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# Tonga POPs Project Country Plan
**(Prepared by SPREP, January 2003)**

## 1. Introduction

The Australian Agency for International Development (AusAID) several years ago identified the mismanagement of hazardous chemicals in the Pacific Island Countries as a serious environmental concern, and hence the Persistent Organic Pollutants in Pacific Island Countries (POPs in PICs) project was developed as an AusAID funded initiative, to be carried out by SPREP. POPs are a group of twelve particularly hazardous chemicals that have been singled out by the recent Stockholm Convention for urgent action to eliminate them from the world. They include polychlorinated biphenyls (PCBs), which are mainly found in transformers, and several pesticides that are very persistent and toxic to the environment.

Phase I of the project involved predominantly an assessment of stockpiles of waste and obsolete chemicals and identification of contaminated sites, for 13 Pacific Island Countries. Other Phase I activities included education and awareness programmes in each country and a review of relevant legislation.

Tonga was a participant in Phase I of this work. A comprehensive report of this Phase I work was prepared and circulated, and significant quantities of hazardous wastes were identified in the countries visited, including estimated figures of 130 tonnes of PCB liquids and 60 tonnes of pesticides (although only about 3 tonnes of POPs pesticides). Many other hazardous wastes were also identified as well. In addition, quite a large number of contaminated sites were discovered, including six locations of buried pesticides. On the basis of this report, it was decided to proceed to the Phase II of the project, which involved the preparation of a more detailed inventory, and then collecting, transporting and disposing of the wastes, to a suitable Australian facility.

The first part (Component 1) of the Phase II work is now nearly complete, and has involved visits to each of the countries involved in the project, including Tonga, for detailed inventories to be carried out, including testing of all stockpiled transformers.

Other work was also carried out during these visits, including improving the temporary storage arrangements where necessary, and obtaining written agreement from each country for the project to proceed. A copy of Tonga visit report is contained in Appendix 1 below.

The most significant conclusion found from this next stage of the work is that the estimated amount of PCB contaminated oils was far too high. Instead of the expected 130 tonnes, only 12.5 tonnes were found. This presented an opportunity to include additional wastes in the project, and it was decided to collect and dispose of all the pesticides, rather than only the POPs pesticides (as well as all the PCB transformer oils that were confirmed positive). A total of 50,265 kg of pesticides will now be dealt with, including 1825 kg of POPs pesticides and 6542 kg of unknowns, some of which may be POPs pesticides.

A full inventory of all pesticides and PCB contaminated oils was prepared in November 2002 as the basis for bid invitations to appoint an Australian Management Contractor (AMC) to carry out the rest of the Phase II work. As a result, the Australian company GHD Pty Ltd was appointed as AMC. GHD is expected to start work shortly and it is important that all countries agree to a confirmed plan for implementing the rest of the Phase II work. The wastes will all go to the BCDT / SRL Plasma plant in Narangba, north of Brisbane.

AusAID have engaged the Australian legal firm of Blake Dawson Waldron ("**BDW**") and instructed them to provide advice in relation to aspects of the POPs Project. As part of this process BDW has asked SPREP to obtain from participating countries some information as presented in Section 4 below.

## 2. Country Inventory

(It is possible that more wastes may be found in the categories below, prior to the time of pickup. If so, these could be added to the inventory, subject to negotiation with AusAID and the AMC.)

There were 114 old transformers stockpiled at the Popua Power Station yard, Tongatapu. Ten of these could not be tested because the oil had completely drained out. All the remaining 104 transformers were tested with Dexsil Chlor-N-Oil 50 test kits and 23 tested positive. Samples of oil from these 23 transformers were therefore sent for testing to Hill Laboratories in New Zealand, and only one large one was confirmed as positive. (Four of these samples were effectively water and so were subjected to a full PCB suite of analyses by Hill Laboratories). The Dexsil kits test for all chlorine and not just chlorine in PCBs, so they are susceptible to "false positive" results.

In addition to the 114 transformers at the Popua Power Station, Mr 'Asipeli Palaki of the Department of Environment visited power stations on Vavau and Ha'apai for the purpose of testing transformers. Several old transformers on Vavau had all been drained. The oil

had been thrown away, together with the transformer internals, and the transformer carcasses were being used of umu ovens. On Ha'apai, ten transformers were tested and four tested positive with the test kits. All these four were subsequently confirmed as negative by Hill Laboratories.

Tonga therefore has the following **PCB Contaminated Oils** to be collected.

| Location | No of Transformers | Wt of Oil (kg) | PCB Conc (mg/kg) | No of Flushes | Total Waste Wt (incl Flushes) (kg) |
|---|---|---|---|---|---|
| | | | | | |
| Popua Power | 1 | 1345 | 98 | 2 | 4035 |
| Station | | | | | |
| | | | | | |

Tonga has the following **Pesticides** to be collected:

| Tonga Pesticides Inventory (all located at Vaini Research Farm) | | | |
|---|---|---|---|
| | | | |
| **Chemical** | **Active Agent** | **Quantity** | **Comments** |
| | | **kg** | |
| | | | |
| Dieldrin | Dieldrin | 20 | Liquid, no label, but staff confirm dieldrin |
| Mocap (Ethoprophos) | Ethoprophos | 30 | Liquid, in two partly empty 20 l drums |
| Amini ICI Hormone Weedkiller | probably 2,4-D | 5 | Liquid, in a 20 l container |
| Captafan | probably captan | 20 | In 4 x 5kg bags |
| Ronilan | Vinclozolan | 10 | |
| Mesurol | Methiocarb | 10 | |
| Karmex | Diuron | 10 | |
| Calirus | Benodanil | 10 | |
| Basamid Soil Fumigant | Dazomet | 4 | |
| Captan Fungicide | Captan | 3 | |
| Amidthin Fungicide | | 0.2 | |
| Furadan 10G (Carbofuran) | Carbofuran | 3 | |
| Manzeb | Mancozeb | 0.1 | |
| Endosulphan Insecticide | Endosulphan | 1 | |
| Alar Inhalt | Daminozide | 1 | |
| Malathion | Malathion | 2 | Liquid |
| Nemacur 400 (Fenamiphos) | Fenamiphos | 5 | Liquid |
| Roundup | Glyphosate | 1 | Liquid |
| Contaminated Packaging | | 30 | 6 bags |
| Unknown white powder | | 15 | |
| Unknown light brown powder | | 3 | |
| Unknown Fungicide | | 5 | |

| | | | |
|---|---|---|---|
| Unknown brown powder | | 0.2 | |
| Unknown green powder | | 4 | |
| Unknown clear liquid | | 10 | |
| Unknown liquid in blue container | | 8 | |
| Unknown dark brown liquid | | 5 | |
| Unknown black liquid | | 3 | |
| Unknown clear liquid | | 1 | |
| Unknown thick black liquid | | 1 | |
| Unknown brown powder | | 10 | |
| Unknown powder | | 2 | Markings indicate pesticide |
| Unknown white powder | | 3 | |
| Unknown liquid | | 0.5 | |
| Unknown brown liquid | | 5 | |
| | | | |
| N.B. 1. All the above are being held in secure storage at the Dept of Ag Research Farm, Vaini. | | | |
| 2. All the above were repackaged in good packaging in March 2002. | | | |

## 3. Other Project Work

Numerous old leaking transformers at the Popua Power Station were sitting in on the concrete floor of an old structure that had never been completed. The low nib wall of this structure acted as a low bund wall and was holding water and some transformer oil contaminated sludge. The contents of this low bunded area frequently overflowed, and ran into the nearby lagoon, so there was real concern that PCBs may have ended up in the lagoon sediments. As a result, two composite samples of sediments in the bunded area (one on either side) were sent for PCB analysis. The results of these analyses were fortunately negative.

The Department of Works site has been subjected to quite heavy contamination from waste oil and waste bitumen. Close by, the Works Maintenance Shop is suffering from serious oil contamination. They have no way of disposing of their waste oil except by dumping on site. These sites were visited and the contamination inspected.

A visit was made to Tonga Timber Ltd, where CCA treatment of timber is carried out. The company produces small regular quantities of CCA sludges, which it disposes of by mixing with concrete and burying. Earlier sludges produced on the site may have been dumped. In the Government Stores (formerly the Ministry of Works) there is a site formerly used for CCA treatment. Soil samples taken in the past have revealed widespread CCA contamination over an area of approximately 600 square metres.

Small stockpiles of old chemicals were reported in the Main Hospital and in some schools, although these stockpiles were not inspected. Small amounts of numerous “non-pesticide” chemicals are also strored at the Vaini Research Farm.

John O'Grady also became quite involved in the AusAID Solid Waste Management Project during his visit, as Ministry of Health and other Government officials were preparing for a visit by AusAID officials to investigate several aspects of the project before finally approval was granted. This involved studying several reports, aattending meetings, and giving advice to the Ministry of Health about the project. (See Appendix 2 of this report.)

## 4. Domestic Laws on Collection, Packaging, Transportation and Export of Hazardous Waste

AusAID have engaged the Australian legal firm of Blake Dawson Waldron ("**BDW**") and instructed them to provide advice in relation to aspects of the POPs Project. As part of this process BDW has asked SPREP to obtain from Tonga (as well as all other participating countries) the following information:

a) What are the legal responsibilities in Tonga for persons involved in collection, packaging, transportation and disposal of hazardous wastes and who are those responsibilities allocated to by the laws in Tonga.

b) Who is the owner of the hazardous wastes in Tonga.

c) Does Tonga have domestic legislation which allocates responsibility for POPs waste during collection, packaging and export? If so, how is this responsibility allocated? Please consider that liability and responsibility may arise from:

- requirements to comply with clean-up notices or Government directions relating to the waste;
- requirements to meet safety, environmental and other standards in relation to the waste; and
- requirements to compensate others for damage to property, human health or the environment.

d) Does Tonga have a domestic policy in relation to providing or withholding consent under the prior informed consent provisions of the Waigani Convention (Article 6) for:

- Tonga
- any other Pacific Island Countries planning to 'transit' wastes through Tonga.

e) Has Tonga developed a national hazardous waste management strategy in accordance with Article 4(4)(e) of the Waigani Convention? If so, how is the strategy relevant to:

- the collection, packaging, transportation and exportation of POP waste; and
- responsibility for and ownership of the POP waste at each of the steps in (i).

Should you have any enquiries, please contact the following relevant Blake Dawson Waldron staff, Tony Hill on (02) 9258 6185 or Joanna Perrens on (02) 9258 6401 in Sydney, Australia.

## 5. Discussion

There has been only one transformer identified in Tonga with PCB contaminated oil, although this is a large one, weighing 5570 kg and containing 1345 kg of oil (about 1580 litres). It should be noted, however, that 10 empty transformers could not be tested. There may also be PCB contaminated oil in some of the "in service" transformers. If the large "positive" transformer is flushed, then this will generate about 4035 kg (or about 4750 litres) of combined contaminated oil plus flushing solvent. About 24 x 200 litre drums will therefore be needed to contain this amount of liquid waste.

There has been extensive spilling of transformer oil at the Popua Power Station and some of this oil must inevitably have found its way into the nearby lagoon, which is a source of food for local people. It is a relief therefore to learn that there is only one transformer that has tested positive for PCBs and that the sludge in the ponded area full of old transformers is PCB free. The chances of there being PCBs in the lagoon sediments are therefore quite low.

The pesticides stored at the Vaini Research Farm are all being kept securely in a soundly constructed shed. They were in a bad condition when first inspected on the recent visit, so were all repacked in sound containers – cardboard boxes and sacks. There is some possibility of water damage when this shed leaks, so all the repacked pesticides were covered in heavy duty plastic.

There is about 241 kg of pesticides stored at the Vaini Research Centre, including about 106 kg of unknowns. The individual quantities of these chemicals are quite small, although there is 20 kg of the POPs pesticide Dieldrin, 30 kg of Mocap, and 20 kg of Captan. About 10 drums will be needed to package these pesticides, including packaging contaminated debris.

The total number of drums needed is therefore about 34 drums. A total of 80 drums will fit inside a 20 ft container, so one 20 ft container should easily be sufficient.

A staging location will be needed for the container, and probably a good location would be at the Popua Power Station. The removal of oil and the flushing of the large transformer will be quite a major operation and it would be useful to have the container nearby. The drummed wastes from the Vaini Research Station can easily be brought to this location. The local transport of the drums to the container staging area needs to be

on safe covered trucks with good containment. The filled container will also need to be moved to the port.

It is also important that consent procedures are in place to process the application from GHD to Tonga to export the waste. Tonga has ratified the Waigani Convention, and needs to be ready to handle effectively, the export application, including any appropriate public consultation processes. SPREP plans to hold a workshop soon to assist countries with this consent process.

The impact on the public in Tonga should be minimal, provided everything is organized and implemented according to a well-designed management plan. The local transport routes and movement times will be part of the plan, and the only risk of public exposure will be if some incident occurs during this local transport, which leads to a spill. The basis of the management plan should be communicated to the public effectively via radio, and printed media, but not in an alarmist fashion, as the risk to the public is very low.

The contaminated sites at the Dept of Works yard (oil and bitumen) and Maintenance Shop (oil) need to be investigated and solutions need to be found to the problem of waste oil disposal. The two potentially contaminated CCA sites need to be investigated too, as should the current Tonga Timber CCA sludge disposal method. Mixing with cement is an acceptable waste stabilization method for metal bearing wastes, but it needs to be done in a scientific fashion with testing for leachate potential, or heavy metals will leach out to contaminate groundwater.

## 6. Conclusions

1. Tonga has only one PCB contaminated transformer, a large one at the Popua Power Station.

2. There are about 241 kg of mixed pesticides to be picked up from the Vaini Agricultural Research Station, including about 106 kg of unknowns.

3. About 34 drums will be required for Tonga, which will fit easily into one container.

4. Tonga also has waste oil and bitumen contamination at the Department of Works, and a serious waste oil contamination problem at the Works Maintenance Shop.

5. Tonga may have some CCA contaminated site problems at Tonga Timber and the Government Stores complex.

6. Stockpiles of used chemicals were identified in several locations, such as schools (advice only), the main hospital, and the Vaini Agricultural Research Station (which also has a stockpile of non-agricultural chemicals).

## 7. Actions

1. It needs to be confirmed with Shoreline that the large transformer with the PCB contaminated oil is to be drained and flushed.

2. It needs to be confirmed with the Dept of Agriculture that these pesticides are definitely to be removed as part of the project. There may also be more pesticides that were not discovered in the recent visit.

3. A local management plan will need to be prepared for all local operations, including the determination of the location of the container while the collection operations are going on. This plan will need to address such issues as local transportation arrangements, local contact focal point, and the best way of carrying out consultation with Tongan public on the local implementation of the project. This plan needs to be developed in conjunction with the AMC.

4. Local systems need to be put in place to ensure effective processing of the application from the AMC to export hazardous waste from Tonga to Australia. This application will be lodged under the Waigani Convention. A SPREP workshop is planned for April this year to assist countries with these procedures, and a Tonga representative should attend this workshop. (Financial assistance will be provided.)

5. Note that it would be appropriate to do further testing to establish properly the full extent of the contamination by waste oil and bitumen at the Dept of Works yard and Maintenance Shop, as well as any possible CCA contamination at the two suspect sites. This should be done as soon as a suitable opportunity arises, which will probably be during the preparation of the National Implementation Plan (NIP) for the Stockholm Convention. Substantial funding is available from the GEF for the preparation of the NIP.

6. A solution needs also to be found to the problem of waste oil disposal and it would be appropriate to take this matter up with local oil suppliers.

7. Continue to safely stockpile used chemicals that are not to be picked up by the current AusAID project. It would be appropriate to find a suitable central locked storage area with proper shelving for these chemicals, and also to ensure that proper segregation of incompatibles (e.g. acids and alkalis, oxidizers and reducers, acids and cyanides) is achieved.

8. Provide SPREP with appropriate responses to the BDW questions regarding Domestic Laws on Collection, Packaging, Transportation and Export of Hazardous Waste

# Appendix 1

## REPORT OF THE VISIT OF JOHN O'GRADY (SPREP) TO TONGA FOR THE POPS PROJECT

**Wednesday 30 Jan**

Arrived in morning and met the ***Director (Uilou Samani) and staff of Department of the Environment***, and made arrangements for presentation in afternoon of the POPs in PICs project.

John O'Grady gave a presentation on the POPs in PICs project and stressed the Action Plan for the visit to Tonga. The presentation was attended by relevant officials of the Tongan Government Service, including staff at the Dept of Environment, and representatives from MAFF, Dept of Health, and Tonga Electric Power Board (TEPB). It was advised that the TEPB was being disbanded that week, when the private company Shoreline took over electricity distribution as well as generation.

**Thursday 31 Jan**

Accompanied by ***'Asipeli Palaki (Conservation Officer) and Lupe from the DOE office***, JOG visited the Popua Power Station, but was unable to meet anyone at the Power Station. Many old disused transformers were spread over a wide area of open field, in about 5 groups. Some of the transformers were open, and the contents had spilled out. Most were covered by long grass. No attempt had been made to safely store the transformers or contain the spills.

Visited the ***Department of Works*** and to the ***Works Maintenance Shop***. There was some oil and bitumen contamination at the former and substantial oil contamination at the latter. The Manager of the Maintenance shop advised that disposal of waste oil was a real problem for him, and disposal into pits on the property was the only real option.

Visited ***Tonga Timber Ltd and met Kaveinga Fa'anunu, Chief Executive and Company Secretary***. Tonga Timber Ltd had a CCA timber treatment system and disposed of their sludges by burial in concrete. Previous poor site management practices may have contributed to site CCA contamination in the past.

Met in the afternoon, ***Mr Angus MacDonald, Australian High Commissioner***, and discussed the project. Mr MacDonald offered the assistance of the High Commission throughout my visit to Tonga.

**Friday 1 Feb**

A courtesy call was made to the ***NZ Deputy High Commissioner***.

Wrote up Tonga Letter of Agreement (LOA) for the project and a detailed covering letter, so the matter could be presented to cabinet for signature.

Was briefed on the situation regarding the privatization of the Electricity Generation and Distribution system. The generation had been taken over by a company called Shoreline a few years ago, and now the whole system was being taken over by Shoreline. Tried for some time unsuccessfully to meet Shoreline and also the TEPB to discuss the PCB issue.

Prepared notes for cabinet papers on Waigani Convention and Stockholm Convention.

**Saturday 2 Feb to Tuesday 12 Feb**

Visit to Niue for the POPs in PICs project work.

**Wednesday 13 Feb**

Commenced identifying the 115 transformers stockpiled at the Popua Power Station. Many were covered in long grass and vines and several had partially or completely leaked out. Many were in a bad state of rust and decay, but there were numerous quite new ones deteriorating quickly.

Tried several ways without success, to secure the cooperation of Shoreline, the new power generation and distribution system owners, to assist with sorting out

**Thursday 14 Feb**

Finally got to meet with the new ***Engineering Manager of Shoreline, Mr Barney Biezuidienhout***. After much persuasion, managed to secure a promise on cooperation, in the way of a crane truck (Hiab) to help sort out the transformers and safely store the ones that tested positive for PCBs. This never materialized, but it was still being promised for later.

Continued identifying and commenced testing the transformers at the Power Station.

**Friday 15 Feb**

Continued identifying and testing transformers at the Popua Power Station in morning.

Wrote draft cabinet paper for DOE, regarding the LOA.

Met Australian High Commissioner again in afternoon with Uilou Samani, to discuss general environmental issues and the POPs in PICs project.

Spent some time at the Australlian High Commission, making phone calls and researching project.

**Monday 18 Feb**

Continued identifying and testing transformers at the Popua Power Station. Efforts were hampered by rain, but worked all day at the Power Station.

**Tuesday 19 Feb**

Continued identifying and testing transformers at the Popua Power Station. Efforts were again hampered by rain.

The storm turned into quite a bad storm, so spent some more time at the Australian High Commission, and also sent some emails.

**Wednesday 20 Feb**

Visited ***Vaini Experimental Research Farm and met Dr Pita Taufotofua***. There are quite a lot of pesticides at the Research Farm and these were inspected.

At the request of the Director of Environment, attended meeting on Tonga Solid Waste Management Project, at the Ministry of Health. This is a project to be funded by AusAID and involves the construction of a "state-of-the-art" solid waste landfill on Tongatapu, together with setting up a waste collection infrastructure and some recycling.

The rain continued, so spent the rest of the day researching the Tonga Solid Waste Management Project.

**Thursday 21 Feb**

Tried some more testing at the Power Station, but got rained off again.

Made some more calls from AusAID, mainly regarding issues that needed to be sorted out for AusAID on disposal of the wastes, consultation, role of the various agencies and levels of Government, etc.

Spent the rest of the day researching and writing the cabinet paper for the Tongan Cabinet on the Stockholm Convention.

**Friday 22 Feb**

Finished the cabinet paper on the Stockholm Convention.

Did some more testing at the Popua Power Station until the rain came again. Was interviewed on Tonga TV, regarding the project.

Finshed the review of the Tonga Solid Waste Management Project.

**Saturday 23 Feb**

Spent 4 hours in afternoon testing transformers at the Power Station.

**Monday 25 Feb**

Long meeting in morning on the Tonga Solid Waste Management Project, at the ***Dept of Health***.

Made calls and emails in afternoon from Australian High Commission, and did some more testing at the Popua Power Station.

**Tuesday 26 Feb**

Spent all morning and part of afternoon at the Power Station – tested all the new ABB ones, when a sample one was found positive.

More calls from the Australian High Commission in the afternoon, and sent some emails.

**Wednesday 27 Feb**

Met Director Uilou Samani in morning to discuss the project and the cabinet papers. We went out to the Power Station site together. Then I stayed and did some more testing and sampling.

Visited the Australian High Commission in the afternoon for a meeting with ***Rick Nicholls, AusAID Officer - First Secretary (Development Cooperation)***, who had just arrived back from Canberra. Briefed him fully on my activities and the project in general. Also discussed the Tonga Solid Waste Management project.

**Thursday 28 Feb**

Spent all day in the office completely revising the SPREP Progress Report for AusAID - except for two hours visiting the ***Minister of Lands*** about the LOA Cabinet Paper.

**Friday 1 March**

At the Power Station for two hours taking samples.

Spent the rest of the day preparing the cabinet paper for the Tongan Government on the Waigani Convention.

**Saturday 2 March**

At the Popua Power Station for four hours, doing the last of the testing, and finishing the sampling. A total of 114 transformers had been tested, with 29 giving positive test-kit results. Of the 114 transformers, 10 were empty and could not be tested. Some of these were in a concrete bunded area, and had emptied out into this area, forming a PCB contaminated oil lake.

**Monday 4 March**

Final work on the three Cabinet Papers.

Visited the Vaini Research Farm to prepare for the pesticide cleanup work.

Had meeting with Shoreline on work to be done storing away the transformers that tested positive.

**Tuesday 5 March**

Packaging pesticides at the ***Vaini Research Farm***. There were about 250 kg of various pesticides, including Dieldrin (20 litres), Mocap, Captafan, Ronilan, Mesurol, Karmex, Basamid, and about 50 kg of unknowns. There were also about 30 kg of various chemicals in small amounts, mostly salts, acids and organics (xylene, isopropyl alcohol, ethyl alcohol, dichlorobenzene, etc). These were all safely packaged in new containers and placed in the locked storage shed at Vaini.

**Wednesday 6 March**

Continued packaging pesticides at the Vaini Research Farm.

Wrap-up meeting and dinner with Director Uilou Samani. Was advised that the Tongan Cabinet had agreed to sign the LOA, and had also agreed to ratify the Waigani Convention and sign the Stockholm Convention. The Director handed over the LOA which had been signed by the Minister.

**Thursday 7 March**

Flew back to Apia in the morning.

# Appendix 2

## "Solid Waste Management for Tonga" – Proposed AusAID Project.

*(Comments by John O'Grady, SPREP, 7 March 2002)*

### Site Selection and Design of Facility

The Site Selection appears to have been thorough. There are no easy answers, as far as a good site is concerned. The chosen site near Vaini is not ideal, but is the best available. The landfill will need to be carefully engineered and operated, if leachate contamination of the fresh water lens and groundwater is to be avoided. Especially important is the bentonite base protection layer. Poor operation of the facility, and failure to construct further cells properly, could result in considerable contamination of the fresh water lens and groundwater. If the landfill is not constructed (on an ongoing basis) and operated properly in the long term, the adverse environmental impacts could be severe. If the planned hazardous waste cell goes ahead, then this will add to the potential for problems to occur.

It is important at this stage that baseline monitoring is carried out, to establish a basis for comparison, once the groundwater monitoring commences. The problem, however, is that once leachate is detected in the monitoring wells, it is likely to be too late to do anything. Detection of leachate will indicate that the landfill liner is leaking and this problem is then extremely difficult to remedy.

### Economic Sustainability of the Project in the Long Term

An expensive and quite technically sophisticated system will be put in place, if the project goes ahead as currently proposed. Although the proposed system is quite sophisticated, however, it is the best one for Tonga in the long term, as there are no easy answers. The present dump-site at Popua is a serious liability and is quite unsatisfactory, and furthermore, refuse will continue to be generated in increasingly larger amounts as the population increases.

The proposed system will set in place a new landfill with a sophisticated liner system, which will need to be maintained, protected and extended. New cells will also need to be constructed. A regular and efficient collection system will also be set up in Nuku'alofa. A transfer station may also be established.

Sustainability of this system in the long term will depend on three things: available finance dedicated to this purpose, a long-term commitment to make the project work, and sufficient in-house technical expertise.

As far as finance is concerned, it is estimated that this system will cost up to T$10/household/month, and businesses will be expected to pay substantially more. Apparently households in Nuku'alofa (based on advice from Dr Malakai 'Ake of MOH) are already paying T$5/household/month for refuse services, so it is likely that they will pay twice this amount, once they are getting a good service. It will be important for AusAID to fund the project (at least partly) until it is operating satisfactorily and until this level of self-funding can be guaranteed. Confidence in the new system will need to be built up, and people will need to think they are getting value for money. A good awareness-raising and publicity campaign will be essential. At least part of the funding should be directly raised through gate charges at the landfill, or at the transfer station if one is installed.

If the system that is installed and constructed is a good one, and everyone is made aware of this fact, then long term commitment to the project will be easier to obtain. If AusAID stays involved for at least two years, then a long training period will be possible, as will proper recruitment of the right staff.

## Need for a Transfer Station in Nuku'alofa

The project waste management plan mentions that a transfer station may be needed in Nuku'alofa, although the cost of this transfer station has not been included in the budget at this stage. Serious consideration should be given to setting up this transfer station, as in the long term as it will be more convenient for Nuku'alofa residents, it could save quite a lot of operational expenses, and it will make the operation of the landfill much easier.

The closeness of the transfer station will provide the convenience, compared with having to drive quite a long way to the new site. The savings in operational expenses will arise from fuel savings by the collection vehicles, and cheaper landfill operation. The landfill is easier to operate, because only a few vehicles will be delivering wastes, and a much smaller tipping face can be maintained. This saving in operational expenses may of course be offset by the additional capital costs of the transfer station and special compaction transfer vehicles, so an economic analysis of this issue is needed.

## Legislation, Regulations and Enforcement Mechanisms

Parallel with the implementation of the project, it will be necessary to ensure that effective regulations and enforcement mechanisms are in place to prevent illegal dumping of garbage. If gate charges are imposed, then it will be very important to prevent illegal dumping as an alternative to using the new facilities.

Regulations will also be needed to ensure that the money raised for refuse management is in fact used for that purpose, and is not diverted for other purposes.

## Rehabilitation of Old Popua Dumpsite

There is a large amount of work required to rehabilitate and safely close down the old Popua dumpsite. In fact this could end up being almost as large a project as building the new landfill, if it is done properly. There has been mention of the New Zealand Government funding this work, but the first thing to do is carry out a proper environmental engineering assessment of the work to be done and the costs involved.

If this rehabilitation work is not carried out properly, then it will to a large extent invalidate the decision to build a new landfill.

## Waste Reduction / Recycling

Waste reduction and recycling has real potential to make an impact on the quantities of wastes that are finally placed in the new facility. Waste reduction is largely achieved through education and publicity, although once an effective "user pays" system is in place, this will act as a further incentive to reduce waste quantities generated.

Most of the waste recycling initiatives that are proposed are low technology local initiatives, which are commendable and will certainly raise awareness of recycling. Trial schemes should be initiated as soon as possible for all the initiatives proposed.

The real gains in recycling can be achieved by exporting recyclables for reuse in Australia or New Zealand. Economics would not generally support private enterprise undertaking such export activities, unless they are subsidized. Aside from the resource conservation benefits, the advantages in such subsidy lie in the savings in landfill space. Effective management of difficult wastes also provides such an incentive – e.g. wastes such as waste oil and lead acid batteries.

## Hazardous Wastes

The solid waste management plan discusses the management of hazardous wastes by placement in a specially lined cell at the new landfill. This is suitable only for certain low-level hazardous wastes, and even then, because of the real risk of groundwater pollution, this operation needs to be carried out with extreme care.

It is likely that only small quantities of higher level hazardous wastes will be generated on a continuous basis, so the problem may not be that large. One possibility that has been discussed, however, is the establishment of an agricultural chemicals collection programme. This is needed, as old stockpiles of pesticides are reported to be accumulating in farms around the country. This collection service will create disposal problems, however, as these wastes should not generally be placed in the special cell at the new landfill. Special storage facilities will be needed.