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

Report for the Republic of the Marshall Islands

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

May 2015

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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 RMI 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 RMI during a field visit undertaken by Claude Midgley between the 14th and 21st of July 2014. The visit was organised through the RMI Office of Environmental Planning and Policy Coordination (OEPPC).

Survey Methodology

The survey work undertaken in RMI included meetings with key government agencies, area-wide surveys of residential properties across the atoll of Majuro, and targeted investigations of public and commercial buildings. There are 26 atolls/islands in the RMI group but the survey was limited to Majuro, mainly for logistical reasons. The most recent census data for Majuro (2011) indicates that there are approximately 4,707 households on Majuro, and this represents about 60% of the total number of households in RMI.

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 in Majuro, every residential area was observed by surveyor thus 100% of the houses were captured in the assessment.

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 RMI. Based on the algorithm adopted as part of the risk assessment to prioritise asbestos management, this study has identified that there are only one site (apart from residences) in RMI 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 RMI RMI had a population of 53,158 in 2011 across the nations' 26 atolls/islands and total land area of 181 km^2. The most populated atoll is Majuro with 27,797 residences in 2011. The population were reportedly housed in approximately 7,785 residential households with over half of those households in Majuro. Only one house was identified as having ACM present at the time of the survey.

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

Survey	No of Households
Total of Households in Majuro (2012 Census)	4,707
Households surveyed	4,707
Households PACM suspected (cladding only)	1
Extrapolating to full Majuro population – No. of houses with suspected asbestos cladding:	1
Cladding observed & positive for ACM (houses only)	1
Extrapolating to full Majuro population – No. of houses with asbestos cladding:	1

The figures provided in the Table indicate that there is a very low presence of asbestos construction materials associated with residential dwellings in Majuro. It can therefore be assumed that the likelihood of asbestos construction materials on the remaining 3,078 households on outer islands is also very low. Having said this any programme to remediate asbestos in RMI should therefore involve a detailed survey of all dwellings in RMI including the outer islands with numerous samples taken of cladding in particular.

Cost Estimates

Pacific-wide cost estimates have been calculated for several remediation 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

Remediation Method	Cost per m^2 (face area) $US
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 added as an extra.

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.

Prioritised Recommended Actions and Indicative Costs

Site Name	ACM	Risk Score	Recommended Remedial Actions	ACM Area (m^2) and/or Volume (m^3)	Estimated Cost ($ USD)
College of The Marshall Islands	Roof Boards	22	Remove to Landfill	$100m^2$	$4,300
College of The Marshall Islands	Cement pipes	18	Encapsulate	$60m^2$	$1,380
Ace Hardware	Cement roof boards	16	Encapsulate	$400m^2$	$33,600

The following should be noted:

a. Unit costs are as per the rates in Section 10.2 above and do not include disposal although the rates do include enclosing the waste for disposal.
b. It would probably be best to remove and replace the asbestos cladding and roofing for small amounts as it provides a permanent solution.
c. One residence on Majuro was identified with asbestos and was assessed as low risk but the SPREP project does not cover residences. If significant amounts of asbestos were discovered in residences in RMI and it was decided to remediate RMI residences, then it is probable that most of it would be cladding. It may therefore be appropriate to encapsulate the cladding with a suitable paint system.

d. Based on advice from Mr Nigel Deacon of the Majuro Water and Sewer Company a project is expected soon that will replace approximately 9.3 km of asbestos cement pipes on Majuro. This project may result in the generation of quite large amounts of asbestos waste as well as generate the need for safe working procedures. Aside from this project, however, there is a need in RMI for safe handling and maintenance practices for asbestos-cement water pipes.

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

A. It is recommended that the above higher priority asbestos work is carried out in RMI as well as removal of all loose asbestos.
B. Only one residential dwelling with asbestos has been identified in Majuro and therefore it is expected that there is very little ACM on the outer Islands as well. However, 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 would then 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. The asbestos associated with the single house on Majuro should be removed.
C. Any asbestos roofs found on houses in RMI should preferably be removed.
D. 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. Disposal of asbestos may become an important issue if the large water pipe replacement project on Majuro goes ahead.
E. 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.
F. The planned replacement of approximately 9.3 km of old asbestos cement water pipes presents a significant challenge in terms of disposal of asbestos waste and also safe work procedures. Consideration of these matters should be incorporated at an early stage into the planning for this project.
G. Aside from the major planned water pipe replacement project, there is a need to set in place safe work procedures for handling and maintaining asbestos cement pipes which are common on Majuro and possibly other islands.
H. Consideration should be given to RMI passing regulations under their Public Health, Welfare and Safety Act 1966 or possibly the Health and Environment Personnel Management Act 1995 to enable the above asbestos work to be carried out.

Contents

Executive Summary i

1. Introduction 1

1.1 Purpose 1

1.2 Scope of Work 1

1.3 Background to RMI 2

1.4 Report Content and Layout 3

2.0 Survey Methodology 4

2.1 Pre-Survey Desk Study 4

2.2 Survey Coverage 4

2.3 Identification of Target Sites 4

2.4 Site Assessment Data Capture 5

2.5 Sample Collection Methodology 5

2.6 Sample Laboratory Analysis 6

3.0 Risk Assessment Methodology 8

3.1 ACM Assessment 8

3.2 ACM Setting Assessment 9

4.0 Asbestos Survey 12

4.1 Residential Survey 12

4.2 Targeted Survey Coverage 13

5.0 Laboratory Results and Site Assessments 15

6.0 Risk Assessment 16

7.0 Remedial and Management Options 18

7.1 General 18

7.2 Management Options 18

7.3 Remedial Options 19

8.0 Selection of Possible Remedial Options 23

8.1 General 23

8.2 Appropriate Asbestos Management for the Pacific 23

8.3 Encapsulation 24

8.4 Removal 26

8.5 Options Specific to RMI 27

9.0 Disposal 29

9.1 Relevant International Conventions 29

9.2 Local Burial ... 30
9.3 Disposal at Sea ... 30
9.4 Export to Another Country ... 32
10.0 Cost Considerations ... 34
10.1 Encapsulation ... 34
10.2 Removal and Replacement ... 35
10.3 Local Contractors ... 37
11.0 Review of RMI Policies and Legal Instruments ... 38
11.1 National Laws and Regulations ... 38
11.2 National Strategies and Policies ... 38
12.0 Recommended Actions for Minimising Asbestos Exposures ... 39
12.1 Discussion ... 39
12.2 Recommendations ... 40
Appendix 1: Edited Copy of the Terms of Reference ... 42
Appendix 2: Organisational Details and List of Contacts ... 44
A2.1 Organisational Details ... 44
A2.2. List of Contacts ... 44
Appendix 3: Summaries of in-Country Discussions ... 45
Appendix 4: Laboratory Reports ... 47
Appendix 5: Build Up to Costs for Remediation Options ... 50
Central Meridian Quote ... 50
Build up to Encapsulation of Asbestos Roofing ... 54
Build Up to Encapsulating Asbestos Cladding ... 56
Build Up to Removing and Replacing Asbestos Roofing ... 58
Remove and Replace Asbestos Cladding ... 60

Definitions

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

Amosite: Brown or Grey Asbestos

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

CEL: Contract Environmental Limited

Chrysotile: White Asbestos

Crocidolite: Blue Asbestos

EMS: EMS Laboratories Incorporated

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

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

GPS: Global Positioning System

Hazard: Is a potential to cause harm

IANZ: International Accreditation New Zealand

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

MDHS100: Methods for the determination of hazardous substances, surveying, sampling and assessment of asbestos-containing materials

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

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

PPE: Personal Protective Equipment

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

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

SMF: Synthetic Mineral Fibres

SPREP: Secretariat of the Pacific Regional Environment Programme

1. Introduction

1.1 Purpose

This report covers the Republic of the Marshall Islands (RMI) component of a survey of the regional distribution and status of asbestos-containing material (ACM), 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, ACM 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 (CEL) and Geoscience Consulting (NZ) Ltd (Geoscience), under contract to the Secretariat of the Pacific Regional Environment Programme (SPREP), with funding provided by the European Union. The majority of information relating to the distribution of ACM in RMI was obtained during a field visit undertaken by Claude Midgely between the 8th and 14th of July 2014 and was organised through the Office of Environmental Planning and Policy Coordination (OEPPC).

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 RMI

The **Republic of the Marshall Islands** (RMI) is an island country located near the equator in the Pacific Ocean, slightly west of the International Date Line. Geographically, the country is part of the larger island group of Micronesia. The country's population of 68,480 people is spread out over 24 low-lying coral atolls, comprising 1,156 individual islands and islets. The most populous atoll is Majuro, which also acts as the capital.

Micronesian colonists gradually settled the Marshall Islands during the 2nd millennium BC. Islands in the archipelago were first explored by Europeans in the 1520s, with Spanish explorer Alonso de Salazar sighting an atoll in August 1526. Other expeditions by Spanish and English ships followed, with the islands' current name stemming from British explorer John Marshall (1788).

RMI has been influenced by Spanish, German and Japanese cultures throughout its history however during World War II, the United States conquered the islands in the Gilbert and Marshall Islands campaign. Along with other Pacific Islands, the Marshall Islands were then consolidated into the Trust Territory of the Pacific Islands governed by the US. Self-government was achieved in 1979, and full sovereignty in 1986, under a Compact of Free Association with the United States.

Politically, the Marshall Islands is a presidential republic in free association with the United States, with the US providing defence, subsidies, and access to social services. The country uses the United States dollar as its currency. The majority of the citizens of the Marshall Islands are of Marshallese descent, though there are small numbers of immigrants from the Philippines and other Pacific islands. The two official languages are Marshallese and English.

Figure 1 – Map of RMI

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, with supporting information on the laboratory results given in section 5, and the risk assessment results in section 6.

Section 7 provides a generic discussion of possible management options for ACMs, and this is followed in section 8 by a specific analysis of the most appropriate options for those ACMs identified in RMI.

Section 9 provides a review and analysis of existing national policies and legal instruments relevant to ACM management, while local contracting capabilities and costs are noted in section 10.

Section 11 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.

Section 12 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 a series of appendices.

2.0 Survey Methodology

2.1 Pre-Survey Desk Study

The survey work undertaken during the visit to RMI included meetings with key government agencies, area-wide surveys across the Island of Majuro and specific investigations of 38 sites.

Prior to conducting the surveys and visiting RMI, 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 RMI Government did not hold any reports on the presence or significance of asbestos in RMI.

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

The survey concentrated on the Majuro Atoll due to the majority of historical development and population being located there.

According to the RMI 2011 population census, RMI had a population of 53.158 in 2011 across the 26 atolls/islands with a total land area of 181 km². The total population is housed in approximately 7,785 residential dwellings with 4,707 of those households in Majuro. All of the houses were surveyed.

Due to the distribution of the population of RMI spread over 26 atolls/islands and the difficulties in accessing each island, a survey of each residential household was not feasible in the timeframes and budget of the project. A statistical approach was therefore adopted to ensure a sufficient number of residential properties were included in the survey to allow a confident estimate of the number of houses with certain characteristics related to asbestos to be made.

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 the survey, the surveyor attended meetings with representatives from the RMI government department responsible for environmental issues (Office of Environmental Policy and Planning Coordination (OEPPC)) and the Majuro Water and Sewer Company. The representatives provided information regarding potential state assets containing asbestos.

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.

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, and 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 RMI are available via SPREP.

2.5 Sample Collection Methodology

24 individual facilities / properties were identified as requiring a detailed site assessment due to their age, use, sensitive location or observations of PACM. In order to assess if PACM actually contained asbestos, samples were to be collected and analysed by a professional accredited laboratory in accordance with international standards.

Samples of PACM were 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 CEL / 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 5 sites. Samples were not collected from those sites.

One site contained building materials which could not be confirmed to be asbestos free without further laboratory testing. A sample of the PACM was collected from that site. The sample was collected in accordance with the following procedures:

- Sampling personnel were required to 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 suspected ACM were sought first where it was easier to remove a small sample. The sample size collected was approximately 5 cm^2
- The sample was 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;
- The sample was individually sealed in their own sealable polythene bag which was then sealed in a second polythene bag.
- After sampling, water was sprayed onto the sample area to prevent fibre release;
- Sampling points were further sealed by PVC tape where necessary;
- The sample was labelled with a unique identifier and in the survey documentation;
- The sample was noted on a chain of custody form provided by the laboratory, and secured in a sealable container.

2.6 Sample Laboratory Analysis

The sample was sent by courier to EMS Laboratories Incorporated (EMS) located in California, United States of America. Analysis of the sample was performed by EMS using Polarised Light Microscopy. According to EMS the analysis method is a semi-quantitative procedure with a detection limit between 0.1-1% by surface area of the bulk sample, depending on the size of the asbestos fibres, sampling method and sample matrix.

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 for use in drawing conclusions. 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.

The result for the sample is discussed in Section 3.3, and copies of the laboratory report are given 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 system to allow an assessment of the 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 method used 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 vs 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(s). The setting assessment therefore considers the normal occupant activity in that area of the site and the likelihood of disturbance. Each ACM setting is scored and these scores are added to those for the material assessment to produce a total score.

3.1 ACM Assessment

The algorithm in MDHS100 considers four parameters that determine the risk from an ACM: that is the ability to release fibres if disturbed. The 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 - ACM

Sample variable	Score	Examples of scores
Product type (or debris product)	1 2 3	Asbestos reinforced composites (plastics, resins, mastics, roofing felts, vinyl floor tiles, semi-rigid paints or decorative finishes, asbestos cement etc) Asbestos insulating board, mill boards, other low density insulation boards, asbestos textiles, gaskets, ropes and woven textiles, asbestos paper and felt Thermal insulation (eg pipe and boiler lagging), sprayed asbestos, loose asbestos, asbestos mattresses and packing
Extent of damage/deterioration	0 1 2 3	Good condition: no visible damage Low damage: a few scratches or surface marks; broken edges on boards, tiles etc Medium damage: significant breakage of materials or several small areas where material has been damaged revealing loose asbestos fibres High damage or delamination of materials, sprays and thermal insulation. Visible asbestos debris
Surface treatment	0 1 2 3	Composite materials containing asbestos: reinforced plastics, resins, vinyl tiles Enclosed sprays and lagging, asbestos insulating board (with exposed face painted or encapsulated), asbestos cement sheets etc. Unsealed asbestos insulating board, or encapsulated lagging and sprays Unsealed laggings and sprays
Asbestos type	1 2 3	Chrysotile Amphibole asbestos excluding crocidolite 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 MDHS100, 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 and / or owners at the majority of the survey sites were considered to be low. Therefore any maintenance undertaken is likely to be 'unplanned' with little or no controls around asbestos exposure. In addition, the amount of maintenance activity was often extremely difficult to quantify through discussion with the building management contacts.

The three areas of the algorithm adopted for the ACM setting assessment are:

- Occupant activity
- Likelihood of disturbance
- Human exposure potential

Each of the above parameters are summarised below.

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 has much less exposure potential than 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 ACM setting is shown in Table 2.

Table 2: HSG227 (2002) Priority Assessment Algorithm - Setting

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

The majority of residential dwellings observed on Majuro were constructed using plywood, concrete blocks (often with cement plaster) and corrugated iron. Little or no asbestos-containing materials were observed. Photo 1 shows a typical building in Majuro.

Photo 1: Typical structure in Majuro showing cement cladding

Information on the population distribution of RMI was provided by the 2011 population census produced by the Economic Policy, Planning and Statistics office in the Office of the President, RMI. RMI had a population of 53,158 in 2011 across the nations' 26 atolls/islands and total land area of 181 km^2. The most populated atoll is Majuro with 27,797 residences in 2011. The population are reportedly housed in approximately 7,785 residential households with over half of those households in Majuro.

Table 4 provides a summary of the RMI census data and the survey data collected during this assessment.

As Majuro is a relatively small atoll and residential areas are limited to a narrow strip of land in many places, all of the residential areas were visited and residential houses assessed (4,707 households). A clear understanding of the common building materials was reached.

Table 4: Statistical Summary

Survey	No of Households
Total of Households in Majuro (2012 Census)	4,707
Households surveyed	4,707
Households PACM suspected (cladding only)	1
Extrapolating to full Majuro population – No. of houses with suspected asbestos cladding:	1
Cladding observed & positive for ACM (houses only)	1
Extrapolating to full Majuro population – No. of houses with asbestos cladding:	1

During the course of the survey, all the residential houses were observed by the surveyor and only 1 household was seen to have asbestos cladding (roof).

The figures provided in Table 4 indicate that there is a very low presence of asbestos construction materials associated with residential dwellings in Majuro. It can therefore be assumed that the likelihood of asbestos construction materials on the remaining 3,078 households on outer islands is also very low. Having said this, any programme to remediate asbestos in RMI should therefore involve a detailed survey of all dwellings in RMI 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 and commercial buildings, particularly those which were likely to be frequented by large numbers of individuals from the general public. The buildings included (but were not limited to) schools, police and fire stations, hospitals and healthcare centres and government administration buildings. The specific sites visited in Majuro are listed in Table 5.

Table 5: Specific Sites Visited in Majuro.

Site Name	Suspected PACM?	Samples Collected of PACM?
1. EPA Office	No	No
2. Majuro Hospital	Yes	Yes
3. Ace Hardware	Yes	No
4. College of The Marshall Islands	Yes	No
5. Majuro City Hall	No	No
6. Weather office	No	No
7. Marshall Islands High School	No	No
8. Rairok Elementary School	No	No
9. Laura Police station	No	No
10. Ajeltake Elementary School	No	No
11. Delap Elementary School	No	No
12. Ministry of Education Admin Building	No	No
13. Majuro Police Station	No	No
14. OEPPC Office	No	No
15. Majuro Japan Construction Company	Yes	No
16. Majuro Fire Station	No	No

Site Name	Suspected PACM?	Samples Collected of PACM?
17. National Telecommunications Authority	No	No
18. Majuro Airport	Yes	No
19. Post Authority (at the airport)	No	No
20. Woja Elementary School	No	No
21. Laura Dispensary	No	No
22. Ajeltake Police Station	No	No
23. Disused Government Building	No	No

5.0 Laboratory Results and Site Assessments

Of the 23 non-residential buildings that were visited, 4 were considered to have ACM present and did not require samples to be collected while one was considered to have PACM and therefore a sample was collected and sent for analysis. The sample was retrieved from deteriorating lagging from the exhaust of a disused generator located at Majuro Hospital.

The analysis of the one sample that was collected in the RMI did not detect any asbestos fibres and therefore no further action is required. A copy of the laboratory report is provided in Appendix 4 of this report.

Four sites were encountered where laboratory testing was not required to confirm the presence of asbestos. Table 6 shows the four sites and the type of ACM that was encountered.

Table 6: Identification of Sites with ACM in Majuro.

Site Name	Type of ACM
Ace Hardware	Corrugated cement roof
College of the Marshall Islands	Cement water pipes and corrugated cement roof
Majuro Japan Construction Company	Corrugated cement roof
Majuro Airport	Cement water pipes

It is important to note however the greatest source of asbestos which could be readily identified in RMI was the public water system infrastructure. The Water and Sanitation Advisor to the Majuro Water and Sewer Company, Nigel Deacon, indicated that the majority of the public water supply is distributed through Asbestos Cement (AC) pipes. Given that observing and assessing mostly underground pipes was outside the scope of this project, it is difficult to quantify how much ACM is present in the form of water pipes and to estimate the cost for removing it.

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) as well as observations of the sites visited, the sites are listed in order of priority in Table 7.

Table 7: Risk Ranking Scores

Site Name	Building Material Type	Risk Ranking Scores		
		ACM	Setting	Total Score
College of The Marshall Islands	Cement water pipes and corrugated cement roof boards	4	18	22
Ace Hardware	Corrugated cement roof	4	12	16
Vacant Residential Site	Corrugated cement roof	4	11	15
Majuro Japan Construction Company	Corrugated cement roof	3	6	9
Majuro Airport	Cement water pipes	4	3	7

The risk ranking scores presented in Table 7 indicate that the survey has identified one site that is considered to currently present a moderate risk of asbestos exposure to the occupants and/or users. Photo 2 shows the asbestos sheets stacked at the College of the Marshall Islands. The remaining sites that have been assessed are considered to be of low or very low risk to occupants. Photo 3 shows the asbestos roof at Ace Hardware while photo 4 shows the deteriorating roof at the Majuro Japan Construction Company. This risk assessment is based on current conditions, ACM condition and site use observed at the time of the survey. Should these change over time, reassessment of the risk presented would be required.The following series of photos show examples of the sites that have been identified with ACM.

Photo 2: Asbestos sheets at the College of MI

Photo 3: Asbestos roof cladding at Ace Hardware

Photo 4: Damaged asbestos roof cladding at the Majuro Japan Construction Co.

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:

a. 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:

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

3. Removal

k. Methods for removing the asbestos-contaminated materials (wet or dry methods)
l. Asbestos removal equipment (spray equipment, asbestos vacuum cleaners, cutting tools, etc)
m. 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
n. 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
o. 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:

p. 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:

q. 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

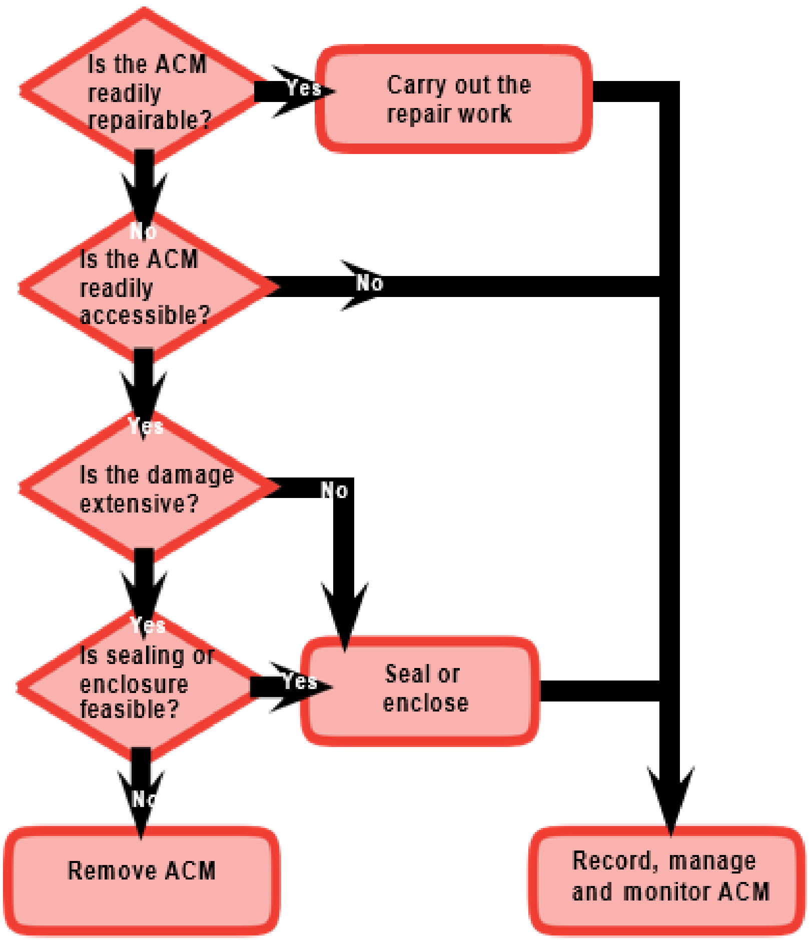

Figure adapted from; UKHSE HSG227 'A Comprehensive Guide to Managing Asbestos in Premises'.

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 5 and 6 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 5 & 6: 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 RMI

Table 8 below shows the sites on RMI that returned a positive result for ACM and the most suitable, cost effective remedial options based on the flow chart process described above.

Table 8: Possible Remedial Options – RMI

Site Name	Building Material Type	Risk Ranking	Applicable Remedial Options				
			Repair	Isolate	Encapsulate	Remove & Replace	Remove to Landfill
College of The Marshall Islands	Cement pipes	22	×	×	✓	×	×
College of The Marshall Islands	Roof Boards		×	×	×	×	✓
Ace Hardware	Cement roof boards	16	×	×	×	✓	×
Vacant Residential Site	Cement roof boards	15	×	×	×	✓	×
Majuro Japan	Cement roof	9	×	×	×	✓	×

Construction Company	boards						
Majuro Airport	Cement pipe	7	×	×	×	✓	×

In order to ensure the most suitable remedial approach is taken, a review of the National and International regulations governing asbestos has been undertaken.

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 9 below.

Table 9: 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.

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). We acknowledge that costs will likely vary according to local conditions but we have cross checked the rates against established rates in New Zealand, and also informally with contractors in other Pacific countries, and believe that the figures put forward are reasonable for preliminary budgeting purposes.

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.

<u>Cladding Encapsulation</u>

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:

<u>Roof Removal and Replacement</u>

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 disposal is addressed separately.

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 disposal is addressed separately.

Table 10: 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
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 added 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 OEPPC, the topic of potential contractors considered suitable to remove asbestos was discussed. The following contractors were identified:

- Pacific International Incorporated (ph: 625 3122 or 625 5316)
- United Atoll General Contractor (ph: 625 3269)

11.0 Review of RMI Policies and Legal Instruments

11.1 National Laws and Regulations

As already mentioned, RMI is a party to the Rotterdam Convention which promotes shared responsibilities between signatories in relation to importation of hazardous chemicals.

Noumea Convention and associated Dumping Protocol are both relevant to the issue of dumping at sea. RMI also have the Coast Conservation Act which provides provision for the prevention of waste disposal within the marine environment.

RMI is also a signatory to the Basel Convention which is relevant to the issue of export of waste to another country.

The National Environmental Protection Act 1984 while it does not specifically control the use and/or disposal of asbestos, it is an all-encompassing statute for the management of waste and pollution generated in the RMI.

11.2 National Strategies and Policies

RMI have a National Waste Management Strategy 2012 – 2106. The report states that "there are no reports of significant quantities of asbestos present in RMI" and therefore is not addressed any further in the document.

RMI 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 RMI. Based on an algorithm adopted as part of the risk assessment to prioritise asbestos management, this study has identified that there is only one sites in RMI 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.

The survey identified only one vacant residential dwelling with ACM out of a total of 4,707 houses. Surveys were not carried out on the remaining 3078 houses on the outer islands of RMI however based on the very low volumes of asbestos detected on Majuro it is unlikely that significant amounts of ACM will be detected in these outer islands. It is suggested however, that any programme to remediate asbestos in RMI should involve a detailed survey of all dwellings in the outer islands with numerous samples taken of cladding in particular.

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.

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 11 below.

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.

Based on advice from Mr Nigel Deacon of the Majuro Water and Sewer Company (see Appendix 3) a project is expected soon that will replace approximately 9.3 km of asbestos cement pipes on Majuro. This project may result in the generation of quite large amounts of asbestos waste as well as generate the need for safe working procedures.

Table 11: Prioritised Recommended Actions and Indicative Costs

Site Name	ACM	Risk Score	Recommended Remedial Actions	ACM Area (m^2) and/or Volume (m^3)	Estimated Cost ($ USD)
College of The Marshall Islands	Roof Boards	22	Remove to Landfill	100m^2	$4,300
College of The Marshall Islands	Cement pipes	18	Encapsulate	60m^2	$1,380
Ace Hardware	Cement roof boards	16	Encapsulate	400m^2	$33,600

The following should be noted:

i. It would probably be best to remove and replace the asbestos cladding and roofing for small amounts as it provides a permanent solution.
ii. One vacant residence was identified on Majuro and assessed as low risk and the SPREP project does not cover residences. If significant amounts of asbestos were discovered in residences in RMI and it was decided to remediate RMI residences, then it is probable that

most of it would be cladding. It may therefore be appropriate to encapsulate the cladding with a suitable paint system.

The disposal method for RMI's asbestos wastes also needs to be determined. The preference would be for disposal on Majuro in the landfill, but Majuro Atoll is low-lying with a high groundwater and ensuring permanent coverage may be difficult. It could be buried in a special lined cell and covered with concrete, assuming a suitable site for the cell could be obtained. It is worth noting that RMI are currently considering a new landfill site which may be provide the option to construct a purpose built cell.

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 RMI although they would be expensive options.

Disposal at sea would require permits under the various protocols and statutes that the RMI have agreed to. 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 RMI and may be unacceptable to customary law that operates in RMI. 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 RMI to another country would be viable and probably Brisbane in Australia would provide a suitable destination although shipping routes would need to be confirmed. This method would need to generate enough asbestos waste to justify the shipment of at least one 20 ft container which can hold about 17 tonnes. Given the small amount of asbestos detected on RMI, this method may not be viable. This may, however, change significantly with the planned large project to remove approximately 9.3 km of asbestos cement water pipes. Currently the Majuro Water and Sewer Company are expressing a preference for disposal at sea (see Appendix 3), but export may be a better option.

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 RMI to Brisbane, so a safe figure from RMI 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.

12.2 Recommendations

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

a) It is recommended that the above higher priority asbestos work is carried out in RMI as well as removal of all loose asbestos.
b) Only one vacant residential dwelling has been identified in Table 8 and therefore it is expected that there is very little ACM on the outer Islands as well. However, 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 would then 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. The asbestos associated with the single house on Majuro should be removed.

c) Any asbestos roofs found on houses in RMI should preferably be removed as the cost of encapsulation is only a little less than removal.
d) 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. Disposal of asbestos may become an important issue if the large water pipe replacement project on Majuro goes ahead.
e) 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.
f) The planned replacement of approximately 9.3 km of old asbestos cement water pipes presents a significant challenge in terms of disposal of asbestos waste and also safe work procedures. Consideration of these matters should be incorporated at an early stage into the planning for this project.
g) Aside from the major planned water pipe replacement project, there is a need to set in place safe work procedures for handling and maintaining asbestos cement pipes The planned replacement of approximately 9.3 km of old asbestos cement water pipes presents a significant challenge in terms of disposal of asbestos waste and also safe work procedures. Consideration of these matters should be incorporated at an early stage into the planning for this project.
h) Aside from the major planned water pipe replacement project, there is a need to set in place safe work procedures for handling and maintaining asbestos cement pipes The planned replacement of approximately 9.3 km of old asbestos cement water pipes presents a significant challenge in terms of disposal of asbestos waste and also safe work procedures. Consideration of these matters should be incorporated at an early stage into the planning for this project.
i) Aside from the major planned water pipe replacement project, there is a need to set in place safe work procedures for handling and maintaining asbestos cement pipes which are common on Majuro and possibly other islands.
j) Consideration should be given to RMI passing regulations under their Public Health, Welfare and Safety Act 1966 or possibly the Health and Environment Personnel Management Act 1995 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, Kiribati
- 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 RMI took place from 14 to 21 July 2014. The consultant, Claude Midgley, was based in Majuro.

The primary agency for liaison was the RMI OEPPC, and the following personnel were involved:

Bruce Kijiner, Director of the OEPPC

Warwick Harris, Deputy Director of the OEPPC

The OEPPC officers were very helpful and provided considerable support during the visit.

Available representatives of strategic businesses and government departments were visited and considerable assistance was willingly provided. Full contact details are given below.

A2.2. List of Contacts

Bruce Kijiner, Director

Office of Environmental Planning and Policy Coordination, Main Road, Majuro

Phone: (692) 625 7944 Email: kijinerb@gmail.com

Warwick Harris, Deputy Director

Office of Environmental Planning and Policy Coordination, Main Road, Majuro

Phone: (692) 625 7945 Email: warwick47@gmail.com

Nigel Deacon, Water & Sanitation Advisor

Majuro Water and Sewer Company, PO Box 1751, Majuro

Phone: (692) 456 6931 Email: nige.deacon@gmail.com

Yuichi Yamaguchi, General Manager

Ace Hardware, Uliga Lagoon Side Road, Majuro

Phone: (692) 625 5564 Email: yuichiy@ntamar.net

Appendix 3: Summaries of in-Country Discussions

Warwick Harris, Deputy Director of OEPPC

Mr Harris indicated that several contacts from the RMI EPA and OEPPC were unavailable during the survey period, as their attendance was required at other important meetings.

Mr Harris stated that RMI did not have legislation specific to asbestos, but that Solid Waste Regulations are in operation. The OEPPC did not have a copy of the regulations, but a copy of the 1989 Solid Waste Regulations was obtained online. Mr Harris was not aware of the UN funded, PacWaste Atoll Waste Management project being undertaken in Majuro.

Three contractor names, who could undertake asbestos stabilisation, handling and disposal were provided by Mr Harris.

Nigel Deacon, Water and Sanitation Advisor for the Majuro Water and Sewer Company

Mr Deacon indicated that water and sanitation is not well provided for in Majuro, where less than half of the population enjoy access to reticulated water and sewage services and only a quarter have their own connection to water. The exact number of people serviced is unknown since many people share services with their neighbours. There are also problems with illegal connections and these combined with leaking trunk mains mean that total unaccounted for water is approximately 50% of supply. The Water and Sewer Company is therefore in the process of planning a project to replace approximately 9.3 km of asbestos cement pipes that have reached the end of their service life to reduce water losses and increase the volume of water available to consumers.

The space allowed for within the current road reserve is insufficient to enable the existing asbestos cement pipes to be decommissioned in-situ. Therefore, the existing pipes must be excavated to provide space for the replacement HDPE / PVC pipes.

Three options were identified by the Water and Sewer Company, to address the generation of a significant amount of asbestos containing waste:

1. Excavate and encase the pipes in concrete containing crushed glass ash from burnt municipal waste to create blocks that can be used for land reclamation or protection of existing land from wave energy,
2. Use the ‘pipe bursting’ method to install the new infrastructure, but also create a future hazard as the asbestos cement pipes will become badly damaged in the process and future excavation to install lateral connections will result in exposure to the damaged pipes, or
3. Find a suitable ocean site where the pipes might be used to stabilise a reef area and act as a substrate for new growth.

Mr Deacon was advised that disposal at sea would contravene the London Convention, to which RMI is not a party. Mr Deacon indicated that disposal at sea was the preferred option.

Yuichi Yamaguchi, General Manager of Ace Hardware

Mr Yamaguchi was informed that roof boards of the stock storage warehouse contains asbestos. Mr Yamaguchi indicated that the buildings are owned by, and leased from, Robert Reimers Enterprises.

Ace Hardware is currently planning to refurbish the buildings as they are in need of maintenance, particularly the warehouse which is the oldest building and has shown signs of instability. Mr Yamaguchi was not aware that asbestos-containing materials were present in the buildings and had not planned to include special precautions for handling hazardous substances during the refurbishment works.

Appendix 4: Laboratory Reports

SUBMITTAL FORM *Laboratory Services*

1602178

PAGE 1 OF 1

TURNAROUND TIME: STD ___ 48 HR ___ 24 HR ___ <8 HR ___ WKND ___ OTHER ___

- RELINQUISHED BY: Claude Midgley
- TIME / DATE: 28 July 2014
- CLIENT: Contract Environmental Ltd
- ADDRESS: 119 Johnson Rd, West Melton, Christchurch, New Zealand
- TELEPHONE: +64 21 311 832
- CONTACT: John O'Grady
- DATE OF SHIPMENT: ___
- CARRIER: DHL
- CLIENT P.O. NO.: SPREP
- CLIENT JOB/PROJECT ID NO(S): SPREP Kosrae and SPREP RMI
- PACKAGE SHIPPED FROM: Christchurch
- RESULTS REQUESTED VIA: VERBAL ☐ FAX ☐ E-MAIL ☒
- E-MAIL: JOGRADY@ACTRIX.CO.NZ
- FAX NO.: ___
- DATE/TIME OF SAMPLE COLLECTION: 7 – 21 July 2014
- SAMPLE PRESERVATIVES: None
- HOLDING TIMES: N/A
- NO. OF SAMPLES SENT: 6
- SAMPLER'S NAME: (signature) / Claude Midgley (printed)
- TYPE: ☐ WATER ☐ WASTE WATER ☐ SOIL ☐ FILTER ☐ SORBENT TUBE ☐ IMPINGER ☒ OTHER Building material

EMS Sample No. (FOR EMS ONLY)				
1602178-1	1	Kosrae Stevedoring: Blue Tile	Tests	
	2	Kosrae Stevedoring: Black/White Tile	Requested	
	3	Public Works Floor Tile	by	
	4	Kosrae Airport Floor Tile	John O'Grady	
6	5	Kosrae State Legislature Ceiling Tile		
6	6	Majuro Hospital Lagging on Old Generator		

(SF 6/07)

FOR EMS ONLY

- Laboratory No.: 1602178
- Received By: Amini M.
- Time: 1030
- Date of Package Delivery: 07-30-14
- Shipping Bill Retained: YES ☐ NONE ☑
- Condition of Package on Receipt: OK
- Condition of Custody Seal: None
- (NOTE: If the package has sustained substantial damage or the custody seal is broken, stop and contact the project manager and the shipper.)
- No. of Samples: 6
- Chain-of-Custody Signature: ___
- Date of Acceptance into Sample Bank: 07-30-14
- Misc. Info.: ___
- Disposition of Samples: EMS

EMS LABORATORIES 117 West Bellevue Drive / Pasadena CA 91105-~~2503~~ / 626-568-4065

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 2
		REPORT #:	0162178
		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 119 Johnson Rd. West Melton Christchurch NZ	PAGE #: REPORT #: PROJECT:	2 of 2 0162178 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% 38% 6%
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 Lab Code: [illegible]

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

central meridian inc

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

02.12.14

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 underside of the existing roof sheeting and all	350.00	280.00	254.55

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