of adequate industrial waste data. Technical activities focus on improved waste management facilities, particularly as regards to sanitation. All technical and educational activities should be established in concert with the “matai” system.

16.3 Recommended Technical Strategies and Activities

- Conduct feasibility/design study for a reticulated sewerage system with treatment facilities for the urban area of Apia. [97 (d)]
- Collect additional data on industrial facilities including production rates (units produced) and raw material usage. Include smaller facilities such as printers. [104 (d)(x)]
- Continue to close dumps in mangroves and identify appropriate inland sites.
- Provide community solid waste disposal containers in communities at convenient locations, with assurance of adequate pickup and disposal. [146 (d)]
- Identify and install appropriate individual sanitation systems for less densely populated urban areas and rural areas. [97 (d)(iv)]
- Install improved oil water separators at the bulk fuel storage tanks, power plant, and fuel landing facilities. Monitor effluent characteristics from the oil/water separators.
- Develop and implement spill prevention and control plans for fuel facilities. [104(d)]
- Conduct feasibility study to determine appropriateness of instituting recycling of aluminum cans

and other non-ferrous materials.

- Support the existing used oil recycling facility and require all government departments and facilities to process their waste oil at such a facility. [104 (d)(iv)]
- Monitor leachate and groundwater quality at the new solid waste landfill site.
- Monitor effluent characteristics from the oil water separators.
- Establish monitoring program for surface and groundwater focusing on sewage related constituents. [97 (d)(xiv)]
- Evaluate potential of using brewery wastes in agricultural activities. [146 (b)]

16.4 Educational and Community-Based Activities

- Promote community value of recycling activities; i.e. all benefit even if waste oil or aluminum can recycling is a commercial venture. [146 (h)]
- Promote recycling at existing facilities. [146 (h)]
- Develop materials to promote re-use of materials, particularly for traditional activities. [146 (d)]
- Involve Churches and other community groups in community awareness programs.
- Develop and implement “Adopt a Clean Beach/Stream/Road Programs” and have community groups organize activities.

16.5 Policy and Legislative

- Incorporate data collection into existing statistics programs.
- Implement review and permitting process for individual sanitation facilities in urban areas.
- Review opportunities to include “Green Business” mechanisms into existing business and tax legislation.
- Establish pesticide importer and seller licensing program to monitor imports and use patterns.
- Develop pesticide a user certificate program to train users in the safe storage, use, and disposal of all non-household pesticides.

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Appendix 1

Best Management Practices

Best Management Practices (BMPs) are specific actions and/or structures designed to reduce or eliminate the discharge of pollutants to local waters, control soil erosion, and prevent the sedimentation of water bodies from industrial, agricultural, and construction activities. Examples of discharges include soil, petroleum products, garbage/litter, pesticides, herbicides, detergents, fertilizers, and other industrial chemicals.

The following list of BMPs provides sample methods for avoiding or mitigating potential erosion and sedimentation as well as pollution from the discharge of chemicals or petroleum based products.

Vegetative Stabilization Practices:

- Retention of natural vegetation during construction and agricultural activities;
- Temporary seeding of exposed soil
- Sod stabilization of exposed soils on steep embankments
- Land area restoration using natural vegetation after the completion of construction activities

Non-Vegetative Stabilization Practices:

- Mulching to stabilize exposed soil where seeding and sod placement are not practical;
- Chemical stabilization, such as vinyl, rubber, or asphalt spray adhesives; and
- Areas exposed to water runoff should be stabilized during construction using gabions, beams, or some equivalent technique.

Specific Structural Controls

- Swales can be built to channel water away from the construction and industrial sites, and erosion prone areas
- Check dams can be constructed in runoff channels to reduce water velocity
- Silt containment devices (curtains) can be used to reduce sedimentation from construction and agricultural activities near water bodies
- Where large volumes of runoff are anticipated sediment traps or basins should be constructed
- Beams or other structural containment devices can be used prevent runoff from excavation/fill materials staged on project sites or industrial

areas

Sediment Capture Controls

- Detention ponds can be created to trap construction runoff prior to its entering the water bodies

Administrative Controls

- Silt and erosion control plans should be established prior to the commencement of construction activities
- Silt control and containment devices and control plans should be approved by local regulatory agencies
- All silt control and containment devices should be placed prior to the start of work, and remain in place until the completion of work
- In-stream or coastal work should not be conducted when water is above normal levels
- Construction work should be terminated when weather conditions become inclement and water flows are expected to rise above normal levels
- Excavation and fill material from construction activities should be removed from the site as soon as practicable
- Excavation and fill materials staged on site should be stored away from sensitive areas or pathways to water bodies
- All fill and excavation material left on site for more than 24 hours should be covered
- If a visible plume and/or petroleum sheen is observed outside of the containment areas, all work should cease and control measures should be modified to avoid further releases
- An individual responsible for environmental monitoring should be on-site during construction activities

Controls for Reducing Industrial Pollution

- Absorbent pads, booms, and other oil spill response equipment should be present on site in case of petroleum spills.
- Maintain an oil-water separator in large industrial areas

- Refueling operations should take place in a designated area over an impermeable surface away from water or exposed soil. Refueling of boats should be conducted in secure areas
- Drip pans should be used under all valves near water bodies
- All containers, 55 gallon drums, petroleum products, solvents, cement curing compounds and adhesives, or any other potentially hazardous or toxic substance, when not in use, should be covered in a containment area
- Vehicles and equipment should be parked over impermeable surfaces away from water bodies
- Wastes from construction, industrial, and agricultural activities should be staged in appropriate locations and collected regularly
- Equipment repair and maintenance should be done away from water bodies with appropriate safeguard against spillage of fluids and materials
- Material used to backfill excavations should consist of clean sediment or soil

Agricultural Controls

- Multi-cropping should be incorporated to reduce erosion
- Reduce planting on steep slopes. And, if planting on steep slopes encourage planting of deep-rooted crops.
- Encourage integrated pest management to reduce pesticide use
- Encourage contour plowing and agriculture
 - Fertilizers and pesticides for weed control/revegetation activities should be applied in accordance manufacturer directions and local regulations

Appendix 2: Summary of Policy and Legislative Instruments

Policies

- Current policies should be updated and formally adopted, as appropriate
- Cabinet policy should be implemented to support recycling and green businesses

Legislation

Comprehensive Environmental Legislation

- Inclusive of natural resource protection, waste management (solid, liquid, air), EIA
- Provide for development and promulgation of specific regulations for the covered environmental issues
- Specifically, promulgate solid waste management regulations

Legislation will need:

- to be flexible and adaptable
- to incorporate customary law where possible
- provide for local control over waste management to the maximum extent possible
- a regulation system that emphasizes cooperation
- a flexible system of enforcement procedures and penalties, that is it allows for a gradual implementation of standards and guidelines to allow community awareness programs and negotiations among EU and other responsible organizations to develop the community and political will to commit to strong waste management measures.

Customs: Through existing customs legislation

- hazardous waste should be a prohibited import
- hazardous materials a restricted import based on requiring

Business: Through existing Business legislation

- develop a "Green Business Program" for recycling and other environmentally friendly businesses, or company programs, be developed and implemented. Incentives for the program include tax exclusion or preferential land utilization treatment.

For recycling businesses:

- business recyclable waste products into other useful and non-toxic products;
- the business shall not produce other toxic wastes as by-products of the recycling process;
- the business shall cooperate with ministry or department responsible for the environment in promoting recycling and environmental awareness programs.

For other businesses that may wish to qualify as "Green Business"

This category is for other businesses not directly involved in waste recycling but which undertake business practices and other activities that contribute to the reduction of waste, pollution prevention, and overall improvement of environmental. To qualify for this program, the business must meet criteria developed by the ministry or department responsible for the environment.