Management of Persistant Organic Pollutants in Pacific Island Countries

Waste and Obsolete Chemicals and Chemical Contaminated Sites

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PREFACE

The world's environment has enjoyed a greater prominence in political and social reasoning over recent years. This has allowed the concept of sustainable development to flourish and many countries are embracing this goal with enthusiasm. This is particularly true in the developed nations of the world but in some regards sadly lacking in some developing countries, where inevitably economic sustainability is perceived to be the first priority. The small island nations of the South Pacific region are no exception. While most of these countries have made significant steps towards protecting the environment, much remains to be done. There are also a number of legacies of the past to be addressed, and one of those legacies is the result of mismanagement of chemicals and hazardous wastes.

The management of chemicals and hazardous wastes is particularly difficult for PICs for the following reasons:

- A lack of information on the types and volumes' of materials being brought into thecountries, or already there.
- A poor understanding within the wider community of how these should be used,stored and disposed.
- Limited knowledge of the threat that certain chemicals pose for community and environmental health.
- An absence of appropriate disposal facilities.

The Australian Agency for International Development (AusAID) has recognised the need for improved waste management expertise and facilities throughout the region and undertook a pre-feasibility study of potential waste management projects in the region in April 1997. The study recommended thirteen areas in which assistance was needed ranging from waste water to landfill management. The management of waste chemicals was rated as highest priority and the Persistent Organic Pollutants in Pacific Island Countries (POPs in PICs) project was developed to address this component.

The long-term objective of POPs in PICs is to upgrade regional capacity for the effective management of chemicals, in order to eliminate the threat posed by POPs and related chemicals towards the environment and human health. This project concentrates on assessments of stockpiles of waste and obsolete chemicals and chemical contaminated sites in PICs. No attempt is made to consider pollution or contamination from current industrial or agricultural activities.

This report covers some of the work carried out for Phase I of the POPs in PICs project, namely an assessment of stockpiles of waste and obsolete chemicals and the identification of contaminated sites in thirteen Pacific Island Countries. Other activities in this stage include education and awareness programmes in each country and a review of relevant legislation. Subsequent stages of the project will be directed at disposal activities and the clean up of contaminated sites.

ACKNOWLEDGEMENTS

The work described in this report was funded by AusAID.

Much of the work was carried out in-country by the three specialist consultants. Additional information on legislation was provided by SPREP legal officers Mr Andreas Volentras and Mr Jacques Mougeot.

Finally, we should note that most of this work would not have been possible without the able assistance of many people within the Pacific Island Countries, including the following government officials who acted as local counterparts:

Mr. Ned Howard, Director of the Environment Service, Ministry of Works, Environmental Protection and Planning, Cook Islands; Dr. Eliuel Pretrick, Department of Health, Education and Social Affairs, Federated States of Micronesia;

Mr Joseph Kono, Executive Director, Chuuk State Environmental Protection Agency, Federated States of Micronesia; Mr Simpson Abraham, Program Director, Kosrae State Government, Federated States of Micronesia; Mr Elden Helen, Director, Pohnpei Environment Protection Authority, Federated States of Micronesia; Mr Abdom Martem, Pesticide Control Officer, Yap Environmental Protection Agency, Federated States of Micronesia; Mr Moti Lal Autar, Principal Plant Protection Officer, Ministry of Agriculture, Forests and Fisheries, Fiji; Mr. Taulehia Pulefou, Pollution Control Officer, Ministry of Environment and Social Development, Kiribati; Mr Jorelic Tibon, General Manager, Environment Protection Authority, Republic of the Marshall Islands; Mr Joseph Cain, Department of Island Development and Industry, Nauru; Mr. Sauni Tongatule, Director, Department of Agriculture, Forestry and Fisheries, Niue; Mr Joseph Tiobech, Pesticide Specialist, Environmental Quality Protection Board, Republic of Palau; Mr Emil Edesomel, Pollution Control Officer, Environmental Quality Protection Board, Republic of Palau; Mr. Lavaasa Malua, Senior Environmental Planning Officer, Division of Environment and Conservation, Department of Lands, Surveys and Environment, Samoa; Mr Moses Biliki, Head, Division of Environment and Conservation, Ministry of Forestry, Environment and Conservation, Solomon Islands; Mr. Uilou Samani, Principal Ecologist, Ministry of Lands, Survey and Natural Resources, Tonga; Mr. Afele Pita, Secretary, Department of Natural Resources and Environment, Tuvalu; Mr Baigeorge Swua, Plant Protection Officer, Vanuatu Quarantine and Inspection Service; and the Department of Agriculture and Horticulture, Vanuatu.

The following people were engaged as local consultants for the project:

Mr Tom Wichman, Cook Islands;

Mr William Peter, University of the South Pacific, Fiji; and

Mr. Tom Lolomae, Solomon Islands.

EXECUTIVE SUMMARY

This report describes the work undertaken for Phase I of the POPs in PICs project. This included assessment of stockpiles of waste and obsolete chemicals, preliminary assessment of contaminated sites, and a review of relevant legislation. Additional work on education and awareness programmes for both government employees and the general public is still to be completed.

POPs are defined by the international chemical community as organic chemicals which are persistent, bioaccumulate, and can have adverse effects on human health and the environment. For the purposes of this project however the term POPs has been interpreted rather broadly and covers all hazardous or potentially hazardous chemicals including pesticides, polychlorinated biphenyls (PCBs), general industrial chemicals, medical wastes, laboratory chemicals, oil, bitumen, timber treatment chemicals and fertilisers.

PROJECT ACTIVITIES

Phase I of the project was carried out amongst all SPREP members with the exception of Papua New Guinea, i.e. the Cook Islands, Federated States of Micronesia, Fiji, Kiribati, Marshall Islands, Nauru, Niue, Palau, Samoa, Solomon Islands, Tonga, Tuvalu and Vanuatu. It is intended to include Papua New Guinea in subsequent phases of the project.

Most of the work was done during 1998, but with some additional follow-up work during 1999. The country visits were carried out by three specialist consultants with expertise in chemical hazard management, contaminated site assessments and waste management and disposal. Each country was visited by one of the specialists and their main objective was to identify and assess all existing stockpiles of waste chemicals, and potentially contaminated sites. The work was done with the assistance of local counterparts and consultants, which was important for the educational part of the project. These people received on-the-job training in matters such as chemical identification, safe handling, sample collection, assessment of storage facilities, repackaging and storage, and the identification and assessment of contaminated sites.

Narrative reports on the consultants' activities and findings were presented in individual country reports, copies of which are given in Annex A of this document. Information on the waste and obsolete chemicals identified during the survey was also entered into a database. This includes details such as the chemical and brand names, quantities, current condition and suggested disposal options. Information on contaminated sites was entered into another database, and this included an assessment of the relative risks at each site, on the basis of a numerical hazard ranking. Information from the databases is included as Annex B of this report.

Other matters considered during the project and included in this report are as follows:

- An assessment of facilities and expertise in each country relevant to chemical management.
- An assessment of current legislation and infrastructure in each country.
- Assessment and recommendations of disposal options for the various chemicals.
- Assessment of the international transport requirements for hazardous wastes and unidentified chemicals.
- Assessment of remediation options for the various contaminated sites.
- Provision of guidelines on specific aspects of chemical or waste management.

WASTE AND OBSOLETE CHEMICALS

Information on the major stockpiles of waste and obsolete chemicals is summarised in the table below. This includes some suggested disposal methods and an indicative range of costs. The actual cost for disposal will depend on the method chosen and the location of the disposal facility.

Chemical	Quantity (tonnes)	Disposal Cost Estimate (Au$)	Comments
Polychlorinated biphenyls (PCBs)	131	$950,000 to $2,850,000	Off-island disposal by chemical treatment or incineration
Pesticides (including 7 tonne of packaging)	42	$300,000 to $650,000	Off-island disposal by incineration
	11	$44,000	On-island disposal by chemical and biological treatment
DDT	10.4	$60,000 to $140,000	Off-island disposal by chemical treatment or incineration
Timber Treatment Chemicals	10.15	$20,300	Off-island disposal by returning to manufacturer
	1	$5,000	On-island disposal by chemical treatment
Bitumen	330	$30,000	On-island disposal using landfill or burial pits
TOTAL COST			**Au$1,409,300 to $3,739,300**

As shown, some of the materials are suitable for on-island disposal, however most are not. Generally these can only be disposed using specialised chemical treatment facilities or by high-temperature incineration. There are no such facilities available in Pacific Island Countries.

Clean-up, re-packaging, and transportation of chemical wastes are specialised activities which should only be carried out by skilled personnel using specialised equipment. It is therefore recommended that this be carried out on a contractual basis using companies with extensive experience in this type of work. Contractors should be chosen using a tendering system with the proposals being assessed against a variety of factors including track record, personnel, equipment and facilities, proposed methodology, proposed environmental management procedures, and price.

The selection of a disposal facility and method should also be done by tender, with a similar assessment process to the above. There are a variety of possible treatment facilities available in Australia, Japan, North America and Europe. Most of the facilities in Australia use specialised chemical and physical treatment processes which have been shown to achieve very high destruction efficiencies, but are limited in the range of wastes able to be treated. This is much less of a problem with high-temperature incinerators, which are available in North America, Europe and Japan. However, incineration is sometimes criticised because of the potential for toxic air emissions and other adverse effects. The recommended approach is to use chemical and physical treatment methods if possible, with incineration as the fall-back option.

CONTAMINATED SITES

Contaminated sites are those at which hazardous substances are present in the soil and/or groundwater. The contamination sometimes arises from the normal site operations (e.g. timber treatment sites or solid-waste landfills) but is more commonly caused by spillages, uncontrolled dumping, or other waste disposal activities. Typical contaminants include toxic heavy metals, pesticides, timber treatment chemicals, oils, tars and a wide range of other possible substances.

Situations were found where hazardous chemicals such as pesticides, had been disposed by burial. DDT has been buried at sites in Pohnpei (FSM) and Palau, and mixtures of pesticides have been buried at two sites in Fiji and one in Samoa. Burial can be effective in reducing the immediate risks from these chemicals, and some of the chemicals will gradually break down in the soil. However, there can be a significant risk of contaminating any nearby groundwater supplies. There is also a risk of problems in the future if the site is redeveloped for other uses, such as residential housing (which has happened in Fiji). Prior to any site remediation the extent of contamination must be determined and this in itself, can be a costly exercise.

The contaminated sites identified in the survey were given a preliminary hazard assessment using the Rapid Hazard Assessment Scheme. This provides a ranking of the sites on a scale of 0 to 100. Those with a score of less than 30 were not considered to warrant further investigation. Over one hundred sites were inspected during the survey with 86 scoring 30 or more.

Further work is proposed for 54 of the sites identified in the country surveys. This will involve a programme of more extensive investigations at each site, to establish the extent of the contamination. At present the sites have been identified as being contaminated, but there is generally no information on how far that contamination has been spread, both across the site surface and into the ground. This work would then be followed by remediation and disposal operations, as required. The overall costs for the programme are summarised in the table below.

Ideally, the PCB, pesticide and DDT remediation and disposal work should be carried out in conjunction with the related disposal work for waste stockpiles.

Contaminant	No. of sites	Assessment Cost	Remediation/ disposal costs	Remediation/ disposal Method
PCBs	3	$30,000	$195,000 –$870,000	Excavation, export for disposal
Buried pesticides	3	$150,000	$600,000 - $1,350,000	Excavation, export for disposal
Pesticide storage sites	13	$130,000	$170,000 - $390,000	Clean, decontaminate and export wastes
Buried DDT	2	$100,000	$385,000 - $900,000	Excavation, export for disposal
Timber treatment sites	4	$100,000	$100,000	Excavate, treat and dispose locally
Oil-contaminated sites	10	$30,000		Bioremediation
Oil-contaminated groundwater	11	$2,200,000		In situ bioremediation
Landfills	18	$900,000	Not included in programme	
Sub-totals:		$1,410,000	$3,680,000 - $5,840,000	
Total Estimated Costs:				**Au$5,090,000 - $7,250,000**

WASTE MANAGEMENT PROGRAMMES

Two areas were identified in the survey that would be best addressed through the development of specific management programmes, rather than one-off disposal exercises. These are the management and disposal of laboratory chemicals, and the management of infectious medical wastes.

The disposal of surplus and obsolete laboratory chemicals was a common problem throughout the region and in all types of laboratories, including schools, hospitals and government departments. Many of the staff in these organisations were aware of the need for, and the general principles of, safe storage and disposal. However, most lacked the detailed knowledge and resources to be able to deal with the issue safely, and with confidence. It is recommended that a regional programme be developed to upgrade chemical management capabilities in laboratories throughout the region. The programme should involve a combination of training and development, and hands-on disposal exercises. This latter element should help to address the existing stockpiles of unwanted chemicals. The total cost of the programme will be at least Au$400,000.

The management and disposal of infectious wastes in hospitals and other medical establishments is another area that needs considerable upgrading. In some countries the hospitals are equipped with dedicated incinerators, but most of these are either fairly primitive and/or in very poor condition. In those countries where there are no such facilities, the current practices consist of a fairly basic level of waste segregation coupled with controlled disposal at the local dump. It is recommended that a comprehensive programme be developed to upgrade medical waste management facilities throughout the region. This programme would be best co-ordinated through the World Health Organization, and is likely to cost at least Au$600,000.

CONCERNS AND ACHIEVEMENTS

This work has highlighted some significant examples of inadequate chemical management practices, including the following:

- DDT stored adjacent to a residential building with uncontrolled access, as evidenced by children's fingerprints in the powder.
- Pesticides buried in the yard of an agriculture research station in Fiji. The land has since been sold and developed as a private residence.
- A pesticides storage shed on Metapona Plains, Solomon Islands, which was effectively abandoned for over ten years, during which time local villagers vandalised the building and removed some of the pesticides, which were later used for killing fish.

On the other hand there are countries in which some types of hazardous materials have obviously been managed very well. This would include pesticide management in Tonga, medical waste disposal in Palau, and the replacement and disposal of PCBs in Fiji. The municipal landfill in Port Vila, Vanuatu was also noted as an excellent example of a properly designed and operated waste management facility.

The project has been effective in providing immediate solutions to some of the problems encountered during the surveys, including the following:

- Reuse of a variety of chemicals which were being stored for quarantine purposes (but no longer required) in Vanuatu.
- Repackaging and placement into safe storage of the DDT referred to above (Solomon Islands).
- Improvements to the storage shed on Metapona Plains by fitting of a new door and a lock.
- Repackaging and placement into safe storage of about 4 tonnes of pesticides held on Pohnpei.
- Sorting and partial repackaging of about 1 tonne of pesticides held on Niue.
- Sorting, local treatment and disposal (where possible), and placement into safe storage of about 600 kg of laboratory chemicals held at a school on Pohnpei.
- Assistance with the repackaging of a stockpile of 65-70 tonnes of mixed agricultural chemicals (mainly copper sulphate) which was stored in a run-down shed in Rarotonga, Cook Islands. Over half of this material was shipped back to New Zealand for reuse.
- Relocation of various small stocks of pesticides and laboratory chemicals into secure storage at an agriculture research centre, in Rarotonga.
- Safe disposal of potentially explosive picric acid, from a laboratory in Rarotonga.

The project has provided on-the-job training of about 30 local counterparts and consultants in the identification, safe handling and storage of hazardous chemicals. It has also led to a heightened awareness amongst government officials throughout the region of the potential dangers associated with the mismanagement of hazardous chemicals.

WHERE TO NOW?

There is one aspect of Phase I of the POPs in PICs project which remains to be completed, namely the education and awareness programmes in each country. This task will be completed over the next few months.

Phases II and III of the project were intended to cover the development of safe storage facilities in each country, and disposal activities, respectively. However, it is now proposed that in most cases the storage phase of the work should be omitted, and priority should be given to the disposal operations.

Nonetheless it must be recognised that there are some storage situations which will need to be addressed in the near future if the disposal activities are delayed. In the first instance, this option should be considered for the following sites, which were assessed by the consultants as having the greatest potential for causing adverse health effects:

- The agricultural chemical storage shed on Metapona Plains, Solomon Islands.
- A shipping container used for storage of agricultural chemicals in Weno, Chuuk, Federated States of Micronesia.
- The agricultural chemical storage shed at Lomaivuna Research Station, Fiji.
- It is also recommended that the stocks of chemicals held at the former agriculture station and at the Amak Women's Unit, both on Tarawa, Kiribati, be moved to more appropriate storage facilities.

The cost of this work would be about Au$60,000.

The primary activity for Phase II/III of the project will be disposal of the stockpiles of obsolete and unwanted chemicals, contaminated site remediation, and other targeted waste management activities. The total cost of these activities will be as follows:

Chemical waste disposal:	Au$1.41 – $3.74 million
Contaminated site assessment:	Au$1.41 million
Contaminated site remediation:	Au$5.09 – $7.25 million
Laboratory waste management programme:	Au$0.4 million
Medical waste management programme:	Au$0.6 million
Interim site improvement (contingency):	Au$0.06 million

Quite clearly, this amount of money is well in excess of that likely to be available from any one source. It is therefore proposed that the work be undertaken in a series of discrete work packages ranging in size from about $6,000 to about $1 - $3million. A number of possible donors will be approached for support for this work.

INSTITUTIONAL STRENGTHENING (CHEMICAL MANAGEMENT STRATEGIES)

The efficient and effective management of chemicals is a complex task and the consequences of inadequate management can be severe. One important aspect of strengthening national programmes for the sound management of chemicals is the need to develop integrated activities which cover and link all aspects of the chemical life cycle including production, import, export, storage, transport, distribution, use and disposal. This can be referred to as “life-cycle” or “cradle-to-grave” management. It is clear that this approach is needed in Pacific Island Countries.

The POPs in PICs project concentrates on the disposal of waste and obsolete chemicals and remediation of chemical contaminated sites, but also aims to assist countries with the development and implementation of long-term strategies for the management of hazardous and potentially hazardous chemicals and other materials. The project will help to provide some first steps in this direction, through the provision of local training courses and community education activities.

Much remains to be done in this area. However, SPREP is confident that with an increased level of participation by Pacific Island Countries in international chemical management programmes, and regional assistance programmes including the NZODA-funded Development of Hazardous Waste Management Strategies project, the goal of efficient and effective chemical management throughout the region can be attained.

RECOMMENDATIONS

The report concludes with the following recommendations:

1. The proposed phases II and III of the POPs in PICs project should be merged into a single programme, with the primary emphasis on waste disposal and contaminated site remediation.
2. Approaches should be made to AusAID and other donor agencies for financial support for individual sub-parts of the proposed programme.
3. Funding (Au$60,000) should also be sought for interim improvements to some of the pesticide storage facilities, as listed in Section 7.5
4. Pacific Island Countries should take action to implement local disposal procedures for those chemicals identified as being solely their responsibility.
5. Pacific Island Countries should be encouraged to participate fully in the current international and regional activities directed at capacity building and institutional strengthening in the areas of chemical management.
6. Pacific Island Countries should consider the development of specific legislation directed at the appropriate management of hazardous chemicals, using a life cycle approach.
7. Pacific Island Countries should actively participate in the current negotiations for a legally binding instrument for certain persistent organic pollutants (POPs).
8. Pacific Island Countries should urgently recognise the desirability of ratifying both the Basel and the Waigani Conventions.

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1. INTRODUCTION

1.1 BACKGROUND

Waste management has become of increasing significance to Pacific Island Countries (PICs) over recent years, and this has been recognised in the current SPREP Action Plan, 1997-2000. The Waste Minimisation, Management and Pollution Prevention Programme, which was endorsed by SPREP member countries at a meeting in Tonga in 1994, provides the umbrella under which all SPREP's waste management projects are implemented. An important aspect of this programme is the management of chemicals and hazardous wastes.

AusAID has recognised the need for improved waste management throughout the region and undertook a pre-feasibility study of potential waste management projects in April 1997. The study recommended thirteen areas in which assistance was needed, ranging from waste water treatment to landfill management. The management of waste chemicals was rated as highest priority and the Persistent Organic Pollutants in Pacific Island Countries (POPs in PICs) project was developed to address this component.

The management of chemicals, including pesticides, solvents, PCBs and waste oils has been recognised for some time as an environmental issue of major significance in the South Pacific region. These materials represent a serious threat to human health through contamination of soil and water resources and also to major ecosystems (mangroves, coastal lagoons) as a result of poor handling and disposal. These problems are particularly difficult for PICs because of:

- A lack of information on the types and volumes of chemicals being stored
- A poor understanding within the wider community of how chemicals should be used and stored
- Limited knowledge of the threat that certain chemicals pose for community and environmental health
- An absence of appropriate disposal facilities
- Government and community resources directed to other (seemingly) more urgent matters.

1.2 OBJECTIVES

The objective of POPs in PICs is to upgrade regional capacity for the management of POPs and related chemicals, in order to eliminate the threats posed by these towards the environment and human health. This project concentrates on the identification and disposal of waste and obsolete chemicals and the assessment and remediation of contaminated sites.

In order to achieve the objective, the project will assist PICs in the management of POPs by:

- Assessing the types and quantities involved.
- Assessing the current extent of contamination resulting from the use and/or disposal of hazardous chemicals.
- Assessing the facilities and expertise available to deal with these materials.
- Developing improved handling, disposal and remediation procedures.
- Recommending measures including legislation, to ensure that PICs can start to move towards the development of effective management systems and procedures.

1.3 SCOPE

The term POPs has been interpreted rather broadly and for the purposes of this project includes much more than those chemicals internationally defined as POPs. POPs are defined here as all hazardous or potentially hazardous chemicals and include pesticides, polychlorinated bi-phenyls (PCBs), industrial chemicals, medical wastes, laboratory chemicals, oil, bitumen, timber treatment chemicals and fertilisers.

The groups being targeted by the project include Governments, industry, farmers and fishermen in the region. Other groups affected by the project include local residents, who will benefit from the removal or remediation of existing hazardous substances, and peoples of the Pacific generally, who will benefit overall from the better management of these environmentally hazardous substances.

It should be noted that the project is only targeting stockpiles of waste and obsolete chemicals, and chemical contaminated sites. It is not considering pollution or contamination from existing or recent industrial or agricultural activities. Radioactive wastes and unused munitions from World War II were also excluded.

1.4 PROJECT OUTPUTS

The project as originally proposed, was to be undertaken in three Phases with outputs as follows:

PHASE 1

1. A comprehensive database on the stocks of waste chemicals and unused pesticides, including types and quantities, the location and state of the current storage, and relevant technical information on each substance identified. The Chemical Consultants will provide on-the-job training to counterparts in sampling, identification, handling and storage. Mechanisms will also be established to ensure that databases will be updated.
2. A comprehensive database containing information on the types and extent of chemically contaminated sites (including those contaminated by oil products) in Pacific Island Countries. The Chemical Consultants will also provide on-the-job training to counterparts in preliminary identification of chemical contaminated sites. Mechanisms will also be established to ensure that these databases will be updated.
3. A report assessing the facilities and technical expertise available in the Pacific Island Countries to deal with the management of waste chemicals, pesticides and contaminated sites.
4. A report reviewing government measures, including legislation and regulations, in each Pacific Island Country relating to the management of waste chemicals, pesticides and contaminated sites. The review will include:
   - A preliminary assessment of the effectiveness of current legislation, and an examination of current chemical management capabilities.
   - Recommendations for improvements required to effect satisfactory management of these materials.
   - An assessment of the implications of related international conventions and recommendations as to their applicability.
   - Recommendations for further in-depth reviews of Pacific Island Countries' legal and administrative capabilities to manage chemicals.
5. A technical document describing appropriate standard procedures for the identification of unlabelled substances, including sampling and transport procedures, and a listing of relevant testing facilities.
6. Plans for appropriate storage facilities in each country where materials may be safely housed prior to final disposal.
7. A report assessing disposal options for waste chemicals and pesticides, including decision-making criteria to ensure that each product is transported in a manner complying with relevant regional and international best practices and treated at an appropriate facility. The report will include an analysis of disposal options for each chemical type identified as recommended by the Technical Working Group to the Secretariat to the Basel Convention, for their suitability in the region. The report will also consider disposal options for each chemical type identified as recommended by Environment Australia for their suitability in the region. The report will consider the option of transporting the disposal facility to the wastes as an alternative to transporting the wastes to the disposal facility. Social, economic and environmental considerations will be included as decision-making criteria for assessing disposal options.
8. A report assessing remediation options for each contaminated site examined.
9. Reduction of future hazardous waste and site contamination problems through education and awareness and capacity building. Capacity building programmes will include formal training of one-week duration for technical staff and multi-media public education and awareness campaigns in each Pacific Island Country.
10. A report analysing the probable effectiveness and desirability of proposed legislation to mitigate the production of waste and ensure proper disposal procedures are adopted.
11. Based on the results of Phase I of the project a detailed project document including costings describing Phase II of the project.

PHASE II

Phase II of the project will involve implementation of the provision of storage facilities in Pacific Island Countries to house the materials requiring disposal in leak-proof and cyclone proof premises, prior to actual disposal occurring.

PHASE III

Phase III will see the safe disposal of these hazardous materials in all Pacific Island Countries.

It is now proposed to combine the work of Phase III with that of Phase II to save unnecessary costs associated with storage facilities.

Phase I of the project was located in 13 SPREP member island countries. These were the Cook Islands, Federated States of Micronesia, Fiji, Kiribati, Marshall Islands, Nauru, Niue, Palau, Samoa, Solomon Islands, Tonga, Tuvalu and Vanuatu. It is intended to include Papua New Guinea in subsequent phases of the work.

1.5 RELATED WORK PROGRAMMES

Related projects undertaken by or involving SPREP include:

- The NZODA funded Development of Hazardous Waste Management Strategies project. In addition to co-ordinating PICs involvement in other international chemical-related activities, this project will assist PICs to develop and implement integrated national programmes for the management of hazardous wastes.
- The UNITAR-developed National Chemical Profiles, which assess the capacity of countries to safely and efficiently manage hazardous chemicals. Profiles have now been completed for Kiribati and Vanuatu and are currently in preparation for Papua New Guinea and Tonga.
- The Global Programme of Action for the Protection of the Marine Environment from Land-Based Activities. SPREP is co-ordinating the development of a South Pacific Regional Programme of Action for this project.
- 'PACPOL' which targets ship-sourced PACific POLlution and includes development and implementation of marine oil pollution response programmes, and the implementation of IMO Conventions, including MARPOL and the London Convention.
- The Basel and Waigani Conventions. SPREP will act as secretariat to the Waigani Convention upon its entry into force following ratification by ten of the sixteen Forum Countries. Compliance with the Basel Convention will be essential to enable Phase II/III of POPs in PICs to proceed.
- The Pacific Regional Waste Education and Awareness Project (WASTE), which is funded by the European Union. WASTE targets solid waste public education in the eight Pacific countries with historical ties to the European Union.

POPs in PICs very much complements these other chemical related activities.

2. SITE INSPECTIONS AND RELATED ACTIVITIES

2.1 COUNTRY VISITS AND SITE INSPECTIONS

Most of the work for Phase I was carried out during 1998, but with some additional follow-up work during 1999. The bulk of the work was done by three specialist consultants with expertise in chemical hazard management, contaminated site assessments and waste management and disposal. Each country was visited by one of the consultants, with local assistance being provided by government officials, who acted as local counterparts. Local consultants were also recruited in some countries to assist with the work.

The work in each country was based around inspections of known chemical stockpiles and contaminated sites, plus visits to a variety of other locations with the potential for similar problems. The range of possible sites included the following:

- Government agriculture offices and research centres
- Power stations
- Waste disposal facilities (eg. landfills)
- Hospitals
- School laboratories
- Port quarantine facilities
- Vehicle maintenance depots
- Industrial and manufacturing operations.

Narrative reports on the consultants' activities and findings are given in individual country reports, copies of which are attached as Annex A of this document. A listing of all the locations where stockpiles of obsolete chemicals and/or contaminated sites were found, is given in Annex B1

2.2 WASTE AND OBSOLETE CHEMICALS

The following procedure was followed when stockpiles of obsolete and/or unwanted chemicals were found during the survey:

- The materials were sorted and identified from information given on the packaging.
- Unlabelled materials were sometimes able to be identified on the basis of inventory records and/or staff knowledge. Samples were occasionally taken for analysis, to assist with the identification. However, this option was only used where absolutely necessary, because of the high costs involved.
- In the case of transformer oils, samples were tested on-site using the Chlor-n-Oil test kits, which give a simple colour indication for the presence of polychlorinated biphenyls (PCBs).
- The quantities of materials were estimated using label information and container size.
- Details of the chemicals, their quantities and general condition were recorded, for later entry into the Chemicals database.
- The stockpile was discussed with local personnel, including the reasons for its existence, safety and security issues, and possible options for re-use or disposal.

The Chemicals database generated by this survey contains over 600 entries. It is not attached to this report due to its length (65 pages). However, the key information has been extracted into Annex B1 (pesticides), Annex B2 (PCBs and hydrocarbons), and Annex B3 (other miscellaneous materials, including timber treatment chemicals and fertilisers).

2.3 CONTAMINATED SITE IDENTIFICATION AND ASSESSMENT

Contaminated sites are those at which hazardous substances are present in the soil and/or groundwater. The contamination sometimes arises from the normal site operations (e.g. solid-waste landfills) but is more commonly caused by spillages, uncontrolled dumping, or other waste disposal activities. Typical contaminants include toxic heavy metals, pesticides, timber treatment chemicals, oils, tars and a wide range of other possible substances.

Contaminated sites and potentially contaminated sites were identified by the consultants on the basis of discussions with local personnel at the various facilities listed in Section 2.2 above. In many cases the contamination was visually obvious. In others it could only be deduced from information about previous waste disposal activities (eg. pesticide burial sites).

Each contaminated site was assessed using the Rapid Hazard Assessment Scheme (New Zealand Ministry for the Environment, 1993). In this system sites are assigned ratings on the basis of the extent of the contamination, the toxicity and mobility of the contaminants, the potential for contamination of the surrounding areas including food and water supplies, and ease of public access to the site. The individual ratings for each of these factors are then combined to arrive at an overall hazard rating for the site. The final rating covers a range from zero (non-hazardous) to 100 (extremely hazardous).

Over 100 contaminated sites were identified during the survey and 86 of these were given a rating of 30 or above. This was taken as the cut-off point for further investigation, and possible remediation. Information on each of these sites is given in Annexes B5 (pesticides), B6 (hydrocarbons) and B7 (other).

2.4 SAMPLING AND ANALYSIS

As indicated in Section 2.2, a limited number of chemical samples were taken for testing to assist with identification. These samples were taken in accordance with the procedures given in Annex C1 and submitted to laboratories in New Zealand and Australia. Information on these and other suitable laboratories are given in Annex C2.

Testing of transformer oils for PCBs was done using the Chlor-n-Oil test kits, which are manufactured by the Dexsil Corporation, Connecticut, USA. The kits are intended for field use, and give a simple colour indication for the presence of chlorinated hydrocarbons. The test is not specific for PCBs, and has the potential to give “false positive” results. More specific laboratory testing will therefore be required at the start of any disposal exercise.

2.5 INTERIM REMEDIAL ACTIONS

Some situations were found in the survey that warranted immediate remedial action to minimise the existing hazards. Others were found where the problems were easily dealt with on the spot. The actions taken in these situations were as follows:

- A variety of chemicals were being stored at a site in Vanuatu for quarantine purposes but were no longer required. These were found to be in good condition and were therefore distributed to other users.
- Approximately 2 tonnes of DDT were stored in a lean-to alongside the Ranadi storage sheds, Solomon Islands. This structure was also being used as housing for a local family. The DDT was relocated to the main storage building.
- Three drums of unidentified chemicals were found at an abandoned fisheries laboratory in Honaria, Solomon Islands. All of the drums were in moderate to poor condition and one of the drums was stored outside in the street. This was moved inside the building, the other drums were placed upright to prevent them leaking, and the store was fitted with a lock.
- About 4 tonnes of mixed pesticides were held in two adjacent buildings in Kolonia, Pohnpei. Many of the containers were in poor condition, and the site was readily accessible to the public. The pesticides were sorted and repacked where necessary, and stacked on pallets inside one of the buildings, which was then secured.
- A stockpile of about 1 tonne of pesticides was held at the Works depot in Niue. Some of this material had been previously placed into drums, but the remainder (in sacks and cardboard drums) was piled loosely about the floor. This material was sorted and placed into used tar drums.
- The Science storeroom at Pohnpei High School contained about 600 kg of old laboratory chemicals, including some which were potentially very dangerous. The chemicals were carefully sorted. The common acid reagents were neutralised by mixing with alkalis, and then flushed down the drain. Non-hazardous materials were set aside for disposal at the local landfill. The remaining chemicals were packed into plastic drums and are now in secure storage awaiting disposal.
- A stockpile of 65-70 tonnes of mixed agricultural chemicals was stored in a run-down shed in Rarotonga. The Cook Islands government had already made arrangements for this material to be repackaged and removed from the store. The SPREP consultant assisted with this operation, including advising on worker safety, possible alternative uses for the chemicals, disposal options, and site clean-up. Most of the material was shipped to New Zealand for reuse.

- Small stockpiles of pesticides and laboratory chemicals were found at various locations around Rarotonga. These were collected up and placed into secure storage with other pesticides held at the Agriculture research centre, Totokiutu.
- Inspection of a hospital laboratory in Rarotonga showed the presence of nearly 1kg of potentially explosive picric acid. This material was disposed by burning at a remote location, with the assistance of the airport Fire Rescue Service.

2.6 TRAINING AND DEVELOPMENT

A key component of this project is institutional strengthening through training and development of local personnel. This will mainly be addressed through the 1-week training courses in each country, which are planned for later in the year. However, it should also be noted that a significant amount of on-the-job training has already taken place, as a result of the involvement of local personnel with the site inspections and remediation work. A total of about 30 people have already been given invaluable experience in chemical identification, safe handling, sample collection, assessment of storage facilities, repackaging and storage, and the identification and assessment of contaminated sites.

2.7 IN-COUNTRY FACILITIES AND EXPERTISE

The existing in-country facilities for waste management and disposal were assessed by the consultants, as part of the site inspection work. Particular attention was paid to solid waste landfills and waste incineration facilities, especially those used for medical and quarantine wastes. Other supporting facilities, such as laboratories, were assessed in the same way.

The consultants were also required to assess the current levels of in-country expertise. While this was not done in any formal sense, a good indication was gained through working directly with the various local counterparts and local consultants.

2.8 LEGISLATION

Information on the existing legislation in each country was taken from the existing NEMS reports, where available, and through discussions with the local counterparts. This information is summarised in the country reports given in Annex A.

3. REGIONAL CONCERNS

This section of the report describes the main problems that were found during the country surveys. The presentation is based around the individual chemicals or groups of chemicals that were identified in stockpiles of waste and obsolete materials, or were believed to be present at contaminated sites. It was quite common for both of these situations to be found at the one site, in that sub-standard storage conditions or mis-handling had resulted in contamination of the surrounding area.

3.1 POLYCHLORINATED BI-PHENYLS (PCBS)

OCCURRENCE AND USE

The term PCBs is an acronym for a class of organic chemicals referred to as *polychlorinated biphenyls.* PCBs are characterised by having one or more chlorine atoms attached to a double benzene (biphenyl) group. As one of the most stable organic compounds known, PCBs have had a variety of uses, the most common being as dielectric fluids for high voltage electrical equipment, such as transformers. They were also used as heat transfer and hydraulic fluids, and in pigments and carbonless copy paper. PCBs have been sold under a number of common trade names, including the following:

Arochlor; Arochlor B; ALC; Apirloio; Asbestol;Askarel; Adkarel; Capacitor 21; Chlorextol;Chlorinol;Chlorphen; Clophen; Clorinol; Diaclor; Dykanol; EEC-18; Elemex; Eucarel;Fenclor; Hyvol; Inclor; Inerteen; Keneclor; Kenneclor; Magvar; No-Flamol; Nepolin;Pheboclor; Pydraul; Pyralene; Pyranol; Pyroclor; Saf-T-Kuhl; Santotherm; Santovac 1 Santovac 2.

Arochlor was one of the few materials to be based on 100% PCB oil. More commonly the PCBs were diluted with other organic liquids, particularly the chlorinated benzenes. This was generally the case for transformer oils.

In 1976, the United States restricted the manufacturing of PCBs under the Toxic Substances Control Act. Most developed countries subsequently adopted similar legislation and PCBs are now no longer used in most parts of the world. Transformers are now filled with non-toxic oils based on hydrocarbons or silicones. However, it is not uncommon for this to become contaminated with PCB residues left over from past uses, especially in older transformers.

HEALTH AND ENVIRONMENTAL EFFECTS

PCBs are amongst the most stable organic compounds known and they break down only very slowly in the environment. In water they can be taken up by freshwater and marine organisms, including phytoplankton. As phytoplankton is the primary food source (directly or indirectly) of all marine animals, transfer of PCBs up the food chain readily occurs in a contaminated environment.

Some PCBs are confirmed human carcinogens. PCBs can enter the body through the lungs, gastrointestinal tract and skin. They can be circulated through the blood stream and are stored in fatty tissue. Exposure during pregnancy can result in developmental problems in the foetus. PCBs can also be transferred through breast milk. Skin exposure can result in a severe and painful irritation, known as chloracne. Animal toxicological data suggests that some PCBs may have negative reproductive effects in humans.

Burning of PCBs can produce other highly toxic chemicals, including polychlorinated dibenzodioxins and furans. This is a particular concern with old transformers, because these can occasionally catch fire.

SURVEY RESULTS – CHEMICAL STOCKPILES

PCBs were identified in the survey by testing samples of oil taken from old transformers, most of which were no longer in use. Only a limited number of tests were taken in each country, but the results were then extrapolated to the remaining stock by considering the relative age of all of the units (both in and out of use). The Chlor-n-Oil test kits give a positive result for PCB concentrations greater than 50 parts per million (ppm).

The total volume of PCB oil identified in the surveys is summarised in Table 3.1 below. The values reported are necessarily conservative because of the limited number of tests carried out. In the absence of any test results, transformers more than about 20 years old were assumed to contain PCBs.

TABLE 3.1 TOTAL VOLUMES OF OIL POTENTIALLY CONTAMINATED WITH PCBS

Country	Quantity (metric tonnes)
Cook Islands	4.0
Fiji	Nil
FSM	55.0
Kiribati	5.5
Marshall Islands	0.8
Nauru	7.0
Niue	1.0
Palau	18.0
Samoa	10.0
Solomon Islands	0.8
Tonga	8.0
Tuvalu	8.0
Vanuatu	13.0
TOTAL	**131.1**

Additional testing will be required at the start of any PCB disposal operation. This should be done after the transformers have been moved to a single staging point within each country. This will allow all units to be tested in a systematic and consistent way.

SURVEY RESULTS – CONTAMINATED SITES

The sites identified as most likely to be contaminated with PCBs are shown in Table 3.2 below. As indicated, all of these sites involve situations where transformers have leaked and contaminated the surrounding soil. All of these sites require further investigation to determine the extent of contamination and a recommended remediation plan.

3.2 PESTICIDES

OCCURRENCE AND USE

The term pesticides has been defined by the FAO as *"Any substance or mixture of substances intended for preventing, destroying or controlling any pest, including vectors of human or animal disease, unwanted species of plants or animals,.. or which may be administered to animals for the control of insects, arachnids or other pests in or on their bodies"*. This rather broad definition therefore encompasses chemicals used throughout agriculture, as well as domestically to control rodents, fleas, mosquitoes, cockroaches, and so on. For the purposes of this report however, DDT which has been used to control mosquitoes as part of the malaria control strategy in the Pacific, has been covered in a separate section (3.3).

Pesticides are used to varying degrees in all of the countries covered by the survey. In countries such as Nauru and Tuvalu, the use is minimal, no more than a few kilograms per year. However in countries such as Fiji, the usage is in the order of hundreds of tonnes per year. A wide range of pesticides (approximately 300 chemicals) was identified in this survey as requiring safe storage and disposal. Many of these chemicals were brought for experimental crops and/or development projects that have now been abandoned, and there is no feasible local use for the chemicals.

HEALTH AND ENVIRONMENTAL EFFECTS

The agricultural pesticides located during this survey cover a wide range of toxicities and potential effects. However, as a generalisation, pesticides are designed to kill unwanted plants or animals with low doses, and therefore must be considered to be hazardous substances. Some examples of the possible health and environmental effects are given below, for some of the pesticides that were found in relatively large quantities during the survey.

Propanil (10.2 tonnes) This herbicide is classified by WHO as moderately toxic (class II) to humans via ingestion and inhalation. It can also be irritating to the eyes and skin. It is moderately toxic to birds, and

TABLE 3.2 SITES IDENTIFIED AS POTENTIALLY CONTAMINATED WITH PCBS

Country	Site	Description	Hazard Rating
Nauru	Nauru Phosphate Corporation #2 Bin	Storage shed for old machinery including 100 transformers, most pre 1970, significant oil spillage to soil on floor	64
Samoa	Electric Power Corporation depot and store, Vaitele	Transformer maintenance, visible oil contamination of soil	64
Samoa	Electric Power Corporation power station, Salelologa	Transformer maintenance, visible oil contamination of soil	32

moderately to highly toxic to a wide range of aquatic species. This is a particular concern as Propanil is soluble in water and absorbs only weakly to soil particles. Micro-organisms in the soil break it down within 7 days so there is generally low potential for groundwater contamination.

Trichlorfon (6.7 tonnes) This is an organophosphate insecticide in toxicity class II - moderately toxic, via ingestion and skin absorption. Trichlorfon primarily affects the nervous system through inhibition of cholinesterase, an enzyme required for nerve function, and other target organs are the liver, lungs and bone marrow. It has been shown to have negative effects on reproduction in rats, although these effects are unlikely to occur in humans at normal exposure levels (when the chemical is used at recommended rates). Trichlorfon is moderately to highly toxic to birds, and very toxic to many aquatic species. It is broken down by micro-organisms in the soil within a month but is very mobile in soil so there is a high potential for groundwater contamination.

Carbaryl / Sevin (4.4 tonnes) This is a carbamate insecticide in toxicity classes I and II, depending the formulation - highly toxic for the concentrated form and moderately toxic for formulations such as Sevin. It can produce adverse effects in humans by skin contact inhalation and ingestion. Direct contact with the skin or eyes with moderate levels of this pesticide can cause burns. Inhalation or ingestion of large amounts can be toxic to the nervous and respiratory system. Other symptoms of high doses include sweating, blurred vision, lack of co-ordination and convulsions. Carbaryl is practically non-toxic to birds, but moderately toxic to aquatic species. It is broken down by sunlight and bacterial action in the soil within a month, and is generally bound to the soil so there is a low potential for groundwater contamination.

Maneb (2.2 tonnes) Maneb is a fungicide which is classified as unlikely to present acute hazard in normal use (class IV). However contact with the skin causes inflammation and acute exposure may result in hyperactivity, loss of co-ordination, nausea, vomiting, diarrhoea, blurred vision, slowed reflexes and confusion. Maneb is practically non-toxic to birds but is highly toxic to fish and other aquatic species. It is strongly bound and persistent in soil and not highly soluble in water. Maneb breaks down rapidly in water under anaerobic conditions.

Furadan (Carbofuran, 0.9 tonnes) Furadan is a broad-spectrum insecticide in toxicity class I - highly toxic by inhalation and ingestion. Death may result at high doses from respiratory system failure. Other symptoms of high doses include nausea, vomiting, cramps, sweating, weakness, blurred vision, lack of co-ordination and breathing difficulty. It is highly toxic to birds (one granule will kill a small bird) and also highly toxic to many fish. It is persistent in soil and soluble in water and has a high potential for groundwater contamination.

SURVEY RESULTS – CHEMICAL STOCKPILES

The total volumes of pesticides identified during the surveys are summarised in Table 3.3. Surplus and obsolete pesticides were identified in all countries except Nauru, Tonga and Tuvalu. Larger quantities were identified in the countries with larger agricultural sectors (ie. Fiji, Solomon Islands) and in the Federated States of Micronesia.

TABLE 3.3 PESTICIDE STOCKPILES IDENTIFIED IN THE SURVEYS

Country	Total Quantities of Pesticides (tonnes)
Cook Islands	5.7
Fiji	19.0
FSM	7.4
Kiribati	0.7[1]
Marshall Islands	0.1
Nauru	Nil
Niue	1.5
Palau	0.1
Samoa	0.2
Solomon Islands	11.0[2]
Tonga	Nil
Tuvalu	Nil
Vanuatu	0.3
TOTAL	**46.0**

1. An unknown quantity of waste pesticides is also known to be stored at Canton Island in Kiribati.
2. Plus approximately 7 tonnes of contaminated packaging at Metapona Plains, Solomon Islands.

CONGRATULATIONS TONGA

The Kingdom of Tonga is well known as having a highly agricultural economy. Despite this no waste pesticides nor pesticide contaminated sites were located in the survey. For this Tonga is to be congratulated.

SURVEY RESULTS – CONTAMINATED SITES

Pesticide contaminated sites generally fall into two categories; those where old pesticides had been disposed by burial, and sites contaminated by spillages. Pesticide disposal by burial can be effective in reducing the immediate risks from these chemicals, and some will gradually break down in the soil. However, there can be a significant risk of contaminating any nearby groundwater supplies. There is also a risk of problems in the future if the site is redeveloped for other uses, such as housing (as found in Fiji).

A full schedule of pesticide contaminated sites is given in Annex B.5, but the most significant are summarised below. A total of 16 contaminated sites were identified, and all of these will require further investigation to determine the extent of contamination, followed by remediation.

PESTICIDES WITH YOUR FISH?

Approximately 10 tonnes of pesticides are stored in an abandoned shed in the former Metapona Plains rice growing area near Honiara. This rice farm was developed in 1980 as a joint project (55 % US interests/45 % Solomon Islands Government) but the US partner withdrew in 1982 and the farm was abandoned after Cyclone Nama in 1986. The chemicals were repackaged in 1994 with the aim of transporting them overseas for disposal. However no agency or Ministry has been able to safely dispose of these chemicals. In the meantime, the containers continue to deteriorate and leak, and the chemicals are gradually seeping into the surrounding soil and streams. Local villagers have broken into the shed and stolen pesticides that they used to kill fish for human consumption. A complete clean up is urgently needed.

TABLE 3.4 EXAMPLES OF PESTICIDE CONTAMINATED SITES

Country	Site	Description	Hazard Rating
FSM (Chuuk)	Weno, private property in residential area	900 kg waste pesticides repackaged by WHO in 1994 into a container. The container is leaking and children living nearby have been affected.	100
FSM (Pohnpei)	DoA storage shed, Kolonia	470 kg waste pesticides repackaged by WHO in 1994. Over 2 tonne of other loose pesticides including DDT and Chlordane added later.	100
FSM (Pohnpei)	DoA storage shed, Kolonia	1,300 kg of agricultural chemicals including DDT and carbamates in an area frequented by tourists.	100
Fiji	Former MAFF research station, Lamaivuna	Over 3 tonnes of old pesticides stored in poor condition, close to a residential area.	90
Solomon Islands	Storage shed on former rice farm, Metapona Plains	Chemicals abandoned in 1986, repackaged by SPREP and WHO in 1996 but since vandalised again.	85
Fiji	MAFF research station, Lakena	Over 2 tonnes of pesticides buried near this site, on land which has since been sold for residential use.	80
FSM (Yap)	DoA research station	800 kg waste pesticides repackaged by WHO in 1994.	80
Fiji	MAFF research station, Dreneki	Pesticide leakage inside store, and dicidex buried beside the store.	60
Samoa	MAFF&M research station, Nu’u	A total of about 2.5 tonnes of pesticides buried in three locations.	60

3.3 DDT

OCCURRENCE AND USE

DDT was originally used as a broad spectrum insecticide. However, most applications have been discontinued because of its known health and environmental effects. DDT is now mainly used for vector (mosquito) management in the control of malaria, and this use tends to be restricted to those parts of the world where malaria is still a major health problem. WHO has spearheaded the global campaign to control malaria and has supported the use of DDT in many developing countries including Papua New Guinea, the Solomon Islands and Vanuatu. The chemical is still manufactured in a number of countries, including China and India, with India for example, producing about 10,000 tonnes annually.

HEALTH AND ENVIRONMENTAL EFFECTS

DDT is classified by WHO as only moderately toxic to humans. There is no evidence of teratogenic or mutagenic effects in humans, but it has been classified as a "possible human carcinogen" on the basis of observed effects in other species. DDT is stored in fatty tissue, and released very slowly. DDT or metabolites may be released via mother's milk to babies.

DDT is only slightly toxic to birds but very toxic to aquatic invertebrates and fish. In addition, DDT may bioaccumulate in fish and other species, leading to long term chronic exposure. It is highly persistent in the environment, with a reported half-life of 2 to 15 years, and is immobile in most soils. Breakdown products are DDD and DDE, which have similar chemical and physical properties to DDT.

SURVEY RESULTS – CHEMICAL STOCKPILES

Stockpiles of DDT identified in the surveys are as shown in Table 3.5 below.

TABLE 3.5 DDT STOCKPILES

Country	DDT (metric tonnes)
Cook Islands	Nil
Fiji	Nil
FSM	0.1*
Kiribati	Nil
Marshall Islands	Nil
Nauru	Nil
Niue	Nil
Palau	Nil*
Samoa	Nil
Solomon Islands	8.3
Tonga	Nil
Tuvalu	Nil
Vanuatu	0.9
TOTAL	**9.3**

(*Additional quantities of DDT have been buried in FSM and in Palau – see entries under contaminated sites below)

SURVEY RESULTS – CONTAMINATED SITES

A list of DDT contaminated sites identified in the surveys is given in the table below. All sites require further investigation to determine the extent of contamination.

TABLE 3.6 DDT CONTAMINATED SITES

Country	Site	Description	Hazard Rating
Solomon Islands	MHMS hardware store, Ranadi	Significant DDT contamination	80
Palau	Disposal site, Ngatpang, Babeldoab	6 x 200 litre drums, partially buried	80
FSM (Pohnpei)	Ex-hospital site, Kolonia	2 tonnes buried in a residential area	80
Solomon Islands	MHMS rural water supply store, Ranadi	Significant DDT contamination	30

(MHMS = Ministry of Health & Medical Services)

DDT in Honiara, Solomon Islands

SPREP Chemicals Consultant, Dr Ian Wallis, sent the following report of his inspections on 14 July 1998 (abridged):

On Tuesday 14 July, the storage sheds owned by the Ministry of Health and Medical Services were inspected by the SPREP Chemicals Consultant in the company of two officers from the Ministry of Health and Medical Services, the medical director of SIMTRI and two officers of WHO.

The Hardware Shed contained a large range of plumbing fittings, a large quantity of bed netting and 3.5t (100 cardboard boxes each containing 35kg) of DDT recently purchased from China (February 1998). The storage was generally neat and tidy, and the shed was locked and secure.

On the roadway outside this shed was a blue 200 L drum labelled DDT ICI Batch 40135 25% EC. The drum was corroded and empty, but smelled of DDT and apparently had recently discharged the contents onto the ground.

The Rural Water Supply Shed contained a large quantity of cement, 19 outboard motors, 2 air conditioning units, and a quantity of files, furniture, chemicals, toolboxes and miscellaneous effects. From the perspective of chemicals, the major items were as follows:

- *five 200 L drums of DDT powder packed in polythene bags,*
- *two cardboard boxes of DDT powder each containing about 75kg;*

Outside, on the East Side of the building, were 13 drums of DDT labelled DDT ICI Batch 40135 25% EC. Ten of the drums were full; three were empty. One theory discussed by those present was that these drums were originally to be shipped to the provinces but had leaked at the wharf and had been temporarily removed to this site. No one at the inspection had been aware that these drums of DDT still existed. The drums were generally damaged, perhaps by rough handling during transport. It is probable that the contents of three drums (600 L) had leaked into the ground.

One or two families were occupying a lean-to built on the West Side of the building. An inspection inside this room revealed cooking equipment, two beds, two children and 7 drums of DDT powder plus 2 cardboard boxes of DDT powder. The polyethylene packages had been ripped open and there were finger marks in the powder. One person said that powder was taken to kill fish. In any event, the DDT is NOT stored properly and is readily available to small children.

Overall, there are a total of 11 full drums of DDT liquid, 12 full drums of DDT powder and 6 empty drums, as well as 4 cardboard boxes of DDT powder. With the assistance of personnel from WHO and the Ministry of Health and Medical Services, all full and empty drums were moved inside the store, and the cardboard boxes of DDT powder were repacked into steel drums and also locked in the store.

3.4 TIMBER TREATMENT CHEMICALS

OCCURRENCE AND USE

Timber treatment chemicals are used to preserve timber from fungal degradation and from attack by insects, especially borer. A range of different preservatives is used, with those that are chemically fixed to the timber being the most effective.

The simplest form of timber treatment process is the “dip” system, in which the wood is simply dipped into a trough of chemicals. Alternatively, the chemicals may be simply applied to the wood with a brush. At the other end of the scale are the pressure processes in which the chemicals are forced into the wood under pressure. The timber is first dried, using either air seasoning or heat. It is then placed inside steel cylinders or retorts, typically 1.5 to 3 meters in diameter and up to 10 to 50 meters in length. The cylinder is closed and filled with preservative. Applied pressure forces the chemicals into the wood. The amount of chemical absorbed is determined by the concentration of the treatment solutions, the amount of pressure applied, and the treatment time. At the end of the treatment cycle the tank is drained, and the load is then removed to a drip area and allowed to dry.

HEALTH AND ENVIRONMENTAL EFFECTS

Some of the chemicals commonly used for timber treatment are as follows:

Boron salts These are rapidly absorbed by humans, both orally and through the skin, but are also rapidly eliminated from the body. Boron exposures can result in a variety of health effects including nausea, abdominal pain, diarrhoea and violent vomiting. Boron compounds are also irritating to the eyes, nose, respiratory tract and the skin. However, most of these effects have only been observed in cases of severe exposures, well above the levels that should occur during normal use.

Pentachlorophenol (PCP) Pentachlorophenol is commonly used in two forms, petroleum solutions of PCP itself and as the water-soluble sodium pentachlorophenate. Chronic exposure to PCP can result in a range of adverse health effects, including irritation of the skin and mucous membranes, chloracne, neurasthenia, depression, headaches and changes in kidney and liver function. In addition, PCP has been classified as a probable human carcinogen. PCP is highly toxic to aquatic life and is also known to bioaccumulate through the food chain. Technical-grade PCP is also a concern because of the presence of impurities such as the polychlorinated dibenzodioxins and polychlorinated dibenzofurans (dioxins and furans). These chemicals are highly persistent and bioaccumulate, and some are known human carcinogens.

Copper/chrome/arsenic (CCA) CCA preservatives are made up of mixtures of a variety of compounds of copper, chromium and arsenic. Arsenic is sometimes also used on its own.

Chromium salts are commonly found in two different oxidation states, +3 and +6, and the environmental properties and potential health effects of these differ markedly. Hexavalent chromium (+6) is classified as a known human carcinogen, for inhalation exposures. Both forms of chromium cause irritation of the skin and mucous membranes, and chromium (+6) can also cause sensitisation and ulceration. Both forms are toxic to aquatic organisms, although the +6 form is much more toxic than the +3 state.

Copper has been associated with a wide range of chronic and acute adverse health effects in humans, including skin and eye irritation, nausea and vomiting, and ulceration of the mucous membranes. However these effects are usually only caused by severe exposures. Copper is a necessary trace element in soils, but can be toxic to plants in high concentrations. It is moderately toxic to aquatic organisms.

Arsenic has been associated with a range of adverse chronic health effects in humans, particularly effects on the central nervous system. In addition, the chemical is classified as a human carcinogen. Other health effects after high doses of arsenic are gangrene of the feet, skin and lung cancers, anaemia and optic nerve degeneration. Arsenic is toxic to plants, and can also accumulate to unacceptable levels in crops grown in contaminated soil. It is only moderately toxic to aquatic organisms, but is readily absorbed by phytoplankton and can therefore enter the food chain by this route.

SURVEY RESULTS – CHEMICAL STOCKPILES

The volumes of waste timber treatment chemicals identified in the survey are summarised in Table 3.7. By far the largest quantity is 127 tonnes stored in two pits on a timber mill at Santo, Vanuatu. However this material is clearly the responsibility of the mill owner and its removal is not recommended as part of this project.

TABLE 3.7 WASTE TIMBER TREATMENT CHEMICALS

Country	Quantity, tonnes
Cook Islands	Nil
Fiji	Nil
FSM	Nil
Kiribati	1
Marshall Islands	Nil
Nauru	Nil
Niue	Nil
Palau	Nil
Samoa	10
Solomon Islands	0.15
Tonga	Nil
Tuvalu	Nil
Vanuatu	127
TOTAL	**138.15**

HIDDEN DANGER

A small abandoned treatment site in Tonga indicates the possible extent of contamination. The site is about 30m x 30m and was previously part of a Government Stores complex. The site is well fenced, but the nearest houses are only a few metres away on the other side of the fence. The only evidence of the treatment plant is a small concrete pit about 2m x 1m x 1m. The concrete shows only minor signs of staining from CCA chemicals. However, soil samples taken from the site showed the following results:

Arsenic: 180 to 4600 mg/kg

Copper: 180 to 3100 mg/kg

Chromium: 84 to 2400 mg/kg

*These results are well above the "acceptable" limits of 20, 60 and 50 mg/kg, for arsenic, copper and chromium, respectively *.*

The Tonga site would be a major health risk if it was ever sold for redevelopment as a residential property.

(These are the investigation limits recommended by the Australia and New Zealand Environment and Conservation Council for contaminated land.)*

SURVEY RESULTS – CONTAMINATED SITES

Most timber treatment sites are known to be contaminated by the chemicals used at the site. This is due to the cumulative effects of drips, leaks, spillages and waste disposal practices. The contamination is usually concentrated around the treatment areas, and the pads where the treated timber is allowed to drip dry. In addition, the process generates a contaminated sludge, which is sometimes disposed by dumping on the site.

A list of sites potentially contaminated with timber treatment chemicals is shown in Table 3.8.

A total of ten sites were identified in the survey, but most are private concerns and any remediation is considered to be the responsibility of the owner. The sites shown in the table are owned by Government agencies and are recommended for remediation under Phase II of this project.

TABLE 3.8 POTENTIALLY CONTAMINATED TIMBER TREATMENT SITES

Country	Site	Description	Hazard Rating
Samoa	Development Bank of Samoa, leased to Bluebird Transport Ltd. Previous use as timber treatment facility.	Abandoned site, visible evidence of CCA contamination, treatment cylinder containing sludge and chemicals tank remaining, nearby residences	80
Vanuatu	Former Forestry research station, Espiritu Santo	Anecdotal evidence of two drums of arsenic pentoxide buried in a concrete lined pit	50
Samoa	Samoa Forest Corporation Ltd. timber mill, Asau	Mill operational, treatment facility abandoned, visible evidence of CCA contamination	48
Tonga	Government stores, ex timber treatment site	Significant CCA contamination of entire site	40

3.5 WASTE OIL

OCCURRENCE AND USE

Oil is typically used as an all-purpose lubricant and insulator in diesel engines, gearboxes and hydraulic systems. Waste oil is generated primarily through replacement of the lubricants and spill events.
The major contributors to waste oil generation in the South Pacific Island nations are; power generation, motor vehicles and fishing vessels. Much of the equipment is ageing and poorly maintained. Consequently, the oil requirements are high due to frequent leakage and top ups.

HEALTH AND ENVIRONMENTAL EFFECTS

Oils themselves are not particularly toxic to humans, although they can become contaminated through the use of additives, solvents and the generation of breakdown products. Waste oil is a combination of hydrocarbon groups including aromatic, polyaromatics and long chain alkanes. Hydrocarbons can have a potent narcotic effect in high doses, with acute intoxication leading to depression of the central nervous system. Some of the polyaromatic components are confirmed or suspected carcinogens. The heating action experienced by oil in an engine can also produce a variety of complex hydrocarbons. Waste oil contains elevated levels of heavy metals produced by engine wear. Waste oils may be also be inadvertently contaminated with traces of more toxic chemicals such as PCBs and chlorinated solvents.

In the aquatic environment, a waste oil spill can have a smothering effect, particularly on plants and benthic organisms. The more common problems include coating of fish gills, causing them to suffocate, and coating of bird feathers, which prevents them from flying. Oil spills on land result in vegetation stress and die-back. Spills or inappropriate storage of waste oil can also pose a fire hazard.

While essentially insoluble in water, an oil spill which contaminates a groundwater aquifer, can impart significant taste and odour, often making the water undrinkable.

SURVEY RESULTS – CHEMICAL STOCKPILES

No attempt was made during the surveys, to obtain data on current waste oil generation rates. However, a survey of the existing stockpiles was carried out, and the results from this are summarised in Table 3.9.

TABLE 3.9 WASTE OIL STOCKPILES

Country	Volume, Litres
Cook Islands	20,000
Fiji	8,000+
FSM	126,000
Kiribati	7,000
Marshall Islands	2,000
Nauru	2,000
Niue	10,000
Palau	10,000
Samoa	Nil
Solomon Islands	4,000+
Tonga	2,000
Tuvalu	2,000
Vanuatu	15,000+
TOTAL	**208,000+**

SURVEY RESULTS – CONTAMINATED SITES

At least 30 oil-contaminated sites were identified throughout the region, with the main sources being as follows:

- Bulk fuel storage depots can be contaminated due to leakage of fuel and oil. Significant volumes of oil-contaminated water can be generated from the flushing of pipes, and from stormwater run-off, although most of this is passed through oil/water separators prior to discharge. The separators are a potential source of oil-contaminated sludges, and sludges are also produced during tank cleaning.
- Most of the power stations in Pacific Island Countries are fired on diesel or light fuel oil. These can be a significant source of waste oil, which is mainly produced during engine servicing. The oil is often disposed by dumping on part of the site. Cooling water discharges are another source of contamination.
- Vehicle workshops are another significant source of oil contamination, with many facilities often disposing of waste oil by dumping it on the ground.

A full list of the oil contaminated sites identified during the surveys is given in Annex B.6. Many are private facilities and any remediation should be the responsibility of the owner. A list of the most highly contaminated Government-owned sites is given in Table 3.10 below. These sites are considered to warrant remediation under Phase II of this project.

Table 3.10 Oil Contaminated Sites

Country	Site	Description	Hazard Rating
FSM (Chuuk)	Ex World War II Japanese bulk fuel depot	Up to 15,000 m^3 of contaminated soil and 60,000 m^3 of free diesel product	81
Kiribati	Power station, Betio	800 m^3 contaminated soil, plus significant groundwater contamination	64
FSM (Pohnpei)	Pohnpei Utility Corporation power station, Kolonia	Significant diesel spill in 1996	64
Nauru	Nauru Phosphate Corporation, #2 Bin	Disused machinery storage, oil spillage	64
Samoa	Electric Power Corporation depot and store, Vaitele	Visible oil contamination on ground	64
Kiribati	Public Vehicle Unit, Betio	200 m^3 contaminated soil	58
FSM (Pohnpei)	Transport Authority, vehicle maintenance depot	Significant fuel and oil spills, widespread soil contamination & oil slicks in adjacent creek	58
FSM (Yap)	Yap power station	Unlined waste oil disposal pit, approximately 400 m^3 of highly contaminated soil	58
Fiji	Fiji Fire Authority, Suva	Significant oil contamination of soil from adjacent steel works	55
Kiribati	Power station, Bikenibue	Approximately 300 m^3 of oil contaminated soil	51

Waste Oil - The Forgotten Pollutant

Waste oil has been a major problem in the region for decades. The need for environmentally acceptable disposal procedures has largely been ignored, and where Governments have had powers to ensure that such procedures are in place, they have frequently failed to enforce them. In Yap (FSM) for example, thousands of litres of waste oil have been burnt in an open pit each year.

With increasing urbanisation the volumes of waste oil produced in Pacific Island Countries have steadily increased. In 1996 the Forum Secretariat estimated that 10.5 million litres or waste oil was generated in the region, in that year alone.

There is a bright light on the horizon however and the Forum Secretariat has now reached an agreement in principle with the major fuel suppliers operating from Fiji, to implement a waste oil collection program. Mobil have commenced transporting waste oil from other countries, for use as a supplementary fuel in the Suva Steel Mill. With a lot of effort by many people and organisations, residents of the Pacific may soon have no need to remain concerned about whether waste oil from the cars and buses they use will end up in the lagoons in which they swim.

TABLE 3.11 SITES WITH SUSPECTED GROUNDWATER CONTAMINATION

Country	Location	Contaminant
FSM (Chuuk)	Former Japanese fuel depot, Tonoas Island,	Diesel
FSM (Kosrae)	MPC bulk fuel depot (former Mobil site)	Diesel
FSM (Yap)	Power station, Yap	Waste oil
FSM (Yap)	Mobil bulk fuel depot (former power station), Yap	Diesel, waste oil
FSM (Pohnpei)	Former power station, Pohnpei	Diesel, waste oil
Kiribati	Betio power station, Tarawa	Waste oil
Kiribati	Bonriki airport, Tarawa	Bitumen
Kiribati	Former British fuel depot, Christmas Island	Diesel
Kiribati	Bitumen disposal area, Christmas Island	Bitumen
Nauru	Wartime oil storage sites	Waste oil
Palau	Ngerbeched landfill, Koror	Waste oil

SURVEY RESULTS – CONTAMINATED GROUNDWATER

Contamination of the underlying groundwater is an almost inevitable consequence of waste oil disposal by dumping on the ground. This is a particular issue on many Pacific islands because the groundwater supplies are often no more than a few metres below the surface. Evidence of possible groundwater contamination was identified at the locations shown in Table 3.11.

3.6 BITUMEN

OCCURRENCE AND USE

Bitumen is used extensively in road and runway construction projects. Foreign contractors undertake most large infrastructure works in the South Pacific. Crude bitumen and the necessary cutters and emulsifiers are imported on a project specific basis, typically in batches of 200 litre drums. As most roads require 50 to 80 cubic metres of bitumen per kilometre, hundreds or thousands of drums can be imported for a given project. Leftover drums from these projects degrade rapidly in the tropical climate, ultimately spilling bitumen onto the ground.

ENVIRONMENTAL AND HEALTH EFFECTS

Bitumen is comprised primarily of high molecular weight long-chain hydrocarbon molecules. It can also be rich in aromatic and polyaromatic hydrocarbons (PAH). Some of the more common PAHs include naphthalene, fluorene, pyrene and benzopyrene. Some PAHs are confirmed carcinogens, many are suspected carcinogens and all are considered to pose a potential health risk.

Bitumen is typically a viscous liquid at ambient temperature. Many of the components have low vapour pressures and readily volatilise. Although not miscible with water some PAH components such as naphthalene, are moderately water-soluble and can contaminate ground and surface water flows. Spilt bitumen readily becomes molten in the hot tropical climates, which assists the spread of contamination. The material can also act as a sticky trap for birds and other small animals.

SURVEY RESULTS – CHEMICAL STOCKPILES

The stockpiles of waste bitumen identified in the country surveys are summarised in Table 3.12.

TABLE 3.12 STOCKPILES OF WASTE BITUMEN

Country	Quantities metric tonnes
Cook Islands	Nil
Fiji	Nil
FSM	20
Kiribati	200
Marshall Islands	20
Nauru	30
Niue	Nil
Palau	Nil
Samoa	Nil
Solomon Islands	Nil
Tonga	Nil
Tuvalu	60
Vanuatu	Nil
TOTAL	**330**

TABLE 3.13 BITUMEN CONTAMINATED SITES

Country	Site	Description	Hazard Rating
Kiribati	Bonriki airport, and adjacent private property and beach	100,000 litres waste bitumen	100
FSM (Pohnpei)	Asphalt manufacturing plants, Madolenihmw, Palikir and Uh	Spills and leaks of bitumen and asphalt additives, pooling of chemicals evident at Palikir	64
Tuvalu	Public Works depot	60,000 litres waste bitumen	55
FSM (Yap)	Old airport	230 drums of old bitumen	45
Marshall Islands	Kwajalein island	100 drums of leaking bitumen	32
Kiribati	Linnex Public Works Division, Christmas Island	More than 500 drums stored at various sites and about 50,000 buried drums (empty)	30

SURVEY RESULTS – CONTAMINATED SITES

All of the sites where waste bitumen is stored were considered to be contaminated sites. The hazards assessment ratings for these sites are summarised in Table 3.13 above. This also includes one currently operational manufacturing plant.

3.7 LABORATORY CHEMICALS

OCCURRENCE AND USE

One revelation of great concern during the surveys was that many secondary school science laboratories appear to have had a remarkable ability to obtain quantities of chemicals which they do not need and do not know how to deal with. However this problem is not unique to the Pacific Islands. In the past, school laboratories in many parts of the world were set up to carry out demonstrations and experiments using a wide range of different chemicals. Many of these experiments have now been discontinued, partly because of the high costs and also because of the potential hazards associated with many of the chemicals.

The problem of surplus chemicals was also not confined to school laboratories. Similar stockpiles of unwanted and obsolete chemicals were also found in hospital laboratories and government research centres. These were sometimes caused by poor stock control and purchasing practices, and sometimes because the laboratories were no longer carrying out some of the tests had for which the chemicals were bought.

ENVIRONMENTAL AND HEALTH EFFECTS

Laboratory chemicals can include a wide range of hazardous materials such as acids, alkalis, solvents, cyanides, aldehydes, chlorinated hydrocarbons, and metal salts. The potential effects of some of these are as follows:

- **Cyanides** Cyanide salts are highly toxic if swallowed, and liberate the highly toxic hydrogen cyanide gas when mixed with acids.
- **Formaldehyde** Solutions of formaldehyde give off a vapour, which is highly irritating to the eyes and lungs. Formaldehyde is also classified as a suspected human carcinogen.
- **Mercury** Exposure to mercury vapour can lead to adverse effects on the central nervous system.
- **Lead, arsenic, chromium, nickel and other heavy metals** All of these metals can have adverse effects on the central nervous system, and some are known or suspected human carcinogens
- **Laboratory acids (nitric, hydrochloric, sulphuric, perchloric)** These acid are all highly corrosive and give off fumes which can be highly irritating to the throat and lungs. Some are strong oxidisers and can react violently with a variety of other materials.
- **Sodium hydroxide and other alkalis** These materials are also highly corrosive and can cause severe burns to the eyes and skin.
- **Chlorinated solvents (chloroform, carbon tetrachloride, dichloroethane, etc)** Most of these solvents can have narcotic effects. Prolonged exposures can cause damage to specific body organs such as the liver. Some are known or suspected carcinogens.
- **Hydrocarbon solvents (benzene, toluene, xylene, etc)** All of these have narcotic effects and some can cause organ damage. Benzene is a known human carcinogen.
- **Metal powders** Finely divided metal powders burn readily and have sometimes been know to spontaneously ignite.
- **Picric acid** This material is a shock-sensitive explosive and bottles have been known to explode when handled carelessly.

PENNIES FROM HEAVEN

Government laboratories are not immune from chemical disposal problems:

In Honiara in the Solomon Islands a Fisheries Laboratory was established under an AusAID project some years ago. In an outside store there were two full 200 L drums of an unidentified chemical. Both drums were rusting, and one had rusted to the extent that the polyethylene liner was partly visible. A further drum with similar labels was stored outside.

The Australian High Commission was contacted and efforts were made to identify the contents. Advice was received from CSIRO Marine Fisheries that the contents were likely to be formaldehyde or ethyl alcohol, but no positive identification could be made.

Also in Honiara a large bait fish laboratory was established with support from both Japan and Australia. The laboratory was fully equipped with laboratory equipment and reagents. The bait fish project has been completed and the laboratory was closed without any action to remove, reuse or dispose of surplus chemicals. There is a large quantity (80 litres) of acids in the store, many in their original packaging and bottles, which are in "as new" condition and could be reused by another laboratory.

SURVEY RESULTS – CHEMICAL STOCKPILES

The stockpiles of laboratory chemicals identified in the country surveys are summarised in Table 3.14.

TABLE 3.14 STOCKPILES OF LABORATORY CHEMICALS

Country	Quantities, (kg and/or litres)
Cook Islands	380
Fiji	36,400
FSM	800+
Kiribati	2300
Marshall Islands	Unknown
Nauru	Nil
Niue	Nil
Palau	7300
Samoa	400
Solomon Islands	300
Tonga	Unknown
Tuvalu	Minor
Vanuatu	100+
TOTAL	**47,980+**

SURVEY RESULTS – CONTAMINATED SITES

No sites contaminated with laboratory chemicals were specifically identified during the surveys. However, most of the laboratory storerooms are likely to be moderately contaminated due to periodic spillages.

3.8 MEDICAL WASTES

OCCURRENCE AND USE

The wastes produced by hospitals and other health care facilities are usually classified into two groups; general wastes (e.g. kitchen wastes and packaging) and special wastes. The special wastes include the following:

- Anatomical wastes (i.e. amputations, foetuses, placentas, and blood, together with related swabs and dressings)
- Soiled dressings, swabs and all other contaminated wastes from treatment areas
- Materials used in the treatment and care of patients suffering from infectious diseases
- Disposables (syringes, needles, scalpel blades, and plastic articles such as probes, tubes, specimen containers, gloves, masks, and empty bottles)
- Laboratory wastes
- Pharmaceuticals and other chemical wastes
- Wastes from the preparation and use of cytotoxic drugs, and radioactive materials.

Special wastes can be hazardous or aesthetically offensive, and it is important that they be disposed safely. Some form of sterilisation is required because of the risk of infection. It is also desirable for the wastes to be made unrecognisable. The method of final disposal should be done in such a way as to minimise any future human exposures.

SURVEY RESULTS

Medical waste management was not examined in detail in any of the country surveys but numerous examples were noted of inadequate management procedures and sub-standard (or non-existent) disposal facilities. The general comment could be made that medical waste management is seriously deficient in most Pacific Island Countries. Little attention is paid to segregation of wastes, storage and transportation is shoddy, and there are many hospital incinerators in a poor state of repair, or completely inoperative.

Another recurring issue in the survey was stockpiles of unwanted medical supplies. It is understood that some of these drugs were provided by donors (including NGOs) and in many cases the drugs are simply inappropriate, unsuitable for their intended purpose, or past their expiry date and hence unusable. In the Federated States of Micronesia, for example,such stocks have amassed to 18 tonnes.

To allow such an accumulation to occur shows evidence of poor management by the relevant authorities and must be a serious concern. The implied message to potential donors must also be heeded.

3.9 LANDFILLS

Most Pacific Island Countries have designated areas for the dumping of household rubbish and other municipal wastes. This is an important first step towards an effective disposal system for household rubbish. However, none of the disposal sites identified in this survey could really be described as a sanitary landfill, which is one of the preferred methods for rubbish disposal in many parts of the world. Most of the disposal sites in PICs are best described as rubbish dumps, with all of the associated problems that are implied by this term. It must be acknowledged however that some landfills are better managed than others with those at Port Vila, Vanuatu and Rarotonga, Cook Islands being among the best. Some other Pacific Island Countries are well advanced with plans to close poorly managed landfills and open high quality sanitary landfills. The proposed new landfill at Suva, Fiji, will include a leachate management system and facilities for segregation of hazardous wastes.

The main hazards from rubbish disposal sites are liquid leachate and flammable gas. Landfill leachate is a highly contaminated liquid, which is formed as a result of rainfall infiltrating the waste and extracting soluble materials. The leachate is usually quite acidic, contains high concentrations of dissolved metals, and has high loadings of suspended solids and organic matter. Landfill gas is a mixture of methane and carbon dioxide, along with traces of other vapours, some of which can be very odorous. The gas is flammable and can be extremely hazardous if allowed to accumulate in enclosed spaces.

A moderate to high level of contamination can be expected at most landfill sites because of the numerous hazardous materials present in municipal wastes. This can include old batteries, waste oil, paints and other household chemicals, plastics, and industrial wastes.

3.10 OTHER CONCERNS

ASBESTOS WASTES

Asbestos is the generic name used for a group of naturally occurring mineral fibres. Common forms of asbestos include amosite (brown), anthophyllite (grey), chrysotile (white) and crocidolite (blue). All forms of asbestos are confirmed carcinogens, primarily effecting the respiratory system. Inhalation of asbestos may result in scarring of the lungs, referred to as asbestosis, or mesothelioma, which is a severe form of lung cancer. These diseases have long latency periods and may not be evident for 10 to 50 years after exposure.

Asbestos is commonly used for its insulation and chemical resistant properties and may be found in lagging and fire retardant materials. Other uses include roof tiles and wall sheeting, and brake and clutch pads. Asbestos fibres are very stable in the environment and do not evaporate, dissolve in water or breakdown over time.

The only stockpile identified in the surveys was a quantity of cement-asbestos water pipe (300 m^3) in Palau. However, this is likely to be a recurring issue through the Pacific Island Countries because cement-asbestos building materials have been widely used in the past. The issue particularly arises when buildings are being demolished.

BURIED MEDICAL WASTE - PALAU

Several areas containing partially buried medical waste have been identified in the Jungle in Ngatpang, Palau. The sites contain hundreds, if not thousands, of small vials (100-500mL) of coloured liquids and powders. The material was reportedly disposed by Japanese troops at the end of WWII. One of the few legible labels identified a group of vials as being a Japanese disinfectant. Analysis of the chemicals and the surrounding soil is now required to confirm the expectation that the materials are medical wastes.

MISCELLANEOUS WASTES

A large number of one-off waste materials were also identified during this survey. The specific problems and hazards associated with each of these are noted below:

- **Calcium hypochlorite** This chemical is used for water treatment and, in diluted form, as household bleach. The concentrated chemical is very corrosive and give off an irritating gas (chlorine). It is a powerful oxidiser, and can react violently with a wide range of organic materials.

- **Car batteries** These contain sulphuric acid and large amounts of lead. The acid is extremely corrosive, while lead is toxic to humans, and can have serious effects on the central nervous system.
- **Dry-cell batteries** Many older dry-cell batteries contained mercury, although much of this use has now been phased out. Most rechargeable batteries contain nickel and cadmium, which are both toxic to humans. Batteries generally are a source of other toxic metals such as zinc and manganese, and alkaline or acidic materials.
- **Fertilisers** Fertilisers and nutrient mixes can include NPK fertilisers, urea, superphosphate, lime, and trace additives such as iron, copper and manganese sulphates. None of these materials is especially hazardous. However, there can be difficulties in disposing of large quantities due to the creation of nutrient imbalances in the soil, or nutrification of marine environments.
- **Lead-based paint** Lead is a neurotoxin and is also harmful to most animals and to aquatic life. Lead-based paint can be especially hazardous when the paint is being removed from structures such as steel bridges prior to repainting. This is due to the generation of large amounts of lead dust.
- **Paints and resins** These contain numerous potentially hazardous chemicals. However, most of these hazards are effectively “neutralised” in the final cured or dried form.
- **Sodium hydroxide** This chemical is also known as caustic soda. It is an extremely corrosive, alkaline material, and is especially damaging to the eyes. It has numerous industrial uses, and can also be used as a cleaning.
- **Sodium pentachlorophenol** This chemical has been used as a fungicide, as an oil additive, and in timber treatment. Chronic exposure to pentachlorophenol can cause irritation of the skin, mucous membranes and respiratory tract, signs of chloracne, headaches, and changes in kidney and liver function. The chemical is also classified as a possible human carcinogen. Commercial grades of pentachlorophenol are usually contaminated with highly toxic polychlorinated dibenzodioxins.
- **Mustard gas** The chemical name for mustard gas is bis (chloroethyl) sulphide. The effects of mustard gas exposure include reddening and blistering of the skin, blistering of the lungs, and blindness. Extreme exposures can be fatal. Specialised disposal facilities are needed for this chemical because of its hazardous nature. Assistance should be sought from the US military.
- **Cyanide canisters** These are used for fumigation and contain a mixture of cyanide salt and an acid which, when activated, releases hydrogen cyanide, which is a highly toxic gas.

3.11 IMPLICATIONS FOR PACIFIC ISLAND COUNTRIES

It is instructive to consider the causes of some of the problems described in this chapter of the report. While the reasons for individual problems may vary, there are a number of common themes running through many of them, which can be summarised as follows:

PCBs	discontinued use, but with no controlled withdrawal, storage and disposal programmes.
Pesticides	surplus stocks and discontinued projects. Inadequate storage conditions.
DDT	poor stock management and inadequate storage conditions.
Timber treatment	abandoned plants plus poor controls on operational sites.
Waste oil	no disposal or recycling systems.
Bitumen	left over materials, indiscriminate dumping.
Lab Chemicals	discontinued use, poor storage, no disposal facilities.
Medical wastes	inadequate waste management and disposal facilities.

The overall message that can be taken from these, is the need for significant improvements in the management of hazardous materials in Pacific Island Countries. This needs to start from the time these materials are brought into a country, with much more thought being given to matching purchasing with actual requirements. In the case of development projects there should be some provision for unwanted materials to be returned to the point of supply.

There needs to be better controls over the use of hazardous materials, including the provision of adequate storage facilities, spill contingency measures, and procedures for waste management.

And there is a need for effective waste treatment and disposal facilities. In some cases this might include requirements for waste materials to be returned to the country of origin, rather than being treated on-island.

The requirements for effective chemical management strategies are discussed in more detail in Section 6 of this report.

4. MANAGEMENT OPTIONS

4.1 HAZARDOUS WASTE MANAGEMENT

Most of the materials identified in this survey can be classified as hazardous wastes. As such, these wastes should be managed in accordance with a commonly accepted protocol, also known as the waste management hierarchy, which is as follows: reduce, re-use, recycle or recover, treat and dispose. The significance of each of these options to this project is discussed below.

WASTE REDUCTION

This should be the first consideration in any waste management system. The goal in waste reduction is to prevent the generation of waste at its source rather than to control, treat or manage the wastes after they have been generated. Various options are available for reducing wastes at source, including process modifications, changes in raw materials, good housekeeping practices, changes in equipment, and recycling within the process.

The waste reduction option is generally not relevant for the wastes identified in this project, because most were generated some time in the past. However, this option should not be ignored altogether because systems should now be put in place to ensure that similar problems do not arise in the future.

RE-USE, RECYCLING AND RESOURCE RECOVERY

Waste is disposed of because it has no direct value to its owner. However this often overlooks the fact that the material may be of value to somebody else. Alternatively, the waste may be a potential source of fuel or energy. Re-use involves the use of the waste for its original purpose; for example the cleaning and re-use of glass drink bottles. In recycling, the waste is re-processed to give a useful product; for example the recycling of paper and cardboard to make egg cartons. Resource recovery involves the recovery of raw materials (e.g. recycling aluminium cans to recover the aluminium metal) or the recovery of energy values by use of the waste as a fuel.

These options should be given a high priority in PICs because of the potential benefits. In addition, they will usually cost far less than any of the disposal options discussed below.

TREATMENT AND DISPOSAL

If waste materials are unable to be used then they must be disposed. This can involve a number of steps; treatment to eliminate or reduce any hazards (e.g. by neutralisation or solidification), treatment to reduce the overall quantities (e.g. by incineration), and ultimate disposal (e.g. to a landfill). The various options within this category are discussed in more detail in Section 4.3 below.

The options for waste treatment and disposal within PICs are very limited. There are no specialised waste treatment facilities and most waste incinerators are in poor condition. In addition, the basic disposal systems such as landfills are often poorly sited and designed. Despite this situation, local disposal options should be adopted whenever possible, provided this can be done without causing any adverse effects. Economics will be another significant factor in this decision, because of the high costs involved in shipping wastes to other countries. However, the development and use of local systems is also relevant to capacity building, because it helps to establish local facilities and expertise for dealing with similar problems in the future. Exporting wastes to other countries should be considered when the only suitable disposal option involves the use of specialised facilities that are not available locally.

4.2 CONTAMINATED SITE MANAGEMENT

The management procedures for contaminated sites follow a similar hierarchy to those given above; i.e. prevent further contamination, recover spilled or dumped material where possible, implement management procedures to contain the contaminants on site, and finally treat on site or remove the residues for disposal elsewhere. The requirements for each of these stages are discussed in more detail below.

PREVENTION

It is essential that action be taken as soon as possible to prevent further contamination from occurring. In the case of a current operation, this might involve making alternative arrangements for waste disposal, introducing spill management procedures, or changing the process to prevent further discharges.

RECOVERY

It will sometimes be possible to recover at least some of the spilled or dumped material. This is especially important where site containment is poor, and there is a significant risk of off-site contamination due to surface run-off or leaching into groundwater.

SITE MANAGEMENT

Steps should be taken to minimise any potential risks from the contaminants. This could include restrictions on site access to prevent direct exposures, and the development of containment systems, such as bunding to prevent surface run-off.

TREATMENT AND DISPOSAL

There are two general options for cleaning up contaminated sites: on-site treatment or excavation and removal to a treatment facility elsewhere. If neither of these is immediately possible (or practical), then the following options should be considered:

- Removal of contaminated soil to a more suitable disposal site or storage facility.
- Isolation of the soil by covering with a layer of concrete or clay, or some other suitable protective layer.
- Leave the material where it is. This option would only be acceptable if an effective site management system was being used to prevent site access, and it had been shown that there were no potential risks, such as those due to surface run-off or groundwater contamination.

Generally, the treatment options for contaminated soil are much the same as those available for hazardous wastes, and are discussed in Section 4.3 below.

4.3 WASTE TREATMENT METHODS

CHEMICAL TREATMENT PROCESSES

There are numerous options available here, but in general terms, most can be classified as neutralisation, oxidation, reduction, hydrolysis, or precipitation. Each of these options can be illustrated by the following examples:

- **Neutralisation** Mixing equal quantities of acidic and alkaline materials to give a neutral product (e.g. treatment of acid wastes by mixing with lime or soda ash).
- **Oxidation** Cyanides can be converted to carbon dioxide and nitrogen by treatment with an oxidising agent such as hydrogen peroxide.
- **Reduction** Treatment of chromic acid wastes with a reducing agent such as sulphur dioxide, converts the chromium from the highly toxic +6 state to the less toxic +3 state.
- **Hydrolysis** Most organophosphate pesticides break down slowly in the environment by reaction with water. These reactions can be accelerated in a treatment system by carrying out the process under alkaline conditions and at elevated temperatures.
- **Precipitation** Many metal wastes can be treated by precipitating the metal in the form of its hydroxide or sulphide salts. These salts usually have very low water solubility, which makes the wastes suitable for disposal in a landfill.

Chemical treatment is not a complete disposal option because the reaction products still have to be disposed. This can include significant volumes of wastewater and sludges. In addition, excess reagents may have to be neutralised prior to disposal.

The major cost element in chemical treatment is for the treatment chemicals, which can be quite high. In PICs shipping charges for these chemicals will also increase the cost. Equipment such as tanks, pumps and mixers will also be required, and there is usually a need for trained operators, often with laboratory support.

PHYSICAL TREATMENT PROCESSES

These processes include solidification, encapsulation, absorption, and desorption.

Solidification and encapsulation In these techniques the wastes are trapped inside a solid material such as concrete or glass. The essential components of the waste are unchanged, but the hazards are removed because the chemicals are locked inside an inert solid. This method is generally only applicable to water-soluble materials, although a range of proprietary materials is also available (at significant cost) for organic wastes.

Absorption This involves trapping the waste chemicals onto a solid, such as activated carbon. The method is commonly used for removing contaminants from wastewater streams.

Desorption This is the opposite of absorption, and is one of the techniques specifically developed for the clean up of contaminated sites. Thermal desorption involves heating the soil to drive off any volatile contaminants, while solvent extraction techniques can also be used.

BIOLOGICAL TREATMENT PROCESSES

Biological treatment involves the use of microbes to degrade waste materials. Wastewater treatment plants use biological processes, and these will sometimes be effective on chemical wastes, but only after dilution. The degradation processes in municipal landfills are also due to biological action.

A number of specialised biological treatment processes have also been developed for specific wastes. These involve the use of specially cultivated microbes, which have been found to thrive on specific chemicals. These systems are very specialised and require a high degree of operator expertise and control.

Landfarming is another form of biological treatment, which is commonly used with waste oil and oil sludges. The wastes are mixed into the top few centimetres of soil, and the surface is periodically cultivated to encourage microbial activity. Fertiliser may also be added.

THERMAL TREATMENT PROCESSES/INCINERATION

The most common thermal treatment process is incineration, which effectively involves the high temperature oxidation of waste materials. Incineration is used mainly with organic substances, where the wastes are broken down into carbon dioxide and water, and other simple molecules. Incineration is not suitable for metal-containing wastes, because these can not be destroyed. However, it may be effective in reducing the volumes of some of these wastes.

There are three parameters which are critical to ensuring effective combustion: temperature, turbulence and residence time (the so-called 3-Ts). Many wastes, such as non-chlorinated solvents, are not particularly demanding in the conditions required for their destruction. In these cases incineration in a boiler, or some other simple combustion system can be used to destroy the wastes. However, other materials, such as the PCBs and other chlorinated organics, are much more intractable and require exposure to high temperatures (1500 to 2000 ×C) for significant periods of time (1 to 4 seconds). These conditions are only achieved in specialised high temperature incinerators.

Waste incineration can have some significant environmental impacts. There is usually a residue in the form of ash, which may be highly alkaline and contain high concentrations of hazardous elements, such as the heavy metals. The flue gases can also contain a variety of toxic gases and vapours, including acid gases, volatile metals such as mercury, and traces of chlorinated organics, including the highly toxic dioxins. Most of these emissions can be controlled through the use of scrubbers and other gas treatment systems. However, this inevitably adds to the complexity and also the cost of incineration as a disposal option.

DISPOSAL TO LANDFILL

Landfill is commonly used for the disposal of municipal wastes, and it can also be used for the disposal of some hazardous wastes, especially after these have been treated. There are two basic types of landfill, dilute-and-disperse, and containment. In the former, the wastes are mixed with other materials and some components may slowly disperse into the surrounding environment (e.g. as leachate). In the latter, the wastes are effectively placed into in-ground storage, and completely isolated from the surrounding environment.

Hazardous wastes are sometimes treated in a landfill by co-disposal with municipal wastes. This practice makes use of some of the special properties of landfilled wastes, including their capacity for absorption of oils and other liquids. Some materials may react chemically with the wastes to form stable complexes or insoluble precipitates. The normal chemical and biological processes that occur during decomposition of the refuse will also be effective in breaking down some of the wastes. Expert advice must be sought however before disposal of any hazardous wastes to landfill.

4.4 WASTE TREATMENT AND DISPOSAL FACILITIES IN PACIFIC ISLAND COUNTRIES

The current situation regarding waste treatment and disposal facilities in Pacific Island Countries can be summarised as follows:

Solid Waste Landfills The standard of landfills is generally very poor, the only exceptions being a few facilities in the Cook Islands, Vanuatu and Fiji. The new Suva landfill is the only one with the capability to accept hazardous wastes.

Wastewater Treatment Plants The only countries with operational municipal wastewater treatment plants are Fiji and the Marshall Islands. These facilities may be suitable for disposal of small quantities of some of the laboratory chemicals.

Waste Incinerators Many of the medical and quarantine waste incinerators in the region are in very poor condition and barely suitable for their current use. However, the few that are in good working order may be suitable for disposal of some of the less hazardous organic wastes. This could include limited quantities of waste oil and other hydrocarbons, some of the laboratory chemicals and a few of the pesticides. They should not be used for any of the organochlorine wastes (eg. PCBs, DDT and some other pesticides).

Chemical Treatment Facilities There are no specialised chemical treatment facilities in the Pacific Island Countries.

4.5 REGIONAL WASTE TREATMENT AND DISPOSAL SERVICES

Table 4.1 below lists the known hazardous waste treatment and disposal services, plus a few developing technologies, available in Australia and New Zealand. Some of the companies shown are simply acting as local agents for European organisations. Many other treatment facilities are available in Japan, Europe and Northern America.

TABLE 4.1 HAZARDOUS WASTE TREATMENT SYSTEMS AND SERVICE IN THE SOUTH PACIFIC REGION (INCLUDING DEVELOPING TECHNOLOGIES)

Company Name	Technology	Treatment Range
BCD Technologies Pty Ltd, Queensland Ph: (61) 7 3203 3400	• Base catalysed dechlorination • Thermal desorption • Plasma arc	• PCB oil • Contaminated soil • Contaminated equipment • Solids, liquids and sludges
Technosafe Waste Disposal, Victoria Ph: (61) 3 9706 7439	• Base catalysed dechlorination • Solvent steam	• PCB oil • Contaminated equipment • Solids, liquids and sludges
Eco Logic, Western Australia Ph: (61) 8 9439 2362	• Sequencing batch vaporiser • Hydrogenation	• PCB oil • Contaminated equipment • Solids, liquids and sludges
SRL Plasma Ltd, Victoria Ph: (61) 3 9726 6222	• Mobile plasma arc units	• PCB oil • High and low volatility liquids
Medical Waste Group Ltd, Auckland Ph: (64) 9 273 9320 Fax: (64) 9 273 9328	• High temperature incineration	• Specialist provider of medical waste treatment and disposal services
Tredi New Zealand Ltd, Auckland Ph: (64) 9 525 1550 Fax: (64) 9 525 3550	• High temperature incineration • Special chemical treatment services	• Local office for a organisation with facilities in Europe
United Environmental Auckland Ph: (64) 9 274 7963 Fax: (64) 9 274 1065	• Specialist treatment facilities	• Liquid and solid inorganic wastes, and industrial solvents • Organochlorines
CSIRO Division of Coal and Energy Technology Ph (61)2 9490 8666	• Catalytic treatment	• PCB oil (with product regeneration) • Low volatility liquids
Molten Metal Technology Inc, Victoria Ph (61)2 9490 8666	• High temperature fluid phase combustion	• PCB oil • Contaminated equipment • High and low volatility liquids
Queensland University of Technology, Australia Ph: (61)73864 2967	• Supercritical water oxidation	• PCB oil • Solids, liquids and sludges

5. DISPOSAL OPTIONS AND COSTS

5.1 PCBS

The currently recognised best practice disposal options for PCB oils, and soil contaminated to a level of greater than 50 ppm with PCBs, are as follows:

- High temperature incineration;
- Plasma arc; and
- Chemical/physical treatment.

High Temperature Incineration This is a well-established and proven technology for the destruction of PCBs, with some units being designed to handle all possible waste types, including concentrated PCB liquids, contaminated equipment (such as transformers), and contaminated soil. Destruction efficiencies of better than 99.9999% are achieved by the best performing units. These would normally be fitted with an independently controlled post combustion chamber; an efficient acid gas scrubbing plant; and other state of the art emission control equipment.

Plasma Arc This process operates by pyrolysis at extremely high temperatures, usually in an inert atmosphere, to break down complex organic molecules. The high temperatures are generated by an electrical discharge Destruction efficiencies are reported to be better than 99.9999%. Plasma arc units are relatively small, and therefore have the potential to be set up as semi-portable units, which could be transported to specific waste sites. However, they are only suitable for use with liquid or gaseous wastes. Additional thermal desorption or solvent extraction facilities would be required for the treatment of contaminated equipment or soil.

Chemical/Physical Treatment There are a number of different treatment technologies in this category, but they all involve the use of powerful chemical reagents, usually at high temperatures and pressures, to break down the PCB molecules. Once again, the processes are best suited to the treatment of liquid wastes, and additional thermal desorption or chemical extraction processes are required for contaminated equipment and soils.

Table 5.1 provides a summary of the PCB treatment technologies currently available in the South Pacific region, along with the indicative treatment costs. The companies listed hold appropriate environmental licences and are recognised by the relevant State environmental authorities. The companies provide a disposal service only, and other waste management contractors would need to be used for the collection and transport of the PCB wastes. The cost estimates shown in Table 5.1 do not include the costs for this additional work.

There are no high temperature incineration facilities for PCB wastes in either New Zealand or Australia. However, these facilities are available in Japan, North America and Europe. Some of the operators of these facilities, such as AVR International (Netherlands) and Tredi (see Table 4.1), are already assisting with waste disposal operations in the region. The indicative costs for PCB disposal by incineration are in the range of Au$3000-$7000 per tonne.

TABLE 5.1 APPROXIMATE TREATMENT/DISPOSAL COSTS (AU$)

Company Name	Item	Cost per tonne
BCD Technologies Pty Ltd	Pure PCB oil Contaminated oil Contaminated equipment	$7,000 $1,500 $10,000
Technosafe Waste Disposal	Pure PCB oil + transformer Contaminated oil + transformer	$5,800 $2,800
Eco Logic	All PCB oils Contaminated equipment	$6,800 $7,000
SRL Plasma Ltd	Mobile plasma arc (this unit can be purchased at a cost of $1,600,000)	Unknown

COST ESTIMATES – PCB WASTES

The current estimate of PCB contaminated oil in the thirteen PICs covered by the surveys is 131 tonnes. The estimated disposal costs could therefore range from Au$196,500 to $990,800. The cost for disposing of the estimated 500 contaminated transformer units will be an additional $500,000 to $1,000,000. These figures do not include the cost of siteworks, transport and handling. Siteworks costs alone are likely to be of the same order of magnitude as disposal costs. Shipping costs are estimated at Aus$220 - $400/tonne (total: $30,000 to $50,000), depending on the port of origin.

Total disposal costs are therefore likely to be in the range of Aus$950,000 to $2,850,000 (rounded up to the nearest $50,000).

COST ESTIMATES – PCB CONTAMINATED SITES

There were only three sites identified as being potentially contaminated with PCBs (see Table 3.2), although more sites could be "discovered" as the PCB clean up proceeds. Remediation of contaminated sites requires an initial site assessment phase, using sampling and analysis to establish the extent of contamination. This would be followed by the actual clean-up work, which in the case of PCBs would involve excavation and removal of the contaminated soil, for disposal in one of the facilities noted above. Ideally this work should be done at the same time as the bulk disposal of PCB oil and contaminated equipment.

A broad estimate of the cost for the assessment phase of this work is about Au$10,000 per site. Disposal costs will depend on the volume of contaminated soil that needs to be removed. If we assume a volume of 20 cubic metres per site (which seems reasonable for the sites given in Table 3.2), then the estimated costs for site works, shipping and disposal would be between about Au$65,000 and $290,000 per site.

The total remediation costs for the three sites would be Au$30,000 for the assessment phase and $195,000 to $870,000 for site clean-up and disposal.

ON-ISLAND DISPOSAL

The above costings are for off-island disposal of the PCB wastes. The alternative approach of on-island disposal using a mobile plasma arc unit (purchase or lease) should also be considered. However, this is unlikely to be cost effective or practical. The total equipment costs would be well in excess of Au$2million, given that additional processing equipment would be required for the treatment of contaminated soil and equipment. There would be significant costs involved, not to mention practical constraints, in setting up the unit in each country. And operating costs are also likely to be very high. This option is therefore not recommended.

5.2 PESTICIDE WASTES

A total of 46 tonnes of waste pesticides were identified in the surveys (see Table 3.3), plus an additional 7 tonnes of contaminated packaging. However, the situation is complicated by the fact that individual stockpiles range in size from just a few kilograms through to several tonnes. In addition, there are about 300 different pesticides present, and the possible disposal requirements for these can vary.

The simplest disposal option for nearly all pesticides is high temperature incineration. This can handle virtually all of the different types of chemicals, and formulations (solid and liquids). It is also suitable for small quantities of unidentified materials. It is however, an expensive option for those pesticides which are able to be disposed using much simpler methods. There are a number of these alternative options, including the following:

- Land application, which can effectively range from use of the pesticides as intended, through to controlled application on waste land.
- Treatment with lime prior to burial at a landfill is also recommended for those materials which are amenable to alkaline hydrolysis.
- Treatment in a disposal pit is recommended for some other materials of low toxicity. A discussion of disposal pits and their use is given in Annex C3.

All of these options can be applied on-island, provided suitable disposal sites can be identified.

For the purposes of this project, the pesticides have been broken down into those that can be disposed on-island, and those that cannot. The pesticides in the latter group were identified using a number of international criteria, as follows:

- Chemicals listed under the proposed POPs convention;
- Chemicals listed under the recently signed Prior Informed Consent convention;
- WHO Class 1A (high toxicity) pesticides;
- Greenhouse gases or Ozone depleting substances (Methyl bromide); plus
- Those chemicals considered to be difficult to dispose of in country.

Other chemicals were also included because they are known to have persistent and/or toxic breakdown products. The chemicals identified on this basis, are as follows:

2,4,5-T	DDT	Fenamiphos	Propanil
Aldicarb	Dieldrin	Isoprocarb	Oxymal
Carbaryl	Disulfoton	Lindane	Sodium PCP*
Carbofuran	Ethoprophos	Methyl bromide	Trichlorfon
Chlordane	Ethylene dibromide	Parathion	Zinc Phosphide

(PCP = pentachlorophenol)

Analysis of the stockpiles listed in Annex B results in the following pesticide disposal requirements for the region:

- 35 tonnes of waste pesticides and 7 tonnes of associated packaging need to be disposed using an off-island treatment facility; and
- A further 11 tonnes should be disposed locally.

COST ESTIMATES - OFF-ISLAND DISPOSAL

Destruction costs at a high temperature incinerator such as those in France, Germany or the Netherlands are likely to be in the order of Au$3,000 to$7,000 per tonne. It is therefore estimated that the costs for pesticides and packaging to be disposed in this way will range from Au$126,000 to $294,000. As with PCBs, sitework costs are expected to be of a similar order, while shipping costs could be somewhat higher at Au$400 - $1,000/ tonne ($16,800 to $42,000).

The total off-island pesticide disposal costs are therefore likely to be in the range of Au$300,000 to $650,000 (rounded up to the nearest $50,000).

COST ESTIMATES - LOCAL DISPOSAL

Specific recommendations for the methods to be used for disposal of some of the pesticides are given in Annex C4. Guidance on the disposal of empty pesticide containers is given in Annex C5. The unit costs for the on-island disposal options are estimated to be about Au$4,000 per tonne. The total cost is therefore approximately Au$44,000.

> ## CONGRATULATIONS DU PONT
>
> *It must be acknowledged that the chemical industry is known to be adopting a responsible attitude internationally to the management of chemicals. A large waste pesticides disposal programme is currently underway in Africa and the Food and Agriculture Organisation (FAO) has reported that in a number of instances the chemical industry has assisted the clean-up efforts, with contributions of 10% of the overall cost being typical.*
>
> *In the South Pacific region Du Pont in New Zealand has indicated that they are prepared to dispose of any Du Pont chemicals on our database. This unsolicited assistance is very much appreciated and Du Pont is to be congratulated for their positive attitude towards environmental issues such as this.*

PESTICIDE CONTAMINATED SITES

A total of 16 pesticide contaminated sites were identified in the surveys and all of these require remediation. Three of the sites have significant quantities of buried pesticides while the remainder are pesticide storage sites.

The pesticide burial sites will require extensive assessment work, followed by site excavations, and removal of the contaminated soil and residual pesticides to an off-island disposal facility. The quantity of pesticides buried at each site is about 2 to 3 tonnes. However, the likely volumes of contaminated material could be up to 10 times this amount. Site assessment costs are likely to be very high, say Au$50,000 per site. Disposal costs will be the same as for the waste pesticides, say Au$3000 to $7000 per tonne, or Au$90,000 to $210,000 per site (assuming 30 m^3). Site works and shipping costs should be much the same as for waste pesticides, which gives a total cost of Au$50,000 plus Au$192,000 to $450,000 per site.
The total costs for these three sites would therefore be Au$150,000 for the assessment phase and Au$600,000 to $1,350,000 for site clean-up and disposal.

Remediation of the 13 pesticide storage sites would mainly consist of sweeping, washing and decontamination of the building surfaces, and excavation and removal of any contaminated soil in the surrounding areas. Site assessment costs would be relatively low, say Au$10,000 per site, while the quantities of material for disposal should be no more than about 2 tonnes per site. If we assume the same unit costs for site works, shipping and disposal as above, the cost per site would be Au$12,800 to $30,000. The total cost for the 13 sites would therefore be Au$130,000 for site assessments and Au$170,000 to $390,000 for site clean-up and disposal.

5.3 DDT

The current estimate of DDT wastes to be disposed in the four PICs where they have been identified is as follows (Tables 3.5 and 3.6):

- FSM: 2 tonnes buried; plus minor quantities inadequately stored with other pesticides
- Palau: 1.2 tonnes partly buried
- Solomon Islands: 8.3 tonnes stored
- Vanuatu: 0.9 tonnes stored

The disposal options for DDT waste are the same as for PCBs and organochlorine pesticides, with high temperature incineration being the most effective option.

COST ESTIMATES – DDT STOCKPILES

Destruction costs for the 9.2 tonnes of DDT held in stockpiles would be Au$3,000 to Au$7,000 per tonne, with the associated site works and transportation costs as given for other pesticides above. This gives an overall unit cost of Au$6,400 to $15,000 per tonne and a total disposal cost of about Au$60,000 to $140,000.

COST ESTIMATES – BURIED DDT

The unit costs here would be the same as for other buried pesticides; ie. site assessment costs of Au$50,000 per site and site works, shipping and disposal costs of Au$192,000 to $450,000 per site. The total costs for the two sites would be Au$100,000 plus $385,000 to $900,000.

The two other contaminated sites shown in Table 3.4 are pesticide storage facilities which have already been included in the cost estimates for pesticide sites.

5.4 TIMBER TREATMENT CHEMICALS

Guidelines for the proper management of timber treatment plants are given in Appendix C6. Observance of these guidelines will ensure that the environmental effects of timber treatment operations are minimised. However, they do not address the issue of stockpiles of waste chemicals, or site remediation.

The quantities of waste timber treatment chemicals identified in the surveys are as follows (see Table 3.7):

- Kiribati — 1 tonne copper/chrome/arsenic (CCA) sludge
- Samoa — 10,000 litres CCA solution
- Solomon Islands — 150 kg arsenic pentoxide

There were also four contaminated sites identified in the surveys. (This excludes those situations where it is believed the owners should take responsibility for disposal.)

Copper, chromium, and arsenic are all hazardous chemicals, which can move readily through the environment and cannot be destroyed. The most effective disposal methods are those which render the chemicals insoluble or “immobile”, while at the same time preventing any future contact with humans or animals. This is normally achieved through treatment with lime or some other alkaline agent, which converts the metals into insoluble forms.

A treatment method recommended by some of the suppliers of CCA timber treatment chemicals involves mixing the chemicals with Portland cement, sand and lime. The exact ratio of the ingredients needs to be determined for each individual waste, but as a general guide it should be about 100 parts waste (sludge) to 100 parts cement, 10 parts sand and 10 parts of lime. Once the mixture has solidified it should be suitable for burial in a landfill or other suitable disposal site.
Further details are provided in Annex C7.

COST ESTIMATES – CCA WASTES

Ideally, the first disposal option for the CCA chemical solution and the arsenic pentoxide should be transportation to another treatment facility for use. Alternatively the materials should be returned to a manufacturer for reformulation and use. The packaging and shipping costs should be no more than about Au$2000 per tonne, giving a total disposal cost of Au$20,300.

The CCA sludge on Kiribati could potentially be disposed by encapsulation and burial. However the likelihood of finding a suitable disposal site on Kiribati is extremely low. The most likely disposal option here is removal to an of-island treatment facility. Treatment and disposal costs for this option would be about $3000 per tonne and shipping costs would be as above, giving a total disposal cost of about Au$5000.

The total disposal costs for all of the timber treatment chemicals would be about Au$25,300.

COST ESTIMATES – CONTAMINATED SITES

The site assessment costs for the timber treatment sites would be lower than those for pesticide sites because of the lower analytical costs, say Au$25,000 per site.
The total quantities of contaminated soil at each site could be very high, possibly 50 cubic metres or more. This material would be best disposed by burial at a local landfill, with the most contaminated materials being pre-treated by mixing with cement. The treatment and disposal costs would be about Au$500 per tonne, or at least Au$25,000 per site.

The total costs for the four contaminated sites would be Au$100,000 for the site assessments and Au$100,000 for treatment and disposal.

5.5 WASTE OIL

The primary management options for waste oil are reduction at source, reuse, and recycle. Power stations are one of the main sources of waste oil in the Pacific and some guidelines on the way these options can be implemented are given in Annex C8. Waste oil has significant value as an energy resource, so use as a supplementary fuel (either on-island or at facilities elsewhere) should be given serious consideration in most Pacific Island Countries.

In June 1998 the Forum Secretariat reached an agreement in principle with major fuel suppliers, to implement a waste oil collection program for those Pacific Island Countries supplied from Fiji. Mobil have commenced transporting waste oil to the Suva Steel Mill for use as a supplementary fuel. The steel mill has the capacity to dispose a significant volume of the region’s waste oil (~1 million litres/year), but is currently receiving only 8% of this volume.

It is understood that Shell and BP are in the process of developing similar collection programs. The Forum Secretariat is also pursuing further agreements with fuel companies supplying to the region from Papua New Guinea, Guam and New Caledonia.

Good Citizen Award to Micronesia Petroleum

The efforts of Micronesia Petroleum Company (MPC) in this area should be acknowledged. In August/September 1998, the company conducted a waste oil collection programme on Kosrae and Yap in the FSM. The programme targeted several long-term stockpiles of waste oil, which were considered to pose an environmental risk. The initiative was provided as a service to the State governments and was undertaken entirely at MPC's expense. The waste oil was transported to a recycling facility in Townsville, Australia.

Volatile Aromatics with your Drinking Water?

On the island of Betio, South Tarawa in Kiribati, local communities supplement the reticulated water supplies with hand dug wells into the water table. Also on the island of Betio generators at the power station have been leaking oil for many years. The water lens is now overlain with a 20-mm thick layer of oil. The extent of this obvious contamination is restricted to the immediate vicinity of the power station but the nature of oil is such that the more soluble components will have spread through a greater proportion of the water lens.

The current waste oil collection program is targeting 'clean' oils, i.e. oils removed during routine maintenance, as opposed to tank sludges, oil spills, bilge waste etc. As a result, this system will not provide a disposal outlet for all of the region's waste oil.
In particular, alternative disposal options for potentially contaminated oil are still required. Recycling would be the preferred option in most situations.

In the case of oil contaminated sites, treatment by bioremediation is likely to be the most cost effective technique. The method can also be applied to the disposal of a range of heavy end hydrocarbons, including waste oils and tank sludges. The simplest application of bio-remediation is referred to as land farming. While not advocated for bulk oil disposal, it is recommended for the on island remediation of oil spills and contaminated soil. Waste hydrocarbons are applied to suitable soil at a controlled rate and ploughed into the top 300-500 mm. Naturally occurring bacteria and chemical processes in the soil degrade the waste, producing carbon dioxide and water. Treatment times typically range from 6 to 12 months. The addition of nutrients (e.g. fertiliser) and regular ploughing help to accelerate the process. Stringent environmental controls and monitoring are required to ensure the surrounding area does not become contaminated. Further details regarding bio-remediation are included as Annex C9.

Bioremediation is also the preferred option for contaminated groundwater. However, this is a considerably more demanding process than landfarming and requires careful management and extensive monitoring, to ensure that adjacent groundwater sources are not adversely affected by the operation. Detailed procedures for this operation are given in Annex C10.

Cost Estimates – Waste Oil

There should be little or no costs (to PICs) associated with the disposal of waste oil by reuse as a supplementary fuel. Ideally, the costs for transportation of contaminated oil to a recycling facility, should be borne by the oil companies. This should in fact be minimal, because the transportation can be provided by oil tankers as they return to their supply bases.

Cost Estimates – Contaminated Sites

There are ten oil contaminated sites listed in Table 3.9 for remediation. The costs for this work should be minimal, say no more than Au$3000 per site for analytical costs and local technical support.

Cost Estimates – Contaminated Groundwater

The remediation of each of these sites could cost up to Aus$200,000. There are 11 sites listed in Table 3.11, so the total costs could be as high as Aus$2,200,000.

5.6 Bitumen

The most practical and cost effective disposal option for waste bitumen is to reuse the material on island. This could include use for road and runway maintenance, the construction of sporting facilities (e.g. basketball courts and running tracks), for stabilisation of embankments, protection of wharf piles and rust proofing.

As bitumen ages, the more volatile components will evaporate and the addition of cutters (e.g. solvents or kerosene) may be necessary to achieve a workable consistency. Reuse of spilt bitumen is feasible as entrained soil and stones do not have a significant impact on the required properties of roadbase material.

Other solid contaminants (e.g. timber, metal) may be able to be separated and removed during heating. The bitumen mixing/spraying equipment used must be carefully selected and maintained as entrained debris can damage pumps and spray nozzles.

In some cases, the material may have degraded to such an extent that it is no longer fit for use in road construction. This is particularly true where the bitumen has been exposed to direct sunlight causing oxidation. The potential health and environmental risks associated with waste bitumen are relatively low, making it difficult to justify the high cost of off-island disposal. On-island disposal is not an ideal solution, but can be undertaken in an environmentally sound manner. Solidified bitumen may be disposed in purpose designed cells, located away from potential groundwater sources. Installation of an impermeable cell liner may be required, depending on the local soil characteristics.

Siting and design of the containment cells should consider the following:

Soil profile and characteristics:	Low permeability soils (clays) preferred.
Distance and depth to groundwater:	Should be greater than 5m.
Distance to sensitive environments:	Should be greater than 100m (e.g. mangroves, inshore reefs).
Local topography:	Flat land preferred.
Distance to residential areas:	Should be greater than 100m.

Contaminated soil from the storage areas would be disposed in the same cells.

COST ESTIMATES – WASTE BITUMEN AND CONTAMINATED SITES

Simple earthworks of the type required for on-island disposal, typically cost in the range of Au$30-40/m^3, including operation of the necessary earthmoving equipment and soil handling. Other support costs for the disposal operations could be about the same amount again. If all of the existing bitumen stockpiles and associated contaminated soils were disposed in this way, the total cost would be about Au$30,000.

5.7 LABORATORY CHEMICALS

The disposal of surplus and obsolete laboratory chemicals was a common problem throughout the region and in all types of laboratories, including schools, hospitals and government departments. Many of the staff in these organisations were aware of the need for, and the general principles of, safe storage and disposal. However, most lacked the detailed knowledge and resources to be able to deal with the issue safely, and with confidence. It is recommended that a regional programme be developed to upgrade chemical management capabilities in laboratories throughout the region. The programme should involve a combination of training and development, and hands-on disposal exercises. These disposal exercises would address some of the existing stockpiles of unwanted chemicals. The remaining wastes would then be dealt with by the individual laboratory staff.

The total cost of the programme would be at least Au$400,000.

5.8 MEDICAL WASTES

The management and disposal of infectious wastes in hospitals and other medical establishments is another area that needs considerable upgrading. In some countries the hospitals are equipped with dedicated incinerators, but most of these are either fairly primitive and/or in very poor condition. In those countries where there are no such facilities, the current practices consist of a fairly basic level of waste segregation coupled with controlled disposal at the local dump. Some guidelines on the correct management and disposal of medical wastes are given in Annex C11.

Once again, it is not intended that the existing stockpiles of medical waste be addressed in this project. Rather, it is proposed that a comprehensive programme be developed to upgrade medical waste management facilities throughout the region. This programme would be best co-ordinated through the World Health Organization, and is likely to cost at least Au$600,000.

5.9 LANDFILLS

Landfill sites are usually extremely difficult to remediate because of the enormous volumes of potentially contaminated materials. The only practical approach for these sites is to ensure an effective management system is put in place to minimise any potential effects. This should include the following actions:

- A review of any site records and discussions with past employees and officials to try and establish what types of wastes had been disposed at the site, and to identify any potentially hazardous materials that might have been included in the wastes (e.g. PCBs and pesticides).
- An extensive survey of the site, including soil and water sampling, to determine the extent of any contamination and to identify any possible risks to public health or the surrounding environment.
- Where off-site contamination is found, remedial action should be taken to stop this occurring. This could include the construction of leachate collection and treatment systems, or excavation and remediation of specific parts of the site.
- Specific actions may also be required to minimise any public health risks. For example, this could include placing a ban on the collection of shellfish from contaminated estuaries.

- Controls may also be required over the future development of the site. Old landfill sites are usually not suitable for residential developments or for public facilities such as schools and hospitals. The growing of crops or livestock production should only be permitted if the soil is shown to be free from contaminants.

Most of the landfill sites identified in this survey have a significant potential to cause adverse environmental or human health effects. In the case of operational sites, the sites should be upgraded wherever possible, to better comply with the appropriate standards. Detailed site investigations are required at all 18 sites inspected to establish the extent of any hazards. The sites should then be managed in accordance with the guidelines noted above. More detailed guidelines for the design and operation of sanitary landfills are given in Annex C12.

The only work proposed for inclusion in this project is the initial site assessments. The cost of this work would be at least Aus$50,000 per site. There were 18 landfill sites noted in the country surveys, which gives a total cost for the assessment work of Au$900,000.

5.10 OTHER CONCERNS

ASBESTOS

The usual disposal procedure for asbestos is controlled burial and this method is recommended here.
This prevents the release of airborne fibres, but it is important to choose a site that will not be disturbed at any time in the future.

There was only one stockpile of asbestos wastes identified in the survey, and this was in Palau. Local disposal is a viable option in this situation, and the costs should be minimal. The work is not recommended for specific inclusion in Phase II/III of this project.

BURIED MEDICAL WASTES (PALAU)

A number of medical waste burial sites were identified in Palau, and there are reportedly numerous similar sites scattered through the Ngatpang jungle. It should be possible for the collection and disposal of these materials to be undertaken locally. Palau is one of the few Pacific Island Countries with an effective well-operated medical waste incinerator, which will be quite adequate for the disposal of these wastes.

A detailed description of the collection and disposal procedure is given in Annex C13. The only significant costs involved will be labour and equipment hire.
The work is not recommended for specific inclusion in Phase II/III of this project.

MISCELLANEOUS WASTES

Procedures for the disposal of the miscellaneous wastes listed in Section 3.10 are given in Annexes C14 and C15. Most of these involve local disposal methods, and should be able to be done at minimal cost. The work is not recommended for specific inclusion in Phase II/III of this project.

5.11 INTERNATIONAL TRANSPORT ISSUES

Many of the proposed disposal options will require the transboundary movement of hazardous materials.
As such it is important that due consideration be given to the requirements under the Basel Convention on the Control of Transboundary movements Solomon Islands of Hazardous Wastes and their Disposal. This global convention establishes a strict control for any transboudary movement of hazardous waste that is not in principle prohibited and ensure the availability of adequate treatment on disposal facilities for the environment sound management.

There are currently about 120 parties to the Basel Convention including Australia, Federated States of Micronesia, New Zealand, Papua New Guinea and many European countries. The implementation of POPS phase I/III in PICs require compliance with the Basel Convention. However under the framework of article eleven, Parties may enter into agreements or arrangements with non-Parties to allow the transboundary movement and management of hazardous waste. Such agreements shall not be the base to rely upon as a long-term mode of compliance.

Therefore countries in the region are urged to become parties to the Basel Convention.

Transboundary movement of hazardous wastes will also be regulated in the future by the Convention to Ban the Importation into Forum Island Countries of Hazardous and Radioactive Wastes and to Control the Transboundary Movement of Hazardous Wastes within the South Pacific Region (Waigani Convention). As of today, the Waigani Convention which has been ratified by only five countries will enter into force upon the deposit of the tenth instrument of accession. The parties to the Convention are Australia, Federated States of Micronesia, Fiji, Papua New Guinea and Solomon islands. SPREP will be the secretariat of the Waigani Convention and the depositary is the secretary- general for the Forum Secretariat.

A more detailed discussion of the requirements of the convention are given in Annex C16, especially with regard to the shipment of wastes to Australia.

6. CHEMICAL MANAGEMENT STRATEGIES

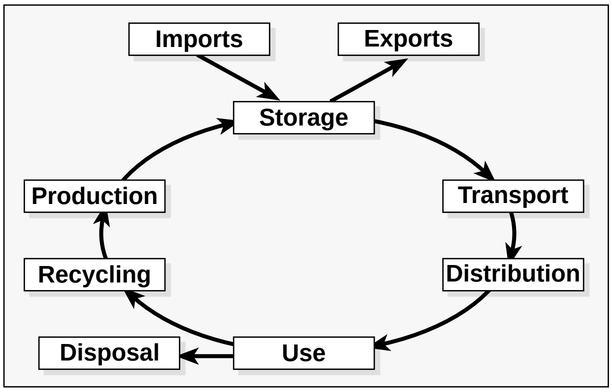
Most of the problems identified in this project can be attributed, at least in part, to the lack of effective chemical management strategies and supporting legislation, in Pacific Island Countries. It should of course, be acknowledged that PICs are not alone in having problems in this area. Most developed countries have really only started to come to grips with these issues over about the last five years.

The main emphasis in this chapter is on actions that Pacific Island Countries should be considering to ensure that similar problems do not arise in the future.

6.1 A 'LIFE-CYCLE' MANAGEMENT APPROACH

One important aspect of strengthening national programmes for the sound management of chemicals is the need to develop integrated activities which cover and link all aspects of the chemical life cycle including production, import, export, storage, transport, distribution, use, and disposal. This is sometimes referred to as "life-cycle" or "cradle-to-grave" management (see Figure 6.1). In many countries (not just PICs), current chemical management systems are based on a sectoral approach and are media specific (i.e. addressing separately air, water, and land). Individual stages of the chemical life cycle are controlled without adequate consideration of possible linkages and opportunities for an integrated approach. This has often led to inadvertent substitution of one problem for another (e.g. end-of-pipe water pollution control leading to an increased amount of waste sludge which needs to be burned or dumped).

Figure 6.1



There is a need for a much better understanding of which chemical-related problems, or potential problems, exist in a country and what mechanisms are available to address these. Concerned parties may not be fully aware of the range of control mechanisms available, since they may be under the jurisdiction of several different agencies. Such control mechanisms may also not be specific to hazardous chemicals (eg. more general environmental controls or laws concerning the control of poisons and public health).

A sound chemical management strategy will also help to identify important gaps or weaknesses in existing systems as a first step in defining where further efforts may be required. The strategy could indicate where there might be overlaps in controls or other inefficiencies, which may prevent the best use of limited resources. Thus, the process of developing a chemical management strategy should assist countries in establishing priorities for future activities.

6.2 CURRENT LEGISLATION

Legislation reviews for each Pacific Island Country were included in the country reports as described Annex A. The extensive legal regulatory framework with respect to hazardous chemicals is split among a variety of acts. These are mainly:

- (Public) Health Act. This usually covers the provision and control of institutionalised health services, the maintenance of safe food and water supplies, and requirements for the disposal of human and municipal wastes. There is also usually provision for preventive measures to be taken in the event of other significant risks to public health, including communicable diseases, pest outbreaks and (sometimes) hazardous chemical incidents.

- Dangerous Goods/Toxic Substances Act. These provide for controls over hazardous substances but usually only to the extent of specifying packaging, labelling and storage requirements. There is sometimes provision for additional controls on specific hazardous substances (eg. restrictions on use, or import controls), but these are often only applied after a specific problem has been identified. The Acts usually do not apply to waste materials or contaminated sites.
- Pesticides/Agricultural Chemicals Acts. These provide for the registration and control of pesticides, but once again the emphasis is on matters such as packaging and labelling. There is usually an assumption that the chemicals will always be used as intended by the manufacturer. The approval or "registration" process is predominantly based on matters such as efficacy and need, and historically there was only limited attention given to potential off-site or downstream environmental effects.
- Environment Act. This is usually concerned with the control of activities with the potential to cause pollution or other adverse environmental effects. In the case of hazardous chemicals, the main focus is on controlling the effects of any processing activities, rather than the materials themselves. Waste disposal activities will usually be controlled to the extent that they do not cause any off-site effects. The legislation is often unable to deal with existing contaminated sites, especially those caused by past activities.
- Customs and Excise. These are directed at the control of imported goods, but primarily from the perspective of foreign exchange controls and revenue generation. There may be extensive powers for prohibiting specific imports, but these are rarely applied to the control of hazardous chemicals (one fairly recent exception to this is the control of imports of CFCs and other ozone depleting substances).

As shown, none of these Acts provides for the overall control of the chemical life cycle. In addition, the existing fragmented coverage is usually highly inadequate in three main areas:

- Controls over imports of hazardous substances, to the extent that new imports of chemicals are adequately assessed before imports are approved.
- Provisions for the control and remediation of contaminated sites caused by past activities.
- Controls over the production and disposal of hazardous wastes.

Also it should be noted that sectoral laws give relevant ministries responsibilities over certain aspects of hazardous chemicals which can lead to a conflicting situation when it comes to coordination of chemicals. This generates a number of gaps, overlaps, or inconsistencies as well as duplication of efforts and other inefficiencies.

The point should also be made that the existing legislation in some Pacific Island Countries is nowhere near as comprehensive as that shown above. In some cases, there is almost no legislation relevant to the management of hazardous chemicals or wastes.

6.3 FUTURE LEGISLATION REQUIREMENTS

There is a trend internationally towards the adoption of legislation which provides for one co-ordinated approach to the management of hazardous chemicals. This legislation will not necessarily replace the various Acts listed above, but will provide an overall "umbrella" for chemical management, and also addresses the existing gaps.

One such example of this approach is the New Zealand Hazardous Substances and New Organisms Act, 1996. However, this is a very complex piece of legislation, and Pacific Island Countries would be better advised to consider developing something simpler, and more appropriate to the level of existing chemical uses and technologies, and the current level of institutional knowledge about chemical hazards.

Any proposed legislation for the management of hazardous chemicals, should include at least the following:

- A definition of "hazardous" chemicals or materials (ie. what types of hazardous properties are to be covered by the legislation).
- A set of Principles which are to be taken into account by persons or organisations exercising functions under the Act (eg. the Precautionary Approach, and possibly recognition of indigenous peoples and their rights).
- Relationships to other existing legislation (including the repeal of other relevant Acts).
- Transitional arrangements for chemicals already in use.
- Administrative arrangements (who is going to exercise functions under the Act?)
- Procedures for the assessment and approval of hazardous chemicals. This could include the adoption of a registration system.
- Details of the information required for registration or approval, and procedures for submitting this information.
- Assessment procedures, including how these will be carried out (eg. a public process or a "closed shop"), time scales, and notification procedures.
- Appeal procedures (who can appeal against what decisions, and how should this be done?).

- Procedures for reviews of existing approvals (eg. once every 10 years, or on receipt of significant new information).
- Monitoring and enforcement provisions.
- Provisions for cost recoveries (application fees, etc).

6.4 INSTITUTIONAL SUPPORT

There is almost no chemical manufacturing in Pacific Island Countries, and consequently a relatively low level of knowledge about the potential hazards.
Most chemicals are imported and it can be difficult for governments to make appropriate decisions on which chemicals to import and which to prohibit. Prospective importers can make their products appear attractive and beneficial not only for consumers but also for a nation's economy. It can be difficult, for example, for a country to prohibit the importation of a pesticide which promises to help increase the country's fruit exports by significant amounts.

However appropriate advice can be obtained from a variety of sources including the following:

- Inter-governmental organisations such as SPREP, SOPAC and SPC.
- Bi-lateral donors including Australia and New Zealand.
- The United Nations Environment Programme, including the Secretariats to the Basel, Rotterdam and the forthcoming POPs Conventions.
- World Health Organisation; Food and Agricultural Organization.

The rapid growth and increasing ease of access to the 'Internet' is also helping to provide ready access to a wide range of information.

6.5 INTERNATIONAL ACTIVITIES AND CONVENTIONS

There are a number of international activities and conventions, which are specifically intended to assist developing countries in achieving effective levels of chemical management.

These include the following:

- The Rotterdam or 'Prior Informed Consent' (PIC) Convention;
- The current international negotiations for a POPs Convention;
- The Inter-governmental Forum on Chemical Safety (IFCS);
- The UNITAR developed National Chemicals Profiles which assess the capacity of countries to safely and efficiently manage chemicals;
- The Global Programme of Action for the Protection of the Marine Environment from Land-Based Activities;
- The Basel and Waigani Conventions; and

Pacific Island Countries will only obtain the maximum benefits from these initiatives through active participation in the various programmes. This includes ratification of the relevant international conventions.

6.6 REGULATIONS AND CODES OF PRACTICE

It is not realistic for small countries to develop their own standards to regulate many chemical management practices. However, there is a risk that if a country lacks standards or regulations (eg. on the operation of bulk fuel facilities) a private facility can theoretically be operated as the owner wishes with no controls whatsoever. Such a situation is untenable and governments and industry must agree to appropriate operational procedures for facilities handling hazardous or potentially hazardous materials, preferably prior to construction. Most large international companies will readily agree to operate their facilities according to recognised international standards. In some cases regional standards have been developed but inevitably they will need interpretation and updating and it may be easier to adopt international standards.

It should also be noted, of course, that government-operated facilities must also comply with the appropriate international standards.

6.7 CAPACITY BUILDING

The tasks involved in chemical management are numerous and complex. Some may consider that it is unrealistic for governments of some small island states to build the capacity to undertake all these tasks. It can be attractive therefore to rely on industry to self-regulate itself, and this approach can indeed be worthwhile. However some basic knowledge of industrial processes is necessary, if only to allow governments to maintain an overview of the potential environmental and health effects of industrial developments. Governments also need to be able to respond to emergency situations, such as chemical spillages or sudden outbreaks of unexplained illnesses. Those responsible for dealing with chemical spills for example, need knowledge of the properties of the spilled chemical and appropriate means of handling and disposal.

Capacity building for Pacific Island Countries is clearly required in many facets of chemical management including:

- Development of chemical and hazardous materials management strategies.
- Drafting of legal mechanisms to implement these strategies.

- Education of both the Government personnel involved in monitoring the operation of industrial facilities, and the personnel operating those facilities.

The development of chemical management capacity is an underlying objective of the POPs in PICs programme, and is also reflected in the proposal for 1-week training programmes to be held in each country.

It is also recognised in the NZODA project for the Development of Hazardous Waste Management Strategies and in regional workshops being undertaken by UNEP Chemicals in support of the POPs, PIC and Basel conventions and other international initiatives.

6.8 PUBLIC EDUCATION AND AWARENESS

It has been argued that increasing the level of public education and awareness can be the key to overcoming many chemical and waste management problems. It could be for example, that the pesticides storage shed, which was vandalised in the Solomon Islands, would not have suffered such a fate if the local people had been educated as to the properties of the chemicals stored. Indeed the shed may not have been allowed to deteriorate for over ten years if the general public in the Solomon Islands had been aware of its existence and its contents. Had the shed been located in a developed country its state of disrepair would have generated a public outcry.

A better-educated public can also act as a watchdog to monitor both industry and the official monitors of industry - the various government departments.

Community education programmes will be undertaken in conjunction with the training course proposed for this project. However, this should be seen as only the first small step in an inevitably long and gradual process.

7. SUMMARY AND RECOMMENDATIONS

7.1 WASTE AND OBSOLETE CHEMICALS

Information on the major stockpiles of waste and obsolete chemicals identified during the country surveys is summarised in Table 7.1 below. This includes the suggested disposal options and an indicative range of costs. In practice, the actual disposal costs will depend on the specific method chosen and the location of the disposal facility.

TABLE 7.1 DISPOSAL OPTIONS AND COSTS FOR WASTE CHEMICALS

Chemical	Quantity (tonnes)	Disposal Cost Estimate (Au$)	Comments
Polychlorinated biphenyls (PCBs)	131	\$950,000 to \$2,850,000	Off-island disposal by chemical treatment or incineration
Pesticides (including 7 tonne of packaging)	42 11	\$300,000 to \$650,000 \$44,000	Off-island disposal by incineration On-island disposal by chemical and biological treatment
DDT	10.4	\$60,000 to \$140,000	Off-island disposal by chemical treatment or incineration
Timber Treatment Chemicals	10.15	\$20,300	Off-island disposal by returning to manufacturer
	1	\$5,000	On-island disposal by chemical treatment
Bitumen	330	\$30,000	On-island disposal using landfill or burial pits
TOTAL COST			**\$1,409,300 to \$3,739,300**

As shown, some of the materials are suitable for on-island disposal, however most are not. Generally these can only be disposed using specialised chemical treatment facilities or by high-temperature incineration. There are no such facilities available in Pacific Island Countries.

Clean-up, re-packaging, and transportation of chemical wastes are specialised activities which should only be carried out by skilled personnel using specialised equipment. It is therefore recommended that this be carried out on a contractual basis using companies with extensive experience in this type of work. Contractors should be chosen using a tendering system with the proposals being assessed against a variety of factors including track record, personnel, equipment and facilities, proposed methodology, proposed environmental management procedures, and price.

The selection of a disposal facility and method should also be done by tender, with a similar assessment process to the above. There are a variety of possible treatment facilities available in Australia, Japan, North America and Europe. Most of the facilities in Australia use specialised chemical and physical treatment processes which have been shown to achieve very high destruction efficiencies, but are sometimes limited in the range of wastes able to be treated. This is much less of a problem with high-temperature incinerators, which are available in North America, Europe and Japan. However, incineration is sometimes criticised because of the potential for toxic air emissions and other adverse effects. The recommended overall approach is to use chemical and physical treatment methods where possible, with incineration as the fall-back option.

7.2 CONTAMINATED SITES

Over one hundred potentially contaminated sites were identified in the country surveys, and further work is proposed for 54 of these. It is now necessary to embark on a programme of more extensive investigations at each site, followed by remediation and disposal operations, as required. The overall costs for the work programme are summarised in Table 7.2.

TABLE 7.2 CONTAMINATED SITE COST ESTIMATES (AU$)

Contaminant	No. of sites	Assessment Cost	Remediation/ disposal costs	Remediation/ disposal Method
PCBs	3	$30,000 –$870,000	$195,000	Excavation, export for disposal
Buried pesticides	3	$150,000 - $1,350,000	$600,000	Excavation, export for disposal
Pesticide storage sites	13	$130,000 - $390,000	$170,000	Clean, decontaminate and export wastes
Buried DDT	2	$100,000 - $900,000	$385,000	Excavation, export for disposal
Timber treatment sites	4	$100,000	$100,000	Excavate, treat and dispose locally
Oil-contaminated sites	10	$30,000		Bioremediation
Oil-contaminated groundwater	11	$2,200,000		In situ bioremediation
Landfills	18	$900,000	Not included in programme	
Sub-totals:		$1,410,000	$3,680,000 - $5,840,000	
Total Estimated Costs:				**Au$5,090,000 - $7,250,000**

Ideally, the PCB, pesticide and DDT remediation and disposal work should be carried out in conjunction with the related disposal work for waste stockpiles.

7.3 OTHER SIGNIFICANT ISSUES

Two areas were identified in the survey that would be best addressed through the development of specific management programmes, rather than one-off disposal exercises. These are the management and disposal of laboratory chemicals, and the management of infectious medical wastes.

The disposal of surplus and obsolete laboratory chemicals was a common problem throughout the region and in all types of laboratories, including schools, hospitals and government departments.
It is recommended that a regional programme be developed to upgrade chemical management capabilities in laboratories throughout the region. The total cost of the programme will be at least Au$400,000.

The management and disposal of infectious wastes in hospitals and other medical establishments is another area that needs considerable upgrading.
It is recommended that a comprehensive programme be developed to upgrade medical waste management facilities throughout the region. This programme would be best co-ordinated through the World Health Organization, and is likely to cost at least Au$600,000.

7.4 OTHER WASTE AND CONTAMINATED SITE ISSUES

A number of other issues were identified in the surveys, as follows:

- Significant quantities of waste oil are generated in the region each year and there are more than 200,000 litres of waste oil currently awaiting disposal. The proposed disposal options are shipping to Fiji for use as a fuel supplement, or recycling.
  It is suggested that the costs for this should be minimal, and that these should be borne by the oil companies.
- The quantities of asbestos wastes and buried medical wastes identified in the country surveys should be disposed using local facilities. Costs are expected to be minimal.
- A number of other miscellaneous chemical wastes were also identified. Disposal recommendations for these are given in Annex C14. The costs are expected to be minimal.

7.5 OVERALL STRATEGY

Phases II and III of the project were intended to cover the development of safe storage facilities in each country, and disposal activities, respectively. However, it is now proposed that in most cases the storage phase of the work should be omitted, and priority should be given to the disposal operations. This proposal is made for a number of reasons as follows:

- With a few exceptions, the storage condition of most of the stockpiles is now secure.
- The cost of building even temporary storage facilities would be relatively high, and this money would be better spent on ultimate disposal of the current stockpiles.
- Siting of the storage buildings would be difficult in most of the countries due to problems over land ownership and/or the NIMBY (not in my back yard) syndrome.
- Many of the current problems with stockpiles of waste chemicals are unlikely to arise again in the future, either because these particular chemicals have been withdrawn from use or the activities associated with them are no longer being carried out. This does not mean there will be no future problems with waste chemicals, but the likelihood should be much lower.

Nonetheless it must be recognised that there are some storage situations which will need to be addressed in the near future if the disposal activities are delayed. In the first instance, this option should be considered for the following sites, which were assessed by the consultants as having the greatest potential for causing adverse health effects:

- The agricultural chemicals storage shed on Metapona Plains, Solomon Islands.
- A shipping container used for storage of agricultural chemicals in Weno, Chuuk, Federated States of Micronesia.
- The agricultural chemicals storage shed at Lomaivuna Research Station, Fiji.
- It is also recommended that the stocks of chemicals held at the former agriculture station and at the Amak Women's Unit, both on Tarawa, Kiribati, be moved to more appropriate storage facilities.

The cost of this work would be about Au$60,000.

The primary activity for Phase II/III of the project will be disposal of the stockpiles of obsolete and unwanted chemicals, contaminated site remediation, and other targeted waste management activities.

The total cost of these activities will be as follows:

Chemical waste disposal:	Au$1.41 – $3.74 million
Contaminated site assessments:	Au$1.41 million
Contaminated site remediation:	Au$5.09 – $7.25 million
Laboratory waste management programme:	Au$ 0.4 million
Medical waste management programme:	Au$0.6 million
Interim site improvements (contingency)	Au$0.06 million

Quite clearly, this amount of money is well in excess of that likely to be available from any one source. It is therefore proposed that the work be undertaken in a series of discrete work packages ranging in size from about Au$6,000 to about $1 - $3million. A number of possible donors will be approached for support for this work.

7.6 LEGISLATION AND CAPACITY BUILDING

The POPs in PICs project concentrates on the disposal of waste and obsolete chemicals and remediation of chemical contaminated sites, but also aims to assist countries with the development and implementation of long-term strategies for the management of hazardous and potentially hazardous chemicals and other materials. The project will help to provide some first steps in this direction, through the provision of local training courses and community education activities. Gaps in current legislation have also been identified.

Much remains to be done in this area. However, SPREP is confident that with an increased level of participation by Pacific Island Countries in international chemical management programmes, and regional assistance programmes including the NZODA-funded Development of Hazardous Waste Management Strategies project, the goal of efficient and effective chemicals management throughout the region can be attained.

7.7 RECOMMENDATIONS

1. The proposed phases II and III of the POPs in PICs project should be merged into a single programme, with the primary emphasis on waste disposal and contaminated site remediation.
2. Approaches should be made to AusAID and other donor agencies for financial support for individual sub-parts of the proposed programme.
3. Funding (Au$60,000) should also be sought for interim improvements to some of the pesticide storage facilities, as listed in Section 7.5.

4. Pacific Island Countries should take action to implement local disposal procedures for those chemicals identified as being solely their responsibility.
5. Pacific Island Countries should be encouraged to participate fully in the current international and regional activities directed at capacity building and institutional strengthening in the areas of chemical management.
6. Pacific Island Countries should consider the development of specific legislation directed at the appropriate management of hazardous chemicals, using a life cycle approach.
7. Pacific Island Countries should actively participate in the current negotiations for a legally binding instrument for certain persistent organic pollutants (POPs).
8. Pacific Island Countries should urgently recognise the desirability of ratifying both the Basel and the Waigani Conventions.

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Annex: A
Country Reports

Waste and Obsolete Chemicals and Chemical Contaminated Sites

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May 2000

COUNTRY REPORT
A.1 COOK ISLANDS

1. OVERVIEW

The South Pacific Regional Environment Programme (SPREP) and AusAID have designed and implemented a programme aimed at improving the management of chemicals in the South Pacific region. The program is being undertaken in 3 Stages as follows:

Stage 1: Preliminary chemical survey and conduct of training in basic chemical handling and disposal procedures.

Stage 2: Repacking of unwanted chemicals as necessary and provision of appropriate temporary storage facilities

Stage 3: Clean-up of contaminated sites and disposal of chemical stockpiles.

The focus of the Stage 1 survey was to identify and quantify the volume of unwanted Persistent Organic Pollutants (POPs) and associated environmental contamination in 13 Pacific Island Countries. POPs typically include chemicals such as pesticides, organic solvents and polychlorinated biphenyls (PCBs). The scope was subsequently expanded to include other potential contaminants such as waste oil, CCA treatment chemicals and laboratory chemicals. This report provides a summary of the POPs survey for the Cook Islands.

The visit to the Cook Islands was carried out by Dr. Bruce Graham from 30 May to 12 June. The main contact point for the visit was Mr. Ned Howard, Director of the Environment Service, Ministry of Works, Environmental Protection and Planning. A local consultant, Mr. Tom Wichman, also assisted with the work. Most of the time was spent on the island of Rarotonga, but with a one day visit to Aitutaki as well.

2. MAJOR FINDINGS

The table below provides a summary of the total volume of unwanted chemicals identified during the 1998 POPs survey of the Cook Islands.

	Estimated Quantity
Agricultural chemicals	5,700 kg
Oil potentially contaminated with PCBs	4,000 L
Laboratory chemicals	380 kg
Waste oil	20,000 L
Contaminated sites	2

The chemical quantities given in this report are necessarily conservative estimates. For example, in the case of PCBs, the value quoted is based on tests carried out on a representative number of transformers. Similarly, the quantities quoted for pesticides are based on mainly visual assessment of the individual stockpiles. More specific details will need to be obtained prior to any clean-up and disposal operations.

The most significant stockpiles of waste chemicals and contaminated sites found in the Cook Islands include:

AGRICULTURAL CHEMICALS

- A total of about 64 tonnes of fertilisers and soil conditioners, of which about 36 tonnes have been repackaged and shipped to New Zealand, about 15 tonnes have been given away for local use and 6 tonnes have been repackaged and stored locally;
- A stockpile of waste pesticides at the Cook Islands Ministry of Agriculture research centre at Rarotonga which includes 80 litres of dieldrin and 21 kg of lindane;

- Stockpiles of pesticides including 750 kg of carbofuran, 650 kg of fenamiphos and 320 litres of oxymal; and fertilisers including one tonne of copper sulphate and 750 kg of sulphur stored at the Cook Islands Ministry of Agriculture agricultural services depot at Aitutaki;

OTHER OBSOLETE CHEMICALS

- 400 litres of ethylene dibromide (EDB) stored at the Cook Islands Ministry of Agriculture airport quarantine centre at Rarotonga;

WASTE OIL

- A total of about 20 tonnes of waste oil; and
- Oil contamination of the ground at the Aitutaki power station.

3. RECOMMENDATIONS

To dispose of waste chemicals, remediate chemicals contaminated sites and upgrade chemical management capacity in the Cook Islands it is recommended that:

- The Cook Islands be included in a regional programme to be developed by SPREP for the removal of PCB contaminated transformer oil;
- Waste pesticides identified in the inspections at the Cook Islands Ministry of Agriculture research centre and airport quarantine centre at Rarotonga and the Aitutaki Ministry of Agriculture depot be included in the regional programme under development by SPREP to dispose of hazardous materials in off-island treatment facilities;
- Other waste chemicals identified in the inspections be disposed of in the regional programme for less hazardous chemicals under development by SPREP. Disposal is to be as recommended in the main body of this report and the attached database summaries.
- The Cook Islands be included in the NZODA/ SPREP regional programme to develop and implement national hazardous waste management strategies;
- The Cook Islands be included in the international chemical management programmes of UNEP, WHO and FAO including those of the Intergovernmental Programme for Chemical Safety;
- The Cook Islands participate in current negotiations for a legally binding instrument for certain persistent organic pollutants;
- The National Chemicals Profile for the Cook Islands (commenced in 1996) be completed;
- The Cook Islands consider ratification of the Waigani Convention;
- The Cook Islands be included in a regional programme under development by SPREP for the environmentally appropriate management of waste oil;
- The Cook Islands be included in a regional programme to be developed by WHO to upgrade capacity to manage medical wastes and chemicals;
- The Cook Islands be included in a regional programme to be developed by SPREP to upgrade capacity to manage school laboratory chemicals; and
- The Cook Islands be included in a regional programme to be developed by SPREP to assess the extent of contamination that has resulted from inadequate management of solid waste disposal sites.

4. WASTE MANAGEMENT INFRASTRUCTURE

The island of Rarotonga has a well-organised solid waste management system with most wastes being disposed at a privately owned landfill at Karika. Burning is used to reduce waste volumes, and the material is periodically covered with soil excavated from other parts of the property. This site is likely to be closed within the next year or so, and a new landfill is currently under consideration.

There is an active and effective aluminium can recycling system on the island, and some minor recovery of bulky waste items at the landfill (e.g. old refrigerators used as water tanks). Waste oil from the power station and some vehicle workshops, is collected and shipped to Fiji for disposal in the steel mill.

Sewage and other liquid wastes are disposed in a variety of ways including septic tanks, small packaged treatment plants, and soakage pits. Water is drawn from river systems and roof collection of rainwater, and there is no significant use of groundwater. The main risks from liquid waste disposal are contamination of the foreshore and fisheries.

There are two specialised waste disposal facilities on the island. The hospital incinerator at Arorangi is a modern 2-stage diesel-fired combustion unit, and is currently well maintained and operated. There are also two 2-stage quarantine incinerators at the airport. However, one of these has been out of service for many years, while the second one is also in need of repair.

There are no solid waste disposal facilities on Aitutaki, and rubbish is simply dumped in a number of “convenient” locations. Sewage is disposed in septic tanks and soakage holes, while open burning and burial are used for the disposal of hospital wastes. Water supplies are drawn from groundwater and roof-collection, and from a desalination plant.

The situation on all other islands in the Cook Islands group is expected to be similar to that on Aitutaki.

5. Summary Of Waste Stockpiles And Contaminated Sites

The following matters were identified as part of this project:

Fertiliser Store, Avarua

Some 65 to 70 tonnes of chemicals were held in this building, mainly copper sulphate, magnesium sulphate and lime. A clean up of the store was being undertaken at the time of the visit, and advice was given on the most appropriate disposal options. Most of the materials were repacked and shipped back to the supplier in New Zealand.

Agriculture Research Centre, Totokoitu

Approximately 1.5 tonnes of old pesticides are held at this site, including 80 litres of dieldrin.

Ministry of Agriculture, Aitutaki

A total of about 1750 litres and 650kg of pesticides, and 11 tonnes of fertilisers and soil conditioners (zinc sulphate, iron sulphate, copper sulphate, sulphur) are stored at this site.

Island Pest Control

This company had some old stocks of aluminium phosphide (32 kg), which were collected and placed in the Totokoitu store.

Laboratory Chemicals (Hospital & four schools)

Small amounts of old chemicals were being held at each of the schools, and about 250kg at the hospital. This included small amounts of picric acid and phosphorus, which were disposed by open burning with the assistance of the Fire Services.

Ministry of Agriculture, Quarantine Service

Two drums of ethylene dibromide (EDB) are held at the airport and no longer needed.

Aviatu Power Station

Waste oil management is generally very good and there is no major site contamination. Clean waste oil is removed by Mobil, but there is about 20,000 litres of dirty oil not covered by this system (and gradually increasing each year).

Transformer Oil (PCBs)

Many of the transformers on Rarotonga were replaced during a major upgrade in 1991. The new units will not contain PCBs. However, some of the old units are now being used on the outer islands, and probably do contain PCBs. Ministry of Energy is holding 6 of these at Avarua for future use, and there are about 8 old units on Aitutaki.

Vehicle Workshops

Some of these were collecting their waste oil and returning it to Mobil for shipment to Fiji. At others the wastes were simply dumped on the ground.

Old Waste Dump, Avarua

It appears that some dieldrin may have been dumped at this site in the past, about 10 to 20 years ago. It is likely that any residues have long since been flushed away.

Aitutaki Power Station

Approximately 200 litres of waste oil is dumped in a soak hole at the back of the site, once every 3 months. Also, there appears to be an on-going problem with oil spillages around the fuel storage tanks. The site needs to be cleaned up, the area around the storage tanks should be covered in concrete and bunded, and a system for waste oil disposal should be put in place.

Timber Treatment Chemicals, Atiu

A small amount (600 litres) of copper/chrome/arsenic mixture is being held on the island of Atiu, for treatment of roofing shingles, while copper sulphate is being used for treatment of kikau roofs.

Old Pharmaceuticals

On Rarotonga these are being taken to the dump for disposal. This is generally acceptable, but the containers need to be broken and the wastes should be buried immediately to guard against scavenging.

Ministry of Health Vector Control

DDT is no longer used for mosquito control, and has been replaced by Malathion.

6. Legislation And Administration

Environmental matters are currently covered under the 1986-87 Conservation Act. Consideration is still being given to an Environment Act, which was first proposed in 1992. This would give more specific coverage to environmental matters, along with the establishment of an Environment Agency (incorporating the Environment Council and the Environment Service).

Pesticides are controlled through registration under the Pesticides Act 1987, and currently over 100 types are imported and registered. However, the Act is no longer being actively administered, due to recent severe staff cuts in the Ministry of Agriculture.

There are no specific provisions in any legislation for controls on the importing and use of hazardous chemicals (other than pesticides), or for the management of hazardous wastes.

No one person in the Environment Service has specific responsibility for hazardous chemicals or hazardous waste management. However, one officer is currently completing a degree in chemistry and will be trained to fill this role.

INTERNATIONAL CONVENTIONS

The Cook Islands is a signatory to 18 international conventions and agreements, which have direct relevance to the environmental conditions prevailing in the Cook Islands. These are as follows:

South Pacific Forum Agency Convention, signed, 10 July 1979

Canberra Agreement (SPC), acceded to 14 October 1980

Law of the Sea Convention, signed 10 December 1982

South Pacific Nuclear Free Zone Treaty (Rarotonga Treaty) signed 6 August 1985, ratified 28 October 1985

United Forum Islands Countries Fishing Agreement, signed 2 April 1987, ratified 17 June 1987

SPREP Convention and its 2 Protocols signed 25 November 1986, ratified 9 September 1987

Agreement establishing SPREP 16 June 1993

Apia Convention, acceded to 27 October 1987

SOPAC Agreement, signed 10 October 1990, not yet ratified

Driftnet Convention (Wellington Convention), signed 29 November 1989, ratified 24 January 1990

Forum Secretariat Agreement, signed 29 July 1991, ratified 23 August 1991

Rio Declaration on Environment and Development, signed June 1992

Convention on Biological Diversity (CBD)

United Nations Framework Convention on Climate Change (UNFCCC)

Kyoto Protocol

Tropical Timber Agreement

Convention on International Trade in endangered species of Wild Fauna and Flora (CITES)

International Whaling Convention

The Cook Islands has acceded to the Basel Convention but has yet to ratify the Waigani Convention.

COUNTRY REPORT
A.2 FEDERATED STATES OF MICRONESIA

1. OVERVIEW

The South Pacific Regional Environment Programme (SPREP) and AusAID have designed and implemented a programme aimed at improving the management of chemicals in the South Pacific region. The programme is being undertaken in 3 Stages as follows:

Stage 1: Preliminary chemical survey and conduct of training in basic chemical handling and disposal procedures.

Stage 2: Repacking of unwanted chemicals as necessary and provision of appropriate temporary storage facilities

Stage 3: Clean-up of contaminated sites and disposal of chemical stockpiles.

The focus of the Stage 1 survey was to identify and quantify the volume of unwanted Persistent Organic Pollutants (POPs) and associated environmental contamination in 13 Pacific Island Countries. POPs typically include chemicals such as pesticides, organic solvents and polychlorinated biphenyls (PCBs). The scope was subsequently expanded to include other potential contaminants such as waste oil, CCA treatment chemicals and laboratory chemicals. This report provides a summary of the POPs survey for the Federated States of Micronesia (FSM).

2. MAJOR FINDINGS

The table below provides a summary of the total volume of unwanted chemicals identified during the 1998 POPs survey of FSM.

	Estimated Quantity
Agricultural chemicals	7,430 kg
Oil potentially contaminated with PCBs	55,000 L
Laboratory chemicals	36,400 kg
Waste oil	126,000 L
Contaminated sites	18 potential sites

The chemical quantities given in this report are necessarily conservative estimates. For example, in the case of PCBs, the value quoted is based on tests carried out on a representative number of transformers. Similarly, the quantities quoted for pesticides are based on mainly visual assessment of the individual stockpiles. More specific details will need to be obtained prior to any clean-up and disposal operations.

The most significant stockpiles of waste chemicals and contaminated sites found in FSM include:

HYDROCARBON WASTES

- A total of about 66 tonnes of bitumen stored in 200 litre drums in deteriorated condition;
- A total of about 126 tonnes of waste oil;

POTENTIALLY PCB CONTAMINATED OIL

- A total of about 55 tonnes of potentially PCB contaminated transformer oil;

AGRICULTURAL CHEMICALS

- 1400 kg of unwanted fertilisers stored at the Yap Department of Agriculture research station;
- 900 kg of miscellaneous pesticides which had been repackaged into a shipping container by WHO in 1994 in Chuuk, but which has since been moved into a residential area. The container is now leaking and three children living in an adjacent house have been admitted to hospital;
- 2800 kg of miscellaneous pesticides including DDT and chlordane had been repackaged by WHO in 1994 in Pohnpei. The site has since deteriorated however and additional poorly packaged chemicals added;
- 1300 kg of miscellaneous pesticides including DDT and carbamates in poor condition stored in the former Japanese communications building in Pohnpei which is now frequented by tourists.

CONTAMINATED SITES

- A pesticide contaminated site at the Yap Department of Agriculture research station;
- A possible pesticide contaminated site at the Kosrae Department of Agriculture and Lands research station;
- A possible pesticide contaminated site at the former Department of Agriculture pesticides store in Chuuk;
- Bitumen contaminated sites at three asphalt manufacturing plants in Pohnpei and one in Chuuk, the old airport in Yap, and the former Loran Coastguard station in Yap;
- Oil and diesel contaminated sites at the Chuuk bulk fuel depot, the Micronesian Petroleum Company bulk fuel depot in Kosrae, the Mobil bulk fuel depot in Yap;
- Oil and diesel contaminated sites at the Pohnpei, Chuuk and Yap power stations and the Pohnpei Transportation Authority depot;
- 2 tonnes of DDT were buried some years ago at a site adjacent to the old Pohnpei hospital; and
- Poorly managed landfills in Kosrae, Pohnpei and Yap.

3. RECOMMENDATIONS

To dispose of waste chemicals, remediate chemicals contaminated sites and upgrade chemical management capacity in FSM it is recommended that:

- Waste pesticides identified in the inspections at the Chuuk pesticides shipping container, the Pohnpei Agriculture and Trades School, Pohnpei Department of Agriculture storage shed, and the former Japanese communications building in Pohnpei be included in the regional programme under development by SPREP to dispose of hazardous materials in off-island treatment facilities;
- Other waste chemicals identified in the inspections be disposed of in the regional programme for less hazardous chemicals under development by SPREP. Disposal is to be as recommended in the main body of this report and the attached database summaries;
- The Chuuk shipping container, Pohnpei Department of Agriculture storage shed, the former Japanese communications building in Pohnpei, the buried DDT at the old Pohnpei hospital, the Yap Department of Agriculture research station, the Kosrae Department of Agriculture and Lands research station, and the former Department of Agriculture pesticide store in Chuuk be included in the regional programme under development by SPREP to remediate pesticide contaminated sites;
- Access be restricted to the former Japanese communications building located at the Department of Agriculture depot in Kolonia, Pohnpei. The site should be made inaccessible to the public in the interests of public safety;
- The shipping container packed with pesticides in Weno, Chuuk should be removed from its present location in a residential area as a matter of urgency;
- FSM be included in a regional programme to be developed by SPREP for the removal of PCB contaminated transformer oil;
- FSM be included in the NZODA/SPREP regional programme to develop and implement national hazardous waste management strategies;
- FSM be included in the international chemical management programmes of UNEP, WHO and FAO including those of the Intergovernmental Programme for Chemical Safety;
- FSM participate in current negotiations for a legally binding instrument for certain persistent organic pollutants;
- A National Chemicals Profile be compiled for FSM;
- FSM be included in a regional programme under development by SPREP for the environmentally appropriate management of waste oil;
- FSM be included in a regional programme to be developed by SPREP for the remediation of bitumen contaminated sites;
- FSM be included in a regional programme to be developed by SPREP for the remediation of oil and diesel contaminated sites;
- FSM be included in a regional programme to be developed by WHO to upgrade management of medical wastes and chemicals;
- FSM be included in a regional programme to be developed by SPREP to upgrade management of school laboratory chemicals; and
- FSM be included in a regional programme to be developed by SPREP to assess the extent of contamination resulting from inadequate management of solid waste disposal sites.

4. CHUUK

4.1 SITE INSPECTIONS

A survey of Chuuk was conducted by Ms Terrie Burns from 15 to 25 May, 1998. The survey was conducted with the aid of EPA Administrator, Mr Joseph Kono, Environmental Officer, Mr Curtis Sos, and Environmental Specialist, Ms Julita Albert.

The following government agencies, sites and industries were visited during the audit programme:

Government Agencies	Chemical stockpiles and contaminated sites	Other
• Environment Protection Authority (EPA) • Department of Agriculture • Department of Marine Resources and Fisheries • Department of Health • Public Works Division • Department of Transportation • Power and Utilities Authority • Office of the Governor	• Public Works Depot • Chuuk Hospital • Weno Power Station • Agriculture Research Station • Agricultural Chemicals Storage Site • Former Agriculture Station • Tonoas Is Power Station • Tonoas Is Former Bulk Fuel Plant	• Mobil Bulk Fuel Plant • Steward Asphalt Plant • Xavier High School • Specialist Adviser for Health Care • Environmental Lawyer • College of Micronesia

4.2 SURVEY FINDINGS

The following provides a summary of the unwanted chemical stockpiles and contaminated sites identified on Chuuk.

AGRICULTURAL CHEMICALS

Department of Agriculture: Approximately 900 kg of unwanted pesticides were repackaged under the 1994 WHO programme. The chemicals are being stored in a shipping container on private property in the centre of Weno. The container is leaking and has visibly contaminated the surrounding soil. There are reports of children being hospitalised with respiratory problems and skin irritations after playing near the contaminated area. The site is the subject of a civil law suit against the Department of Agriculture.

POTENTIAL PCB OIL

Weno Power Station: Over 210 out- of- service transformer units were identified at the Weno Power Station. It is estimated that up to 40,000L of used oil may be present in the transformers. Many of the units are deteriorating and have leaked oil onto the surrounding soil. There are unconfirmed reports that PCB testing and removal was undertaken by the USEPA in the early 1980s.

Tonoas Power Station: 16 out-of-service transformer units were identified at the Tonoas Island Power Station. It is estimated that up to 3000L of used oil may be present in the transformers.

LABORATORY CHEMICALS

Xavier High School: The high school has a small stockpile (190kg) of unwanted laboratory chemicals. Most of the containers are labelled and appear in sound condition.

WASTE OIL

Department of Marine Resources and Fisheries: The Department has 2 x 200 litre drums of new hydraulic oil which they can no longer use.

At the time of the audit, no other significant waste oil stockpiles were identified. Most waste oil is taken by a local dive boat, *The Dolphin*, for use as a supplementary fuel. There is no formal collection system for this programme.

WASTE ASPHALT

Steward Asphalt Plant: Approximately 20,000 L unwanted asphalt contained in deteriorating drums was identified at a privately owned and operated site. The site is due to close at the end of 1998, and concerns were raised regarding the final disposal of this material.

CONTAMINATED SITES

Tonoas Island - Former Bulk Fuel Plant: The site contains the remains of 3 aboveground 10,000 gal diesel tanks. The tanks were part of a Japanese refuelling facility and sustained heavy damage during WWII. A

1994 report by Barrett Consulting estimated that up to 15,000 m^3 of contaminated soil and 60,000 m^3 of free diesel may be present. Some Tonoas Island residents live within 50m of the site and many rely on local groundwater for drinking and washing purposes.

Agricultural Chemicals Storage Site: Unwanted pesticides repackaged under the 1994 WHO program are being stored in a shipping container on private land in Weno. The site is owned by Mr Fostino Antonio and was being leased by the Department of Agriculture. The container has leaked and visibly contaminated the surrounding soil. Vegetation along a drainage channel leading from the container shows signs of significant stress including chemical burns. It is estimated that up to 50m^3 of soil will require some form of remediation.

College of Micronesia: One of the college campuses is located on the site of a former agricultural storage shed. The shed was partially remediated under the 1994 WHO programme, however, cleaning of the storage area was not undertaken. The area gives off strong chemical odours and staff and students report frequent headaches.

Weno Power Station: The site has a history of multiple spills from an aboveground waste oil storage tank. A stormwater drain leading from the tank to the street shows signs of heavy contamination. It is estimated that up to 100 m^3 of heavily stained soil is present, including some offsite contamination. The spills reportedly occurred due to poor operational procedures.

4.3 CURRENT WASTE MANAGEMENT

Most domestic, industrial and hazardous wastes are disposed at the Weno landfill, a government owned and operated facility. Waste disposed at the landfill is not covered or compacted. Most domestic waste from the outer islands is disposed at small local landfills. The sites are poorly managed and are often located in mangrove areas or used for land reclamation. The main island has a significant problem with litter and uncontrolled waste disposal. There is no formal waste collection program and limited options for the disposal of potentially hazardous material.

Infectious medical waste and unwanted chemicals are disposed in an old incinerator at the hospital. The ashes from the incinerator are disposed to the landfill. Expired chemicals may also be disposed to the landfill without pre-treatment (e.g. burning).

The FSM National Quarantine Division has recently upgraded its facilities with new incinerator units in each state.

5. KOSRAE

5.1 SITE INSPECTIONS

A survey of Kosrae was conducted by Ms Terrie Burns from 14 to 27 April, 1998. The survey was conducted with the aid of Mr Simpson Abraham,Development Review Commission Administrator

The following government agencies, sites and industries were visited during the audit programme:

Government Agencies	Chemical Stockpiles and Contaminated sites	Other
• Development Review Commission • Kosrae Utilities Authority (KUA) • Department of Agriculture and Lands • Department of Health • Department of Transport • Lelu Council • Department of Fisheries and Marine Resources • Office of the Governor General • Office of the Lt. Governor General	• Tofol Landfill • Tafunsak Landfill • Vehicle Maintenance Depot • KUA Power Station • Agriculture Research Centre • Kosrae Hospital • MPC Bulk Fuel Farm	• Semo Micronesia • Micronesia Petroleum Company • Black Micro Construction • Legislative Speaker • Legislative Counsel • Administrator for Women's Affairs • Pacific Tuna Industries

5.2 SURVEY FINDINGS

The following provides a summary of the unwanted chemical stockpiles and contaminated sites identified on Kosrae.

AGRICULTURAL CHEMICALS

No significant stockpiles of unwanted agricultural chemicals were identified. however, methyl bromide is used for fumigation by the Department of Agriculture.

POTENTIAL PCB OIL

The KUA Power Plant: There are currently over 100 out of service transformers stockpiled on the site, containing approximately 5800 L of used transformer oil. Many of the units are reportedly ~20 years old and may contain PCB oil. Many of the units are in poor repair and have leaked oil onto the surrounding soil. Some of the oil has been transferred into drums to minimise contamination. No other potential PCB sources were identified.

LABORATORY CHEMICALS

No significant volumes of unwanted laboratory chemicals were identified.

WASTE OIL

Over 50,000 L of waste oil was recorded on Kosrae during the audit. The primary sources were the Kosrae Utility Authority (KUA), the Department of Transport and Utilities' depot and Black Micro Construction Company. Subsequent communications with Micronesia Petroleum Company (MPC) indicates that all stockpiled oil from KUA and the depot has been removed for off island recycling in Australia.

CONTAMINATED SITES

Micronesia Petroleum Company Bulk Fuel Plant: The site was formerly owned by Mobil. During Mobil's operations, a 19,000 L diesel spill reportedly occurred contaminating the surrounding soil and groundwater. At the time of the audit, a remediation programme had not been established. Kosrae State Government were considering legal options to obtain compensation from Mobil to remediate the site.

Kosrae Hospital: The hospital disposes of pathogenic and chemical waste in an onsite pit. The waste is typically burnt on an open bonfire prior to burial. There are few controls at the disposal site and unrestricted public access.

Department of Agriculture and Lands: The site has historically been used for testing pesticides and herbicides. The long term chemical application is likely to have resulted in some degree of soil contamination.

KUA Power Station: The site has a large stockpile of old transformers. Many of the units have leaked and there is a potential for PCB contamination of the surrounding soil.

5.3 CURRENT WASTE MANAGEMENT

Most domestic, industrial and hazardous wastes on Kosrae are disposed at the Tofol landfill. The landfill is a government owned and operated facility. Provision is made for the segregation of potentially hazardous wastes (in particular, batteries and oil), however, the site is not manned and segregation relies on the landfill users. There are no disposal options available for potentially hazardous wastes. Waste disposed at the landfill is not covered or compacted.

Most domestic waste from outlying villages is disposed at the Tafunsak landfill or at a number of small local landfills. The sites are not managed and are typically located in mangrove areas.

Infectious medical waste and unwanted chemicals are burnt on an open bonfire at the hospital. The ashes from the incinerator are disposed onsite in aboveground mounds. Expired chemicals may also be disposed to the landfill without pre-treatment (e.g. burning).

The FSM National Quarantine Division has recently upgraded its facilities with new incinerator units in each state.

6. POHNPEI

6.1 SITE INSPECTIONS

A survey of Pohnpei's main island was conducted by Ms Terrie Burns from 28 April to 13 May, 1998. Local counterparts Mr Elden Helen, (Pohnpei Environment Protection Authority) and Mr Anthony Wallis (FSM Department of Health, Education & Social Affairs)provided invaluable assistance during the audits.

The following government agencies, sites and industries were visited during the audit programme:

Government Agencies	Chemical stockpiles and contaminated sites	Other
• Environment Protection Board • FSM National Health Service • Public Utilities Board • Department of Agriculture • Department of Health • Transport Authority • US Department of Agriculture Conservation Office • Maritime Surveillance • National Quarantine Service • Plant Protection Authority	• Pohnpei hospital • Agriculture storage sheds • Power station • Kolonia landfill • Vehicle maintenance depots • Pohnpei Agriculture and Trade School (PATS) • Pohnpei International High School (PICS) • Former CCA treatment site • Former power plant site • Asphalt plants (x3) • DDT burial site • Mr Jack Adams property (transformer stockpile)	• Waste Management Services (landfill operators) • Civil Action Team • FSM National Attorney • Speciality Hydrogeologists • PICCAP National Co-ordinator • College of Micronesia

6.2 SURVEY FINDINGS

The following provides a summary of the unwanted chemical stockpiles and contaminated sites identified on Pohnpei.

AGRICULTURAL CHEMICALS

Department of Agriculture Storage Shed: The shed originally contained ~2000 kg of mixed pesticides (including DDT, chlordane and strychnine) repackaged under the 1993 WHO program. Since that time, an additional 800 kg of mixed chemicals, most in poor condition, have been added to the store. (The contents of this store were repackaged in 1999).

Former Japanese Communications Building: Approximately 1300kg of loose pesticides, (including DDT, carbamates and many unknowns) were identified in a building frequented by tourists. The chemicals and containers are in very poor condition. (The contents of this store were repackaged in 1999 and moved to the adjacent Department of Agriculture storage shed).

PATS: The school has a small stockpile (~230 kg) of unwanted agricultural chemicals, including malathion and Sevin.

POTENTIAL PCB OIL

Kolonia Power Station: Approximately 8000L of used transformer oil is being stored in abandoned units around the power plant and adjoining maintenance yard. The station recently purchased a transformer oil recycle system and propose to recycle and reuse all existing oil. There were anecdotal reports of PCB testing and removal conducted by the USEPA in the early 80s, however, supporting documentation was not available at the time of this survey.

Jack Adams Property: 26 empty transformers were identified on the site. Many of the units are over 20 years old and were reportedly empty when brought to the site in the early 80s. It is possible that some PCB contamination of the surrounding soil has occurred.

Kolonia Landfill: The landfill has a stockpile of 14 used transformer units, most still containing oil and a history of transformer disposal at the site.

LABORATORY CHEMICALS

Pohnpei Hospital: The hospital medical store currently has an $18m^3$ stockpile of expired chemicals. Much of these were unwanted drugs donated under foreign aid projects.

PICS Chemistry Laboratory: The laboratory has 600 kg of various laboratory chemicals which are no longer wanted. Most of the chemicals are labelled and the containers appear in good condition. (These chemicals were sorted and prepared for disposal in 1999).

WASTE OIL

Over 56,000L of waste oil was recorded on Pohnpei. Waste oil is produced by a number of key activities including the power station, vehicle maintenance depot and US Civil Action Team. The Kolonia power station burns all its waste oil in a small onsite incinerator. The station proposes to extend this service to the local industries. Waste oil is also segregated and stockpiled at the Kolonia landfill. There are no immediate plans for the disposal of this oil

USED BATTERIES

Kolonia Landfill: The landfill has over 400 used car and truck batteries stockpiled at the site. There is currently no alternate disposal option proposed for these items.

CONTAMINATED SITES

DDT Burial Site: It is reported that 2 tonne of DDT was buried in Kolonia in the late 70s at the site of the former Pohnpei hospital. The site has since developed into a residential area with groundwater wells and coastal waters within 200m.

Former Power Plant: The site operated from 1960 to the mid 80s and is now used as a gas cylinder warehouse. Recent earthworks reported significant stained soil and strong hydrocarbon odours.

Former CCA Treatment Plant: The site was privately owned and operated from 1990 to 1996. On closure, the chemicals were reportedly evaporated and the dip bay filled with cement. The site is now used as a maintenance yard and does not display evidence of significant contamination.

Vehicle Maintenance Depot: The depot displays evidence of widespread hydrocarbon contamination, including visible oil slicks in the adjacent creek. Much of the contamination is attributable to poor housekeeping practices.

Asphalt Plants: Pohnpei has 3 operating asphalt plants, all of which exhibit significant soil contamination. Contamination of surface water flows from the sites was also observed.

Former Japanese Communications Building: The building contains a significant amount of unknown agricultural chemical dusts and residues. The site has almost unrestricted access and is frequented by tourists.

6.3 CURRENT WASTE MANAGEMENT

Most domestic, industrial and hazardous wastes around Kolonia are disposed at the Kolonia landfill. The landfill is a government owned but privately operated facility, run by Waste Management Services Inc (WMS). The site has been significantly upgraded over the last 18 months, with provision of surface water control, weekly cover and staged rehabilitation. The site is fully manned and potentially hazardous wastes are segregated from the general waste stream. WMS has stockpiled 4500L of waste oil, 400 car batteries and 14 transformers onsite and is seeking alternative disposal options for these items. While significant improvements in landfill management have been made, the location of the site in a tidal mangrove zone is likely to have serious adverse environmental impacts.

Domestic waste from outlying villages is typically disposed at small local landfills. The sites are not managed and are often located in mangrove areas.

Infectious medical waste is burnt in an open 200 litre drum at the Kolonia landfill and the ashes disposed onsite. However, expired chemicals are often disposed to landfill without pre-treatment (e.g. burning).

The FSM Nation Quarantine Division has recently upgraded its facilities with new incinerator units in each state.

7. YAP

7.1 SITE INSPECTIONS

A survey of Yap was conducted by Ms Terrie Burns from 6 to 12 July, 1998. The survey was conducted with EPA's Pesticide Control Officer, Mr Abdom Martem.

The following government agencies, sites and industries were visited during the audit program:

Government Agencies	Chemical stockpiles and contaminated sites	Other
• State Supply Division • Dept of Agriculture • Quarantine Division • Department of Transportation • Public Works Division • Department of Marine Resources • Department of Health • Board of Education • Yap State Public Service Corporation	• Yap Landfill • Yap Power Station • Public Works Depot • Agriculture Research Centre • Supply Warehouse • Education Storeroom • Former US Coastguard Bulk Fuel Storage • Asphalt contamination at former airport	• Mobil Bulk Fuel Plant • Micronesia Petroleum Company Bulk Fuel Plant Agriculture Research Center • Waab Transportation Company • Waab Hardware • Public Bus Company • Yap High School • Black Micro Construction Company

7.2 SURVEY FINDINGS

The following provides a summary of the unwanted chemical stockpiles and contaminated sites identified on Yap.

AGRICULTURAL CHEMICALS

Agriculture Research Station: Approximately 900 kg of unwanted pesticides were repackaged under the 1994 WHO program. The chemicals are stored in open 44 gal drums in a locked shed at the Agriculture Research Station. 1300 kg of unwanted fertilisers are also stored in the shed.

POTENTIAL PCB OIL

Yap Power Station: 75 out of service transformers were identified at the power station, many still containing oil. It is estimated that up to 12,000L of used oil may be present. Additionally, 10 to 12 old transformers are reportedly present on the outer islands of Wollei and Ulithi.

LABORATORY CHEMICALS

Board of Education Storeroom: Approximately 100 kg of unwanted laboratory chemicals are being stored in boxes in a locked storeroom. The chemicals were removed from the outer islands high school. Many of the containers are not labelled and appear in poor condition.

State Supply Warehouse: The warehouse has a number of unused and unwanted chemicals including; 12,000L of liquid sulphate and 550L of film developer and fixer. Most of the chemical containers are sound and labelled.

Waab Warehouse: The warehouse has a number of unused and unwanted chemicals including; 4200L of granular caustic soda and 400L of acetone. The chemical containers are sound and are clearly labelled.

WASTE OIL

Yap Power Station: The power station disposes waste oil from the station and many local industries in an onsite earth pit. The oil is periodically burnt. It is estimated that up to 20 m^3 of waste oil may be present in the pit at any time.

CONTAMINATED SITES

Yap Power Station: The onsite disposal of waste oil has resulted in significant contamination both onsite and offsite. It is estimated that up to 400m^3 of soil have been heavily contaminated.

Former Airport: Approximately 230 x 200 litre drums of unwanted bitumen are stockpiled at the old airport site. Most of the drums have rusted and leaked bitumen onto the surrounding soil.

Former US Coastguard Bulk Fuel Storage: The site formerly housed 8 x 30,000L aboveground diesel fuel tanks. Micronesia Petroleum Co recently removed the tanks for use in their bulk fuel plant, and emptied the tank bottom sludges onto the surrounding soils. It is estimated that 10 m^3 of soil has been heavily contaminated.

Mobil Bulk Fuel Plant: The fuel plant is located on the site of the old Yap power station. Recent excavation works during the installation of the current plant discovered a floating hydrocarbon layer on the water table. The free product was pumped out but no additional remediation or validation work was undertaken.

7.3 CURRENT WASTE MANAGEMENT

Most domestic, industrial and hazardous wastes are disposed at the Yap landfill. The landfill is a government owned and operated facility. The site is manned part-time and waste is periodically compacted and pushed into the adjacent creek gully. Waste oil from the adjacent power plant has contaminated part of the site. Domestic waste from outlying villages is typically disposed at small local landfills. The sites are not managed and are often located in mangrove areas.

There is no formal waste collection programme and limited options for the disposal of potentially hazardous material.

Infectious medical waste is burnt in an old incinerator located at the hospital and the ashes disposed at the landfill. Some expired chemicals may be disposed to landfill without pre-treatment (e.g. burning).

The FSM National Quarantine Division has recently upgraded its facilities with new incinerator units in each state.

8. ENVIRONMENTAL LAW REVIEW

The following review focuses on National and State Legislation which may assist with the management of hazardous materials, including the import, transport, storage, use and disposal of toxic chemicals.

8.1 NATIONAL GOVERNMENT

The Federated States of Micronesia (FSM) is made up of four highly autonomous states, each with their own government and legislation system, with an overarching national system. The fundamental law of FSM is contained in its constitution of 1979, which contains aspects of both Western and traditional governing structures. The constitution provides a prohibition on the testing, storing, using or disposing of radioactive or toxic chemicals within FSM, without the express approval of the National Government.

Responsibility for environmental protection, nature conservation, biodiversity, tourism, sanitation and cultural resources is split between several national Departments, including: the Office of Administrative Services; the Office of Planning and Statistics; the Department of Resources and Development; the Department of Human Resources and the Department of External Affairs. With few linkages between Departments, and limited funding available to start new Divisions, a coherent National Government response to environmental issues has not been established.

Previous investigations have identified the need for clarification of conflicting jurisdictional claims between the National and State Governments, in 15 separate areas of environmental law. Centralisation of environmental powers to a single Department or independent Agency was also strongly recommended.

There are currently no formally enforced national strategies for solid waste or hazardous waste management. The former Trust Territory Regulations for Solid Waste Management and Pesticides are still in effect but are rarely called on.

The *FSM Environmental Protection Act (EPA*), provides for the protection and enhancement of the environmental quality of the air, land and water of FSM. The FSM EPA is administered by the Department of Human Resources and is the primary legal instrument for the prevention of ‘pollution’ in FSM. Enforcement is often difficult due to resistance to Government control over private land by traditional landowners.

The FSM *Earthmoving Regulations*, require all persons, including Government bodies, who engage in earthmoving activities anywhere in FSM, to obtain a permit from the National Government. This allows for permit conditions, including environmental protection measures, to be placed on all development projects. However, very few permits are processed, particularly from the States.

The National *Environmental Impact Assessment (EIA) Regulation*, requires that the National Government and its Agencies submit an Environmental Impact Statement (EIS) prior to undertaking any major action which may affect the quality of the human environment. All foreign investment permits must also consider potential environmental impacts. There have been several constitutional debates over the imposition of National EIA Regulations and Standards on projects within the States. This issue has yet to be resolved. It has also been recommended that private projects should be subject to the EIA Regulation.

8.2 CHUUK STATE GOVERNMENT

The Chuuk constitution was enacted in 1989 and states that the Legislature shall provide by law, for the development and enforcement of standards of environmental quality and for the establishment of an independent State agency with responsibility for environmental matters. The National Earthmoving Regulations have been enacted in Chuuk, but not the EIA Regulations. It is reported that there is limited enforcement of permit conditions and many projects proceed without a permit.

Chuuk is divided up into thirty-nine municipalities. The powers and functions of a municipality with respect to its local affairs are superior to statutory law, and there is a need for a clear definition of their functions.

The Chuuk State government has established an Environmental Protection Agency which is responsible for the administration of the Environmental Protection Act, including chemical and pollution control, although several other Departments are responsible for some elements. For example, the Transportation Division controls some aspects of water pollution, such as fuel or oil leaks from boats and dumping within the harbour. In the absence of State laws, it is the opinion of the State Attorney General that FSM's National pollution laws may be applied.

The State Constitution expressly provides for the Government to make laws for the development and enforcement of environmental standards, and for the establishment of an independent agency to administer them.

8.3 KOSRAE STATE GOVERNMENT

The Kosrae State Constitution states that 'a person has a right to a healthful, clean and stable environment', and requires the State Government to protect Kosrae's environment, ecology and natural resources. It also reinforces the National initiative that 'no hazardous wastes or other hazardous substances may be disposed within the State except as expressly authorised by State law'.

Kosrae's environmental legislation is administered by the Development Review Commission (DRC) an independent agency comprising a Commission Board, a Technical Advisory Committee (TAC) and a Program Office. DRC Board members are appointed by the Legislature, from delegates nominated by the Governor. The Board appoints the Administrator of the Program Office. TAC members are drawn from various Public Service Departments, as appointed by the Governor. The Program Office is responsible for drafting environmental regulations and policies and for enforcement. The Board has the final decision on all environmental issues, acting on advice from the TAC. TAC also develops license conditions for projects requiring environmental permits.

Kosrae also has four municipalities which are responsible for local issues, and provide input into projects within their areas.

The DRC has established a *Regulation for Development Projects*. This Regulation is intended to integrate the EIA process with all proposed development works, and provides a mechanism for the imposition of environmental conditions. A Development Review Permit is also required for development projects involving the use, handling or disposal of toxic or hazardous chemicals. There are no provisions for the control of hazardous materials outside the limited definition of a development project.

More specifically, Kosrae currently has no regulations regarding the import, management or disposal of hazardous materials. Despite the assertion of the Constitution, it does not empower any Government Agency to prevent the disposal of hazardous materials, or to take action against individuals or companies who do so. The misdemeanour of 'littering' could be applied, but it specifically excludes the consensual contamination of public or private land. The Use of Public Sewers Regulations, prohibit the discharge of certain pollutants into public sewers.

A general provision to prevent environmental harm is urgently required. Several sections of the Kosrae State Code allow for the DRC to establish the necessary regulations.

8.4 POHNPEI STATE GOVERNMENT

The Constitution of Pohnpei was enacted in 1984 and states that 'the Government of Pohnpei shall establish and faithfully execute comprehensive plans for the conservation of natural resources and the protection of the environment'. The constitution also provides for strict control of hazardous materials and harmful substances.

Pohnpei has eleven local governments, each with their own constitutions and autonomy over many issues.

The State of Pohnpei formally enforced the *Trust Territory Environmental Quality Protection Act* and its supporting Regulations. The controversy over the use of superseded legislation prompted the drafting of the *Environmental Protection Act (EPA)*, which came into effect in late 1992. The Act established an EPA Board, Agency and Advisory Council. The Board members are appointed by the Governor with the approval of the Legislature, and are responsible for Policy and direction within the unit. The Agency is responsible for the administration of the Act, including environmental and sanitation aspects. The Advisory Council has not been adopted. The State EPA also revamped and promulgated the former Trust Territory Regulations including those for Pesticides, Solid Waste, Marine and Fresh Water Quality, Earthmoving and Environmental Impact Assessment.

The EPA requires the submission of an EIS for all private and public projects which may impact on the environment. The Act enables the development and enforcement of environmental standards. Some specific quantitative guidelines have been developed including those for water quality and restricted pesticides. There are currently no guidelines to identify contaminated land. The EPA also includes powers for pollution prevention and a permit system for controlled discharges of pollutants. There are situations where the regulations are unable to be met, (for example ‘proper disposal of pesticides’), due to a lack of resources and facilities within Pohnpei.

8.5 YAP STATE GOVERNMENT

The constitution of Yap places emphasis on the conservation of traditional heritage and treatment of the environment.

Draft Regulations for the control of earthmoving and sedimentation have been developed and permits will be required for all such activities.

Yap’s *Environmental Quality Protection Act* provides for compulsory environmental impact studies for all development projects. Supporting EIA Regulations for pesticide use and earthmoving are being developed but have yet to be promulgated. The Act is administered by the State EPA, with technical input from various government offices and an independent legal advisory counsel.

Some difficulties have been experienced over issues of State and national jurisdiction, as it has resulted in two regulatory and permitting systems with similar legislative instruments. A single, cohesive approach to environmental management is required.

8.6 INTERNATIONAL CONVENTIONS

The following international environmental conventions have been ratified by FSM

- International Plant Protection Convention. 1951
- Treaty on the Prohibition of the Emplacement of Nuclear Weapons and Other Weapons of Mass Destruction on the Seabed and Ocean Floor and in the Subsoil thereof. 1971
- Convention on the Prohibition of Military or any other Hostile Use of Environmental Modification Techniques. 1977
- United Nations Convention on the Law of the Sea. 1982
- Agreement relating to the Conduct of a Joint Program of Marine Geoscientific Research and Mineral Resource Studies of the South Pacific Region. 1982
- Vienna Convention for the Protection of the Ozone Layer. 1985
- Convention for the Protection of the Natural Resources and Environment of the South Pacific Region and Related Protocols (SPREP Convention). 1986
- Convention for the Prohibition of Fishing with Long Driftnets in the South Pacific. 1989
- United Nations Framework Convention on Climate Change. 1992
- Convention on Biological Diversity. 1992
- United Nations Convention to Combat Desertification in those Countries Experiencing Serious Drought. 1994
- Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal. 1989
- Waigani Convention to Ban the Importation into Forum Island Countries of Hazardous and Radioactive Wastes and to Control the Transboundary Movement and Management of Hazardous Wastes within the South Pacific Region

COUNTRY REPORT
A.3 FIJI

1. OVERVIEW

The South Pacific Regional Environment Programme (SPREP) and AusAID have designed and implemented a programme aimed at improving the management of chemicals in the South Pacific region. The programme is being undertaken in 3 Stages as follows:

Stage 1: Preliminary chemical survey and conduct of training in basic chemical handling and disposal procedures.

Stage 2: Repacking of unwanted chemicals as necessary and provision of appropriate temporary storage facilities

Stage 3: Clean-up of contaminated sites and disposal of chemical stockpiles.

The focus of the Stage 1 survey was to identify and quantify the volume of unwanted Persistent Organic Pollutants (POPs) and associated environmental contamination in 13 Pacific Island Countries. POPs typically include chemicals such as pesticides, organic solvents and polychlorinated biphenyls (PCBs). The scope was subsequently expanded to include other potential contaminants such as waste oil, timber treatment chemicals and laboratory chemicals. This report provides the findings of the survey of waste chemicals and site contamination in Fiji.

The survey was carried out in April and May, 1998. The team comprised:

Dr. Ian Wallis:	SPREP consultant
Moti Lal Autar:	Ministry of Agriculture, Forests and Fisheries
Ms. Hitexa Maysuria:	Department of Environment
William Peter:	University of the South Pacific

2. MAJOR FINDINGS

The table below provides a summary of the total volume of unwanted chemicals identified during the 1998 POPs survey of Fiji.

	Estimated Quantity
Agricultural chemicals	21,210 kg
Other obsolete chemicals	75 kg
Oil potentially contaminated with PCBs	Nil
Laboratory chemicals	> 800 L
Waste oil	> 8,000 L/year
Contaminated sites	19 potential sites

The chemical quantities given in this report are necessarily conservative estimates. For example, in the case of PCBs, the value quoted is based on tests carried out on a representative number of transformers. Similarly, the quantities quoted for pesticides are based on mainly visual assessment of the individual stockpiles. More specific details will need to be obtained prior to any clean-up and disposal operations.

The most significant stockpiles of waste chemicals and contaminated sites found in Fiji include:

AGRICULTURAL CHEMICALS

- Stockpiles of waste pesticides totalling approximately 19 tonnes were identified at research stations of the Ministry of Agriculture, Forests and Fisheries at Lakena, Lomaivuna, Navua, Korokadi, Dreketi, Sigatoka and Legalega; plus the Agchem chemical plant in Suva.

OTHER OBSOLETE CHEMICALS

- A total of approximately 75 kg of old hydrogen cyanide canisters.

LABORATORY CHEMICALS

- More than 800 L of surplus laboratory chemicals.

WASTE OIL

- More than 8,000 L/year of waste oils in outlying areas.

CONTAMINATED SITES

- Two tonnes of buried pesticides at the former site of the Lakena research station. The land has since been sold and has been developed for housing;
- Up to two tonnes of buried pesticides at the Dreneki research station;
- Site contamination at the Lomaivuna research station;
- Oil contamination at the Fiji Fire Authority depot, and the Lautoka power station;
- CCA site contamination at Fiji Forest Industries; and
- Poorly managed landfills in Nausori, Lautoka and Lami.

In addition, management of CCA wastes at the Tropic Wood Industries sawmill at Lautoka although superficially good, is reported to by the Fiji Department of Environment to be deficient in that leachate has contaminated the nearby creek.

3. RECOMMENDATIONS

To upgrade chemical management capacity, dispose of waste chemicals and remediate sites contaminated with chemicals in Fiji it is recommended that:

- Waste pesticides identified in the inspections at the Ministry of Agriculture, Forests and Fisheries Lakena, Navua, Korokadi and Dreketi research stations be included in the regional programme under development by SPREP to dispose of hazardous materials in off-island treatment facilities;
- Other waste chemicals identified in the inspections be disposed of in the regional programme for less hazardous chemicals under development by SPREP. Disposal is to be as recommended in the main body of this report and the attached database summaries;
- The research stations at Lakena, Lomaivuna, Navua, Korokadi and Dreketi be included in the regional programme under development by SPREP to remediate sites contaminated by pesticides;
- The present owner of the block of land adjacent to the Lakena research station be advised immediately that pesticides are buried on this land. An urgent assessment for contamination must also be undertaken at this site;
- The Agchem chemical plant in Suva be instructed to dispose of waste isoprocarb (ETRO);
- Fiji be included in a regional programme to be developed by SPREP to assess the extent of contamination that has resulted from inadequate management of solid waste disposal sites;
- Fiji be included in the NZODA/SPREP regional programme to develop and implement national hazardous waste management strategies;
- Fiji be included in the international chemical management programmes of UNEP, WHO and FAO including those of the Intergovernmental Programme for Chemical Safety;
- Fiji participate in current negotiations for a legally binding instrument for certain persistent organic pollutants;
- Fiji consider ratification of the Basel Convention;
- Fiji be included in a regional programme under development by SPREP for the environmentally appropriate management of waste oil;
- Fiji be included in a regional programme to be developed by SPREP for the remediation of oil and diesel contaminated sites. The Fiji Fire Authority site at Walu Bay in Suva should be used as a landfarming demonstration site;
- Fiji be included in a regional programme to be developed by WHO to upgrade management of medical wastes and chemicals;
- Fiji be included in a regional programme to be developed by SPREP to upgrade management of laboratory chemicals at schools and other workplaces; and
- A National Chemicals Profile be compiled for Fiji.

4. OBSOLETE CHEMICAL WASTES

The main stockpiles of obsolete chemical wastes were found to be associated with former agricultural research stations. Pesticides, herbicides and other chemicals had been brought to Fiji for these projects but not completely used. In many cases, the projects had been discontinued some years ago, and the chemicals remained in storage awaiting some new use, or disposal. As the chemicals were typically 10 years old, deterioration of the active ingredient must be expected.

The sites and stockpiles which were investigated during this project are described below.

LAKENA RESEARCH STATION

The Lakena Research Station had over 9 tonnes of obsolete chemicals in storage. Most of the pesticides had been purchased about 10 years ago for a rice growing project, which was no longer in operation. The storage shed was locked and generally in good condition, but some of the chemicals were not labelled (e.g. Sevin powder was in unlabelled polyethylene bags) and the containers of other chemicals had failed (e.g. Dicidex 1 litre containers had split) causing leaks and spills.

About three years ago, about 2 tonnes of surplus pesticides from this research station were buried on government land 0.5 km south of the station. This land has now been subdivided and sold for residential use. The pesticides are now buried in the yard of a house. The suggested site examination and rectification programme is presented later in this report under the discussion of contaminated sites.

LOMAIVUNA RESEARCH STATION

The Lomaivuna Research Station had over 2 tonnes of obsolete chemicals in storage. The storage shed was in poor condition, as the door was missing and weeds were growing through the walls. Drums and packages of chemicals had been disturbed and tipped over. Not all drums had labels and it was apparent that some of the stored chemicals had been repackaged into new drums.

There are residences within 100 m of this store. Hence as an immediate short-term measure, it is recommended that a security door and a warning notice be installed. These chemicals should be moved to a more secure store as soon as it can be arranged.

NAVUA RESEARCH STATION

The Navua Research Station had only 225 kg of obsolete chemicals in storage. The storage shed was in good condition. The research station is well away from residences but is in a flood plain, and therefore is not a suitable area for long term storage of obsolete chemicals. All stored chemicals were labelled.
The Dicidex containers were failing.

AGCHEM CHEMICAL PLANT

The Agchem chemical plant at Suva had approximately 3 tonnes of ETRO (Isoprocarb) in storage. This product had been formulated locally but the particle size was too large for effective dispersal, and hence the product was not commercially saleable. Small quantities are being used as a herbicide by a local golf course. The storage area was a roofed and bunded area at the back of the formulation shed. The disposal of this material is considered to be the responsibility of the owner.

MINISTRY OF HEALTH VECTOR CONTROL UNIT

The Ministry of Health has about 100 cyanide canisters in storage (Vector Control Yard, Suva). These canisters were formerly used for fumigation of ship holds.
The Chief Health Officer advised that the canisters were in poor condition and potentially dangerous.

KOROKADI RESEARCH STATION

The Korokadi Research Station (on Vanua Levu) had 2.9 tonnes of obsolete chemicals in storage, most of which is Dicidex. The storage shed was in good condition. The research station is separated from residences and is a suitable area for long term storage of obsolete chemicals. All stored chemicals were labelled.
The Dicidex containers were failing.

DREKETI RESEARCH STATION

The Dreketi Research Station (on Vanua Levu) had 1.3 tonnes of obsolete chemicals in storage, most of which is Dicidex. The storage shed was in good condition. The research station is separated from residences and is a suitable area for long term storage of obsolete chemicals. All stored chemicals were labelled.
The Dicidex containers were failing.

About three years ago, about 1 to 2 tonnes of surplus pesticides from this research station were buried within the research station, on land adjacent to the chemical store.

SIGATOKA RESEARCH STATION

The Sigatoka Research Station (on Viti Levu) had four separate chemical stores - each containing a number of known and unknown chemicals in small quantities.
The chemicals are stored in two adjacent sheds and result from the fruit, vegetable, cereal and rice growing programmes. The materials were in reasonably good condition, although some of the containers were failing. Not all the containers were labelled, and some of the labels were in Arabic or other foreign languages.
The research station is separated from residences and is a suitable area for long term storage of obsolete chemicals. The total quantity of chemicals at Sigatoka is 103 kg.

LEGALEGA RESEARCH STATION

The Legalega Research Station (near Nadi) had 176 kg of obsolete chemicals in storage, all in small quantities. The storage shed was in good condition. All stored chemicals were labelled. This store also had a small quantity of old fertiliser which had consolidated into solid blocks.

5. TIMBER INDUSTRY WASTES

There are 12 operating timber treatment plants in Fiji and a small number (3 or 4) of plants which have closed. Most of the plants were inspected to obtain an indication of the current disposal methods for CCA sludge and the likelihood of contamination of the site due to sludge or treatment chemicals. The observations are summarised below.

Timber Treatment Plant	Location	Observations
Mana Forest Products	Suva	
Best Industries	Lautoka	
South Seas Timber	Suva	
Fiji Forest Industries	Malau	Large onsite dumping pit
Nur Ahmed Sawmill	Navua	
Valebasoga Tropikboard	Labasa	Small, little waste produced
Fenning Pacific	Lautoka	
Waiqele Sawmill	Labasa	Small, little waste
Dayal Sawmillers	Lautoka	
Tropik Wood Industries	Lautoka	Leachate contamination of creek reported
Southern Forest Products	Nabukavesi	
Vunimoli Sawmill	Labasa	
G P Reddy Lumber	Lautoka	

Performance ranged from good to poor. At most sites wastes were generally being handled well, but it was not possible to ascertain without soil tests whether CCA contamination of the sites had occurred.

It is recommended that the Forest (Preservative Treatment) Specifications issued by the Ministry of Forests be expanded to describe appropriate methods for disposal of timber treatment sludges. A draft of the new text for the Specification was prepared by the SPREP consultant and provided to the Ministry for Agriculture Forests and Fisheries.

6. SURPLUS LABORATORY CHEMICALS

Most laboratories in Fiji have obsolete chemicals for which there is no satisfactory disposal route.
All laboratories which were contacted reported having stored chemicals which were surplus to requirements, including the laboratories at the University of the South Pacific (USP), the Public Works Department, hospital, geology, agriculture and major colleges and secondary schools. Based on inspections of these laboratories, there is estimated to be over 800 litres of surplus and waste laboratory chemicals in Fiji.

7. WASTE HYDROCARBONS

A study of waste oil carried out by the South Pacific Forum Secretariat concluded that Fiji is currently the only Pacific island country with a programme to collect and dispose of waste oil. The waste oil is used as an energy source in the Fletcher Challenge steel mill in Suva. It is anticipated that it will be possible to extend the waste oil collection programme to smaller sources of waste oil in Fiji (garages and bus maintenance depots) and to major sources of waste oil in neighbouring countries (Tonga, Vanuatu and Solomon Islands).

Only in the outlying areas, including Viti Levu, were significant stockpiles of waste oil seen. However, most small garages, and domestic repairs of cars and trucks, produce waste oil which is not recycled. The quantity of waste oil which is not recycled at present is estimated to exceed 8,000 litres per year.

During the period of this study there was a major spill of waste oil into Walu Bay which was suspected as having leaked from the Fletcher Challenge steel mill. The controversy surrounding this event precluded any site investigations and discussions with the steel mill about their waste oil programme.

8. POLYCHLORINATED BI-PHENYLS (PCBS)

Both the Fiji Electricity Authority and the Pacific Forum advised that there are no PCBs in electricity transformers in Fiji. Transformer oil is cleaned and recycled in Fiji using filtration equipment supplied by Waterford holdings of New Zealand. The manager of Waterford Holdings (Mr David Rutherford) advised that all recycled oil was tested prior to filtration and no PCB’s had been detected in Fiji.

Later testing using Dexsil Chlor-n-Oil test kits by William Peter confirmed the absence of PCBs.

9. LANDFILLS (MUNICIPAL WASTE DUMPS)

The landfills at the major urban centres of Suva (Lami), Nausori and Lautoka were assessed during this study. Chemical wastes (e.g.: malathion, liquid sludges) are known to have been dumped in the Lami landfill, and all industrial wastes were permitted access. Similarly industrial solid and liquid wastes had easy access to the

Nausori and Lautoka landfills. The Lami and Lautoka landfills have involved placing fill on tidal mudflats while the Nausori landfill is on the banks of the Rewa River. All are unsatisfactory from an environmental and waste management perspective.

The Suva City Council has selected a new site for a properly managed sanitary landfill at Naboro about 15 km west of Suva. This site has a clay soil and seems to be a considerable improvement on the Lami site. Detailed plans for the development of the new landfill are being prepared. It is recommended that consideration be given to including secure cells for the storage of hazardous wastes in the new landfill.

10. CONTAMINATED SITES

This study established that there is no register or planning procedure to record or manage contaminated sites. As discussed above, the three municipal landfills would be considered to be contaminated sites, as would be several major industrial sites, most vehicle maintenance depots, the FEA transformer maintenance depot at Lautoka, the tailings dam of the gold mine and the agricultural research stations with buried wastes.

The site of greatest concern identified in this study was the residence with buried agricultural wastes near Lakena. It is recommended that an inter-departmental committee be established to manage this site, and that the present residence should not be used.

11. FIJI WASTE INVENTORY

The main stockpiles of obsolete chemical wastes in Fiji were found to be associated with former agricultural research projects. The total quantity of waste agricultural chemicals is 21.2 tonnes, of which the largest single chemical is Dicidex (5.6 t). The Dicidex containers were mostly in poor condition and the chemicals are not considered to be of any further use in Fiji.

12. RE-USE OPTIONS

The supplier of all the Dicidex to Fiji was ICI Chemicals of Auckland, New Zealand. However, this company no longer exists. The successor company is Cropcare of Australasia, who were contacted to establish if it would be possible to reuse or reformulate the Dicidex in another pesticide product. Cropcare advised that Dicidex was replaced by other more effective and biodegradable pesticides about 10 years ago, and the product in Fiji has no known commercial application. No reuse applications could be found for Sevin or Propanil, the other two chemicals stored in Fiji in significant quantities.

13. LEGISLATION

Comprehensive environmental legislation has been prepared for Fiji but has not been enacted. Hence the Department of Environment has no authority to control wastes or to achieve more effective management of chemicals and chemical wastes in Fiji.

The legislative framework is exceptionally fragmented. Fourteen Ministries, bodies or agencies administer some 27 pieces of environmental legislation as shown below. The essential problems relating to environmental legislation are three-fold. Firstly, there is no single body responsible for the administration of the current existing environmental law and which can influence Government at policy making level. This has resulted in the lack of a uniform policy and a shortage of information and awareness at high levels. Secondly, this lack of a single body of environmental law has resulted in inadequate enforcement of current standards and a lack of trained staff to do so. This is true both in individual Ministries and in areas which fall between Ministries. Thirdly, the existing environmental laws need modification in at least nine areas. These are: the land tenure system, planning and assessment, agriculture, minerals, fisheries, water quality, waste management and pollution and the establishment of protected areas.

LAND AND RESOURCE USE LEGISLATION

- Mining Act 1966
- Forest Act 1953
- Town Planning Act 1946
- Native Land Trust 1940
- Land Development Act 1961
- Land Conservation and Improvement Act 1953
- Agricultural Landlord and Tenant Act 1966

CONSERVATION AND QUARANTINE

- Birds and Game Protection Act 1923
- National Trust for Fiji Act 1970
- Treatment of Object of Archaeological and Palaeontologist interest Act 1978
- Plant Quarantine Act 1982
- Noxious Weeds, Pests and Disease of Plants Act 1964
- Animal Importation Act 1970

MARINE AND POLLUTION / CONSERVATION

- Marine Species Act 1977
- Fisheries Act 1941
- Fisheries Regulations 1965
- Continental Shelf Act 1970
- Ports Authority of Fiji Regulations 1990

WATER POLLUTION

- River and Streams Act 1982
- Irrigation Act 1973
- Drainage Act 1961
- Water Supply Act 1955
- Mining Regulations

POLLUTION GENERALLY

- Pesticides Act 1971
- Traffic Regulations 1974
- Public Health Act 1955
- Penal Code 1945
- Litter Decree 1991

INTERNATIONAL CONVENTIONS TO WHICH FIJI IS SIGNATORY:

- International Plant Protection Agreement 1956
- Convention on the Continental Shelf 1970
- Convention on the High Seas 1970
- Convention on Fishing and Conservation of the Living Resources of the High Seas 1971
- Plant Protection Agreement for South East Asia 1971
- Treaty Banning Nuclear Weapons Tests in the Atmosphere, Outer Space and Underwater 1972
- Treaty on the Non-proliferation of Nuclear Weapons 1972
- International Convention for the Prevention of Pollution of the Sea by Oil 1972
- Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological and Toxic Weapons and their Destruction 1973
- International Atomic Energy Agency 1973
- International Convention Relating to an Intervention of the High Seas in Cases of Oil Pollution Casualties 1975
- International Convention on Civil Liability for Oil Pollution Damage 1975
- South Pacific Forum Fisheries Agency Convention 1979
- United Nations Convention on the Law of the Sea 1982
- International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage 1983
- South Pacific Nuclear Free Zone Treaty and Protocol 1985
- Vienna Convention and Montreal Protocol on Substances that Deplete the Ozone Layer 1989
- Convention on the Conservation of Nature in the South Pacific (Apia Convention) 1989
- Convention for the Protection of Natural Resources and Environment of the South Pacific Region and their Related Protocols - (SPREP Convention) 1986
- Convention Concerning the Protection of the World Cultural and Natural Heritage - (World Heritage Convention) 1990
- United Nations Framework Convention on Climate Change 1992
- Convention on Biological Diversity 1992
- Wellington Convention on Driftnet Fishing 1994
- Waigani Convention to Ban the Importation into Forum Island Countries of Hazardous and Radioactive Wastes and to Control the Transboundary Movement and Management of Hazardous Wastes within the South Pacific Region 1996
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) 1997

14. LABORATORY FACILITIES

There are no laboratories in Fiji which routinely analyse pesticides or contamination of soil by metals or organic contaminants. The agriculture laboratory has the capability of soil analyses but has very limited resources. The PWD laboratory has the capability to analyse metals in water.

USP has equipment and trained academic and technical staff to carry out metal analyses. They currently have a number of projects that study trace metals in biological samples, dust and water. The USP laboratory has carried out analyses of trace levels of pesticides in soil and water in the past as part of specific contracts or research projects, but the specialist laboratory personnel are no longer resident in Fiji. However, one of the staff has recently received training in pesticide analysis and work has recommenced in this area. USP has applied for funding from the Global Environment Facility (GEF) which will allow it to develop a full range of POPs analyses.

COUNTRY REPORT
A.4 KIRIBATI

1. OVERVIEW

The South Pacific Regional Environment Programme (SPREP) and AusAID have designed and implemented a programme aimed at improving the management of chemicals in the South Pacific region. The programme is being undertaken in 3 Stages as follows:

Stage 1: Preliminary chemical survey and conduct of training in basic chemical handling and disposal procedures.

Stage 2: Repacking of unwanted chemicals as necessary and provision of appropriate temporary storage facilities

Stage 3: Clean-up of contaminated sites and disposal of chemical stockpiles.

The focus of the Stage 1 survey was to identify and quantify the volume of unwanted Persistent Organic Pollutants (POPs) and associated environmental contamination in 13 Pacific Island Countries. POPs typically include chemicals such as pesticides, organic solvents and polychlorinated biphenyls (PCBs). The scope was subsequently expanded to include other potential contaminants such as waste oil, CCA treatment chemicals and laboratory chemicals. This report provides a summary of the POPs survey undertaken in Kiribati.

Surveys of Tarawa and Christmas Islands, Kiribati were conducted by Ms. Terrie Burns on March 30 to April 10 1998, and July 22 to 29 1998, respectively. Local counterpart Mr. Taulehia Pulefou (Environment Unit Officer) provided invaluable assistance during the audits and inspected Nanouti Island by himself. Confirmation of information received for anton Island is ongoing.

2. MAJOR FINDINGS

The table below provides a summary of the total volume of unwanted chemicals identified during the 1998 POPs survey of Kiribati.

	Estimated Quantity
Agricultural chemicals	700 kg[1]
Oil potentially contaminated with PCBs	5,500 L
Laboratory chemicals	2,270 kg
CCA sludge	1000 L
Waste bitumen	200,000 L
Waste oil	7,000 L
Contaminated sites	6 sites

[1] Additional quantities of pesticide are stored on Kanton Island.

The chemical quantities given in this report are necessarily conservative estimates. For example, in the case of PCBs, the value quoted is based on tests carried out on a representative number of transformers. Similarly, the quantities quoted for pesticides are based on mainly visual assessment of the individual stockpiles. More specific details will need to be obtained prior to any clean-up and disposal operations.

The most significant stockpiles of waste chemicals and contaminated sites found in Kiribati include:

- A total of about 200 tonnes of bitumen stored in 200 litre drums in deteriorated condition;
- A total of about 7 tonnes of waste oil;
- 1000 kg of CCA sludge at the animal health unit at Tanea, South Tarawa;
- 2000 kg of unwanted drugs at the animal health unit at Tanea, South Tarawa;

- A total of approximately 13 tonnes of waste fertilisers at Bikenibue, South Tarawa and Christmas Island;
- 200 litres of waste zinc phosphide at Bikenibue, South Tarawa; and
- Waste oil and bitumen contaminated sites at Bonriki airport, and the Betio and Bikenibue power stations, South Tarawa.

3. RECOMMENDATIONS

To dispose of waste chemicals, remediate chemicals contaminated sites and upgrade chemicals management capacity in Kiribati it is recommended that:

- Kiribati be included in a regional programme to be developed by SPREP for the removal of PCB contaminated transformer oil;
- Kiribati be included in a regional programme to be developed by SPREP for the remediation of bitumen contaminated sites;
- Kiribati be included in a regional programme to be developed by SPREP for the remediation of oil and diesel contaminated sites. Remediation of both the oil contaminated soil by landfarming and the oil contaminated groundwater lens at the Betio power station should be used as demonstration sites under this programme;
- Waste chemicals identified in the inspections at the Tanea animal health unit and the Bikenibue handicraft centre, South Tarawa be included in the regional programme under development by SPREP to dispose of hazardous materials in off-island treatment facilities;
- Other waste chemicals identified in the inspections be disposed of in the regional programme for less hazardous chemicals under development by SPREP. Disposal is to be as recommended in the main body of this report and the attached database summaries;
- Waste fertilisers should be used in landfarming of oil-contaminated soil at the Betio power station and South Tarawa vehicle maintenance unit. Surplus fertilisers should be given to a local user;
- Kiribati be included in the NZODA/SPREP regional programme to develop and implement national hazardous waste management strategies;
- Kiribati be included in the international chemical management programmes of UNEP, WHO and FAO including those of the Intergovernmental Programme for Chemical Safety;
- Kiribati participate in current negotiations for a legally binding instrument for certain persistent organic pollutants;
- Kiribati consider ratification of the Basel and Waigani Conventions;
- Kiribati be included in a regional programme under development by SPREP for the environmentally appropriate management of waste oil;
- Kiribati be included in a regional programme to be developed by WHO to upgrade management of medical wastes and chemicals;
- Kiribati be included in a regional programme to be developed by SPREP to upgrade management of school laboratory chemicals; and
- Kiribati be included in a regional programme to be developed by SPREP to assess the extent of contamination that has resulted from inadequate management of solid waste disposal sites.

4. SITE INSPECTIONS

The following government agencies, sites and industries were visited during the audit programme:

5. SURVEY FINDINGS

The following provides a summary of the unwanted chemical stockpiles and contaminated sites identified on Kiribati.

AGRICULTURAL CHEMICALS

Agriculture Storage Shed, Tarawa: Approximately 12,000 kg of unwanted fertilisers and a small volume (<100L) of mixed pesticides. Most of the fertiliser bags appear in good condition and could be reused. Many of the pesticide containers were leaking and some were not labelled.

Former Agriculture Station, Tarawa: The site is currently used as a handicraft centre with high public access. Three drums of unwanted chemicals are stored on the site including a 44 gal drum of zinc phosphide and 2 x 44 gal drums of unknown liquids.

Agriculture Station, Christmas Is: The site has 1300 kg of unwanted fertilisers. The bags appear in poor condition and are likely to disintegrate when handled.

Kanton Island: The island reportedly has a stockpile of unwanted agricultural chemicals (including Sevin and Malathion) stored in an open shed. Further information regarding this site is pending.

CCA TREATMENT CHEMICALS

Animal Health Storage Shed: Approximately 1000 L of dried CCA sludge is stored in open plastic buckets in the shed.

Outer Islands: A mobile CCA timber treatment plant was operated on the islands of Abemema, Aranuka and Nanouti during the mid 80s. Assessment of the sites for residual CCA chemicals is pending.

OIL POTENTIALLY CONTAMINATED WITH PCBS

Tarawa has 56 in service transformers, many over 30 years old. There were no out of service units on the

Government Agencies	Chemical stockpiles and contaminated sites	Other
• Ministry of Environment • Department of Health • Agroforestry Division • Animal Health Unit • Department of Lands • Department of Agriculture • Public Vehicle Unit • Public Works Division • Power and Utilities Authority • Plant Protection Division • Linnex Development Officers • Fisheries Division	• Animal Health Storage Shed • Bonriki Airport • Amak Women's Unit • Agriculture Storage Shed • Former Agriculture Station • Betio Power Station • Tarawa Hospital • Vehicle Maintenance Depot (Betio) • Bikenibue Power Station • Teaoraereke Landfill • Bikenibue Landfill • Betio Landfill • Bitumen Disposal Sites (Banana) • Former US Defence Force Camp (Main Camp) • Former Bulk Fuel Storage Site (London) • Public Vehicle Unit (London) • Public Works (London) • Banana Power Station • Poland Power Station	• AusAID Tarawa Office Manager • Office of the People • Tarawa Teachers College • Integral Energy • AusAID Water and Sanitation Project Manager • Kiribati Oil Bulk Fuel plant (London) • Christmas Island High School • Mr John Briden (long time resident) • Mr Tonga Fou (long time resident) • B'hai Community

island. Given the age of the units, it is estimated that up to 5,500 L of oil may contain PCBs.

One out of service transformer was identified on Christmas Island at the London power station.

LABORATORY CHEMICALS

Animal Health Storage Shed: Approximately 2000 kg of mixed veterinary and human expired medicines.

Amak Women's Unit: 55 kg of unwanted caustic soda. The containers are badly deteriorated.

Tarawa Teachers College: 150 kg of unwanted photographic chemicals. Most appear to be expired stock.

Tarawa Hospital: 65 L of expired photographic chemicals.

WASTE OIL

Waste oil is periodically removed from Tarawa by Kiribati Oil for recycling in Fiji. At the time of the audit, approximately 7000L of waste oil was stockpiled in 200 litre drums at the Betio Power Station. There is no formal waste oil collection system.

There are no disposal outlets for waste oil on Christmas Island and it is understood that most oil is disposed on the ground. Some waste oil is reused for rust protection and general lubrication.

WASTE BITUMEN

Bonriki Airport: Approximately 100,000L of unwanted bitumen was abandoned by a Chinese contracting company at the end of the runway construction project. The drums are located at two sites at the eastern end of the runway. Much of the material has leaked contaminating the reef, private property and local drinking water aquifer. The drums are badly deteriorated and likely to disintegrate on contact.

Banana: Approximately 100,000L of waste bitumen is stored in 44 gal drums at various sites around Banana (Christmas Is). Much of the material has leaked, contaminating the surrounding soil (~200m^3 at each site). There are also unconfirmed reports of local hydrocarbon groundwater contamination. It is estimated that over 50,000 empty 44 gallon drums have been disposed in the area. The Linnex Public Works Division proposes to reuse the waste bitumen in construction projects.

CONTAMINATED SITES

Bonriki Airport: Waste bitumen drums have leaked contaminating approximately 1300 m^2 of the surrounding soil and reef. Groundwater is located from 1m below surface and displays strong hydrocarbon odours. Some of the contamination has spread to private property.

Betio Power Station: Onsite oil disposal has resulted in severe contamination of approximately 800m^3 of soil. A floating hydrocarbon layer was observed on the local groundwater table, at 3m below surface.

Public Vehicle Unit Depot: The depot is located adjacent the Betio Power Station and has been subject to migration of hydrocarbons. Approximately 200m^3 of soil have become contaminated.

Bikenibue Power Station: The station has experienced a number of oil leaks and spills, contaminating approx. 300m^3 of soil. The site is located on the sand dunes, with groundwater from 2m below surface.

Former British Bulk Fuel Depot, London: 15 x 1,000,000 L fuel tanks are located on the site. During the site operations, the tanks reportedly leaked contaminating the local groundwater. Strong hydrocarbon odours are evident in the groundwater from 1m below surface.

Waste Bitumen Disposal, Banana: Approximately 600 m^2 of soil has been contaminated with bitumen at each disposal site. It is estimated that a dozen such sites may exist.

6. CURRENT WASTE MANAGEMENT

Domestic, industrial and medical waste generated on Tarawa is disposed to one of several Council operated landfills. Council collects domestic waste twice weekly on average. The landfills are typically located on the island foreshore, with many doubling as land reclamation projects. Rock walls are sometimes used to provide a degree of containment for the waste. Disposal sites are not manned and the waste is not regularly covered or compacted. The landfill at Teaoraereke was used to dispose of 60,000 household batteries collected during a battery drive.

Green waste is typically disposed in earth pits at each household to create a compost mix for crops. Collection of aluminium cans for off- island recycling was trialed, but was deemed to be unprofitable.

Infectious medical waste is burnt in a 200 litre drum at the hospital and the ashes disposed to landfill. The hospital has two waste incinerators, neither of which was operating at the time of the survey.

There is no formal waste collection system on Christmas Island. Waste is disposed at a number of small aboveground landfills, located at each village.

7. ENVIRONMENTAL LAW REVIEW

The power to enforce environmental protection measures in Kiribati does not rest in a single piece of legislation. Rather it is shared over a number of Acts and Ordinances dealing with local government powers, land tenure, air pollution, water supply, agriculture, marine protection and conservation.

While there is nothing in the Kiribati Constitution which guarantees the citizens a clean environment, or requires that development should be ecologically sustainable, there are also no substantial impediments to the Government seeking to achieve these objectives through legislation.

The responsibility for the administration of environmental matters is concentrated within the Environmental Unit in the Ministry for Environment and Social Development. The Ministry is responsible for establishing environmental policies and standards for better management to be implemented through the Environment Unit.

The Town Councils, of which there are three on Tarawa, also play a role in overseeing environmental matters within their sectors. Concern has been expressed that there may not be adequate supervision by the Government over the effective exercise of these responsibilities.

Much of the existing legislation has provisions that will allow the enforcement of environmental protection measures. For example, under the Land Planning Ordinance (1993), developers are required to obtain a permit from the Local Planning Board. The permit application could be amended to include a requirement for the preparation of an environmental impact statement. Similarly, under the Closed Districts Act (1990), areas of land or seabed, could be set-aside for environmental conservation purposes.

There appears to be some uncertainty with regard to the allocation of responsibility in the area of water supply and sewage. There are a number of authorities with related functions, but no adequate provision for co-ordination. Under the Public Utilities Ordinance (1977), no duty is placed to ensure provision of an adequate water supply, or conservation of water. However, the President, acting with the advice of Cabinet, has a very broad power to make regulations to prevent the pollution of any water.

The most significant omissions in Kiribati environmental legislation are in the areas of solid waste and hazardous waste management. This is being addressed through the development of Solid Waste Management Regulations, which are still in draft format. The Regulations cover requirements for storage and collection, designate lines of responsibility, establish a waste permit system, outline license conditions for the operation and management of disposal facilities and include a limited discussion of hazardous waste disposal.

The development of legislation to monitor and regulate the import of pesticides, including requirements for storage, handling and disposal, would also assist in the protection of the Kiribati environment.

It is apparent that the obstacles to Government pursuing a vigorous approach in the field of environmental regulation are political and customary, rather than constitutional. While statutory powers exist to help promote environmental protection, most are not explicit and those which are, rarely enforced.

COUNTRY REPORT
A.5 MARSHALL ISLANDS

1. OVERVIEW

The South Pacific Regional Environment Programme (SPREP) and AusAID have designed and implemented a programme aimed at improving the management of chemicals in the South Pacific region. The programme is being undertaken in 3 Stages as follows:

Stage 1: Preliminary chemical survey and conduct of training in basic chemical handling and disposal procedures.

Stage 2: Repacking of unwanted chemicals as necessary and provision of appropriate temporary storage facilities

Stage 3: Clean-up of contaminated sites and disposal of chemical stockpiles.

The focus of the Stage 1 survey was to identify and quantify the volume of unwanted Persistent Organic Pollutants (POPs) and associated environmental contamination in 13 Pacific Island Countries. POPs typically include chemicals such as pesticides, organic solvents and polychlorinated biphenyls (PCBs). The scope was subsequently expanded to include other potential contaminants such as waste oil, CCA treatment chemicals and laboratory chemicals. This report provides a summary of the POPs survey undertaken in the Marshall Islands.

Site inspections were carried out by Dr. Bruce Graham during a visit to the Marshall Islands from 17th to 23rd July. The main contact point was Mr. Jorelic Tibon, General Manager, Marshall Islands Environmental Protection Authority.

All inspections were undertaken at Majuro Atoll.

2. MAJOR FINDINGS

The table below provides a summary of the total volume of unwanted chemicals identified during the 1998 POPs survey of the Marshall Island.

	Estimated Quantity
Agricultural chemicals	60 kg
Oil potentially contaminated with PCBs	800 L
Waste bitumen	20,000 L
Waste oil	800 L plus
Contaminated sites	4 sites

The chemical quantities given in this report are necessarily conservative estimates. For example, in the case of PCBs, the value quoted is based on tests carried out on a representative number of transformers. Similarly, the quantities quoted for pesticides are based on mainly visual assessment of the individual stockpiles. More specific details will need to be obtained prior to any clean-up and disposal operations.

The most significant stockpiles of waste chemicals and contaminated sites found in the Marshall Islands include:

- A total of approximately 20 tonnes of bitumen stored in 200 litre drums in deteriorated condition;
- A finding of only one electricity transformer suspected to contain PCBs. The USEPA undertook a programme to remove PCBs from Republic of the Marshall Islands in 1994 and it appears that this is the only suspect transformer remaining;
- A finding of only minor quantities of unwanted pesticides;
- Site contamination by oil at the Majuro Dry Dock.

3. RECOMMENDATIONS

To dispose of waste chemicals, remediate chemicals contaminated sites and upgrade chemicals management capacity in the Marshall Islands it is recommended that:

- The Marshall Islands be included in a regional programme to be developed by SPREP for the removal of PCB contaminated transformer oil;
- The Marshall Islands be included in a regional programme to be developed by SPREP for the remediation of bitumen contaminated sites;
- The Marshall Islands be included in a regional programme to be developed by SPREP for the remediation of oil and diesel contaminated sites;
- The Marshall Islands be included in the NZODA/ SPREP regional programme to develop and implement national hazardous waste management strategies;
- The Marshall Islands be included in the international chemical management programmes of UNEP, WHO and FAO including those of the Intergovernmental Programme for Chemical Safety;
- The Marshall Islands participate in current negotiations for a legally binding instrument for certain persistent organic pollutants;
- A National Chemicals Profile be compiled for the Marshall Islands;
- The Marshall Islands consider ratification of the Basel and Waigani Conventions;
- The Marshall Islands be included in a regional programme under development by SPREP for the environmentally appropriate management of waste oil;
- The Marshall Islands be included in a regional programme to be developed by WHO to upgrade management of medical wastes and chemicals;
- The Marshall Islands be included in a regional programme to be developed by SPREP to assess the extent of contamination that has resulted from inadequate management of solid waste disposal sites; and
- Waste chemicals identified in the inspections are disposed of in the regional programme for less hazardous chemicals under development by SPREP. Disposal is to be as recommended in the main body of this report and the attached database summaries.

4. WASTE STOCKPILES AND CONTAMINATED SITES

The following matters were identified as part of this project:

MAJURO POWER STATION (MARSHALLS ENERGY CO.)

Waste oil is currently mixed with fuel oil, cleaned and burned in the power plant. This will not be possible with the planned new station and they are looking at installing an incinerator that could be used for waste oil generally.

Waste oil is a problem at power stations on 3 other atolls (Kwajalein, Jaluit, and Enewetak).

MARSHALLS ENERGY CO.

All PCB transformers (all atolls) were identified by US EPA 3 years ago and moved then to a central location. The oil was drained and shipped to San Francisco for disposal. Empty transformers were buried in a concrete bunker that forms the foundations of a building near the Dry Dock.

One large PCB transformer is still in service. Other transformers (non-PCBs) are taken away by a scrap dealer every 2/3 years.

DEPARTMENT OF PUBLIC WORKS

There is minor evidence of oil dumping around the vehicle workshops. A dumpsite alongside this building is one of the main disposal sites for old machinery.

DEPARTMENT OF AGRICULTURE

Approximately 60kg of assorted pesticides are held at the Arno Farm.

Quarantine wastes are burnt on open ground.

MINISTRY OF HEALTH SERVICES / HOSPITAL

No laboratory chemicals for disposal (pre-packaged reagents are mainly used).

Medical wastes and pharmaceuticals are currently burned in a 200 litre drum at the rear of the buildings, because the incinerator is unserviceable.

A replacement incinerator is planned for next fiscal year.

HISTORIC PRESERVATION OFFICE

No chemical stockpiles were noted in archaeological surveys of main Japanese bases and the main storage bunkers are empty.

The US Army is searching for and disposing of old munitions.

MOBIL BULK OIL DEPOT AND AIRPORT TERMINAL

Clean and tidy site with sludges and spillages stored in drums until taken away for “other” uses (e.g. fire training).

Will require advice from EPA soon on sludge disposal following tank cleaning.

2 drums of sludges, etc are held on site awaiting disposal advice.

DRY DOCK

There is visible oil dumping in front of the workshops.

ISLAND DRY CLEANERS

Perchloroethylene residues and sludges are being collected for disposal. This will be required about once every 2-3 years, but they need to contact equipment suppliers for disposal arrangements (i.e. ship to US).

PACIFIC INTERNATIONAL INC.

Waste oil is stored and taken away for burning at the power station. They have also used open burning in 200 litre drums and have a small oil burner on site. There is minor evidence of oil contamination in the rear yard – probably due to leaks and spillages.

AIR MARSHALL ISLANDS

4 drums of waste oil are stored on open land at the airport.

KWAJALEIN ATOLL

Approximately 100 drums (very old) of bitumen are stored on this atoll. These were leftover from past road and runway construction activities.

OTHER VISITS WITH NO SIGNIFICANT PROBLEMS

- Office of Procurement and Supply
- Copra Processing Authority
- Marshall Islands Pest Control
- Marshall Islands Journal
- Chinese garment factory (Laura)
- Chinese farm (Laura) – they use about 2.5 kg pesticide per year.

5. WASTE MANAGEMENT INFRASTRUCTURE

Solid waste disposal on Majuro is currently done by landfill. The only controlled site is an area of reclaimed land on the ocean side of the island. Most of the site is separated from the sea by a low rock wall. The site is immediately alongside the main highway and clearly visible to passers by. Site management requires daily compaction and covering of the wastes, but this is not done on a regular basis. The government is considering a proposal to build a solid-waste incinerator on the island.

There is an active aluminium can recycling system on the island, although the level of compaction appears to be very low. This would have a significant adverse effect on the financial returns from the operation.

Waste oil from the Majuro power station is mixed with fuel oil and burned in the power plant. This will not be possible with the new station, which is currently under construction. The company is looking at installing an incinerator, which could be used for waste oil generally. Waste oil disposal is a problem at power stations on 3 other atolls.

Most of the sewage on Majuro is piped to a treatment plant. Septic tanks are used in non-reticulated parts of the island, and on most other atolls. The main supply of drinking water on Majuro is a large rainwater collection system at the airport.

The hospital incinerator on Majuro is unserviceable and needs to be replaced. Hospital wastes are currently burned in a 55-gal drum, and then disposed at the landfill. Quarantine wastes are disposed by burning on open ground.

6. ENVIRONMENTAL LAW REVIEW

The Republic of the Marshall Islands' (RMI) Constitution sets forth a democratic system of government that contains aspects of Commonwealth, US and traditional governing structures. The President is the Head of State, supported by 10 Cabinet Ministers.

The RMI has entered into a Compact of Free Association with the US. Title 1 of the Compact pledges 'to promote efforts to prevent or eliminate damage to the environment and biosphere and to enrich understanding of the natural resources of the Marshall Islands'. In addition, under the Compact the US is required to adhere to the standards enshrined in the US National Environmental Protection Act when conducting any activities in RMI. In return, RMI is required to develop and enforce comparable environmental standards for their own activities.

RMI has established a National Environmental Protection Authority (EPA), which is an independent authority legislatively, linked to the Ministry of Health Services and fully funded by the RMI government. The EPA Board of Directors governs broad policy directions. The EPA is charged with a wide range of environmental tasks under the National Environmental Protection Act (1984) including:

- the study of the impact of human activities on natural resources;
- the prevention of degradation or impairment of the environment;
- the regulation of individual and collective human activity in such a manner as to ensure to the people safe, healthful, productive and aesthetically and culturally pleasing surroundings; and
- the treatment of important historical, cultural and natural aspects of the nation's culture and heritage, maintaining at the same time an environment which supports multiplicity and variety of individual choice.

Under the Act, the EPA has broad powers to regulate with respect to:

- primary and secondary drinking water;
- pollutants;
- pesticides and other harmful chemicals;
- hazardous waste, including the storage and disposal

of nuclear and radioactive waste;

- the treatment of important historical, cultural and natural aspects of the nation's heritage;
- other aspects of the environment which may be required.

Regulations passed or proposed under the Act include the following:

Solid Waste Regulations, 1989
(+ 1994 amendment)

Toilet Facilities and Sewage Disposal Regulations, 1990

Environmental Impact Assessment Regulations, 1994

Pollutant Discharge Elimination System Regulations (draft)

Pesticide Regulations (draft)

Adequate enforcement of environmental regulations is a pervasive problem in RMI. While the EPA's devolved powers are flexible and strong; they often face technical and financial difficulties.

An Environmental Impact Assessment (EIA) is required for any government project in which there is or may be an environmental impact. However, the wording is vague as to what type of proposals require an EIA and very few have reportedly been undertaken. The Environmental Protection Act also sets out some of the necessary content of an EIA, however the description is not considered sufficient and the degree of detail required is left open. There is also no distinction between the requirements for small and large-scale projects.

The Pesticide Regulations allow partial control over the use and licensing of pesticides in RMI. The proposed controls under the Pesticides Regulations are based around a listing of "Restricted" pesticides. Permits will be required by anyone wishing to purchase or use any of the pesticides on this list. The list is relatively short, and the only significant control on other pesticides is the need for importers to notify the RMIEPA prior to receipt of any shipments.

Pesticide importers are required to submit a 'notice of intent' before the arrival of any chemicals, and EPA officers are required to inspect and release incoming pesticide cargoes. In reality, there is minimal control over the import of pesticides. The EPA may ban the use of pesticides that are suspected to have an adverse environmental or health impact, but cannot ban the import of the material. Many of the imported pesticides do not contain written instructions in English or Marshallese. Consequently, many of the applicators have little knowledge regarding the toxicity or correct dosage of the chemicals they are using. The Regulations also offer little guidance on storage and disposal of chemicals.

The EP Act is the pre-eminent legal instrument for the control of pollution. Pollution is broadly defined as '*any direct or indirect alteration of the physical, thermal, chemical, biological, or radioactive properties of any part of the environment by the discharge, emission or deposit of wastes so as to affect any beneficial use adversely or to cause a condition which is hazardous or potentially hazardous to public health, safety or welfare, or to animals, bird, wildlife, aquatic life or to plants of every description'*. The Act provides for the issuance of cease and desist orders for the purpose of pollution control. The orders are implemented using a four tiered system involving notification, counselling and public hearings. The Act also provides for the forced cleanup of a polluted area by the polluter.

The control of waste management and pollution discharges in RMI is hampered by the widespread nature of the islands and the Marshallese strong cultural resistance to external controls being imposed on privately owned land.

RMI's Marine Water Quality Regulations prescribe standards for maintaining designated water quality and uses. The Regulations provide for a permitting system (the Pollutant Discharge Elimination System) for the discharge of any waste to marine waters. There are also requirements for the preparation of Spill Prevention Control and Countermeasure Plans for fuel and oil storage facilities.

The Solid Waste Regulations also cover hazardous wastes and have a number of general requirements regarding methods of disposal. The operators of any process likely to produce hazardous wastes are required to submit a waste management plan for prior approval by the RMIEPA. Waste generators are also required to adopt all practical measures to minimise waste quantities, including reuse and recycling. Methods for the disposal of waste oil must be approved by the RMIEPA.

The Ministry of Public Works is responsible for the collection and disposal of solid waste. The EPA is granted oversight authority for waste management and is responsible for the issuance of Solid Waste Disposal Facility permits and for monitoring public and private landfills. RMI's Solid Waste Regulations provide minimum standards for the design, construction, operation and maintenance of solid waste collection, storage and disposal systems. Over the past few years, financial difficulties have resulted in the landfills being poorly managed, with no leachate control and infrequent compaction or covering.

The legislation review reveals that a significant body of environmental law is in effect or in draft form in RMI. However, there are often competing environmental management responsibilities dispersed between various government agencies and embodied in widely varied legislative instruments. Staff training and public awareness programmes are needed to effectively enforce the existing regulations.

Internationally, the Marshall Islands government is not a signatory to the Basel Convention, and has yet to ratify the Waigani Convention.

COUNRTY REPORT
A.6 NAURU

1. OVERVIEW

The South Pacific Regional Environment Programme (SPREP) and AusAID have designed and implemented a programme aimed at improving the management of chemicals in the South Pacific region. The programme is being undertaken in 3 Stages as follows:

Stage 1: Preliminary chemical survey and conduct of training in basic chemical handling and disposal procedures.

Stage 2: Repacking of unwanted chemicals as necessary and provision of appropriate temporary storage facilities

Stage 3: Clean-up of contaminated sites and disposal of chemical stockpiles.

The focus of the Stage 1 survey was to identify and quantify the volume of unwanted Persistent Organic Pollutants (POPs) and associated environmental contamination in 13 Pacific Island Countries. POPs typically include chemicals such as pesticides, organic solvents and polychlorinated biphenyls (PCBs). The scope was subsequently expanded to include other potential contaminants such as waste oil, CCA treatment chemicals and laboratory chemicals. This report provides a summary of the POPs survey for Nauru.

Dr. Bruce Graham carried out the visit to Nauru in June 1998. The main contact point for the visit was Mr. Joseph Cain of the Nauru Department of Island Development and Industry (IDI).

2. MAJOR FINDINGS

The table below provides a summary of the total volume of unwanted chemicals identified during the 1998 POPs survey of Nauru.

	Estimated Quantity
Agricultural chemicals	100 kg
Oil potentially contaminated with PCBs	40,000 L
Laboratory chemicals	Nil
Waste oil	2,000 L
Contaminated sites	5 sites

The chemical quantities given in this report are necessarily conservative estimates. For example, in the case of PCBs, the value quoted is based on tests carried out on a representative number of transformers. Similarly, the quantities quoted for pesticides are based on mainly visual assessment of the individual stockpiles. More specific details will need to be obtained prior to any clean-up and disposal operations.

The most significant stockpiles of waste chemicals and contaminated sites found in Nauru include:

- A total of about 30 tonnes of bitumen stored in 200 litre drums in deteriorated condition;
- A total of over 100 disused electricity transformers suspected of containing PCBs;
- 1200 litres of fuel oil additive containing 2% sodium pentachlorophenol; and
- Significant contamination by oil and bitumen at several sites, including oil contamination of the water lens at several locations on the island.

3. RECOMMENDATIONS

There is no doubt that the waste management problems now experienced by Nauru are a direct result of the mining activities of the Nauru Phosphate Company and its predecessor, the British Phosphate Corporation. It is also understood that a large project has recently commenced to rehabilitate the island of Nauru from its present degraded state. It is imperative that the Government of Nauru recognise that the remediation of contaminated sites and the environmentally responsible disposal of wastes generated by mining activities must be included in the rehabilitation programme. It could therefore be argued that all wastes and all contaminated sites identified under the POPs in PICs project should become the responsibility of the rehabilitation project. It is therefore recommended that with the exception of waste oil disposal and PCB contaminated transformer oil disposal and other regional programmes which can be more appropriately managed by SPREP or WHO, all the waste management issues identified be included in the rehabilitation programme. It is therefore recommended that:

- Nauru be included in a regional programme to be developed by SPREP for the removal of PCB contaminated transformer oil;
- Nauru be included in the NZODA/SPREP regional programme to develop and implement national hazardous waste management strategies;
- Nauru be included in the international chemical management programmes of UNEP, WHO and FAO including those of the Intergovernmental Programme for Chemical Safety;
- Nauru participate in current negotiations for a legally binding instrument for certain persistent organic pollutants;
- A National Chemicals Profile be compiled for Nauru;
- Nauru consider ratification of the Basel and Waigani Conventions;
- Nauru be included in a regional programme under development by SPREP for the environmentally appropriate management of waste oil;
- Nauru be included in a regional programme to be developed by WHO to upgrade management of medical wastes and chemicals;
- Nauru be included in a regional programme to be developed by SPREP to assess the extent of contamination that has resulted from inadequate management of solid waste disposal sites.

4. WASTE STOCKPILES AND CONTAMINATED SITES

The following matters were identified as part of this project:

NAURU PHOSPHATE CORPORATION (NPC) POWER STATION AND DISTRIBUTION SYSTEM

Approximately 10 old transformers have been dumped on topside. The transformers should be moved to a single location, before they are irretrievably buried in bush. Initial testing with field kits of two transformers proved negative for PCBs. Any PCBs found will be removed as part of Phase II of this project.

NPC WORKSHOPS, TOPSIDE

About 160 drums (30,000 litres) of lubrication grease have been dumped at the rear of the site. The drums are very rusty and will be difficult to move. There has been some spillage around the area. More information is required on the composition of the grease before recommendations can be made as to disposal options.

About 10 rusty drums of waste oil are also stored here.

NPC WASTE DUMP, TOPSIDE

About 160 drums (30,000 litres) of bitumen are stored on site, left over from road and/or runway sealing. The drums are very rusty and will be difficult to move. Also there has been some spillage around the area.

There are also about 50 x 20 litre drums of old epoxy resins and paints. These should be relocated to the landfill site.

NPC DANGEROUS GOODS STORE, BOTTOMSIDE

There are a number of unwanted materials in this store including:

- 6 drums of fuel oil additive (contains 2% pentachlorophenol);
- 3 drums of polyelectrolyte boiler water additive;
- 6 small drums of anti-corrosive wax;
- 4 small drums of wax remover; and
- 10kg of white lead in oil.

NAURU GENERAL HOSPITAL LABORATORY

Dr. Graham has given instructions on the disposal of about 500g of sodium cyanide.

WASTE OIL, PUBLIC WORKS DEPOT

Oil/water separators on this site (and probably most others) need a major overhaul. IDI should develop standard specifications for these systems, plus instructions on their use. (SPREP to provide information).

MEDICAL WASTES

The current uncontrolled method of landfill disposal needs to be changed. The most basic system recommended by WHO involves controlled burial at a landfill, and it should be possible to adopt this approach here.

The special waste incinerator ($500,000) proposed in the NACRDFS report, is unnecessarily expensive and not warranted by the quantities of special wastes currently being produced.

GOVERNMENT STORES

There are about 2000 litres of various surplus adhesives, sealants and lubricating oils held in the store, many in rusty containers, which are starting to leak. Most can be disposed locally.

NPC, NO.2 BIN

Approximately 100 old transformers have been dumped in this store (capacity 5000 –10,000 litres). Preliminary testing with field kits revealed only one of eleven tested as containing PCBs. Some have been scavenged for parts, and the oil spilled on the ground. Access to the building should be restricted until testing of the remainder is undertaken and any necessary site remediation carried out.

NPC OIL STORAGE DEPOT

There is significant oil spillage throughout this site, with probable leaching onto the nearby reef.

NPC CADMIUM SLIMES DUMP, TOPSIDE

This site was used in the past for dumping processing residues from the now defunct calcination plant. The material has a high cadmium content (up to 500 ppm), although tests show that it is in a relatively immobile form. The disposal site is likely to be contaminated with cadmium, however the off-site risks should be very low because of the low mobility. Cadmium surveys around the island show elevated cadmium levels near the processing plant and loading gantries. This is most likely due to direct deposition of phosphate dust, rather than leaching from the slimes dump.

The issue of the cadmium slimes dump appears to have come in for a lot of attention in the past but has never been properly assessed. Most of the investigations have been directed at cadmium in the wider environment, especially shellfish and other marine organisms. Elevated cadmium levels have been found, but this is to be expected because soils on the island have elevated cadmium levels.

It does not appear that cadmium is leaching from the waste dump. In fact, some of the investigations showed that the cadmium could only be mobilised using strong acids. Even if mobilisation did occur, the leachate would be highly attenuated by the alkaline nature of the underlying strata.

Clearly there is a need for a detailed site assessment so that the size and extent of the dump can be established. The NACRDFS report recommends leaving the waste where it is and capping it with imported clays. However it would be preferable to excavate the material and dispose it in a clay-lined cell alongside the new landfill.

5. WASTE MANAGEMENT INFRASTRUCTURE

Most of the solid wastes generated on Nauru are disposed at a landfill on Topside, near the Buada Lagoon, although there is a significant amount of illegal dumping elsewhere. Burning is used to reduce waste volumes, and scavenging is common. The wastes are periodically compacted and covered with soil. A new landfill site on the north-eastern end of the island has been proposed as part of the Nauru rehabilitation programme.

Most sewage and other liquid wastes are disposed through an ocean outfall adjacent to the phosphate loading wharves. Septic tanks and small treatment plants are used in non-reticulated areas. Drinking water is provided to most of the island through a desalination plant. The limited groundwater supplies are brackish, but are reticulated to parts of the island, for use in toilets and other low grade uses.

An aluminium can recycling system is operated at the landfill, although there is significant evidence of dumping elsewhere. There is no collection system for other scrap metals, and the island is littered with old mining vehicles and equipment.

There is no collection system for waste oil and it appears that some of this may be disposed through the ocean outfall.

Hospital wastes are disposed by burning at the landfill.

6. LEGISLATION AND ADMINISTRATION

There is no specific environmental legislation in Nauru, with most of the key issues being covered under other topics such as health. A review of all relevant legislation has been proposed in the National Environmental Management Strategy (NEMS), and one unifying act will be considered as part of this review. There are no controls on the imports of hazardous chemicals although the need for this has also been noted in NEMS. The Police are currently the only agency with the authority to enforce any legislation.

The Government of Nauru is not a signatory to the Basel Convention, and has yet to ratify the Waigani Convention.

COUNTRY REPORT
A.7 NIUE

1. OVERVIEW

The South Pacific Regional Environment Programme (SPREP) and AusAID have designed and implemented a programme aimed at improving the management of chemicals in the South Pacific region. The programme is being undertaken in 3 Stages as follows:

Stage 1: Preliminary chemical survey and conduct of training in basic chemical handling and disposal procedures.

Stage 2: Repacking of unwanted chemicals as necessary and provision of appropriate temporary storage facilities

Stage 3: Clean-up of contaminated sites and disposal of chemical stockpiles.

The focus of the Stage 1 survey was to identify and quantify the volume of unwanted Persistent Organic Pollutants (POPs) and associated environmental contamination in 13 Pacific Island Countries. POPs typically include chemicals such as pesticides, organic solvents and polychlorinated biphenyls (PCBs). The scope was subsequently expanded to include other potential contaminants such as waste oil, CCA treatment chemicals and laboratory chemicals. This report provides a summary of the POPs survey for Niue.

The Nuie site inspections were carried out by Dr. Bruce Graham from 12th to 18th May. The main contact point for the visit was Mr. Sauni Tongatule, Director, Department of Agriculture, Forest and Fisheries (DAFF). DAFF employee, Ms. Crispina Fakanaiki also assisted with the work.

This report provides a summary of the POPs survey for Niue.

2. MAJOR FINDINGS

The table below provides a summary of the total volume of unwanted chemicals identified during the 1998 POPs survey of Niue.

	Estimated Quantity
Agricultural chemicals	1500 kg
Oil potentially contaminated with PCBs	1000 L
Waste bitumen	Nil
Waste oil	Nil
Contaminated sites	1 site

The chemical quantities given in this report are necessarily conservative estimates. For example, in the case of PCBs, the value quoted is based on tests carried out on a representative number of transformers. Similarly, the quantities quoted for pesticides are based on mainly visual assessment of the individual stockpiles. More specific details will need to be obtained prior to any clean-up and disposal operations.

The most significant stockpiles of waste chemicals and contaminated sites found in Niue include:

- A total of three disused electricity transformers suspected of containing PCBs;
- A total of 1.5 tonnes of waste pesticides including small quantities of ethoprophos and chlordane stored at two locations;
- A total of four tonnes of waste fertilisers stored at the Department of Agriculture research farm;
- A total of 300 kg of unwanted medicines stored at the hospital; and
- Minor contamination by oil at the Department of Public Works depot.

3. RECOMMENDATIONS

To dispose of waste chemicals, remediate chemicals contaminated sites and upgrade chemicals management capacity in Niue it is recommended that:

- Niue be included in a regional programme to be developed by SPREP for the removal of PCB contaminated transformer oil;
- Waste pesticides identified in the inspections at the Department of Agriculture research farm at Vaipapahi and storage shed at Alofi be included in the regional programme under development by SPREP to dispose of hazardous materials in off-island treatment facilities;
- Niue be included in the NZODA/SPREP regional programme to develop and implement national hazardous waste management strategies;
- Niue be included in the international chemical management programmes of UNEP, WHO and FAO including those of the Intergovernmental Programme for Chemical Safety;
- Niue participate in current negotiations for a legally binding instrument for certain persistent organic pollutants;
- A National Chemicals Profile be compiled for Niue;
- Niue consider ratification of the Basel and Waigani Conventions;
- Niue be included in a regional programme under development by SPREP for the environmentally appropriate management of waste oil;
- Niue be included in a regional programme to be developed by SPREP for the remediation of oil and diesel contaminated sites;
- Niue be included in a regional programme to be developed by WHO to upgrade management of medical wastes and chemicals;
- Niue be included in a regional programme to be developed by SPREP to assess the extent of contamination that has resulted from inadequate management of solid waste disposal sites.

4. WASTE STOCKPILES AND CONTAMINATED SITES

The following matters were identified as part of this project:

DEPARTMENT OF PUBLIC WORKS DEPOT, ALOFI

Approximately 1 tonne of old pesticides stored with all stocks sorted, and packed in drums or sacks.
The unknowns have been sampled for identification.
It is recommended that a new lock be installed on the door. All materials with the exception of Mancozeb should be taken offshore in Phase II of the project.

DEPARTMENT OF AGRICULTURE, FORESTS AND FISHERIES (DAFF) EXPERIMENTAL FARM, ALOFI

Approximately 0.5 tonnes of old pesticides are stored here and should be treated similarly to those at the Public Works Depot. Some are still usable, but most are in poor condition. Also 2.5 tonnes of old fertiliser and soil conditioners are also stored here and should be able to be used. Samples have been taken for identification of unknowns.

DEPARTMENT OF HEALTH, ALOFI

Six sacks of old medicines and chemicals are stored here. These should be removed offshore, although the medicines could be disposed in the hospital incinerator.

NUIE POWER STATION

This is a good clean site with minimal oil contamination. Waste oil is currently used for sports field marking and other low-grade uses.

There are approximately 80 transformers in use on the island, and some of these have been shown to contain PCBs.

DEPARTMENT OF PUBLIC WORKS, HEAVY PLANT DEPOT

Oil contamination was noted on this site, and was due to unauthorised dumping, and overflows from a storage tank and the workshop wastewater system. There is a need to clean out the oil/water separator, and prevent further overflows from the storage tank.

Old lead/acid batteries are also stored on site.

DAFF QUARANTINE

An old cylinder of methyl bromide (30 kg) is held at the old piggery site. Methyl bromide is a greenhouse gas and ozone depleting substance and therefore it is recommended that the cylinder be removed from Niue for disposal.

Old chemicals, syringes and medicines at the piggery need to be cleaned up and could be used, dumped or incinerated.

NIUE HIGH SCHOOL

Old laboratory chemicals were dumped some time ago at the local landfill.

NIUE TIMBER PRODUCTS

Only a very small amount of timber treatment is done at this site, and contamination control is good.

PESTICIDE RETAILERS

Very small current stock holdings, and no old stocks.

5. WASTE MANAGEMENT INFRASTRUCTURE

Niue has a good waste collection service, which includes aluminium can recycling. Most of the solid wastes are dumped at a site near Alofi, and there is no attempt at controlled landfilling. A new landfill site is currently being sought because the current site is near to capacity.

Most sewage and other liquid wastes are disposed through septic tanks. The sludges from these tanks are dumped at an isolated site near the airport. Drinking water is drawn from the freshwater lens beneath the island, and shows evidence of contamination by faecal coliforms.

Hospital and quarantine wastes are disposed by burning in simple incinerators.

6. LEGISLATION AND ADMINISTRATION

The Community Affairs Department is responsible for environmental matters, although the relevant regulations are spread through a range of sector-specific legislation. A new Environment Management Bill (1992) is still under consideration.

There is no specific legislation covering imports of hazardous chemicals in general, or the management of hazardous wastes.

National Environmental Legislation pertinent to waste management includes the following:

LAND ACT 1969

This Act contains a number of provisions relating to land law generally, but also includes provision for the establishment (with the consent of the landowners) of reservations for communal purposes, including places of historic interest, and fishing grounds.

MARINE POLLUTION ACT 1974

This Act, passed by the Parliament of New Zealand, is Niue law also. A number of regulations in force under the Act are also Niue law. These include:

- Oil in Navigable Waters (Exceptions) Regulations 1971
- Oil in Navigable Waters (Heavy Diesel Oil) Regulations 1971
- Oil in Navigable Waters (Prohibited Sea Areas) Regulations 1971
- Oil in Navigable Waters (Records, Transfer and Enforcement of Convention Order) Regulations 1971
- Oil in Navigable Waters (Ships Equipment) Regulations 1971

The combined effect of the Act and the Regulations provides for the prevention and management of pollution of the sea.

MINING ACT 1977

This Act vests all minerals in the Crown, and establishes a licensing procedure for the exploration for and mining of minerals of all kinds.

Although no mining operations are taking place at present, a number of exploratory bores have been drilled, and indications are that exploiting the minerals may at some future time become a commercially viable activity.

NIUE PUBLIC HEALTH ACT 1965

Although the principal provisions of the Act relate to health and disease, this Act also contains provisions prohibiting water pollution, and enables sources of water to be declared as water supply sources.

PESTICIDES ACT 1991

This enables the import of pesticides to be restricted, by requiring all imports to be approved by a Pesticides Committee, which includes representatives from the Departments of Health and Agriculture. The Act deals with the importation and sale of agricultural chemicals but does not regulate their use.

INTERNATIONAL CONVENTIONS

Niue is not a signatory to the Basel Convention, and has yet to ratify the Waigani Convention.

COUNTRY REPORT
A.8 PALAU

1. OVERVIEW

The South Pacific Regional Environment Programme (SPREP) and AusAID have designed and implemented a programme aimed at improving the management of chemicals in the South Pacific region. The programme is being undertaken in 3 Stages as follows:

Stage 1: Preliminary chemical survey and conduct of training in basic chemical handling and disposal procedures.

Stage 2: Repacking of unwanted chemicals as necessary and provision of appropriate temporary storage facilities

Stage 3: Clean-up of contaminated sites and disposal of chemical stockpiles.

The focus of the Stage 1 survey was to identify and quantify the volume of unwanted Persistent Organic Pollutants (POPs) and associated environmental contamination in 13 Pacific Island Countries. POPs typically include chemicals such as pesticides, organic solvents and polychlorinated biphenyls (PCBs).
The scope was subsequently expanded to include other potential contaminants such as waste oil, CCA treatment chemicals and laboratory chemicals.
This report provides a summary of the POPs survey undertaken in Palau.

A survey of Palau was conducted by Ms Terrie Burns on June 26 to July 15, 1998. Local counterparts from the Environmental Quality Protection Board, Mr Emil Edesomel (Pollution Control Officer) and Mr Joseph Tiobech (Pesticide Inspector) provided invaluable assistance during the audits.

2. MAJOR FINDINGS

The table below provides a summary of the total volume of unwanted chemicals identified during the 1998 POPs survey of Palau.

	Estimated Quantity
Agricultural chemicals	100 L
Oil potentially contaminated with PCBs	18,000 L
Laboratory chemicals	7,300 L
Asbestos	300 m^3
Paint/bitumen	5,200 L
Waste oil	10,000 L
Contaminated sites	2 sites

The chemical quantities given in this report are necessarily conservative estimates. For example, in the case of PCBs, the value quoted is based on tests carried out on a representative number of transformers. Similarly, the quantities quoted for pesticides are based on mainly visual assessment of the individual stockpiles. More specific details will need to be obtained prior to any clean-up and disposal operations.

The most significant stockpiles of waste chemicals and contaminated sites found in Palau include:

- A total of approximately 18 tonnes of potentially PCB contaminated transformer oil;
- A total of about 4 tonnes of bitumen stored in 200 litre drums in deteriorated condition;
- A total of about 10 tonnes of waste oil;
- A stockpile of approximately 1200 lead/acid batteries awaiting shipment off-island;
- A total of about 4 tonnes of unwanted hypochlorite;

- A total of about 2 tonnes of materials suspected to be medical drugs leftover during the Japanese occupation of Palau in World War II. These drugs are scattered over many sites on the island of Babeldoab;
- A total of about 1.2 tonnes of DDT partly buried at one site on Babeldoab;
- 300 m^3 of asbestos pipe stored at the Koror sewage plant storage shed;
- Oil contaminated sites at the Aimeliik and Ngadmau power stations;
- Sub-standard landfills in Ngerbeched, Peleliu and Anguar.

3. RECOMMENDATIONS

To dispose of waste chemicals, remediate chemicals contaminated sites and upgrade chemicals management capacity in Palau it is recommended that:

- Palau be included in a regional programme to be developed by SPREP for the removal of PCB contaminated transformer oil;
- Waste chemicals identified in the inspections be disposed of in the regional programme for less hazardous chemicals under development by SPREP. Disposal is to be as recommended in the main body of this report and the attached database summaries;
- The DDT burial site in Babeldoab be included in the regional programme under development by SPREP to remediate pesticide contaminated sites;
- The sites containing medicines left over from World War II on Babeldoab be included in the regional programme under development by SPREP to remediate miscellaneous contaminated sites;
- Palau be included in the NZODA/SPREP regional programme to develop and implement national hazardous waste management strategies;
- Palau be included in the international chemical management programmes of UNEP, WHO and FAO including those of the Intergovernmental Programme for Chemical Safety;
- Palau participate in current negotiations for a legally binding instrument for certain persistent organic pollutants;
- A National Chemicals Profile be compiled for Palau;
- Palau be included in a regional programme under development by SPREP for the environmentally appropriate management of waste oil;
- Palau be included in a regional programme to be developed by SPREP for the remediation of oil and diesel contaminated sites;
- Palau be included in a regional programme to be developed by WHO to upgrade management of medical wastes and chemicals;
- Palau be included in a regional programme to be developed by SPREP to upgrade management of school laboratory chemicals; and
- Palau be included in a regional programme to be developed by SPREP to assess the extent of contamination that has resulted from inadequate management of solid waste disposal sites.
- Palau consider ratifying the Basel and Waigani conventions.

4. SITE INSPECTIONS

The following government agencies, sites and industries were visited during the audit programme:

Government Agencies	Chemical stockpiles and contaminated sites	Other
• EQPB • Public Works Division • Environmental Health and Sanitation Division • Department of Commerce • Department of Transportation • Department of Agriculture • Entomology Division • Quarantine Division • Department of Health	• 9 Regional Power Stations • Public Utilities Storeroom • State Public Works Yard • National Public Works Yard • M-Dock • The Digger (dredge) • Palau Hospital • Koror STP • Koror Landfill • DDT Disposal Site • Medical Waste Disposal Site	• Socio Construction Company • Black Micro Construction • US Army Corps Engineers • Science Demonstration Laboratory • Mobil Bulk Fuel Plant • Shell Bulk Fuel Plant • Palau High School • Malakal Quarry • Environmental Attorney • Peleliu Island • Angaur Island

5. SURVEY FINDINGS

The following provides a summary of the unwanted chemical stockpiles and contaminated sites identified on Palau.

AGRICULTURAL CHEMICALS

Entomology Division: Small volume (<100 L) of mixed pesticides. Many of the containers were leaking and some were not labelled.

POTENTIALLY PCB CONTAMINATED TRANSFORMER OIL

Public Utilities Chemical storeroom: Approximately 18,000 L of used transformer oil is stored in old units and drums outside the storeroom. The oil reportedly tested negative for PCBs during the 1997 USEPA Program. Supporting documentation was not available at the time of the survey. There are no out-of-service transformers on the outer islands.

LABORATORY CHEMICALS

Public Utilities Chemical storeroom: 15 x 200 litre drums of new transformer oil are stored at the PUC storeroom. The oil cannot be used in Palau's current transformer system and is no longer wanted.

M-Dock: 4000 kg of granular hypochlorite has been abandoned at the dock. The material was slightly damaged during transit but is still usable.

Palau High School: 3 kg of unlabelled laboratory chemicals for disposal.

Palau Hospital Pharmacy: 300 kg of expired medicines.

Science Demonstration Lab: 200g of metallic mercury (from broken thermometers).

WASTE OIL

Waste oil generated from government related activities (e.g. regional power stations, public works depots) is transported to the Aimeliik power station for blending and reuse with the diesel fuel. Waste oil generated from other sources is typically disposed to landfill.

The Digger: The Digger is an old dredging ship currently moored in the harbour by the KB bridge. There is approximately 10,000L of waste oil in the ship's open cargo hold. The ship was being sold and preparing to leave Palau at the time of the survey.

ASBESTOS

Koror Sewage Treatment Plant: Approximately 300m^3 of unused asbestos pipe are located in a storeroom adjacent the STP. The pipes appear to be in sound condition.

BATTERIES

Koror Public Works Yard: Storage of over 1200 used car and truck batteries.

PAINT/TAR

The Digger: There are approximately 4,600 L of tar, grease and paint located on the ship deck in badly deteriorated containers.

Black Micro Construction: The company has ~600 L of expired paints and adhesives stored in a secure flammable goods shed on the site. Most of the material has hardened and can no longer be used.

CONTAMINATED SITES

DDT Disposal Site: In the early 1980s, 6 x 200 litre drums of liquid and powdered DDT were buried at a site in the mangroves in Ngatpang. Several drums are still identifiable at the site.

Medical Waste Disposal Sites: Several disposal sites have been located in the jungle at Ngatpang. The sites contain thousands of small vials of unknown liquid and powdered chemicals. The chemicals are believed to be old medical stock from the Japanese troops in WWII.

6. CURRENT WASTE MANAGEMENT

There is no formal waste collection system on Palau. Domestic and industrial waste is typically transported by the generators to the main landfill in Koror. The landfill is State owned and operated. The site is manned and the waste is periodically covered and compacted. The site has an in-ground disposal pit in which waste oil and other liquid wastes are periodically burnt. Segregation of other potentially hazardous materials is not conducted. The site is located in a tidal zone and was reportedly built on reclaimed reef flats.

Small aboveground landfills are also located at outlying villages. These are often located in a mangrove area. Waste on Peleliu Island is disposed into a creek gully. Waste on Anguar Island is disposed in an abandoned phosphate mining pit.

The hospital has a suitable incinerator for the disposal of infectious wastes. The ashes are disposed to landfill.

The power station at Aimeliik has some capacity to reuse waste oil. The site currently accepts 'clean' waste oil generated by government activities, (e.g. other power stations). The oil is stored in a 1 000 000 L tank and gradually fed with diesel fuel into the generators. The station cannot reuse all the waste oil generated on Palau. However, the storage tank is connected to the wharf and could be used as a transfer point to allow off- island recycling of waste oil.

7. ENVIRONMENTAL LAW REVIEW

The following review of environmental law focuses on legislation which may be used to help control hazardous waste management, including generation, tracking, storage and disposal. Palau has many additional pieces of environmental legislation such as the Endangered Species Act, Wildlife Protection Act etc that were not considered directly relevant to the current task.

Title 24 of Palau's Environmental Quality Protection Act establishes the tone for environmental policy in Palau as follows:

The Olbiil Era Kelulau (the Legislative Branch of the Palau National Congress), recognising the profound impact of human activity on the interrelations of all components of the natural environment, ...declares that it is the continuing policy of the national government...... to use all practicable means and measures.......to create and maintain conditions under which humankind and nature can co-exist in productive harmony...

The scope of Title 24 emphasises the interrelationship of economic growth and the protection of the environment, and ensures that these goals of sustainable development must be taken into account in the drawing up of Palau's environmental legislation.

Palau's Constitution is the supreme law and no law, act of government or agreement may conflict with the Constitution. Article II provides that 'any agreement or compact between Palau and another nation or international organisation which authorises the use, testing, storage or disposal of nuclear, toxic chemical, gas or biological weapons intended for use in warfare, shall require the approval of not less that three-fourths of the votes cast in a referendum'.

Palau has adopted a modified federal system of government in which responsibilities are shared by the national government and 16 states. The national government comprises a President and Vice President supported by a Cabinet of Ministers. The legislative power of Palau is vested in the Olbiil Era Kelulau that consists of the House of Delegates and the Senate. Each of the states has a Governor, a state government and a Constitution. All government powers not expressly delegated to the states and not denied the national government, are powers of the national government.

Under Palau's Compact of Free Association with the United States, both governments 'are bound by such environmental standards as may be mutually agreed for the purpose of carrying out the policies set forth in the Compact'.

Administration and responsibility for environmental issues is under the joint control of the Environmental Quality Protection Board (EQPB) and various government departments (e.g. sanitation lies with the Health Department). The EQPB currently oversees water pollution prevention, earthmoving permits, National Pollutant Discharge Elimination System permits, waste management programmes (including pesticides and hazardous waste), environmental assessment programmes and public education and training. One of EQPB's priorities is to promulgate regulations in areas where the USEPA currently has responsibility, and areas, which there are no existing regulations.

Solid waste management is controlled by two separate pieces of legislation, namely the Solid Waste Regulations administered by the EQPB, and the sanitation laws contained in the Public Health, Safety and Welfare legislation. The solid waste regulations set standards for the design, installation, operation and maintenance of solid waste collection, storage and disposal systems. Limited guidance on the storage and disposal of hazardous wastes is provided.

The use of pesticides is regulated by the EQPB. The regulations extend to the use, training and licensing of pesticide application, but not to storage and disposal. The EQPB may restrict or ban the use of any pesticides considered to have adverse effects on human health or the environment.

The Land Planning Act established a planning mechanism through the National Master Development Plan. The Master Plan incorporates components of environmental protection including:

- a process for establishing a nature reserve system,
- the conduct of environmental reviews of significant projects,
- legislation to mitigate adverse environmental impacts, and
- a conservation strategy.

The Environmental Quality Protection Act establishes the need and standards for the conduct of Environmental Impact Assessments. An EIA is required for any actions which propose to use national or state land, any land classified as a conservation zone, and any use which impacts on coastal waters, wetlands, mangroves, historic sites or any areas of environmental significance. The EIA is required to provide adequate alternatives and/or mitigation measures for any potential adverse impacts.

Palau's Marine and Fresh Water Quality Standards Regulations were adopted from the equivalent USEPA regulations and apply to all fresh and marine water bodies in Palau. The Regulations prescribe guidelines to maintain health and environmental standards and to control discharges into the nation's waters. A National Pollutant Discharge Elimination System has been implemented which requires any point source discharge to a water body, to be licensed, monitored and controlled.

The range of responsibilities for environmental law through the EQPB and the various Ministries is sufficiently broad and the legal powers incorporated in the existing range of legislation is considered adequate, however, the effective exercise of these powers and the enforcement of the law could be strengthened.

COUNTRY REPORT
A.9 SAMOA

1. OVERVIEW

The South Pacific Regional Environment Programme (SPREP) and AusAID have designed and implemented a programme aimed at improving the management of chemicals in the South Pacific region. The programme is being undertaken in 3 Stages as follows:

Stage 1: Preliminary chemical survey and conduct of training in basic chemical handling and disposal procedures.

Stage 2: Repacking of unwanted chemicals as necessary and provision of appropriate temporary storage facilities

Stage 3: Clean-up of contaminated sites and disposal of chemical stockpiles.

The focus of the Stage 1 survey was to identify and quantify the volume of unwanted Persistent Organic Pollutants (POPs) and associated environmental contamination in 13 Pacific Island Countries. POPs typically include chemicals such as pesticides, organic solvents and polychlorinated biphenyls (PCBs). The scope was subsequently expanded to include other potential contaminants such as waste oil, CCA treatment chemicals and laboratory chemicals. This report provides a summary of the POPs survey for Samoa.

The Samoa inspections were carried out by Dr. Bruce Graham from 30 May to 17 June. The main contact point for the visit was Mr. Lavaasa Malua, Senior Environmental Planning Officer, Division of Environment and Conservation, Department of Lands, Surveys and Environment.

2. MAJOR FINDINGS

The table below provides a summary of the total volume of unwanted chemicals identified during the 1998 POPs survey of Samoa.

	Estimated Quantity
Agricultural chemicals	200 kg
Buried agricultural chemicals	3,000 kg
Oil potentially contaminated with PCBs	9,000 L
Abandoned timber treatment chemicals	10,000 L
Laboratory chemicals	400 kg
Contaminated sites	8 sites

The chemical quantities given in this report are necessarily conservative estimates. For example, in the case of PCBs, the value quoted is based on tests carried out on a representative number of transformers. Similarly, the quantities quoted for pesticides are based on mainly visual assessment of the individual stockpiles. More specific details will need to be obtained prior to any clean-up and disposal operations.

The most significant stockpiles of waste chemicals and contaminated sites found in Samoa include the following:

AGRICULTURAL CHEMICALS

- Minor quantities only of stockpiled waste pesticides.
- A total of about 2.5 tonnes of waste pesticides buried at three separate locations at the Ministry of Agriculture, Forests, Fisheries and Meteorology Nu'u research farm.

POTENTIALLY PCB CONTAMINATED TRANSFORMER OIL

- A total of about 20 tonnes of potentially PCB contaminated transformer oil.

TIMBER TREATMENT CHEMICALS

- A tank containing about 10,000 litres of timber treatment chemicals at an abandoned timber treatment facility at Vaitele.
- CCA site contamination at the abandoned timber treatment facility in Vaitele and the operational timber treatment facility in Asau.

WASTE OIL

- Oil contaminated sites at the Electric Power Corporation maintenance depot in Vaitele, and two power stations at Savaii.

The chemical volumes detailed in this report are necessarily conservative estimates. For example, in the case of PCB oils, the value quoted is the total volume of used transformer oil identified. Subsequent to the findings of this report, chemical analysis of the transformer oil stockpiles is being undertaken, to determine the actual percentage of oil that contains PCBs. This and other revised data, will be incorporated in subsequent reports to help refine the survey estimates.

3. RECOMMENDATIONS

To dispose of waste chemicals, remediate chemicals contaminated sites and upgrade chemicals management capacity in Samoa it is recommended that:

- Waste CCA identified at the abandoned timber treatment facility in Vaitele be included in the regional programme under development by SPREP to dispose of hazardous materials in off-island treatment facilities;
- Other waste chemicals identified in the inspections be disposed of in the regional programme for less hazardous chemicals under development by SPREP. Disposal is to be as recommended in the main body of this report and the attached database summaries;
- The buried pesticides site at the Nu'u research farm be included in the regional programme under development by SPREP to remediate pesticide contaminated sites;
- The abandoned timber treatment facility in Vaitele be included in the regional programme under development by SPREP to remediate CCA contaminated sites. In the interest of public safety access to this site should be restricted immediately until such time as a comprehensive site evaluation be undertaken and any necessary remediation be undertaken. In particular the current industrial development at this site should be immediately curtailed;
- Samoa be included in the NZODA/SPREP regional programme to develop and implement national hazardous waste management strategies;
- Samoa be included in the international chemical management programmes of UNEP, WHO and FAO including those of the Intergovernmental Programme for Chemical Safety;
- Samoa participate in current negotiations for a legally binding instrument for certain persistent organic pollutants;
- A National Chemicals Profile be compiled for Samoa;
- Samoa be included in a regional programme under development by SPREP for the environmentally appropriate management of waste oil;
- Samoa be included in a regional programme to be developed by SPREP for the removal of PCBs contaminated transformer oil;
- Samoa be included in a regional programme to be developed by SPREP for the remediation of oil and diesel contaminated sites;
- Samoa be included in a regional programme to be developed by WHO to upgrade management of medical wastes and chemicals;
- Samoa be included in a regional programme to be developed by SPREP to upgrade management of school laboratory chemicals;
- Samoa be included in a regional programme to be developed by SPREP to assess the extent of contamination that has resulted from inadequate management of solid waste disposal sites.

4. WASTE STOCKPILES AND CONTAMINATED SITES

The following matters were identified as part of this project:

TIMBER TREATMENT SITE, VAITELE

This is an abandoned timber treatment site. The pressure tank and a 10,000 litre storage tank are still intact, and the tank is believed to be full of treatment chemicals. Site access is poorly controlled and there are anecdotal reports of domestic animals dying after foraging through the site.

TIMBER TREATMENT SITE, ASAU

This site is also abandoned, although it still forms part of an operational timber mill. The pressure tank is intact, but two large storage tanks have rusted through. There is visible evidence of CCA contamination on the ground.

MINISTRY OF AGRICULTURE, FORESTS, FISHERIES AND METEOROLOGY (MAFFM) NU'U

Approximately 2.5 tonnes of pesticides have been buried in at least 3 locations on this site. However, the site is reasonably remote from other activities, and there is no significant use of groundwater in the area. There is an additional 85 kg of old pesticide stocks held in the main store, awaiting disposal.

MAFFM FORESTRY OFFICES

A total of 190 kg of old pesticides are held at 3 sites on Savaii (Asau, 2, Mauta, 1). Most of the pesticides are usable, but unlikely to be used by the Ministry staff.

MAFFM STORE, VAITELE

Small quantities of old or damaged stocks of pesticides are re-packed at 3-monthly intervals, with packaging disposed by burning or burial outside the warehouse.

ELECTRIC POWER CORPORATION (EPC)

Staff had no knowledge of whether PCBs had been previously used in transformers, but this seems likely. Hydrocarbon oils are now used for reconditioning of old transformers, and the waste oil is used as a wood preservative on fencing posts, etc. About 50 old transformers are stored on Savaii, most with oil intact. Field testing of 50 transformers at the Vaitele maintenance depot on Upolu revealed 10 positive for PCBs with another 50 at both Vaitele and Savaii to be tested.

EPC POWER STATIONS

Cooling water contaminated with oil is being discharged to ground at all 3 power station sites (Savaii and Vavau), and waste oil is also disposed by dumping on site.

S C PERCIVAL LTD, APIA

300 litres of household insecticide is currently stored in rusty drums and needs to be either repackaged or disposed.

LABORATORIES

Stocks of old chemicals were found in most of the laboratories visited, including the following – Apia Hospital (100 kg), MAFFM Livestock Research Centre, Vailima (200 kg), and the Curriculum Development Unit, Department of Education (50 kg).

5. WASTE MANAGEMENT INFRASTRUCTURE

Solid wastes from Apia are disposed at the Tafiagata landfill. Some attempts have been made in developing this as a controlled landfill, but there are significant problems with scavenging and burning. The wastes are periodically compacted and covered with soil. There is no organised collection of solid wastes from other areas outside of Apia, and no designated disposal facilities.

Most sewage is disposed through septic tanks, soakage pits and latrines. This raises the possibility of contamination of drinking water, which is mainly drawn from groundwater supplies. In addition, there is evidence of faecal contamination of the coastal waters adjacent to urban areas such as Apia.

Hospital wastes are disposed by burial in a designated area of the landfill.

An oil recycling plant that was built some years ago is no longer operating.

6. LEGISLATION AND ADMINISTRATION

A significant body of environmental law is already in legal effect or in draft form in Samoa. Various Government Departments are mandated with administrative environmental responsibility. No single Samoa Government Department has final responsibility or authority for the full range of necessary initiatives.

To remedy this situation, the legislature passed the 1989 Land and Environment Act establishing a Division of Environment and Conservation within the Department of Lands, Surveys and Environment.

A number of existing pieces of legislation require some amendment in one form or another to take into consideration the environmental problems and concerns facing Samoa.

There are also other international conventions under the same auspices of the International Maritime Organisation relating to the protection of the marine environment, which Samoa is presently considering implementing as part of its domestic legislation. Undoubtedly a combination of domestic and international legislation would enhance the protection and management of the marine environment.

The national statutes directly or indirectly relevant to waste management are as follows:

HEALTH ORDINANCE 1959

This Act, administered through the Department of Health, controls public health matters. As environmental pollution frequently is linked closely to public health and sanitation problems, there is a great deal of overlap between these two fields of endeavour. The Department of Health oversees such environmental concerns as village sanitation, siting of dumping facilities, and public water quality sampling programmes. The Department has also prosecuted cases involving human waste disposal in Apia streams.

WATER ACT 1965

This early Act was generally more concerned with the use and supply of water than its conservation. Currently, fresh and marine water conservation and anti-pollution efforts are divided between the Department of Works, Agriculture, Forests and Fisheries, Lands and Environment, and Health.

PETROLEUM ACT 1984

Negligent transport, transfer and storage of petroleum often pose grave danger to the marine and terrestrial environment. Oil spill contingency plans are scarce, and materials to contain oil spills are frequently not available during emergency situations. This Act makes provision for the supply, transport and storage of petroleum. The Minister of Finance administers the Act, and appoints the place of entry of petroleum into Samoa. The Act authorises the Head of State, acting on the advice of Cabinet, to prescribe the rules to be observed in any place where petroleum is kept, stored, used or conveyed (Section 14(2)(f)).

AGRICULTURE, FORESTS AND FISHERIES AMENDMENT ACT (1989)

This Amendment Act refers specifically to the treatment of pesticides, an area generally placed under the category of pollution control. The recent Amendment Act expands DAFF functions by including a fourth Departmental requirement: "to regulate, control and supervise the manufacture, importation, storage and use of pesticides" (Section 3). The parent act is further amended to allow for pesticides regulations to be drafted.

PORTS AUTHORITY BILL 1989

Section 57 of this Bill is the only marine pollution provision relating specifically to the pollution of waters of a port.

LANDS AND ENVIRONMENT ACT 1989

The Lands and Environment Act 1989 is now the pre-eminent legal environment instrument in Samoa. The Act expands the Land Ordinance 1959 and enlarges the functions of the Department of Lands, by creating a Division of Environment and Conservation (DEC) within the Department, and empowering that Division with wide-ranging functions and duties. Unlike many Pacific environmental units, whose legislative authority entitles them to handle only natural resources protection, or pollution control, or sanitation, the DEC is given responsibility for all aspects of environmental control.

EIA REGULATIONS

These regulations for environmental impact assessment are now in force.

INTERNATIONAL CONVENTIONS RATIFIED OR ACCEDED TO BY SAMOA:

- Law of the Sea Convention 1982
- Vienna Convention and Montreal Protocol
- United Nations Framework Convention on Climate Change 1992
- Convention on Biological Diversity 1992

The Government of Samoa has yet to ratify the Basel or Waigani Conventions.

COUNTRY REPORT
A.10 SOLOMON ISLANDS

1. OVERVIEW

The South Pacific Regional Environment Programme (SPREP) and AusAID have designed and implemented a programme aimed at improving the management of chemicals in the South Pacific region. The programme is being undertaken in 3 Stages as follows:

Stage 1: Preliminary chemical survey and conduct of training in basic chemical handling and disposal procedures.

Stage 2: Repacking of unwanted chemicals as necessary and provision of appropriate temporary storage facilities

Stage 3: Clean-up of contaminated sites and disposal of chemical stockpiles.

The focus of the Stage 1 survey was to identify and quantify the volume of unwanted Persistent Organic Pollutants (POPs) and associated environmental contamination in 13 Pacific Island Countries. POPs typically include chemicals such as pesticides, organic solvents and polychlorinated biphenyls (PCBs). The scope was subsequently expanded to include other potential contaminants such as waste oil, CCA treatment chemicals and laboratory chemicals. This report provides a summary of the POPs survey for the Solomon Islands.

The initial survey was carried out in May and June, 1998. The team comprised:

Dr. Ian Wallis: SPREP consultant

Mr. Moses Biliki: Ministry of Forestry Environment andConservation

Mr. Joe Horokim: Ministry of Forestry, Environment and Conservation

Mr. Tom Lolomae: Local Consultant, Solomon Islands

An additional survey was undertaken in April and May 1999 principally to determine the extent of unwanted chemicals in the Western Province of the Solomon Islands. The inspections were carried out by (or with the assistance of) the following persons:

Dr. Ian Wallis: SPREP Consultant

Billy Apusae: Principal Health Inspector, Ministry of Health & Medical Services (MHMS)

Martin Rasu: Distribution Engineer, Solomon Islands Electricity Authority (SIEA)

Robinson Fugui: Director, Environmental Health Division, MHMS

Christina Mamupio: Noro Town Council Health Inspector

Janita Radford: Liapari Ltd

Mona Clarita Zosa: Quality Control Manager, Solomon Taiyo Ltd

Shady Taro: Occupational Health, Solomon Taiyo Ltd

2. MAJOR FINDINGS

The summary table below provides a summary of the total volume of unwanted chemicals identified during the 1998 POPs survey of Solomon Islands.

	Estimated Quantity
Agricultural chemicals (excl. DDT)	11,000 kg
DDT	9,000 kg
Other obsolete chemicals	750 kg
Oil potentially contaminated with PCBs	1,200 L
Laboratory chemicals	300 L
Waste oil	> 4,000 L/year
Contaminated sites	> 8 potential sites

The chemical quantities given in this report are necessarily conservative estimates. For example, in the case of PCBs, the value quoted is based on tests carried out on a representative number of transformers. Similarly, the quantities quoted for pesticides are based on mainly visual assessment of the individual stockpiles. More specific details will need to be obtained prior to any clean-up and disposal operations.

The most significant stockpiles of waste chemicals and contaminated sites found in the Solomon Islands include:

AGRICULTURAL CHEMICALS (EXCLUDING DDT)

- Approximately 11,000 kg of various pesticides, including propanil and ethoprophos stored at an abandoned shed in a former rice growing area on Metapona Plains shed. This shed was abandoned over twelve years ago and is in a poor state of repair. The pesticide drums are corroding and leaking, and there is a pool of mixed pesticides on the floor.

DDT

- A total of approximately 9,000 kg of DDT stored in various locations and in varying condition. This includes approximately one tonne that was stored in open drums and boxes in a residence adjacent to a storage shed in Honiara.

OTHER OBSOLETE CHEMICALS

- 150 kg of arsenic pentoxide stored at the geology laboratory in Honiara and 600 L of unknown chemicals, possibly fixatives and preservatives, at Fisheries.

POTENTIALLY PCB CONTAMINATED OIL

- At least 1,200 L of transformer oil contaminated with PCBs at the Solomon Islands Broadcasting Authority.

LABORATORY CHEMICALS

- More than 200 L of surplus laboratory chemicals. Most of these laboratory chemicals are in good condition and can potentially be reused elsewhere.

WASTE OIL

- More than 5,000 L/year of waste oil.

CONTAMINATED SITES

- The site at the abandoned Metapona Plains rice growing area is contaminated with pesticides.
- DDT contamination at the Ministry of Health and Medical services shed in Ranadi, Honiara.
- Ranadi landfill site, where all wastes (including liquid wastes) from Honiara have been dumped for the last 20 years.

3. RECOMMENDATIONS

To dispose of waste chemicals, remediate chemicals contaminated sites and upgrade chemicals management capacity in the Solomon Islands it is recommended that:

- Waste pesticides identified in the inspections at the Metapona Plains abandoned rice facility be included in the regional programme under development by SPREP to dispose of hazardous materials in off-island treatment facilities;
- The Ministry of Health and Medical Services sheds in Ranadi be included in the regional programme under development by SPREP to dispose of hazardous materials in off-island treatment facilities;
- The arsenic pentoxide at the Honiara geology laboratory be repackaged and taken off-island for re-use or disposal;
- Other waste chemicals identified in the inspections are disposed of in the regional programme for less hazardous chemicals under development by SPREP. Disposal is to be as recommended in the main body of this report and the attached databases summaries;
- The use of DDT for mosquito control be curtailed in the Solomon Islands and all current stocks be treated as hazardous wastes;
- Waste CCA identified in the inspections at the abandoned timber treatment facilities at Aola and east of Honiara be included in the regional programme under development by SPREP to dispose of hazardous materials in off-island treatment facilities;
- The abandoned timber treatment facilities at Aola and east of Honiara be included in the regional programme under development by SPREP to remediate CCA contaminated sites;
- The Solomon Islands be included in the NZODA/ SPREP regional programme to develop and implement national hazardous waste management strategies;
- The Solomon Islands be included in the international chemical management programmes of UNEP, WHO and FAO including those of the Intergovernmental Programme for Chemical Safety;

- The Solomon Islands participate in current negotiations for a legally binding instrument for certain persistent organic pollutants;
- The Solomon Islands consider ratification of the Basel Convention;
- The Solomon Islands be included in a regional programme under development by SPREP for the environmentally appropriate management of waste oil;
- The Solomon Islands be included in a regional programme to be developed by SPREP for the removal of PCB contaminated transformer oil;
- The Solomon Islands be included in a regional programme to be developed by SPREP for the remediation of oil and diesel contaminated sites;
- The Solomon Islands be included in a regional programme to be developed by WHO to upgrade management of medical wastes and chemicals;
- The Solomon Islands be included in a regional programme to be developed by SPREP to upgrade management of school laboratory chemicals;
- The Solomon Islands be included in a regional programme to be developed by SPREP to assess the extent of contamination that has resulted from inadequate management of solid waste disposal sites; and
- A National Chemicals Profile be compiled for the Solomon Islands.

4. Agricultural Chemicals - Metapona Plains Storage Shed

Metapona Plains was developed as a rice growing area in the early 1980's. The rice farm was initially operated by Solrice and then by Brewers Solomon Agriculture Ltd, who went out of business in 1985, abandoning all chemicals and equipment. The chemicals are stored in a shed, which was within the rice growing area. The shed has a concrete floor, blockwork walls and a galvanised iron sheeting roof.

The first records of the contents are from a WHO mission in 1992 during which the presence of about 55 drums and many cardboard boxes of pesticides and other chemicals was noted. In September 1996 a four-day repackaging project was carried out jointly by WHO and SPREP with the collaboration of 10 officers from the Ministries of Health and Medical Services, Agriculture, Environment and Labour. The participants, wearing protective equipment, repackaged the pesticides and other chemicals in accordance with a workplan. An inventory was prepared, the pesticides, chemicals and associated contaminated materials were segregated, repackaged into 200 L steel drums where necessary, wrapped in plastic, numbered and labelled. The wastes were stored on new timber pallets and the door was locked.

The SPREP Chemicals Consultant inspected the Metapona Plains chemical store on 9 July 1998 in the company of two officers from the Ministry of Health and Medical Services. The door of the chemical store was missing. It was apparent that a number of persons had access to the store and there had been considerable damage. Plastic sheeting on most drums has been pulled down or damaged by wind and rain. Twelve drums were on their side; three were visibly leaking.

Most of the drums were badly corroded and the bungs were falling out. There was about 10 mm depth of a black liquid over the floor, which corresponded to the black liquid leaking from two of the drums. Many of the drums are now too corroded to handle without special equipment. Two leaking drums, which could be safely handled, were placed upright.

The lids from three drums containing powder had been removed and one drum was tipped on its side, sending the contents onto the floor, to mix with the black liquid. There were clear footprints across the floor (adults and children) indicating that the site has been visited by people from nearby villages. In its present condition the store is a serious risk to public health and the environment.

An inventory of the contents was prepared using the records from the 1996 repackaging work as the basis for establishing the likely contents of each drum. Many drums had lost their labels and it was not possible to establish the contents with any certainty. A total of 58 drums (full and empty) were counted, which is 15 drums less than in 1996. From the inventory it seems that 8 drums of Rice Saturn have been removed. These drums had original labels in 1996. Rice growing has recently recommenced in the area, and it is possible that the removal of the Rice Saturn could be related to the resurgence of interest in rice cultivation.

The total quantity of chemical wastes at the site, excluding drums and pallets, was estimated to be approximately 11,000 kg. When account is made of contaminated drums and packaging, as well as the additional waste that would be created by cleaning the floor, there is approximately 20,000 kg of waste requiring safe disposal.

The roof is partly missing and there is leakage of the drum contents onto the floor. During wet weather, runoff from the store flows to the surrounding ground, causing contamination of the adjacent soil. There are houses within 400 m of the store.

A subsequent visit was made to the site and a door was installed.

5. Other Obsolete Chemicals

Obsolete chemicals were found in two laboratories and these wastes are discussed later in this report in the section describing laboratory wastes.

The manager of Russell Islands Plantations Ltd advised that 500 cylinders of mustard gas remained in the bush of Russell Island. Inquiries with the bomb disposal squad attached to the military revealed that the US Army had removed mustard gas cylinders several years ago. It is not clear whether or not any cylinders still remain. War wastes such as mustard gas are outside the scope of this project and if confirmed it is recommended that the issue be referred to the US Army.

Fisheries Laboratory

In an outside store at the Fisheries Laboratory in Honiara there were two full 200 L drums of an unidentified chemical. Both drums were rusting, and one had rusted to the extent that the polyethylene liner was visible. A further drum was stored outside.

The Australian High Commission was contacted and efforts were made to identify the contents. Advice was received from CSIRO Marine Fisheries that the contents were likely to be formaldehyde or ethyl alcohol, but no positive identification could be made.

There was no key for the lock on the store, so a new lock with two keys was purchased. The old lock was removed, the drum from outside moved into the store, two drums were stood up so the plugs were on the top and the store was locked with the three drums stored inside.

Fenitrothion

Four shipping containers (containing about 50 tonne) of Fenitrothion were shipped from Solomon Islands back to Japan about 3 years ago. At the time, it was believed that all Fenitrothion had been exported. However during this project it was reported that 800 kg of Fenitrothion remain in storage at Munda. Despite a visit to Munda the stockpile could not be located. Hence this remains an issue which must be clarified on a subsequent visit.

The store was again visited in May 1999. The purpose of the visit was to search for a possible storage of Fenitrothion. The store for malaria chemicals is behind the offices of the MHMS malaria control offices. The store was locked and contained two 200L drums of unlabelled chemicals. Further information on the contents is being obtained. It can be confirmed that one carton (25 kg) of waste Fenitrothion remains.

Arsenic Pentoxide

Three 50 kg drums of arsenic pentoxide were found stored beneath the offices of the Department of Forestry in Honiara. The drums are in reasonable condition and security also is reasonable. However the storage location has no floor or bund and any leakage would cause a significant environmental and health problem.

Liapari

Liapari Island is approximately 22km west of Gizo. For many years, it was one of the largest trade stores, shipping agencies and boat building operations in the Western Province. In recent years, operations have been substantially reduced and so the site was inspected to check if chemicals remained on the site.

The site was neat and orderly, with little activity. Inspection showed that all equipment and chemicals had been removed.

Noro

The fish processing factory at Noro near Munda was inspected on 2 May 1999 in co-operation with Christina Mamupio, Noro Town Council Health Inspector, Mona Clarita Zosa, Quality Control Manager, Solomon Taiyo Ltd and Shady Taro Occupational Health, Solomon Taiyo Ltd. Chemicals used at the site may be classified into four groups:

- Fish meal preservative;
- Detergents and disinfectants;
- Pest control chemicals; and
- Water and wastewater treatment chemicals.

All chemicals of the site are for current use. No stocks of obsolete or waste chemicals were identified on the site.

6. DDT Use For Mosquito Control

There is a very high incidence of malaria in Honiara and throughout the entire Solomon Islands. As a result, there have been extensive and prolonged campaigns to reduce the incidence of malaria. These campaigns have included spraying mosquitoes, mosquito habitat and the ceilings and walls of buildings.

Ranadi Storage Sheds

On 14 July 1998, the storage sheds owned by the Ministry of Health and Medical Services were inspected by Dr Wallis in the company of two officers from the Ministry of Health and Medical Services, the medical director of SIMTRI and two officers of WHO. These sheds are used to store materials and supplies for the rural water supply programme and the malaria control programme.

The first shed (Hardware Shed) contained a large range of plumbing fittings, a large quantity of bed netting and 3.5 tonnes (100 cardboard boxes each containing 35 kg) of DDT (75 % water dispersible powder) recently purchased from China (February 1998). The store was generally neat and tidy, and was locked and secure.

On the roadway outside this shed was a blue 200 L drum labelled as containing DDT. The drum was corroded and empty, but smelled of DDT and the contents appeared to have been discharged onto the ground.

The second shed (Rural Water Supply Shed) contained a large quantity of cement, 19 outboard motors, 2 air conditioning units, and a quantity of files, furniture, chemicals, toolboxes and miscellaneous effects.
The major chemicals present were as follows:

- five 200 L drums of DDT powder packed in polythene bags, each containing about 250 kg of DDT powder;
- two cardboard boxes of DDT powder each containing about 75 kg;
- one box of photographic chemicals, containing about 5 L of eight different types of chemicals (labels were acid; silver nitrate); and
- two boxes of *Hach* laboratory chemicals, containing about 8 bottles, varying in size from 2 L to 250 ml (labels were potassium dichromate, silver nitrate, strong acid, caustic solution, etc).

On the east side of the building, exposed to the weather, were 13 drums of DDT. Ten of the drums were full while three were empty. One theory discussed by those present was that these drums were originally to be shipped to the provinces but had leaked at the wharf and had been temporarily removed to storage. No one present at the inspection was aware that these drums of DDT still existed. The drums were generally damaged, perhaps by rough handling during transport. It is probable that the contents of three drums (600 L) have leaked into the ground where the drums are currently stored.

One or two families were occupying a lean-to built on the west side of the building. An inspection inside this room revealed cooking equipment, two beds, two children and 7 drums of DDT powder, plus 2 cardboard boxes of DDT powder. The polyethylene packages had been ripped open and there were finger marks in the powder. One person said that the powder was taken to kill fish. In any event, the DDT is not stored properly and is readily available to small children.

Overall, there are a total of 11 full drums of DDT liquid, 12 full drums of DDT powder and 6 empty drums, as well as 4 cardboard boxes of DDT powder, at this site.

A further inspection of the MHMS storage sheds at Ranadi was made on 29 April 1999 with Mr R Fugui, Director of Environmental Health Division, MHMS.
It was noted that all full drums of DDT were no longer in storage. Subsequently, we were advised by the Director of SIMTRI that these drums had been sent to the provinces for spraying mosquitoes as part of malaria control programme. The store contained ten 200L steel drums of powder DDT.

In the yard, there were four damaged drums formerly containing liquid DDT - all were damaged and empty.

The residence beside the store (in which DDT was formerly stored) was checked. All DDT had been removed to the store.

GIZO

The inspections at Gizo were carried out on 1 May 1999 in co-operation with Billy Apusae, Principal Health Inspector, MHMS. He advised that the possible sites with obsolete chemicals were the Malaria Spraying Programmes, Agriculture and the power station.

The store for the malaria chemicals is beneath the Gizo hospital. In this store there were 400kg (ten boxes, each of 40kg) of DDT powder (25%DDT). The powder was being repacked into 1kg parcels for mixing in spray packs. The Malaria Officer advised that liquid DDT was no longer available, and they were therefore obliged to use the powder form. The present stock of DDT would all be used this year.

The Agriculture office in Gizo was inspected. There were no chemicals in storage at that location.

MUNDA

The inspections at Munda were carried out on 1 May 1999. The following waste and other chemicals were observed:

- DDT powder
  In use
  4 cartons
  100 kg
- Fenitrothion (Sumithion)
  1 carton
  25 kg
- Acephate (Orthene)
  In use
  2 cartons
  50 kg
- Diuron
  In use
  2 cartons
  50 kg

7. PCB CONTAMINATED OIL

SOLOMON ISLANDS ELECTRICITY AUTHORITY (SIEA)

SIEA has a workshop at Ranadi where the oil from electricity transformers is changed and stored. Oil from four of the transformers was tested for PCB content and all four were found to have a chlorine content below 1 ppm. Hence it is concluded that PCBs in transformer oil may not be a significant problem for the power industry in the Solomon Islands.

Four samples of transformer oil were also sampled and analysed for PCB content in 1998. The analyses showed PCB levels of < 0.05ppm, < 0.05ppm, 1.2ppm and 14ppm, all of which are below the trigger level of concern of 50ppm. However in view of the single slightly elevated result of 14ppm, it was decided to test oil from two additional old transformers in the Honiara area during the 1999 inspection. The results for these two samples were negative.

Solomon Islands Broadcasting Authority

The Solomon Islands Broadcasting Authority operates a series of high power radio transmitters that require power transformers. There was a leak in the transformers at the Honiara transmitter (near the airport) and the leaking oil was found to contain PCBs. A specialist technician was brought from Australia and he removed all the oil from the Honiara transmitters, flushed the transformers and installed new (PCB-free) oil. Three drums of PCB-contaminated oil are stored at the radio station. It is considered likely that the transformers in the regional station also may have PCB-contaminated oil.
The total quantity is estimated to be 1200 L.

Gizo

The Gizo power station is approximately 1km from the town. A sample of oil was taken from the non-operational transformer at the power station to test for PCB content using the test kit supplied by SPREP.
The test result showed no PCB content.

8. Laboratory Chemicals

Surplus laboratory chemicals were found at the geology laboratory, the fisheries laboratory, the bait fish laboratory and the Ranadi stores (the last is a small quantity of *Hach* chemicals, as described above). There are no commercial laboratories in Solomon Islands.

There are several science laboratories in secondary schools and colleges. All laboratories, which were contacted, reported having stored chemicals that were surplus to requirements. Overall, the total quantity of surplus and waste chemicals is estimated to be 500 litres.

Geology Laboratory

The geology laboratory had two chemical storerooms. An inventory of surplus chemicals (some of which had no labels) totalled approximately 80 litres, mostly in bottles of 200 ml to 1 litre.

Bait Fish Laboratory

A large bait fish laboratory was established in the Solomon Islands and supported by aid from both Japan and Australia. The laboratory was fully equipped with laboratory equipment and reagents. The bait fish project has been completed and the laboratory was closed without any action to remove, reuse or dispose of surplus chemicals. A detailed list of the chemicals was prepared. There is a large quantity (80 litres) of acids in the store, many in their original packaging and bottles, which are in ‘as new’ condition and could be reused by another laboratory.

9. Waste Oil

Waste oil from the power station in Honiara operated by the Solomon Islands Electricity Authority is collected in a concrete tank and reused in a range of applications - sealing dust on roads, marking sportsfields, chain saws, etc.

There is no programme to manage or collect waste oil from the transport industry (trucks, minibuses and cars) or the logging industry. There are no estimates of the quantity of waste oil involved. It can be anticipated that some of this waste oil is used to suppress dust on unsealed roads and as a lubricant for mechanical equipment. A proportion of the waste oil is poured onto the ground, especially in rural areas. There is estimated to be in excess of 5,000 litres per year of waste oil produced in the Solomon Islands.

10. Contaminated Sites

These studies established that there is no register or planning procedure to record or manage contaminated sites in the Solomon Islands. As discussed below, the Ranadi landfill would be considered to be a contaminated site, as would be the former timber treatment mills, most major vehicle maintenance depots, the SIBA transformer sites and the chemical store at Metapona Plains.

Other sites of potential concern are rural hospitals and clinics, the areas of DDT storage and the industrial area at Ranadi in general.

11. Timber Industry Wastes

There were no operating timber treatment plants in Solomon Islands at the time of this project.

The Hyundai CCA plant at Aola used a simple dip tank but was closed in 1993.

The Foxwood timber works on the east of Honiara has a small CCA pressure cell but the works were closed and the site locked (and had been so for a long period) and thus not able to be inspected during this project.

The extent to which waste CCA chemicals and sludge remain on these two sites, and the extent of soil contamination, remain issues which must be clarified on a subsequent visit.

12. Landfills (Municipal Waste Disposal)

The principal landfill at the major urban centre of Honiara is the Ranadi dump, adjacent to Burns Creek and the coast. The landfill is operated and controlled by the Honiara Town Council.

The Ranadi landfill has all the problems of a poorly planned and operated dump. There is no liner, no leachate collection, uncontrolled dumping of liquid and solid wastes, inadequate compaction and cover, flies, mosquitoes and rodents, odour and fires. The leachate flows via the creek into the ocean. This site would have to be considered to be a contaminated site.

There is no provision for safe long-term storage of hazardous wastes in this landfill or elsewhere in Guadalcanal.

Hospital wastes are generally burnt in an open pit at the hospital. The hospital incinerator at Honiara does not operate.

13. Legislation and Management

Comprehensive environmental legislation has been prepared for the Solomon Islands but has not been enacted. Hence the Environment Unit has no authority to control wastes or to achieve more effective management of chemicals and chemical wastes in the Solomon Islands.

It is fair to say that the Environment Unit has very little resources or funds, and there is no suitable site in the Solomon Islands for secure storage of hazardous wastes. Hence there is negligible chance of a locally funded cleanup of chemical wastes.

COUNTRY REPORT
A.11 TONGA

1. OVERVIEW

The South Pacific Regional Environment Programme (SPREP) and AusAID have designed and implemented a programme aimed at improving the management of chemicals in the South Pacific region. The programme is being undertaken in 3 Stages as follows:

Stage 1: Preliminary chemical survey and conduct of training in basic chemical handling and disposal procedures.

Stage 2: Repacking of unwanted chemicals as necessary and provision of appropriate temporary storage facilities

Stage 3: Clean-up of contaminated sites and disposal of chemical stockpiles.

The focus of the Stage 1 survey was to identify and quantify the volume of unwanted Persistent Organic Pollutants (POPs) and associated environmental contamination in 13 Pacific Island Countries. POPs typically include chemicals such as pesticides, organic solvents and polychlorinated biphenyls (PCBs). The scope was subsequently expanded to include other potential contaminants such as waste oil, CCA treatment chemicals and laboratory chemicals. This report provides a summary of the POPs survey for Tonga.

Two visits were made to Tonga by Dr Bruce Graham, from 5 to 12, and 18 to 24 May 1998. The main contact point for the visit was Mr. Uilou Samani, Principal Ecologist, Ministry of Lands, Survey and Natural Resources.

2. MAJOR FINDINGS

The table below provides a summary of the total volume of unwanted chemicals identified during the 1998 POPs survey of Tonga.

	Estimated Quantity
Agricultural chemicals	Nil
Oil potentially contaminated with PCBs	6,000 L
Waste oil	2,000 L
Contaminated sites	3 sites

The chemical quantities given in this report are necessarily conservative estimates. For example, in the case of PCBs, the value quoted is based on tests carried out on a representative number of transformers. Similarly, the quantities quoted for pesticides are based on mainly visual assessment of the individual stockpiles. More specific details will need to be obtained prior to any clean-up and disposal operations.

The most significant stockpiles of waste chemicals and contaminated sites found in Tonga include the following:

WASTE OIL

- A total of about 2 tonnes of waste oil.
- Oil contaminated sites at the Ministry of Works vehicle testing station, and the Electric Power Board power station.

POTENTIALLY PCB CONTAMINATED TRANSFORMER OIL

- A total of about 6 tonnes of potentially PCB contaminated transformer oil.

TIMBER TREATMENT WASTES

- Significant CCA contamination at the Government stores depot which was previously used as the Department of Public Works timber treatment facility. It is considered that this contamination may preclude the suitability of the site for other future uses.

The chemical volumes detailed in this report are necessarily conservative estimates. For example, in the case of PCB oils, the value quoted is the total volume of used transformer oil identified. Subsequent to the findings of this report, chemical analysis of the transformer oil stockpiles is being undertaken, to determine the actual percentage of oil that contains PCBs. This and other revised data, will be incorporated in subsequent reports to help refine the survey estimates.

3. RECOMMENDATIONS

To dispose of waste chemicals, remediate chemicals contaminated sites and upgrade chemicals management capacity in Tonga it is recommended that:

- Tonga be included in a regional programme to be developed by SPREP for the removal of PCBs contaminated transformer oil;
- Tonga consider ratification of the Basel and Waigani Convention
- Tonga be included in a regional programme to be developed by SPREP for the remediation of oil and diesel contaminated sites;
- Tonga be included in the NZODA/SPREP regional programme to develop and implement national hazardous waste management strategies;
- Tonga be included in the international chemical management programmes of UNEP, WHO and FAO including those of the Intergovernmental Programme for Chemical Safety;
- Tonga participate in current negotiations for a legally binding instrument for certain persistent organic pollutants;
- A National Chemicals Profile be compiled for Tonga;
- Tonga be included in a regional programme under development by SPREP for the environmentally appropriate management of waste oil;
- Tonga be included in a regional programme to be developed by WHO to upgrade management of medical wastes and chemicals;
- Tonga be included in a regional programme to be developed by SPREP to upgrade management of school laboratory chemicals; and
- Tonga be included in a regional programme to be developed by SPREP to assess the extent of contamination that has resulted from inadequate management of solid waste disposal sites.

4. WASTE STOCKPILES AND CONTAMINATED SITES

The following matters were identified as part of this project:

POPUA POWER STATION

There is an area of land at the rear of this site and immediately adjacent to the lagoon, which shows significant contamination from waste oil disposal and cooling water discharges (area approximately 20m x 20m). There are about 80 old transformers stored on site, some on concrete pads but most on open ground with no shelter. These belong to the Tonga Electric Power Board. The power station operation was recently corporatised and new generating units built. The development includes a facility for storing, mixing and burning waste oil.

MINISTRY OF WORKS, DEPOT AND GARAGE

Waste oil has been disposed on this site creating an area of contamination about 3m x 10m.

MINISTRY OF AGRICULTURE AND FISHERIES (MAF) RESEARCH STATIONS, VAINI & VAVAU

There are no old stocks of pesticides at either of these sites, although some drums of dieldrin were known to be stored at Vaini in the past. The fate of these stocks is unknown.

PUBLIC HEALTH/HOSPITAL

Small quantities of laboratory chemicals need to be disposed.

TONGA TIMBER

CCA sludges are stored on site and disposed by burial in concrete. Nonetheless, it is highly likely that the site will have CCA contamination due to past practices.

GOVERNMENT STORES (EX MINISTRY OF WORKS)

This site was previously used for timber treatment. Soil samples taken for CCA analysis show widespread contamination over an area about 20 x 30 metres.

5. WASTE MANAGEMENT INFRASTRUCTURE

Collection services for solid waste are provided on most of the main population areas throughout the Tonga group. However, disposal is generally by dumping with little or no attempts at controlled landfilling. In addition many of the disposal sites are on or near estuarine environments.

Most sewage disposal is through septic tanks or pit latrines and there is significant faecal contamination in some of the lagoons Most drinking water is drawn from freshwater supplies beneath the islands.

Medical wastes, pharmaceuticals and quarantine wastes are currently disposed in a MAF incinerator.

6. LEGISLATION AND ADMINISTRATION

The responsibility for environmental matters is vested with the Ministry of Lands, Survey and Natural Resources (MLSNR), mainly through the Environmental Planning Section. However, there is no specific environmental legislation, and the relevant regulations are spread throughout a variety of other Acts. The need for specific environmental legislation has been recognised in recent years, but little progress has been made in achieving this goal.

There is a large body of legislation containing provisions of environmental importance, some going back more than 50 years, such as the Birds and Fish Preservation Act 1934. Legislation of most relevance to waste management is as follows:

- The Public Health Act 1913 covers water supply, tanks and wells, health dangers, infections, disease control, food inspections, facilities, building regulations, litter and inspections of public facilities;
- The Minerals Act 1949 sets conditions for permits for mineral exploration and mining for protection and restoration of forest areas;
- The Pesticides Act 1975/1981 regulates the registration, manufacture, sale and use of pesticides;
- The Garbage Act provides for garbage control and dumping;
- The Customs and Excise Act 1983, as amended prohibits importation of toxic or hazardous wastes into the Kingdom, and provides for coral protection;

There are also two pieces of draft legislation that have significant implications for the environment:

- The draft Land-Use and Environmental Planning Act provides a framework for development planning, planning schemes and for development applications and the detailed information required for environmental impact assessment; and
- The draft Marine Pollution Act 1992 provides for discharge of oil or pollutants outside and inside Tongan waters and as well as discharge of garbage and sewage from ships and platforms into the marine environment.

Tonga is not a signatory to the Basel Convention, and has yet to ratify the Waigani Convention.

COUNTRY REPORT
A.12 TUVALU

1. OVERVIEW

The South Pacific Regional Environment Programme (SPREP) and AusAID have designed and implemented a programme aimed at improving the management of chemicals in the South Pacific region. The programme is being undertaken in 3 Stages as follows:

Stage 1: Preliminary chemical survey and conduct of training in basic chemical handling and disposal procedures.

Stage 2: Repacking of unwanted chemicals as necessary and provision of appropriate temporary storage facilities

Stage 3: Clean-up of contaminated sites and disposal of chemical stockpiles.

The focus of the Stage 1 survey was to identify and quantify the volume of unwanted Persistent Organic Pollutants (POPs) and associated environmental contamination in 13 Pacific Island Countries. POPs typically include chemicals such as pesticides, organic solvents and polychlorinated biphenyls (PCBs). The scope was subsequently expanded to include other potential contaminants such as waste oil, CCA treatment chemicals and laboratory chemicals. This report provides a summary of the POPs survey for Tuvalu.

The visit to Tuvalu was carried out by Dr. Bruce Graham, from 17 to 23 July 1998. The main contact point for the visit was Mr. Afele Pita, Secretary, Department of Natural Resources and Environment. All inspections were undertaken at Funafuti Atoll.

2. MAJOR FINDINGS

The table below provides a summary of the total volume of unwanted chemicals identified during the 1998 POPs survey of Tuvalu.

	Estimated Quantity
Agricultural chemicals	Nil
Oil potentially contaminated with PCBs	8000 L
Waste bitumen	60,000 L
Waste oil	1500 L plus
Contaminated sites	4 sites

The chemical quantities given in this report are necessarily conservative estimates. For example, in the case of PCBs, the value quoted is based on tests carried out on a representative number of transformers. Similarly, the quantities quoted for pesticides are based on mainly visual assessment of the individual stockpiles. More specific details will need to be obtained prior to any clean-up and disposal operations.

The most significant stockpiles of waste chemicals and contaminated sites found in Tuvalu include:

WASTE OIL AND BITUMEN

- A total of about 60 tonnes of bitumen stored in 200 litre drums in deteriorated condition.
- A total of about 2 tonnes of waste oil.
- Oil and bitumen contaminated sites at the Tuvalu Electric Power Corporation and Department of Public Works depot.

PCB CONTAMINATED TRANSFORMER OIL

- A total of about 8 tonnes of potentially PCB contaminated transformer oil.

MISCELLANEOUS WASTES

- A total of approximately 1.5 tonnes of unwanted fertilisers.
- A stockpile of approximately 7 tonnes of unwanted nitropril.
- An unknown quantity of unwanted medical drugs at the Funafuti hospital.

The chemical quantities given in this report are necessarily conservative estimates. For example, in the case of PCBs, the value quoted is based on tests carried out on a representative number of transformers. Similarly, the quantities quoted for pesticides are based on mainly visual assessment of the individual stockpiles. More specific details will need to be obtained prior to any clean-up and disposal operations.

3. RECOMMENDATIONS

To dispose of waste chemicals, remediate chemicals contaminated sites and upgrade chemicals management capacity in Tuvalu it is recommended that:

- Tuvalu be included in a regional programme to be developed by SPREP for the removal of PCB contaminated transformer oil;
- Tuvalu be included in a regional programme to be developed by SPREP for the remediation of bitumen contaminated sites;
- Tuvalu be included in a regional programme to be developed by SPREP for the remediation of oil and diesel contaminated sites;
- Tuvalu be included in the NZODA/SPREP regional programme to develop and implement national hazardous waste management strategies;
- Tuvalu be included in the international chemical management programmes of UNEP, WHO and FAO including those of the Intergovernmental Programme for Chemical Safety;
- Tuvalu participate in current negotiations for a legally binding instrument for certain persistent organic pollutants;
- Tuvalu consider ratification of he Basel and Waigani Conventions;
- A National Chemicals Profile be compiled for Tuvalu;
- Tuvalu be included in a regional programme under development by SPREP for the environmentally appropriate management of waste oil;
- Tuvalu be included in a regional programme to be developed by WHO to upgrade management of medical wastes and chemicals;
- Tuvalu be included in a regional programme to be developed by SPREP to upgrade management of school laboratory chemicals;
- Tuvalu be included in a regional programme to be developed by SPREP to assess the extent of contamination that has resulted from inadequate management of solid waste disposal sites; and
- Waste chemicals identified in the inspections be disposed of in the regional programme for less hazardous chemicals under development by SPREP. Disposal is to be as recommended in the main body of this report and the attached database summaries.

4. WASTE STOCKPILES AND CONTAMINATED SITES

The following matters were identified as part of this project:

FUNAFUTI POWER STATION

Approximately 1500 litres of waste oil is held in storage, awaiting disposal. There is a significant area of oil contamination at the rear of the site (3m x 10m).

Three of four out-of-service transformers on site were tested positive for PCBs. There are about 25 transformers altogether in the country, and over half are likely to contain PCBs.

PUBLIC WORKS DEPARTMENT

About 300 drums (60,000 litres) of bitumen are stored on site, left over from a runway sealing job, which was done in about 1990. The drums are very rusty and will be difficult to move. There is significant spillage around the area.

Waste oil produced on the site is used in treating formwork timber.

DEPARTMENT OF AGRICULTURE

Approximately 1 tonne of potassium chloride and 0.5 tonne superphosphate held in a storage shed is no longer needed Small quantities (<5 kg) of Orthene, Malathion and Benlate are also no longer needed.

There is uncertainty about existing controls on pesticides, but Agriculture is the sole supplier.

Quarantine wastes are burned in the open, although aircraft cabin waste is not controlled.

MINISTRY OF HEALTH / PRINCESS MARGARET HOSPITAL

There are small amounts (<20 kg) of laboratory chemicals for disposal.

Small amounts of Malathion are used for vector control. DDT use ceased about 10 years ago.

Medical wastes and pharmaceuticals are currently burned in the open and / or buried, although there is a medical waste incinerator in storage, waiting to be installed.

The disposal of septic tank sludge may be an issue in the future.

DEPARTMENT OF EDUCATION

Oil contamination is reported around power stations on Amatuku (Maritime School) and Vaitupu (secondary school).

There are small quantities of surplus laboratory chemicals at Vaitupu secondary school.

BP BULK OIL DEPOT

This is a tidy site but due for a major upgrade to bring it up to current standards (waiting on new lease arrangements for the land). There is a regular groundwater monitoring programme.

Oil separator slops are taken to Fiji.

Tank sludges are stored in plastic bags on site for disposal.

BP will assist with waste oil returns to Fiji once the upgrade of the site and the shipping tankers are complete.

OTHER WASTE MANAGEMENT MATTERS

Old car batteries are being collected and returned to NZ for recycling.

Funafuti Town Council has a waste collection system in place, and designated dumping areas on the atoll. The site location (near the airport) is visually not the best, and there is no attempt at sorting, composting, or recycling.

5. WASTE MANAGEMENT INFRASTRUCTURE

The Funafuti Town Council provides a regular collection service for solid wastes. However, the wastes are simply dumped in designated areas on the atoll, with no attempt at controlled landfilling.

Most sewage and other liquid wastes are disposed through septic tanks. Drinking water is obtained almost solely from roof collected rainwater.

Old car batteries are being collected and shipped offshore for recycling. There are no systems for the recycling of other scrap metals, including aluminium cans.

Medical wastes and pharmaceuticals are currently burned in the open and / or buried, although there is a medical waste incinerator in storage, waiting to be installed at the hospital.

Quarantine waste is burned in the open.

6. LEGISLATION AND ADMINISTRATION

There is no specific environmental legislation in Tuvalu, with most of the key issues being covered under other topics such as health. There are no specific controls on imports of hazardous chemicals, or on the disposal of hazardous wastes. The Department of Natural Resources and Environment are currently undertaking an internal assessment of environmental responsibilities within Government Departments.

Staff of the Department of Agriculture were uncertain about existing controls on pesticides. However, this was not seen as a problem because the Department is currently the sole supplier of such chemicals.

International conventions to which Tuvalu is a signatory, or has acceded include:

- South Pacific Nuclear Free Zone Treaty;
- Nuclear Non-Proliferation Treaty;
- Convention for the Protection of the Natural Resources and Environment of the South Pacific Region (SPREP Convention);
- Prohibition of Fishing with Long Driftnets;
- Framework Convention on Climate Change 1992;
- Convention on the Conservation of Bio Diversity; and
- London Dumping Convention.

The Government of Tuvalu is not a signatory to the Basel Convention, and has yet to ratify the Waigani Convention.

COUNTRY REPORT
A.13 VANUATU

1. OVERVIEW

The South Pacific Regional Environment Programme (SPREP) and AusAID have designed and implemented a programme to improve the management of chemicals in the South Pacific region. The programme is being undertaken in 3 Stages as follows:

Stage 1: Preliminary chemical survey and conduct of training in basic chemical handling and disposal procedures.

Stage 2: Repacking of unwanted chemicals as necessary and provision of appropriate temporary storage facilities

Stage 3: Clean-up of contaminated sites and disposal of chemical stockpiles.The purpose of the Stage 1 survey was to identify and quantify the volume of unwanted Persistent Organic Pollutants (POPs) and associated environmental contamination in 13 Pacific Island Countries. POPs typically include chemicals such as pesticides, organic solvents and polychlorinated biphenyls (PCBs). The scope was subsequently expanded to include other potential contaminants such as waste oil, CCA treatment chemicals and laboratory chemicals. This report provides a summary of the POPs survey for Vanuatu.

The survey was carried out in May and June 1998. The team comprised:

Dr. Ian Wallis:	SPREP consultant
Mr. Baigeorge Swua:	Quarantine Service, Port Vila
Mr. Marley Regenvanu:	Malapoa College, Port Vila
Ms. Sarah Mecartney:	Environment Unit, Vanuatu
Mr. Mark Kalotap:	Department of Forestry

2. MAJOR FINDINGS

The summary table below provides a summary of the total volume of unwanted chemicals identified during the 1998 POPs survey of Vanuatu.

	Estimated Quantity
Agricultural chemicals (excl DDT)	300 kg
DDT	900 kg
Oil potentially contaminated with PCBs	13,000 L
Laboratory chemicals	> 100 L
Timber treatment wastes	122,000 kg
Waste oil	> 15,000 L/year
Contaminated sites	4 sites

The chemical quantities given in this report are necessarily conservative estimates. For example, in the case of PCBs, the value quoted is based on tests carried out on a representative number of transformers. Similarly, the quantities quoted for pesticides are based on mainly visual assessment of the individual stockpiles. More specific details will need to be obtained prior to any clean-up and disposal operations.

The most significant stockpiles of waste chemicals and contaminated sites found in Vanuatu include:

Agricultural Chemicals (excluding DDT)

- Minor quantities of miscellaneous pesticides including lindane and 2,4,5-T at the former Chapius Agricultural Research Site and an old store on Espiritu Santo.
- A total of approximately 1400 kg of unwanted fertilisers stored at the French and Vanuatu Government agricultural stations on Espiritu Santo.

DDT

- 900 kg of DDT stored at the Luganville hospital. The malaria control officer at the Health Department in Port Vila was unaware of the existence of this DDT.

Potentially PCB Contaminated Transformer Oil

- A total of about 13 tonnes of potentially PCB contaminated transformer oil.

Laboratory Chemicals

- More than 100 L of surplus laboratory chemicals.

Timber Treatment Wastes

- 120 tonnes of waste timber treatment chemicals at the Santo Veneer and Timber mill on Espiritu Santo.
- 5 tonnes of antiborer solution in use illegally on Espiritu Santo.

Waste Oil

- About 12,000 L/year of waste oil is recycled while approximately 15,000 L/year is disposed of locally.

Contaminated Sites

- Minor site contamination by pesticides at the former Chapius Agricultural Research Site on Espiritu Santo.
- CCA site contamination at the Melcoffe Timber and Santo Veneer and Timber sites and an illegal bush timber treatment site on Espiritu Santo, and the PITT Ltd. site at Mele on Efate.
- Three previous landfills on Efate and the current landfill on Espiritu Santo have been poorly managed and must be considered as contaminated sites. The existing landfill at Bouffa on Efate is well managed.

3. Recommendations

To dispose of waste chemicals, remediate chemicals contaminated sites and upgrade chemicals management capacity in Vanuatu it is recommended that:

- DDT identified in the inspections at the Luganville hospital be included in the regional programme under development by SPREP to dispose of hazardous materials in off-island treatment facilities;
- Other waste chemicals identified in the inspections are disposed of in the regional programme for less hazardous chemicals under development by SPREP. Disposal is to be as recommended in the main body of this report and the attached database summaries;
- Vanuatu be included in a regional programme to be developed by SPREP for the removal of PCB contaminated transformer oil;
- Vanuatu be included in a regional programme under development by SPREP for the environmentally appropriate management of waste oil;
- Vanuatu be included in the international chemical management programmes of UNEP, WHO and FAO including those of the Intergovernmental Programme for Chemical Safety;
- Vanuatu be included in the NZODA/SPREP regional programme to develop and implement national hazardous waste management strategies;
- Vanuatu participate in current negotiations for a legally binding instrument for certain persistent organic pollutants;
- Vanuatu consider ratification of the Basel and Waigani Conventions;
- Vanuatu be included in a regional programme to be developed by SPREP for the remediation of oil contaminated sites;
- Vanuatu be included in a regional programme to be developed by WHO to upgrade management of medical wastes and chemicals;
- Vanuatu be included in a regional programme to be developed by SPREP to upgrade management of school laboratory chemicals;
- Vanuatu be included in a regional programme to be developed by SPREP to assess the extent of contamination that has resulted from inadequate management of solid waste disposal sites.

There is a large logging and timber treatment industry in Vanuatu. Timber treatment wastes are clearly a significant problem and also clearly the responsibility of the owners of these facilities. A major effort is required to upgrade both the environmental awareness of the industry and the capability of the Department of Forestry to manage the industry. The AusAID funded Vanuatu Sustainable Forest Utilisation Project currently underway is addressing these and other forest management issues.

4. Obsolete Agricultural Wastes

There were no large stockpiles of obsolete chemical wastes found in Vanuatu. Most of the wastes were leftovers from quarantine collections, agricultural research or former malaria spraying campaigns.

The largest quantity of wastes by volume were found on Santo and are timber treatment compounds. Some of the wastes found on Vanuatu were recycled into commercial uses as a result of this project.

The stockpiles and related waste management areas that were investigated during this project are described below.

TABAGE QUARANTINE STORAGE SHED

The Tabage Quarantine storage shed had small quantities of wastes that had been collected in quarantine activities. The wastes were stored on shelves in a storage shed behind the quarantine office. The shed had no door but the compound had a security fence that was locked at night. The shed had an elevated concrete floor, concrete walls, good ventilation and lighting.

All of the wastes were properly labelled and in good condition. Arrangements were made during the project for all of these wastes to be recycled into existing commercial activities in Vanuatu (pest management, pool chlorination) so that at the end of the project these wastes no longer existed. There had been no spillage and hence there was no residual contamination of the site.

LUGANVILLE QUARANTINE STORE

The Luganville Quarantine Store had 3 x 11 kg containers of methyl bromide, partly full. This chemical is still used for fumigation but these containers need new pipe fittings before they can be used. The use of methyl bromide is being phased out.

CHAPIUS AGRICULTURAL SITE, SANTO, STORE NO. 1

The former Chapius Agricultural Research Site had a significant quantity of residual waste chemicals stored in a locked shed near houses. The storage shed was in good condition. The bags and containers have deteriorated in most cases, making it difficult to identify all the wastes, particularly the boxes of repackaged pesticides stored at this site.

CHAPIUS AGRICULTURAL SITE, SANTO, OLD STORE

A small shed at the back of the Chapius site contained another array of waste chemicals in small quantities. This shed was not locked and the concrete floor had been contaminated by spillages. The storage shed was fabricated from roofing iron and was only in moderate condition.

PESTICIDE EXTERMINATOR, PORT VILA

The pesticide extermination company in Port Vila (Ezykill) was inspected. Only small quantities of chemicals were stored, and all were in current use. There were no wastes. The manager advised that the purchases of chemicals were matched closely to the demand for use, and no wastes were generated. The principal chemicals used were diazon, chlorpiryphos, dursban, pestoc, coopex powder and permethrin.

COCONUT PRODUCTS LTD., SANTO

The Coconut Products factory in Luganville was inspected. There were no wastes from the production process, which mainly involves soap manufacture. The only wastes at this site were 2 cylinders each of 200 g of aluminium phosphide pellets (UN3048, made in India, distributed by Top Australia, use by 31 August 1996). These pellets are used to poison rats. Although out of date, use for the correct purpose would seem to be the appropriate disposal method.

CHEMICAL SUPPLIERS, PORT VILA

The principal chemical importer and supplier in Port Vila is Vanuatu Agricultural supplies (VAS). The office and storage areas of this company were inspected and no wastes were seen. The manager advised that they control imports to ensure little surplus product, and sell surplus product at a discount to prevent wastes from accumulating. They do not manufacture or package pesticides.

5. DDT

ENVIRONMENTAL HEALTH STORE, PORT VILA

The malaria control officer at Port Vila advised that all DDT had been removed from Port Vila. The former DDT storage area was inspected and found to be clean and tidy, with no DDT. The only chemicals in storage were permethrin used for bed nets.

He advised that a few kilograms of DDT were still stored at Tanna and Malekula. These sites could not be inspected in this project because of transport costs. Apart from this all DDT had been removed from Vanuatu about five years ago. Malathion has replaced DDT in mosquito spraying at Port Vila and Luganville.

ENVIRONMENTAL HEALTH STORE, LUGANVILLE

The Luganville Hospital Manager advised that there was no DDT in Luganville. The storage could not be inspected as the stores officer was away.

Subsequently, in October 1998 SPREP Project Co-ordinator Mr. Andrew Munro was shown 900 kg of DDT at the Luganville hospital which the health inspector had kept in case he needed it. The DDT was in poor condition with some bags starting to split. Clearly neither the malaria control officer at Port Vila, nor the Luganville Hospital Manager were aware of its existence.

6. TIMBER INDUSTRY WASTES

There are five operating timber treatment plants in Vanuatu, three on Santo and two on Efate. The plants were inspected to obtain an indication of the disposal methods for CCA sludge and the likelihood of contamination of the site due to sludge disposal or treatment chemicals. The observations are summarised in the following table.

Timber Preservation Plant	Location	Observations
Side River Timbers	Luganville	Very small; well operated
Local Timbers Treatment	Mele	Very small; well operated
Santo Veneer & Timber	Luganville	Large quantity of waste onsite
Melcoffe Sawmill	Luganville	Onsite discharge & contamination
PITT Ltd	Mele	Onsite discharge & contamination
Illegal bush operation	Luganville	Onsite discharge

The two small plants (Side River Timbers and Local Timbers treatment) were the best. They both had concrete drip pads, low sumps and knowledge about CCA waste management. The CCA waste was reported to be kept in the sump, although periodically it must be emptied and disposed of, most likely at a local landfill. The operator at Side River timbers was familiar with solidification of sludge using cement, sand and lime.

SANTO VENEER AND TIMBER, LUGANVILLE

Santo Veneer and Timber operate a large sawmill, veneer plant and timber treatment plant in Luganville. The treatment uses both the dip process, where timber is stored under weights in a large steel tank of anti-blue / anti-borer solution; and a pressure cylinder treatment.

There was approximately 120,000 L of waste treatment solution stored in two large concrete tanks at the site. The lower tank was leaking into the soil. The operator was uncertain as to how the wastes came to be left on the site. There is a substantial waste disposal problem at the site, particularly as almost all employees have bare feet and there is an extensive area of contaminated soil.

The site also had a significant area of soil contaminated with waste oil.

MELCOFFE TIMBER PRESERVATION, LUGANVILLE

Melcoffe treats green timber in a pressure cylinder principally with Tanalith (a CCA formulation supplied by Hicksons NZ) and occasionally Immutan (a mixture of boric acid and sodium borate). There is no drip pad to prevent soil contamination.

Empty drums are returned to Hicksons NZ. The residual sludge is mixed with sand and sawdust and taken in 200 L drums to the Luganville tip. (Inspection of the tip indicated that two sawmills were providing CCA sludge wastes). The quantity of waste sludge is estimated to be about 1 to 2 tonne/year.

PITT LTD

Pacific Timber and Trading operate a sawmill and CCA timber treatment plant at Mele. There is no drip pad and therefore constant soil contamination. The plant is generally in poor condition and waste sludges appear to be disposed of on the site.

ILLEGAL BUSH TIMBER PRESERVATION PLANT, LUGANVILLE

While carrying out inspections in Santo, an illegal timber treatment plant was observed in the bush west of Luganville. The site had approximately 6,000 litres of a CCA solution in a steel tank and the area around the tank was stained with spillages.

ARSENIC PENTOXIDE

There was a former European Union Forestry project on Santo that was reported to involve the use of arsenic pentoxide for poisoning trees. The Department of Forestry advised that about two drums of arsenic pentoxide that had been left over from the project was buried in a concrete lined pit in Santo.

7. MISCELLANEOUS WASTES

SURPLUS LABORATORY CHEMICALS

There are no commercial laboratories in Vanuatu and only very small government laboratories. The largest laboratories are in secondary schools and colleges. All laboratories that were contacted reported having stored chemicals that were surplus to requirements. It is estimated that there is over 100 litres of surplus and waste laboratory chemicals in Vanuatu.

ASIAN PAINT FACTORY, PORT VILA

The Asian Paint Factory in Port Vila was inspected. Washings and any spills are collected and directed to a sump where they are treated with a flocculant and allowed to settle. The solids are collected and taken to the municipal landfill.

Wastewater from the treatment process is discharged to land on the site. Waste solvents are collected and recycled into other products (e.g. black paint). A small quantity (250 L) of strongly coloured waste solvents are stored at the site awaiting a suitable disposal route. Overall, the factory is considered to have a responsible approach to waste management.

ABATTOIR WASTES

The solid wastes from the Port Vila and Luganville abattoirs are disposed of on the abattoir sites.

8. WASTE HYDROCARBONS

There is no collection of waste oil in Vanuatu from the power generation, transport or logging industries. According to the Energy Unit, the quantities of waste oil requiring disposal are estimated to be a total of 27,000 L per year. This includes about 13,000 L per year from power generation, 10,000 L per year from transportation (trucks, minibuses and cars) and 4,000 L per year from the logging industry.

UNELCO and Mobil have recently commenced shipping waste oil from Port Vila to Lami (Fletcher Steel Industries) in Fiji for use as a supplementary fuel. This is believed to take about 12,000 L per year.

The remainder of the waste oil (approximately 15,000 L per year) is used to suppress dust on unsealed roads and as a lubricant for chain saws and other mechanical equipment. A proportion of the waste oil is poured onto the ground, especially in rural areas. A small quantity of waste oil, principally containing sludges, is disposed of to the pond at the Port Vila landfill. Minor quantities of waste oil also are taken to the Luganville landfill. Waste sludges from BP, Shell and Mobil are mixed with sand and taken to the Port Vila landfill.

Although not a waste hydrocarbon problem, the recent development of solar power in Vanuatu is leading to a significant battery disposal problem that needs to be addressed.

9. PCBs

Electricity in Vanuatu is generated by UNELCO, a private utilities company. UNELCO have about 45 transformers, either disused or being reconditioned for reuse. Oil from four of the transformers was tested for PCB content and three were positive.

UNELCO proposed to test the remaining units and provide the results but these have yet to be received. However the results to date confirm that there is a PCB problem in Vanuatu and it is estimated at present that there is about 13,000 litres of transformer oil potentially contaminated with PCBs.

10. Landfills (Municipal Waste Disposal)

The landfills at the major urban centres of Port Vila and Luganville were assessed during this study. Port Vila has had a succession of landfills as follows:

Agathis area, 2 km north of CBD:	closed in 1987
Fres Wata, 1 km north of CBD:	started 1987, closed 1993
Montmartre, 8 km east of CBD:	started 1993, closed 1994
Bouffa, 10 km east of CBD:	opened 1994.

The disposal at the first three sites was essentially uncontrolled. A lot of wastes were dumped in the Agathis area in 1987 following Cyclone Umo. The Agathis and Fres Wata areas would have to be considered to be contaminated sites.

The new Port Vila landfill is impressive, possibly the best landfill in the Pacific Island countries. The site has favourable geology, being underlain by up to 9 m of clay soils, and groundwater flow to the north and east, away from the Port Vila water supply aquifer. A confined active face was being used, with soil placed over the previous day’s waste. Leachate is designed to collect in a pond below the active cell. The site has a good buffer zone from residential areas.

Quarantine waste is burnt in an open pit, with the ash transferred periodically to the active face.

The three issues of concern are as follows:

1. Hospital wastes are received on the active face, not in special cells;
2. There is no leachate collection system yet; and
3. There is no provision for safe long-term storage of hazardous wastes.

The Luganville landfill is not so comforting. The site occupies a small valley with active dumping over a large area. There is no compaction, trenching or cover applied. Leachate and drainage water flows down to an adjacent creek, or seeps into the ground. A wide variety of materials were dumped indiscriminately around the site, including recent CCA sludges and a small quantity of oil. However inspection, as far as was possible given the large and active fly population, did not reveal any recent dumping of drums. This site is not satisfactory from an environmental and waste management perspective.

Hazardous Waste Storage Cells

In response to a request from the Municipality of Port Vila, a concept plan for secure hazardous waste disposal in the Bouffa landfill was drawn up and submitted to the Municipality. The concept involves solidification of the wastes with cement in steel or polyethylene drums, with storage of the drums inside a tank sealed with concrete to provide a second protection barrier. Similar procedures are used in Australian landfills for secure storage of hazardous wastes.

11. Contaminated Sites

These studies established that there is no register or planning procedure to record or manage contaminated sites in Vanuatu. As discussed above, the previous Port Vila municipal landfills, and the present Luganville landfill, would be considered as contaminated sites, as would be timber treatment mills, most major vehicle maintenance depots, the UNELCO transformer depot and the former forestry research station with buried arsenic pentoxide.

Other sites of potential concern are rural hospitals and clinics, the abattoirs and the ship repair area at Santo. A large quantity of materials were dumped in the sea near Santo at the end of 1945 but it is not known if this has created significant contamination.

12. Legislation

General responsibility for environment and conservation in Vanuatu is vested in the Environment Unit within the Ministry of Lands & Natural Resources. The unit advises the government on the environmental impacts of development projects, undertakes environmental surveys and monitoring, initiates environmental awareness and education programmes, identifies and establishes protected areas, and serves as the national focal point for Vanuatu's participation in international environmental programmes and organisations.

A number of Ministries and departments have sectoral responsibilities assigned under law for conservation and environment in their areas of interest. The Agriculture Department is responsible for wildlife protection under the Wildlife Protection (Birds) Regulations, 1962, which gives total protection to 16 species, provides a closed season for 11 species, and places an export ban on 11 species. The Forestry Department is responsible under the Forestry Act 1982, for forest plantations and conservation in forest areas. The Fisheries Department implements the Fisheries Act 1982 with provisions for fisheries management, marine reserves and species protection. A Bill for a National Parks Act was tabled in Parliament in November 1992 by the Minister of Natural Resources, who is also responsible for the environment.

There already exists a substantial body of environmental law in Vanuatu. This consists not only of sectoral legislation specifically referring to environmental issues, but also other parts of the general law which have considerable potential for use in ensuring the protection of the environment and the wise use of natural resources.

However there are major gaps in the sectoral coverage. The most striking are in the areas of waste management, water resources and dangerous substances. Recent escalation of development pressures in Vanuatu, especially in the coastal zone, means there is an urgent need for the extension of planning control to the littoral zone. There should also be statutory a requirement for environmental impact assessment for major projects.

With regard to international conventions, Vanuatu became a party to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) in 1998 and ratified the Convention in 1989. The International Trade (Fauna and Flora) Act was gazetted in 1991. At the Earth Summit in Rio de Janeiro, Vanuatu signed the Bio Diversity Convention and the Framework Convention on Climate Change that it has now ratified. Vanuatu has also ratified the Montreal Protocol on Substances that Deplete the Ozone Layer and the London Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matters.

Vanuatu is not yet party to the Basel or Waigani conventions.

[1] Additional quantities of pesticides are stored on Canton Island.

ANNEX: B
INVENTORIES

WASTE AND OBSOLETE CHEMICALS AND CHEMICAL CONTAMINATED SITES

THERESE BURNS
BRUCE GRAHAM
ANDREW MUNRO
IAN WALLIS

MAY 2000

Annex B.1 – List of Sites in Each Country

Cook Islands

Site	Location	Site Owner	Site Activity	Surplus Chemicals	Contamination
Cook01	Rarotonga	Cook Islands Development Corporation	Old fertiliser store	yes	no
Cook02	Rarotonga	Ministry of Agriculture	Research centre	yes	no
Cook03	Rarotonga		Old dump site	no	yes
Cook04	Rarotonga	Ministry of Agriculture	Airport quarantine	yes	no
Cook05	Rarotonga	Ministry of Health	Hospital laboratory	yes	no
Cook06	Rarotonga	Ministry of Education	School laboratory	yes	no
Cook07	Rarotonga	Ministry of Education	School laboratory	yes	no
Cook08	Rarotonga	7th Day Adventist Church	School laboratory	yes	no
Cook09	Rarotonga	Ministry of Education	School laboratory	yes	no
Cook10	All islands	Ministry of Energy	Electricity supply	yes	no
Cook11	Rarotonga	Cook Islands EPB	Electricity distribution	yes	no
Cook12	Rarotonga	Aviatu Power Station	Electricity generator	yes	no
Cook13	Rarotonga	Island Pest Control	Pest control company	yes	no
Cook14	Aitutaki	Ministry of Agriculture	Agricultural services	yes	no
Cook15	Aitutaki	Cook Islands Power Board	Electricity generation	yes	yes
Cook16	Takuvaine Valley		Dump site	yes	yes
Cook17	Mangaia	Ministry of Agriculture	Research centre	yes	no
Cook18	Atiu	Ministry of Agriculture	Research centre	yes	no

FIJI

Site	Location	Site Owner	Site Activity	Surplus Chemicals	Contamination
Fj01	Lakena, Nausori	Min. of Ag. Forests & Fisheries (MAFF)	Research Station	yes	yes
Fj02	Lamaivuna, Viti Levu	MAFF	Research Station	yes	yes
Fj03	Navua, Viti Levu	MAFF	Research Station	yes	no
Fj04	Suva	Agchem	Chemical Manufacture	yes	no
Fj05	Suva	Ministry of Health	Vector Control	yes	no
Fj06	Korokati, Vanua Levu	MAFF	Research Station	yes	no
Fj07	Dreneki, Vanua Levu	MAFF	Research Station	yes	yes
Fj08	Sigatoka	MAFF	Cereal Chemical Store	yes	no
Fj08	Sigatoka	MAFF	Fruit Chemical Store	yes	no
Fj08	Sigatoka	MAFF	Research Station	yes	no
Fj08	Sigatoka	MAFF	Vegetables Chemical Store	yes	no
Fj09	Legalega	MAFF	Research Station	yes	no
Fj10	Malau, Vanua Levu	Fiji Forest Industries	Sawmill & Timber Preservation	yes	yes
Fj11	Lambasa	Weigele Sawmill	Sawmill	yes	yes
Fj12	Lambasa	Valebasunge Mill	Sawmill	yes	yes
Fj13	Suva	Lami Dump	Rubbish Disposal	no	yes
Fj14	Nausori	Nausori Dump	Rubbish Disposal	no	yes
Fj15	Lautoka	Lautoka Dump	Rubbish Disposal	no	yes
Fj16	Lautoka	Fiji Electricity Authority	Power Station	no	yes
Fj17	Tamavua	Ministry of Health	Hospital	yes	no
Fj18	Lautoka	Tropic Wood Industries	Timber milling & treatment	no	no
Fj19	Suva	Fiji Fire Authority	Depot	no	yes

FSM (Chuuk)

Site	Location	Site Owner	Site Activity	Surplus Chemicals	Contamination
Chk01	Weno	Private land	Old shipping container	yes	yes
Chk02		Private land	Asphalt plant	yes	no
Chk03	Weno		Power plant	yes	yes
Chk04		Xavier High School	Chemistry laboratory	yes	no
Chk05	Weno	College of Micronesia	Former govt pesticide store	no	yes
Chk06	Tanoas Island		Power plant	yes	no
Chk07	Tanoas Island		Former Japanese bulk fuel depot	no	yes
Chk08	Weno		Former Public Works yard	yes	no

FSM (Kosrae)

Site	Location	Site Owner	Site Activity	Surplus Chemicals	Contamination
Kos01		Department of Transportation	Depot & maintenance yard	yes	minor
Kos02		Department of Agriculture & Lands	Quarantine & research stations	no	yes
Kos03		Department of Fisheries & Marine Resources	Depot	yes	no
Kos04		Kosrae Utility Authority	Power plant	yes	yes
Kos05		Kosrae Hospital		no	yes
Kos06		Micronesian Petroleum Company	Bulk Fuel Depot	no	yes
Kos07		Semo Micronesia Inc.	Depot	no	no
Kos08		Black Micro Construction Co.	Depot	yes	no
Kos09	Tofol		Landfill	no	yes
Kos10	Tafunsak		Landfill	no	yes

FSM (POHNPEI)

Site	Location	Site Owner	Site Activity	Surplus Chemicals	Contamination
Pohn01	Kolonia	Pohnpei Hospital		yes	no
Pohn02	Kolonia	Pohnpei Utility Corporation	Power station & maintenance yard	yes	yes
Pohn03	Kolonia		Landfill	yes	yes
Pohn04	Madolenihmw	Pohnpei Agricultural & Technical school	Agricultural chemical store	yes	no
Pohn05		US Military Civil Action Team	Depot	yes	no
Pohn06	Kolonia	Department of Agriculture	Storage shed	yes	yes
Pohn07	Kolonia	Department of Agriculture	ex-Japanese communications building	yes	yes
Pohn08		Private land	Former CCA plant	no	no
Pohn09			Former power plant closed late 80s	no	yes
Pohn10	Nett	Transport Authority	Vehicle maintenance depot	no	yes
Pohn11	Palikir, Uh & Madolenihmw		Asphalt manufacturing plants	no	yes
Pohn12	Kolonia	Private land	Old hospital	yes	yes
Pohn13	Kolonia	PICS (High School)	Chemistry laboratory	yes	no
Pohn14	Kolonia	Jack Adams	Transformer stockpile	no	no

FSM (YAP)

Site	Location	Site Owner	Site Activity	Surplus Chemicals	Contamination
Yap01		State Supply Division	Warehouse	yes	no
Yap02		Yap Landfill		no	yes
Yap03		Yap Power Station	Transformers, oil disposal	yes	yes
Yap04		Department of Public Works	Depot	no	no
Yap05		Department of Agriculture	Agriculture Research Station	yes	yes
Yap06		Old Airport - asphalt dump		yes	yes
Yap07		Waab Warehouse	Chemicals store	yes	no
Yap08		Board of Education	Chemical storeroom	yes	no
Yap09		Waab Hardware		yes	no
Yap10		Loran	Former Coastguard Station	no	yes
Yap11		Mobil	Bulk Fuel Depot	no	yes
Yap12		Quarantine Division	Depot	no	no
Yap13		Marine Resources Division	Depot	no	no
Yap14		Micronesian Petroleum Company	Bulk Fuel Depot	no	no
Yap15		Public Transportation Service	Depot	no	no
Yap16		Public Bus Company	Depot	yes	no
Yap17		Yap State Hospital		no	no
Yap18		Black Micro Construction	Depot	no	no
Yap19		Yap High School		no	no

KIRIBATI

Site	Location	Site Owner	Site Activity	Surplus Chemicals	Contamination
Kir01	Tanaea	Animal Health Unit	Chemical storage shed	yes	yes
Kir02	Bonriki Airport	Private land	Asphalt dump	yes	yes
Kir03	Bonriki Airport	Beach	Asphalt dump	yes	yes
Kir04	Bikenibue	Amak Women's Unit	Chemical storage	yes	no
Kir05	Betio		Power Station	yes	yes
Kir06	Bikenibue	Tarawa Teacher's College	Chemical storeroom	yes	no
Kir07	Bikenibue	Agricultural Unit	Chemical storage shed	yes	no
Kir08	Bikenibue	Handicraft Centre	Former agriculture store	yes	possible
Kir09	Betio	Public Vehicle Unit	Depot	no	yes
Kir10	Bikenibue	Tarawa Hospital	Laboratory	yes	no
Kir11	Bikenibue		Power Station	no	yes
Kir12	Bikenibue		Landfill	no	yes
Kir13	Betio		Landfill	no	yes
Kir14	Abemema Island		Former timber treatment site	no	minor
Kir15	Aranuka Island		Former timber treatment site	no	minor
Kir16	Nanous Island		Former timber treatment site	no	minor
Kir17	Canton Island		Former quarantine station	yes	yes
Kir18	Banana, Christmas Is.	Linnex Public Works Division	Asphalt disposal	yes	yes
Kir19	Christmas Island	Division of Agriculture	Fertiliser storage	yes	no
Kir20	Christmas Island	Former US Defence camp	General waste disposal	no	yes
Kir21	London, Christmas Is.		Former British bulk fuel store	no	yes
Kir22	Christmas Island		Transformer oil storage	yes	no

Marshall Islands

Site	Location	Site Owner	Site Activity	Surplus Chemicals	Contamination
Marsh01	Arno	Department of Agriculture	Research farm	yes	no
Marsh02	Majuro	Ministry of Public Works	Vehicle workshops	no	yes
Marsh03	Majuro	Majuro Dry Dock Inc.	Ship repairs	no	yes
Marsh04	Kwajalein	Unlabelled	WW2 oil/fuel depot	yes	yes
Marsh05	Majuro	Mobil Oil	Oil depot	yes	no
Marsh06	Majuro	Air Marshall Islands	Aircraft servicing	yes	yes

Nauru

Site	Location	Site Owner	Site Activity	Surplus Chemicals	Contamination
Nau01	Aiwo	Nauru Phosphate Corp (NPC)	Hazardous goods store	yes	no
Nau02	Buada	NPC	Waste dump	no	yes
Nau03	Buada	NPC	Waste dump	yes	minor
Nau04	Buada	NPC	Waste dump	yes	yes
Nau05	Nibok	NPC	Field workshop	yes	yes
Nau06	Denigomodu	Government Stores	Warehouse	yes	no
Nau07	Aiwo	NPC	Oil storage	no	yes
Nau08	Aiwo - No. 2 Bin	NPC	Equipment store	yes	yes
Nau09	Aiwo	NPC	Power Station	yes	minor

NIUE

Site	Location	Site Owner	Site Activity	Surplus Chemicals	Contamination
Nu01	Alofi	Department of Public Works	Storage shed/Public Works depot	yes	no
Nu02	Vaipapahi	Department of Agriculture	Research farm	yes	no
Nu03	Alofi	Department of Health	Hospital	yes	no
Nu04	Alofi	Department of Agriculture	Ex piggery	yes	no
Nu05	Alofi	Department of Public Works	Heavy plant maintenance	no	yes
Nu06	Alofi	Niue Power Company	Power station	yes	no

PALAU

Site	Location	Site Owner	Site Activity	Surplus Chemicals	Contamination
Pal01	Aimeliik		Power Station	no	yes
Pal02(a)	Various		Small Power Stations	no	minor
Pal02(b)	Ngadmau		Power Station	no	yes
Pal03		PUC	Storeroom	yes	no
Pal04		Koror State Public Works	Depot	yes	no
Pal05	Ngatpang		DDT disposal site	yes	yes
Pal06	M-Dock		Warehouse	yes	no
Pal07	Malakal		Quarry	no	no
Pal08	Ngerbeched		Landfill	no	yes
Pal09	Harbour		Abandoned dredge	yes	yes
Pal10		Socio Construction Co.	Depot	no	no
Pal11			Agriculture research	no	no
Pal12			Entomology Research	yes	no

Site	Location	Site Owner	Site Activity	Surplus Chemicals	Contamination
Pal13	Palau High School		Laboratory	yes	no
Pal14	Hospital		Laboratory & pharmacy	yes	no
Pal15			Science demonstration laboratory	yes	no
Pal16		National Public Works	Depot	no	no
Pal17	Sewage plant		Storage shed	yes	no
Pal18	Ngatpang rainforest		Chemicals disposal site	yes	yes
Pal19		Black Micro Construction	Depot	yes	no
Pal20	Peleliu		Landfill	no	yes
Pal21	Anguar		Landfill	no	yes

Samoa

Site	Location	Site Owner	Site Activity	Surplus Chemicals	Contamination
Sam01	Vaitele	Bluebird Transport Ltd	Ex timber treatment site	no	yes
Sam02	Nu'u	Ministry of Agriculture	Agriculture research & extension	yes	yes
Sam03	Savalalo, Apia	S C Percival Ltd	Pest control chemicals	yes	no
Sam04	Apia	Department of Health	National Hospital	yes	no
Sam05	Vailima	Ministry of Agriculture	Livestock development	yes	no
Sam06	Apia	Education Department (CDU)	Curriculum Development	yes	no
Sam07	Viatele	Electric Power Corporation	Maintenance base	yes	yes
Sam08	Vailima	Electric Power Corporation	Power station	no	yes
Sam09	Tafaigata	Department of Environment & Conservation	Apia landfill	no	yes
Sam10	Apia	Agriculture Stores Corporation	Agriculture chemical & other retail	no	yes
Sam11	Vaitele	Agriculture Store Corporation	Agriculture chemical & other	no	yes
Sam12	Asau	Ministry of Agriculture / Forestry Division	Forestry office	yes	no
Sam13	Asau	Ministry of Agriculture / Forestry Division	Forestry nursery	yes	no
Sam14	Maota	Ministry of Agriculture / Forestry Division	Forestry office	yes	no
Sam15	Asau	Samoa Forest Corporation Ltd	Timber mill	yes	yes
Sam16	Salelologa	Electric Power Corporation	Power station	yes	yes
Sam17	Savaii (2)	Electric Power Corporation	Power station	yes	yes

Solomon Islands

Site	Location	Site Owner	Site Activity	Surplus Chemicals	Contamination
Sol01	Honiara	Metapona Plains	Storage Shed on Rice Farm	yes	yes
Sol02	Honiara (Ranadi)	Min. of Health & Medical Services (MHMS)	Rural Water Supply Shed	yes	yes
Sol03	Munda	MHMS Store	Store	no	yes
Sol04	Honiara	Geology Laboratory	Laboratory & Storage	no	yes
Sol05	Honiara	Fisheries Store	Store	no	yes
Sol06	Honiara	Baitfish Laboratory	Laboratory	no	yes
Sol07	Honiara	Broadcasting Site	Radio Transmitting Site	yes	yes
Sol08	Gizo			yes	yes
Sol09	Ranadi	Solomons Islands Electricity Authority (SIEA)	Power station	yes	no
Sol10	Ranadi	MHMS	Hardware Shed	yes	yes
Sol11	Gizo	MHMS	Hospital / malaria control	yes	no
Sol12	Gizo	Department of Agriculture	Store	no	no
Sol13	Gizo	SIEA	Power station	yes	yes
Sol14	Liapari Is.		Store	no	no
Sol15	Noro, Munda	Solomon Taiyo Ltd.	Fish processing	yes	no

Tonga

Site	Location	Site Owner	Site Activity	Surplus Chemicals	Contamination
Tong01	Nukualofa	Tonga EPB & Shoreline Power	Power station	yes	yes
Tong02	Nukualofa	MOW testing station	Vehicle servicing	no	yes
Tong03	Nukualofa	Government Stores	Ex DPW timber treatment site	no	yes

TUVALU

Site	Location	Site Owner	Site Activity	Surplus Chemicals	Contamination
Tuva01	Funafuti	Tuvalu Electric Power Corp	Electricity generation	yes	yes
Tuva02	Funafuti	Ministry of Health	Hospital laboratory	yes	no
Tuva03	Funafuti	Department of Agriculture	Storage shed (wharf)	yes	no
Tuva04	Funafuti	Public Works	PW Depot	yes	yes
Tuva05	Amatuku	Department of Health	Maritime School	no	yes
Tuva06	Vaitupu	Tuvalu Electric Corporation	Power station	no	yes
Tuva07	Vaitupu	Department of Education	Secondary school	yes	no
Tuva08	Funafuti	Ministry of Health	Hospital	yes	no
Tuva09	No. 2 Hangar	Funafuti Traders	Storage shed	yes	no

VANUATU

Site	Location	Site Owner	Site Activity	Surplus Chemicals	Contamination
Van01	Tabage, Port Vila	Quarantine Store	Fumigation & Quarantine	yes	yes
Van02	Luganville	Quarantine Store	Fumigation & Quarantine	yes	yes
Van03	Espiritu Santo	Chapuis, Store 1	Agricultural Station	yes	yes
Van04	Espiritu Santo	Chapuis - Old Store	Agricultural Store	yes	yes
Van05	Luganville	Santo Veneer & Timber	Sawmill	yes	yes
Van06	Espiritu Santo	Bush Site	Timber Preservation	yes	yes
Van07	Espiritu Santo	Coconut Products Ltd	Soap Manufacture	no	yes
Van08	Luganville	Melcoffe Timber	Sawmill & Timber Preservation	yes	yes
Van09	Luganville Hospital		Environmental Health Store	yes	no
Van10	Espiritu Santo	French Agricultural Station	Agriculture research	yes	no

Site	Location	Site Owner	Site Activity	Surplus Chemicals	Contamination
Van11	Port Vila	UNELCO	Power generation	yes	no
Van12	Espiritu Santo	UNELCO	Power generation	yes	no
Van13	Port Vila		Landfill	no	no
Van14	Espiritu Santo		Landfill	no	no
Van15	Port Vila	Rainbow Gardens	Market Gardens	no	no
Van16	Port Vila	Teouma Market Gardens		no	no
Van17	Espiritu Santo		Former forestry research station	no	no

Annexes B.2, B.3 & B.4 - Chemicals Identified in the Surveys

The chemicals database for the POPs in PICs report contains over 600 entries including about 300 individual chemicals. Reports generated from this database are as follows:

Chemicals - Master Copy	This is a record of all 600 entries. It is not attached to this report due to its length (65 pages) but is available upon request.
Pesticides	This report is given in Annex B2 and contains all materials commonly referred to as pesticides.
Hydrocarbons	This report includes oils and bitumen, and is given in Annex B3.
Miscellaneous Chemicals	This report is given in Annex B4, and contains all materials not listed above and includes fertilisers and timber treatment chemicals.

Annex B.2: Pesticides

Cook Islands

Site ID	Chemical Name	Brand Name	Type	Quantity kg	Quantity litres	Other	Condition	Disposal Options	Comments
Cook01	Sulphur		Fungicide	500.0			Useable	Land application	Given away for local use
Cook02	Dieldrin	Dieldrite 25 EC	Insecticide		80.0	5 drums	Ok	Off-island disposal	Listed in POPs Convention
Cook02	Methabenzthiazuron	Tribunil	Herbicide	1.0		1 packet	Poor	Off-island disposal	
Cook02	Simazine	Simazine 50 SC	Herbicide		5.0	1 bottle	Ok	Off-island disposal	
Cook02	Mancozeb	Dithane M45	Fungicide	100.0		4 sacks	Poor	Land application	
Cook02	Mancozeb/metalaxyl	Ridomil M78	Fungicide	160.0		8 sacks	Poor	Land application	
Cook02	2,4,5-T ester		Herbicide		1.0	1 bottle	Ok	Off-island disposal	Listed in PIC Convention
Cook02	Oxamyl	Vydate	Insecticide		10.0	2 bottles	Ok	Off-island disposal	
Cook02	Lenocil	Venzar 80%		0.5		1 packet	Ok	Off-island disposal	
Cook02	Benomyl	Benlate 50%	Fungicide	3.5		4 packets	Ok	Off-island disposal	
Cook02	Metribuzin	Sencor	Herbicide		0.1	1 bottle	Poor	Off-island disposal	
Cook02	Carbaryl	Sevin	Insecticide	0.1		10 cartridges	Ok	Off-island disposal	
Cook02	Terbacil	Sinbar 80%	Herbicide	4.5		9 packets	Ok	Off-island disposal	
Cook02	Phosamid	Krenite 48%	Herbicide		4.0	1 bottle	Ok	Off-island disposal	
Cook02		Devrinoll 50	Herbicide		2.0	1 packet	Ok	Off-island disposal	
Cook02	Unlabelled liquid			5.0		1 bottle	Poor	Off-island disposal	
Cook02	Aldicarb	Termic 10%	Insecticide	1.0		1 packet	Poor	Off-island disposal	WHO Class 1A
Cook02	Carbaryl	Septan 80W	Insecticide	0.5		1 packet	Poor	Off-island disposal	
Cook02	Cyfuthrin	Baythroid 5%	Insecticide		1.0	1 bottle	Ok	Off-island disposal	
Cook02	Sulphur		Fungicide		270.0	12 sacks	Ok	Local use	
Cook02	Lindane 50W	BHC	Insecticide	21.0		11 packets	Ok	Off-island disposal	Listed in PIC Convention
Cook02	Permethrin	Ambush	Insecticide		1.0	1 can	Rusty	Off-island disposal	
Cook02	Unlabelled powder			25.0		1 sack	Poor	Off-island disposal	
Cook02	Atrazine	Actazine 80	Herbicide	3.0		2 packets	Poor	Off-island disposal	
Cook02	Chlorpiryfos	Lorsban 4 E	Insecticide		2.0	1 bottle	Ok	Off-island disposal	
Cook02	Simazine	Gesatop 80	Herbicide	2.0		1 packet	Ok	Off-island disposal	

Site ID	Chemical Name	Brand Name	Type	Quantity kg	Quantity litres	Other	Condition	Disposal Options	Comments
Cook02	Trifluralin	Treflane	Herbicide		2.0	1 bottle	Ok	Off-island disposal	
Cook02	Copper sulphate		Fungicide	20.0		2 bags	Ok	Local use	
Cook02	Biertanol	Baycor EC 300	Fungicide		1.0	1 bottle	Ok	Off-island disposal	
Cook02	Dinocap	Karathane WD	Fungicide	1.0		1 packet	Ok	Off-island disposal	
Cook02	Bentazone	Basagran	Herbicide	6.0		2 bottles	Poor	Off-island disposal	
Cook02	Unlabelled black liquid			0.8	1 bottle	Ok	Off-island disposal		
Cook02	Lime-sulphur		Fungicide		20.0	1 can	Ok	Local use	
Cook02		Nemacor P	Nematocide		1.0	1 bottle	Ok	Off-island disposal	
Cook02		Multiprop			2.0	2 bottles	Poor	Off-island disposal	
Cook02	Permethrin	Ambush 10 EC	Insecticide		6.0	3 bottles	Ok	Off-island disposal	
Cook02		Counter 10G	Insecticide		6.0	2 cans	Poor	Off-island disposal	
Cook02	Diazinon	Diazinon 50W	Insecticide	8.0		4 packets	Ok	Off-island disposal	
Cook02	Naphthyl acetic acid	Planofix	Plant growth regulator		40.0	400 bottles	Poor	Off-island disposal	
Cook02	Copper oxide	Perenox	Fungicide	25.0		5 cans	Poor	Local use	
Cook02	Dasomet	Basamid	Fumigant	12.0		6 packets	Ok	Off-island disposal	
Cook02	Propiconazole	Tilt 250 EC	Fungicide		1.0	1 bottle	Ok	Off-island disposal	
Cook02	2,4-D amine	Herbicide			5.0	1 bottle	Ok	Off-island disposal	
Cook02	Chlorothanil	Bravo	Fungicide		0.2	1 bottle	Ok	Off-island disposal	
Cook02	Unlabelled powder			2.0		3 packets	Poor	Off-island disposal	
Cook02	Unlabelled liquid				3.0	3 bottles	Poor	Off-island disposal	
Cook02	Diazinon	Basudin 50	Insecticide	2.0		2 packets	Ok	Off-island disposal	
Cook02	2,4-D ester	2,4-D ester 80%	Herbicide		10.0	2 bottles	Ok	Off-island disposal	
Cook02	Aluminium phosphide	Phostoxin	Fumigant	65.0		65 bottles	Ok	Off-island disposal	
Cook02		Nemazon 75%		20.0		1 can	Ok	Off-island disposal	
Cook02	Chlorothanil	Bravo W75	Fungicide	25.0		1 drum	Ok	Off-island disposal	
Cook02	Unlabelled powder		Fungicide	50.0		2 sacks	Ok	Off-island disposal	
Cook02	Izasofos	Miral 10g	Nematocide	0.5		1 packet	Ok	Off-island disposal	
Cook02		Allisan	Fungicide	2.0		1 packet	Ok	Off-island disposal	
Cook02	Chlorpyrifos	Chlorpyrofos	Insecticide	10.5		7 cans	Ok	Off-island disposal	
Cook02	Quintozene	Brassicol 75W	Fungicide	1.0		1 packet	Poor	Off-island disposal	
Cook02	Metsulfuron	Escort	Herbicide	0.3		1 jar	Ok	Off-island disposal	
Cook02	Methiocarb	Mesurol 2%	Snail bait	0.5		1 jar	Ok	Off-island disposal	
Cook02	Unlabelled liquid				1.0	1 bottle	Poor	Off-island disposal	
Cook02	Diphenamid	Enide 50W	Herbicide	0.3		3 jars	Ok	Off-island disposal	

Site ID	Chemical Name	Brand Name	Type	Quantity kg	Quantity litres	Quantity Other	Condition	Disposal Options	Comments
Cook02	Glyphosate	Sting	Herbicide		1.0	1 bottle	Poor	Off-island disposal	
Cook02	Dimethoate	Rogor	Insecticide		5.0	1 can	Ok	Off-island disposal	
Cook02	Nitrofen	TOK 2	Herbicide		2.0	1 can	Poor	Off-island disposal	
Cook02	Sulphur		Fungicide	270.0		12 sacks	Ok	Local use	
Cook02	Bacillus thurigenisis	BTK	Insecticide	5.5		6 packets	Ok	Off-island disposal	
Cook02	Chlorthal	Herbicide		5.0		2 packets	Ok	Off-island disposal	
Cook02	Propachlor	Ramrod 50%	Herbicide	0.2		1 packet	Poor	Off-island disposal	
Cook02	Kepone 5%			1.0		1 packet	Poor	Off-island disposal	
Cook02	Delsene M200				10.0	1 bottle	Poor	Off-island disposal	
Cook02	Prothios	Tokuthion	Insecticide		1.0	1 can	Rusty	Off-island disposal	
Cook02	Carbendazim	Bavistin	Fungicide	1.0		1 packet	Poor	Off-island disposal	
Cook02	Benodanile	Calirus 50%	Fungicide	0.5		1 packet	Poor	Off-island disposal	
Cook02	Unlabelled powder		Soil sterilant	3.0		3 jars	Ok	Off-island disposal	
Cook02	Tridemorph	Calixin	Fungicide		0.5	1 bottle	Poor	Off-island disposal	
Cook02	Oxadizon	Foresite	Herbicide		2.0	2 bottles	Ok	Off-island disposal	
Cook02		Copac E			0.4	1 bottle	Ok	Off-island disposal	
Cook02	Atrazine	Actazine 50%	Herbicide		2.5	1 can	Leaking	Off-island disposal	
Cook02	Planavin 75		Herbicide	2.5		1 packet	Ok	Off-island disposal	
Cook02	Methamiphos	Monitor 60%	Insecticide		2.5	1 can	Poor	Off-island disposal	
Cook02	Unlabelled liquid				5.0	1 can	Poor	Off-island disposal	
Cook02	Iprodione	Rovral 50%	Fungicide	0.5		1 packet	Poor	Off-island disposal	
Cook02	Triadimefon	Bayleton 12%	Fungicide	0.5		1 packet	Poor	Off-island disposal	
Cook02	Ioxynil	Totrill	Herbicide		5.0	1 bottle	Poor	Off-island disposal	
Cook02	Chlorbufan/ Chloridazon	Alicep	Herbicide	2.5		1 packet	Ok	Off-island disposal	
Cook02	Fenarimol	Rubigan	Insecticide		1.0	1 bottle	Poor	Off-island disposal	
Cook02	Chlorthal	Dacthal 75W	Herbicide	5.0		1 packet	Poor	Off-island disposal	
Cook02	Propyzamide	Kerb 50W	Herbicide	0.2		1 jar	Ok	Off-island disposal	
Cook02	Unlabelled powder			250.0		8 sacks	Poor	Off-island disposal	
Cook04	Ethylene dibromide	EDB	Fumigant		400.0	2 drums	Ok	Off-island disposal	Listed in PIC Convention
Cook13	Aluminium phosphide	Phostoxin	Fumigant	25.0			Poor	Local disposal	
Cook13	Unlabelled liquids				22.0	2 cans	Poor	Off-island disposal	
Cook14	Copper sulphate		Fungicide	1000.0		20 sacks	Ok	Local use	
Cook14		Larvicide	Soil fumigant		100.0	5 drums	Poor	Off-island disposal	
Cook14	Sulphur		Fungicide	750.0		16 sacks	Ok	Local use	

Site ID	Chemical Name	Brand Name	Type	Quantity kg	Quantity litres	Other	Condition	Disposal Options	Comments
Cook14	Carbofuran	Furadan	Insecticide	750.0		30 sacks	Ok	Off-island disposal	
Cook14	Feanamiphos	Nemacur 10G	Nematicide	650.0		26 bags/drums	Poor	Off-island disposal	WHO Class 1A
Cook14	Oxamyl	Vydate L	Insecticide		320.0	80 bottles	Ok	Off-island disposal	
Cook17		Redicote N-606			300.0		Ok	Off-island disposal	
Cook17	Iron sulphate		Soil nutrient	2000.0			Ok	Land application	
Cook17	Copper sulphate		Fungicide	1000.0			Ok	Local use	
Cook17	Potash		Fertiliser	2000.0			Ok	Local use	
Cook17	Ammonium Nitrate		Fertiliser	350.0			Ok	Local use	
Cook17	Mancozeb	Maneb 80	Fungicide	50.0			Ok	Off-island disposal	
Cook17	Diazinon 20P		Insecticide	12.0			Ok	Off-island disposal	
Cook17		Fusillade		15.0			Ok	Off-island disposal	
Cook17	Malathion		Insecticide		750 0		Ok	Off-island disposal	
Cook17		Cops Ban 50W			7.5		Ok	Off-island disposal	
Cook17		OC Oil			7.0		Ok	Off-island disposal	
Cook17		Kocide 101		2.0			Ok	Off-island disposal	
Cook17		Dysol 20		2.0			Ok	Off-island disposal	
Cook17		Karmex		2.0			Ok	Off-island disposal	
Cook17	Potassium Sulphate		Fertiliser	150.0			Ok	Local use	
Cook17		Stabiliser 260605		50.0			Ok	Off-island disposal	
Cook17	DDT		Insecticide	20.0		1 drum	Ok	Off-island disposal	Listed in POPs Convention
Cook18		Cops Ban 50W		7.5			Ok	Off-island disposal	
Cook18		Ridomil			130.0	13 buckets	Ok	Off-island disposal	
Cook18		Karmex		20.0		8 pkts.	Ok	Off-island disposal	
Cook18		Hyvarx		135.0		9 cartons	Ok	Off-island disposal	
Cook18		Fertilon Canbi		20.0		1 bag	Ok	Off-island disposal	
Cook18	Borax		Nutrient	50.0		10 bags	Ok	Local use	
Cook18		Lorsban	Herbicide	50.0		1 bag	Ok	Off-island disposal	
Cook18		Basidin		10.0		1 bag	Ok	Off-island disposal	
Cook18		Plantofix	Fertiliser		15.6		Ok	Local use	
Cook18	Malathion		Insecticide	20.0		10 pkts	Ok	Off-island disposal	
Cook18		Attack	Herbicide		2.0		Ok	Off-island disposal	
Cook18		Milcurb			5.0		Ok	Off-island disposal	
Cook18	Diazinon		Insecticide		2.0	2 pkts	Ok	Off-island disposal	
Cook18		Misting oil			40.0	2 bottles	Ok	Local use	

Site ID	Chemical Name	Brand Name	Type	Quantity kg	Quantity litres	Quantity Other	Condition	Disposal Options	Comments
Cook18	Unlabelled			5.6		16 pkts	Ok	Off-island disposal	
Cook18	Urea		Fertiliser	320.0		9 sacks	Ok	Local use	
Cook18	Superphosphate		Fertiliser	160.0		4 sacks	Ok	Local use	
Cook18	Sulphate of Ammonia	Fertiliser	200.0		5 sacks	Ok	Local use		
Cook18	Borax		Fertiliser	680.0		17 sacks	Ok	Local use	
Cook18	Blood & Bone		Fertiliser	120.0		3 sacks	Ok	Local use	
Cook18	Sulphate		Nutrient	10.0		1 sack	Ok	Local use	
Cook18	Unlabelled		Fertiliser	20.0			poor	Land application	

Fiji

Site ID	Chemical Name	Brand Name	Type	Quantity kg	Quantity litres	Quantity Other	Condition	Disposal Options	Comments
Fj01	Carbaryl	Sevin	Insecticide	2250.0		1,500 pkts	Ok	Off-island disposal	
Fj01	Carbaryl	Sevin 80%	Insecticide	723.0		482 pkts	Ok	Off-island disposal	
Fj01	Trichlorfon	Dicidex	Insecticide		2422.0	2422 bottles	Leaking	Off-island disposal	
Fj01	Acephate	Orthene	Insecticide	414.2		5522 pkts	Ok	Lime treatment	
Fj01	Propanil	Riceclean	Herbicide		4656.0	1164 cans	Fair	Off-island disposal	
Fj01	Malathion	Malathion	Insecticide		100.0	Poor	Ok	Off-island disposal	Has been repacked
Fj01	Propanil		Herbicide		48.0		Ok	Off-island disposal	
Fj01	Atrazine	Gesaprim 80	Herbicide	14.0			Poor	Off-island disposal	
Fj02	Fumazone		Nematicide		180.0	9 cans	Poor	Lime treatment	
Fj02	Mancozeb	Maneb	Fungicide	2200.0		100 sacks	Broken	Land application	
Fj02	X-55		Solvent	360.0		18 drums	Fair	Local use	
Fj03	Trichlorfon	Dicidex	Insecticide		21.0	21 cans	Poor	Off-island disposal	
Fj03	Carbaryl	Sevin	Insecticide	48.0		32 bags	Fair	Off-island disposal	
Fj03	Propanil	Riceclean 1	Herbicide		156.0	39 cans	Fair to poor	Off-island disposal	
Fj04	Isoprocarb	ETRO	50% powder	3000.0		2000 bags	Mostly good	Off-island disposal	
Fj06	Trichlorfon	Dicidex	Insecticide	3585.0		2390 bags	Poor, leaking	Off-island disposal	

Site ID	Chemical Name	Brand Name	Type	Quantity kg	Quantity litres	Quantity Other	Condition	Disposal Options	Comments
Fj06	Carbaryl	Sevin	Insecticide	484.5		323 pkts	Good	Off-island disposal	
Fj07	Propanil	Riceclean	Herbicide		16.0	4 cans	Poor	Off-island disposal	
Fj07	Carbaryl	Sevin	Insecticide	350.0		700 pkts	Poor	Off-island disposal	
Fj07	Carbaryl	Sevin	Insecticide	483.0		322 pkts	Good	Off-island disposal	
Fj07	Trichlorfon	Dicidex	Insecticide	730.0		730 pkts	Poor	Off-island disposal	
Fj08	Beromyl	Benlate	Fungicide	1.0		1 pkt	Ok	Off-island disposal	
Fj08	Bugcor			1.0		1 pkt	Poor	Off-island disposal	
Fj08	Chlorothalonil	Bravo			1.0	1 bottle	Poor	Off-island disposal	
Fj08	Flusaiazol	Punch			0.3	1 bottle	Open	Off-island disposal	
Fj08	Unlabelled				4.0	4 bottles	Open	Off-island disposal	
Fj08		A3953E			1.0	1 bottle	Ok	Off-island disposal	
Fj08	Oxadiazon	Ronstarflo	Herbicide		2.0	2 bottles	Ok	Off-island disposal	
Fj08	Carbaryl	Sevin	Insecticide	3.0		2 pkts	Ok	Off-island disposal	
Fj08	Chlorothalonil	Bravo	Fungicide		2.0	1 can	Ok	Off-island disposal	
Fj08	Metalaxyl	Ridomil	Fungicide	2.0		1 bag	Poor	Off-island disposal	
Fj08	Oxadiazon	Ronstar	ex Israel		1.0	1 bottle	Poor	Off-island disposal	
Fj08	Benomyl	Benlate	Fungicide	2.0		1 bag	Poor	Off-island disposal	
Fj08	Unlabelled	Powder		4.0		1 bag	Poor	Off-island disposal	
Fj08	Unlabelled	Liquid		2.0		2 bottles	Ok	Off-island disposal	
Fj08	Endosulfan		Insecticide		4.0	1 can	Poor	Off-island disposal	
Fj08	Unlabelled				4.0	2 cans	Ok	Off-island disposal	
Fj08	Dimethoate	Rogor	Insecticide		1.0	1 bottle	Ok	Off-island disposal	
Fj08	Penconatole	Topas			2.0	1 bottle	Poor	Off-island disposal	
Fj08	Proprineb	Antracol	Fungicide	2.0		2 pkts	Poor	Off-island disposal	
Fj08	Iprodine	Rovral	Fungicide		1.0	1 bottle	Fair	Off-island disposal	
Fj08	Methomyl	Lannate	Insecticide		4.0	2 cans	Poor	Off-island disposal	
Fj08	Unlabelled				1.0	1 bottle	Poor	Off-island disposal	
Fj08	Dicofol	Mithgan			1.0	1 bottle	Poor	Off-island disposal	
Fj08	Cyfluthrin	Baythrome			1.0	1 bottle	Poor	Off-island disposal	
Fj08	Eplain				4.0	1 can	Poor	Off-island disposal	
Fj09	Unlabelled			3.0		1 bag	Ok	Off-island disposal	
Fj09	Unlabelled		Nematacide	20.0		1 sack	Ok	Off-island disposal	
Fj09	Unlabelled				1.0	1 bottle	Ok	Off-island disposal	
Fj09	Isoprocarb	Etro 50	Insecticide		2.0	2 bottles	Good	Off-island disposal	

Site ID	Chemical Name	Brand Name	Type	Quantity kg	Quantity litres	Quantity Other	Condition	Disposal Options	Comments
Fj09	Unlabelled				12.0	3 PE cans	Ok	Off-island disposal	
Fj09	Thiobencarb	Saturn 50	Herbicide		3.0	3 bottles	Good	Off-island disposal	
Fj09	Thiobencarb	Saturn	Herbicide		1.0	1 bottle	Good	Off-island disposal	
Fj09	Cypermethrin	Cymbush 3ED	Insecticide		1.0	1 bottle	Good	Off-island disposal	
Fj09	Unlabelled				12.0	3 cans	Ok	Off-island disposal	
Fj09	Dimethoate	Rogor	Insecticide		4.0	1 can	Poor	Off-island disposal	
Fj09	Trichlorfon	Tridex	Insecticide		5.0	1 can	Good	Off-island disposal	
Fj09		Terracoat 5D			1.0	1 bottle	Ok	Off-island disposal	
Fj09	Trichlorfon	Dicidex	Insecticide		6.0	6 bottles	Ok	Off-island disposal	
Fj09		MLPL		0.4		1 pkt	Ok	Off-island disposal	
Fj09		Ammophos		8.0		4 pkts	Ok	Off-island disposal	
Fj09	Propanil	Riceclean 1	Herbicide		4.0	1 can	Good	Off-island disposal	
Fj09		Pyrinex Jolt CA			1.0	1 bottle	Ok	Off-island disposal	
Fj09	Fosetyl	Aliette	Insecticide	5.0		1 bag	Poor	Off-island disposal	
Fj09		Kilral			1.0	1 bottle	Good	Off-island disposal	
Fj09	Carbaryl	Septene 80	Insecticide	4.5		3 pkts	Poor	Off-island disposal	
Fj09		Sopra			1.0	1 bottle	Fair	Off-island disposal	
Fj09		Aerophos		15.0		1 sack	Ok	Off-island disposal	
Fj09	Copper oxychloride	Cobox 34% EC	Fungicide		3.0	3 botte	Ok	Local use	
Fj09		Primex			4.0	1 can	Poor	Off-island disposal	
Fj09	Permethrin	Ambush 10 EC	Insecticide		1.0	1 bottle	Ok	Off-island disposal	
Fj09	Carbenazim	Bavistin FL	Fungicide		1.0	1 bottle	Ok	Off-island disposal	
Fj09		Brestambo		2.0		2 pkt	Fair	Off-island disposal	
Fj09	Metribuzin	Sencor WP 70	Herbicide	2.0		1 pkt	Ok	Off-island disposal	
Fj09	2,4-D ester	Imputox			4.5	1 can	Good	Off-island disposal	
Fj09	Metalaxyl	Ridomil WP 45	Fungicide	2.0		1 pkt	Poor	Off-island disposal	
Fj09		Beadex		1.0		1 pkt	Ok	Off-island disposal	
Fj09	Triadimefon	Bayleton	Fungicide, ex		2.0	2 bottles	Ok	Off-island disposal	
Fj09	Chlormequat	Cycocel 750	Plant growth		1.0	1 bottle	Good	Off-island disposal	
Fj09	Vinclozolin	Ronilan FL	Fungicide	1.0		1 pkt	Ok	Off-island disposal	

FSM (CHUUK)

Site ID	Chemical Name	Brand Name	Type	Quantity kg	Quantity litres	Other	Condition	Disposal Options	Comments
Chk01		Vapam	Soil Fumigant		70.0		Poor	Off-island disposal	(All Chk01 stocks were)
Chk01	Bacillus thuringiensis	Dipell	Insecticide	35.0			Poor	Off-island disposal	(packed into drums in 1994)
Chk01	Unlabelled Powder			10.0			Poor	Off-island disposal	
Chk01	Chlorthal	Dacthal W-75	Herbicide	31.0			Poor	Off-island disposal	
Chk01	Sulphur	Flotox		8.0			Poor	Off-island disposal	
Chk01	Diuron	Karmex	Herbicide	114.0			Poor	Off-island disposal	
Chk01	Unlabelled Liquid				24.0		Poor	Off-island disposal	
Chk01	Metaldehyde/ Chlordane		Molluscide		10.0		Poor	Off-island disposal	
Chk01		Premise	Disinfectant		4.0		Poor	Off-island disposal	
Chk01	Captan	Ortho	Fungicide		100.0		Poor	Off-island disposal	
Chk01	Methyl Bromide				5.0		Poor	Off-island disposal	Ozone depleter
Chk01	Malathion 95%	Fyfanon	Insecticide		40.0		Poor	Off-island disposal	
Chk01	Ethepon				8.0		Poor	Off-island disposal	
Chk01	Dimethoate	Dimethoate	Insecticide		48.0		Poor	Off-island disposal	
Chk01		Zerlate		12.0			Poor	Off-island disposal	
Chk01	Dimethoate	Cygon	Insecticide	45.0			Poor	Off-island disposal	
Chk01		Phenolic	Disinfectant	0.1			Poor	Off-island disposal	
Chk01	1-napthylacetamide	Fruitone	Plant growth reg.	0.3			Poor	Off-island disposal	
Chk01	Quintozene	Terraclor 75%	Fungicide	50.0			Poor	Off-island disposal	
Chk01		Marlate		4.1			Poor	Off-island disposal	
Chk01		Ortho	Fly Bait	6.0			Poor	Off-island disposal	
Chk01	Captan	Orthocide	Fungicide	131.0			Poor	Off-island disposal	
Chk01	Parathion	Parathion	Insecticide	22.0			Poor	Off-island disposal	WHO Class 1A
Chk01	1-napthylacetic acid	Rootone	Plant growth reg.	0.1			Poor	Off-island disposal	
Chk01		Tomato dust	Fungicide	4.0			Poor	Off-island disposal	
Chk01	Carbaryl	Sevin 50	Insecticide	2.0			Poor	Off-island disposal	
Chk01	Captan	Captan 50 WP	Fungicide	31.0			Poor	Off-island disposal	
Chk01		Tersan 75		12.0			Poor	Off-island disposal	
Chk01	Mancozeb	Manzate	Fungicide	11.0			Poor	Off-island disposal	
Chk01	Streptomycin	Agrimycin		4.5			Poor	Off-island disposal	
Chk01		Banrot 40% WP	Fungicide	7.0			Poor	Off-island disposal	

Site ID	Chemical Name	Brand Name	Type	Quantity kg	Quantity litres	Quantity Other	Condition	Disposal Options	Comments
Chk01	Benomyl	Benlate		14.0			Poor	Off-island disposal	
Chk01		Blossom Set		0.2			Poor	Off-island disposal	
Chk01	Bordeaux mixture			17.3			Poor	Off-island disposal	
Chk01		Semesan	Turf Fungicide	2.0			Poor	Off-island disposal	

FSM (Pohnpei)

Site ID	Chemical Name	Brand Name	Type	Quantity kg	Quantity litres	Quantity Other	Condition	Disposal Options	Comments
Pohn06	Diuron	Karmex	Herbicide	1.0			Poor	Off-island disposal	Drum 1, 1994
Pohn06	Dimethoate	Dimethoate	Insecticide		12.0		Poor	Off-island disposal	Drum 2, 1994
Pohn06	Diuron	Karmex	Herbicide	2.0			Poor	Off-island disposal	Drum 2, 1994
Pohn06	Chlorpyrifos		Insecticide		8.0		Poor	Off-island disposal	Drum 1, 1994
Pohn06	Phosphoric Acid				2.5		Poor	Off-island disposal	Drum 2, 1994
Pohn06	Simazin	Algi-Gon	Herbicide		2.0		Poor	Off-island disposal	Drum 1, 1994
Pohn06	Captan	Captan	Herbicide	8.0			Poor	Off-island disposal	Drum 2, 1994
Pohn06	Phosphate		Insecticide	0.5			Poor	Off-island disposal	Drum 2, 1994
Pohn06	Carbaryl	Carbaryl	Insecticide	2.0			Poor	Off-island disposal	
Pohn06	Mancozeb	Manzate	Fungicide	1.5			Poor	Off-island disposal	Drum 2, 1994
Pohn06	Carbaryl	Sevin	Insecticide	0.1			Poor	Off-island disposal	
Pohn06	Malathion	Malathion	Insecticide		6.0		Poor	Off-island disposal	Drum 2, 1994
Pohn06	2,4-D		Herbicide		4.0		Poor	Off-island disposal	Drum 2, 1994
Pohn06	Disulfoton	Di-Syston	Insecticide	1.5			Poor	Off-island disposal	WHO Class 1A
Pohn06	Unlabelled powder			2.0			Poor	Off-island disposal	Drum 2, 1994
Pohn06	Unlabelled liquid				20.0		Poor	Off-island disposal	Drum 2, 1994
Pohn06	Disulfoton	Di-Syston	Insecticide	34.0			Poor	Off-island disposal	WHO Class 1A,
Pohn06	Unlabelled liquid				4.0		Poor	Off-island disposal	Drum 3, 1994
Pohn06	Disulfoton	Di-Syston	272.0				Poor	Off-island disposal	WHO Class 1A,
Pohn06	Copper sulphate	Blue Stone	Fungicide	1.0			Poor	Local use	Drum 2, 1994
Pohn06	Captan	Captan	Insecticide	2.0			Poor	Off-island disposal	Drum 1, 1994
Pohn06	Mancozeb	Dithane	Fungicide	7.0			Poor	Off-island disposal	Drum 1, 1994

Site ID	Chemical Name	Brand Name	Type	Quantity kg	Quantity litres	Quantity Other	Condition	Disposal Options	Comments
Pohn06	Carbaryl	Carbaryl	Insecticide	0.5			Poor	Off-island disposal	
Pohn06	Malathion	Malathion	Insecticide		3.0		Poor	Off-island disposal	Drum 1, 1994
Pohn06	Diazinon	Diazinon	Insecticide	0.1			Poor	Off-island disposal	Drum 1, 1994
Pohn06		Liquid Iron	Nutrient		1.0		Poor	Local use	Drum 2, 1994
Pohn06	2,4-D		Herbicide		12.0		Poor	Off-island disposal	Drum 1, 1994
Pohn06	Diazinon	Diazinon	Insecticide	0.1			Poor	Off-island disposal	Drum 2, 1994
Pohn06	Dicofol	Kelthane	Insecticide	2.0			Poor	Off-island disposal	Drum 1, 1994
Pohn06	Chlorothalonil	Bravo	Herbicide	1.5			Poor	Off-island disposal	Drum 1, 1994
Pohn06	Unlabelled liquid				8.0		Poor	Off-island disposal	Drum 1, 1994
Pohn06	Dinocap	Karathane	Herbicide	9.0			Poor	Off-island disposal	Drum 2, 1994
Pohn06	Chlorothalonil	Bravo	Herbicide	3.0			Poor	Off-island disposal	Drum 2, 1994
Pohn06		Dexon		4.0			Poor	Off-island disposal	Drum 2, 1994
Pohn06		Botran		4.0			Poor	Off-island disposal	Drum 2, 1994
Pohn06	Dicofol	Kelthane	Insecticide		16.0		Poor	Off-island disposal	Drum 2, 1994
Pohn06	Dimethoate	Dimethoate	Insecticide		4.0		Poor	Off-island disposal	Drum 2, 1994
Pohn06		Diabron			2.0		Poor	Off-island disposal	Drum 2, 1994
Pohn06	Mancozeb	Manzate	Fungicide	4.0			Poor	Off-island disposal	Drum 1, 1994
Pohn07	Unlabelleds			1300.0			Poor	Off-island disposal	Includes DDT
Pohn12	DDT		Insecticide	2000.0			Buried	Off-island disposal	Included in POPs convention

FSM (YAP)

Site ID	Chemical Name	Brand Name	Type	Quantity kg	Quantity litres	Quantity Other	Condition	Disposal Options	Comments
Yap05	Mancozeb	Manzate 20D	Fungicide	6.0			Poor	Off-island disposal	(All stocks at Yap 05 were
Yap05	Bacillus Thuringiengsis	Dipel	Worm Killer	1.0			Poor	Off-island disposal	packed into drums in 1994)
Yap05		Thiodan 50 WP	Insecticide	2.0			Poor	Off-island disposal	
Yap05	Mancozeb	Dithane M4D	Fungicide	1.0			Poor	Off-island disposal	
Yap05	Mancozeb	Dithane M45	Fungicide	6.0			Poor	Off-island disposal	
Yap05	Captan	Orthocide 50	Fungicide	13.0			Poor	Off-island disposal	
Yap05	Benomyl	Benlate	Fungicide	4.0			Poor	Off-island disposal	
Yap05	Carbaryl	Sevin 50 W	Insecticide	14.0			Poor	Off-island disposal	

Site ID	Chemical Name	Brand Name	Type	Quantity kg	Quantity litres	Other	Condition	Disposal Options	Comments
Yap05		Unlabelled Powder		114.0			Poor	Off-island disposal	
Yap05		Unlabelled Powder		5.0			Poor	Off-island disposal	
Yap05	Dicofol	Kelthane 35	Miticide	2.0			Poor	Off-island disposal	
Yap05	Methomyl	Golden Malrin	Fly Bait	1.0			Poor	Off-island disposal	
Yap05		Triton			4.0		Poor	Off-island disposal	
Yap05	Captan	Captan WP	Fungicide	2.0			Poor	Off-island disposal	
Yap05	Methomyl	Lannate L	Insecticide		16.0		Poor	Off-island disposal	
Yap05	Naled	Ortho Bibrom 8	Insecticide		4.0		Poor	Off-island disposal	
Yap05	Dimethoate	Cygon	Insecticide		8.0		Poor	Off-island disposal	
Yap05		Paramite	Tick Killer		0.3		Poor	Off-island disposal	
Yap05	Unlabelled Liquid				2.0		Poor	Off-island disposal	
Yap05	Methyl bromide		Fumigant			110 tubes	Good	Off-island disposal	Ozone depleter
Yap05	Dinocap	Karathane WD	Fungicide	22.0			Poor	Off-island disposal	
Yap05	Unlabelled powders		Fertilisers	1300.0			Ok	Local use	
Yap05		OLW Terracide		4.0			Poor	Off-island disposal	
Yap05	Unlabelled Liquid				20.0		Poor	Off-island disposal	
Yap09		Copper Clear	Wood preservative	37.0			Ok	Local use	

KIRIBATI

Site ID	Chemical Name	Brand Name	Type	Quantity kg	Quantity litres	Other	Condition	Disposal Options	Comments
Kir08	Zinc Phosphide		Rat poison	200.0			Poor	Off-island disposal	
Kir08	Unlabelled liquids				400.0		Poor	Off-island disposal	
Kir17	Diazinon	Ag 500	Insecticide	*			Poor	Off-island disposal	
Kir17	Unlabelled		Poisons	*			Poor	Off-island disposal	
Kir17	Carbaryl	Sevin	Insecticide	*			Poor	Off-island disposal	
Kir17	Malathion	Malathion	Insecticide	*			Poor	Off-island disposal	
Kir17	Bromacil	Bromacil	Herbicide	*			Poor	Off-island disposal	

(Note: An inventory of the stocks on Kanton Island (siteKir17) is not yet available)

Marshall Islands

Site ID	Chemical Name	Brand Name	Type	Quantity kg	Quantity litres	Other	Condition	Disposal Options	Comments
Marsh01		Dinocap	Fungicide	3.0		3 packets	Ok	Off-island disposal	
Marsh01	Carbaryl	Sevin	Insecticide	7.5		16 packets	Ok	Off-island disposal	
Marsh01	unlabelled		Pesticide		13.5	27 bottles	Ok	Off-island disposal	
Marsh01	Warfarin		Rat poison	4.0		40 packets	Ok	Off-island disposal	
Marsh01	Metaldehyde	Metaldehyde	Molluscide	2.5		21 packets	Ok	Off-island disposal	
Marsh01	Tetraclorterephthalic acid			5.0		20 packets	Ok	Off-island disposal	
Marsh01	Methyl 1-(butylcarbamoyl)-2-			6.0		6 packets	Ok	Off-island disposal	
Marsh01	Dicofol	Kelthane	Acaricide	2.0		4 packets	Ok	Off-island disposal	
Marsh01	Tetrachloro- isophthal onitrile			4.5		9 packets	Ok	Off-island disposal	
Marsh01	O,O-dimethyl-S-(N-methyl..		Insecticide		3.0	3 bottles	Ok	Off-island disposal	
Marsh01		Zineb	Fungicide	1.8		3 packets	Ok	Off-island disposal	
Marsh01	Triphenyl acetate	Brestan	Fungicide	0.7		7 packets	Ok	Off-island disposal	
Marsh01	O-ethyl-O-P- nitrophe nylthio…		Insecticide		4.0	4 bottles	Ok	Off-island disposal	

Niue

Site ID	Chemical Name	Brand Name	Type	Quantity kg	Quantity litres	Other	Condition	Disposal Options	Comments
Nu01	Copper oxychloride	Recap	Fungicide	28.0		7 pkts	Poor	Local use	
Nu01		Fetrilon	Nutrient mix	75.0		3 sacks	Ok	Local use	
Nu01	Chlorothalonil	Bravo 500	Fungicide		20.0	4 bottles	Poor	Off-island disposal	
Nu01	Unlabelled powder			25.0		1 sack	Poor	Off-island disposal	
Nu01	Mancozeb	Manzate	Fungicide	60.0		3 barrels	Poor	Land application	
Nu01		Cosan		25.0		1 sack	Poor	Off-island disposal	
Nu01	Unlabelled powder			150.0		6 sacks	Poor	Off-island disposal	
Nu01	Dicofol	Kelthane	Insecticide	25.0		1 sack	Poor	Off-island disposal	
Nu01	Captan	Captan	Fungicide	22.0		11 pkts	Poor	Off-island disposal	
Nu01	Carbaryl	Carbaryl 80W	Insecticide	40.0		20 pkts	Poor	Off-island disposal	
Nu01	Unlabelled liquid				40.0	8 bottles	Poor	Off-island disposal	

Site ID	Chemical Name	Brand Name	Type	Quantity kg	Quantity litres	Quantity Other	Condition	Disposal Options	Comments
Nu01		Kamax		10.0		5 pkts	Poor	Off-island disposal	Drum 2
Nu01	Unlabelled powder			25.0		1 sack	Poor	Off-island disposal	Drum 13
Nu01	Mancozeb	Dithane 78	Fungicide	160.0		80 pkts	Poor	Off-island disposal	
Nu01	Unlabelled powder			50.0		1 sack	Poor	Off-island disposal	Drum 13
Nu01	Unlabelled solid			5.0		1 bottle	Poor	Off-island disposal	Drum 11
Nu01	Unlabelled powder			25.0		1 sack	Poor	Off-island disposal	Drum 11
Nu01	Bromacil	Hyvar	Insecticide	7.5		3 pkts	Poor	Off-island disposal	
Nu01	Asulam	Asulox	Insecticide		125.0	25 bottles	Poor	Off-island disposal	
Nu02	Chlordane	Chlordane 40%	Insecticide		0.5	2 bottles	Ok	Off-island disposal	Included in POPs convention
Nu02	Ethoprophos	Mocap	Insecticide	13.0		1 x drum	Ok	Off-island disposal	WHO Class 1A
Nu02	Mancozeb	Manzeb	Fungicide	300.0		6 drums	Poor	Land application	
Nu02	Glyphosate	Sting	Herbicide		0.1	1 bottle	Ok	Off-island disposal	
Nu02	Coumaphos	Asuntol	Insecticide		0.2	1 bottle	Poor	Off-island disposal	WHO Class 1A
Nu02	Unlabelled liquids				3.8	5 bottles	Poor	Off-island disposal	
Nu02			Lab chemicals	2.0		various	Ok	Off-island disposal	
Nu02	Captan	Captan 50%	Fungicide	0.1		1 pkt	Poor	Off-island disposal	
Nu02		Attack	Insecticide		0.6	3 bottles	Ok	Off-island disposal	
Nu02		Neverong	Ant poison		0.2	1 bottle	Ok	Off-island disposal	
Nu02	Iprodione	Rovral 50%	Fungicide	0.5		1 pkt	Poor	Off-island disposal	
Nu02	Mancozeb	Mancozeb 80%	Fungicide	2.0		2 pkts	Poor	Off-island disposal	
Nu02	Copper oxychloride	Bordeaux	Fungicide	0.3		2 pkts	Ok	Local use	
Nu02	Zineb	Zineb 75% WP	Fungicide	0.6		4 pkts	Poor	Off-island disposal	
Nu02	Paraquat	Gramoxone	Herbicide			5 bottles	Ok	Off-island disposal	
Nu02	Dimethirimol	Milcurb	Fungicide		8.0	8 bottles	Ok	Off-island disposal	
Nu02	Pyrimphos methyl	Actellic 50EC	Insecticide		2.0	2 bottles	Ok	Off-island disposal	
Nu02	Pyrimphos/pyrethrum	Target	Insecticide		0.7	5 bottles	Ok	Off-island disposal	
Nu02	Levamisole HCl	Aviverm	Vet. medicine		0.1	1 bottle	Poor	Off-island disposal	
Nu02	Hydrocarbon oil	Conqueror oil	Insecticide		4.0	1 bottle	Ok	Off-island disposal	
Nu02	Glyphosate	Glyphosate 360	Herbicide		2.0	1 bottle	Ok	Off-island disposal	
Nu02		Yates Fruit Spray	Insecticide	0.4		3 pkts	Ok	Off-island disposal	
Nu02	Unlabelled powder			0.5		1 jar	Poor	Off-island disposal	
Nu02	Unlabelled liquid				0.5	1 bottle	Poor	Off-island disposal	
Nu02	4-indol-3-ylbutyric	Seradix	Plant growth reg.	1.8		3 bottles	Ok	Off-island disposal	
Nu02		Protein Bait	Attractant	2.0		1 pkt	Poor	Off-island disposal	

Site ID	Chemical Name	Brand Name	Type	Quantity kg	Quantity litres	Quantity Other	Condition	Disposal Options	Comments
Nu02	Copper oxychloride		Fungicide	7.0		11 pkts	Ok	Local use	
Nu02	Tetrachloroethane		Lab. chemical		0.5	1 bottle	Ok	Off-island disposal	
Nu02	Methyleugenol		Lab. chemical		0.2	2 bottles	Poor	Off-island disposal	
Nu02	Unlabelled liquid				0.1	1 bottle	Poor	Off-island disposal	
Nu02		Diforine			0.3	1 bottle	Poor	Off-island disposal	
Nu02	Chloethephon	Ethrel 48	Plant growth reg.		2.0	2 bottles	Ok	Off-island disposal	
Nu02	Unlabelled liquid				5.0	1 bottle	Poor	Off-island disposal	
Nu02	Thymol		Lab. Chemical	0.1		1 jar	Poor	Off-island disposal	
Nu02	Propyzamide		Lab. Chemical	1.0		1 jar	Ok	Off-island disposal	
Nu02		Derris Dust	Insecticide	3.5		7 pkts	Ok	Off-island disposal	
Nu02	Carbofuran	Furadan	Insecticide	25.0		1 sack	Ok	Off-island disposal	

PALAU

Site ID	Chemical Name	Brand Name	Type	Quantity kg	Quantity litres	Quantity Other	Condition	Disposal Options	Comments
Pal05	DDT		Insecticide	1200.0		6 drums	Buried	Off-island disposal	Included in POPs convention
Pal12		Mixed pesticides		100.0			Poor	Off-island disposal	

SAMOA

Site ID	Chemical Name	Brand Name	Type	Quantity kg	Quantity litres	Quantity Other	Condition	Disposal Options	Comments
Sam02	Mancozeb	Manzate	Fungicide	2.0		1 pkt	Poor	Off-island disposal	
Sam02	Maneb	Manex	Fungicide	10.0		1 bag	Poor	Off-island disposal	
Sam02	Dimethoate	Perfekthion S	Insecticide		5.0	1 bottle	Ok	Off-island disposal	
Sam02	Acephate	Orthene	Insecticide	0.5		1 pkt	Ok	Off-island disposal	
Sam02	Mancozeb	Manzeb	Fungicide	60.0		1pkts	Poor	Off-island disposal	
Sam03	Pyrethroid	Bolt	Insect spray		150.0	15 drums	Ok	Local use	
Sam12	Iprodione	Rovral Flo	Fungicide		5.0	1 bottle	Ok	Off-island disposal	
Sam12	Etridiazole	Terrrazole	Fungicide	2.0		4 pkts	Ok	Off-island disposal	
Sam12	Deltamethryn	Decis 2.5%	Insecticide		1.0	1 bottle	Ok	Off-island disposal	
Sam12	Permethrin	Perigen 500	Insecticide		3.0	3 bottles	Ok	Off-island disposal	
Sam12	Formaldehyde		Sterilant		5.0	1 bottle	Ok	Local use	
Sam13	Carbofuran	Furadan	Insecticide	4.0		4 pkts	Ok	Off-island disposal	
Sam13	Acephate	Orthene	Insecticide	7.5		100 pkts	Ok	Off-island disposal	
Sam13	Iprodione	Rovral Flo	Fungicide		5.0	1 bottle	Ok	Off-island disposal	
Sam13	Dalapon	Agripon	Herbicide		2.0	2 pkts	Ok	Off-island disposal	
Sam13	Formaldehyde		Sterilant		85.0	8 bottles	Ok	Local use	
Sam14	Fosetyl (aluminium)	Aliette	Fungicide	1.0		1 pkt	Ok	Off-island disposal	
Sam14	Etridiazole	Terrazole	Fungicide	4.0		8 pkts	Ok	Off-island disposal	
Sam14	Deltamethryn	Decis 2.5%	Insecticide		1.0	1 bottle	Ok	Off-island disposal	
Sam14	Iprodione	Rovral Flo	Fungicide		10.0	2 bottles	Ok	Off-island disposal	
Sam14	Amitrole	Amitrole 400	Herbicide		5.0	1 bottle	Ok	Off-island disposal	
Sam14	Mancozeb/metalaxyl	Ridomil MZ	Fungicide	7.5		3 pkts	Ok	Off-island disposal	
Sam14	4-indol-3-ylbutyric	Seradix	Plant growth reg.	1.0		2 pkts	Ok	Off-island disposal	

Solomon Islands

Site ID	Chemical Name	Brand Name	Type	Quantity kg	Quantity litres	Other	Condition	Disposal Options	Comments
Sol01	Unlabelled liquids				1600.0	8 drums	Poor	Off-island disposal	
Sol01	Propanil	Stam F-34	Herbicide		5400.0	27 drums	Ok	Off-island disposal	
Sol01	Zinc chelate		Nutrient		200.0	1 drum	Poor	Lime treatment	
Sol01	Ethoprophos	Mocap	Nematicide	320.0		16 sacks	Poor	Off-island disposal	WHO Class IA
Sol01	Thiobencarb	Rice Saturn	Insecticide		200.0	1 drum	Poor	Lime treatment	
Sol01	Thiobencarb	Saturn D	Insecticide		600.0	3 drums	Poor	Lime treatment	
Sol02	DDT		Insecticide	2000.0		10 boxes	Poor	Off-island disposal	Included in POPs convention
Sol02	DDT		Insecticide,		800.0	4 drums	Fair	Off-island disposal	Included in POPs convention
Sol03	Fenitrothion		Insecticide,	300.0		3 sacks	Poor	Lime treatment	
Sol03	Fenitrothion		Insecticide		400.0	2 drums	Poor	Lime treatment	
Sol04	Arsenic pentoxide		Stump treatment	150.0		3 sacks	Fair	Off-island disposal	WHO Class 1A
Sol04	Paraquat		Herbicide		20.0		Ok	Off-island disposal	
Sol04	Borax		Nutrient	100.0		4 sacks	Ok	Off-island disposal	
Sol05	Unlabelled				600.0	3 drums	Poor	Off-island disposal	
Sol10	DDT		Insecticide	3500.0		100 sacks	Good	Local use	Included in POPs convention
Sol10	DDT		Insecticide	2000.0			Corroded	Off-island disposal	Included in POPs convention
Sol11	Fenitrothion	Sumithion	Insecticide	25.0		1 sack	Good	Local use	

VANUATU

Site ID	Chemical Name	Brand Name	Type	Quantity kg	Quantity litres	Quantity Other	Condition	Disposal Options	Comments
Van02	Methyl bromide		Fumigant	33.0		3 bottles	Ok	Off-island disposal	Ozone depletor
Van03	Lindane	Lindane	Insecticide	5.0		1 bag	Ok	Off-island disposal	Included in PIC convention
Van03	Unlabelled		Poison	88.0		7 sacks	Poor	Off-island disposal	
Van03	Fosetyl	Aliette	Fungicide	20.0		1 sack	Poor	Off-island disposal	
Van03	Borax		Nutrient	75.0		3 bags	Poor	Off-island disposal	
Van03	Mancozeb	Dithane M45	Fungicide	29.0		42 pkts	Poor	Off-island disposal	
Van03	Mancozeb	Dithane M45	Fungicide	10.0		1 bag	Poor	Off-island disposal	
Van03	Difolatan		Fungicide	4.0		9 pkts	Ok	Off-island disposal	
Van04	Unlabelled		Herbicide		4.0	1 bottle	Poor	Off-island disposal	Included in PIC convention
Van04	Trichlorfon	Dicidex	Insecticide		4.0	4 bottles	Poor	Off-island disposal	
Van04	Acephate	Orthene	Insecticide		0.2	1 bottle	Ok	Off-island disposal	
Van04	Agral LN		Insecticide		3.0	3 bottle	Ok	Off-island disposal	
Van04	Dimethoate	Dimethoate	Insecticide		8.0	2 bottles	Ok	Off-island disposal	
Van04	Permethrin	Ambush	Insecticide		4.0	4 bottles	Poor	Off-island disposal	
Van09	DDT		Insecticide	900.0		18 sacks	Poor	Off-island disposal	Included in POPs convention

Annex B.3: Chemicals – Hydrocarbons and PCBs

Cook Islands

Site ID	Chemical Name	Brand Name	Type	Quantity kg	Quantity litres	Quantity Other	Condition	Disposal Options	Comments
Cook02	Petroleum oil	Sunspray 11E	Spraying oil		4.0	1 can	Rusty	Local use	
Cook10	PCBs		Transformer oil		1000		In use	Off-island disposal	Included in POPs convention
Cook11	PCBs		Transformer oil		3000		Ok	Off-island disposal	Included in POPs convention
Cook12			Waste oil		20000		Dirty	Waste oil disposal programme	
Cook15	PCBs		Transformer oil		400		Ok	Off-island disposal	Included in POPs convention

FSM (Chuuk)

Site ID	Chemical Name	Brand Name	Type	Quantity kg	Quantity litres	Quantity Other	Condition	Disposal Options	Comments
Chk02	Bitumen			20000		100 drums	Poor	Landfill	
Chk03	PCBs		Transformer oil		40000		Ok	Off-island disposal	Included in POPs convention

FSM (Kosrae)

Site ID	Chemical Name	Brand Name	Type	Quantity kg	Quantity litres	Quantity Other	Condition	Disposal Options	Comments
Kos01	Waste oil				16000		Ok	Waste oil disposal programme	
Kos04	Waste oil				18000		Ok	Waste oil disposal programme	
Kos04	PCBs		Transformer oil		5800		Ok	Off-island disposal.	Included in POPs convention
Kos08	Waste oil				16400		Ok	Waste oil disposal programme	

FSM (Pohnpei)

Site ID	Chemical Name	Brand Name	Type	Quantity kg	Quantity litres	Other	Condition	Disposal Options	Comments
Pohn02	Waste oil				50000		Ok	Incinerate on-site.	
Pohn02	PCBs		Transformer oil		8000		Ok	Off-island disposal	Included in POPs convention
Pohn03	Waste oil				4500		Ok	Waste oil disposal programme	
Pohn05	Waste oil				2000		Poor	Waste oil disposal programme	

FSM (Yap)

Site ID	Chemical Name	Brand Name	Type	Quantity kg	Quantity litres	Other	Condition	Disposal Options	Comments
Yap03	Waste oil				40000		Ok	Waste oil disposal programme	
Yap06	Bitumen			46000		230 drums	Poor	Landfill	

Kiribati

Site ID	Chemical Name	Brand Name	Type	Quantity kg	Quantity litres	Other	Condition	Disposal Options	Comments
Kir02	Waste bitumen				40000		Poor	Landfill	
Kir03	Waste bitumen				60000		Poor	Landfill	
Kir05	Waste oil				7000		Ok	Waste oil disposal programme	
Kir05	PCBs		Transformer oil		22000		Ok	Off-island disposal	Included in POPs convention
Kir18	Bitumen				100000	500 drums	Poor	Landfill	
Kir22	PCBs		Transformer oil		800		Ok	Off-island disposal	Included in POPs convention

MARSHALL ISLANDS

Site ID	Chemical Name	Brand Name	Type	Quantity kg	Quantity litres	Quantity Other	Condition	Disposal Options	Comments
Marsh04	Bitumen			20000		100 drums	Poor	Landfill	
Marsh05	Waste oil				800	4 drums	Ok	Waste oil disposal programme	
Marsh05	PCBs		Transformer oil		800		Ok	Off-island disposal	Included in POPs convention
Marsh06	Waste oil			800		5 drums	Ok	Waste oil disposal programme	

NAURU

Site ID	Chemical Name	Brand Name	Type	Quantity kg	Quantity litres	Quantity Other	Condition	Disposal Options	Comments
Nau01	White lead in oil			10.0		2 drums	Ok	Local use	
Nau01		Gearkote M	Grease	3000		160 drums	Poor	Local use	
Nau03	PCBs		Transformer oil		1000		Ok	Off-island disposal	Included in POPs convention
Nau04	Bitumen			30000		150 drums	Poor	Landfill	
Nau05	Waste oil				2000	10 drums	Poor	Waste oil disposal programme	
Nau06	Refrigerator oil				60	3 drums	Ok	Waste oil disposal programme	
Nau08	PCBs		Transformer oil		4000		Poor	Off-island disposal	Included in POPs convention
Nau09	PCBs		Transformer oil		2000		Ok	Off-island disposal	Included in POPs convention

NIUE

Site ID	Chemical Name	Brand Name	Type	Quantity kg	Quantity litres	Quantity Other	Condition	Disposal Options	Comments
Nu06	PCBs		Transformer oil		1000		Ok	Off-island disposal	Included in POPs convention

PALAU

Site ID	Chemical Name	Brand Name	Type	Quantity kg	Quantity litres	Quantity Other	Condition	Disposal Options	Comments
Pal03	PCBs		Transformer oil		4400	7 drums	Ok	Off-island disposal	Included in POPs convention
Pal09	Waste Oil				10000		Ok	Waste oil disposal programme	
Pal09	Tar, Paint, grease			4000			Poor		Responsibility of the owner

SAMOA

Site ID	Chemical Name	Brand Name	Type	Quantity kg	Quantity litres	Quantity Other	Condition	Disposal Options	Comments
Sam07	PCBs		Transformer oil			50 transformers	Empty	Off-island disposal	Included in POPs convention
Sam15	PCBs		Transformer oil		250		Ok	Off-island disposal	Included in POPs convention
Sam16	PCBs		Transformer oil		1000		Ok	Off-island disposal	Included in POPs convention

SOLOMON ISLANDS

Site ID	Chemical Name	Brand Name	Type	Quantity kg	Quantity litres	Quantity Other	Condition	Disposal Options	Comments
Sol07	PCBs		Transformer oil		400	2 drums	Ok	Off-island disposal	Included in POPs convention

TONGA

Site ID	Chemical Name	Brand Name	Type	Quantity kg	Quantity litres	Quantity Other	Condition	Disposal Options	Comments
Tong01	Waste oil				2000	10 drums	Ok	Waste oil disposal programme	
Tong01	PCBs		Transformer oil		6000		Poor	Off-island disposal	Included in POPs convention

TUVALU

Site ID	Chemical Name	Brand Name	Type	Quantity kg	Quantity litres	Quantity Other	Condition	Disposal Options	Comments
Tuva01	PCBs		Transformer oil		8000		Ok	Off-island disposal	Included in POPs convention
Tuva01	Waste oil				1500		Ok	Waste oil disposal programme	
Tuva04	Bitumen				60000		Poor	Landfill disposal	

VANUATU

Site ID	Chemical Name	Brand Name	Type	Quantity kg	Quantity litres	Quantity Other	Condition	Disposal Options	Comments
Van11	PCBs		Transformer oil		14000		Ok	Off-island disposal	Included in POPs convention
Van12	PCBs		Transformer oil		4000		Ok	Off-island disposal	Included in POPs convention

Annex B.4: Miscellaneous Chemicals

Cook Islands

Site ID	Chemical Name	Brand Name	Type	Quantity kg	Quantity litres	Quantity Other	Condition	Disposal Options	Comments
Cook01			Fertiliser	5000			Poor	Repackaged June 1998	
Cook01	Calcium hydroxide	Hydrated lime		15000			Ok	Given away for local use	
Cook01	Copper sulphate		Fungicide	17000			Poor	Repackaged & shipped to New Zealand, June 1998	
Cook01	Manganese sulphate		Nutrient	19000			Ok	Repackaged & shipped to New Zealand, June 1998	
Cook02		Delfoam	Anti-drift agent		20.0	1 can	Ok	Local use	
Cook02		Dasanti granules	Grass seed	20.0		1 sack	Ok	Local use	
Cook02	Ethanol	Alcohol	Solvent		20.0	1 can	Ok	Local use	
Cook02		Fetrilon	Fertiliser	125.0		5 sacks	Ok	Local use	
Cook02		Wilt pruf	Plant extract		1.0	1 bottle	Ok	Local use	
Cook02	Unidentified granules			2.0		2 pkts	Ok	Local use	
Cook05			Lab chemicals	250.0			Ok	Local treatment & disposal	
Cook06			Lab chemicals	100.0			Ok	Local treatment & disposal	
Cook07			Lab chemicals	5.0			Poor	Local treatment & disposal	
Cook08			Lab chemicals		5.0		Ok	Local treatment & disposal	
Cook09			Lab chemicals	20.0			Poor	Local treatment & disposal	
Cook14	Iron sulphate		Nutrient	1000		20 sacks	Ok	Local use	
Cook14	Unidentified powders		Nutrient	500		10 sacks	Ok	Local use	
Cook14	Zinc sulphate		Nutrient	8000		160 sacks	Ok	Local use	
Cook16	Copper Sulphate		Fungicide	1000		30 sacks	Ok	Local use	

FIJI

Site ID	Chemical Name	Brand Name	Type	Quantity kg	Quantity litres	Other	Condition	Disposal Options	Comments
Fj05	Hydrogen cyanide		Fumigant	75.0		75 cans	Ok	Chemical treatment	WHO Class 1A
Fj17	Cyanide		Poison	0.0			Ok	Chemical treatment	WHO Class 1A

FSM (CHUUK)

Site ID	Chemical Name	Brand Name	Type	Quantity kg	Quantity litres	Other	Condition	Disposal Options	Comments
Chk04			Lab chemicals		190		Ok	Local treatment & disposal	

FSM (KOSRAE)

Site ID	Chemical Name	Brand Name	Type	Quantity kg	Quantity litres	Other	Condition	Disposal Options	Comments
Kos03			Fibreglass resin		15.0			Solidify then landfill	

FSM (POHNPEI)

Site ID	Chemical Name	Brand Name	Type	Quantity kg	Quantity litres	Other	Condition	Disposal Options	Comments
Pohn01			Medical supplies		18000		Poor	Mix with cement & landfill	
Pohn13			Lab chemicals	600				Local treatment & disposal	

FSM (YAP)

Site ID	Chemical Name	Brand Name	Type	Quantity kg	Quantity litres	Other	Condition	Disposal Options	Comments
Yap01	Sulphonate		Asphalt additive		12000		Ok	Locate regional user	
Yap01			Film developer		550		Ok	Locate regional user	
Yap05			Fertiliser	1300			Poor	Land application	
Yap07	Acetone				400		Ok	Local use	
Yap07	Sodium hydroxide	caustic soda			4200		Ok	Local use	
Yap08			Lab chemicals	100			Ok	Local treatment & disposal	
Yap09			Car body filler		45.0			Solidify then landfill	

KIRIBATI

Site ID	Chemical Name	Brand Name	Type	Quantity kg	Quantity litres	Other	Condition	Disposal Options	Comments
Kir01		CCA sludge		1000				Off-island disposal	WHO Class 1A
Kir01			Medicines	2000			Poor	Controlled landfill	
Kir04	Sodium hydroxide	Caustic soda		55.0			Ok	Local use	
Kir06		Photographic chemicals		150.0			Ok	Local use or disposal	
Kir07		Fertiliser		12000			Ok	Land application	
Kir10		Photographic chemicals			65.0		Ok	Local use or disposal	
Kir19		Fertiliser		1400			Ok	Land application	

NAURU

Site ID	Chemical Name	Brand Name	Type	Quantity kg	Quantity litres	Other	Condition	Disposal Options	Comments
Nau01			Wax remover		80	4 drums	Ok	Local use	
Nau01		Rust proofing wax				450	6 drums	Ok	Local use
Nau01		Maxitreat 457	Boiler additive		600	3 drums	Old	Local use	
Nau01	Sodium pentachlorophenol (2%)		Fuel oil additive		1200	6 drums	Ok	Off-island disposal	Included in PIC Convention
Nau04		Epoxy resins		1000		50 drums	Poor	Solidify then landfill	
Nau06		Dinitrol			440	11 drums	Ok	Local use	
Nau06		Qickset One	Cement additive		80	4 drums	Ok	Solidify then landfill	
Nau06		Mobileflex	Cement additive		180	9 drums	Ok	Solidify then landfill	
Nau06		Pave-Fix	Cement additive		880	44 drums	Ok	Solidify then landfill	
Nau06		EvoStick	Adhesive		120	6 drums	Ok	Local use	
Nau06		Estalpol			20.0	1 drum	Ok	Solidify then landfill	

NIUE

Site ID	Chemical Name	Brand Name	Type	Quantity kg	Quantity litres	Other	Condition	Disposal Options	Comments
Nu01	Lime/sulphur		Fertiliser		20.0	4 bottles	Poor	Local use	
Nu02	Propyzamide		Lab Chemical	1.0		1 jar	Ok	Off-island disposal	
Nu02	Unlabelled solids		Fertiliser	1000			Poor	Local use	
Nu02	Unlabelled solids		Fertiliser	60			Poor	Local use	
Nu02	Unlabelled solids		Fertiliser	75			Poor	Local use	
Nu02	Unlabelled solids		Fertiliser	500			Poor	Local use	
Nu02	Unlabelled solids		Fertiliser	500			Poor	Local use	
Nu02			Lab chemicals	2.0			Ok	Local treatment and disposal	
Nu02	Unlabelled solids		Fertiliser	500			Poor	Local use	
Nu02	Alcohol 40%				0.5	1 bottle	Poor	Local use or disposal	
Nu02	Tetrachloroethane				0.5	1bottle	Ok	Off-island disposal	
Nu02	Glycerol				1.0	2 bottles	Ok	Local use	
Nu02	Acetic acid				0.5	1 bottle	Ok	Local use	
Nu02	Thymol			0.1		1 jar	Poor	Off-island disposal	
Nu02	Methyleugenol				0.2	2 bottles	Poor	Off-island disposal	
Nu02	Fetrilon	Nutrient mix		130.0		65 pkts	Ok	Local use	
Nu02	Orchid Food				0.4	2 bottles	Ok	Local use	
Nu03	Medicines / chemicals		300		6 sacks	Unusable	Hospital incinerator		
Nu04	Methyl bromide			35.0		1 cylinder	Usable	Off-island disposal	

PALAU

Site ID	Chemical Name	Brand Name	Type	Quantity kg	Quantity litres	Quantity Other	Condition	Disposal Options	Comments
Pal04			Car batteries			>1200 units	Poor	Ship to battery recycling facility	
Pal06	Calcium hypochlorite		3915		87 drums	Ok	Local use		
Pal13			Lab. chemicals	3.0			Poor	Local treatment & disposal	
Pal14			Lab chemicals	300.0			Poor	Local treatment & disposal	
Pal15	Mercury			0.2			Ok	Off-island disposal	WHO Class 1A
Pal18			Old medicines	2000			Poor	Hospital incinerator	
Pal19			Glues & paints		600		Poor	Solidify then landfill	

SAMOA

Site ID	Chemical Name	Brand Name	Type	Quantity kg	Quantity litres	Quantity Other	Condition	Disposal Options	Comments
Sam01	Copper/chrome/arsenic		CCA Timber treatment			10000		Off-island disposal	WHO Class 1A
Sam04			Lab. chemicals	200			Ok	Local use or disposal	
Sam05			Lab. chemicals	100			Ok	Local use or disposal	
Sam06			Lab. chemicals	50			Ok	Local use or disposal	

SOLOMON ISLANDS

Site ID	Chemical Name	Brand Name	Type	kg	Quantity litres	Other	Condition	Disposal Options	Comments
Sol02			Lab. chemicals		8.0	8 bottles	Ok	Local use or disposal	
Sol02			Photographic chems		5.0	5 bottles	Ok	Local use or disposal	
Sol04		Polyurethane		200.0		1 drum	Poor	Solidify & landfill	
Sol04			Lab. chemicals		180		Ok	Local use or disposal	
Sol06			Solvents		30.0	30 bottles	Ok	Local use or disposal	
Sol06			Lab. chemicals		100.0	100 bottles	Ok	Local use or disposal	
Sol06	Formaldehyde	Formalin			1.0	1 bottle	Good	Local use or disposal	
Sol06			Lab. chemicals		62.5	25 bottles	Good	Local use or disposal	
Sol06			Lab. acids		32.5	13 bottles	Good	Local use or disposal	
Sol06	Acetone				10.0	4 bottles	Ok	Local use or disposal	

TUVALU

Site ID	Chemical Name	Brand Name	Type	kg	Quantity litres	Other	Condition	Disposal Options	Comments
Tuva02			Lab. chemicals	20.0			Ok	Local use or disposal	
Tuva03	Potassium chloride			1000			Ok	Local use or disposal	
Tuva03		Superphosphate		Fertiliser	500			Poor	Local use or disposal
Tuva07			Lab. chemicals	10.0			Poor	Local use or disposal	
Tuva08			Old medicines	1000			Unusable	Hospital incinerator	
Tuva09	Ammonium nitrate	Nitropril		7000			Good	Local use or disposal	

VANUATU

Site ID	Chemical Name	Brand Name	Type	Quantity kg	Quantity litres	Quantity Other	Condition	Disposal Options	Comments
Van03	Ammonium sulphate/KCl		Fertiliser	920		46 sacks	Poor	Local use or disposal	
Van05	CCA, boric acid, + others		Timber treatment		150000	4 tanks	Poor	Local use or disposal	
Van06		Antiborer solution				5000	1 tank	Ok	Local use or disposal
Van10	Urea		Fertilizer	480		12 sacks	Poor	Local use or disposal	

ANNEXES B.5, B.6 & B.7 - CONTAMINATED SITES

The tables given in the following three annexes have been taken from the contaminated site database. The sites have been grouped under the three categories of Pesticides, Hydrocarbons and Miscellaneous, for consistency with the chemical tables.

Each contaminated site was assessed using the Rapid Hazard Assessment Scheme (New Zealand Ministry for the Environment, 1993). In this system sites are assigned ratings on the basis of the extent of the contamination, the toxicity and mobility of the contaminants, the potential for contamination of the surrounding areas including food and water supplies, and ease of public access to the site. The individual ratings for each of these factors are then combined to arrive at an overall hazard rating for the site. The final rating covers a range from zero (non-hazardous) to 100 (extremely hazardous).

Over 100 contaminated sites were identified during the survey. However, only those scoring 30 or above have been included in the following tables.

All sites shown in the tables are identified by a country code. The codes used are as follows:

Country	Code
Cook Islands	Ck
FSM (Chuuk)	Chk
FSM (Kosrae)	Kos
FSM (Pohnpei)	Pohn
FSM (Yap)	Yap
Fiji	Fj
Kiribati	Kir
Marshall Islands	Marsh
Nauru	Nau
Niue	Nu
Palau	Pal
Samoa	Sam
Solomon Islands	Sol
Tonga	Tong
Tuvalu	Tuva
Vanuatu	Van
Yap	Yap

Annex B.5 Pesticide Contaminated Sites

Site ID	Activity	Commentary	Hazard Rating	Remediation Options	Priority
Chk01	Pesticide storage	Leaking shipping container	100	Excavate contaminated soil, off-island disposal	1
Pohn06	Pesticide storage	Spillages within building	100	Collect spillages & decontaminate, off-island disposal	2
Pohn07	Pesticide storage	Spillages within building	100	Collect spillages & decontaminate, off-island disposal	3
Fj02	Pesticide storage	Spillages within building	90	Collect spillages & decontaminate, off-island disposal	4
Sol01	Pesticide storage	Spillages within building	85	Collect spillages & decontaminate, off-island disposal	5
Fj01	Pesticide storage	Spillages within building	80	Collect spillages & decontaminate, off-island disposal	6
Pal05	DDT storage	Spillages within building	80	Collect spillages & decontaminate, off-island disposal	7
Pohn12	DDT disposal site	2 tonnes of buried DDT	80	Excavate contaminated soil, off-island disposal	8
Sol10	Hardware store	DDT spillages within building	80	Collect spillages & decontaminate, off-island disposal	9
Yap05	Pesticide storage	Spillages within building	80	Collect spillages & decontaminate, off-island disposal	10
Kos02	Chemical storage	Spillages within building	64	Collect spillages & decontaminate, off-island disposal	11
Fj07	Pesticide storage	Spillages and some burial	60	Excavate contaminated soil, off-island disposal	12
Sam02	Ag research station	Pesticide burial (3 locations)	60	Excavate contaminated soil, off-island disposal	13
Chk05	Pesticide storage	Spillages within building	50	Collect spillages & decontaminate, off-island disposal	14
Fj06	Ag research station	Spillages within building	50	Collect spillages & decontaminate, off-island disposal	15
Sam11	Pest control chemicals	Leaking containers	32	Collect spillages & decontaminate, off-island disposal	16
Fj03	Ag research station	Spillages within building	30	Collect spillages & decontaminate, off-island disposal	17
Kir17	Quarantine store	Spillages within building	30	Collect spillages & decontaminate, off-island disposal	18
Sol02	Agriculture store	Spillages within building	30	Collect spillages & decontaminate, off-island disposal	19
Van04	Pesticide storage	Spillages within building	30	Collect spillages & decontaminate, off-island disposal	20

Annex B.6 Hydrocarbon Contaminated Sites

Site ID	Activity	Commentary	Hazard Rating	Remediation Options	Priority
Kir02	Bonriki Airport	40,000 litres waste bitumen	100	Local use or solidify & bury	1
Kir03	Bonriki Airport	60,000 litres waste bitumen	100	Local use or solidify & bury	2
Chk07	Bulk Fuel Depot	Oil spillages on site	81	Landfarming + oil management programme	3
Kos06	Fuel storage	Oil spillages on site	72	Landfarming + oil management programme	4
Kir05	Power station	Waste oil dumping on site	64	Landfarming + oil management programme	5
Nau08	Equipment storage	PCB spillage from old transformers	64	Excavate contaminated soil for off-island disposal	6
Pohn02	Power station	Oil spillages on site	64	Landfarming + oil management programme	7
Pohn05	Construction depot	Oil spillages on site	64	Landfarming + oil management programme	8
Pohn11	Asphalt plant	Waste bitumen	64	Local use or solidify & bury	9
Sam07	Transformer maintenance	PCB spillage from old transformers	64	Excavate contaminated soil for off-island disposal	10
Kir09	Vehicle workshop	Oil spillages on site	58	Landfarming + oil management programme	11
Pohn10	Vehicle workshop	Waste oil dumping on site	58	Landfarming + oil management programme	12
Yap03	Power Station	Waste oil dumping on site	58	Landfarming + oil management programme	13
Fj19	Fire station	Oil spillages on site	55	Landfarming + oil management programme	14
Tuva04	Vehicle workshop	60,000 litres waste bitumen	55	Local use or solidify & bury	15
Kir11	Power station	Oil spillages on site	51	Landfarming + oil management programme	16
Pal01	Power station	Waste oil dumping on site	51	Landfarming + oil management programme	17
Pal02(b)	Power station	Oil spillages on site	51	Landfarming + oil management programme	18
Yap11	Bulk fuel depot	Oil spillages on site	51	Landfarming + oil management programme	19
Kir21	Bulk fuel depot	Oil spillages on site	50	Landfarming + oil management programme	20
Chk03	Power Station	Oil spillages on site	46	Landfarming + oil management programme	21
Chk02	Asphalt plant	100 drums of waste bitumen	45	Local use or solidify & bury	22
Yap06	Airport construction	230 drums of waste bitumen	45	Local use or solidify & bury	23
Yap10	Construction depot	Oil spillages on site	41	Landfarming + oil management programme	24
Marsh03	Boat maintenance	Oil spillages on site	40	Landfarming + oil management programme	25
Nu05	Vehicle servicing	Oil spillages on site	40	Landfarming + oil management programme	26
Tong02	Vehicle servicing	Oil spillages on site	40	Landfarming + oil management programme	27
Fj16	Power Station	Oil spillages on site	35	Landfarming + oil management programme	28
Cook15	Power station	Waste oil dumping on site	32	Landfarming + oil management programme	29
Marsh04	Construction depot	100 drums waste bitumen	32	Local use or solidify & bury	30
Sam16	Power station	PCB spillage from old transformers	32	Excavate contaminated soil for off-island disposal	31
Sam17	Power station	Waste oil dumping on site	32	Landfarming + oil management programme	32

Site ID	Activity	Commentary	Hazard Rating	Remediation Options	Priority
Tong01	Power station	Oil spillages on site	32	Landfarming + oil management programme	33
Tuva01	Power station	Oil spillages on site	32	Landfarming + oil management programme	34
Tuva05	Power station	Oil spillages on site	32	Landfarming + oil management programme	35
Tuva06	Power station	Oil spillages on site	32	Landfarming + oil management programme	36
Kir18	Construction depot	Waste bitumen	30	Local use or solidify & bury	37

Annex B.7 Miscellaneous Contaminated Sites

Site ID	Activity	Commentary	Hazard Rating	Remediation Options	Priority
Pal18	Forest	WW2 medical supplies	80	Collect and incinerate	1
Sam01	Timber treatment plant	Visible evidence of CCA spillages	80	Excavate soil, treat and dispose locally	2
Pohn03	Landfill	General municipal wastes	72	No remediation but need to upgrade site management	3
Kos10	Landfill	General municipal wastes	64	No remediation but need to upgrade site management	4
Fj14	Landfill	General municipal wastes	60	No remediation but need to upgrade site management	5
Sol04	Laboratory buildings	Chemical spillages	60	Excavate soil, treat and dispose locally	6
Fj15	Landfill	General municipal wastes	55	No remediation but need to upgrade site management	7
Pal08	Landfill	General municipal wastes	50	No remediation but need to upgrade site management	8
Van17	Former forestry site	2 buried drums of arsenic pentoxide	50	Excavate soil, treat and dispose locally	9
Sam15	Timber mill	Visible evidence of CCA spillages	48	Excavate soil, treat and dispose locally	10
Kos09	Landfill	General municipal wastes	46	No remediation but need to upgrade site management	11
Kos05	Hospital	On site waste burning	41	Upgrade medical waste facilities	12
Pal17	Sewage Plant	$300m^3$ of unused asbestos pipe	41	Excavate and dispose locally	13
Fj10	Sawmill	Large open pit used for CCA treatment	40	Excavate soil, treat and dispose locally	14
Fj13	Landfill	General municipal wastes	40	No remediation but need to upgrade site management	15
Tong03	Government store	Ex CCA site, visible evidence of spillages	40	Excavate soil, treat and dispose locally	16
Pal20	Landfill	General municipal wastes	38	No remediation but need to upgrade site management	17
Pal21	Landfill	General municipal wastes	38	No remediation but need to upgrade site management	18
Yap02	Landfill	General municipal wastes	38	No remediation but need to upgrade site management	19
Fj11	Sawmill	CCA sludge buried in pits	35	Excavate soil, treat and dispose locally	20
Van08	Sawmill	CCA spillages	35	Excavate soil, treat and dispose locally	21
Kir12	Landfill	General municipal wastes	30	No remediation but need to upgrade site management	22
Kir13	Landfill	General municipal wastes	30	No remediation but need to upgrade site management	23
Kir20	Former US base	General waste disposal	30	No remediation but need to upgrade site management	24
Sam09	Landfill	General and medical waste disposal	30	No remediation but need to upgrade site management	25
Van06	Timber treatment site	Spillages on site	30	Excavate soil, treat and dispose locally	26
Van13(a)	Landfill	General municipal wastes	30	No remediation but need to upgrade site management	27
Van13(b)	Landfill	General municipal wastes	30	No remediation but need to upgrade site management	28
Van14	Landfill	General municipal wastes	30	No remediation but need to upgrade site management	29

Annex: C
Guidelines

Waste and Obsolete Chemicals and Chemical Contaminated Sites

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May 2000

C.1 Sampling and Analysis of Unknown Chemicals

These notes are intended as a general guide for people who are required to collect samples of unknown chemicals in the field. Such people should have a good knowledge and understanding of material handling principles, and basic chemistry. Whenever possible, there should be prior consultation with the analytical laboratory to check for any additional requirements specific to the types of sample or types of tests.

Handling Precautions

Adequate protective equipment should always be worn when handling unknown chemicals. As a minimum this should include rubber gloves, overalls, goggles, and a dust mask or respirator.

Wherever possible, the work area should be well ventilated and have adequate lighting. Alternatively, materials should be moved to a more suitable location, prior to sample collection.

No electrical equipment should be used if there is a danger of flammable materials being present.

The work area should be covered with sheets of plastic to contain any spillages.

Sampling

The minimum sample size typically required for analysis is 0.5 kg or 0.5 litres. Samples larger than this may be taken, but it should be recognised that this will usually incur additional freight costs.

Solid materials should be sampled using a plastic scoop or shovel. Liquids should be sampled by pouring from the original container, or by dipping the sample container directly into the liquid.

It is important to ensure that the sample taken is representative of the bulk material. This can be achieved either by pre-mixing the bulk materials, or by taking multiple samples, which are then mixed and re-sampled.

Sample Containers

Wherever possible, sample containers should be obtained from the laboratory contracted to carry out the analyses. This is because of the need to use containers which have been thoroughly cleaned, so that there is no risk of sample contamination.

Most samples can be placed into clean glass jars with plastic or metal screw caps. Before use, the jars should be thoroughly washed with water and detergent, rinsed with clean water, triple rinsed with acetone or laboratory grade alcohol (if available), and thoroughly dried. A layer of aluminium foil should be placed in between the top of the jar and the lid to provide additional sealing.

The main exception to the above is flammable liquids, which should only be placed into tightly sealed metal cans.

Sample bottles should be clearly labelled with a sample number and description. Other details such as who took the samples, where they came from and their possible identity should be recorded on a separate sheet of paper. A copy of this information should always accompany the samples during shipping. However, another copy should also be sent directly to the laboratory by fax or mail.

Sample Storage

Wherever possible, samples should be stored in a cool dark place prior to despatch. The storage area should be locked or otherwise secured.

Packaging for Transport

Containers used for transporting the samples to the laboratory should be made of wood or heavy duty cardboard. The containers should be lined with heavy duty plastic and absorbent materials such as sand or vermiculite (“kitty litter”) should be used to protect the sample bottles. The amount of absorbent used should be about 50% of the total container volume.

Sample bottles should be individually wrapped in plastic bags before being placed in the container. A copy of the sample record sheet should be included with the samples, and this should also be placed inside a plastic bag.

TRANSPORT

The samples should be transported to the laboratory using the most efficient means available. This would generally be by air freight, but some samples may not be acceptable for air transport. This can only be established by checking with the airlines involved.
It will usually be necessary to complete a dangerous goods declaration form to accompany the samples. Also, arrangements may need to be made for the receiving laboratory to complete any customs and other border formalities at the delivery end.

ANALYSIS

There should be clear communications at all times between the person collecting the samples, and the laboratory. This should include a discussion of the types of samples and their possible composition (if known). It can be very expensive for a laboratory to analyse samples “from scratch”. Ideally, there should be agreement that the samples should be analysed for specific types of chemicals, such as toxic metals, pesticides, petroleum hydrocarbons, and so on. Wherever possible, analytical costs should be agreed in advance.

C.2 LABORATORY FACILITIES

There are many laboratories in the region offering a range of analytical services for environmental samples, especially in Australia and New Zealand. Those shown below are known to offer specific services relevant to this project; i.e the analysis of organic contaminants in soil and/or water.

The Australian laboratories are accredited by the National Association of Testing Authorities (NATA), while those in New Zealand are accredited by International Accreditation New Zealand (IANZ). This certifies that the work of the laboratories is being carried out in accordance with a recognised standard, such as ISO Guide 25 – General Requirements for the Competence of Calibration and Testing Laboratories.

AUSTRALIA

Australian Laboratory Services Pty Ltd.	Phone: (61) 2 9841 9500 Fax: (61) 2 9841 9530
Australian Analytical Laboratories Pty Ltd	Phone: (61) 2 9842 1922 Fax: (61) 2 9842 1734
HLA-Envirosciences Pty Ltd	Phone: (61) 2 4968 0044 Fax: (61) 2 4968 0005
GM Laboratories	Phone: (61) 2 9564 1033 Fax: (61) 2 9564 1697
Johnstone Environmental Technology Pty Ltd	Phone: (61) 2 9958 2266 Fax: (61) 2 9958 1483
NSW Agriculture	Phone: (61) 2 6621 2632 Fax: (61) 2 6621 4319
Australian Environmental Laboratories	Phone: (61) 2 9316 4255 Fax: (61) 2 9316 5541
Fluordaniel FTI (Australia) Pty Ltd	Phone: (61) 2 9502 4844 Fax: (61) 2 9502 2105
Australian Water Technologies (AWT)	Phone: (61) 2 9502 4844 Fax: (61) 2 9334 0741
Water Environmental Laboratory	Phone: (61) 2 9597 4444 Fax: (61) 2 9597 4808
WSL Consultants Pty Ltd	Phone: (61) 3 9429 4666 Fax: (61) 3 9429 2294
Orice Australia Pty Ltd	Phone: (61) 3 9283 6400 Fax: (61) 3 9283 6408
Australian Government	Phone: (61) 3 9685 1777 Fax: (61) 3 9685 1788

NEW ZEALAND

Allan Aspell and Associates	Phone: (64) 9 415 2136 Fax: (64) 9 415 2137.
Cawthron Institute	Phone: (64) 3 548 2319 Fax: (64) 3 546 9464
Hill Laboratories	Phone: (64) 7 858 2000 Fax: (64) 7 858 2001.
Institute of Environmental Science & Research (ESR)	Phone: (64) 4 570 1555 Fax: (64) 4 569 4500

FIJI

IAS Analytical Services Laboratory (University of the South Pacific)	Phone: (679) 212 339 Fax: (679) 300 373

GUAM

Guam Environmental Science Laboratory	Phone: (671) 649 0708 Fax: (671) 649 0718

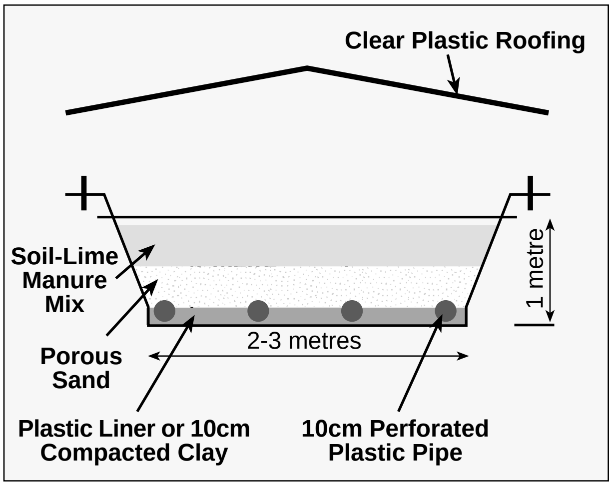
C.3 PESTICIDE DISPOSAL PITS

Pesticide disposal pits make use of naturally occurring soil microbes for pesticide degradation. The systems are mainly intended for liquid wastes, such as left-over spray solutions. However, they can also be used for the disposal of small quantities of surplus pesticides.

Much of the original development work for pesticide disposal pits was carried out at the Universities of Iowa and California. In the Iowa system a number of different pits were used. The two main systems included a covered concrete pit of about 30,000 litres capacity and a canopied pit lined with two layers of polythene, of about 90,000 litres capacity. The concrete pit was filled with three layers of material: gravel, soil (silt loam), and gravel, and wastes were simply poured on to the surface. In the plastic lined pit a layer of soil was covered with gravel. A galvanised metal pipe in an H-shape was buried within the latter for liquid distribution.

A number of smaller versions of the pits were also tested. Options included a 1400 litre concrete tank, 200 litre plastic barrels, and 110 litre plastic rubbish bins. These were filled with soil and gravel, or just soil. They were buried in soil to provide temperature stability, and covered to exclude rain.

In California a system of lined "evaporation beds" was used for waste disposal at a number of university field stations throughout the State. The beds typically were 6m x 12m x 0.9m pits, lined with a butyl rubber membrane and back-filled with 0.3 to 0.45 m of sandy loam soil. A layer of sand separated the soil from the rubber, and a series of 100mm perforated PVC pipes were buried at the sand/soil interface. A schematic drawing of the system is shown below.



Used containers and spray equipment were washed on an adjacent concrete pad. The wastewater drained into a sedimentation box for trapping particulates, followed by a distribution box connected to the pipes in the bed. The system was designed so that water moves up through the soil by capillary action and evaporates off the surface. The beds were covered with a corrugated fibreglass roof which provides shelter from rainfall, but at the same time transmits sunlight.

In most of the beds approximately one tonne of hydrated lime was incorporated into the soil. This was intended to increase the degradation rate of organophosphate and carbamate pesticides. In some cases this was well-mixed throughout the bed, while in others it was simply applied to the surface.

Formulae have been developed for calculating the area required for an evaporation bed based on the expected wastewater volumes and the "pan evaporation rate" for the region. In metric units the formula converts to:

$$\text{Area required } (m^2) = \frac{\text{usage (litres/month)} \times 32}{\text{pan evaporation rate (cm/month)}}$$

Pan evaporation rates will vary depending on local climate and soil types.

Extensive tests on both the Iowa and California systems show that they appear to achieve their desired function. High levels of pesticides do not accumulate and there is extensive evidence for microbiological and other degradation processes occurring. Pesticides generally rise to the surface of the pits in a "wicking" effect, but no significant levels of pesticides were detected in the air above the pits. The systems are attractive for their simplicity of construction and ease of use.

Two drawbacks to these systems are the potential for environmental contamination as the result of leaks (it may be necessary to design an above-ground system instead of a buried system) and the uncertain nature of the treatment processes and their degradation products. The contents of the pits may ultimately have to be disposed of as hazardous wastes with a rather poorly defined composition. Given the time scale over which this might occur and the reduction in waste volumes achieved, this does not seem to be a major impediment to the use of these systems.

C.4 DISPOSAL OPTIONS FOR SPECIFIC PESTICIDE WASTES

The notes given below cover those pesticides found in the greatest quantities in the survey. These recommendations are intended as a guide only and more detailed instructions will be required prior to their implementation.

Acephate (Orthene). Acephate is a modified organophosphate that breaks down under alkaline conditions. Lime treatment followed by burial in a landfill is therefore the preferred disposal option. Land application may also be an option because the pesticide is only moderately toxic (LD_{50} = 945 mg/kg).

Carbamates (Carbaryl, Sevin, Isoprocarb, Carbofuran, and Oxamyl/Vydate). Carbamates break down quite rapidly after application. Treatment with strong alkali is also an effective destruction method (2 kg of caustic soda to 5 kg of active ingredient). However, in both cases, one of the primary breakdown products is alpha-napthol, which can be environmentally persistent and harmful to aquatic life. It is therefore recommended that all stocks be removed to an off-island treatment facility.

Copper sulphate. Copper sulphate is already being used on some islands, e.g. Atiu in the Cook Islands for treating kikau roofs, so the local use option is recommended. Copper sulphate is of moderate toxicity (LD_{50} = 300 mg/kg).

Dithiocarbamates (Maneb, Mancozeb). These fungicides do not store well so old stocks will be fairly inactive. The chemicals are suitable for disposal by land application or in a disposal pit. They break down to secondary amines, which will themselves degrade slowly in the environment. However, small amounts of ethylene thiourea and nitrosamines can also be formed, and these are carcinogenic. Overall, the risk will be minimal if the material can be dispersed widely over wasteland or some other suitable disposal site. It should also be noted that Maneb (and other Dithiocarbamates) have been known to spontaneously ignite. This is because they slowly liberate carbon disulphide on reaction with moisture. This is mainly a problem with new stocks, and most of the old stocks have long since passed the critical stage. Dithiocarbamates are of low toxicity, e.g. Maneb LD_{50} = 6750 mg/kg & Mancozeb LD_{50} = 8000 mg/kg.

Fenamiphos. Fenamiphos is an organophosphorous compound. Lime treatment followed by landfill disposal is a possible disposal option. However, because of its relatively high toxicity (LD_{50} = 15 mg/kg) removal to an off-island treatment facility is the recommended approach.

Fenithrothion. As with most organophosphates, Fenitrothion is readily degraded by alkali. The addition of hypochlorite to the mixture can be helpful in reducing any odours. The resulting breakdown products are less toxic than the original organophosphates and will slowly break down over time. Lime treatment followed by burial in a landfill is therefore the preferred disposal option. Land application may also be an option because the pesticide is only moderately toxic (LD_{50} = 945 mg/kg).

Malathion. Malathion decomposes readily when treated with alkaline materials such as lime. Small quantities can therefore be disposed by mixing with lime followed by burial in a landfill. The toxicity is low (LD_{50} = 5000 mg/kg).

Propanil. Propanil is an anilide group herbicide of relatively low toxicity (LD_{50} = 1500 mg/kg). However, some of the breakdown products formed from this group of chemicals can be much more toxic, and also highly persistent. Treatment with acid or alkali is also not recommended. In the case of Propanil, this leads to the more toxic 3,4-dichloraniline. High temperature incineration appears to be the only viable disposal option.

Pyrethroid (Bolt). The formulation of Bolt is 0.136% tetramethryn, 0.02% di-phenothrin, 0.3% piperonyl butoxide and 99.5% petroleum distillate. The first of these chemicals is the Pyrethroid, and the second one is a pyrethrum analogue. The third chemical is a so-called synergist and is quite innocuous. Pyrethroids are “natural” plant extracts, which are highly unstable in the presence of light, moisture and air, and therefore break down readily in the environment. They can also be disposed by incineration with minimal effect. This option appeals as the bulk of the material is a flammable solvent. Treatment with lime prior to burial in a landfill would also be acceptable, but it would be necessary to first remove most of the solvent by evaporation. This could be done by pouring into a shallow metal tray. Tetramethryn has low toxicity (LD_{50} = 5000 mg/kg).

Sulphur. Sulphur will store indefinitely, and would only be a hazard if the store caught fire. The best disposal option is to find an alternative local use, noting that it can be used as a fungicide, insecticide or soil additive. Sulphur is of low toxicity (LD_{50} = 3000 mg/kg).

Thiobencarb. Thiobencarb is a member of the thiocarbamate group of pesticides. These are non-persistent in the environment and disappear fairly rapidly from the soil, within 1 to 4 weeks after application. The breakdown products can include secondary amines, which are a potential source of (carcinogenic) nitrosamines. However, these have not been detected in field studies. The chemicals are also broken down readily by alkali, with similar degradation products to field use. The preferred disposal methods for small quantities would therefore be land application, disposal pits, or treatment with lime followed by burial in a landfill.

Trichlorfon (Dicidex.) Trichlorfon reacts with water to initially form the more toxic, dichlorvos. However, dichlorvos is also degraded in water, 50% hydrolysis occurs in 25 min at 70 deg C, and in 61.5 days at 20 deg C. At pH 8, and 37.5 C, 50% hydrolysis occurs in 301 min, and there are no toxic residues. Treatment with lime followed by burial is therefore a viable disposal option for small quantities of waste pesticide. However, Trichlorfon is moderately toxic (LD_{50} = 560 mg/kg) and it would be preferable for larger quantities to be removed to an off-island treatment facility.

Zinc Chelate. Zinc chelate is used as a soil nutrient. Treatment with lime or mixing with concrete prior to burial in a landfill are the preferred disposal options.

Zinc Phosphide. Zinc phosphide is used as a rat poison. The chemical reacts with stomach acids to release the highly toxic phosphine gas. Zinc phosphide will slowly break down on contact with moisture to form zinc salts and phosphine gas. Phosphine readily oxidises to phosphorous oxides which are in turn converted to acidic phosphates. The simplest disposal option for zinc phosphide involves burial in a controlled location. However, this method should only be used when there is no risk of ground water contamination due to the leaching of zinc salts or phosphates. This is not the case in Kiribati and hence shipment to a specialised treatment facility with the CCA sludge is recommended. Toxicity is high (LD_{50} = 45 mg/kg).

C.5 DISPOSAL OF EMPTY PESTICIDE CONTAINERS

In developing countries, the reuse of pesticide containers for storage of water, food and fuel is sometimes a major problem. The high cost of new steel drums or plastic jerry cans makes used pesticide containers a valuable commodity. However, it is nearly always impossible to completely decontaminate these used containers. Regardless of the number of washings, residues will continue to be released from the inner wall of the container and can contaminate anything placed inside. It is therefore important to arrange for the destruction and disposal or recycling of all used pesticide containers to prevent unauthorised use and they should never be used for any other purpose.

In large-scale clean-ups, it may be desirable to obtain special equipment for the treatment of empty containers, such as a shredder, drum-crusher and / or drum-rinser or pre-flusher. This equipment is relatively easy to transport and has limited energy requirements.

The available options for disposal of used containers are incineration, recycling or burial in a landfill. Containers should only be disposed by burial after they have been triple-rinsed and crushed or shredded. Only designated landfills should be used.

RECYCLING

At large pesticide stores, empty steel drums that are still in good condition may be retained as spares to repack the same product from leaking or deteriorating drums, or to pack contaminated spill control material after clean-up activities. Drums retained for this purpose should be triple rinsed.

If it is possible to return containers to the supplier, this is the preferred option. One could consider negotiating an arrangement (e.g. as part of the procurement order) under which the supplier agrees to take the empty containers back after the product has been used.

Old and deteriorated steel drums and surplus steel drums can be used as raw material at a steel smelter. They should be rinsed, punctured or crushed before being sent to the smelter. It may be possible to sell them to the steel smelter because an empty 200 litre steel drum represents about 25 kg of good quality scrap metal.

Plastic drums should be returned to the supplier for recycling.

DISPOSAL BY INCINERATION

All common types of contaminated packaging can in principle be destroyed safely in a specialised hazardous waste incinerator.

International regulations on the transport of hazardous wastes apply when empty containers are exported for destruction. Under such regulations, unrinsed empty contaminated containers are regarded as a hazardous product in the same category as the original contents. This means that empty pesticide containers need to be re-packed prior to shipping. This can be done by overpacking the containers in their original form, or by packaging them after cutting or shredding.

It may be possible to incinerate small quantities of contaminated bags, boxes, and crates in a local incinerator, such as those used for medical wastes. Plastic containers should be cut or shredded first.

DISPOSAL BY LANDFILL

Bags and boxes can be cut up and stored in plastic bags prior to disposal in a designated sanitary landfill under authority of the government. Empty plastic and steel containers should be thoroughly emptied, triple-rinsed with water or solvent and punctured, crushed or shredded before they are sent to the landfill. The rinsate must be drained, collected and stored separately in appropriate and clearly labelled containers. The rinsate should be managed in the same manner as the pesticide. If the product was still usable, the rinsate can be applied with the product.

C.6 MODEL CODE OF PRACTICE: TIMBER PRESERVATION PLANTS[1]

1. GENERAL

This code is intended as a guide to plant owners, managers and operators. The code deals with the siting, layout, design and operation of timber preservation plants. The recommendations given in the code are intended to assist in minimising the occupational health risks to plant operators and the potential for environmental pollution.

This code is not intended to over-ride or replace any requirements of national governments or local authorities, and these must be checked out prior to the design, siting and construction of any plant. Government approval will most likely be required before the development of any timber preservation plant.

2. TRANSPORTATION AND LABELLING

Timber treatment chemicals shall be transported in accordance with the requirements of the relevant government departments for the transportation of dangerous goods (usually the Ministry of Transport). All containers of timber preservatives should be clearly identified and labelled with the appropriate international dangerous goods symbols (eg. corrosive or toxic materials). All preservation chemicals should be transported directly to the chemical store or treatment tanks and should not be off-loaded elsewhere in the plant.

3. PLANT SITING

This section deals with the siting of plants in relation to potential off-site effects. Consideration should be given to the need for buffer zones around treatment plants. Buffer zones are areas in which conflicting land uses are not allowed. In the case of timber preservation plants, this should include residential housing and other community facilities such as schools, hospitals and sports fields.

3.1 WATER BODIES AND FLOODING

The chosen site should be at least 250 metres away from any significant surface water bodies, such as streams and estuaries. In addition, there should be no significant groundwater resources within 100 metres of the site, both vertically and horizontally. (In many Pacific Islands, this will require more detailed assessment, taking into account the soil permeability and the potential use of the resource.)

There must be no risk of flooding at the chosen site. This may be assessed by consideration of the surrounding topography and from historical records.

3.2 AIR EMISSIONS

The chosen site should be at least 250 metres away from any current or proposed residential or commercial areas, and down from prevailing wind lines.

3.3 RAIN WATER DISCHARGE OUTLETS

All rain water discharge outlets from the plant site shall incorporate a sump with a capacity of not less than 1,000 litres. This is required for sediment control and to enable the monitoring of site discharge water.

3.4 Treated Timber Storage Area

A designated area should be set aside for the storage of all timber after removal from the drip pad area (see section 4 below). This area shall be sloped so that it drains into a suitably sized pond or pool prior to discharge from the site. The capacity of the pond should be determined on the basis of expected rainfall over the storage area.

This requirement could be reduced through the provision of a roofed storage area for the treated timber. This would effectively prevent any leaching of freshly treated timber by rainfall.

3.5 Future Land Use

Land that has been previously used for timber preservation plants must not be used for grazing animals or for the production of food crops, unless it can be shown that the land is free from unacceptable chemical contamination.

4. Plant Layout

4.1 General

This section deals with the layout of plant and equipment so as to ensure safe and healthy work conditions, and minimising any potential effects on the environment.

The most important feature in plant and equipment layout is the containment of toxic liquids and vapours, and the control of any spillages. The site must be designed in such a manner as to prevent the discharge of any escaped materials into the surrounding environment.

4.2 Holding Capacity

Plants shall be designed so that the maximum total volume of timber preservative solutions contained in all vessels, pipes and tanks, as well as that stored on site in portable containers, can be contained within the plant areas, in the event of an accident, sabotage or equipment failures. Impermeable levee bunds or other means of containment shall be provided sufficient to accommodate 120% of the nominal volume of all solutions and concentrate storage vessels, fixed or mobile, excluding wastewater tanks.

4.3 Containment of Spillages

The plant shall be laid out so that any liquids resulting from spillage shall be prevented from flowing into drains and watercourses, or in the case of dry material, from washing away.

The spillage or retention devices should conduct the material to a sump or holding area from which it may be reclaimed or disposed; and these areas shall be designed so that they may be hosed or swept clean and the cleaning fluid disposed of safely.

4.4 Working Areas

All areas where preservative solutions may be spilled, or may drip from freshly treated timber, shall be sealed with impervious load bearing material such as concrete, to prevent contamination of the soil and adjacent watercourses. These areas shall be laid out so that the drippings and spillages shall be drained to a collection sump for recycling or disposal.

4.5 Storage Areas for Treatment Chemicals and Treated Timber

All deliveries of preservative materials shall be made into the bunded area. The storage areas should be of sufficient size to accommodate both bulk and drum supplies, and must be adequately secured against unauthorised entry and theft.

The storage areas shall be paved with impervious load bearing material such as concrete, and should be designed to drain into collection sumps.

A holding area shall be provided for freshly treated timber. This area shall be large enough to hold all freshly treated timber for a minimum period of 24-hours, and preferably longer. After this time the timber may be moved to the treated stock storage area..

4.6 Unroofed Areas

Unroofed areas in which there is no possibility of surface contamination, may be drained so that stormwater falling on them is diverted to storm water drains rather than into the spillage collection sumps.

4.7 Site Access and Activity Separations

In general, access to the overall plant site should be restricted and can only be entered with permission from the site office. It is also desirable for the administration and operating area to be physically separated from each other.

Entry to the preservation plant area should be restricted to operating personnel only, unless authorised by the site supervisor.

The site should be adequately secured, including perimeter fencing and an –on-site security guard. For an integrated sawmilling and treatment plant, fencing of the entire site would be acceptable.

4.8 PLANT ENTRY, CHANGING AND TOILET FACILITIES

The plant shall be laid out so that personnel working with treatment chemicals and processes are able to enter and leave the plant via separate facilities providing for the storage of street clothes and working clothes. Neither of these facilities shall be used for any other storage purpose.

Changing room, shower and toilet facilities shall be made available for the exclusive use of all persons working with preservative chemicals, processes and treated timber. Provision shall be made for staff using these toilet facilities to remove protective clothing and to wash prior to using the facilities. Provision shall be made for storage of personal protective clothing and equipment.

4.9 EMERGENCY SHOWERS, WASHING AND EYE WASHING FACILITIES

Facilities shall be provided at appropriate locations throughout the plant for emergency showers and eye-wash facilities.

4.10 EATING FACILITIES

The staff lunchroom or other eating and relaxation facilities shall be provided outside the treatment area of the site. Treatment plant staff shall not be permitted to use these facilities without first washing and removing their work clothes using the facilities described in 4.8 above.

5. WORKER SAFETY

5.1 GENERAL

It is essential that treatment plant staff be properly instructed in their duties and realise that a timber preservation plant involves the use of severely hazardous chemicals. Respect for the dangers inherent in handling chemicals, coupled with a respect for personal hygiene requirements, are absolutely essential for safe working conditions. A set of chemical safety rules should be drawn up and placed on notice boards in key locations around the site.

5.2 PROTECTIVE EQUIPMENT

All treatment plant personnel and their supervisors shall wear clean, protective clothing and personnel safety equipment as may be necessary to prevent contamination. In addition other protection items such as eye and hearing protection or breathing apparatus shall be worn as required. This clothing and equipment should be donned and removed in the areas referred to in 4.8 above.

At the completion of a working shift or more often if necessary, all contaminated protective clothing and equipment shall be decontaminated and laundered, or disposed.

Appropriate barrier creams shall be used by all personnel where there is any likelihood of creosote type timber preservative materials coming into contact with the skin.

5.3 EMERGENCY PROCEDURE AWARENESS

All treatment plant staff shall be trained in the emergency procedures necessary when spillage or accidents occur. In addition to this training, warning signs shall be erected in all working areas indicating the following information:

- Areas where hazardous chemicals are used
- Preservatives in use and their hazardous components
- List of the neutralising and absorbent materials appropriate to the particular materials being used
- Contact telephone numbers in case of accidents. These shall include:

For large spillages	the local village council or government agency
For poisons	the local hospital
For fire	the local fire services

- First aid action to be taken in case of poisoning

6. EQUIPMENT DESIGN AND OPERATION

6.1 GENERAL

This section sets out the broad requirements for the design and operation of the equipment used in a plant. It does not claim to cover all the machinery that might be used. Personnel responsible for the operation of plants should ensure that any procedures not covered in this section, but necessary to the safe operation of a plant, shall be recorded and brought to the attention of plant operators.

6.2 PRESSURE PLANTS

Plant pressure vessels shall be inspected regularly and certified for their ability to withstand designated pressures in excess of normal working pressure, as recommended by the manufacturer. Records of the inspections shall be maintained by the plant supervisor.

6.3 VACUUM PUMPS

Vacuum pumps shall be fitted with condensing traps capable of catching any preservative droplets contained in their exhausts. Any contaminated water issuing from vacuum pumps shall be transferred to mixing or waste tanks in the treatment plant for recycling or disposal.

A mist eliminator shall be installed on the vent to atmosphere line from any vacuum system. These vents should be directed away from any working areas. Spray emissions from leaks in pump glands or mechanical seals should be covered and trapped, and repairs carried out at the earliest opportunity.

6.4 TREATMENT VESSEL DOORS

Treatment vessels with quick action doors should be fitted with a safety interlock to prevent accidental pressurising when the door is improperly closed. The treatment vessel door should also be interlocked with an extraction system for the removal of chemical vapours when the door is open following a treatment cycle. This would normally be done using the vacuum pump, preferably on a timed cycle.

The door sump should be designed with a large enough capacity to contain any leakage from faulty seals.

6.5 FIRE FIGHTING EQUIPMENT

Portable fire extinguishers shall be provided throughout the plant. These should be located in prominent, accessible positions and should be of a type appropriate to the chemicals being used. They should be checked for operating efficiency at intervals specified by the manufacturer and must be available for use at all times.

Provision shall be made for the installation of fixed fire fighting equipment throughout the plant. This equipment must not be used for any other purpose and must be accessible and available at all times.

Treatment plant staff should be given regular training in the correct use of the fire fighting equipment.

6.6 TANKS AND FITTINGS

All tanks and fittings shall be made of corrosion-resistant materials, compatible with the timber preservative solution being stored. All chemical valves shall be provided with padlocking devices to prevent unauthorised or accidental usage.

6.7 AUTOMATIC TREATMENT PLANTS

Where the plant operations are partly automated, an emergency shut down system, such as a master on/off switch, should be provided for use in emergencies.

7. DISPOSAL OF WASTE

7.1 GENERAL

The procedures given in this section are intended for guidance only. As a general rule, the methods to be used for waste disposal must be agreed in advance with the relevant government authorities. When appropriate, reference should be made to emergency procedure guides and safe storage and handling information cards. These should be requested from the chemical suppliers.

In the disposal of waste materials it is important that personnel be properly supervised and provided with the appropriate protective clothing. Where a number of different preservatives are being used on a site it is important for the different wastes to be handled and stored separately. This is because they may have different disposal requirements.

7.2 COPPER CHROME ARSENIC

All personnel involved in the disposal of CCA wastes must wear suitable, impervious footwear and protective clothing, including industrial eye protectors.

Liquid spills should be managed as follows:

Small spills (less than 1 kg) should be covered with sawdust, sand, lime, cement or soil. When the spill has been completely absorbed, the material should be placed in drums clearly labelled as CCA wastes. The wastes may be disposed in an approved tip.

In the case of large spills as much of the liquid as possible should be collected up and recycled. The remaining material should then be covered with a mixture of 90% lime and 10% sodium metabisulphate. The resulting sludge should be placed in drums and buried in an approved tip.

CCA treatment plants are a regular source of contaminated sludges. This includes the solid paste and other suspensions that accumulate in some of the equipment, including pressure cylinder door sumps, flooding pits, and at the bottom of work tanks. This material should be disposed as follows:

The sludge shall be collected in suitably lined and labelled drums or tanks and allowed to settle. Any free liquid should then be decanted and returned to the mixing or working tanks.

The remaining concentrated sludge should be treated with a lime and sodium metabisulphite neutralising mixture. This may be most easily done using a cement mixer. It is important to add enough of the treatment mixture to ensure reduction and precipitation of the CCA components. The correct amount of neutralising mixture required can be determined by carrying out some initial tests on **representative** samples of the sludge. Take about 0.5 to 1 kg of sludge and add measured amounts of sodium metabisulphate, with regular mixing, until the yellow colour changes to green. Measured quantities of lime are then added until the mixture becomes alkaline (pH greater than 9).

The treated sludge may be buried in an approved tip.

Another technique for disposal of neutralised sludge is to incorporate it into concrete. The procedure for this method is given in Annex C7.

7.3 CREOSOTE

All personnel must wear suitable gloves, impervious footwear and protective clothing while handling creosote or creosote contaminated materials. Industrial eye protectors should also be worn.

Any free liquids should be recovered from creosote spills or wastes wherever possible and returned to the plant for reuse. Residual materials should be soaked up with sand or soil and placed in drums for disposal in an approved tip. Concrete surfaces and other sealed work areas should be washed with down detergent where necessary after removing the bulk of the absorbed spillage. The washings should be discharged into the site drainage sumps.

7.4 BORON COMPOUNDS AND SODIUM FLUORIDE

All personnel must wear suitable gloves, impervious footwear and protective clothing. Industrial eye protectors and respirators may also be required depending on circumstances.

Any spillages of these chemicals should be swept up, and if possible, re-used. Residual wastes should then be mixed into a slurry with lime and placed in drums for disposal in an approved tip.

7.5 TREATED WOOD, SAWDUST AND SHAVINGS

Treated wood, sawdust and shavings shall be disposed of in a landfill area approved for the purpose by the Local Authority. Treated wood, sawdust and shavings should not be disposed by burning, and the sawdust and shavings should not be used for mulching, composting, or in other garden applications.

7.6 CONTAINERS

All containers should be completely emptied, rinsed with water and allowed to drain. The rinsate should be recovered and added to the plant mixing tanks.

All empty containers should be returned to the manufacturer wherever possible. Otherwise, they should be punctured and crushed prior to disposal in a land-fill area approved for the purpose by the Local Authority.

Empty containers must never be used for the storage of water or foodstuffs.

8. MONITORING

8.1 EMPLOYEE HEALTH

All treatment plant employees should be given a general medical examination prior to their appointment, and this should be followed by regular check-ups at 6-monthly intervals. The check-ups should include specific examinations for chemical-related problems, including chrome ulcers and urinary arsenic testing.

8.2 STORMWATER DISCHARGES

Stormwater discharges from the site should be tested at least once every three months for elevated levels of treatment chemicals. Water samples should be taken from the drainage sumps soon after rainfall, and sent to a laboratory for analysis for copper, chromium, arsenic and boron, and other relevant chemicals. The chemical suppliers should be able to assist with these tests if there is no local laboratory available.

8.3 GROUNDWATER

A series of groundwater sampling wells should be established around the perimeter of the site, and water samples should be collected for testing at least once every three months. The siting of these wells should be decided in conjunction with the government environment agency.

Samples of drinking water should also be taken from any domestic bores within 1000 metres of the site.

8.4 Soil Samples

Surveys of surface soil contamination in and around the site should be carried out at least once a year. The location and numbers of samples should be agreed with the government environment agency, but as a minimum should include systematic sampling along the site perimeter and adjacent to the main treatment plant working areas.

8.5 Interpretation of Results and Follow-up Actions

The results for all of the above samples should be compared with government guidelines for water and soil quality. In the absence of any such guidelines, reference should be made to those published by international agencies, such as the World Health Organisation, or guidelines used in other countries. For example, the New Zealand Ministry for the Environment (MfE) has recently published a very comprehensive set of guidelines for discharges from timber treatment plants (Health and Environmental Guidelines for Selected Timber Treatment Chemicals, MfE, Wellington, June 1997).

Elevated levels of treatment chemicals in the samples would indicate the presence of significant contamination on some or all of the site. This should be investigated further using soil and dust analysis. Contaminated areas should be excavated and the soil treated and disposed using the method given above for plant sludges. Plant operating practices should also be reviewed and revised so as to prevent further contamination.

C.7 DISPOSAL OF WASTE CCA SLUDGE

Details are provided below of an alternative procedure for the treatment of CCA waste and sludge. The procedure is based on micro-encapsulation or immobilisation to produce non-structural concrete.

PREPARATION OF SLUDGE FOR TREATMENT

Ideally the sludge is best suited for treatment when a minimum amount of 'free chemical' (orange colouration) is present in the sludge. Remaining quantities can affect fixation and bonding within the treated waste resulting in unacceptably high levels of leaching. Free chemical can be washed out of the waste using the following procedure:

Add water to half-filled waste drums, stir, allow to settle, and decant off the clear liquid on top. Return this liquid to the treatment tanks.

Repeat this process until all colouration in the liquid is gone.

Alternatively, the waste may be treated with lime and a reducing chemical such as sodium metabisulphite, using the procedure given in Annex C6, section7.2.

TREATMENT METHOD

1. Mix the sludge in a suitable vessel. If the waste is dry, water should be added to form a thick slurry.

2. Depending on sludge types various formulations may be used and additives, such as acid, may be required. The basic formulation is as follows:

To every	100kg of sludge
add	100kg of Portland cement
	10kg of sand
	1kg of lime

Blend in a mixer and add enough water to produce a mouldable consistency.

3. Pour into suitable moulds, either made with formwork or into drums or small concrete pipes. Be sure to keep mould sizes to an easily handled size and weight. When pouring, incorporate any necessary lifting hooks or forklift tine pockets.

TECHNICAL NOTE:

Sludge types, metal concentrations and impurity content can all have an effect on the formulation used for waste treatment. Depending on waste types it may be necessary to add acid or lime to a waste mix or substitute flyash or pozzolanic cement in place of Portland cement. Usually it is best to:

- ensure your waste is properly pre-treated;
- mix all waste streams to ensure that the waste will not vary during treatment;
- do a number of trial batches in bucket size and have the results analysed before undertaking the full scale work; and
- Use the formula specified in Point 2 above first, as a starting point.

This procedure has been developed by Koppers-Hickson, who can provide additional advice on formulation changes, analytical facilities and the required storage and disposal procedures.

For further information contact:

Koppers - Hickson Timber Protection (NZ) Limited

P O Box 22-148, OTAHUHU
Auckland 6, New Zealand

Ph: (64) 9276 3646
Fax: (64) 9270 2020

C.8 WASTE OIL MANAGEMENT AT POWER STATIONS

Power stations are a significant source of waste oil in Pacific Island Countries. Disposal of this waste is a major problem for many PICs, and it has the potential to cause significant adverse environmental effects if not done properly.

The following notes describe the main sources of waste oil, a variety of management techniques that can be used to minimise waste generation, and the possible disposal options.

WASTE GENERATION

Engine oil is the major source of waste oil in oil-fired power stations. Manufacturers usually recommend that engine be oil be replaced once every 3 months. In a 5 to 10 MW installation, this typically generates about 200 litres of used oil with each maintenance cycle.

Cooling water discharges are another significant source of oil, although this mainly occurs with older installations not fitted with closed loop cooling systems.

Maintenance of transformers, motor vehicles and other mechanical equipment is another potential source.

Oil spillages around the site are another source of contamination, especially if these are washed off-site by stormwater run-off.

POTENTIAL EFFECTS

The environmental effects of waste oil are caused mainly by its non-miscibility with water. Thin layers of waste oil can act as a barrier to many of the transfer processes that form an essential part of biological life. For example, fish will not be able to breathe if their gills become coated with a thin layer of oil. In the case of plant life, oil can act as a barrier to respiration through the leaves or nutrient uptake through the roots.

Oil contamination of marine environments is a particular concern in PICs because of the fragile nature of the marine ecosystems. For example, mangrove ecosystems are key components in estuarine and estuarine-dependant marine fisheries, primarily through mangrove leaf litter that serves as a basis for the food chains supporting these fisheries. Leaf fragmentation into detritus is colonised by fungi and bacteria, that in turn are ingested by fish. Oil contamination can cause major disruptions to these and other biological processes, mainly through inhibition of bacterial growth.

Waste oil is not especially toxic to humans, although it will often contain toxic contaminants such as heavy metals, or complex organic chemicals such as the polycyclic aromatic hydrocarbons. The main concern for humans is contamination of groundwater and other sources of drinking water. Oil contamination renders the water unfit for drinking because of its taste and odour. This is especially relevant to PICs, which are often highly dependent on limited and fragile fresh water supplies.

WASTE OIL MANAGEMENT

The management of waste oil should be designed around the usual hierarchy of reduction at source, followed by recycle and reuse, with disposal as the option of last recourse.

WASTE REDUCTION

Waste oil production from engine maintenance can be reduced through the use of an effective engine wear monitoring programme. These programmes are available through some of the oil suppliers (e.g. Mobil Oil Micronesia) and provide a quick and effective system for monitoring the build up of engine wear particles in the oil. The oil only needs to be changed once the wear levels reach a pre-set limit, rather than in accordance with the arbitrary schedules recommended by the engine manufacturers. Experience in some PICs has shown that this can considerably extend the time between oil changes on power station engines.

Waste oil from cooling water discharges can be eliminated through the use of closed-loop cooling systems. These should be standard equipment on most modern units but can also be retro-fitted to older installations.

Drip trays should be used around all equipment and work areas where there is the potential for oil spillages or leaks. Larger areas should be fully sealed and bunded to prevent run-off.

Site run-off from oil-contaminated areas should be collected and passed through an interceptor system prior to discharge. Designs for some simple interceptors are shown in Figure 1 below. The primary system on the left is mainly used for separating out small quantities of oil from relatively high volume water flows. The system on the right can achieve capture rates of over 95%, when designed in accordance with the expected flows.

Oil Recycling

Oil recycling involves the removal of metals and other contaminants followed by reconstitution to comply with the original specifications. There is only one oil recycling plant in the Pacific Islands, and this is based in Samoa. However, the plant is currently not operating for a variety of reasons. Despite the lack of facilities, recycling should be the preferred option for waste oil management in PICs. It is strongly recommended that individual countries negotiate with their suppliers so that arrangements can be made for waste oil to be returned to the source country for recycling through a suitable refinery.

Some waste oil can be recycled using small commercially available units, which simply remove any water and solid particles. This method is commonly used for the recycling of transformer oil, and may also be suitable for oil used in other low-grade applications.

Oil Disposal

The only viable option for waste oil disposal in many PICs is by burning as a supplementary fuel. However, it must be emphasised that this should be seen as a less-preferred option to recycling.

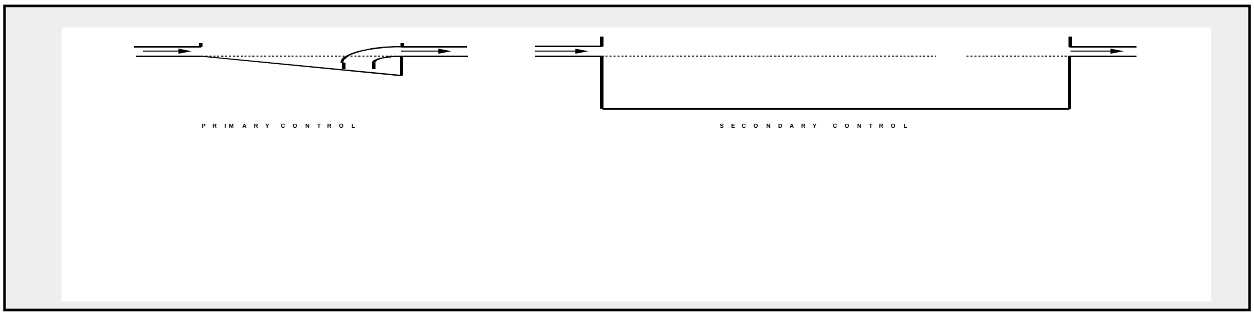
Clean waste oil can be burned in power station engines by mixing at a rate of no more than 5% with fuel oil (usually diesel or HFO). This should be done in a mixing tank which is separate from the normal fuel storage system. Ideally the mixed fuel should be tested for flash point prior to use, as a check for contamination with other more flammable materials such as petrol.

The equipment manufacturers should always be consulted prior to using waste oil as a supplementary fuel. This is because some manufacturers have specific warranty exclusions against this practice. Others will only agree to the burning of waste oil produced from their own engines. This aspect should also be considered when PICs are negotiating for the purchase of new generating plant.

Waste oil can also be disposed in other industrial burners. For example, waste oil is currently being used as a supplementary fuel in the secondary steel mill in Fiji, and in the phosphate dryers on Nauru.

The burning of waste oil produces toxic air emissions such as sulphur dioxide and heavy metals. However, these emissions are also produced by the burning of “clean” fuel and there will be little or no difference when waste oil is added at the recommended low rates. The primary benefit of waste oil burning is an overall reduction in fuel usage and costs.

Figure 1. Simple Oil-Water Separator Systems



C.9 ON-ISLAND HYDROCARBON REMEDIATION (LANDFARMING)

OVERVIEW

On-island remediation of waste hydrocarbons including oil, fuel, bitumen and contaminated soil and sludge, is possible through the use of bio-remediation. The most simple bio-remediation technique is referred to as land farming.

During landfarming, waste hydrocarbons are applied to soil at a controlled rate and ploughed into the top 300-500 mm. Naturally occurring bacteria and chemical processes in the soil degrade the waste, producing carbon dioxide and water. While not advocated for bulk oil disposal, this procedure may be used for the remediation of surface oil/fuel spills and the associated contaminated soil.

Treatment times typically range from 6 to 12 months. The addition of nutrients (e.g. fertiliser) and regular ploughing help accelerate the process. Stringent environmental controls and monitoring are required to ensure the surrounding area does not become contaminated.

A slightly more controlled approach to bio-remediation involves slurrying the waste oil or contaminated soil with water, to yield a 5-10% solids content. The mixture is continuously stirred in a tank, with the addition of nutrients and air. Treatment times for this process range from 6 to 12 weeks.

PROCEDURE

SITE PREPARATION

1. Select a suitable site, preferably with good security and well away from any residential activities. The site should not be prone to flooding and there should be no significant groundwater sources within 100 metres. Very sandy soils and clays, are generally not suitable for landfarming.
2. Allow a minimum surface area of $10m^2$ per tonne of hydrocarbons or $5m^2$ per tonne of contaminated soil.
3. Establish site access controls, including fencing and signage as appropriate.
4. Establish a suitable level, graded base, with bunding around the perimeter to prevent surface run-off.
5. Clear the base of debris and excess vegetation.
6. Establish stormwater control measures. This may include small compacted earth bunds to divert stormwater away from the remediation area and drainage to collect contaminated runoff.

OPERATION

7. Spread the waste hydrocarbon material on the prepared base.
8. Mix the waste material with the top 300 - 500mm of natural soil using a bulldozer with tines or a rotary hoe.
9. Spread fertiliser (e.g. NPK) on the soil and remix. Repeat this action every two weeks initially. This may be reduced to every four - six weeks after the first 2 months.
10. Wet down the soil with freshwater. (Soil should be just moist, not muddy). Repeat every two-four weeks, depending on rainfall.
11. Stormwater runoff and/or leachate from the remediation area should be recirculated onto the soil stockpiles.

VALIDATION

12. After 4-6 months, obtain soil samples from the surface of the remediation area and at 500mm depth. A minimum of 1 sample per $10m^3$ is advised.
13. Mark each sample location on a site map, including permanent reference points.
14. Store the samples in a triple rinsed glass jars and label with a unique sample identification number.
15. Transport the samples to a registered laboratory for analysis of Total Petroleum Hydrocarbons (TPH).

16. Continue steps 7 to 15 until the laboratory results are below 5000 mg/kg.

Decommissioning

17. Excavate the top 300-500mm of soil. The remediated soil may be used as landfill cover or in controlled filling operations. Soil with TPH levels below 1000 mg/kg may be used without restrictions.
18. Backfill the excavation as necessary.
19. Regrade the base and revegetate as appropriate.
20. Remove site improvements (e.g. stormwater drains and bunding) as necessary.

C.10 IN-SITU REMEDIATION OF HYDROCARBON CONTAMINATED GROUNDWATER

OVERVIEW

This paper provides an overview of the issues to be considered in the development of passive, in-situ bio-remediation systems. Each site and contaminant will have a unique set of conditions and constraints, and detailed investigations will be required.

In-situ bio-remediation is considered the most practical and cost effective management option for hydrocarbon contaminated groundwater in the Pacific Islands. The typically shallow water tables and high permeability sand or limestone aquifers, are ideal for the application of this technology. Biological treatment systems have been demonstrated to successfully reduce hydrocarbon levels in groundwater aquifers to below drinking water standards.

Most hydrocarbon material will gradually breakdown in the environment to form carbon dioxide, water and simple organic molecules. This occurs due to the action of naturally occurring bacteria and sunlight. The breakdown process can be accelerated by the addition of specialised bacteria, oxygen and nutrients. In-situ bio-remediation of simple hydrocarbon material takes in the order of 3-6 months. More complex or chlorinated hydrocarbons can require up to 12 months to degrade to acceptable levels. Combining bio-remediation with a simple soil venting system can further accelerate this process.

The first stage of the remediation process is to pump any free hydrocarbon product from the aquifer. Contaminated water removed with the product should be returned to the aquifer for subsequent treatment. The hydrocarbon material is often relatively clean having been filtered through a sand layer. Where the contaminants are diesel fuel or waste oil, case studies indicate that the recovered product can often be reused or recycled.

Insitu biological remediation involves pumping of nutrients (nitrogen and phosphorus) and oxygen (compressed air) into the contaminated aquifer. The forced air pumping also provides a degree of mixing. In some instances, pH correction may also be necessary.

Hydraulic controls such as impermeable liners, slurry walls, spear point wells or interception trenches may be required to prevent the migration of contaminants and the influx of clean groundwater into the aquifer.

A large volume of background data is required prior to commencement of a groundwater remediation programme. As a minimum, the following information is required:

- nature of the contaminant, including; solubility, vapour pressure, density, soil partitioning coefficients and sorption coefficients
- nature of the aquifer, including; size, depth, water quality, potentiometric surface, pump test data, slug test data and sieve analysis
- vertical and lateral extent of contamination
- geological conditions including; local and regional soil profiles, depth to confining layer, geological cross sections, porosity and permeability.

To design a successful remediation programme, a detailed understanding of the chemical and physical interactions of the contaminant in the environment is necessary. For example, light hydrocarbons such as diesel will float on top of the aquifer, while many chlorinated hydrocarbons will settle below the water table. Similarly, hexachlorobenzene is relatively insoluble in water, however, its solubility greatly increases in the presence of benzene.

OPERATING PARAMETERS

The following provides a summary of the typical operating parameters employed for in-situ bio-remediation systems.

- For every 100 parts of organic carbon (measured as BOD), between 5-10 parts of nitrogen are required. A residual soluble ammonia concentration of 1-2 mg/L is desirable.
- For every 100 parts of organic carbon (measured as BOD), 1 part of soluble ortho-phosphate is required. A residual soluble phosphate concentration of 1-2 mg/L is desirable.
- Temperature greatly affects the rate at which bacteria metabolise the hydrocarbon contaminants. As a rule of thumb, for every 10^{o}C increase in water temperature, the rate of metabolic activity will double. However, above 45^{o}C the bacteria will begin to die off.
- The optimal pH range for hydrocarbon metabolising bacteria is 6 - 9 pH units.
- The groundwater should contain a residual dissolved oxygen level of > 1mg/L.
- Certain heavy metals and organic compounds can have a toxic effect on the bacteria. In particular, soluble concentrations of copper, lead, arsenic and chromium should not exceed 1 mg/L. Additionally, compounds such as perchloroethylene, quaternary amines, chlorinated aromatics and tertiary alcohols can inhibit the metabolic process.

Procedure

The following provides a guide to establishing an in-situ bio-remediation system.

- Locate and map the extent of the contamination.
- Establish site infrastructure and controls, including appropriate storage tanks, chemical delivery pumps, air pumps, bunding, diversion drainage, fire protection, monitoring equipment, fencing and signage as necessary.
- Establish local hydraulic controls to isolate the desired aquifer treatment zone. This may include placement of intercept trenches, sheet pile walls, slurry walls, extraction wells etc.
- Remove any free floating product from the aquifer. The recovered material should be incorporated in the regional waste oil recycling program. Any contaminated water should be returned to the aquifer.
- Establish injection and monitoring wells around the treatment zone. For optimal performance in a passive release system, the injection wells should be placed 0.5-1.0 m apart. This distance can be increased where an external mixing system (such as forced air), is provided.
- Pump the desired nutrient mix and air flow through the injection wells. The optimal concentrations and flow rate will depend on the quantity and nature of hydrocarbons in the aquifer.
- Monitor the aquifer to determine the biodegradation rate of the hydrocarbons. The initial degradation rate may be increased by the addition of specially cultured bacteria.
- Continue the process until the total petroleum hydrocarbon levels are below 1 mg/L. The system could be designed to operate on automatic feedback, with minimal operator input.

C.11 DISPOSAL METHODS FOR MEDICAL WASTES

Historically, high-temperature incineration has been the preferred method for disposing of hospital wastes. This involves burning the wastes with additional fuel inside a specially designed combustion chamber. If done properly, the wastes are reduced to a harmless and unrecognisable ash. In the past it was always considered that incineration was the most appropriate way to dispose of these wastes because of its high destruction efficiency (>99%) and relatively minor environmental impacts. As well, the production of a clean homogeneous ash gave continuing reassurance that the wastes were effectively destroyed.

The hospitals in some Pacific Island countries are equipped with incinerators. However, in many cases the facilities are less than adequate, mainly because the equipment is old and in poor condition. In other situations, the units are very basic and would not meet the performance criteria now applied in most developed countries. Modern waste incinerators are very expensive, and beyond the financial resources of many PICs.

It should be recognised that incineration is no longer seen as the ideal disposal method for hospital wastes. During incineration, most organic materials in the wastes are converted to carbon dioxide and water, which are discharged to the air. However, there can be traces of other contaminants, including carbon monoxide, smoke, metals, acid gases, complex organics such as the dioxins and polycyclic aromatic hydrocarbons, and airborne pathogens. Most of these are caused by incomplete destruction of the waste materials. All of these contaminants can have adverse effects on human health and the environment. The emissions of metals and dioxins are particularly significant because of their potential to accumulate in the environment, and their high toxicity.

Concern over these emissions has prompted some major reviews of the performance requirements for medical waste incinerators in many countries. For example, when new performance standards were introduced in the USA, it was expected that most of the 5000 medical waste incinerators operating throughout the country would have to be shut down. This will result in the majority of wastes either being disposed through a few dedicated service providers using state-of-the-art incinerators with much lower emission levels, or through the use of other waste treatment technologies.

A variety of alternative methods are available, or under development, for the treatment of medical wastes, including the following:

- Other forms of thermal treatment, e.g. plasma torch, glass furnace
- Heat treatment using steam, radiant heating or microwaves
- Chemical disinfection
- Irradiation using gamma rays or electron beams.

Many of these systems are still prohibitively expensive. However, a number of units have been developed recently in the US for use in small clinics, and some of these may be suitable for PICs. For example, a small pyrolysis unit (about the size of a domestic oven) is available at a cost of about US$50,000.

A recent WHO report on waste management indicates that controlled burial in a landfill should be one of the preferred disposal options for hospital wastes when incineration is not available. This disposal method is used in many PICs. However, the degree of control over the disposal activities is often not as rigorous as it should be. Ideally, the disposal site should be in a secure area with no public access. Wastes should be placed in pits at least 1 metre deep, and should be covered with fill material immediately after placement.

C.12 Basic Requirements for Sanitary Landfills

The term sanitary landfill describes a disposal facility for municipal solid wastes in which the site has been carefully selected, designed, constructed, and operated so as to minimise any potential environmental hazards and risks to public health. This includes the potential hazards from infectious and hazardous materials, and the leachate and gases formed from decomposing rubbish.

Site Locations

Sanitary landfills are best sited well away from populated areas, in locations where there is little or no risk of the buried waste coming into contact with surface or groundwater. Engineering design requirements should include a minimum distance between the base of the landfill and the maximum water table.

Some of the dumpsites seen in this survey are sited on the edge of lagoons, and in some cases the waste is regularly inundated with water. This situation will almost certainly lead to contamination of the marine environment.

Site Security

Landfill sites should be securely fenced and site access should be controlled to prevent scavenging. This is important because of the potential risks from hazardous and infectious materials that might be present.

Scavenging is discouraged at some of the landfills in PICs, but in others it is almost encouraged, as a means of reducing waste volumes.

Design and Construction

Most new landfills are constructed with an impermeable synthetic or clay liner, to prevent contaminant migration into the subsoil and any underlying groundwater. However, there were no sites identified in the survey where this had been done, mainly because of the cost and/or non-availability of liner materials.

Operation

Landfills are normally operated on a daily cell system. Each cell is formed on a confined portion of the site in which the refuse is spread and compacted in thin layers. Several layers may be placed on top of one another to a maximum depth of about 3 metres. At the end of each day, the refuse is covered with a layer of soil or other clean fill, and additional cover layers are put in place when the cell is full. At sites where excavations can be made below grade, the so-called trench method of construction is used, with the cells being formed inside a trench. If excavations are not possible, the rubbish is compacted into discrete piles or mounds, using the area method.

Daily cover material is an essential part of the landfill operation, because this helps to control odour, windblown litter, scavenging, and insect or rodent problems. The cover material is either taken from the surrounding soil (especially with the trench method of operation), or needs to be trucked in from other sites. Heavy machinery such as crawler tractors or rubber tired bulldozers are used to spread and compact the refuse and the cover layers.

In most of the landfills seen in the survey there had been little or no attempt to develop a cell type of operation. Some facilities were attempting to cover the wastes on a regular basis, although this was usually done weekly rather than daily. One of the main limitations was the availability of suitable cover material. Many operations also lacked the basic heavy equipment needed to move the waste into position and to achieve good compaction.

WASTE ACCEPTANCE

A properly operated landfill should have specific procedures for the acceptance and disposal of hazardous wastes. Generally these should not be mixed in with other refuse. If hazardous wastes are to be disposed at a landfill they should be buried in a specific part of the site, preferably one with a high degree of containment. Additional liner and cover materials should be used, and the waste should be covered immediately after placement to minimise any risks to the public. The locations of hazardous waste disposal pits should be clearly identified on a site plan. This of course, is quite easy to do if the site is operated to a cell system.

None of the sites seen in the survey had special procedures for the acceptance of hazardous wastes, although some had areas set-aside for the disposal of medical wastes.

C.13 DISPOSAL OF BURIED MEDICAL WASTES (PALAU)

ADMINISTRATION

The Palau Environmental Quality Protection Board (EQPB) has a range of environmental expertise and is considered well placed to manage the remediation works. The remediation programme is expected to be labour intensive and assistance from external contract workers may be required.

PREPARATION AND EQUIPMENT

A number of medical waste burial sites were identified through the POPs survey. There are reportedly numerous similar sites scattered through the Ngatpang jungle. Location and documentation of all known or suspected sites is the first step in the remediation programme.

The sites are very isolated and the risk from potential soil contamination is not considered significant. Should the analysis identify hazardous chemicals, a soil remediation programme will be developed.

The vials should be gently excavated by hand and placed into suitable containers for transport. Packing should be placed around the vials to protect against breakage. Equipment required for the clean up will include:

- Personal protective equipment (rubber gloves, safety glasses, long sleeves, long trousers, enclosed footwear);
- Hand trowels, shovels and rakes;
- Drums / containers to carry the vials;
- Packing (e.g. styrofoam, sawdust) to protect the vials; and
- Transport to the sites.

DISPOSAL

The Palau Hospital has an on-site high temperature incinerator, equipped with an afterburner. The unit is in good condition and reportedly meets the USEPA air quality criteria.

The incinerator is considered an appropriate and cost effective disposal option for the medical wastes. Chemical analysis will be undertaken to ensure that the material will not pose an air quality or explosion hazard when placed in the incinerator. The residual ash will be suitable for landfill disposal.

Negotiations are required with officials from the Palau Health Department and Hospital Administration, to obtain approval for disposal of the medical waste in the incinerator.

The issue of disposal fees should be discussed with the Palau Hospital Administration Board. It is proposed that the waste material be disposed during the routine operation of the incinerator. This should not result in significant additional expense for the hospital.

C.14 MISCELLANEOUS CHEMICAL WASTES

The disposal options for the various wastes listed in section 3.10 are discussed below:

CALCIUM HYPOCHLORITE

The most appropriate disposal option for calcium hypochlorite would be to find a use for it. This should not be difficult as the chemical is widely used for water treatment.

If no suitable use can be found, then it could be disposed by spreading over waste ground in a controlled location, and moistening with water. The chosen site should have little or no vegetation or other organic matter on the surface, because hypochlorite is a very strong oxidiser and can react violently with organic materials. The chemical will gradually lose its chlorine through exposure to the elements, leaving a residue of calcium hydroxide, or lime. After a period of 2 to 4 weeks, the residue should be either worked into the soil, or scraped up and disposed in a landfill.

CYANIDE CANISTERS

The most appropriate procedure to use with the cyanide canisters will be as follows:

the canisters should first be placed into drums or tanks containing a strong solution of sodium or potassium hydroxide. This will slowly erode the container, and release the cyanide into solution. A solution of oxidising agent such as sodium or calcium hypochlorite should then be added, in sufficient amount to ensure an excess of available chlorine. Careful monitoring of cyanide levels and pH is required to ensure that the reaction is carried out under alkaline conditions to prevent any releases of hydrogen cyanide gas prior to destruction. This takes about 24 hours, after which the contents may be disposed by pouring over waste ground or discharge to the municipal sewer. Any residual metal from the canisters should be disposed by burial at a landfill. The cyanide is converted to carbon dioxide gas.

CAR (LEAD-ACID) BATTERIES

The two hazardous components in lead-acid batteries need to be treated quite separately. Any acid should be removed by draining the casing. This should be diluted with an excess of water to give a 5 to 10-fold dilution. The liquid should then be neutralised by mixing with an equal volume of agricultural lime, or other alkaline material. Coral rock may be a suitable alternative in many PICs.

The lead in these batteries should be recovered and reused. There are secondary smelters in New Zealand and Australia that accept old batteries for recycling, and the purchase price should usually be sufficient to cover the costs of shipping from PICs. Lead recovery is also practised at a domestic level in some PICs; e.g. for making fishing sinkers. However this should not be encouraged because of the potential environmental and human health hazards. Lead recycling operations require a high degree of control because of the potential hazards from air emissions and wastewater discharges.

Empty battery cases must also be disposed carefully because they can still contain significant amounts of lead. Disposal in a secure landfill is the preferred option, and domestic uses should be discouraged.

DRY-CELL BATTERIES

Most dry-cell batteries contain a complex mixture of different chemicals and this makes it very difficult (and uneconomic) to recycle any of the individual components. In fact, recycling of these batteries is only practised at a few places in Europe and North America where the available volumes are very large.

The only suitable option for disposing of dry cell batteries in PICs is to mix them with concrete followed by burial in a landfill. The concrete effectively locks up any hazardous metals and will also neutralise any acidic components. The batteries should be added to concrete at a rate of about 1 to 4. (1 kg of batteries to 4 kg concrete).

FERTILISERS AND NUTRIENT MIXES

The best disposal option for these chemicals is for them to be used as originally intended. However, this will not always be possible if the quantities are large (>100kg) and the available land areas are limited. For example, an area of 50 hectares of land would be required for the disposal of 100kg of fertiliser at the typical usage rate of 2 kg/ha.

Small quantities of nutrient metal salts can be disposed by mixing with the cover material used on a landfill. The rate of mixing should be similar to that recommended for normal use and is typically less than 1 kg/ha. Larger amounts could be disposed in a landfill after mixing with concrete (see notes for CCA in Annex C.7).

Urea breaks down readily in the environment to form ammonia and carbon dioxide, although continued use can lead to a build up of nitrates in soil and groundwater.

Quantities of lime can have beneficial effects when disposed in a landfill, because it helps to neutralise any acid leachate.

If none of the above options are suitable, then the chemicals may need to be shipped to a suitable treatment facility in Australia, New Zealand, or elsewhere.

PAINTS AND RESINS

These materials can be safely disposed in a landfill once they have been allowed to harden or cure.

SODIUM HYDROXIDE

Ideally, this chemical should be disposed by using as intended, or for neutralisation of other wastes. It can also be disposed in a landfill, where it should have a beneficial effect on any acidic leachate. Liquid wastes should be soaked up in some suitable absorbent material prior to landfill disposal.

C.15 REMOVAL OF LEAD-BASED PAINT FROM STEEL STRUCTURES

OVERVIEW

Lead based paints are often used as primers on steel structures as an anti-corrosion measure. Historically lead was also used in many top coats, but this use has been largely discontinued because of problems due to lead toxicity. Nonetheless lead may still be present in top coats if the paint is more than 10 to 20 years old.

The removal of lead-based paint is potentially very hazardous because of the possible health effects. Lead is a neurotoxin which acts on the central nervous system. It can enter the body by ingestion or inhalation. The symptoms of acute lead poisoning include nausea, vomiting, stomach cramps, insomnia, irritability, moodiness and loss of co-ordination. Prolonged exposure to small amounts of lead can cause chronic lead poisoning, the symptoms of which include headaches, loss of energy, nausea, vomiting, anaemia and loss of co-ordination. Lead exposure has also been shown to cause developmental and behavioural problems in young children.

Lead is also harmful to small animals, and there have been many examples of household pets being accidentally poisoned during lead removal operations.

IDENTIFICATION

Old paint should always be tested prior to removal, if there is any possibility of lead based paints having been used. The probability is extremely high for most steel structures, and is also very high for house paints more than about 20 years old.

The presence of lead in light coloured paints is easily tested by wiping the surface with a 5% solution of sodium sulphide. Some of the lead reacts to form lead sulphide, which causes a dark stain. Unfortunately this simple test is not suitable for dark coloured paints. Nor can it test for lead in any underlying paint layers. In these situations, small samples of the paint should be collected and sent to a laboratory for lead analysis. The amount of paint needed for testing is very small; a teaspoonful would be quite adequate.

PAINT REMOVAL METHODS

The removal of lead based paint should only be carried out using methods that minimise the generation of airborne dust. Manual scraping or water blasting have the least potential for dust generation and would be the preferred methods for use in most PICs.

The use of a heat gun to soften the paint is not recommended because this can produce lead fumes. Dry sand blasting should never be used unless the operation is carried out in a fully enclosed system, with a high level of dust control. In the case of large steel structures this can only be achieved by surrounding the entire structure in a temporary enclosure made from plastic sheeting, and fitted with extraction fans and a dust collection system.

PERSONAL PROTECTION

Whatever method is used for removing the paint, it is essential that the people doing the work be provided with equipment to protect them from dust exposures. This should include high quality dust masks, gloves and disposable overalls.

Good personal hygiene practices are also important. One of the most common routes for lead poisoning is inadvertent exposure through handling food with hands covered in paint dust. Cigarette smoking is also a major risk factor in this context. It is essential that workers be made to remove any contaminated clothing and have a thorough wash before any meal breaks and also at the end of each work shift.

ENVIRONMENTAL PROTECTION

Paint flakes and dust should not be allowed to contaminate the work site and surrounding areas. As indicated previously, this can be a hazard to pets and other small animals. In addition, lead persists in the environment and can be taken up into crops and other components of the food chain.

Attempts should be made to prevent contamination of the surrounding environment during the paint removal operations. This should include covering the ground around the site with tarpaulins or sacking. These should also be suspended beneath any elevated structures such as bridges. As much of the paint dust as possible should be collected at the end of each work shift, and the site should be given a thorough clean up at the end of the removal operation. All paint flakes and dust should be placed into sealed containers for secure storage prior to disposal.

WASTE DISPOSAL

Most paint residues can be safely disposed by burial in a landfill, although it is desirable that the site has a good level of leachate control. For many of the landfills in PICs, any potential leachate problems could be minimised by mixing the paint with concrete prior to burial. A mixture of about 1 part paint to 1 of concrete should be used.

FURTHER INFORMATION

Detailed procedures for the management of lead based paints are given in an Australian Standard; AS 4361, 1995 – Guide to Lead Paint Management.

C.16 A GUIDE TO THE IMPORTATION OF HAZARDOUS WASTES TO AUSTRALIA

THE REQUIREMENTS OF THE BASEL CONVENTION

The Basel Convention is an internationally recognised convention which provides for controls on the import/export and international movement of hazardous materials. Australia is a party to the convention and in 1996 amended the *Hazardous Wastes (Regulation of Import and Exports) Act* to fulfil its obligations under the convention. Annex IV of the Convention provides guidance as to what constitutes a 'waste' and 'disposal'. It is important to note that disposal operations include both final disposal and recovery or recycling.

Under the Convention, wastes may only be imported to Australia from countries which are also party to the Basel Convention. In the Pacific region this includes FSM, Papua New Guinea and New Zealand. Special permits can be arranged for export from non-party countries, but this is typically difficult, time consuming, and can not be relied upon as a long-term solution.

Prior to obtaining an import permit, written consent in the form of a contract is required from the waste owner, transporter(s), countries of transit and the final disposal or treatment facility. Details of the applicant's financial state and the transporters' insurance cover are also required. The application must be accompanied by one original copy of the Environment Australia Application Form and associated fee, and one original copy of the Basel Transboundary Movement of Waste Notification Form for each country involved in the transboundary shipment, (including transit countries). A minimum of 60 days is required to process the import application.

Transport of hazardous materials through international waters must comply with the International Dangerous Goods Code (DGC), administered by the IMO. The DGC also has a permit system, which requires the appropriate labelling, packaging and tracking of hazardous materials. Under the DGC, all shipments of hazardous material must include a dangerous goods declaration with the main transport document (e.g. the consignment note). Each transport 'unit' must include:

- the proper shipping name as determined by section 13.8 of the UN Orange Book,
- the class, or when assigned, the division of goods. Class 1 articles should be followed by the compatibility group letter,
- the UN number preceded by the letter 'UN', and where assigned, the packing group, and
- the total quantity of dangerous goods.

The UN Orange Book also recommends that those responsible for supervising the packaging of hazardous goods provide a 'container packing certificate'. This should certify that:

- the container is clean and fit for purpose,
- incompatible packages have not been stored together,
- packages have been inspected for signs of damage,
- all goods have been properly loaded, adequately braced and the load evenly distributed,
- for goods bearing a Class 1 code, the container must be structurally serviceable in accordance with the Orange Book, and
- the container and all packages are properly labelled.

It may also be necessary to provide an Emergency Response Plan, which contains sufficient information to safely address and mitigate an accidental spill or leak of hazardous material during transport. The IMO has developed 'Emergency Procedures for Ships Carrying Dangerous Goods' which would provide an appropriate guide. This should be augmented by health and safety data specific to the material being transported.

A copy of the Environment Australia guide to the Basel permit system and copies of the application forms are available from Environment Australia.

More information can be obtained by contacting:

The Hazardous Waste Section
Environment Australia

ph: (02) 6274 1411
fax: (02) 6274 1164
Email: hwa@dest.gov.au

[1] Based on the Vanuatu draft Code of Practice for Timber Preservation Plants