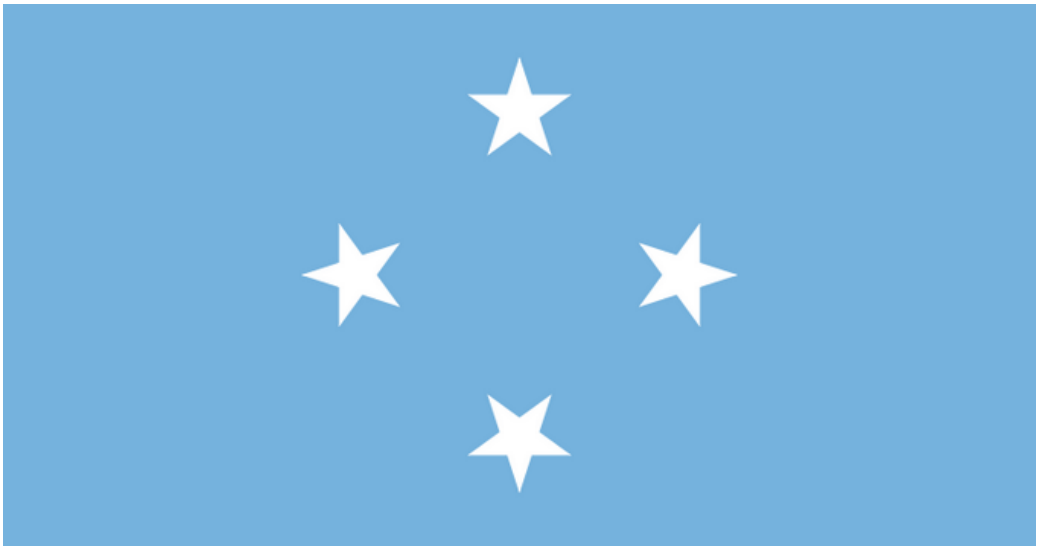
Survey of the Regional Distribution and Status of Asbestos-Contaminated Construction Material and Best Practice Options for its Management in Pacific Island Countries

Report for the Federated States of Micronesia



Prepared for the Secretariat of the Pacific Regional Environment Programme (SPREP)

May 2015

GEOSCIENCE A proud partner of ENGEO

contract environmental ltd.

Contact Details

John O'Grady
Director
Contract Environmental Ltd
14 Wookey Lane,
Kumeu 0841
Auckland, New Zealand
jogrady@actrix.co.nz
ph +64 21 311 532

Dave Robotham
Associate Environmental Consultant
Geoscience Consulting (NZ) Ltd
P O Box 373
Christchurch 8140
New Zealand
david@nzgeoscience.co.nz
ph +64 3 328 9012

Claude Midgley
Senior Environmental Scientist
Geoscience Consulting (NZ) Ltd
P O Box 373
Christchurch 8140
New Zealand
claude@nzgeoscience.co.nz
ph +64 3 328 9012

This publication has been produced with the assistance of the European Union. The contents of this publication are the sole responsibility of Contract Environmental Ltd and can in no way be taken to reflect the views of the European Union.

Executive Summary

PacWaste (Pacific Hazardous Waste) is a four year (2013-2017), €7.85 million, project funded by the European Union and implemented by Secretariat of the Pacific Regional Environment Programme (SPREP) to improve regional hazardous waste management in 14 Pacific island countries plus Timor Leste, in the priority areas of healthcare waste, asbestos, E-waste and integrated atoll solid waste management.

Asbestos-containing wastes and materials are a major issue for many Pacific Island countries with a history of use of asbestos-containing building materials in construction. All forms of asbestos are carcinogenic to humans and inhalation of asbestos fibres that have become airborne can cause serious lung disease or cancer.

SPREP's regional priorities for asbestos management include conducting an inventory of the distribution of asbestos-containing materials (ACMs) in thirteen Pacific island countries, assessing the risks posed to human health by asbestos, progressive stabilization of high-risk facilities such as schools and occupied dwellings, and final disposal of ACM wastes in suitable locations.

PacWaste has commenced with a series of baseline surveys that will collect and collate information about the current status of all three hazardous waste streams targeted (healthcare waste, asbestos, E-waste) and its management in the South Pacific region and will identify best practice options for interventions that are cost-effective, sustainable and appropriate for Pacific island communities. These remedial interventions will be implemented in priority countries identified through the baseline survey.

This report aims to meet part of the objectives of SPREP'S Pacific Regional Solid Waste Management Strategy 2010–2015 and the regional hazardous waste strategies, 'An Asbestos Free Pacific: A Regional Strategy and Action Plan 2011'.

This report covers the FSM component of a survey of the regional distribution and status of asbestos-contaminated construction material, and best practice options for its management, in selected Pacific island communities. The objectives of the survey are summarised as follows:

- To assess the status of, and management options for, asbestos throughout the Pacific region; and
- To develop recommendations for future management interventions, including a prioritised list of target locations.

The work was carried out by a consortium led by Contract Environmental Ltd and Geoscience Consulting (NZ) Ltd, under a contract to the Secretariat of the Pacific Regional Environment Programme (SPREP), with funding provided by the European Union.

This report presents the information gathered for FSM during a field visit undertaken by Claude Midgley between the 15th of June and the 14th of July 2014 and was organised through the FSM Office of Environment and Emergency Management (OEEM).

Survey Methodology

The survey work undertaken in FSM included meetings with key government agencies, area-wide surveys of residential properties across the Island States of Micronesia, and targeted investigations of public and commercial buildings. There are numerous islands associated with FSM but the survey was limited to the main centres/islands of Yap, Chuuk (Weno), Phonpei and Kosrae for logistical reasons. The most recent census data for FSM (2010) indicates that there are approximately 14,237 households within the main areas that were surveyed, and this represents about 85% of the total number of households in FSM.

The usual approach for assessing residential properties was by adopting a statistical method. This would involve calculating the minimum sample size required from the total population to give the required confidence level and margin of error. In this case however because of the consolidated nature of housing throughout FSM, 75% of residential properties within the survey area were observed by the surveyor.

In addition to residential households, the survey sought to identify public buildings and government-owned industrial and commercial properties containing ACMs. The primary focus of this part of the survey was on public buildings that would potentially present the most prolonged and thus significant risks for public exposure. Commercial and industrial buildings were included if they were observed in close proximity to residential housing or public areas.

The basic approach taken for all property types was an initial visual assessment, usually from the roadside or property boundary, followed by closer inspection if the buildings appeared to contain potential ACMs, such as fibreboard cladding, roofing materials, or pipes. The information collected in the close-up inspections was recorded on the spot using a tablet-based application designed specifically for this project. In addition, samples of any suspect materials were collected for testing.

The collected samples were sent by courier to EMS Laboratories Incorporated in California, USA. Analysis was by Polarised Light Microscopy, which is a semi-quantitative procedure for identifying asbestos fibres, with a detection limit in the range of 0.1 to 1% on a surface area basis.

Risk Assessment

A systematic risk assessment approach was adopted in order to assess the relative risks of each building identified as containing ACMs. The method used was that given in the UK HSE guidance document '*Methods for the Determination of Hazardous Substances (MDHS100) Surveying, sampling and assessment of asbestos-containing materials (2001)*' and UK HSE guidance document '*A comprehensive guide to Managing Asbestos in premises (2002)*'. The method uses a simple scoring system to allow an assessment of the relative risks to health from ACMs. It takes into account not only the condition of the asbestos, but the likelihood of people being exposed to the fibres.

The risk assessment approach adopted presents algorithms that allow a score to be calculated for each ACM item observed or confirmed by laboratory analysis. The sites with high scores may present a higher risk to human health than those with lower scores.

Survey Outcomes

ACM has been identified by this study to be present at several locations in FSM. Based on the algorithm adopted as part of the risk assessment to prioritise asbestos management, this study has identified that there are seven sites (apart from residences) in FSM that is considered to be moderate risk with regards to the occupant's and/or public's potential exposure to asbestos. The remaining sites identified are considered to present a low to very low risk to human health.

With regard to residences FSM had a population of 102,843 in 2010 across all the island states. The population were reportedly housed in approximately 16,767 residential households with 85% of those households within the survey areas. Only six houses were identified as having ACM present at the time of the survey.

The Table below provides a summary of the FSM census data and the survey data collected during this assessment.

Survey	No of Households
Total of Households in FSM (2010 Census)	19,502
Households Surveyed	14,626
Households confirmed ACM (cladding only)	2
Extrapolating to full FSM Population – No. of houses with suspected asbestos cladding	3 +/- 0.5%
Households confirmed ACM (all types)	6
Extrapolating to full FSM Population – No. of houses with suspected asbestos (all types)	8 +/- 0.5%

The figures provided in the Table indicate that there is a very low presence of asbestos construction materials associated with residential dwellings in FSM. Having said this any programme to remediate asbestos in FSM should involve a detailed survey of all dwellings in FSM, including those on the outer islands, with numerous samples taken of cladding in particular.

Cost Estimates

Pacific-wide cost estimates have been calculated for remediation several scenarios as shown in the table below:

Summary of Costs for Various Remediation Options (Costs rounded to nearest $US)

Remediation Method	Cost per m^2 (face area) $US
Encapsulation	
Roofs:	
Encapsulate roof where there is no ceiling present below the roof	50.00
Encapsulate roof where there is an existing ceiling below the roof that needs to be removed and replaced	91.00
Cladding:	
Encapsulate wall cladding where there is no internal wall sheeting	26.00
Encapsulate wall cladding where there is internal wall sheeting in good condition, which means only the exterior needs to be encapsulated	18.00

Remediation Method	Cost per m² (face area) $US
Encapsulate wall cladding where there is internal wall sheeting in poor condition, which must be treated as asbestos contaminated and removed and replaced: USD65.92/m2 (face area)	66.00
Removal and Replacement	
Roofs:	
Remove and replace roof	96.00
Cladding:	
Remove and replace cladding	76.00
Miscellaneous	
Remove and replace floor tiles*	80.00
Pick up debris, pipes	40.00

**$US80 is the lower end of the cost spectrum for removing and replacing vinyl floor tiles and the cost could easily double (or more) for difficult removal projects. To balance this out, the vinyl tile matrix is stable and there is little risk of asbestos exposure unless they are badly deteriorating. Vinyl floor asbestos projects could therefore be lower down on the priority list.*

Recommendations and Prioritised List of Actions

Remediation of sites has been prioritised based on the level of risk posed to the building occupants and public at each site according to the risk assessment methodology. The quantities of ACM observed at the sites were used to estimate costs for abatement. A summary of the recommended actions and estimated costs are included in the table below.

Site	ACM	Risk Score	Recommended Remedial Actions	ACM Area (m²)	Estimated Cost (US$)
Pohnpei					
LP Gas Corporation, Pohnpei	Chrysotile 15% Amosite 2%	23	Remove the asbestos cement cladding and replace with an alternative product.	1,625	113,750 to 292,500
Kuniora Gallen's private Residence, Pohnpei	Chrysotile 15%	18	Paint asbestos cement columns.	75	1,665
	Chrysotile 15%	18	Pickup and disposal of asbestos cement pieces.	2	85
Johnny P. David's private residence, Pohnpei	Chrysotile 15% Amosite 2%	16	Pickup and disposal of a stockpile of asbestos cement boards.	1,000	250
Pohnpei Fishing Corporation generator shed, Pohnpei	Chrysotile 15% Amosite 2%	16	Remove the asbestos cement cladding and replace with an alternative product.	200	14,000 to 36,000

Site	ACM	Risk Score	Recommended Remedial Actions	ACM Area (m^2)	Estimated Cost (US$)
Kolonia Public market, Pohnpei	Chrysotile 15% Amosite 2%	15	Remove the asbestos cement fence and replace with an alternative product.	50	3,500 to 9,000
Public Reserve area, Pohnpei	Chrysotile 15% Amosite 2%	14	Pickup and disposal of asbestos cement pieces.	3	250
Kolonia Roadside, Pohnpei	Chrysotile 15%	13	Pickup and disposal of asbestos cement pipe.	2	118
Pohnpei Botanic Gardens	Chrysotile 12%	10	Remove the asbestos cement roof prior to demolition of the building	45	?
Antonia P. Dosolua's private residence, Pohnpei	Chrysotile 15%	17	Paint asbestos cement columns.	50	945
Yap					
Yap Department of Education Administration Buildings.	Chrysotile 3%	18	Remove existing floor tiles and replace with new.	700	4,850
College of Micronesia: FSM Fisheries and Maritime Institute, Yap Campus	Chrysotile 2%	18	Remove existing floor tiles and replace with new in the workshop.	70	650
Colonia Catholic Church, Yap	Chrysotile 10% Amosite 15%	17	Remove the asbestos cement roof and replace with an alternative roof.	300	21,000 to 54,000
Mr Atal's private residence, Yap	Chrysotile 15%	14	Pickup and disposal of asbestos cement pipes and surrounding soil.	3	$1,215
Yap Central Water Treatment Plant	Chrysotile 15%	16	Pickup and disposal of asbestos cement pipes.	3	$250
FSM Telecommunications Corporation, Yap Branch	Not tested	13	Remove the existing generator exhaust and replace with an alternative product.	2	?
Yap Department of Public Works and Transportation Depot	Vinyl floor tiles (buried)	4	Nothing. Asbestos is securely buried at the site.	30	0
Chuuk					

Site	ACM	Risk Score	Recommended Remedial Actions	ACM Area (m^2)	Estimated Cost (US$)
Mr Mori's private residence, Chuuk	Chrysotile 15%	19	Remove the asbestos cement roof and replace with an alternative roof.	150	10,500 to 27,000
	Chrysotile 15%	19	Pickup and disposal of a stockpile of asbestos cement boards.		$250
Immaculate Heart of Mary Church, Chuuk	Chrysotile 10% Amosite 15%	16	Remove the asbestos cement roof and replace with an alternative roof.	525	36,750 to 94,500
Chuuk State Court	Chrysotile 20%	13	Paint ceiling tiles	30	$630
Kosrae					
FSM Telecommunications Corporation, Kosrae Branch	Not tested	13	Remove the existing generator exhaust and replace with an alternative product.	2	?
Former Kosrae Hospital and Mrs Torenda Jona's Residence, Kosrae	Chrysotile 15%	10	Pickup and disposal of asbestos cement pipes.	9	$285

The following should be noted:

a. It would probably be best to remove and replace the asbestos cladding and roofing for small amounts as it provides a permanent solution.
b. Some residences were included in Table 15 above as high risk but the SPREP project does not cover residences.
c. There is some loose asbestos waste discovered around FSM. This has been assessed as low risk and could be picked up and disposed of cheaply. It is recommended that this be done as well.
d. All estimated costs exclude supervision by an asbestos expert as cost saving could be achieved by an expert supervising multiple sites concurrently therefore the cost cannot be accurately estimated on a project by project basis.
e. Remediation of sites has been prioritised based on the level of risk posed to the building occupants and public at each site according to the methodology described in Section 3.0.
f. The quantities of ACM observed at the sites were used to estimate costs for abatement. A summary of the recommended actions and estimated costs are included in Table 15 above.

The risk assessment scoring and prioritisation presented in the table above indicates that there are 7 moderate to high risk ACM sites which would benefit from additional ACM management. The 15 remaining sites are considered to present a low to very low risk to occupants and the public in their current state, but can pose greater risks in the future if they are not managed appropriately.

The following recommendations are therefore made in relation to asbestos on FSM:

A. It is recommended that the above higher priority asbestos work is carried out in FSM as well as removal of all loose asbestos.
B. Residential dwellings are identified in Table 15 above. It is recommended that all houses that have tested positive are notified and included in an awareness campaign. They should be remediated (i.e. the asbestos removed or encapsulated) where resources permit.
C. If a large number of houses are found to contain asbestos cladding then encapsulation would probably be the most cost-effective option for remediation although ongoing management procedures then would be needed and re-encapsulation (i.e. re-painting) would probably be needed 10-15 years later. If a small number of houses are found to contain asbestos cladding then removal and replacement of the cladding should be considered.
D. Any asbestos roofs found on houses in FSM should preferably be removed rather than encapsulated as encapsulation of roofs costs only a little less than removal and removal is a permanent solution.
E. If a suitable cheap on-island disposal location can be found that was locally acceptable then on-island disposal would be the preferred disposal option. Otherwise the next preferred option is placement in a 20 ft shipping container and export to Brisbane for disposal in the Remondis Landfill as another option
F. Before asbestos remediation takes place (and after if all the asbestos is not removed) it would be appropriate to set in place suitable asbestos management practices and procedures to deal with the ongoing risk posed to human health by asbestos exposure. This should be accompanied by an appropriate education and training programme.
G. Consideration should be given to FSM passing suitable regulations to enable the above asbestos work to be carried out.

Contents

Definitions

Asbestos: The fibrous form of mineral silicates belonging to the Serpentine and Amphibole groups of rock-forming minerals, including amosite (brown asbestos), crocidolite (blue asbestos), chrysotile (white asbestos), actinolite, tremolite, anthophyllite or any mixture containing one or more of these.

ACM: "Asbestos Containing Material" – i.e. any material that contains asbestos.

PACM: "Presumed Asbestos Containing Material" – i.e. any material presumed to contain asbestos, based on observation and knowledge of other relevant factors.

Amosite: Brown or Grey Asbestos

Chrysotile: White Asbestos

Crocidolite: Blue Asbestos

PPE: Personal Protective Equipment

SMF: Synthetic Mineral Fibres

Friable: With respect to asbestos containing material means able to be crumbled, pulverised or reduced to powder by hand pressure when dry and includes non-bonded asbestos fabric.

Non-Friable: With respect to asbestos containing material means unable to be crumbled, pulverised or reduced to powder by hand pressure when dry.

Hazard: Is a potential to cause harm.

Risk: Is the likelihood of illness or disease arising from exposure to airborne asbestos fibres.

Internal: Refers to the underside of roof sheeting, or the inside of building/wall sheeting and structures therein.

External: Refers to the top or outside of roof sheeting or the outside of building/wall cladding.

Practicable: Able to be done / put into practice having regard to:

- The severity of the hazard or risk in question;
- The state of knowledge about the hazard or risk;
- The availability and suitability of ways to remove or mitigate that hazard or risk;
- The cost of removing or mitigating that hazard or risk

CEL: Contract Environmental Limited

SPREP: Secretariat of the Pacific Regional Environment Programme

GPS: Global Positioning System

EMS: EMS Laboratories Incorporated

MDHS100: Methods for the Determination of Hazardous Substances: Surveying, Sampling and Assessment of Asbestos-Containing Materials

AusAid: Australian Agency for International Development

IANZ: International Accreditation New Zealand

FSM: Federated States of Micronesia

1. Introduction

1.1 Purpose and Timing

This report covers the FSM component of a survey of the regional distribution and status of asbestos-contaminated construction material, and best practice options for its management, in selected Pacific island communities. The objectives of the survey are summarised as follows:

- To assess the status of, and management options for, asbestos throughout the Pacific region; and
- To develop recommendations for future management interventions, including a prioritised list of target locations.

The work was carried out by a consortium led by Contract Environmental Ltd and Geoscience Consulting (NZ) Ltd, under contract to the Secretariat of the Pacific Regional Environment Programme (SPREP), with funding provided by the European Union. Most of the information required for the FSM survey was obtained in a field visit undertaken Claude Midgley between the 15th of June and the 14th of July 2014 and was organised through the FSM Office of Environment and Emergency Management (OEEM).

1.2 Scope of Work

A copy of the Terms of Reference for this work is given in Appendix 1. It lists the following tasks:

1. *Collect and collate data on the location (geographic coordinates), quantity and condition of asbestos-containing building materials (including asbestos-containing waste stockpiles) in each nominated Pacific Island country;*

2. *Review, and recommend a prioritised list of local best-practice options for stabilisation, handling and final disposal of asbestos-contaminated materials in each nominated Pacific Island country (including review of existing local institutional, policy and regulatory arrangements);*

3. *Recommend and prioritise actions necessary to minimise exposure (potential and actual) of the local population to asbestos fibres for each nominated Pacific Island country. An approximate itemised national cost should be presented for each option identified;*

4. *Identify any local contractors who have the expertise and capacity to potentially partner with regional or international experts in future asbestos management work; and*

5. *Develop a schedule of rates for local equipment hire, mobilisation, labour, etc., to guide the development of detailed cost-estimates for future in-country asbestos remediation work.*

1.3 Background to Federated States of Micronesia

The Federated States of Micronesia (abbreviated to FSM) is an independent sovereign island nation and a United States associated state consisting of four island states – from west to east, Yap, Chuuk, Pohnpei and Kosrae - spread across the Western Pacific Ocean. Together, the states comprise around 607 islands (a combined land area of approximately 702 km^2 or 271 sq mi) that cover a longitudinal distance of almost 2,700 km (1,678 mi) just north of the equator. They lie northeast of

Papua New Guinea, south of Guam and the Marianas, west of Nauru and the Marshall Islands, east of Palau and the Philippines.

While the FSM's total land area is quite small, it occupies more than 2,600,000 km^2 (1,000,000 sq miles) of the Pacific Ocean. The capital is Palikir, located on Pohnpei Island. The largest city is Weno, located in the Chuuk Atoll.

The FSM was formerly a part of the Trust Territory of the Pacific Islands (TTPI), a United Nations Trust Territory under U.S. administration, but it formed its own constitutional government on May 10, 1979, becoming a sovereign state after independence was attained on November 3, 1986 under a Compact of Free Association with the United States. The Compact was renewed in 2004. Other neighboring island entities, and also former members of the TTPI, formulated their own constitutional governments and became the Republic of the Marshall Islands (RMI) and the Republic of Palau (ROP).

The ancestors of the Micronesians settled over four thousand years ago. European explorers—first the Portuguese and then the Spanish—reached the Carolines in the sixteenth century. The Spanish incorporated the archipelago to the Spanish East Indies and in the 19th century established a number of outposts and missions. In 1887 they founded the town of *Santiago de la Ascension* in what today is Colonia on the island of Pohnpei. Following the Spanish–American War the Spanish sold the archipelago to Germany in 1899. It was awarded to the Empire of Japan following World War I as a League of Nations mandate.

FSM has a tropical climate with an annual mean temperature of 28 °C. Rainfall is heavy throughout the year, averaging around 3,500 – 4000 mm. The average humidity is 82% and although rain falls more frequently between July and October, there is still much sunshine.

Table 1 presents a summary of census data for FSM that is relevant to this project.

Table 1: Summary of Relevant 2010 census data for FSM

FSM 2010 Census Information		
	Population	**No of Households**
National Total	102,843	16,767
Yap State	7,371*	1,680*
Weno (Chuuk)	36,152*	5,444*
Pohnpei State	34,789*	5,970*
Kosrae State	6,616	1,143
Total	**84,928**	**14,237**
Survey Percentage of National Total	82	85

* excludes Outer Islands

A Map of FSM is shown in Figure 1 below:

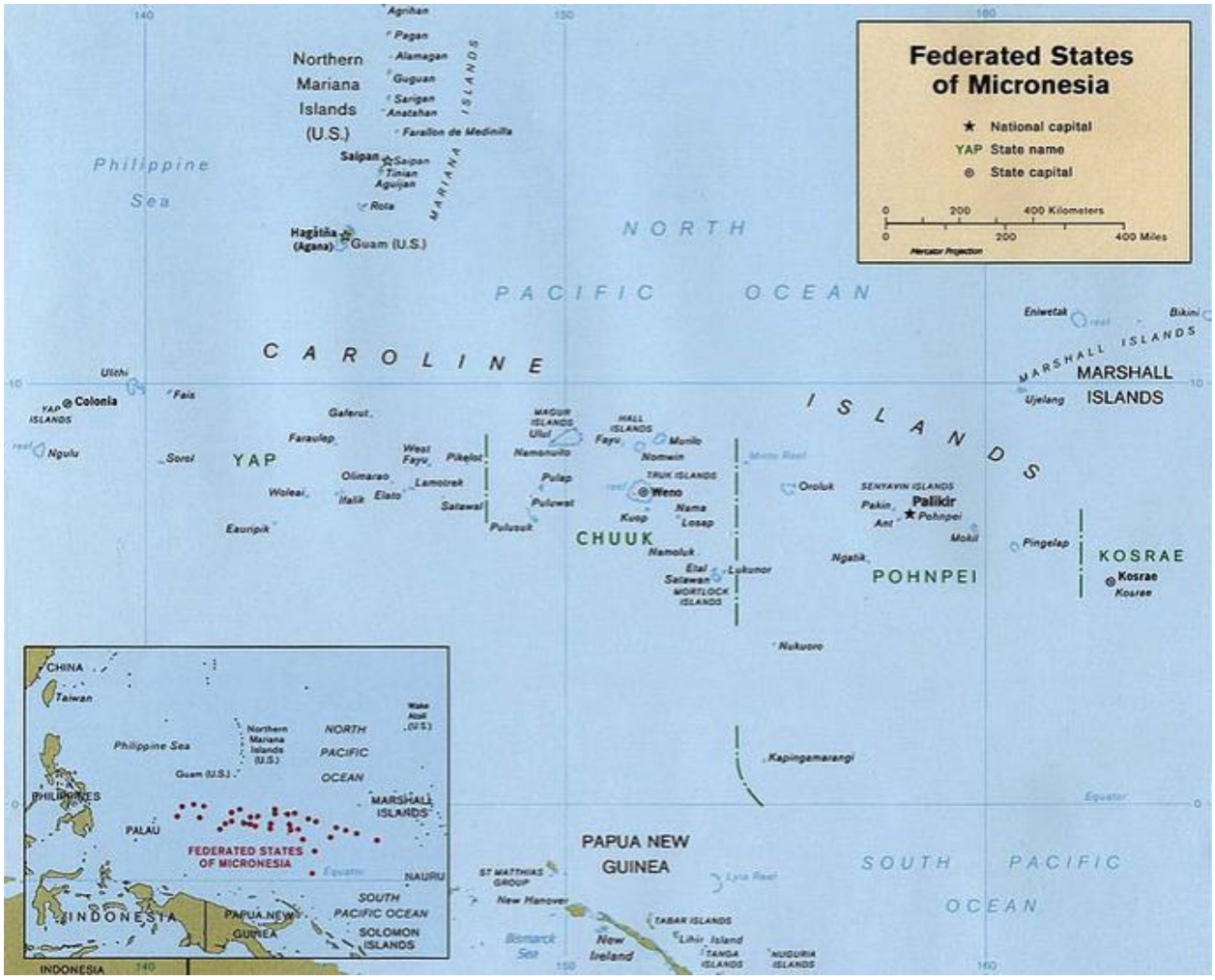


Figure 1 – Map of FSM

1.4 Report Content and Layout

Section 2 of this report gives details of the methodology used for the study including the approach used for determining the survey coverage, the identification of specific target sites, procedures for site inspections and data capture, and sample collection and analysis. In addition, the relative importance of different sites was assessed using a risk assessment methodology, which is described in section 3.

The results of the survey are presented in section 4 of the report, including the laboratory results.

Section 5 discusses remedial and management options, both general and for Palau. Section 7 discusses disposal. Section 8 covers cost considerations with a focus on Palau costs, and Section 9 discusses local issues including relevant legislation, programs and policies.

Section 10 of the report provides a final discussion and a list of recommended actions, including cost estimates for those sites identified as priority targets for remediation.

Additional supporting information is given in the appendices. Appendix 1 contains the Terms of Reference for the Study. Appendix 2 contains the organisational details and list of contacts. Appendix 3 contains in-country discussions. Appendix 4 contains the laboratory reports.

2.0 Survey Methodology

2.1 Pre-Survey Desk Study

The survey work undertaken during the visit to FSM included meetings with key government agencies, area-wide surveys across the main islands of the four states and specific investigations of 115 sites.

Prior to conducting the surveys and visiting FSM, the survey team completed a desk study to enable a more targeted assessment of buildings potentially containing ACM. The desk study included contacting relevant local Government agencies in advance of the trip to discuss and evaluate if the agencies were aware of any buildings where ACM was a concern. In addition, the consultation aimed to evaluate local regulations and practices with respect to ACM identification, removal and disposal practices.

The FSM Government did not hold any reports on the presence or significance of asbestos in FSM.

A second objective of the desk study was to evaluate the population distribution on the survey islands in order to prioritise which population centres and, if possible, which individual buildings should be included in the survey. The most recent census data was sought and reviewed in order to ensure a sufficient statistically representative number of residential buildings were included in the survey.

Where population centres were identified existing aerial photographs and geographically positioned photographs (where available) provided on Google Earth were reviewed. The review of Google Earth photographs enabled the survey team to appreciate the typical types of building construction materials in the centres, an approximate age of the buildings and in certain cases possible asbestos containing material (PACM). Conclusions on any PACM observed in the photographs were to be verified during the surveys.

2.2 Survey Coverage

This survey was based around a field visit to FSM between the 15th of June and 14th of July 2014. The work carried out during the visit included meetings with key government agencies, surveys on the primary islands across the four states of FSM, and specific investigations of 115 sites. The outer islands could not be assessed within the timeframe allowed by this project.

With regard to residences FSM had a population of 102,843 in 2010 across all the island states. The population were reportedly housed in approximately 16,767 residential households with 85% of those households within the survey areas. Only six houses were identified as having ACM present at the time of the survey.

Residential properties were assessed using a statistical approach. The statistical approach adopted is a technique commonly used in household marketing surveys, political polls and the like. For a specified total population size you calculate the required sample numbers required to give a target level of uncertainty, or conversely, you can determine the uncertainty level associated with an actual sample number.

The statistical approach required that a random method was used for selecting residential buildings to be surveyed and included in the sample size. In practice this involved selecting a cluster of properties at random when viewed from the road. The surveyor then undertook a more detailed

inspection of the properties. Where possible, samples of the building material were collected and tested in the field for indications of asbestos fibres.

2.3 Identification of Target Sites

In addition to residential households, the survey sought to identify public buildings and government-owned industrial and commercial properties containing ACM. The primary focus of the survey was on residential properties and public buildings that would potentially present the most prolonged and thus significant risks for public exposure. Commercial and industrial buildings were also included in surveys where they were observed in close proximity to residential housing and public areas.

The asbestos surveys had three main objectives. Firstly, it was, as far as reasonably practicable within the time available, to record the location, extent and product type of any presumed or known ACMs. Secondly, it was to inspect and record information on the accessibility, condition and surface treatment of any presumed or known ACMs based on worst case scenarios. Thirdly, the survey aimed to determine and record the asbestos type, either by collecting representative samples of suspect materials for laboratory identification, or by making a presumption based on the building age, product type and its appearance.

A list of the people and organisations contacted during the visit is given in Appendix 2, and the key points arising from the discussions are summarised in Appendix 3.

During the initial day of each of the four FSM State surveys, the surveyor attended meetings with representatives from the State government department responsible for hazardous waste and asbestos. The representatives provided information regarding potential state assets containing asbestos as well as current waste disposal practices in each state.

The remainder of the survey consisted of inspecting residential areas and government-owned facilities including (but not limited to) schools, hospitals and healthcare centres, power stations, water treatment facilities, research centres and government administration buildings.

The primary focus was on residential properties and public buildings that might present the most significant potential risks for public exposures. The surveyor attended meetings with representatives from the Kosrae Island Resource Management Authority (KIRMA) in Kosrae, the Environmental Protection Authorities (EPA) in Yap, Chuuk and Pohnpei and public utilities authorities in each state. The representatives provided information regarding asbestos regulations, known state assets containing asbestos and the development of a government policy specific to asbestos.

The representatives assisted in identifying and inspecting government owned and semi-government facilities including (but not limited to) schools, police and fire stations, hospitals and healthcare centres, power stations, water treatment facilities and government administration buildings.

A general survey of common residential construction materials was undertaken during the survey by observing residential dwellings and associated structures across as much of each main island as possible, as well as by questioning government representatives and employees regarding their knowledge of the use of asbestos-containing building materials at residential properties. Photographs and samples of asbestos-containing materials used in the residential environment were shown to representatives at each site to aid their recognition of the materials.

It is estimated that approximately 70% to 80% of the nation's government facilities were included in this process and the results are expected to be applicable to the remaining government buildings. Based on aerial photos showing residential settlement patterns, it is estimated that approximately 75% of the residential areas were visited and a clear understanding of the common building materials was reached.

2.4 Site Assessment Data Capture

Information was collected from each survey site using a tablet-based application designed specifically for this project. The software requires certain information to be recorded including location, type of facility, whether asbestos was identified, type, volumes, and most applicable remedial methodology. The software also allows for pictures to be taken of the sites and uses a Global Positioning System (GPS) to record where the pictures were taken. Information provided by owners/occupants of the building relating to its age, state of repairs, previous ACM knowledge was also recorded in the software.

The use of the application ensures that data is collected in a uniform manner across all of the surveyed countries regardless of the survey team members. Copies of all of the individual site assessment reports for FSM are held in electronic form by SPREP.

2.5 Sample Collection Methodology

118 individual facilities / properties were identified as requiring a detailed site assessment due to their age, use, sensitive location or observations of Potentially Asbestos-containing Materials (PACMs). In order to assess if PACM contained asbestos, samples were collected and analysed by a professional accredited laboratory in accordance with international standards.

Samples of PACM were only collected if the following conditions were met:

- Permission was granted by the property owner;
- The work would minimise the disruption to the owner's operations;
- The sampling would not put the health and safety of occupants at risk;
- The areas to be sampled inside buildings were as far as possible unoccupied;
- Entry of other people not wearing personal protective equipment (PPE) to the sampling area was restricted;
- Where the material to be sampled could be safely pre-wet (i.e. excludes items with a risk of electrocution or where permission to wet a surface was not received); and
- Collection of a sample would not significantly damage the building material.

Where the above conditions were met, sampling was conducted following standard Geoscience Procedure and in accordance with international guidance provided by the United Kingdom Health & Safety Executive (UK HSE) and New Zealand Demolition and Asbestos Association (NZDAA).

Clearly identifiable asbestos-containing materials were present at 13 sites. Samples were collected from a few of those sites to allow secondary verification of the presence of asbestos.

Thirty eight sites contained building materials which could not be confirmed to be asbestos free without further laboratory testing. Samples of the PACMs were collected from those 38 sites. Subsequent laboratory testing confirmed that asbestos was present in 9 of the samples. Two sites were suspected of containing ACMs, but collection of a sample would have damaged the structure containing the PACMs and samples were therefore not obtained.

A total of 22 sites with asbestos-containing materials were identified throughout FSM and 23 sites suspected of having asbestos-containing materials were demonstrated to be free of asbestos.

The samples were collected in accordance with the following procedures:

- Sampling personnel must wear adequate personal protective equipment (PPE), as determined by the risk assessment (disposable overalls, nitrile gloves, overshoes and a half face respirator with P3 filters);
- Airborne emissions were controlled by pre- wetting the material to be sampled, with a fine water mist.
- Damaged portions of PACM were sought first where it will be easier to remove a small sample. The sample size collected was approximately 5 cm^2
- Samples were obtained using pliers or a screwdriver blade to remove a small section from an edge or corner;
- A wet-wipe tissue was used between the pliers and the sample material to prevent fibre release during the sampling;
- All samples were individually sealed in their own polythene bag which was then sealed in a second polythene bag.
- Water was sprayed onto the sample area to prevent fibre release after sampling;
- Sampling points were further sealed masking and PVC tape where necessary;
- Samples were labelled with a unique identifier and in the survey documentation;
- Each sample was noted on a laboratory provided chain of custody and secured in a sealable container.

As with any environmental assessment, sampling of a medium, in this case building material, can vary over spatially and temporally. Due to the wide scope of the survey including all residential and public buildings on the islands, a limited number of samples were collected. The collection of samples was based on the aforementioned considerations but also with the project scope in mind. Where similar building materials were encountered at numerous sites, a single sample was considered sufficient to be used to base conclusions on. Also, where a large amount of PACM was identified at a single site, one sample of each main material identified was considered sufficient for this stage of the assessment.

2.6 Sample Laboratory Analysis

The samples were sent by courier to EMS Laboratories Incorporated (EMS) located in California in the United States of America for analysis. Analysis of the samples was performed by EMS using 'Polarised Light Microscopy'. According to EMS the analysis method is a semi-quantitative procedure with the detection limit between 0.1-1% by area and dependent upon the size of the asbestos fibres, sampling method and sample matrix. The type of asbestos fibre present was also reported with the three most common fibres types being chrysotile (white asbestos), crocidolite (blue asbestos) and amosite (brown asbestos).

The results for these samples are discussed in Section 5, and copies of the laboratory report are provided in Appendix 4 of this report.

3.0 Risk Assessment Methodology

A systematic risk assessment approach was adopted in order to assess the risk that identified asbestos containing material presented to site occupants and if applicable the public. The risk assessment adopted was that provided by the UK HSE guidance document 'Methods for the Determination of Hazardous Substances (MDHS100) Surveying, sampling and assessment of asbestos-containing materials (2001)' and UK HSE guidance document 'A comprehensive guide to Managing Asbestos in premises (2002)'.

The documents present a simple scoring systems to allow an assessment of the risks to health from ACMs. They take into account not only the condition of the asbestos, but the likelihood of people being exposed to the fibres.

The risk assessment approach adopted presents algorithms that allow a score for each ACM item observed or confirmed by laboratory analysis, to be calculated. The sites with high scores may present a higher risk to human health than those with lower scores.

The risk assessment approach has two elements, the first algorithm is an assessment of the type and condition of the ACMs or presumed ACMs, and their ability to release fibres if disturbed. The final score for each ACM or presumed ACM depends on the type of ACM i.e. concrete v's lagging, the condition of the ACM, if there is any surface treatment and the actual type of asbestos (i.e. chrysotile (white), amosite (brown), or crocidolite (blue).

The second algorithm considers the ACM setting, likelihood of the ACM actually being disturbed and exposure to a receptor or many. The setting assessment therefore considers the normal occupant activity in that area of the site and the likelihood of disturbance. Each ACM is again scored and these scores are added to those for the material assessment to produce a total score.

3.1 ACM Assessment

UK HSE (2001) MDHS100 recommends the use of an algorithm to carry out the material assessment. The algorithm is a numerical way of taking into account several influencing factors, giving each factor considered a score. The algorithm in MDHS100 considers four parameters that determine the risk from an ACM: that is the ability to release fibres if disturbed. These four parameters are:

- product type;
- extent of damage;
- surface treatment; and
- asbestos type.

Each of the parameters is scored and added to give a total score between 2 and 12:

- materials with scores of 10 or more should be regarded as high risk with a significant potential to release fibres if disturbed;
- those with a score between 7 and 9 are regarded as medium risk;
- materials with a score between 5 and 6 are low risk; and
- scores of 4 or less are very low risk.

The material assessment algorithm shown in MDHS100 is reproduced in Table 1.

Table 1: MDHS100 Material assessment algorithm

Sample variable	Score	Examples of scores
Product type (or debris from product)	1	Asbestos reinforced composites (plastics, resins, mastics,roofing felts, vinyl floor tiles, semi-rigid paints or decorative finishes, asbestos cement etc)
	2	Asbestos insulating board, mill boards, other low density insulation boards, asbestos textiles, gaskets, ropes and woven textiles, asbestos paper and felt
	3	Thermal insulation (eg pipe and boiler lagging), sprayed asbestos, loose asbestos, asbestos mattresses and packing
Extent of damage/deterioration	0	Good condition: no visible damage
	1	Low damage: a few scratches or surface marks; broken edges on boards, tiles etc
	2	Medium damage: significant breakage of materials or several small areas where material has been damaged revealing loose asbestos fibres
	3	High damage or delamination of materials, sprays and thermal insulation. Visible asbestos debris
Surface treatment	0	Composite materials containing asbestos: reinforced plastics, resins, vinyl tiles
	1	Enclosed sprays and lagging, asbestos insulating board (with exposed face painted or encapsulated), asbestos cement sheets etc.
	2	Unsealed asbestos insulating board, or encapsulated lagging and sprays
	3	Unsealed laggings and sprays
Asbestos type	1	Chrysotile
	2	Amphibole asbestos excluding crocidolite
	3	Crocidolite
Total score		Out of 12

3.2 ACM Setting Assessment

The location of the ACM is equally important as the type and condition of the ACM when considering the potential risk to human health. There are four aspects presented in the HSE guidance, however this algorithm has been modified in this assessment with 'maintenance activity' not considered.

The removal of maintenance activity from the algorithm is due to the level of awareness of asbestos by the building management or owners at the majority of surveys was considered to be low. Therefore any maintenance undertaken is likely to be 'unplanned' with little or no controls around asbestos exposure. In addition, quantifying the amount of maintenance activity by the surveying team and with the building management contacts was often extremely difficult to quantify.

The three areas of the algorithm adopted when considered risk posed by the ACM;

- Occupant activity
- Likelihood of disturbance
- Human exposure potential

Each of the above parameters are summarised in the following sections.

Occupant activity

The activities carried out in an area will have an impact on the risk assessment. When carrying out a risk assessment the main type of use of an area and the activities taking place within it should be taken into account.

Likelihood of disturbance

The two factors that will determine the likelihood of disturbance are the extent or amount of the ACM and its accessibility/vulnerability. For example, asbestos soffits outdoors are generally inaccessible without the use of ladders or scaffolding, and on a day to day basis are unlikely to be disturbed. However if the same building had asbestos panels on the walls they would be much more likely to be disturbed by occupant movements/activities.

Human exposure potential

The human exposure potential depends on three factors:

- The number of occupants of an area,
- The frequency of use of the area, and
- The average time each area is in use.

For example, a hospital boiler which contains friable asbestos cladding in a room which is likely to be unoccupied is a lower risk than say in a school classroom lined with an exposed asbestos cement roof, which is occupied daily for six hours by 30 pupils and a teacher.

The algorithm adopted for ranking the ACMs setting is shown in Table 2.

Table 2: HSG227 (2002) Priority Assessment Algorithm

Assessment factor	Score	Examples of score variables
Normal occupant activity		
Main type of activity in area	0	Rare disturbance activity (eg little used store room)
	1	Low disturbance activities (eg office type activity)
	2	Periodic disturbance (eg industrial or vehicular activity which may contact ACMs)
	3	High levels of disturbance, (eg fire door with asbestos insulating board sheet in constant use)
Likelihood of disturbance		
Location	0	Outdoors
	1	Large rooms or well-ventilated areas
	2	Rooms up to 100 m2
	3	Confined spaces
Accessibility	0	Usually inaccessible or unlikely to be disturbed
	1	Occasionally likely to be disturbed
	2	Easily disturbed
	3	Routinely disturbed
Extent/amount	0	Small amounts or items (eg strings, gaskets)
	1	<10 m2 or <10 m pipe run.
	2	>10 m2 to ≤50 m2 or >10 m to ≤50 m pipe run
	3	>50 m2 or >50 m pipe run
Human exposure potential		
Number of occupants	0	None
	1	1 to 3
	2	4 to 10
	3	>10
Frequency of use of area	0	Infrequent
	1	Monthly
	2	Weekly
	3	Daily
Average time area is in use	0	<1 hour
	1	>1 to <3 hours
	2	>3 to <6 hours
	3	>6 hours
Total		Out of 21

Each of the parameters is scored and added together to give a total score between 0 and 21. The setting score is then added to the ACM score to provide an overall score and risk rating in order to rank the sites in order of priority for management and/or remedial action. The scoring system is detailed in Table 3.

Table 3: Risk Ranking Scoring

ACM Score	Setting Score	Total Score	Risk Rating
10 – 12	16 – 21	24 - 33	High risk – significant potential to release fibres if disturbed and significant risk to occupants
7 – 9	11 - 15	17 - 23	Moderate risk
5 – 6	8 - 10	12 - 16	Low risk
0 – 4	0 – 7	0 – 11	Very low risk

4.0 Asbestos Survey

4.1 Residential Survey

Residential dwellings observed throughout the FSM were constructed mainly using plywood or fibre board, concrete blocks and corrugated iron however there are still a number of traditional houses made of natural materials.

Photos 1 - 4: typical structures in FSM

Information on the population distribution of FSM was provided by the 2010 population census produced by the Division of Statistics of the Office of Statistics, Budget & Economic Management, Overseas Development Assistance and Compact Management (SBOC). FSM had a population of 102,843 in 2010 across the four States and total land area of 700 km^2. Table 4 presents the population size and number of households for each of the FSM States that were surveyed while Table 5 shows the possible number of households that could have ACM present as cladding or as other types of asbestos materials.

Based on aerial photographic evidence of household distribution, approximately 75% of the residential areas on primary islands in FSM were visited.

Table 4: Population and Households in FSM (census 2010)

State	National Total	Yap	Weno (Chuuk)	Pohnpei	Kosrae
Population	102,843	7,371*	36,152*	34,789*	6,616
No. Households	16,767	1,680*	5,444*	5,970*	1,143

* survey area; excludes Outer Islands

Table 4: Statistical Summary – Population and Households in FSM (census 2010)

Survey	No of Households
Total of Households in FSM (2010 Census)	19,502
Households Surveyed	14,626
Households confirmed ACM (cladding only)	2
Extrapolating to full FSM Population – No. of houses with suspected asbestos cladding	3 +/- 0.5%
Households confirmed ACM (all types)	6
Extrapolating to full FSM Population – No. of houses with suspected asbestos (all types)	8 +/- 0.5%

1 house with AC roof but rumours that stockpile was drawn on for other houses.
1 house with AC sheet stockpile with rumours that stockpile was drawn on for other houses.
5 houses with AC pipes acting as roof support columns.

Assuming that the figures presented in Table 5 are a true representation of asbestos material present on residential properties in FSM the number of houses in that may have asbestos materials is no greater than 9. For those that may have asbestos cladding only will be no greater than 4 households.

The figures provided in Table 5 indicate that there is a very low presence of asbestos construction materials associated with residential dwellings in the areas of FSM that were surveyed. It can therefore be assumed that the likelihood of asbestos construction materials used on residential dwellings on the outer islands is also very low. Having said this any programme to remediate asbestos in FSM should therefore involve a detailed survey of all dwellings in FSM including the outer islands with numerous samples taken of cladding in particular.

4.2 Targeted Survey Coverage

The remainder of the survey consisted of visits to government buildings, including those which were likely to be frequented by large numbers of individuals. In limited cases, former government buildings which had become private commercial buildings, as well as churches were visited based on information received from the EPA representatives that PACMs may be present at those sites. The buildings surveyed included (but were not limited to) schools, police and fire stations, hospitals and healthcare centres, power stations, water treatment facilities, research centres and government administration buildings. The visits consisted of an introduction regarding the purpose of the project

and a request for a tour of the facilities. A visual assessment of construction materials was then undertaken while being guided through the buildings. A total of 118 government, semi-government and/or private commercial buildings were visited. Also included in the 118 sites are the 6 private residential sites and 2 state housing areas. The specific sites visited are listed in Table 6.

Table 6: Specific Sites Visited in FSM.

Site Name	Suspected PACM?	Samples Collected of PACM?
Yap State		
1. Colonia Catholic Church	Yes	Yes
2. Yap State Government administration building	Yes	Yes
3. Yap Hospital	No	No
4. Gogil elementary school	No	No
5. College of Micronesia: FSM Fisheries and Maritime Institute	Yes	Yes
6. Maap dispensary / health clinic	No	No
7. Tamil elementary school	No	No
8. Fanif elementary school	No	No
9. Yap state housing in Colonia	No	No
10. Malaay elementary school	No	No
11. Yap International Airport	No	No
12. Yap power plant	Yes	Yes
13. Yap State court	Yes	Yes
14. Mr Atal's private residence	Yes	No
15. Yap EPA office	No	No
16. Yap Department of Public Works and Transportation Depot	Yes	No
17. Yap Department of Education Administration Buildings	Yes	Yes
18. Colonia public library	No	No
19. Yap National Sports Centre	No	No
20. Gogil dispensary / health clinic	No	No
21. Maap elementary school	No	No
22. The northern water treatment plant in Tamil	No	No
23. Tamil dispensary / health clinic	No	No
24. Colonia police and fire station	Yes	Yes
25. Colonia post office	No	No
26. The southern water treatment plan	No	No
27. Yap high school and College of Micronesia, Yap campus	Yes	Yes
28. The Central water treatment plant	Yes	No
29. A government supply storage building in Colonia	No	No
30. FSM Telecommunications Corporation (Yap Branch)	Yes	No
31. Yap Fisheries Authority	No	No
Chuuk State		
32. Weno Police Station	Yes	Yes
33. College of Micronesia: Weno campus	Yes	Yes
34. Weno International Airport	No	No
35. Weno power plant	No	No
36. Former state housing	No	No
37. Chuuk State Hospital	Yes	Yes
38. Mr Mori's private residence	Yes	Yes
39. Chuuk State Court	Yes	Yes

Site Name	Suspected PACM?	Samples Collected of PACM?
40. Chuuk weather office	No	No
41. Former Weno post office building	Yes	Yes
42. FSM Supreme Court	Yes	Yes
43. Chuuk Public Utilities Corporation	No	No
44. Chuuk EPA office	No	No
45. High Tide Hotel	Yes	Yes
46. FSM Telecommunications Corporation (Chuuk Branch)	No	No
47. Chuuk Department of Education	No	No
48. Blue Lagoon resort	No	No
49. Immaculate Heart of Mary Church	Yes	Yes
Pohnpei State		
50. Pohnpei Fishing Corporation generator shed	Yes	Yes
51. State Hospital Public health department	Yes	Yes
52. State health insurance department	Yes	Yes
53. LP Gas Corporation (former power plant)	Yes	No
54. Department of Education early childhood administration	No	No
55. Water plant admin (Public Utilities Corporation)	No	No
56. Public reserve area (asbestos cement waste)	Yes	Yes
57. Attorney General's office	Yes	Yes
58. Roadside dump site (1 asbestos cement water pipe)	Yes	No
59. Wastewater treatment plant	No	No
60. Post office	No	No
61. College of Micronesia: Kolonia Campus	Yes	Yes
62. Weather station	No	No
63. Tourism office	Yes	Yes
64. Scrap Metal Plant	No	No
65. Historic Preservation Department	No	No
66. FSM Capitol building compound including the office of emergency management	No	No
67. College of Micronesia Palikir campus	No	No
68. Johnny P. David's private residence	Yes	Yes
69. Enpein Elementary school	No	No
70. Madglonihmw police station	No	No
71. Antonia P. Dosolna's private residence	Yes	Yes
72. Pohnpei power plant	No	No
73. Pohnpei Botanic Gardens	Yes	Yes
74. PFC (Pohnpei State Fisheries Corporation) Offices	Yes	Yes
75. Department of Labour and Immigration	Yes	Yes
76. Public market (asbestos cement fence)	Yes	Yes
77. Old Spanish church	No	No
78. FSM Telecommunications Corporation (Pohnpei Branch)	No	No
79. Kolonia police and fire station	Yes	Yes
80. Pohnpei supreme court	No	No
81. State legislature chamber and admin building	No	No
82. Agricultural centre	No	No
83. Transport and infrastructure department (TNI)	No	No
84. Tax office	No	No
85. Pohnpei hospital	No	No

Site Name	Suspected PACM?	Samples Collected of PACM?
86. Department of Education Administration building	Yes	Yes
87. Visitors Bureau	No	No
88. Department of Land and Natural Resources	No	No
89. V6AH radio Pohnpei	Yes	Yes
90. Government owned asphalt plant	No	No
91. Seinwak Elementary School	No	No
92. Kitti Dispensary	No	No
93. Madglonihmw Dispensary	No	No
94. Mrs Gallens private residence	Yes	Yes
95. Pohnpei water plant	No	No
96. Pohnpei EPA office	No	No
Kosrae State		
97. KIRMA Office	No	No
98. Kosrae Hospital	No	No
99. Kosrae public library	No	No
100. College of Micronesia Kosrae Campus in Toful	No	No
101. Power Plant	No	No
102. FSM Telecommunications Kosrae Branch	Yes	No
103. Kosrae Airport Buildings	Yes	Yes
104. Kosrae State Gymnasium	No	No
105. Department of Public Works Depot	Yes	Yes
106. Tufansak School	No	No
107. State Government administration building	No	No
108. Kosrae Police Station	No	No
109. Former Kosrae Hospital	Yes	No
110. Kosrae Department of Education admin	No	No
111. Kosrae Transport and Infrastructure Department (TNI)	No	No
112. Kosrae Legislature Building	Yes	Yes
113. Kosrae Weather Office	No	No
114. Post office	No	No
115. Kosrae State Court	No	No
116. Kosrae Government Stevedoring Company	Yes	Yes
117. Malem School	No	No
118. Mrs Torenda Jona's private residence	Yes	No

5.0 Laboratory Results and Findings

5.1 Laboratory Results

A total of 62 samples were collected from 38 sites in the FSM survey and the presence of asbestos was confirmed in 9 of them. A further 13 sites were encountered where laboratory testing was not necessary to confirm the presence of asbestos. Table 7 shows all the sites were sampled including the laboratory result and the likely volume of material for sites that showed a positive detection for asbestos. Table 8 shows the sites where visual observations confirmed the presence of asbestos materials.

Table 7: Sites where samples were collected including the laboratory results and volume estimate

Sample No	Location	Type	Results	Area Where Positive (m2)
Yap1	Yap Power Plant	Floor Tile	None Detected	
Yap2	Yap High School	Cladding	None Detected	
Yap3	Yap Court Library	Floor Tile	None Detected	
Yap4	Yap Education Dept	Floor Tile	Chrysotile 2%	350
Yap5	Colonia Catholic Church	Roof	Chrysotile 10%, Amosite 15%	300
Yap6	Yap Govt Administration	Ceiling Tile	None Detected	
Yap7	Colonia Fire Station	Floor Tile	None Detected	
Yap8	Yap Maritime Institute	Floor Tile	Chrysotile 2%	70
Chuuk1	Immaculate Heart of Mary Church	Roof	Chrysotile 20%	525
Chuuk 1	Immaculate Heart of Mary Church	Ceiling Tile	None Detected	
Chuuk 1	Immaculate Heart of Mary Church	Ceiling Tile	None Detected	
Chuuk2	Chuuk Police	Floor Tile	None Detected	
Chuuk3	Former Post Office	Ceiling Tile	None Detected	
Chuuk4	Weno Court	Floor Tile	None Detected	
Chuuk5	Chuuk Hospital	Generator Lagging (Subject to Fire)	None Detected	
Chuuk6	High Tide Hotel	Fibreboard Stockpile	None Detected	
Chuuk7	Mr Mori's House	Roof and Stockpile	Chrysotile 15%	150
Chuuk8	Chuuk Community College	Drywall and Ceiling	None Detected	
Chuuk9	Chuuk State Court	Ceiling Tile	Chrysotile 20%	30
Chuuk9	Chuuk State Court	Ceiling Tile	None Detected	

Sample No	Location	Type	Results	Area Where Positive (m2)
Chuuk9	Chuuk State Court	Floor Tile	None Detected	
Chuuk10	FSM Telecom Chuuk	Exhaust Insulation	None Detected	
Pohnpei1	Botanic Garden Spanish Building	Roof	Chrysotile 12%	45
Pohnpei2	Johnny David Residence	Roof Sheeting Stockpile	Chrysotile 10%	1000
Pohnpei3	Pohnpei Fishing Corporation	Cladding	Chrysotile 15%, Amosite 10%	200
Pohnpei4	Botanic Garden Spanish Building	Plaster	None Detected	
Pohnpei5	Pohnpei Public Health Building	Ceiling Tile	None Detected	
Pohnpei6	Pohnpei Attorney General Building	Ceiling Tile	None Detected	
Pohnpei7	College of Micronesia Pohnpei Campus	Ceiling Tile	None Detected	
Pohnpei8	Pohnpei State Health Insurance Building	Ceiling Tile	None Detected	
Pohnpei9	Pohnpei Police Station	Floor Tile	None Detected	
Pohnpei10	Pohnpei Dept of Immigration and Labour	Floor Tile	None Detected	
Pohnpei11A	Pohnpei Fisheries Dept	Floor Tile	None Detected	
Pohnpei11B	Pohnpei Fisheries Dept	Floor Tile	None Detected	
Pohnpei11C	Pohnpei Fisheries Dept	Floor Tile	None Detected	
Pohnpei12	Pohnpei Dept of Education	Floor Tile	None Detected	
Pohnpei13	Pohnpei Tourism Office	Floor Tile	None Detected	
Pohnpei14	Pohnpei Police Station Detectives' Wing	Floor Tile	None Detected	
Pohnpei15	V6AH Radio Pohnpei	Floor Tile	None Detected	
Kosrae1	Kosrae Stevedoring	Floor Tile	None Detected	
Kosrae2	Kosrae Stevedoring	Floor Tile	None Detected	
Kosrae3	Kosrae Public Works	Floor Tile	None Detected	
Kosrae4	Kosrae Airport	Floor Tile	None Detected	

Sample No	Location	Type	Results	Area Where Positive (m2)
Kosrae5	Kosrae State Legislature	Ceiling Tile	None Detected	

Table 8: Locations not Tested but Very Likely to be Asbestos

Sample No	Location	Type	Results	Area (m2) or Amount
Pohnpei	Antonia Dosolua's Shade House,	AC Pipes as roof supports	Probably 12% Chrysotile	10 Pipes
Yap	Yap Water Treatment Plant	Old AC Pipes lying around	Probably 12% Chrysotile	About 10 Pipes
Kosrae	Former Kosrae Hospital	AC Pipes as Posts (not used)	Probably 12% Chrysotile	4 pipes
Pohnpei	Kolonia Public Reserve	Old Sheets and some broken pieces	Unknown but reputed to be asbestos cement	3m2 and 40 m2 Ground Contaminated
Kosrae	FSM Telecom, Kosrae	Suspect lagging (branded Selkirk Metalbestos)	Unknown	2
Pohnpei	Kuniora Gallen's House	AC Pipes as Roof supports and some broken asbestos	Probably 12% Chrysotile	Numerous Posts (75m2) and about 3m2 contaminated soil
Yap	Mr Atal's House	Damaged AC Pipes and some broken asbestos	Probably 12% Chrysotile	About 4 damaged pipes and about 2m2 contaminated soil
Kosrae	Mrs Torendra Jona's House	Damaged AC Pipes and some broken asbestos	Probably 12% Chrysotile	About 4 damaged pipes and about 2m2 contaminated soil
Pohnpei	Pohnpei LPG Corporation	Badly Damaged AC roofing material used as cladding	Unknown	1625
Pohnpei	Pohnpei Public Market	Damaged AC Roofing Material used as a fence	Unknown	50

Pohnpei	Pohnpei Roadside	Abandoned Pipe and another protruding from ground	Probably 12% Chrysotile	2 pipes
Yap	Controlled Dump	Asbestos floor tiles buried from Yap Hospital	Unknown	Record of Burial only

Some of the above locations are presented in Photos 5 - 20 below.

Yap Photos

Photo 5 – Colonia Catholic Church

Photo 6 – Yap Water Treatment Plant

Photo 7 - Mr Atal's House

Photo 8 – Education Dept Floor Tiles

Chuuk Photos

Photo 9 –Catholic Church

Photo 10 – State Court Ceiling

Photos 11 and 12 – Mr Mori's House, Stacked Sheets and Roof

Pohnpei Photos

Photo 13 – Botannic Garden Spanish Bldg

Photo 14 – Fishing Corp Generator Bldg

Photo 15 – LPG Corporation

Photo 16 – Public Market Fence

Photo 17 – Residence – Stacked Sheets

Photo 18 – Residence – AC Pipe Columns

Kosrae Photos

Photo 19 – Hospital – Old AC Columns

Photo 20 – Residence – Old Pipes

5.2 General Comments on the Results

The greatest source of asbestos which could be readily identified in FSM was the public water system infrastructure. The Public Works representative indicated that the public water supply is distributed through Asbestos Cement (AC) pipes. The majority of excavated AC pipes had been either removed to the water treatment facilities for storage, or disposed of (sometimes at sea). However, a few cases existed where members of the public had been able to obtain AC pipes for use at their residential properties. The uses varied from culverts or bridges to pillars supporting the roofs of shade houses.

The majority of residential dwellings observed were constructed using plywood, concrete blocks and corrugated iron. Very few examples of asbestos-containing materials were observed in the residential setting throughout FSM.

Similarly, the majority of government owned buildings have been constructed using concrete blocks, with plywood ceilings / internal walls and corrugated iron or flat concrete roofs. Building materials which could contain asbestos in those buildings consisted of acoustic ceiling tiles, cement fibre boards and vinyl floor tiles.

Special use buildings such as power stations and facilities, where backup power generation is required (hospital, telecommunications etc) were found to contain potential sources of asbestos lagging and / or insulation of the generators.

The potential exists for more asbestos cement pipes and / or boards to be present in some residential properties. However, based on the apparent rarity of the pipes, the number of affected properties is considered likely to be low. Stockpiles of boards encountered on residential properties were there for the purpose of distribution to the wider public and this should be prevented to minimise the amount of ACM at unknown locations.

Future sources of asbestos-containing materials are likely to be limited to asbestos cement water pipes which may be excavated when the aging infrastructure is replaced with PVC or HDPE pipes. However, if asbestos regulations are not incorporated into the FSM national legislature, new asbestos-containing products could be imported and used for construction purposes.

6.0 Risk Assessment

Utilising the algorithms described in Section 3 of this report and based on the laboratory analysis data of ACM samples (where available) and observations of the sites visited, the sites are listed in order of priority in Table 9. The completed risk ranking algorithm spreadsheets are provided in Appendix 5.

Table 9: Risk Ranking Scores

Site Name	Building Material Type	Asbestos Type and %	Risk Ranking Scores		
			ACM	Setting	Total Score
LP Gas Company Warehouse, Pohnpei	Cement roof and cladding	Chrysotile 15% Amosite 2%	7	16	23
Mr Mori's Residence, Chuuk	Cement roof	Chrysotile 15%	5	14	19
Kuniora Gallen's Residence, Pohnpei	Broken and whole cement pipes	Chrysotile 15%	7	11	18
Yap Department of Education Administration Buildings	Vinyl floor tiles	Chrysotile 3%	3	15	18
College of Micronesia: FSM Fisheries and Maritime Institute, Yap Campus	Vinyl floor tiles	Chrysotile 2%	3	15	18
Colonia Catholic Church	Cement roof	Chrysotile 10% Amosite 15%	6	11	17
Antonia P. Dosolua's Residence, Pohnpei	Cement pipe	Chrysotile 15%	6	11	17
Yap Central Water Treatment Plant	Cement pipe	Chrysotile 15%	6	10	16
Pohnpei Fishing Corporation Generator Shed	Cement boards	Chrysotile 15% Amosite 2%	6	10	16
Immaculate Heart of Mary Church, Chuuk	Cement roof	Chrysotile 10% Amosite 15%	5	11	16
Johhny P. David's Residence, Pohnpei	Stacked cement roof boards	Chrysotile 15% Amosite 2%	5	11	16
Kolonia Public Market	Cement fence	Chrysotile 15% Amosite 2%	6	9	15
Mr Atal's Residence, Yap	Cement pipe	Chrysotile 15%	8	6	14
Public Reserve Area, Pohnpei	Broken pieces of cement roof	Chrysotile 15% Amosite 2%	6	8	14
FSM Telecommunications, Yap Branch	Generator exhaust lagging	Not tested	6	7	13
Roadside, Pohnpei	Cement pipe	Chrysotile 15%	6	7	13
FSM Telecommunications Corporation, Kosrae Branch	Generator exhaust lagging	Not tested	6	7	13
Chuuk State Court	Soffits	Chrysotile 20%	4	9	13
Mrs Torenda Jona's Residence	Cement pipe	Chrysotile 15%	6	4	10
Pohnpei Botanic Gardens	Cement roof	Chrysotile 12%	5	5	10
Former Kosrae Hospital	Cement pipe	Chrysotile 15%	5	4	9
Yap Department of Public Works and Transportation Depot	Vinyl floor tiles (buried)	Chrysotile 2%	2	2	4

The risk assessment scoring and prioritisation presented in Table 9 indicates that there are 7 moderate to high risk ACM sites which would benefit from additional ACM management. The 15 remaining sites are considered to present a low to very low risk to occupants and the public in their current state, but can pose greater risks in the future if they are not managed appropriately.

Some of the low risk sites have the potential for their level of risk to be increased if their circumstances are changed. The potential exists for some materials to be removed and used elsewhere which would result in a different Risk Score than the one calculated for their current location and exposure scenario. These considerations have been included in the recommended actions for minimising asbestos exposure in Section 8.

7.0 Remedial and Management Options

7.1 General

Based on all of the country visits made by the consultants for the PacWaste asbestos surveys, it is evident that:

a. The types of asbestos problems are relatively similar from country to country although there are very significant variations in incidence and quantity of asbestos.

b. Most asbestos is non-friable, or at least was non-friable when installed. Often the asbestos has deteriorated significantly and, in part at least, could be considered friable because of the risk of release of significant amounts of fibres on a regular basis. Certainly where fibres have been involved the asbestos becomes friable.

c. There has been almost no asbestos identified anywhere that was friable when installed. Remediation of the few friable (at least friable when installed) asbestos projects in the Pacific will need specialist management as exceptions.

d. The predominant form of asbestos is Chrysotile (White) Asbestos, although incidences of Amosite (Brown) Asbestos and Crocidolite (Blue) Asbestos do occur occasionally. Chrysotile is hazardous, but not as hazardous as the other forms of asbestos.

e. Labour rates are similar from country to country.

f. There will most likely be a need to bring in specialist supervision for any remedial work, and rates for that supervision will be similar throughout the Pacific.

g. The cost of materials in most countries is similar as almost all materials need to be imported from manufacturing countries with similar pricing structures.

h. There is some level of awareness of asbestos management techniques in all countries (and certainly more in the countries where there are significant amounts of asbestos). Generally, however, there is little expertise available to perform professional asbestos removals to the standard that would be required in, for example, Europe, UK, USA or Australia.

i. The correct equipment for properly managing asbestos remediation is not available in any of the countries visited, with the exception of some PPE and the simpler tools required for removal operations.

j. Safe and acceptable remediation techniques will be the same everywhere.

A case can therefore easily be made for a universal policy and set of procedures to be developed across the whole Pacific region for addressing asbestos problems.

7.2 Management Options

Where ACM or PACM has been identified then there are some management measures that can be taken immediately as follows:

- communicate with building/property owners, employees, contractors and others of its presence, form, condition and potential health risks associated;
- monitor the condition of the ACM;
- put a safe system of work in place to prevent exposure to asbestos.

7.2.1 Communicating ACM Hazard

Although every attempt was made during the survey work to communicate the potential level of risk apparent during the site visits, further consultation with the relevant regulator, site/building owners

and occupants will be required based upon the findings and specifically the laboratory confirmation of the presence of ACM. Where an immediate significant risk to human health was apparent during the surveys, regulators were informed and actions taken to manage/remedy the situation.

All site owners and employees should be made aware of the location of any ACMs in the buildings identified. This is particularly important for maintenance workers or contractors who may directly disturb ACMs while working. A means of communicating with contractors who come on site to carry out other work must also be set up to prevent disturbance of ACMs without implementing the correct controls. The means of communication could include a site induction sheet or training session on the hazards presented by the ACM on site together with a formal contractor acknowledgement sheet.

If the location is a private residence then an information sheet could be handed out and an education / awareness programme initiated.

7.2.2 Monitor ACM

ACMs which are in good condition, sealed and/or repaired, and are unlikely to be disturbed, are of a lower risk than those which are damaged and in certain situations can be left in place. Often, encapsulation and management is a safer option than removal, which can result in the ACMs being disturbed further and potential further exposure to the building occupants. The on-going operations at the site will also factor into whether the ACM can be left on site. It should be noted, however, that effective encapsulation, especially of roofing, can be expensive.

If ACMs are left in place, the condition of the ACMs will have to be monitored regularly and the results recorded. A useful way of monitoring the condition of the ACMs is to regularly take photographs, which can be used to compare the condition over time. When the condition of the ACM starts to deteriorate, remedial action can be taken. The time period between monitoring will vary depending on the type of ACM, its location and the activities in the area concerned, but as a minimum should be at least once every 12 months.

7.2.3 ACM Safe System

Where an ACM is going to be left in place, one option would be to label or colour-code the material. This may work in an industrial environment, but may not be acceptable in a suite of offices or suitable in public areas, for example, retail premises. The decision to label or not will in part depend on confidence in the administration of the asbestos management system and whether communication with workers and contractors coming to work on site is effective.

Labelling and colour coding alone should not be relied upon solely as the only control measure. The physical labels and colour coding may deteriorate over time without sufficient maintenance.

7.3 Remedial Options

The management options of ACM outlined in Section 7.1 above are administration controls that can assist with effectively managing the risk ACM presents. However, in certain situations, administration controls may not be sufficient or the risk posed by the ACM by way of its damaged condition or setting sensitivity may present an unacceptable risk. Remedial measures for managing the ACM may include one or a combination of the following;

- protect/enclose the ACM;
- seal/encapsulate the ACM;

- repair of the ACM;
- removal of the ACM.

7.3.1 Protection/enclosure of ACMs

Protecting ACMs means the construction or placing of a physical barrier of some sort to prevent accidental disturbance of the ACM. This may mean placing a bollard in front of a wall panel of asbestos insulating board to prevent accidental damage by fork lift truck movements. Enclosing the ACM involves the erection of a barrier around it, which should be as airtight as possible to prevent the migration of asbestos fibres from the original material. Enclosing the ACM is a good option if it is in reasonable condition and in a low sensitivity environment.

If enclosure is chosen as the desired management option it is important that the existence of the ACM behind the enclosure is notified to all who may work or visit the site. Labelling on the enclosure to indicate the presence of the hidden ACM would assist with communicating the hazard. The condition of the enclosure should also be periodically monitored and the results of the inspection recorded.

7.3.2 Sealing or encapsulation of ACM

Encapsulation of an ACM is only suitable if the ACM is in good condition and in a low sensitivity environment. The additional weight of the encapsulant is also an important consideration and this may unwittingly cause delamination and possible damage to the ACM.

According to the UKHSE (2001) there are two types of encapsulants; bridging and penetrating encapsulants. Bridging encapsulants adhere to the surface of the ACM and form a durable protective layer. Bridging encapsulants include high build elastomers, cementitious coatings and polyvinyl acetate (PVA). The different types of encapsulants available will suit different circumstances and ACMs and should therefore be selected by a specialist in asbestos management to ensure the correct encapsulant is chosen.

Of the bridging encapsulants, high-build elastomers can provide substantial impact resistance as well as elasticity, and are reported to provide up to 20 years of life if undisturbed. Cementitious coatings are generally spray-applied and are compatible with most asbestos applications. They provide a hard-set finish, but may crack over time. PVA is used for sealing of asbestos insulating board and may be spray or brush applied. PVA is not suitable for use on friable ACMs such as insulation or sprayed coatings. PVA will only provide a very thin coating and may not be suitable as a long-term encapsulant.

Penetrating encapsulants are designed to penetrate into the ACM before solidifying and locking the material together to give the ACM additional strength. Penetrative encapsulants are typically spray-applied and will penetrate non-friable and friable asbestos materials, strengthening them as well as providing an outer seal.

The selection, preparation and application of encapsulants requires skill, knowledge and experience with asbestos remedial work.

7.3.3 Repair of the ACM

To be readily repairable, the damage should be minimal, therefore repair should be restricted to patching/sealing small areas where cracks or exposed edges have become apparent. Where significant damage has occurred it may be more cost effective to remove the ACM.

The repair methodology selected will largely depend on the type of ACM to be repaired. For example, small areas of damaged pipe or boiler lagging can be filled with non-asbestos plaster and if necessary wrapped with calico (cotton cloth). Small areas of damaged sprayed asbestos can be treated with encapsulant and, if necessary, an open mesh scrim of glass fibre or calico reinforcement used. Damaged asbestos panelling or tiles can be sprayed with PVA sealant or a similar type of sealant such as an elastomeric paint. Asbestos cement products can be sealed using an alkali-resistant and water-permeable sealant or impermeable paint.

7.3.4 Removal of the ACM

Where ACMs have been identified that are not in good condition, or are in a vulnerable position and liable to damage, the remedial options described previously should be explored first. Where it is not practical to repair, enclose or encapsulate the ACMs, they will need to be removed. ACMs will also need to be removed if the area is due to undergo refurbishment which will disturb the ACM, or where a building is going to be demolished.

Rigorous safety procedures are required to be followed for the removal of ACM. Typically the following procedure should be followed for non-friable asbestos although some variations may be necessary from site to site.

a) Place warning barrier tape around the site at a minimum distance of ten metres, where practicable, and place warning signs to clearly indicate the nature of work.

b) The contractor shall wear protective disposable type overalls, gloves and at least a half face respirator with a P2 (and preferably a P3) replaceable filter.

c) Wet down the ACM to be removed and carefully remove any fasteners using hand tools. Attempt to remove the ACM intact – do not break it up, or throw it into a waste bin or skip.

d) Place asbestos material and debris in an approved asbestos waste bag and seal for disposal in accordance with local requirements. Sheets of asbestos cement product should be placed wet one on top of another into a skip lined with a heavy duty plastic liner, a portion of which remains outside the skip and is of sufficient size to cover the waste when the skip is full.

Vacuum asbestos removal area using a vacuum fitted with a high efficiency particulate air filter (HEPA filter).

Normally air monitoring is not required for the removal of non-friable asbestos containing materials, as if done correctly no excessive quantities of asbestos fibres should be generated. However, some operators prefer to undertake such monitoring to obtain evidence that no risks to health occurred during the removal exercise.

The whole project should be supervised by an experienced asbestos removalist. Certification processes are in place in several countries to make sure such removalists are suitably qualified and experienced.

In each case of an asbestos removal project a detailed **"Asbestos Removal Plan"** should be prepared that addresses the following matters:

1. Identification:

- Details of the asbestos-contaminated materials to be removed – for example, location/s, whether it is friable or non-friable, condition and quantity to be removed – include references to analyses.

2. Preparation:

- Consultation with regulators, owners and potentially affected neighbours
- Assigned responsibilities for the removal
- Programme of commencement and completion dates
- Consideration of other non-asbestos related safety issues such as safe working at heights
- Asbestos removal boundaries, including the type and extent of isolation required and the location of any signs and barriers
- Control of electrical and lighting installations
- Personal protective equipment (PPE) to be used, including respiratory protective equipment (RPE)
- Details of air monitoring programme
- Waste storage and disposal programme

3. Removal

- Methods for removing the asbestos-contaminated materials (wet or dry methods)
- Asbestos removal equipment (spray equipment, asbestos vacuum cleaners, cutting tools, etc)
- Details of required enclosures, including details on their size, shape, structure, etc, smoke-testing enclosures and the location of negative pressure exhaust units if needed
- Details of temporary buildings required for asbestos removal (eg decontamination units), including details on water, lighting and power requirements, negative air pressure exhaust units (see Section 7.10) and their locations
- Other control measures to be used to contain asbestos within the asbestos work area. This includes dust suppression measures for asbestos-contaminated soil.

4. Decontamination:

- Detailed procedures for the workplace decontamination, the decontamination of tools and equipment, personal decontamination of non-disposable PPE and RPE, decontamination of soil removal equipment (excavator, bobcat etc)

5. Waste Disposal:

- Methods for disposing of asbestos waste, including details on the disposal of:
  - Disposable protective clothing and equipment and
  - Structures used to enclose the removal area

8.0 Selection of Possible Remedial Options

8.1 General

The flow chart presented below in Figure 2 has been adapted from that presented in UKHSE HSG227 'A Comprehensive Guide to Managing Asbestos in Premises'. It details the decision process adopted by this study in determining the most suitable management option for the majority of sites with ACM.

Figure 2: ACM Management Flow Chart

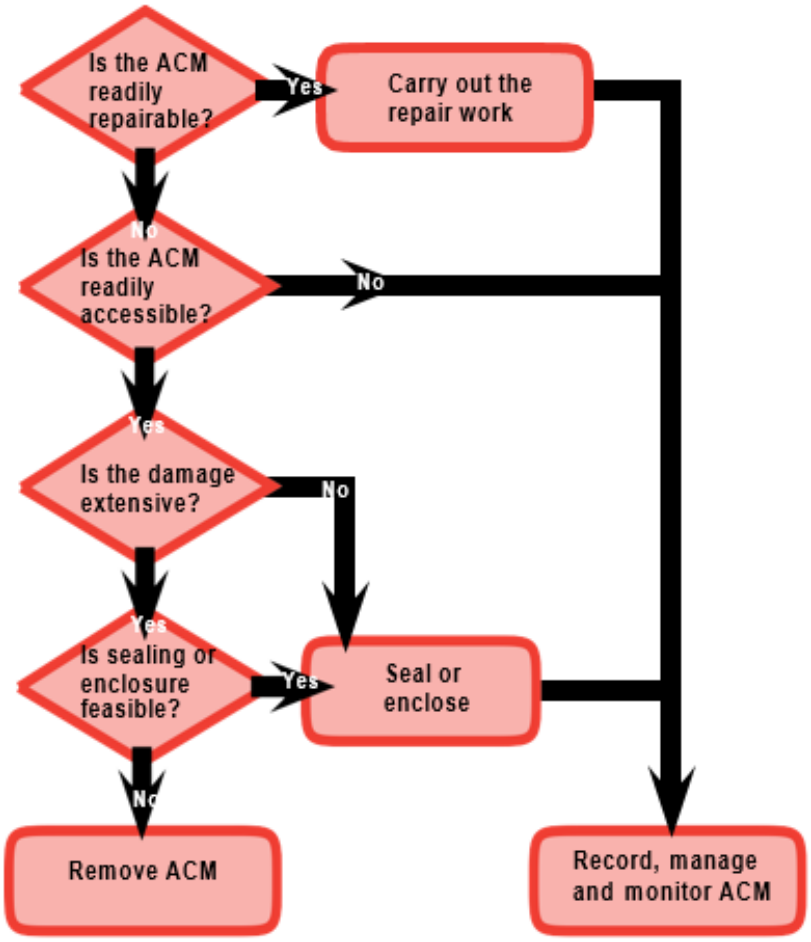


Figure adapted from; UKHSE HSG227 'A Comprehensive Guide to Managing Asbestos in Premises'.

Clearly there is a need to adopt a logical process such as above to select the correct management procedure in each case, and the flowchart above sets out such a procedure. There are some specific Pacific factors, however, that need to be considered.

8.2 Appropriate Asbestos Management for the Pacific

There are limited funds available for asbestos remediation in the Pacific and a wide range of health initiatives that may be deserving of funding besides asbestos remediation. It will therefore be necessary to prioritise which remediation projects are to be carried out, based on the risk ranking methodology and available funding. Whichever projects cannot be undertaken will need interim management until funding is available.

Management of un-remediated asbestos buildings is discussed in Section 7.2 above. The key factors in this management will be education and awareness so that minimising the generation of airborne fibres can be achieved.

Where remediation can be undertaken the first option that could be considered is encapsulation. Most asbestos roofs in the Pacific are, however, in a deteriorating condition and need to be encapsulated on the underside as well as the top surface. In most cases there is also a ceiling in place so the ceiling will need to be removed, as well as electrical and other services if they cannot be worked around. The top surface of the ceiling, as well as the services, must be treated as potentially contaminated with asbestos, especially if the asbestos roof is old, so the rooms below will need to be protected. The services and ceiling will then need to be returned or replaced as appropriate.

This process is expensive and, in fact may cause the project to be of a similar cost to removal and replacement of the roof. If there is no ceiling in place then the underside of the asbestos roof may, however, be able to be painted quite easily, although the project will still be an asbestos remediation project with all the resultant controls that must be put in place.

If an asbestos roof is encapsulated then it will still be necessary to replace any asbestos guttering and downpipes.

Asbestos cladding may be able to be satisfactorily encapsulated at a reasonable cost if it is in good condition. If there is also a wall cavity and an internal wall in good condition then there would be no need to encapsulate the inside of the asbestos cladding. Otherwise the inside would need to be encapsulated as well.

Encapsulation is discussed further in Section 8.3 below.

Removal of the asbestos roof would require all the appropriate asbestos management controls to be put in place as well as edge protection / fall arrest for safe working at heights and procedures for working on a brittle asbestos roof. Once the roof has been removed then the asbestos dust would need to be carefully vacuumed up in the ceiling space. Then a new roof would need to be put in place. With the hot conditions in the Pacific an insulating layer would also be required. Asbestos does have the merit of being cool to live under.

Removal is discussed further in Section 8.4 below.

8.3 Encapsulation

If encapsulation is to be used then several factors need to be considered as follows:

- Durability – the encapsulating system applied should last for a long time.
- There should be minimal (or preferably no) surface preparation involved as the high pressure washing and abrasive techniques normal for surface preparation for painting will generate a large amount of asbestos fibres.
- The encapsulant product should be simple to apply.
- Preferably the solar reflection should be enhanced by the use of light colours.

Normal priming type paints (especially oil or mineral turps based paints) generally do not bind well to asbestos cement roofs and cladding and special high quality alkali resistant primers are recommended

prior to using a typical high quality 100% acrylic based exterior undercoat and exterior top coat system.

Alternatively, a semi-gloss, two-component epoxy paint suitable for metal, concrete, asbestos, cement and heavy machinery can be used. Such epoxy resin based paints exhibit long lasting durability under harsh conditions, such as acid, alkaline, salt and very humid conditions. Such paint can as used as a primer coat as well.

Another alternative is to use a special asbestos encapsulating system such as that offered by Global Encasement Inc (www.encasement.com). Global Encasement recommends for the Pacific a primer called "MPE" (Multi-Purpose Encapsulant) and a top coat called "Asbestosafe". MPE is promoted as not requiring any surface preparation and is described as a penetrating encapsulant. It does, however, require surfaces to be "clean and dry, and free of mould, mildew, chalking, dirt, grease and oil. In most cases old roofs in the Pacific would still therefore require surface preparation.

Based on coverage and cost per litre the Global Encasement paint systems are probably about 20-30% more expensive than high quality exterior acrylic paint systems and the cost of the paint (encapsulant) would in turn be about 40-50% of the overall cost of an encapsulating project, depending on labour costs. The additional cost of using a specialist coating like the Global Encasement systems may not therefore be that significant. Global Encasement do say that a 20 year life is expected while a high quality acrylic system is unlikely to last longer than 10-15 years. Global Encasement offer a guarantee for the 20 year life but it is a very limited and conditional guarantee.

The following steps would be typical for a roof asbestos encapsulation project:

a) Prepare asbestos removal plan, set up asbestos boundaries and signage, prepare PPE and decontamination area.
b) Set up scaffolding to both sides of building for access to roof sheeting & to remove asbestos guttering from building. Set up anchor point for fall arrest systems.
c) Spray with a particle capture technology such as Foamshield (www.foamshield.com.au) to the inside of the ceiling space before removal of the ceiling. This will control any asbestos dust in the ceiling space before removal of the ceiling. Alternatively the ceiling space could be vacuumed thoroughly if safe access is possible to all the ceiling space.
d) Lay down black plastic sheeting to the floor of each room, remove all ceiling linings and place all rubbish into suitable containers for disposal (plastic lined bins or fabric bags such as "Asbags" – see Photos 21 & 22 below) for correct removal & disposal. All ceiling material will need to be treated as asbestos-contaminated as debris and fibres fall from the roofing with roof movement and wear.
e) Disconnect & remove all electrical items, ceiling fans, lights, extractor fans. Vacuum thoroughly and store safely ready for reconnection after new ceilings are installed. Ensure all wiring is made safe for ongoing work.
f) Vacuum the underside of the existing roof sheeting and all timber roof framing. After removal of ceiling materials and plastic, vacuum all the inside of the premises.
g) Spray 3 coats of protective paint system (pre-coat, undercoat and top coat) to the underside of all the asbestos roof sheeting. Ensuring that all surface areas are correctly coated.
h) Supply & fix appropriate ceiling sheeting to ceilings of all rooms. Supply & fix timber battens to all sheet joints & to perimeter of each room.

i) Paint with 2 coats of acrylic ceiling paint to all new ceiling sheets & perimeter battens.
j) Reposition all wiring for lights & fans and connect up all fittings as previously set out.
k) Spray 3 coats of specialist paint finish (pre-coat, undercoat and top coat) to all the exterior roof area according to painting specifications.
l) Remove, and contain for disposal, asbestos gutters and downpipes from both sides of the building and supply & install new suitable box gutters (e.g. Colourbond) with down pipe each side leading to water tank.
m) Remove asbestos boundaries and signage and decontamination area and decommission from site.

NB: All vacuuming will need to be done with a specialist vacuum cleaner fitted with a high efficiency (HEPA) filter.

Asbags are fabric bags in various sizes with lifting strops – see photos below. There are special ones for roofing sizes.


Photos 21 & 22: Asbags in use

8.4 Removal

Removal of friable asbestos will need to be carried out with specialist asbestos contractors who will not normally be available in Pacific countries.

Removal of non-friable asbestos roofs and cladding will need to be done according to appropriate protocols and will again need specialist supervision and training.

The following steps would be typical for a roof asbestos removal project:

a) Prepare asbestos removal plan, set up asbestos boundaries and signage, prepare PPE and decontamination area.
b) Set up scaffolding to both sides of building to assist in removal of roof sheeting & to remove asbestos guttering from building. Set up anchor point for fall arrest systems.
c) Spray the entire roof with a water based PVA solution.
d) Carefully remove the roof sheeting by unscrewing, (not breaking) the roof sheets. All roof sheets to be stacked onto plastic sheeting sitting on bearers for ease of removal. Sheeting to be fully wrapped in plastic & taped shut. Roof sheeting and all materials, (ridging, barge flashing, gutters etc) to be loaded into suitable containers for disposal (plastic lined bins or fabric bags such as “Asbags”) for correct removal & disposal.
e) Vacuum clean the existing ceiling & roof space, (rafters, purlins, ceiling joists) with a suitable vacuum cleaner fitted with a HEPA filter.

f) Supply & fit heavy duty tarpaulins to keep the roof waterproof before installation of new roofing.

The new roof sheeting, insulation, guttering and downpipes should be durable (long life and resistant to corrosion from marine environments. Suitable insulation will also need to be installed to keep the building cool.

One option where a large amount of roofing is to be installed is to use a roof roll forming machine and form the roofs locally. Roofing materials could then be cut to suit and purchase of the sheet metal rolls would be cheaper than the finished roofing sheets. Of course the capital cost of the roll forming machine would need to be included in the cost calculations. It may also be appropriate to use aluminium rolls which would be corrosion resistant in marine environments.

Alternatively suitable roofing materials can just be imported such as Colourbond Ultra Grade, which is suitable for corrosive marine environments.

The following steps would be typical for a roof replacement project:

a) Supply & fit suitable roof netting over existing purlins & fix in place ready to support suitable insulation such as 50mm thick, foil coated, fiberglass insulation.
b) Supply & lay a top layer of sisalation foil over the fibreglass insulation blanket as a dust and moisture barrier.
c) Supply & screw fix suitable roofing material such as Colourbond Ultra Grade corrugated roofing, including for ridging & barge flashings.
d) Supply & fix suitable guttering such as Colourbond box guttering to both sides of the roof & include for one downpipe each side, feeding to a tank.

8.5 Options Specific to FSM

Encapsulation by painting and / or removal of asbestos-containing materials to landfill are viable and easily achievable options in FSM.

Table 10 below shows the sites in FSM that returned a positive result for ACM and the most suitable, cost effective remedial options based on the flow chart process described above.

Table 10: Possible Remedial Options

Site Name	Building Material Type	Asbestos Type and %	Risk Ranking	Applicable Remedial Options			
				Repair	Isolate	Encapsu - late	Remove
LP Gas Company Warehouse, Pohnpei	Cement roof and cladding	Chrysotile 15% Amosite 2%	23	×	×	×	✓
Mr Mori's Residence, Chuuk	Cement roof	Chrysotile 15%	19	×	×	×	✓
Kuniora Gallen's Residence, Pohnpei	Broken and whole cement pipes	Chrysotile 15%	18	×	×	✓	✓
Yap Department of Education	Vinyl floor tiles	Chrysotile 3%	18	×	×	✓	✓

Site Name	Building Material Type	Asbestos Type and %	Risk Ranking	Applicable Remedial Options			
				Repair	Isolate	Encapsu - late	Remove
Administration Buildings							
College of Micronesia: FSM Fisheries and Maritime Institute, Yap Campus	Vinyl floor tiles	Chrysotile 2%	18	×	×	✓	✓
Colonia Catholic Church	Cement roof	Chrysotile 10% Amosite 15%	17	×	×	×	✓
Antonia P. Dosolua's Residence, Pohnpei	Cement pipe	Chrysotile 15%	17	×	×	✓	✓
Yap Central Water Treatment Plant	Cement pipe	Chrysotile 15%	16	×	✓	×	✓
Pohnpei Fishing Corporation Generator Shed	Cement boards	Chrysotile 15% Amosite 2%	16	×	×	✓	✓
Immaculate Heart of Mary Church, Chuuk	Cement roof	Chrysotile 10% Amosite 15%	16	×	×	×	✓
Johhny P. David's Residence, Pohnpei	Stacked cement roof boards	Chrysotile 15% Amosite 2%	16	×	×	×	✓
Kolonia Public Market	Cement fence	Chrysotile 15% Amosite 2%	15	×	×	✓	✓
Mr Atal's Residence, Yap	Cement pipe	Chrysotile 15%	14	×	×	×	✓
Public Reserve Area, Pohnpei	Broken pieces of cement roof	Chrysotile 15% Amosite 2%	14	×	×	×	✓
FSM Telecommunications, Yap Branch	Generator exhaust lagging	Not tested	13	×	×	×	✓
Roadside, Pohnpei	Cement pipe	Chrysotile 15%	13	×	×	×	✓
FSM Telecommunications Corporation, Kosrae Branch	Generator exhaust lagging	Not tested	13	×	×	×	✓
Chuuk State Court	Soffits	Chrysotile 20%	13	×	×	✓	✓
Mrs Torenda Jona's Residence	Cement pipe	Chrysotile 15%	10	×	×	×	✓
Pohnpei Botanic Gardens	Cement roof	Chrysotile 12%	10	×	×	×	✓
Former Kosrae Hospital	Cement pipe	Chrysotile 15%	9	×	×	×	✓
Yap Department of Public Works and Transportation Depot	Vinyl floor tiles (buried)	Chrysotile 2%	4	×	×	×	×

**Note that it is not intended that residential houses clad or roofed with asbestos containing materials be remediated as part of the PacWaste project.*

In order to assist with ensuring the most suitable and remedial approach is taken, a review of the National and International regulations governing asbestos has been undertaken – see Section 11 below.

9.0 Disposal

9.1 Relevant International Conventions

The three options for disposal of ACM and asbestos-contaminated wastes are as follows:

a) Local burial in a suitable landfill
b) Disposal at sea
c) Export to another country with suitable disposal

These three alternatives are discussed below.

Several International Conventions may be relevant to sea disposal and export of asbestos. These conventions and their status as at 2011 are set out in Table 11 below.

Table 11: Related International Conventions

Country	Rotterdam Convention	Basel Convention	London Convention & Protocol*	Waigani Convention	Noumea Convention
Australia	Y	Y	Y*	Y	Y
Cook Islands	Y	Y		Y	Y
FSM		Y		Y	Y
Fiji				Y	Y
Kiribati		Y	Y	Y	
Marshall Is	Y	Y	*		Y
Nauru		Y	Y		Y
New Zealand	Y	Y	Y*	Y	Y
Niue				Y	
Palau				Not ratified	
PNG		Y	Y	Y	Y
Samoa	Y	Y		Y	Y
Solomon Is			Y	Y	Y
Tonga	Y	Y	Y*	Y	
Tuvalu			Y	Y	
Vanuatu			Y*	Y	

Source; SPREP (2011) 'An Asbestos-Free Pacific: A Regional Strategy and Action Plan'

Later in 2011 Palau also became a party to the Basel Convention.

The Rotterdam Convention (formally, the *Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade*) is a multilateral treaty to promote shared responsibilities in relation to importation of hazardous chemicals. The convention promotes open exchange of information and calls on exporters of hazardous chemicals to use proper labelling, include directions on safe handling, and inform purchasers of any known restrictions or bans. Signatory nations can decide whether to allow or ban the importation of chemicals listed in the treaty, and exporting countries are obliged to make sure that producers within their jurisdiction comply.

The Convention covers asbestos as one of its listed chemicals but not Chrysotile asbestos. The Convention, however, is for the purpose of managing imports of products and not wastes.

The London Convention and Protocol, and the Noumea Convention and associated Dumping Protocol are both relevant to the issue of dumping at sea and hence are discussed in Section 9.3 below.

The Basel and Waigani Conventions are relevant to the issue of export of waste to another country and are hence discussed in Section 9.4 below.

9.2 Local Burial

In order for local burial of ACM and asbestos-contaminated wastes to occur in a local landfill that takes general refuse, there must be a suitable landfill available as follows:

a) The landfill must be manned and secure so that no looting of asbestos materials can occur.

b) The landfill must have proper procedures for receiving and covering asbestos waste. A suitable hole must be excavated, the asbestos waste placed in the hole, and the asbestos waste covered with at least one metre of cover material. The asbestos waste should be buried immediately on receipt at the landfill.

c) Machinery must be available to enable the excavation and covering to occur.

d) The location of the asbestos should be logged or an asbestos burial area designated.

e) Records of dates and quantities should be kept.

The alternative to burial in a local landfill is to construct a special monofill for asbestos waste. This landfill could be lined and sealed once it is full. This process is expensive, however, and would only be justified where there is a large amount of asbestos for disposal.

The other factor to consider in relation to local disposal is whether such a practice is acceptable to the local people. A programme of consultation is necessary to determine if this is the case.

9.3 Disposal at Sea

The international convention governing sea disposal is the *Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter 1972*, (the London Convention), which has the objective to promote the effective control of all sources of marine pollution and to take all practicable steps to prevent pollution of the sea by dumping of wastes and other matter (International Maritime Organization (IMO)). The *1996 "London Protocol"* to the Convention which came into force in March 2006 updates the convention to prohibit the dumping of any waste or other matter that is not listed in Annex 1 to the Protocol.

Annex 1 to the Protocol covers the following wastes

1. Dredged material
2. Sewage sludge
3. Fish waste, or material resulting from industrial fish processing operations
4. Vessels and platforms or other man-made structures at sea.
5. Inert, inorganic geological material
6. Organic material of natural origin
7. Various bulky inert items – iron, steel, concrete etc.
8. Carbon dioxide streams form carbon dioxide capture processes for sequestration

Probably asbestos would come under the category of inert inorganic geological material.

Any dumping of such Annex 1 wastes requires a permit from the country of origin and is limited to those circumstances where such wastes are generated at locations with no land disposal (or other disposal) alternatives. The 1996 protocol also prohibits the exports of wastes or other matter to non-Parties for the purpose of dumping at sea.

The decision to issue a permit is to be made only if all impact evaluations are completed and the monitoring requirements are determined. The provisions of the permit are to ensure that, as far as practicable, any environmental disturbance and detriment are minimised and the benefits maximised. Any permit issued is to contain data and information specifying:

1. The types and sources of materials to be dumped
2. The location of the dumpsite(s)
3. The method of dumping
4. Monitoring and reporting requirements.

It should be noted that the overall thrust of the Convention (as amended by the Protocol), as set out at the start of the Protocol is to eliminate pollution of the sea caused by dumping and to protect and preserve the marine environment. The Protocol also recognises the particular interests of Small Island Developing States. It would be fair to say, therefore, that even if the dumping of asbestos met the requirements of the Convention and Protocol, it would probably be contrary to the overall thrust of the Convention and Protocol, particularly if such dumping was initiated by Small Island Developing States.

If asbestos was dumped at sea, the following information would be needed (in terms of Annex 2 of the Protocol), in order for a permit to be issued:

1. Full consideration of alternatives
2. Full assessment of human health risks, environmental costs, hazards (including accidents), economics, and exclusion of future uses.

The other relevant convention is the *Convention for the Protection of the Natural Resources and Environment of the South Pacific Region* (1986), known also as the SPREP Convention or Noumea Convention. This Convention, along with its two Protocols, is a comprehensive umbrella agreement for the protection, management and development of the marine and costal environment of the South Pacific Region. It is the Pacific region component of UNEP's Regional Seas Programme which aims to address the accelerating degradation of the world's oceans and coastal areas through the sustainable management and use of the marine and coastal environment. In order to protect the environment in the Pacific region, through the Noumea Convention the Parties agree to take all appropriate measures in conformity with international law to prevent, reduce and control pollution in the Convention Area from any source, and to ensure sound environmental management and development of natural resources.

One of two associated protocols is the Dumping Protocol which aims to prevent, reduce and control pollution by dumping of wastes and other matter in the South Pacific. Annexes associated with the protocol would permit the dumping of asbestos provided such dumping did not present a serious obstacle to fishing or navigation. A General Permit would be needed, however, that covers a number of matters including impacts on the marine environment and human health and whether sufficient

scientific knowledge exists to determine such impacts properly. Parties are required to designate an appropriate authority to issue permits.

Again the overall thrust of the Noumea Convention and its associated Dumping Protocol is to eliminate pollution of the sea caused by dumping and to protect and preserve the marine environment. Again it would be fair to say, therefore, that even if the dumping of asbestos met the requirements of the Convention and Dumping Protocol, it would probably be contrary to the overall thrust of the Convention and Dumping Protocol.

Given all the above, it may still possibly be the best option to dump the asbestos at sea. In order to successfully carry out such dumping several operating requirements would need to be met as follows:

1. The asbestos waste would need to be sealed completely and packed so that it could be loaded and unloaded satisfactorily. Probably it would best be wrapped in plastic and then placed in fabric bags fitted with loading strops. “Asbags” would meet these criteria and have a maximum 3 tonne capacity.
2. There must be a way of loading the asbestos waste satisfactorily. A shore-based crane could load asbestos in Asbags.
3. There must be a means of sea transport. A barge that towed a raft would be suitable, or a vessel with sufficient deck space.
4. There must be a safe way to unload the waste asbestos at sea. If a vessel was available with a crane with at least 3 tonne capacity at a reasonable reach then that would meet this requirement. Otherwise a shore-based crane or crane truck (Hiab) could be tied to a raft. The raft would need to have side protection around its perimeter and operating personnel would need life jackets.
5. A suitable dumping location would need to be found that a) was deep enough to ensure that no asbestos would ever return to shore; and b) had no environmental sensitivity. It is likely that such a location would be some distance from shore.

It is evident that an operation that was able to meet the permit requirements of Annex 2 of the London Protocol and the operating requirements listed above would be an expensive one. Dumping at sea would, aside from any other considerations, therefore only be considered if there was a large enough amount of asbestos waste to justify it.

9.4 Export to Another Country

The final disposal option that should be considered is export to another country. Asbestos waste is a hazardous waste in terms of both the Basel Convention and the Waigani Convention.

The *Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and their Disposal*, (the Basel Convention), is an international treaty that was designed to reduce the movements of hazardous waste between nations, and specifically to prevent transfer of hazardous wastes from developed to less developed countries. The Convention is also intended to minimise the amount and toxicity of wastes generated, to ensure their environmentally sound management as closely as possible to the source of generation. The Basel Convention states clearly that the trans-

boundary movement of hazardous wastes and other wastes should be permitted only when the transport and the ultimate disposal of such wastes is environmentally sound.

The *Convention to Ban the Importation into Forum Island Countries of Hazardous and Radioactive Wastes and to Control the Trans-boundary Movement of Hazardous wastes within the South Pacific Region*, known also as the Waigani Convention, entered into force on the 21st October 2001. It represents the regional implementation of the international regime for controlling the trans-boundary movement of hazardous wastes. The objective of the Convention is to reduce and eliminate trans-boundary movements of hazardous and radioactive waste, to minimise the production of hazardous and toxic wastes in the Pacific region and to ensure that disposal of wastes in the Convention area is completed in an environmentally sound manner.

The two countries that border the Pacific and are able to receive asbestos waste are Australia and New Zealand. Both countries are parties to both the Basel Convention and the Waigani Convention. All Pacific countries that are part of the asbestos project are party to either the Basel or the Waigani Conventions or both. In terms of trans-boundary movement, therefore, asbestos wastes could be moved from these Pacific countries to Australia or New Zealand.

Australia is not known to have ever received asbestos waste but discussions with the Hazardous Waste Section of the Australian Department of the Environment confirmed that, in terms of the Basel and Waigani Consent requirements, there would be no problem importing asbestos waste into Australia if it was done properly and safely and met other legislative requirements such as Customs and Biosecurity.

Permits are currently held to import asbestos waste into New Zealand from New Caledonia, French Polynesia and Niue. The New Zealand Government is currently funding a project to import a large amount of waste asbestos from Niue into New Zealand for disposal. This is being done under the Waigani Convention.

Potentially also, Fiji could accept waste asbestos from other Pacific countries as it has a well-run landfill at Naboro near Suva with all the controls necessary to receive asbestos. It does receive asbestos waste from within Fiji in a properly managed way. At present, however, Fiji is a party to the Waigani Convention but not the Basel Convention so it would only be able to receive asbestos waste from Waigani Convention parties.

A suitable landfill must be found in the importing country, a suitable ship and shipping route is needed, and biosecurity concerns need to be addressed. Asbestos is regarded as a Class 9 Dangerous Good for shipment purposes.

9.5 Disposal Options Suitable for FSM

The preferred option for disposal of asbestos materials throughout FSM is on-island burial. This disposal option is reliant on the relevant Government Departments securing and permitting a cheap and appropriate location on each island or one location for all island states to use based on a Federal mandate. If such a facility(s) cannot be established then the next preferred option is off-island disposal to a location such as Australia as discussed above.

10.0 Cost Considerations

A typical example of local Pacific costs has been obtained from Central Meridian Inc in Nauru, which is a contracting company that has worked for 14 years in Nauru and employs about 60 staff (see Appendix 5). Costs will likely vary according to local conditions but rates have been cross checked against established rates in New Zealand, and also informally with contractors in other Pacific countries, and it is believed that the figures put forward are reasonable for preliminary budgeting purposes.

One contractor provided day rates for labour as well as a truck and driver. The cost of materials was obtained by contacting the local hardware store.

The rates are provided as an indicative guide to potential costs and exclude personal protective equipment and other consumables required during asbestos removal/repair work. The rates are summarised in Table 12.

Table 12: Costs of Labour and Materials in FSM

Item	*Cost (US$)*
Rubberised acrylic primer	*$115 per 5 Gal*
Rubberised acrylic exterior finish	*$70 to $115 per 5 Gal*
Landfill Disposal	*No charge*
Labour	*$85 per day*
Truck with driver	*$150 per day*

10.1 Encapsulation

For the encapsulation option, cost build ups have been prepared for roofs and wall cladding based on the Central Meridian estimate. The Central Meridian costs have been changed from AUD to USD at an exchange rate of 0.8, and the figures have been reduced by 10% based on the assumption that cheaper prices could be obtained by competitive tendering, and also based on reconciliation with established rates in New Zealand.

The full cost build ups are presented in Appendix 5 and a summary is presented as follows:

<u>Roof Encapsulation</u>

Costs:

- Encapsulate roof where there is no ceiling present below the roof: USD49.64/m2 of roof (face area)
- Encapsulate roof where there is an existing ceiling below the roof that needs to be removed and replaced: USD90.79/m2 of roof (face area)

Assumptions:

- Rates have been built up based on a roof of a single storey building with a floor area of 14m x 12m with a roof pitch of 30 degrees. Extra will be required for scaffolding for buildings greater than 1 storey high.
- Rates assume that work is done in a tradesman like fashion to New Zealand or Australian standards, including compliance with applicable safety requirements relating to working at height and working with asbestos.
- Rates allow for an independent SPREP appointed representative to oversee works to ensure quality, safety and commercial requirements are complied with.
- Rates do not allow for any costs relating to disruption of the usual activities undertaken in the building being worked on – eg moving furniture in and out.
- Rates are approximate only and there will be country specific variances depending on the availability of resources and materials.

Cladding Encapsulation

Costs:

- Encapsulate wall cladding where there is no internal wall sheeting: USD25.92/m2 (face area)
- Encapsulate wall cladding where there is internal wall sheeting in good condition, which means only the exterior needs to be encapsulated: USD17.92/m2 (face area)
- Encapsulate wall cladding where there is internal wall sheeting in poor condition, which must be treated as asbestos contaminated and removed and replaced: USD65.92/m2 (face area)

Assumptions:

- Rates have been built up based on a single storey building with a floor area of 14m x 12m and walls 2.4m high. Extra will be required for scaffolding for buildings greater than 1 storey high.
- Rates assume that work is done in a tradesman like fashion to New Zealand or Australian standards, including compliance with applicable safety requirements relating to working at height and working with asbestos.
- Rates allow for an independent SPREP appointed representative to oversee works to ensure quality, safety and commercial requirements are complied with.
- Rates do not allow for any costs relating to disruption of the usual activities undertaken in the building being worked on – eg moving furniture in and out.
- Rates are approximate only and there will be country specific variances depending on the availability of resources and materials.

10.2 Removal and Replacement

For the removal and replacement option cost build ups have been prepared for roofs and wall cladding based on the Central Meridian estimate. As for the encasement option, the Central Meridian costs have been changed from AUD to USD at an exchange rate of 0.8, and the figures have been reduced by 10% based on the assumption that cheaper prices could be obtained by competitive tendering, and also based on reconciliation with established rates in New Zealand.

The full cost build ups are presented in Appendix 5 and a summary is presented as follows:

Roof Removal and Replacement

Cost:

- Remove and replace roof: USD96.31/m2 (face area)

Assumptions:

- Rates assume that the existing roofs are replaced with Colourbond Ultra grade roof sheeting (for sea spray environments) with 50mm of foil coated fibreglass insulation (to address heat issues).
- Rates have been built up based on a roof of a single storey building with a floor area of 14m x 12m with a roof pitch of 30 degrees. Extra will be required for scaffolding for buildings greater than 1 storey high.
- Rates assume that work is done in a tradesman like fashion to New Zealand or Australian standards, including compliance with applicable safety requirements relating to working at height and working with asbestos.
- Rates allow for an independent SPREP appointed representative to oversee works to ensure quality, safety and commercial requirements are complied with.
- Rates do not allow for any costs relating to disruption of the usual activities undertaken in the building being worked on – eg moving furniture in and out.
- A 10% contingency has been allowed for tidying up any damaged or inadequate rafters purlins and barge boards.
- Rates are approximate only and there will be country specific variances depending on the availability of resources and materials.
- Rates assume asbestos waste secure wrapping and disposal to a suitable nearby local landfill. If the waste needs to be exported or if sea disposal is being considered, then this will need to be costed as an extra.

Cladding Removal and Replacement

Costs:

- Remove and replace cladding: USD76.04/m2 (face area)

Assumptions:

- Rates assume that the existing cladding is replaced with a cement fibre board with treated timber battens to make water tight. An allowance has also been made to wrap the building in foil and to apply two coats of paint to complete the works.
- Rates have been built up based on a single storey building with a floor area of 14m x 12m and walls 2.4m high. Extra will be required for scaffolding for buildings greater than 1 storey high.
- Rates assume that work is done in a tradesman like fashion to New Zealand or Australian standards, including compliance with applicable safety requirements relating to working at height and working with asbestos.

- Rates allow for an independent SPREP appointed representative to oversee works to ensure quality, safety and commercial requirements are complied with.
- Rates do not allow for any costs relating to disruption of the usual activities undertaken in the building being worked on – eg moving furniture in and out.
- A 10% contingency has been allowed for tidying up any damaged or inadequate framing.
- Rates are approximate only and there will be country specific variances depending on the availability of resources and materials.
- Rates assume asbestos waste secure wrapping and disposal to a suitable nearby local landfill. If the waste needs to be exported or if sea disposal is being considered, then this will need to be costed as an extra.

Table 13: Summary of Costs for Various Remediation Options (Costs rounded to nearest $US)

Remediation Method	Cost per m² (face area) $US
Encapsulation	
Roofs:	
Encapsulate roof where there is no ceiling present below the roof	50.00
Encapsulate roof where there is an existing ceiling below the roof that needs to be removed and replaced	91.00
Cladding:	
Encapsulate wall cladding where there is no internal wall sheeting	26.00
Encapsulate wall cladding where there is internal wall sheeting in good condition, which means only the exterior needs to be encapsulated	18.00
Encapsulate wall cladding where there is internal wall sheeting in poor condition, which must be treated as asbestos contaminated and removed and replaced: USD65.92/m2 (face area)	66.00
Removal and Replacement	
Roofs:	
Remove and replace roof	96.00
Cladding:	
Remove and replace cladding	76.00
Miscellaneous	
Remove and replace floor tiles*	80.00
Pick up debris, pipes	40.00

**$US80 is the lower end of the cost spectrum for removing and replacing vinyl floor tiles and the cost could easily double (or more) for difficult removal projects. To balance this out, the vinyl tile matrix is stable and there is little risk of asbestos exposure unless they are badly deteriorating. Vinyl floor asbestos projects could therefore be lower down on the priority list.*

The above rates assume asbestos waste disposal to a suitable nearby local landfill. If the waste needs to be exported or if sea disposal is being considered, then this will need to be costed as an extra.

10.3 Local Contractors

An objective of the study was to identify any local contractors who may have the expertise and capacity to potentially partner with regional or international contractors with expertise in asbestos management, repair and removal.

During discussions with the Yap, Chuuk and Pohnpei EPAs as well as KIRMA in Kosrae, the topic of potential contractors considered suitable to remove asbestos was discussed. Potential contractors were visited, if possible, and asked whether they were interested in undertaking work such as pickup of asbestos-containing water pipes or painting asbestos-containing materials. The majority indicated that they were not comfortable working with asbestos without the supervision of an asbestos expert to ensure that their worker health and safety was protected. The following contractors were identified:

- Centrelane Construction Company (Yap ph: 350 7751 or 350 6650)
- GPPC Incorporated (Yap ph: 350 8893, 350 6152 or 952 2788; Chuuk ph: 330 7039 or 330 7040)
- VCS Construction Supplies (Pohnpei ph: 320 1455, 320 6333 or 320 7820)
- Ace Construction Company (Pohnpei ph: 320 5728)
- Building Solutions Corporation (Pohnpei ph: 320 4810)
- Kosrae Department of Transportation and Infrastructure (Kosrae ph: 370 3165 – Director Weston Luckymis)

It is recommended that the EPA / KIRMA are invited to assist with the collection and disposal of the materials as a capacity building initiative that will allow the departments to manage similar projects in the future (if required).

The Director of the Kosrae Department of Public Works expressed his willingness to assist and provided an indicative price for the pickup and removal of asbestos materials identified in Kosrae.

Day rates provided by a Pohnpei based company, for labour and a truck with a driver, have been used as indicative costs for other FSM states. The day rates were extrapolated to estimate the costs for the replacement of vinyl floors, painting asbestos materials as well as pickup and removal of materials to the government landfill.

11.0 Review of FSM Policies and Legal Instruments

11.1 National Laws and Regulations

No federal or state laws or regulations exist which are specific to asbestos. Regulations regarding the release of hazardous substances have been used in each state until now, but the relevant environmental enforcement authorities (EPA or KIRMA) have limited knowledge and experience with asbestos. Therefore, the existing regulations are likely to be inadequate to result in the protection of human health and the environment through the requirement of appropriate personal protection equipment or implementation of safe working procedures.

No national laws or regulations exist which are specific to asbestos in FSM.

The following reference refers to an article discussing the lack of information and understanding of asbestos related issues within the community (http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3846257/). The abstract to the article titled *A baseline profile of asbestos in the US-affiliated Pacific islands* states "*asbestos is a recognized occupational and environmental hazard in the Asia-Pacific region, yet information regarding asbestos consumption, exposure, and asbestos-related diseases in the US-affiliated Pacific Islands (USAPIs) is scarce, and the situation regarding asbestos in these islands, particularly with regard to disease burden, surveillance, and health care capacity, is not well understood. Searching through scientific and "gray" literature and interviews with local cancer registry personnel and health professionals yielded no published data, only sufficient, indirect evidence of past and ongoing asbestos exposure, documented cases of mesothelioma and asbestosis, and minimal capacity for preventing and recognizing asbestos-related illnesses. Capacity and resource limitations within the USAPIs can impede regional progress in asbestos prevention and highlight the need for an integrated regional approach to address these data and capacity gaps. A regional mechanism to share expertise and resources and facilitate technical assistance to the USAPIs is urgently needed."*

As already mentioned, FSM is a party to the Noumea Convention which will regulate any disposal of asbestos to sea.

FSM is also a party to the Basel and Waigani Conventions which will regulate any trans-boundary movement of asbestos waste to any other Basel and Waigani member countries.

11.2 National Strategies and Policies

Discussions with representatives from the FSM Government, the EPA in Yap, Chuuk and Pohnpei, as well as KIRMA in Kosrae, indicated that no regulations specific to asbestos have been developed. However, work is being undertaken by the Yap EPA to develop asbestos regulations. Once the regulations have been adopted, the Chuuk and Pohnpei EPA's and KIRMA aim to adopt the same regulations as Yap.

With the exception of the SPREP (2011) 'An Asbestos-Free Pacific: A Regional Strategy and Action Plan' there are currently no national strategies or policies related to asbestos exposure or asbestos removal and management implemented in FSM.

FSM has confirmed its support for the aims and objectives of the PacWaste Project.

12.0 Recommended Actions for Minimising Asbestos Exposures

12.1 Discussion

ACM has been identified by this study to be present at several locations in FSM. Based on an algorithm adopted as part of the risk assessment to prioritise asbestos management, this study has identified that there are only two sites in FSM that are considered moderate to high risk with regard to the occupants' and/or publics' potential exposure to asbestos. The remaining sites identified are considered to present a low to very low risk to human health.

A summary of the recommended actions and estimated costs are included in Table 15.

Table 15: Indicative Costs of Remediation at All ACM Sites

Site	ACM	Risk Score	Recommended Remedial Actions	ACM Area (m^2)	Estimated Cost (US$)
Pohnpei					
LP Gas Corporation, Pohnpei	Chrysotile 15% Amosite 2%	23	Remove the asbestos cement cladding and replace with an alternative product.	1,625	113,750 to 292,500
Kuniora Gallen's private Residence, Pohnpei	Chrysotile 15%	18	Paint asbestos cement columns.	75	1,665
	Chrysotile 15%	18	Pickup and disposal of asbestos cement pieces.	2	85
Johnny P. David's private residence, Pohnpei	Chrysotile 15% Amosite 2%	16	Pickup and disposal of a stockpile of asbestos cement boards.	1,000	250
Pohnpei Fishing Corporation generator shed, Pohnpei	Chrysotile 15% Amosite 2%	16	Remove the asbestos cement cladding and replace with an alternative product.	200	14,000 to 36,000
Kolonia Public market, Pohnpei	Chrysotile 15% Amosite 2%	15	Remove the asbestos cement fence and replace with an alternative product.	50	3,500 to 9,000
Public Reserve area, Pohnpei	Chrysotile 15% Amosite 2%	14	Pickup and disposal of asbestos cement pieces.	3	250
Kolonia Roadside, Pohnpei	Chrysotile 15%	13	Pickup and disposal of asbestos cement pipe.	2	118
Pohnpei Botanic Gardens	Chrysotile 12%	10	Remove the asbestos cement roof prior to demolition of the building	45	?

Site	ACM	Risk Score	Recommended Remedial Actions	ACM Area (m^2)	Estimated Cost (US$)
Antonia P. Dosolua's private residence, Pohnpei	Chrysotile 15%	17	Paint asbestos cement columns.	50	945
Yap					
Yap Department of Education Administration Buildings.	Chrysotile 3%	18	Remove existing floor tiles and replace with new.	700	4,850
College of Micronesia: FSM Fisheries and Maritime Institute, Yap Campus	Chrysotile 2%	18	Remove existing floor tiles and replace with new in the workshop.	70	650
Colonia Catholic Church, Yap	Chrysotile 10% Amosite 15%	17	Remove the asbestos cement roof and replace with an alternative roof.	300	21,000 to 54,000
Mr Atal's private residence, Yap	Chrysotile 15%	14	Pickup and disposal of asbestos cement pipes and surrounding soil.	3	$1,215
Yap Central Water Treatment Plant	Chrysotile 15%	16	Pickup and disposal of asbestos cement pipes.	3	$250
FSM Telecommunications Corporation, Yap Branch	Not tested	13	Remove the existing generator exhaust and replace with an alternative product.	2	?
Yap Department of Public Works and Transportation Depot	Vinyl floor tiles (buried)	4	Nothing. Asbestos is securely buried at the site.	30	0
Chuuk					
Mr Mori's private residence, Chuuk	Chrysotile 15%	19	Remove the asbestos cement roof and replace with an alternative roof.	150	10,500 to 27,000
	Chrysotile 15%	19	Pickup and disposal of a stockpile of asbestos cement boards.		$250
Immaculate Heart of Mary Church, Chuuk	Chrysotile 10% Amosite 15%	16	Remove the asbestos cement roof and replace with an alternative roof.	525	36,750 to 94,500
Chuuk State Court	Chrysotile 20%	13	Paint ceiling tiles	30	$630
Kosrae					

Site	ACM	Risk Score	Recommended Remedial Actions	ACM Area (m^2)	Estimated Cost (US$)
FSM Telecommunications Corporation, Kosrae Branch	Not tested	13	Remove the existing generator exhaust and replace with an alternative product.	2	?
Former Kosrae Hospital and Mrs Torenda Jona's Residence, Kosrae	Chrysotile 15%	10	Pickup and disposal of asbestos cement pipes.	9	$285

The following should be noted:

g. It would probably be best to remove and replace the asbestos cladding and roofing for small amounts as it provides a permanent solution.
h. Some residences were included in Table 15 above as high risk but the SPREP project does not cover residences.
i. There is some loose asbestos waste discovered around FSM. This has been assessed as low risk and could be picked up and disposed of cheaply. It is recommended that this be done as well.
j. All estimated costs exclude supervision by an asbestos expert as cost saving could be achieved by an expert supervising multiple sites concurrently therefore the cost cannot be accurately estimated on a project by project basis.
k. Remediation of sites has been prioritised based on the level of risk posed to the building occupants and public at each site according to the methodology described in Section 3.0.
l. The quantities of ACM observed at the sites were used to estimate costs for abatement. A summary of the recommended actions and estimated costs are included in Table 15 above.

The most appropriate disposal method for FSM's asbestos wastes also needs to be determined.

If no suitable disposal site can be found, then the other options are disposal at sea or export to another country as discussed in Sections 9.3 and 9.4 above. Both alternatives are permissible for FSM although they would be expensive options.

Disposal at sea would require permits under the Noumea Convention. A suitable barge would be required with a crane mounted on it. Another crane for loading the asbestos on the barge would be required and a suitable deep dumping location would be needed. This option is probably impractical for FSM and may be unacceptable to customary law that operates in FSM. The process of obtaining permits would also be expensive as there would be a need to carry out expensive and detailed investigations before permits could be obtained.

Export from FSM to another country would be viable and probably Brisbane in Australia would provide a suitable destination although shipping routes would need to be confirmed and obtaining Waigani consents for transit ports may be difficult and time-consuming. Perhaps sufficient waste could be generated to justify the shipment of at least one 20 ft container which can hold about 17 tonnes of asbestos waste, provided some residences were included as well.

Shipping costs for a container of asbestos from Nauru to Brisbane for disposal have been calculated at $US768/tonne including disposal to the Remondis Landfill in Brisbane. There is a direct route from

Nauru to Brisbane and a much higher shipping volume than from FSM to Brisbane, so a safe figure from FSM to Brisbane would be about 1.5 times that figure or $US1150/tonne, which would be $19,550 per container, plus the cost of the container. If a figure of $25,000 per container is chosen then this would be a reasonable estimate and would probably be cheaper than constructing a special lined cell and covering it with concrete. This would need to be done for each individual state of FSM as required.

12.2 Recommendations

The following recommendations are therefore made in relation to asbestos on FSM:

i. It is recommended that the above higher priority asbestos work is carried out in FSM as well as removal of all loose asbestos.
ii. Residential dwellings are identified in Table 15 above. It is recommended that all houses that have tested positive are notified and included in an awareness campaign. They should be remediated (i.e. the asbestos removed or encapsulated) where resources permit.
iii. If a large number of houses are found to contain asbestos cladding then encapsulation would probably be the most cost-effective option for remediation although ongoing management procedures then would be needed and re-encapsulation (i.e. re-painting) would probably be needed 10-15 years later. If a small number of houses are found to contain asbestos cladding then removal and replacement of the cladding should be considered.
iv. Any asbestos roofs found on houses in FSM should preferably be removed rather than encapsulated as encapsulation of roofs costs only a little less than removal and removal is a permanent solution.
v. If a suitable cheap on-island disposal location can be found that was locally acceptable then on-island disposal would be the preferred disposal option. Otherwise the next preferred option is placement in a 20 ft shipping container and export to Brisbane for disposal in the Remondis Landfill as another option
vi. Before asbestos remediation takes place (and after if all the asbestos is not removed) it would be appropriate to set in place suitable asbestos management practices and procedures to deal with the ongoing risk posed to human health by asbestos exposure. This should be accompanied by an appropriate education and training programme.
vii. Consideration should be given to FSM passing suitable regulations to enable the above asbestos work to be carried out.

Appendix 1: Edited Copy of the Terms of Reference

Background

Asbestos-containing materials were in wide use in the past in Pacific Island countries for housing and building construction. The region is subject to periodic catastrophic weather and geological events such as tsunamis and cyclones which are highly destructive to built infrastructure, and as a consequence, asbestos has become a significant waste and human health issue in many Pacific countries. However, quantitative data on the location, quantity and condition of asbestos is not available for the region. This data is needed to define the problem and plan for future actions. This project will contribute to improved management of regional asbestos waste through collection, collation and review of such data on the location, quantity and status of asbestos-containing building materials in priority Pacific Island countries.

SPREP has received funding from the European Union under the EDF10 programme to improve the management of asbestos waste in priority Pacific Island countries.

The work for this consultancy is located in the following Sub-regions and countries;

- Sub-region A, (Nauru):
  Nauru
- Sub-region B, (Micronesia):
  FSM, Kiribati, Marshall Islands, FSM
- Sub-region C, (Melanesia):
  Fiji, Solomon Islands, Vanuatu
- Sub-region D, (Polynesia):
  Cook Islands, Niue, Samoa, Tonga, Tuvalu

Objective

Pacific asbestos status and management options are assessed and future intervention recommendations presented on a regional basis to identify prioritised areas for future intervention.

Scope of Work

The scope of work for this consultancy covers the following tasks:

Tasks
For each of the sub-regions and countries above, the Consultant will:

1. Collect and collate data on the location (geographic coordinates), quantity and condition of asbestos-containing building materials (including asbestos-containing waste stockpiles) in each nominated Pacific Island country.

2. Review, and recommend a prioritised list of local best-practice options for stabilisation, handling and final disposal of asbestos contaminated materials in each nominated Pacific Island country (including review of existing local institutional, policy and regulatory arrangements).

3. Recommend and prioritise actions necessary to minimise exposure (potential and actual) of the local population to asbestos fibres for each nominated Pacific Island country. An approximate itemised national cost should be presented for each option identified.

4. Identify any local contractors who have the expertise and capacity to potentially partner with regional or international experts in future asbestos management work.

5. Develop a schedule of rates for local equipment hire, mobilization, labour, etc., to guide the development of detailed cost estimates for future in-country asbestos remediation work.

Project Deliverables

1. Final report detailing the location, quantity and status of asbestos-containing building materials (including asbestos-contaminated waste stockpiles) for each Pacific Island country identified in the work region(s).

2. Final report providing recommendations for local best-practice options including local institutional and policy arrangements for national asbestos management for each Pacific Island country identified in the work region(s).

3. Final report identifying local labor and equipment hire rates and availability of in-country asbestos management expertise for each Pacific Island country identified in the work region(s).

4. Final report presenting costed priority actions necessary to minimise the exposure of the local population to asbestos fibres for each Pacific Island country identified in the work region(s).

Project Timeframe

All final reports completed and submitted to SPREP within twenty (20) weeks from signature of the contract.

Appendix 2: Organisational Details and List of Contacts

A2.1 Organisational Details

The visit to FSM took place between the 15th of June and 14th of July 2014. The consultant was Claude Midgley who was based in Colonia (Yap), Nepukos (Chuuk), Kolonia (Pohnpei) and Putukte (Kosrae).

The primary agency for liaison was the FSM OEEM where Patricia Pedrus provided local contacts at each state EPA office as follows:

Mr Jeremy Wayaan, Yap EPA

Mr Jack Sham, Chuuk EPA

Mr Charles Lohn, Pohnpei EPA

Mr Presley Abraham, Kosrae EPA

The EPA officers were very helpful and provided considerable support during the visits.

Numerous other people were visited and considerable assistance was willingly provided. Full contact details are given below.

A2.2. List of Contacts

Christina Fillmed, Director
Yap Environmental Protection Agency
Phone: (+691) 350 2113 / 2317 Email: cfillmed@gmail.com

Charles Falmeyog, Water Treatment Manager and Board Member of the Yap EPA
Yap State Public Service Corporation
Phone: (+691) 350 2113 / 2317 Email: charlesfalmeyog@gmail.com

Paul Howell, Water and Wastewater Operations Manager
Chuuk Public Utilities Corporation
Phone: (+691) 330 2400 Email: howell921678@gmail.com

Charles Lohn, Officer
Pohnpei Environmental Protection Agency
Phone: (+691) 925 5847 Email: lempweienepa@yahoo.com

Brad Henry, Manager
Pohnpei Wastewater Treatment Plant, Pohnpei Utilities Corporation
Phone: (+691) 320 2800 / 924 7262 Email: pucsewer@mail.fm

Abraham Bahillo, Chief Engineer

Kosrae Transport and Infrastructure Department
Phone: (+691) 370 3011 Email: abem.bahillo@hotmail.com

Kiobu Luey, Development Project Inspector
Kosrae Island Resource Management Authority
Phone: (+691) 370 2076 Email: lkiobu@hotmail.com

Appendix 3: Summaries of in-Country Discussions

Christina Fillmed, Director of the Yap EPA

The Yap EPA is responsible for administering the earthmoving regulations of the Yap State government. Asbestos is managed under the regulations that prohibit the discharge of hazardous substances. However, specific regulations regarding asbestos are proposed and are in the process of being drafted.

Charles Falmeyog, Yap Water Treatment Manager

The Yap State Public Services Corporation owns the majority of asbestos-containing material in Yap. The original infrastructure from the central treatment facility reaches some parts of Colonia and was constructed using AC pipes. As more areas became connected to the water reticulation network, a switch from AC pipes to PVC / HDPE pipes occurred. Therefore, not all parts of Colonia have AC pipe infrastructure in the ground. The northern and southern water treatment facilities were constructed more recently and no AC pipes were used in those areas.

Mr Falmeyog indicated that water supply through existing AC infrastructure would be diverted to new PVC / HDPE pipes in the future. The old AC pipes would be left *in-situ* to minimise the risk of worker and public exposure during the unnecessary excavation and disposal of the old pipes.

Sebastian Mangarfir, Manager of Waab Hardware, Colonia

Mr Mangarfir stated that the majority of their building products were imported from the USA. The only products he was aware of that weren't sourced from the USA were cement and reinforcing steel imported from Korea.

Paul Howell, Chuuk Water and Wastewater Operations Manager

The Chuuk Public Utilities Corporation owns the majority of asbestos-containing material in Chuuk. The underground water and sewerage infrastructure was constructed using AC pipes. Recent road works in Weno resulted in the excavation of some AC pipes. These were disposed of underwater in the Weno Harbour.

Mr Howell indicated that water supply through existing AC infrastructure would be diverted to new PVC / HDPE pipes in the future. The old AC pipes would be left *in-situ* to minimise the risk of worker and public exposure during the unnecessary excavation and disposal of the old pipes.

Brad Henry, Manager of the Pohnpei Wastewater Treatment Plant

Mr Henry indicated that the Pohnpei Public Utilities Corporation has some basic health protection measures when working on AC pipes. The most effective protection measure which can be practically implemented is to coordinate the cutting of AC pipes with the fire service. The fire service provides a fire engine to apply an appropriate amount of water while pipes are being cut. This reduces the amount of dust generated to negligible levels.

Under the circumstances where an old AC pipe would be upgraded with new materials (HDPE or PVC), Mr Henry agreed that old AC pipes would be left *in-situ* to minimise the risk of worker and public exposure during the unnecessary excavation and disposal of the old pipes.

Mr Henry indicated that additional information and safety procedures would be appreciated and incorporated if practicable.

Charles Lohn, Pohnpei EPA Officer

Mr Lohn indicated that the Pohnpei EPA does not currently have specific regulations relating to asbestos. However, a recently written solid waste management document could be updated to include a subsection specific to asbestos.

Bill Pendergraft, Manager of Pohnpei Ace Hardware

Mr Pendergraft indicated that Ace Hardware is the largest importer of hardware and building products in Pohnpei, Chuuk, Kosrae and the Marshall Islands (Majuro). The materials are all sourced from the Ace Hardware distribution centre in the USA where asbestos-containing materials are banned. Therefore, Mr Pendergraft suggested that no new building materials available from Ace Hardware should contain asbestos.

Weston Luckymis, Director of Kosrae Department of Transport and Infrastructure

As the Kosrae Department of Transport and Infrastructure owns the majority of existing asbestos materials, predominantly in the form of buried asbestos cement water pipes, Director Luckymis was enthusiastic about the prospect of leaving the asbestos pipes *in-situ* when the infrastructure is upgraded to HDPE / PVC alternatives. This option will minimise the risk of worker and public exposure during the unnecessary excavation and disposal of the old pipes. Director Luckymis stated that a quote for the replacement of the existing asbestos pipes with HDPE / PVC alternatives had been received within the past year and that the cost was unaffordable. It was concluded that the cost of replacement is likely to decrease significantly if the existing infrastructure can be decommissioned *in-situ*.

Robert Jackson, Director of KIRMA

Director Jackson is eager to be provided with asbestos regulations and safe working procedures so that KIRMA can monitor work sites and provide advice to minimise the risks to worker and public health.

Appendix 4: Copies of Laboratory Reports

Yap Bulk Sample Reports

EMS LABORATORIES INC.
117 W. Bellevue Drive, Pasadena, CA 91105-2548 626-568-4065

National Institute of Standards and Technology (NIST) NVLAP Lab Code 101218-0
California Department of Health Services Environmental Testing Laboratory ELAP 1119
County Sanitation Districts of Los Angeles County ID No. 10120
AIHA Laboratory Accreditation Programs, LLC 101634

CUSTOMER:	Contract Environmental	PAGE #:	1 of 3
	119 Johnson Rd. West Melton	REPORT #:	0161688
	Christchurch NZ	PROJECT:	PLM ANALYSIS
CONTACT:	John O'Grady	DATE COLLECTED:	06/15/2014
REFERENCE:	SPREP YAP	COLLECTED BY:	
METHOD:	EPA 600/R-93/116	DATE RECEIVED:	06/24/2014
		ANALYSIS DATE:	06/27/2014

BULK SAMPLE ANALYSIS FOR ASBESTOS CONTENT BY POLARIZED LIGHT MICROSCOPY

Laboratory ID - Sample No.	Sample Location Description	Layer No. Layer %	Asbestos Type	(%)	Non-Asbestos Components	(%)
0161688-001						
1	LAYER 1 Floor Tile, Blue, Homogeneous, Hard, melt, non-friable Note: 26°C, 1.550	LAYER 1 90%	None Detected		Non-Fibrous Material	100%
	LAYER 2 Mastic, Yellow, Homogeneous, Sticky, melt, non-friable Note: 26°C, 1.550	LAYER 2 10%	None Detected		Cellulose Fiber Synthetic Fiber Non-Fibrous Material	5% 2% 93%
	LAYER 3 Cream, Homogeneous, Chalky, melt, friable Note: 26°C, 1.550	LAYER 3 100%	None Detected		Fibrous Glass Cellulose Fiber Mica Non-Fibrous Material	5% 2% 3% 90%
	LAYER 4 Drywall, Pink, Homogeneous, Granular, acid, non-friable Note: 24°C, Acid	LAYER 4 100%	None Detected		Non-Fibrous Material	100%
0161688-002						
2	Gray, Non-homogeneous, Solid/Fibrous, crush/tease, non-friable Note: 23°C, 1.55	LAYER 1 100%	None Detected		Cellulose Fiber Non-Fibrous Material	30% 70%
0161688-003						
3	Vinyl, Tan, Non-homogeneous, Rubbery, ash, non-friable Note: 23°C, 1.55	LAYER 1 100%	None Detected		Non-Fibrous Material	100%

CUSTOMER:	Contract Environmental	PAGE #:	2 of 3
	119 Johnson Rd. West Melton	REPORT #:	0161688
	Christchurch NZ	PROJECT:	PLM ANALYSIS

BULK SAMPLE ANALYSIS FOR ASBESTOS CONTENT BY POLARIZED LIGHT MICROSCOPY

Laboratory ID - Sample No.	Sample Location Description	Layer No. Layer %	Asbestos Type	(%)	Non-Asbestos Components	(%)
0161688-004						
4	LAYER 1 Floor Tile, White, Homogeneous, Solid, melt, non-friable Note: 23°C, 1.55	LAYER 1 20%	None Detected		Non-Fibrous Material	100%
	LAYER 2 Floor Tile, Gray, Homogeneous, Solid, melt, non-friable Note: 24°C, 1.55	LAYER 2 55%	Chrysotile	3%	Non-Fibrous Material	97%
	LAYER 3 Mastic, Yellow, Homogeneous, Solid, melt, non-friable Note: 24°C, 1.55	LAYER 3 5%	None Detected		Non-Fibrous Material	100%
	LAYER 4 Floor Tile, Red, Homogeneous, Solid, melt, non-friable	LAYER 4 20%	None Detected		Non-Fibrous Material	100%
0161688-005						
5	Transite, Gray, Non-homogeneous, Solid/Fibrous, tease, non-friable Note: 24°C, 1.55	LAYER 1 100%	Chrysotile Amosite	10% 15%	Non-Fibrous Material	75%
0161688-006						
6	Ceiling Tile, Gray/White, Non-homogeneous, Fibrous, tease, non-friable Note: 24°C, 1.55	LAYER 1 100%	None Detected		Cellulose Fiber Non-Fibrous Material	80% 20%
0161688-007						
7	LAYER 1 Floor Tile, Gray, Homogeneous, Solid, melt, non-friable Note: 24°C, 1.55	LAYER 1 98%	None Detected		Non-Fibrous Material	100%
	LAYER 2 Mastic, Yellow, Homogeneous, Solid, melt, non-friable Note: 24°C, 1.55	LAYER 2 2%	None Detected		Non-Fibrous Material	100%

CUSTOMER: Contract Environmental
119 Johnson Rd. West Melton
Christchurch NZ

PAGE #: 3 of 3
REPORT #: 0161688
PROJECT: PLM ANALYSIS

BULK SAMPLE ANALYSIS FOR ASBESTOS CONTENT BY POLARIZED LIGHT MICROSCOPY

Laboratory ID - Sample No.	Sample Location Description	Layer No. Layer %	Asbestos Type	(%)	Non-Asbestos Components	(%)
0161688-008 8	LAYER 1 Floor Tile, Red, Homogeneous, Solid, melt, non-friable Note: 24°C, 1.55	LAYER 1 40%	None Detected		Non-Fibrous Material	100%
	LAYER 2 Floor Tile, Gray, Homogeneous, Solid, melt, non-friable Note: 24°C, 1.55	LAYER 2 58%	None Detected		Non-Fibrous Material	100%
	LAYER 3 Mastic, Black/brown, Non-homogeneous, Sticky, melt, non-friable Note: 24°C, 1.55	LAYER 3 2%	Chrysotile	2%	Non-Fibrous Material	98%

Analyst - Weslene Sabhat **Approved Signatory** Laboratory Director

The EPA method is a semi-quantitative procedure. The detection limit is between 0.1-1% by area and dependent upon the size of the asbestos fibers, the means of sampling and the matrix of the sampled material. The test results reported are for the sample(s) delivered to us and may not represent the entire material from which the sample was taken. The EPA recommends three samples or more be taken from a "homogeneous sampling area" before friable material is considered non-asbestos-containing. Negative floor tile samples may contain significant amounts (>1%) of very thin fibers which cannot be detected by PLM. Confirmation by TEM is recommended by the EPA (Federal Register Vol.59, No.146). Asbestos fibers bound in a non-friable organic matrix may not be detected by PLM. Alternative preparation methods are recommended. This report, from a NIST-accredited laboratory through NVLAP, must not be used by the client to claim product endorsement by NVLAP or any agencyof the U.S. government. This report shall not be reproduced, except in full, without the written approval of EMS Laboratories, Inc. Samples were received in good condition unless otherwise noted.

NVLAP Lab Code 101278-0

EMS LABORATORIES INC 117 W Bellevue Drive / Pasadena CA 91105-2548 / 626-568-4065

Chuuk Bulk Sample Results

EMS LABORATORIES INC.
117 W. Bellevue Drive, Pasadena, CA 91105-2548 626-568-4065

National Institute of Standards and Technology (NIST) NVLAP Lab Code 101218-0
California Department of Health Services Environmental Testing Laboratory ELAP 1119
County Sanitation Districts of Los Angeles County ID No. 10120
AIHA Laboratory Accreditation Programs, LLC 101634

CUSTOMER:	Contract Environmental 119 Johnson Rd. West Melton Christchurch NZ	PAGE #:	1 of 3
		REPORT #:	0161806
		PROJECT:	PLM ANALYSIS
CONTACT:	John O'Grady	DATE COLLECTED:	06/25/2014
REFERENCE:	SPREP CHUUK	COLLECTED BY:	
METHOD:	EPA 600/R-93/116	DATE RECEIVED:	07/02/2014
		ANALYSIS DATE:	07/08/2014

BULK SAMPLE ANALYSIS FOR ASBESTOS CONTENT BY POLARIZED LIGHT MICROSCOPY

Laboratory ID - Sample No.	Sample Location Description	Layer No. Layer %	Asbestos Type	(%)	Non-Asbestos Components	(%)
0161806-001						
1	1 Transite, Gray, Homogeneous, Granular, crush, non-friable Note: 27°C, 1.55 Oil		Chrysotile	20%	Non-Fibrous Material	80%
	2 Ceiling Tile, Gray, Homogeneous, Fibrous, dry, tease, non-friable Note: 27°C, 1.55 Oil		None Detected		Fibrous Glass Cellulose Fiber Non-Fibrous Material	50% 30% 20%
	3 Ceiling Tile, Gray, Homogeneous, Fibrous, dry, tease, non-friable Note: 27°C, 1.55 Oil		None Detected		Cellulose Fiber Fibrous Glass Non-Fibrous Material	70% 5% 25%
0161806-002						
2	LAYER 1 Floor Tile, Gray, Homogeneous, Granular, melt, non-friable Note: 27°C, 1.55 Oil	LAYER 1 95%	None Detected		Non-Fibrous Material	100%
	LAYER 2 Mastic, Yellow, Homogeneous, solid, crush, non-friable Note: 27°C, 1.55 Oil	LAYER 2 10%	None Detected		Cellulose Fiber Non-Fibrous Material	<1% 100%
0161806-003						
3	Ceiling Tile, White/gray, Non-homogeneous, paint/fibrous, ash, tease, non-friable Note: 27°C, 1.55 Oil	LAYER 1 100%	None Detected		Cellulose Fiber Fibrous Glass Non-Fibrous Material	50% 30% 20%
0161806-004						
4	Gray, Homogeneous, Granular, crush, non-friable Note: 27°C, 1.55 Oil	LAYER 1 100%	None Detected		Non-Fibrous Material	100%

CUSTOMER:	Contract Environmental	PAGE #:	2 of 3
	119 Johnson Rd. West Melton	REPORT #:	0161806
	Christchurch NZ	PROJECT:	PLM ANALYSIS

BULK SAMPLE ANALYSIS FOR ASBESTOS CONTENT BY POLARIZED LIGHT MICROSCOPY

Laboratory ID - Sample No.	Sample Location Description	Layer No. Layer %	Asbestos Type	(%)	Non-Asbestos Components	(%)
0161806-005						
5	fiberglass insulation, White/black, Non-homogeneous, fibrous/tar like, crush, tease, non-friable Note: 27°C, 1.55 Oil	LAYER 1 100%	None Detected		Fibrous Glass Cellulose Fiber Non-Fibrous Material	80% 5% 15%
0161806-006						
6	Siding, Gray, Homogeneous, Granular, crush, non-friable Note: 27°C, 1.55 Oil	LAYER 1 100%	None Detected		Cellulose Fiber Non-Fibrous Material	20% 80%
0161806-007						
7	Transite, Gray/white, Homogeneous, granular/fibrous, crush, non-friable Note: 27°C, 1.55 Oil	LAYER 1 100%	Chrysotile	15%	Non-Fibrous Material	85%
0161806-008						
8	Wall, Gray, Homogeneous, Granular, crush, non-friable Note: 27°C, 1.55 Oil	LAYER 1 100%	None Detected		Non-Fibrous Material	100%
0161806-009						
9	1 Transite, Gray, Homogeneous, Granular, crush, non-friable Note: 27°C, 1.55 Oil		Chrysotile	20%	Non-Fibrous Material	80%
	2 Ceiling Tile, Gray, Homogeneous, Fibrous, dry, teasen, non-friable Note: 27°C, 1.55 Oil		None Detected		Cellulose Fiber Non-Fibrous Material	75% 25%
	3 Floor Tile, Black, Homogeneous, Fibrous, melt, non-friable Note: 27°C, 1.55 Oil		None Detected		Synthetic Fiber Non-Fibrous Material	<1% 100%
0161806-010						
10	Pink, Homogeneous, Powdery, crush, friable Note: 27°C, 1.55 Oil	LAYER 1 100%	None Detected		Cellulose Fiber Non-Fibrous Material	<1% 100%

CUSTOMER:	Contract Environmental	PAGE #:	3 of 3
	119 Johnson Rd. West Melton	REPORT #:	0161806
	Christchurch NZ	PROJECT:	PLM ANALYSIS

Analyst - JEFF WAN

Approved Signatory Laboratory Director

The EPA method is a semi-quantitative procedure. The detection limit is between 0.1-1% by area and dependent upon the size of the asbestos fibers, the means of sampling and the matrix of the sampled material. The test results reported are for the sample(s) delivered to us and may not represent the entire material from which the sample was taken. The EPA recommends three samples or more be taken from a "homogeneous sampling area" before friable material is considered non-asbestos-containing. Negative floor tile samples may contain significant amounts (>1%) of very thin fibers which cannot be detected by PLM. Confirmation by TEM is recommended by the EPA (Federal Register Vol.59, No.146). Asbestos fibers bound in a non-friable organic matrix may not be detected by PLM. Alternative preparation methods are recommended. This report, from a NIST-accredited laboratory through NVLAP, must not be used by the client to claim product endorsement by NVLAP or any agencyof the U.S. government. This report shall not be reproduced, except in full, without the written approval of EMS Laboratories, Inc. Samples were received in good condition unless otherwise noted.

NVLAP

NVLAP Lab Code: 100236-0

Pohnpei Bulk Sample Results

EMS LABORATORIES INC.
117 W. Bellevue Drive, Pasadena, CA 91105-2548 626-568-4065

National Institute of Standards and Technology (NIST) NVLAP Lab Code 101218-0
California Department of Health Services Environmental Testing Laboratory ELAP 1119
County Sanitation Districts of Los Angeles County ID No. 10120
AIHA Laboratory Accreditation Programs, LLC 101634

CUSTOMER:	Contract Environmental	PAGE #:	1 of 4
	119 Johnson Rd. West Melton	REPORT #:	0161871
	Christchurch NZ	PROJECT:	PLM ANALYSIS
CONTACT:	John O'Grady	DATE COLLECTED:	07/01/2014
REFERENCE:	SPREP Pohnpei	COLLECTED BY:	
METHOD:	EPA 600/R-93/116	DATE RECEIVED:	07/08/2014
		ANALYSIS DATE:	07/15/2014

BULK SAMPLE ANALYSIS FOR ASBESTOS CONTENT BY POLARIZED LIGHT MICROSCOPY

Laboratory ID - Sample No.	Sample Location Description	Layer No. Layer %	Asbestos Type	(%)	Non-Asbestos Components	(%)
0161871-001						
1	Transite, Gray, Homogeneous, Granular, crush, non-friable Note: 27°C, 1.55 Oil	LAYER 1 100%	Chrysotile	12%	Non-Fibrous Material	88%
0161871-002						
2	Transite, Gray, Homogeneous, Granular, crush, non-friable Note: 27°C, 1.55 Oil	LAYER 1 100%	Chrysotile	10%	Non-Fibrous Material	90%
0161871-003						
3	Transite, Gray, Homogeneous, Granular, crush, non-friable Note: 27°C, 1.55, 1.68 Oil	LAYER 1 100%	Chrysotile Amosite	15% 2%	Non-Fibrous Material	83%
0161871-004						
4	Plaster, Green/white, Non-homogeneous, paint/granular, ash, crush, acid, non-friable Note: 27°C, 1.55 Oil	LAYER 1 100%	None Detected		Cellulose Fiber Non-Fibrous Material	<1% 100%
0161871-005						
5	Ceiling Tile, White/gray, Non-homogeneous, paint/fibrous, ash, tease, non-friable Note: 27°C, 1.55 Oil	LAYER 1 100%	None Detected		Cellulose Fiber Fibrous Glass Non-Fibrous Material	50% 30% 20%
0161871-006						
6	Ceiling Tile, White/gray, Non-homogeneous, paint/fibrous, ash, tease, non-friable Note: 27°C, 1.55 Oil	LAYER 1 100%	None Detected		Cellulose Fiber Fibrous Glass Non-Fibrous Material	45% 35% 20%

CUSTOMER: Contract Environmental
119 Johnson Rd. West Melton
Christchurch NZ

PAGE #: 2 of 4
REPORT #: 0161871
PROJECT: PLM ANALYSIS

BULK SAMPLE ANALYSIS FOR ASBESTOS CONTENT BY POLARIZED LIGHT MICROSCOPY

Laboratory ID - Sample No.	Sample Location Description	Layer No. Layer %	Asbestos Type	(%)	Non-Asbestos Components	(%)
0161871-007 7	Ceiling Tile, gray, Homogeneous, fibrous, ash, tease, non-friable Note: 27°C, 1.55 Oil	LAYER 1 100%	None Detected		Cellulose Fiber Non-Fibrous Material	60% 40%
0161871-008 8	White/gray, Non-homogeneous, paint/fibrous, ash, tease, non-friable Note: 27°C, 1.55 Oil	LAYER 1 100%	None Detected		Cellulose Fiber Non-Fibrous Material	50% 50%
0161871-009 9	LAYER 1 Floor Tile, Pink, Homogeneous, Granular, melt, non-friable Note: 27°C, 1`.55 Oil	LAYER 1 90%	None Detected		Non-Fibrous Material	100%
	LAYER 2 Mastic, Gray, Homogeneous, Granular, melt, non-friable Note: 27°C, 1.55 Oil	LAYER 2 10%	None Detected		Non-Fibrous Material	100%
0161871-010 10	Floor Tile, Gray, Homogeneous, Granular, melt, non-friable Note: 27°C, 1`.55 Oil	LAYER 1 100%	None Detected		Non-Fibrous Material	100%
0161871-011 12	Floor Tile, Tan, Homogeneous, Granular, melt, non-friable Note: 27°C, 1.55 Oil	LAYER 1 100%	None Detected		Non-Fibrous Material	100%
0161871-012 13	LAYER 1 Floor Tile, Gray, Homogeneous, Granular, melt, non-friable Note: 27°C, 1.55 Oil	LAYER 1 80%	None Detected		Non-Fibrous Material	100%
	LAYER 2 Mastic, Black, Homogeneous, tar like, melt, non-friable Note: 27°C, 1.55 Oil	LAYER 2 20%	None Detected		Non-Fibrous Material	100%

CUSTOMER:	Contract Environmental	PAGE #:	3 of 4
	119 Johnson Rd. West Melton	REPORT #:	0161871
	Christchurch NZ	PROJECT:	PLM ANALYSIS

BULK SAMPLE ANALYSIS FOR ASBESTOS CONTENT BY POLARIZED LIGHT MICROSCOPY

Laboratory ID - Sample No.	Sample Location Description	Layer No. Layer %	Asbestos Type	(%)	Non-Asbestos Components	(%)
0161871-013						
14	LAYER 1 Floor Tile, Gray, Homogeneous, Granular, melt, non-friable Note: 27°C, 1.55 Oil	LAYER 1 85%	None Detected		Non-Fibrous Material	100%
	LAYER 2 Mastic, Gray, Homogeneous, solid, crush, non-friable Note: 27°C, 1.55 Oil	LAYER 2 15%	None Detected		Non-Fibrous Material	100%
0161871-014						
15	Floor Tile, Red, Homogeneous, Granular, melt, non-friable Note: 27°C, 1.55 Oil	LAYER 1 100%	None Detected		Non-Fibrous Material	100%
0161871-015						
11A	Floor Tile, Tan, Homogeneous, Granular, melt, non-friable Note: 27°C, 1.55 Oil	LAYER 1 100%	None Detected		Non-Fibrous Material	100%
0161871-016						
11B	LAYER 1 Floor Tile, Blue, Homogeneous, Granular, melt, non-friable Note: 27°C, 1.55 Oil	LAYER 1 80%	None Detected		Cellulose Fiber Non-Fibrous Material	1% 99%
	LAYER 2 Mastic, Beige, Homogeneous, solid, melt, non-friable Note: 27°C, 1.55 Oil	LAYER 2 20%	None Detected		Non-Fibrous Material	100%
0161871-017						
11C	LAYER 1 Floor Tile, Black, Homogeneous, Granular, melt, non-friable Note: 27°C, 1.55 Oil	LAYER 1 90%	None Detected		Non-Fibrous Material	100%
	LAYER 2 Mastic, Black, Homogeneous, solid, crush, non-friable Note: 27°C, 1.55 Oil	LAYER 2 10%	None Detected		Non-Fibrous Material	100%

CUSTOMER:	Contract Environmental	PAGE #:	4 of 4
	119 Johnson Rd. West Melton	REPORT #:	0161871
	Christchurch NZ	PROJECT:	PLM ANALYSIS

Analyst - JEFF WAN

Approved Signatory Laboratory Director

The EPA method is a semi-quantitative procedure. The detection limit is between 0.1-1% by area and dependent upon the size of the asbestos fibers, the means of sampling and the matrix of the sampled material. The test results reported are for the sample(s) delivered to us and may not represent the entire material from which the sample was taken. The EPA recommends three samples or more be taken from a "homogeneous sampling area" before friable material is considered non-asbestos-containing. Negative floor tile samples may contain significant amounts (>1%) of very thin fibers which cannot be detected by PLM. Confirmation by TEM is recommended by the EPA (Federal Register Vol.59, No.146). Asbestos fibers bound in a non-friable organic matrix may not be detected by PLM. Alternative preparation methods are recommended. This report, from a NIST-accredited laboratory through NVLAP, must not be used by the client to claim product endorsement by NVLAP or any agencyof the U.S. government. This report shall not be reproduced, except in full, without the written approval of EMS Laboratories, Inc. Samples were received in good condition unless otherwise noted.

NVLAP

NVLAP Lab Code: 101298-0

EMS LABORATORIES INC 117 W Bellevue Drive / Pasadena CA 91105-2548 / 626-568-4065

Kosrae Bulk Sample Results

EMS LABORATORIES INC.
117 W. Bellevue Drive, Pasadena, CA 91105-2548 626-568-4065

National Institute of Standards and Technology (NIST) NVLAP Lab Code 101218-0
California Department of Health Services Environmental Testing Laboratory ELAP 1119
County Sanitation Districts of Los Angeles County ID No. 10120
AIHA Laboratory Accreditation Programs, LLC 101634

CUSTOMER:	Contract Environmental	PAGE #:	1 of 2
	119 Johnson Rd. West Melton	REPORT #:	0162178
	Christchurch NZ	PROJECT:	PLM ANALYSIS
CONTACT:	John O'Grady	DATE COLLECTED:	07/21/2014
REFERENCE:	SPREP KOSRAE & SPREP RMI	COLLECTED BY:	
METHOD:	EPA 600/R-93/116	DATE RECEIVED:	07/30/2014
		ANALYSIS DATE:	08/05/2014

BULK SAMPLE ANALYSIS FOR ASBESTOS CONTENT BY POLARIZED LIGHT MICROSCOPY

Laboratory ID - Sample No.	Sample Location Description	Layer No. Layer %	Asbestos Type	(%)	Non-Asbestos Components	(%)
0162178-001						
1	Black/White, Non-homogeneous, Rubbery, ash, non-friable Note: 27°C, 1.550	LAYER 1 100%	None Detected		Non-Fibrous Material	100%
0162178-002						
2	LAYER 1 Blue, Homogeneous, Hard, melt, non-friable Note: 27°C, 1.550	LAYER 1 90%	None Detected		Non-Fibrous Material	100%
	LAYER 2 Cream, Homogeneous, Chalky, melt, non-friable Note: 27°C, 1.550	LAYER 2 10%	None Detected		Cellulose Fiber Non-Fibrous Material	5% 95%
0162178-003						
3	LAYER 1 Gray, Homogeneous, Rubbery, ash, non-friable Note: 27°C, 1.550	LAYER 1 90%	None Detected		Non-Fibrous Material	100%
	LAYER 2 Beige, Homogeneous, Resinous, melt, non-friable Note: 27°C, 1.550	LAYER 2 10%	None Detected		Non-Fibrous Material	100%
0162178-004						
4	LAYER 1 Beige, Homogeneous, Hard, melt, non-friable Note: 27°C, 1.550	LAYER 1 95%	None Detected		Non-Fibrous Material	100%
	LAYER 2 Yellow, Homogeneous, Resinous, melt, non-friable Note: 27°C, 1.550	LAYER 2 5%	None Detected		Cellulose Fiber Non-Fibrous Material	8% 92%

CUSTOMER:	Contract Environmental	PAGE #:	2 of 2
	119 Johnson Rd. West Melton	REPORT #:	0162178
	Christchurch NZ	PROJECT:	PLM ANALYSIS

BULK SAMPLE ANALYSIS FOR ASBESTOS CONTENT BY POLARIZED LIGHT MICROSCOPY

Laboratory ID - Sample No.	Sample Location Description	Layer No. Layer %	Asbestos Type	(%)	Non-Asbestos Components	(%)
0162178-005						
5	White/Gray, Non-homogeneous, Paint/Fibrous, ash/tease, friable Note: 26°C, 1.550	LAYER 1 100%	None Detected		Fibrous Glass Cellulose Fiber Perlite	50% 35% 8%
0162178-006						
6	White, Homogeneous, Fibrous, tease, friable Note: 26°C, 1.550	LAYER 1 100%	None Detected		Fibrous Glass Non-Fibrous Material	98% 2%

Analyst - MEGHAN SWEENEY **Approved Signatory** Laboratory Director

The EPA method is a semi-quantitative procedure. The detection limit is between 0.1-1% by area and dependent upon the size of the asbestos fibers, the means of sampling and the matrix of the sampled material. The test results reported are for the sample(s) delivered to us and may not represent the entire material from which the sample was taken. The EPA recommends three samples or more be taken from a "homogeneous sampling area" before friable material is considered non-asbestos-containing. Negative floor tile samples may contain significant amounts (>1%) of very thin fibers which cannot be detected by PLM. Confirmation by TEM is recommended by the EPA (Federal Register Vol.59, No.146). Asbestos fibers bound in a non-friable organic matrix may not be detected by PLM. Alternative preparation methods are recommended. This report, from a NIST-accredited laboratory through NVLAP, must not be used by the client to claim product endorsement by NVLAP or any agencyof the U.S. government. This report shall not be reproduced, except in full, without the written approval of EMS Laboratories, Inc. Samples were received in good condition unless otherwise noted.

NVLAP®
NVLAP Lab Code: 102289-0

Appendix 5: Build Up to Costs for Remediation Options

Four scenarios have been costed:

1. Encapsulate asbestos roofing
2. Encapsulate asbestos exterior wall cladding
3. Remove and replace asbestos roofing
4. Remove and replace asbestos exterior wall cladding

Build ups are mostly based on costs provided by Central Meridian Inc based in Nauru, cross checked against costs in New Zealand.

It is noted that the costs prepared are for preliminary budgeting purposes only. Costs may vary according to local requirements, but we anticipate that the amounts allowed will be adequate to get the work done.

For the cost build ups prepared we have taken the Central Meridian rates, priced in Australian dollars, and converted them to United States dollars at an exchange rate of 0.8. We have then deducted 10% for savings that we anticipate would be achievable through competitive tendering of the work.

Provision has also been made for the works to be overseen by a SPREP appointed asbestos expert. The actual cost for this item will depend on the programme of works achievable and it is noted that this expert could also complete any contract administration and act as engineer to the contract ensuring safety, quality and commercial requirements are achieved.

Central Meridian Quote

02.12.14

PO Box 106
Republic of Nauru
Central Pacific
T 674 557 3731
AH 674 557 3813
E pfcmnauru@gmail.com
paulfinch1954@gmail.com

Quotation: 6814

Mr John O'Grady
Contract Environmental Ltd.

Cost estimates to undertake various asbestos removal work.

Dear John,

As requested I have detailed below costs to undertake various items of work involved in the removal of asbestos roof sheeting and replacement with colourbond corrugated roofing.

A full schedule of work to be undertaken during the removal and replacement process is detailed to - provide a clear build-up of costs and the relevant stages of work involved.

All work will be undertaken to the relevant NZ & Australian standards for asbestos removal & disposal.

REMOVAL OF EXISTING ASBESTOS ROOF SHEETING.
The costings detailed below are based on a roof area of 165m2. This is a standard size of many of the houses on Nauru with asbestos roof sheeting.
The cost of set up & removal of existing roofing is based on our historical costs for undertaking a number of similar roof removals on the island.
There are additional costs included as detailed:
(a) purchase of a 60 Litre Foamer unit at a price of $5,000.00 (including ocean freight & 10% import duty.) The cost of this is spread over the removal of 20 roofs.
(b) purchase of specialist vacuum cleaner with HEPA filter at a price of $2,000.00 (including freight & 10% import duty.)
(c) delivery to a central staging point for removal off island.

Establish asbestos boundaries, mark out the property, set up relevant warning signage around the property, decontamination entry points, personal protective clothing, (PPE) for staff & disposal.
$1,400.00

Set up scaffolding to both sides of building to assist in removal of roof sheeting & to remove asbestos guttering from building. Set up anchor point for fall arrest systems
$2,200.00

Coat the roof with a sprayed on water based PVA solution.
$1,250.00

Carefully remove the roof sheeting by unscrewing, (not breaking) the roof sheets. All roof sheets to be stacked onto plastic sheeting sitting on bearers for ease of removal. Sheeting to be fully wrapped in plastic & taped shut. Roof sheeting and all materials, (ridging, barge flashing, gutters etc) to be loaded into 'Asbags' for safe removal.
All removed materials will be taken and stored at a suitable staging point ready to be loaded into containers for removal from Nauru.
$4,465.00

Vacuum clean the existing ceiling & roof space, (rafters, purlins, ceiling joists) with a specific vacuum cleaner with a HEPA filter. (dispose of contents of cleaner into an 'Asbag' for correct disposal $325.00

Supply & fit heavy duty tarpaulins to keep the roof waterproof before installation of new roofing. $300.00

TOTAL COST FOR REMOVAL OF EXISTING ROOFING & GUTTERS $9,940.00

INSTALLATION OF NEW ROOF SHEETING, INSULATION, GUTTERING, DOWNPIPES.
We have quoted for Ultra grade of colourbond roof sheeting. This has a greater protective coating & is better for an oceanside environment. (Long life heavy duty).
The sq metre costs & grade of materials for this work are the same as that for the TVET school project in Yaren we have recently completed to AusAID Standard.

Supply & fit 'Kiwisafe' roof netting over existing purlins & fix in place ready to support the 50mm thick, foil coated, fiberglass insulation. Supply & lay a top layer of sisalation foil over the fibreglass insulation blanket. $2,541.00

Supply & screw fix Colourbond Ultra grade corrugated roofing, including for ridging & barge flashings. $7,722.00

Supply & fix Colourbond box guttering to both sides of the roof & include for one downpipe each side, feeding to a tank. $1,060.00

TOTAL COST FOR SUPPLY & FIXING OF NEW ROOF, ROOF INSULATION & GUTTERS & DOWN PIPES. $11,323.00

NB A contingency of 10% may need to be added as necessary for repairs to roof purlins and rafters.

RETENTION OF EXISTING ASBESTOS ROOF SHEETING AND FULL ENCAPSULATION WITH CORRECT PAINT SYSTEM. INCLUDING REMOVAL & REPLACEMENT OF EXISTING CEILINGS.
The square area of ceiling to be replaced & painting to be undertaken is based on a house size of 14m x 12m in size. (168 m2)
Work involved in this process is as follows and detailed below:

Establish asbestos boundaries, mark out the property, set up relevant warning signage around the property, decontamination entry points, personal protective clothing, (PPE) for staff & disposal.
$1,400.00

Set up scaffolding to both sides of building to assist in removal of roof sheeting & to remove asbestos guttering from building. Set up anchor point for fall arrest systems
$2,200.00

Spray with Foamshield to the inside of the ceiling space before removal of the sheeting.
$475.00

Disconnect & remove all electrical items, ceiling fans, lights, extractor fans. Allow to store safely ready for reconnection after new ceilings are installed. Ensure all wiring is made safe for ongoing work. $350.00

Lay down black plastic sheeting to floor of each room, remove all ceiling linings and place all rubbish into Asbags for correct removal & disposal. $1,850.00

Vacuum with specialist cleaner the underside of the existing roof sheeting and all timber roof framing. After removal of ceiling materials vacuum clean all the inside of the premises with vacuum cleaner with specialist HEPA filter. $350.00

Prepare correct paint product to seal & spray 2 coats of protective paint system to the underside of all the asbestos roof sheeting. Ensuring that all surface areas are correctly coated. A total of 3 coats to be applied. $2,050.00

Supply & fix 4.8mm Masonite sheeting to ceiling of all rooms. Supply & fix 40x10mm timber batten to all sheet joints & to perimeter of each room. $6,370.00 (Standard Ceiling liner)

Paint with 2 coats of acrylic ceiling paint to all new ceiling sheets & perimeter battens. $1,425.00

Reposition all wiring for lights & fans and connect up all fittings as previously set out. $450.00

Prepare to apply 3 coats of specialist paint finish to all the exterior roof area according to painting specifications. $2,250.00

Remove and dispose of correctly asbestos gutters to both sides of the building and supply & install new colourbond box gutters with down pipe each side leading to water tank. $1,760.00

TOTAL COST FOR FULL PAINT ENCAPSULATION OF EXISTING ROOF SHEETING, INCLUDING FOR REMOVAL & REPLACEMENT OF EXISTING CEILINGS & ALL ASSOCIATED WORK. $20,930.00

Thank you for the opportunity to provide a quotation & I await your instructions.

Yours truly,

Paul Finch
Central Meridian Inc.

Build up to Encapsulation of Asbestos Roofing

BUILD UP TO RETENTION OF EXISTING ASBESTOS ROOF SHEETING AND FULL ENCAPSULATION WITH CORRECT PAINT SYSTEM, INCLUDING REMOVAL AND REPLACEMENT OF EXISTING CEILINGS.

The costing detailed below are based on building area of 168m2 (14m x 12m). For roof area multiply by 1.15 to account for the pitch, which gives an area of 193m2.

This estimate assumes that there is an existing ceiling in place within the building, which would need to be treated as asbestos contaminated and removed. Once the ceiling was removed the building would need to be cleaned of asbestos fibres, the existing roof encapsulated, and the ceiling then reinstated. The items relating to the ceiling removal are shaded in blue, and if there was no ceiling then these items could be deducted from the budgeted costs.

The estimate does not include any costs related to removing items from within the building prior to starting works, or putting them back, or any costs relating to the disruption of normal activities in the affected building.

Item	AUD estimate (based on Central Meridian costings)	Convert to USD (0.8 exchange rate)	Reduce by 10% to account for competitive tendering
Establish asbestos boundaries, mark out the property, set up relevant warning signage around the property, decontamination entry points, personal protective equipment (PPE) for staff.	1,400.00	1,120.00	1,018.18
Set up scaffolding to both sides of building to remove asbestos guttering from building and provide safe access to the roof. Set up anchor point for fall arrest systems.	2,200.00	1,760.00	1,600.00
Spray ceiling with Foamshield, or similar particle capture system, to the inside of the ceiling space before removal of the sheeting.	475.00	380.00	345.45
Disconnect and remove all electrical items, ceiling fans, lights, extractor fans. Allow to store safely ready for reconnection after new ceilings are installed. Ensure all wiring is made safe for ongoing work.	350.00	280.00	254.55
Lay down black plastic sheeting to floor of each room, remove all ceiling linings and place all rubbish into Asbags for correct removal and disposal.	1,850.00	1,480.00	1,345.45
After removal of ceiling materials vacuum clean all the inside of the premises with a vacuum cleaner with HEPA filter. Then vacuum the	350.00	280.00	254.55

underside of the existing roof sheeting and all timber roof framing.			
Prepare correct paint product to seal and spray 3 coats of protective paint system to the underside of all the asbestos roof sheeting. Ensuring that all surface areas are correctly coated.	2,050.00	1,640.00	1,490.91
Supply and fix 4.8mm Masonite sheeting to ceiling of all rooms. Supply and fix 40x10mm timber batten to all sheet joints and to perimeter of each room. (Standard ceiling liner)	6,370.00	5,096.00	4,632.73
Paint with 2 coats of acrylic ceiling paint to all new ceiling sheets and perimeter battens.	1,425.00	1,140.00	1,036.36
Reposition all wiring for lights and fans and connect up all fittings as previously set out.	450.00	360.00	327.27
Apply 3 coats of specialist paint finish to all the exterior roof area according to painting specifications.	2,250.00	1,800.00	1,636.36
Remove gutters to both sides of the building and supply and install new colourbond box gutters with down pipe each side leading to water tank. Transport asbestos contaminated materials to central collection point for disposal (cost of disposal not included).	1,760.00	1,408.00	1,280.00
Oversight by SPREP appointed asbestos management expert	2,875.00	2,300.00	2,300.00
Total	**23,805.00**	**19,044.00**	**17,521.82**

Work back in to a m2 rate for encapsulating asbestos roofs where there is a ceiling present (per area of roof assuming the roof has a 30 degree pitch)	/ 193m2	90.79
Work our alternate rate for where there is no ceiling		
Deduct ceiling related costs shaded in blue		-7,941.82
Adjusted cost for a 168m2 building		9,580.00
Adjusted m2 rate for encapsulating an asbestos roof where there is no ceiling present (per area of roof assuming the roof has a 30 degree pitch)	/ 193m2	49.64

Build Up to Encapsulating Asbestos Cladding

BUILD UP TO RETENTION OF EXISTING ASBESTOS WALL CLADDING AND FULL ENCAPSULATION (INSIDE AND OUT) WITH CORRECT PAINT SYSTEM.

The estimate assumes work is completed in a building 14m x 12m in size = 168m2 (single storey - 2.4m high). Assuming windows and doors account for 10% of building exterior, the total cladding area would be approximately 360m2.

This estimate assumes that there is no internal wall sheeting (eg plaster board) and that the asbestos containing material is exposed. For a scenario where there is internal wall sheeting in good condition within the building, only the exterior would need to be treated. Items where savings could be made in this scenario are shaded in blue.

In a situation where there is internal wall sheeting in poor condition that would need to be removed and replaced, an extra $40/m2 would need to be allowed for as an extra over cost.

The estimate does not include any costs related to removing items from within the building prior to starting works, or putting them back, or any costs relating to the disruption of normal activities in the affected building.

Item	AUD estimate (based on Central Meridian costings)	Convert to USD (0.8 exchange rate)	Reduce by 10% to account for competitive tendering
Establish asbestos boundaries, mark out the property, set up relevant warning signage around the property, decontamination entry points, personal protective equipment (PPE) for staff.	1,400.00	1,120.00	1,018.18
Vacuum clean all the inside of the premises with Vacuum cleaner with specialist HEPA filter. Then vacuum the inside of the existing cladding and all timber framing.	350.00	280.00	254.55
Prepare correct paint product to seal and spray 3 coats of protective paint system to the **outside** of all the cladding. Ensuring that all surface areas are correctly coated. A total of 3 coats to be applied.	3,960.00	3,168.00	2,880.00
Prepare correct paint product to seal and spray 3 coats of protective paint system to the **inside** of all the cladding. Ensuring that all surface areas are correctly coated.	3,960.00	3,168.00	2,880.00
Oversight by SPREP appointed asbestos management expert	2,875.00	2,300.00	2,300.00
Total	**12,545.00**	**10,036.00**	**9,332.73**

Work back in to a m2 rate for encapsulating wall cladding inside and out (per face area of cladding)	/ 360m2	25.92
Work out alternate rate for where there is adequate internal wall sheeting which would mean that the interior of the asbestos cladding would not need to be encapsulated.		
Deduct interior encapsulation costs		-2,880.00
Adjusted cost		6,452.73
Adjusted m2 rate for encapsulating asbestos cladding where there is adequate internal wall sheeting (per face area of cladding)	/ 360m2	17.92
Work out alternate rate for where the internal wall sheeting is in poor condition and would need to be stripped out and replaced.		
Add in cost of removing the existing interior walls and replacing after encapsulation		14,400.00
Adjusted cost (360m2 of cladding)		23,732.73
Adjusted m2 rate for scenario where internal wall sheeting is in poor condition and also needs to be stripped out and replaced.	/ 360m2	65.92

Build Up to Removing and Replacing Asbestos Roofing

BUILD UP TO REMOVAL OF EXISTING ASBESTOS ROOF SHEETING.

The costing detailed below are based on building area of 168m2 (14m x 12m). For roof area multiply by 1.15 to account for the pitch, which gives an area of 193m2.

The costs are as worked out with Central Meridian, who are an experienced contractor based in Nauru.

Transport and packaging costs are allowed for bring asbestos containing materials to a central point but disposal costs are excluded and treated separate.

Purchase of a 60 Litre FoamShield unit at a price of $5,000.00 (including ocean freight and 10% import duty) is allowed for and the cost of this is spread over the removal of 20 roofs.

Purchase of specialist vacuum cleaner with HEPA filter at a price of $2,000.00 (including freight and 10% import duty) is allowed for and the cost of this is spread over the removal of 20 roofs.

Item	AUD estimate (based on Central Meridian costings)	Convert to USD (0.8 exchange rate)	Reduce by 10% to account for competitive tendering
Establish asbestos boundaries, mark out the property, set up relevant warning signage around the property, decontamination entry points, personal protective equipment (PPE) for staff.	1,400.00	1,120.00	1,018.18
Set up scaffolding to both sides of building to assist in removal of roof sheeting and to remove asbestos contaminated guttering from building. Set up anchor point for fall arrest systems.	2,200.00	1,760.00	1,600.00
Coat the roof with a sprayed on water based PVA solution.	1,250.00	1,000.00	909.09
Carefully remove the roof sheeting by unscrewing, (not breaking) the roof sheets. All roof sheets to be stacked onto plastic sheeting sitting on bearers for ease of removal. Sheeting to be fully wrapped in plastic and taped shut. All removed materials will be taken and stored at a suitable staging point ready to be disposed of.	4,465.00	3,572.00	3,247.27
Vacuum clean the existing ceiling and roof space, (rafters, purlins, ceiling joists) with a specialised vacuum cleaner with a HEPA filter. Dispose of contents of cleaner into an 'Asbag' for correct disposal	325.00	260.00	236.36
Supply and fit heavy duty tarpaulins to keep the roof waterproof ready for installation of new roofing.	300.00	240.00	218.18

Oversight by SPREP appointed asbestos management expert.	2,875.00	2,300.00	2,300.00
Total	12,815.00	10,252.00	9,529.09
Work back in to a m2 rate		/ 193m2	49.37

BUILD UP TO INSTALLATION OF NEW ROOF SHEETING, INSULATION, GUTTERING, DOWNPIPES.

The cost estimate allows for Colourbond Ultra grade roof sheeting and 50mm of foil coated fibreglass insulation. This has a greater protective coating and is better for an oceanside environment. (Long life heavy duty.)

Item	AUD estimate (based on Central Meridian costings)	Convert to USD (0.8 exchange rate)	Reduce by 10% to account for competitive tendering
Supply and fit 'Kiwisafe' roof netting over existing purlins and fix in place ready to support the 50mm thick, foil coated, fiberglass insulation. Supply and lay a top layer of sisalation foil over the fibreglass insulation blanket.	2,541.00	2,032.80	1,848.00
Supply and screw fix Colourbond Ultra grade corrugated roofing, including for ridging and barge flashings.	7,722.00	6,177.60	5,616.00
Supply and fix Colourbond box guttering to both sides of the roof and include for one downpipe each side, feeding to a tank.	1,060.00	848.00	770.91
NB A contingency of 10% may need to be added as necessary for repairs to roof purlins and rafters.	1,132.30	905.84	823.49
Total	**12,455.30**	**9,964.24**	**9,058.40**
Work back in to a m2 rate		/ 193m2	46.93

SUMMARY OF COSTS TO REMOVE ROOF AND REPLACE WITH NEW ROOF

Cost to remove old roof	49.37
Cost to install new roof	46.93
Total cost to remove and replace asbestos roofing (per m2 of roof area)	**96.31**

Remove and Replace Asbestos Cladding

BUILD UP TO REMOVAL AND REPLACEMENT OF ASBESTOS WALL CLADDING.

The estimate assumes work is completed on a building 14m x 12m in size = 168m2 (single storey - 2.4m high). (Assume windows and doors account for 10% of building exterior, the total cladding area would be approximately 360m2).

If a building was two stories it is recommended that USD12.00 is added per m2 for scaffolding. This figure is a rough estimate only but should provide adequate coverage.

Item	AUD estimate (based on Central Meridian costings)	Convert to USD (0.8 exchange rate)	Reduce by 10% to account for competitive tendering
Establish asbestos boundaries, mark out the property, set up relevant warning signage around the property, decontamination entry points, personal protective equipment (PPE).	1,400.00	1,120.00	1,018.18
Coat the walls with a sprayed on water based PVA solution.	1,875.00	1,500.00	1,363.64
Carefully remove the existing cladding. All wall sheets to be stacked onto plastic sheeting sitting on bearers for ease of removal. Sheeting to be fully wrapped in plastic and taped shut. All misc asbestos contaminated material to be loaded into 'Asbags' for safe removal. All removed materials will be taken and stored at a suitable staging point ready to be disposed of.	6,697.50	5,358.00	4,870.91
Vacuum clean the existing wall cavities with a vacuum cleaner with a HEPA filter. (Dispose of contents of cleaner into an 'Asbag' for correct disposal	325.00	260.00	236.36
Wrap the building in building foil, supply and fix composite cement board sheeting to exterior of buildings. Supply and fix treated 40mmx10mm timber batten to all sheet joints.	18,000.00	14,400.00	13,090.91
Paint with 2 coats of acrylic paint to all new wall cladding sheets and perimeter battens.	3,060.00	2,448.00	2,225.45
NB A contingency of 10% may need to be added as necessary for repairs to framing.	3,135.75	2,508.60	2,280.55
Oversight by SPREP appointed asbestos management expert.	2,875.00	2,300.00	2,300.00
Total	**37,368.25**	**29,894.60**	**27,386.00**

Work back in to a m2 rate for removing and replacing asbestos cladding (per face area of cladding)	/ 360m2	76.07