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

Report for the Republic of Vanuatu

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

May 2015

Contact Details

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

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

Ellen Clara
Staff Environmental Scientist
Geoscience Consulting (NZ) Ltd
PO Box 373
Christchurch 8140
New Zealand
ellen@nzgeoscience.co.nz
ph +64 3 328 9012

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

Executive Summary

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

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

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

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

This report aims to meet part of the objectives of SPREP'S Pacific Regional Solid Waste Management Strategy 2010–2015 and the regional hazardous waste strategies, 'An Asbestos Free Pacific: A Regional Strategy and Action Plan 2011'.This report covers the Republic of Vanuatu (hereafter referred to as Vanuatu) 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 Vanuatu during a field visit undertaken by Dirk Catterall and Ellen Clara between the 29th June and 9th of July 2014. The visit was organised through Vanuatu's Ministry of Lands and Natural Resources, Department of Environment and Conservation.

Survey Methodology

The survey work undertaken in Vanuatu included meetings with key government agencies, area-wide surveys of residential properties across the Islands of Efate and Santo, and targeted investigations of public and commercial buildings.

A statistical method was adopted for the survey of residential properties. This involved calculating the minimum sample size required from the total population to give the required confidence level and margin of error.

The survey sample size was based upon a 95% confidence level and 4% margin of error. With 167,400 households across the nation the number of houses needed to ensure a statistically representative number of households were included, and to allow estimates to be made, was 584, and 600 houses were inspected in Efate and Santo.

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

The most abundantly encountered AC building material was cement sheeting. This AC cement sheeting is mostly applied as wall cladding and can also be encountered in soffits, gables, pathways connecting buildings, etc. The conditions in which the AC cement sheets were encountered varied from badly damaged (residential demolition site in Port Vila and a residential dwelling in Luganville) to very good (the Presbyterian College and the Paonangisu Health Centre).

There were 23 cement sheeting samples collected, and 11 returned positive. The positive samples were mostly collected from what appeared to be the older cement sheets.

Vinyl flooring was abundantly present and a total of 20 samples were collected. Only one sample returned positive – a sample at Port Vila Central Hospital contained 2% chrysotile. This suggests that a very limited quantity of the vinyl flooring used at Vanuatu contains asbestos.

The presence of AC cement pipes was proven at the Northern Provincial Hospital at Santo. No further information was collected about the presence of AC cement pipes and therefore large uncertainty remains about to what extent such pipes have been used in Vanuatu.

Super 6 roofing was only encountered at two places; at the Forari Mine infrastructure (Efate) and on one residential dwelling in Luganville with Super 6 roofing and cement cladding. The survey results show that Super 6 roofing is not abundantly present at Vanuatu.

AC pipe lagging was only encountered at the Port Vila Main Hospital. Pipe lagging was not encountered at other inspected sites. The survey results show that AC pipe lagging is unlikely to be abundantly present at Vanuatu.

AC Bitumen roof was only encountered at the Malapoa College. Bitumen roofing was only at one other location sampled (Lycee Bougainville) but this sample proved to be negative. The survey results indicate that AC bitumen roofing is not abundantly present at Vanuatu.

No friable asbestos was encountered during the survey at either Efate or Santo.

The survey of the islands of Efate and Santo covered 600 houses and the total number of houses was 21,055 on those two islands combined. This gives a margin of error for the survey of 3.94%. Based on this information it can therefore be said that there are about 35 houses with asbestos roofs and about 140 houses with asbestos cladding. The houses in the samples were not, however, selected randomly over the islands but were focussed on Port Vila and Luganville, which would skew the result. For example houses in rural areas tend to be constructed more of traditional local materials. It should also be noted that the sole example of an asbestos roof was in Luganville where the roof was scavenged from old WWII buildings.

An adjustment should be made to account for the fact that out of the 23 collected cement sheeting samples 11 returned positive. Therefore about 50% of the fibre-cement cladding on Vanuatu may not be asbestos. This would reduce the figures to about 18 houses with asbestos roofs and about 70 houses with asbestos cladding (not necessarily the same houses as those that have asbestos roofs).

If the result is extended to the total population of Vanuatu, then there would be 76-82 houses (say approximately 79) with asbestos roofs and 152-164 houses (say approximately 158) with asbestos cladding. This extrapolation is also speculative, however, as building conditions on the outer islands may be different from those on Efate and Santo.

Cost Estimates

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

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

Remediation Method	Cost per m^2 (face area) $US
Encapsulation	
Roofs:	
Encapsulate roof where there is no ceiling present below the roof	50.00
Encapsulate roof where there is an existing ceiling below the roof that needs to be removed and replaced	91.00
Cladding:	
Encapsulate wall cladding where there is no internal wall sheeting	26.00
Encapsulate wall cladding where there is internal wall sheeting in good condition, which means only the exterior needs to be encapsulated	18.00
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 removal and replacement rates assume asbestos waste disposal to a suitable nearby local landfill. If the waste needs to be exported or if sea disposal is being considered, then this will need to be costed as an extra.

Depending on the condition of the ACMs, encapsulation and / or specialist removal are proposed remediation options. An asbestos-free replacement will be necessary if removal is undertaken. The ACMs need to be disposed at the Bouffa Landfill (Efate) or at the Luganville Waste Disposal Site (Santo). Ideally a separate, closed off area within these landfills should be designated for asbestos disposal.

Ideally laws and regulations would be put in place to stop the import of new ACMs and regulate the present ACMs in Vanuatu. Compliance officers would need to be trained to recognize ACMs and to take the appropriate actions to deal with the potential hazards ACMs present.

The table below presents the recommended actions and indicative costs for Vanuatu.

Prioritised Recommended Actions and Indicative Costs

Location	Building Material Type	Risk Ranking Score	Area (m2)	Total Cost ($)
Presbyterian College	Cladding	25	2000	142,000
Malapoa College	Bitumen Roof	23	600	50,400
Malapoa College	Cladding	21	1000	71,000
Manganese Mine, Forari	Cladding and Roofing	21	7000	231,000
Paonangisu Health Centre	Cladding	19	2000	142000
Port Vila Central Hospital	Pipe Lagging	19	250	25000
Port Vila Central Hospital	Cladding	18	2400	170400
Port Vila Central Hospital	Vinyl Flooring	18	1333	106640
Ministry of Lands and Natural Resources	Cladding, gables, soffits	16	300	21300
Northern Provincial Hospital	Underground Pipes	15	Length Unknown	N/A
Chinese Hardware Store	Cladding	N/A	N/A	N/A

In March 2015 Vanuatu experienced the very severe Tropical Cyclone Pam, which caused extensive damage to Efate and several other islands. This cyclone is known to have damaged buildings that were covered by this survey including the some of the above buildings. This damage will have very likely made the asbestos situation worse than described in this report. Exposure levels will have been worsened and considerable asbestos debris will have been generated. A further visit is now needed to re-assess the situation in light of the cyclone and also to carry out any emergency asbestos relief that is needed. The report in Appendix 6 was prepared to assist with dealing with asbestos exposure during the cyclone relief work.

Recommendations

The following recommendations are therefore made:

A. Before any asbestos remediation work is carried out in Vanuatu a reassessment of the situation is needed in light of the damage caused by Cyclone Pam.
B. The high and moderate priority locations identified by this report should be remediated as well as lower priority ones if Cyclone Pam has increased the risk.

C. About 79 houses may have asbestos roofs and about 158 houses may have asbestos cladding in Vanuatu. Houses with asbestos cladding and/or roofing may also have been affected by Cyclone Pam and this also needs to be assessed. It is recommended that all houses with PACM on Vanuatu are tested for asbestos and that all the houses tested positive are notified and included in an awareness campaign. They should be remediated (i.e. the asbestos removed or encapsulated) where resources permit. If they have been damaged by Cyclone Pam then the damaged asbestos needs to be carefully dealt with.
D. If a large number of undamaged houses are found to contain asbestos cladding then encapsulation would probably be the most cost-effective option for remediation although ongoing management procedures then would be needed and re-encapsulation (i.e. re-painting) would probably be needed 10-15 years later. If a small number of houses are found to contain asbestos cladding then removal and replacement of the cladding should be considered. Damaged cladding should be removed.
E. Any asbestos roofs found on houses in Vanuatu should preferably be removed rather than encapsulated as encapsulation of roofs costs only a little less than removal and removal is a permanent solution.
F. Asbestos waste should be disposed of at the Bouffa Landfill in Efate and the Luganville Waste Disposal Site in Santo. Special provision should be made at each landfill for the receipt and management of asbestos waste, including setting up of special landfill cells for asbestos and establishing the procedure to immediately cover up asbestos wastes as they are received.
G. When remediation and disposal actions are undertaken, it is recommended that this is done together with the Department of Environment Protection and Conservation. This would allow officers to gain experience to manage similar projects in future.
H. Specialist supervision is also recommended to ensure that appropriate protection measures are implemented to eliminate the risks to workers, the environment and the surrounding population.
I. Suitable legislation should be enacted to prevent any further importation of asbestos into Vanuatu.

Contents

Definitions

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

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

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

Amosite: Brown or Grey Asbestos

Chrysotile: White Asbestos

Crocidolite: Blue Asbestos

PPE: Personal Protective Equipment

SMF: Synthetic Mineral Fibres

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

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

Hazard: Is a potential to cause harm.

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

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

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

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

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

CEL: Contract Environmental Limited

SPREP: Secretariat of the Pacific Regional Environment Programme

GPS: Global Positioning System

EMS: EMS Laboratories Incorporated

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

IANZ: International Accreditation New Zealand

1. Introduction

1.1 Purpose and Timing

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

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

The work was carried out by a consortium led by Contract Environmental Ltd and Geoscience Consulting (NZ) Ltd, under contract to the Secretariat of the Pacific Regional Environment Programme (SPREP), with funding provided by the European Union. Most of the information required for the Vanuatu survey was obtained in a field visit undertaken by Dirk Catterall and Ellen Clara between the 29th June and 9th of July 2014. The visit was organised through Vanuatu's Ministry of Lands and Natural Resources, Department of Environment and Conservation.

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 Vanuatu

Vanuatu (officially the Republic of Vanuatu) is an island nation located in the South Pacific Ocean. The archipelago, which is of volcanic origin, is some 1,750 kilometres (1,090 mi) east of northern Australia, 500 kilometres northeast of New Caledonia. It is east of Papua New Guinea, southeast of the Solomon Islands, and west of Fiji.

Vanuatu was first inhabited by Melanesian people. The first Europeans to visit the islands were a Spanish expedition that claimed the archipelago for Spain, as part of the colonial Spanish East Indies. It was named "Austrialia del Espiritu Santo". Europeans did not return until 1768 when the French visited the islands. In 1774 Captain Cook named the islands New Hebrides. In the 1880s, France and the United Kingdom claimed parts of the archipelago, and in 1906 they agreed on a framework for jointly managing the archipelago as the New Hebrides through a British–French Condominium. An independence movement arose in the 1970s, and the Republic of Vanuatu was founded in 1980.

Vanuatu's total area is roughly 12,274 square kilometres, of which its land surface is very limited (roughly 4,700 square kilometres). Most of the islands are steep, with unstable soils and little permanent fresh water. One estimate, made in 2005, is that only 9% of land is used for agriculture. The shoreline is mostly rocky with fringing reefs and no continental shelf, dropping rapidly into the ocean depths.

A map of Vanuatu is shown below in Figure 1.

Figure 1 – Map of Vanuatu

Vanuatu has six separate provinces and they are listed in Table 1 below with their 2009 Census Populations.

Table 1: Census Data

Province	Population (2009 Census)
Malampa	36724
Penama	30819
Sanma	45860
Shefa	78721
Tafea	32540
Torba	9359
Total	**234023**

The island of Efate, which contains the capital Port Vila, is in Shefa province and had a 2009 population of 65829. The island of Santo (in Sanma Province), which contains the next largest town Luganville, had a 2009 population of 39606.

In the 2009 Census, there were 47373 private houses in Vanuatu. Efate had 13190 houses and Santo had 7865 houses.

The climate is tropical, with about nine months of warm to hot rainy weather and the possibility of cyclones and three to four months of cooler, drier weather characterized by winds from the southeast. The days are cooler between April and September, and become hotter and more humid starting in October. The daily temperature ranges from 20°C to 32 °C).

Vanuatu has a long rainy season, with significant rainfall almost every month. The wettest and hottest months are December through April, which also constitute the cyclone season. The driest months are June through November.

In March 2015, Cyclone Pam devastated much of Vanuatu, caused extensive damage to all the islands and several deaths. Cyclone Pam is probably the worst natural disaster in Vanuatu's history. As a result of the cyclone, an urgent short summary was made of the asbestos arisings in Vanuatu, assist with the Cyclone Pam clean up. This short report is in Appendix 6.

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 asbestos survey is discussed in section 4 of the report, with the laboratory and residential 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 Vanuatu.

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

Section 11 contains a review of Vanuatu Policies and Legal Instruments.

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 Vanuatu included meetings with key government agencies, area-wide surveys across the main islands of the four states and specific investigations of key sites.

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

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 presumed asbestos containing material (PACM). Conclusions on any PACM observed in the photographs were to be verified during the surveys.

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.

2.2 Survey Coverage

This survey was based around a field visit to Vanuatu between the 29th June and 9th July 2014. The work carried out during the visit included meetings with key government agencies, surveys on the main islands of Efate and Santo, and specific investigations of 43 sites. The outer islands could not be assessed within the timeframe allowed by this project.

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

The statistical approach required that a random method was used for selecting residential buildings to be surveyed and included in the sample size. In practice this involved selecting a cluster of properties at random when viewed from the road. The surveyor then undertook a more detailed inspection of the properties. Where possible, samples of the building material were collected and tested in the field for indications of asbestos fibres.

2.3 Identification of Target Sites

The primary focus was on residential properties and public buildings that might present the most significant potential risks for public exposures. Therefore, a general survey of residential buildings was undertaken and representative samples of domestic construction materials were obtained, where possible, throughout the survey.

Thereafter, the surveyors attended meetings with representatives from various government departments, notably the:

- Ministry of Lands and Natural Resources, Department of Environment and Conservation,
- Ministry of Health, Department of Public Health, Environmental Health Unit,
- Luganville Municipal Council (Town Planning, & Waste Managing); and
- Sanma Provincial Government Council

The representatives provided information regarding asbestos regulations, known state assets containing asbestos and the development of a government policy specific to asbestos.

The remainder of the survey consisted of inspecting government owned and semi-government facilities including (but not limited to) schools, airports, hospitals/healthcare centres, power stations, landfills and government administration buildings. Non-governmental infrastructures were inspected as well, when access was permitted. These included (but were not limited to) hardware stores, churches, resorts, mining infrastructure and harbour infrastructure. The surveys of the inspected government owned, semi-government owned and non-governmental structures are available via SPREP.

Approximately 270 residential structures were inspected in the urban areas, i.e. in Port Vila (Efate) and in Luganville (Santo) as part of the area wide investigations. In addition to this, the structures in 7 rural villages along the Ring Road in Efate and the structures along the East Coast Road between Luganville and Port Olry in Santo were inspected. The results of the area-wide investigations are presented in 15 site reports (refer to Tables 6 and 7). It is therefore concluded that a clear understanding of the common buildings materials, both in the urban and rural areas, was obtained.

2.4 Site Assessment Data Capture

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

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

2.5 Sample Collection Methodology

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

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

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

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

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

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

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

The samples were collected in accordance with the following procedures:

- Sampling personnel must wear adequate personal protective equipment (PPE), as determined by the risk assessment (disposable overalls, nitrile gloves, overshoes and a half face respirator with P3 filters);

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

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

2.6 Sample Laboratory Analysis

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

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

3.0 Risk Assessment Methodology

3.1 Description

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. They take into account not only the condition of the asbestos, but the likelihood of people being exposed to the fibres.

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

The risk assessment approach has two elements, the first algorithm is an assessment of the type and condition of the ACMs or presumed ACMs, and their ability to release fibres if disturbed. The final score for each ACM or presumed ACM depends on the type of ACM i.e. concrete 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 or many. The setting assessment therefore considers the normal occupant activity in that area of the site and the likelihood of disturbance. Each ACM is again scored and these scores are added to those for the material assessment to produce a total score.

3.2 ACM Assessment

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

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

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

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

- scores of 4 or less are very low risk.

The material assessment algorithm shown in MDHS100 is reproduced in Table 2.

Table 2: MDHS100 Material assessment algorithm

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

3.3 ACM Setting Assessment

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

The removal of maintenance activity from the algorithm is because the level of awareness of asbestos by the building management or owners at the majority of surveys is 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 by the surveying team and with the building management contacts was often extremely difficult to quantify.

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

- Occupant activity
- Likelihood of disturbance
- Human exposure potential

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

Occupant activity

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

Likelihood of disturbance

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

Human exposure potential

The human exposure potential depends on three factors:

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

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

The algorithm adopted for ranking the ACMs setting is shown in Table 3.

Table 3: HSG227 (2002) Priority Assessment Algorithm

Assessment factor	Score	Examples of score variables
Normal occupant activity		
Main type of activity in area	0	Rare disturbance activity (eg little used store room)
	1	Low disturbance activities (eg office type activity)
	2	Periodic disturbance (eg industrial or vehicular activity which may contact ACMs)
	3	High levels of disturbance, (eg fire door with asbestos insulating board sheet in constant use)
Likelihood of disturbance		
Location	0	Outdoors
	1	Large rooms or well-ventilated areas
	2	Rooms up to 100 m2
	3	Confined spaces
Accessibility	0	Usually inaccessible or unlikely to be disturbed
	1	Occasionally likely to be disturbed
	2	Easily disturbed
	3	Routinely disturbed
Extent/amount	0	Small amounts or items (eg strings, gaskets)
	1	<10 m2 or <10 m pipe run.
	2	>10 m2 to ≤50 m2 or >10 m to ≤50 m pipe run

Assessment factor	Score	Examples of score variables
	3	>50 m2 or >50 m pipe run
Human exposure potential Number of occupants	0 1 2 3	None 1 to 3 4 to 10 >10
Frequency of use of area	0 1 2 3	Infrequent Monthly Weekly Daily
Average time area is in use	0 1 2 3	<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 score and risk rating in order to rank the sites in order of priority for management and/or remedial action. The scoring system is detailed in Table 4.

Table 4: 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	Nov-15	17 - 23	Moderate risk
5 – 6	8-Oct	Dec-16	Low risk
0 – 4	0 – 7	0 – 11	Very low risk

4.0 Asbestos Survey

4.1 Residential Survey

The survey was carried out on the islands of Efate and Santo and based on the 2009 Census figures the figures for population and number of houses is presented in Table 5 below. On Efate 330 houses were inspected and on Santo 270 houses were inspected. This was a "slow drive-by" inspection of residences.

Table 5 – Statistical Data Relevant to the Survey

Location	Population	Houses	Houses Surveyed
Efate	65829	13190	400
Santo	39606	7865	200
Other Islands	128588	26318	Nil
Total	234023	47373	600

NB: Source is the 2009 Census of Vanuatu

4.1 Targeted Survey Coverage

The survey covered the islands of Efate and Santo. External visual assessments of building materials were completed in those areas to gain an understanding of the commonly used building materials. Detailed investigations were undertaken, where possible, when PACMs were observed from the exterior of the property. The potential therefore exists for asbestos materials to have been present at a greater number of residential properties than would be concluded from this survey, but due to the time constraints of the survey, it would have been unrealistic to undertake exhaustive door to door assessments.

The remainder of the survey consisted of visits to government buildings, including 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, airports, hospitals/healthcare centres, power stations, landfills and government administration buildings. Non-governmental infrastructures were inspected as well, when access was permitted. These included (but were not limited to) hardware stores, churches, resorts, mining infrastructure and harbour infrastructure.

The visits consisted of an introduction regarding the purpose of the project and a request for a tour of the facilities. A visual assessment of construction materials was then undertaken while being guided through the buildings.

A total of 37 site investigations were conducted at Efate. These included 7 rural villages along the Ring Road, residential properties inspected in several residential areas within Port Vila, 5 hardware stores, 6 government administration buildings, 1 hospital, 1 health centre, 7 schools and 7 "other" sites. The specific sites visited are listed in Table 6. This table also shows if PACM were encountered or not and if samples were collected. ACM were with certainty visually identified at 5 sites. In total 330 residential properties were inspected on Efate.

A total of 21 site investigations were conducted at Santo. These included locations in the rural villages along the East Coast Road between Luganville and Port Olry and several residential areas within Luganville including residential properties, 3 hardware stores, 1 government administration buildings, 1 hospital, 3 schools and 8 “other” sites. The specific sites visited are listed in Table 7. This table also shows if PACM were encountered or not and if samples were collected. ACMs were visually identified, with certainty, at 3 sites. A total 270 residential sites were inspected on Santo.

Table 6: Specific Sites Visited in Vanuatu, Efate.

Site details	Observations	Collected samples
Rural Villages		
Eton	PACMs encountered	S27, S28
Emua	No PACMs encountered	-
Epau	No PACMs encountered	-
Pang Pang	ACMs encountered	S29
Paonangisu	PACMs encountered	None collected
Siviri	No PACMs encountered	-
Tanoliu	No PACMs encountered	-
Port Vila Residential Areas		
Residential area 2014/07/01 (approximately 30 structures inspected)	No potentially ACMs encountered	-
Residential area 2014/07/03 (approximately 200 structures inspected)	ACMs encountered	S34
Residential houses by airport 2014/07/02 (approximately 40 structures inspected)	PACMs encountered	None collected
Hardware Stores		
Chinese Hardware Store	PACMs encountered	S13B
Hardware Store VilaDistribution	No PACMs encountered	-
Port Vila New Hardware	No PACMs encountered	-
Hardware Store Wilco	No PACMs encountered	-
Carpenters Hardware Store	No PACMs encountered	S14, S15
Government Administration Buildings		
Ministry of Lands and Natural Resources	PACMs encountered	S1, S2, S3, S4, S5
Vanuatu Meteorology & Geo-Hazards Department	PACMs encountered	None collected
Public Library	PACMs encountered	S9, S10

Site details	Observations	Collected samples
Ministry of Buildings	PACMs encountered	S16
Ministry of Health	PACMs encountered	S21
Old Efate Island Court	PACMs encountered	None collected
Hospitals / Health Care Centres		
Paonangisu Health Centre	PACMs encountered	S33
Port Vila Central Hospital	ACMs encountered	S17, S18, S19, S20
Schools		
Port Vila Central School	PACMs encountered	S23, S24
Presbyterian College	PACMs encountered	S32
Malapoa College	ACMs encountered	S6, S7, S8
Lycee Bougainville	PACMs encountered	S11, S12, S13A
USP Emalus Campus	PACMs encountered	S22
Ulei Junior Secondary School	No PACMs encountered	-
Vila East Kindergarten	PACMs encountered	S26
Other		
Bouffa Landfill	No PACMs encountered but likely to be present.	-
EU building close to Port Vila airport	PACMs encountered	None collected
Holiday Inn Resort	No PACMs encountered	-
House with AC cladding	PACMs encountered	None collected
Manganese Mine Forari	ACMs encountered	S30 and S31
Port Vila Power Plant	No access permitted	-
Residential demolition site	PACMs encountered	S25

Table 7: Specific Sites Visited in Vanuatu, Espiritu Santo.

Site Name	Observations	Samples collected
Rural and Urban residential areas		
Structures along the eastern road		
from Luganville to Port Olry	No PACMs encountered	None collected
(Approximately 50 Structures inspected)		
Residential dwelling with WWII sourced materials and surrounding area	ACMs encountered	S39 and S40

Site Name	Observations	Samples collected
(Approximately 25 structures inspected)		
Residential area Centre – Northeast Luganville (Approximately 70 structures inspected)	PACMs encountered	None collected
Residential area East Luganville (Approximately 30 structures inspected)	No PACMs encountered	None collected
Residential Centre – West Luganville (Approximately 150 structures inspected)	PACMs encountered	S49
Hardware stores		
Wilco Hardware	No PACMs encountered	S43
Santo Hardware	No PACMs encountered	S48
Supercool	PACMs encountered	S45
Hospitals / Health Care Centres		
Northern Provincial Hospital, Ministry of Health	ACMs encountered	S35, S36, S37 and S38
Government Administration Buildings		
Sanma Province Headquarters	PACMs encountered	S50
Schools		
Vanuatu Agricultural College	PACMs encountered	S41 and S42
Santo East School	PACMs encountered	S44
School St Michel	No PACMs encountered	
Other		
Meat Factory	PACMs encountered	S51
Harbour Infrastructure	No PACMs encountered	
Luganville Waste Disposal Site	No PACMs encountered but likely to be present	
Luganville Airport	PACMs encountered	S46
Luganville Power Plant	PACMs encountered	S52
Residential dwelling with AC sheeting	ACMs encountered	S47
Residential dwelling Luganville	No PACMs encountered	
Storage Units WWII	No PACMs encountered	

5.0 Laboratory Results and Findings

5.1 Laboratory Results

A total of 53 samples were collected in the Vanuatu survey of which 35 were collected at Efate and 18 at Santo. The presence of asbestos was confirmed in 10 samples collected at Efate and in 5 samples collected at Santo. Copies of the laboratory reports are given in Appendix 4 of this report. Five sites at Efate and three sites at Santo were encountered where laboratory testing was not required to confirm the presence of asbestos.

The sites where the presence of ACM was confirmed, visually or though the laboratory test results, are summarised in table 8. This table also presents the type of ACM, the location, the quantity, the condition, the potential receptors, the risk and the indicative cost of remediation.

Table 8 – Summary of Results

Sample No	Location	Type	Condition	Quantity (m2)	Result
S31	Pang Pang Residential (sourced from nearby Forari Mine)	Roofing	Damaged	25	20% Chrysotile
S13B	Chinese Hardware Store, Elluk Rd (Routine Sale Item)	New Cladding	Undamaged	1 sheet but may be lots more	20% Chrysotile
S2	Ministry of Lands and Natural Resources	Cladding, gables and soffits	Mixed - some badly damaged		15% Chrysotile
S33	Paonangisu Health Centre	Cladding	Undamaged	2000	20% Chrysotile
S17	Port Vila Central Hospital	Cladding Walkways	Mixed - some damaged	2000	15% Chrysotile
S19	Port Vila Central Hospital	Vinyl Flooring in Theatre Corridor (only 1 of 3 positive)		4000 m2 of different types	One of three samples positive
No sample collected	Port Vila Central Hospital	Services and heating pipes with AC rope lagging	Mixed - some damaged	Unknown length	Visual confirmation only
S32	Presbyterian College	Soffits around most classrooms	Undamaged	2000	20% Chrysotile
S6	Malapoa College	Cladding	Mixed - some badly damaged	500	10% Chrysotile and 10% Amosite
S7	Malapoa College	Cladding	Mixed - some badly damaged	500	15% Chrysotile and 5% Amosite
S8	Malapoa College	Bitumen Roof	Damaged	600	60% Chrysotile

Sample No	Location	Type	Condition	Quantity (m2)	Result
S31	Old Manganese Mine	Roofing and Cladding - All Super 6, on four remaining structures	Badly Damaged	7000	20% Chrysotile
S39	Residence in Luganville with WW2 sourced asbestos	Cladding	Damaged	25	10% Chrysotile and 2% Amosite
S40	Residence in Luganville with WW2 sourced asbestos	Roofing	Damaged	50	20% Chrysotile and 2% Amosite
S49	Residential Centre, West Luganville - Shed next to Church	Cladding	Damaged	40	20% Chrysotile
S37	Western Part of Hospital Grounds	Cement Piping - mostly underground and not visible	Unknown	Unknown length	20% Chrysotile
S47	Residence in Luganville	Cladding	Badly Damaged	100	15% Chrysotile and 2% Amosite

The following photos below illustrate the positive sample locations identified above.

Photo 1 below is of a residence in Pang Pang with an asbestos roof. The dwelling owner reported that the roofing material had been resourced from the nearby Forari Mine, which returned a positive sample.

Photo 2 below shows a residential demolition site in Rue de Wales where asbestos cement (AC) cladding was lying spread out on the ground. It was located in a residential area with a playground adjacent to the north and Port Vila's main hospital to the east.

Photo 1 - Pang Pang Residential

Photo 2 – Residential Demo Site Rue de Wales

Photo 3 below shows an AC sheet at the entrance to a Chinese Hardware Store (MOK 3) in Elluk Rd. The shop manager had previously reported that he sometimes sells asbestos cement sheeting but that he did not have any in stock at the moment. The above panel was then found and sampled.

Photo 4 shows AC cladding on the Ministry of Land and Natural Resources building at Port Vila. The AC sheeting was confined mostly to the outside gable and soffits, although limited quantities were also used as wall cladding.

Photo 3 – Hardware Store New Sheeting **Photo 4 – Ministry of Lands and Nat Resources**

Photo 5 below shows AC cladding on the Paonangisu Health Centre. The sample was collected at the reception area but ACM has presumably been used on all the five structures present at the site.

Photos 6, 7 and 8 were all taken at the Port Vila Central Hospital. Photo 6 shows the covered walkways connecting the building. Photo 7 shows an example of the vinyl floor. Only one of the three sampled floors returned a positive result and this sample was collected from the theatre corridor. Photo 8 shows the services and heating pipes running the length of the covered walkways connecting the buildings. Some of these pipes are lagged with asbestos lagging, as confirmed by visual inspection.

Photo 5 – Paonangisu Health Centre **Photo 6 – Port Vila Central Hospital**

Photo 7 – Port Vila Central Hospital **Photo 8 – Port Vila Central Hospital**

Photo 9 shows the soffit material surrounding most of the classrooms at the Presbyterian College. Photos 10 and 11 are from the Malapoa College. Photo 10 shows AC cladding material which is applied to walls throughout the whole college. Photo 11 shows the roof with bitumen coating, which has been applied to roofs on all four buildings. Photo 12 has been taken at the abandoned manganese mine in Forari, and there is AC cladding and roofing on four remaining structures. The site is abandoned and in a rural area.

Photo 9 – Presbyterian College **Photo 10 - Malapoa College**

Photo 11 – Malapoa College **Photo 12 – Manganese Mine Forari**

Photos 13 -16 were all taken in Luganville. Photo 13 shows AC cladding on a residence and Photo 14 shows the asbestos roofing on the same dwelling. The house was made of concrete, except for the roof and several sheets. The owner reported that he sourced these asbestos materials from other WWII structures in the neighbourhood. He stated that he had also built a shelter out of these materials. It was unclear where this shelter was located. A family member pointed out that most of the houses in the surrounding area (approximately 100 dwellings) originally had similar roofing but that most of them had been replaced over the years. He was not sure where the asbestos had been deposited. Approximately 25 structures in the immediate surrounding area were inspected but no other PACMs were encountered.

Photos 13 and 14 – Residence in Luganville

Photo 15 – Shed, West Luganville

Photo 16 – Northern Provincial Hospital Piping

5.2 Residences

The survey of the islands of Efate and Santo covered 600 houses and the total number of houses was 21,055 on those two islands combined. This gives a margin of error for the survey of 3.94%. Based on this information it can therefore be said that there are about 35 houses with asbestos roofs and about 140 houses with asbestos cladding. The houses in the samples were not, however, selected randomly over the islands but were focussed on Port Vila and Luganville, which would skew the result. For example houses in rural areas tend to be constructed more of traditional local materials. It should also be noted that the sole example of an asbestos roof was in Luganville where the roof was scavenged from old WWII buildings.

An adjustment should be made to account for the fact that out of the 23 collected cement sheeting samples 11 returned positive. Therefore about 50% of the fibre-cement cladding on Vanuatu may not be asbestos. This would reduce the figures to about 18 houses with asbestos roofs and about 70 houses with asbestos cladding (not necessarily the same houses as those that have asbestos roofs).

If the result is extended to the total population of Vanuatu, then there would be 76-82 houses with asbestos roofs and 152-164 houses with asbestos cladding. This extrapolation is also speculative, however, as building conditions on the outer islands may be different from those on Efate and Santo.

5.3 General Comments on the Results

General building style

The majority of structures observed, both at Efate and Santo, have a concrete, timber or metal structure. Corrugated iron or tin are the materials mostly installed as roofing on residential dwellings. Bituminous membrane is sometimes applied, mainly on larger structures. Plywood, masonite, timber or cement sheets are used as cladding. In Santo also weatherboard was noted as a common cladding material. The flooring inside is mostly concrete, ceramic tiles or vinyl. Especially in the villages and rural areas, a considerable amount of dwellings is still constructed in a traditional style with branches and leaves sourced from the jungle.

Relation of structure age to asbestos presence

Most of the visited public buildings were built during colonial times by either the French or the British; from 1906 until independence in 1980 Vanuatu was governed by the British-French Condominium. The survey results show that buildings constructed during colonial times are likely to contain ACMs (e.g the Malapoa College, the Ministry of Lands and Natural Resources, Forari Mine infrastructure).

Mr Leodoro (Environmental Officer, Ministry of Land and Natural Resources) reported that most schools within Port Vila have been built during the nineties. Only the visited Malapoa College was built during colonial times. Because ACMs were only encountered at the this school and not at the other visited schools within Port Vila (i.e. Port Vila Central School, Lycee Bougainville, USP Emalus Campus, Ulei Junior Secondary School and Vila East Kindergarden), the survey results show that ACMs are unlikely to be found in the post 1980 school buildings within Port Vila.

A total of eight hardware stores (five in Port Vila and three in Luganville) were visited and a sample of the cement cladding available for purchase was collected at most of them. AC cement sheeting was only identified at one of them; Chinese Hardware store in Port Vila - MOK 3. This proves that ACMs are still being imported into Vanuatu. The presence of ACM can therefore not be ruled out in more recent buildings (e.g. Presbyterian College).

Evidence was found that some of the remaining WWII structures of the Allied forces at Santo contain ACMs. However, very little of these ACMs remain: only one residential dwelling was encountered in Luganville with AC roofing and cladding sourced from a WWII structure. Residents reported that most the houses in the surrounding area (approximately 100 dwellings) used to have AC roofing but that most of it had been replaced over the years. It is unclear where the ACMs have been deposited.

Encountered ACMs

The most abundantly encountered AC building material was **cement sheeting**. This AC cement sheeting is mostly applied as wall cladding and can also be encountered in soffits, gables, pathways connecting buildings, etc. The conditions in which the AC cement sheets were encounter varied from badly damaged (residential demolition site in Port Vila and a residential dwelling in Luganville) to very good (the Presbyterian College and the Paonangisu Health Centre).

Out of the 23 collected cement sheeting samples 11 returned positive. The positive samples were mostly collected from what appeared to be the older cement sheets. Based on the area surveys in urban residential neighbourhoods, it was concluded that approximately 1 out of 20-30 residential dwellings at Efate and 1 out of 30-40 residential dwellings at Santo contains asbestos, mostly in the form of AC sheets. This numbers are lower in the rural areas.

Vinyl flooring was abundantly present and a total of 20 samples were collected. Only one sample returned positive: S19 collected at the Port Vila Central Hospital contained 2% chrysotile. This suggests that a very limited quantity of the vinyl flooring used at Vanuatu contains asbestos.

The presence of AC **cement pipes** was proven at the Northern Provincial Hospital at Santo. No further information was collected about the presence of AC cement pipes and therefore large uncertainty remains about to what expend these kind of pipes have been used in Vanuatu.

Super 6 roofing was only encountered at two places; at the Forari Mine infrastructure (Efate) and on one residential dwelling in Luganville with Super 6 roofing and cement cladding sourced from a WWII structure. The survey results show that Super 6 roofing is not abundantly present at Vanuatu.

AC pipe lagging was only encountered at the Port Vila Main Hospital. Pipe lagging was not encountered at other inspected sites. The survey results show that AC pipe lagging is unlikely to be abundantly present at Vanuatu.

AC Bitumen roof was only encountered at the Malapoa College. Bitumen roofing was only at one other location sampled (Lycee Bougainville) but this sample proved to be negative. The survey results indicate that AC bitumen roofing is not abundantly present at Vanuatu.

No friable asbestos was encountered during the survey at either Efate or Santo.

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 10.

Table 10: Risk Ranking Scores

Location	Type	Risk Ranking Scores		
		ACM	Setting	Total Score
Presbyterian College	Cladding	8	17	25
Malapoa College	Bitumen Roof	7	16	23
Malapoa College	Cladding	6	15	21
Manganese Mine, Forari	Cladding and Roofing	9	12	21
Paonangisu Health Centre	Cladding	5	14	19
Port Vila Central Hospital	Pipe Lagging	8	11	19
Port Vila Central Hospital	Cladding	5	13	18
Port Vila Central Hospital	Vinyl Flooring	4	14	18
Ministry of Lands and Natural Resources	Cladding, gables, soffits	5	11	16
Northern Provincial Hospital	Underground Pipes	4	11	15
Chinese Hardware Store	Cladding	N/A	N/A	N/A

The risk assessment scoring and prioritisation presented in Table 10 above indicates that there are 8 high or moderate risk ACM sites which would benefit from additional ACM management. Two sites are considered to present a low to very low risk to occupants and the public in their current state, but can pose greater risks in the future if they are not managed appropriately. The Chinese Hardware site cannot be evaluated as sheets are being sold and it is not known where they will end up.

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. 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 above are administrative controls that can assist with effectively managing the risk ACM presents. However, in certain situations, administrative 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 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.

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

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

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

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

1. Identification:

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

2. Preparation:

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

3. Removal

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

4. Decontamination:

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

5. Waste Disposal:

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

8.0 Selection of Possible Remedial Options

8.1 General

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

Figure 2: ACM Management Flow Chart

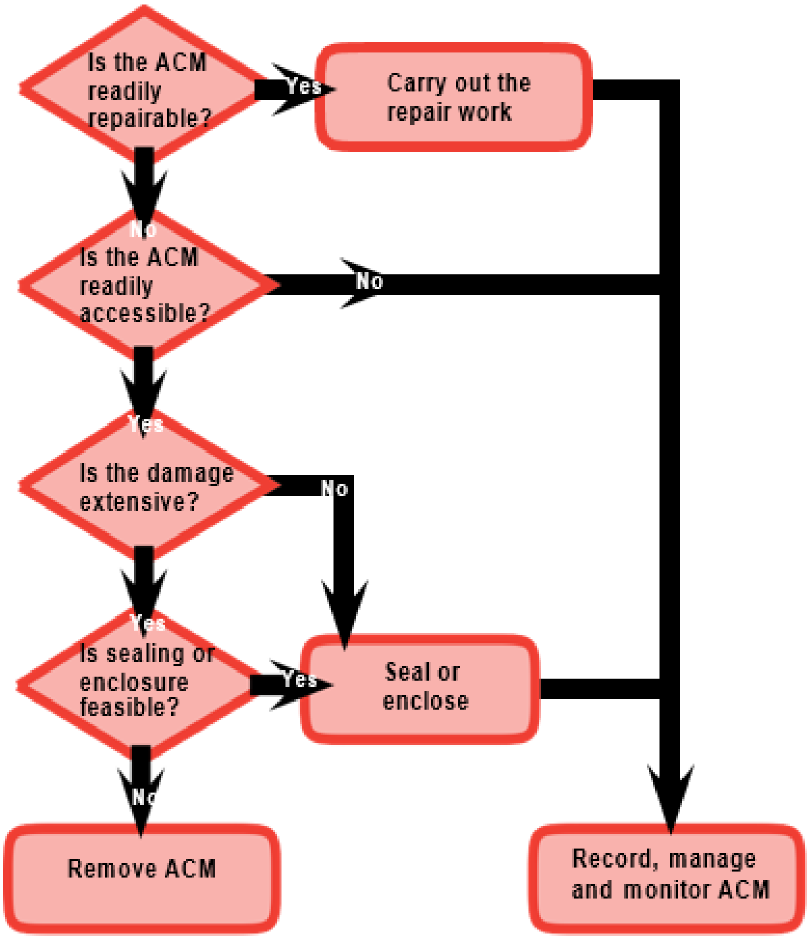

Figure adapted from: UKHSE HSG227 'A Comprehensive Guide to Managing Asbestos in Premises'.

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 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 17 & 18 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 10 and 11 below. There are special ones for roofing sizes.

Photos 17 and 18: 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 Vanuatu

Table 11 below shows the sites on Vanuatu that returned a positive result for ACM and the most suitable, cost effective remedial options based on the flow chart process described above.

Table 11: Possible Remedial Options for Vanuatu

Location	Building Material Type	Risk Ranking Score	Applicable Remedial Options			
Presbyterian College	Cladding	25	**Repair**	**Isolate**	**Encap**	**Remove**
Malapoa College	Bitumen Roof	23	×	×	×	✓
Malapoa College	Cladding	21	×	×	×	✓
Manganese Mine, Forari	Cladding and Roofing	21	×	×	×	✓

Location	Building Material Type	Risk Ranking Score	Applicable Remedial Options			
Paonangisu Health Centre	Cladding	19	×	×	×	✓
Port Vila Central Hospital	Pipe Lagging	19	×	×	×	✓
Port Vila Central Hospital	Cladding	18	×	×	×	✓
Port Vila Central Hospital	Vinyl Flooring	18	✓	×	×	×
Ministry of Lands and Natural Resources	Cladding, gables, soffits	16	×	×	✓	✓
Northern Provincial Hospital	Underground Pipes	15	×	✓	×	✓
Chinese Hardware Store	Cladding	N/A	N/A	N/A	N/A	N/A

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. Pacific countries that are party to the various relevant conventions are set out in Table 12 below as at 2011.

Table 12: Summary of asbestos related conventions and protocol

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		Y			
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'

Palau became a party to the Basel Convention in 2011 but is not a party to any of the other conventions above.

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 below.

The Basel and Waigani Conventions are relevant to the issue of export of waste to another country and are also discussed below.

9.2 Local Burial

In order for 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 may be necessary to determine if this is the case.

9.3 Disposal at Sea

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

Annex 1 to the Protocol covers the following wastes

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

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

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

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

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

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

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

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

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

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

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

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

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

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

9.4 Export to Another Country

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

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

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

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

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

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

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

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

9.5 Disposal Options Suitable for Vanuatu

At Efate, ACMs should be disposed at the Bouffa Landfill located approximately 6 km east of Port Vila. The functioning of this landfill is semi-aerobic with clay lining at the base. The waste is compacted with a crusher and covered up with soil. A leachate catchment pond is present. Currently there is no separation of hazardous wastes other than quarantine waste and medical waste which gets burnt in a hole in a separate area of the landfill. This landfill is not fenced off. Information was provided that the dump site is to be moved to an as yet undetermined location within a few years.

At Santo, ACMs should be disposed at the Luganville Waste Disposal Site located approximately 2.5 km north of Luganville. The landfill is not lined at the base, is full aerobic and uses little or no soil cover. Metal, hospital, paper and quarantine waste are to a certain extent collected separately. The hospital and quarantine waste gets burned on the ground. The site is relatively well enclosed with wires separating it from the surrounding farming land. There are also plans for this landfill to halt and relocate the dumping activities to an as yet undetermined location.

It would be advisable to create a separate, closed of area, to dispose ACMs at both landfills.

10.0 Cost Considerations

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

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:

Roof Encapsulation

Costs:

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

Assumptions:

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

Cladding Encapsulation

Costs:

- Encapsulate wall cladding where there is no internal wall sheeting: USD25.92/m2 (face area)

- Encapsulate wall cladding where there is internal wall sheeting in good condition, which means only the exterior needs to be encapsulated: USD17.92/m2 (face area)
- Encapsulate wall cladding where there is internal wall sheeting in poor condition, which must be treated as asbestos contaminated and removed and replaced: USD65.92/m2 (face area)

Assumptions:

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

10.2 Removal and Replacement

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

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

<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 waste secure wrapping and disposal to a suitable nearby local landfill. If the waste needs to be exported or if sea disposal is being considered, then this will need to be costed as an extra.

Cladding Removal and Replacement

Costs:

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

Assumptions:

- Rates assume that the existing cladding is replaced with a cement fibre board with treated timber battens to make water tight. An allowance has also been made to wrap the building in foil and to apply two coats of paint to complete the works.
- Rates have been built up based on a single storey building with a floor area of 14m x 12m and walls 2.4m high. Extra will be required for scaffolding for buildings greater than 1 storey high.
- Rates assume that work is done in a tradesman like fashion to New Zealand or Australian standards, including compliance with applicable safety requirements relating to working at height and working with asbestos.
- Rates allow for an independent SPREP appointed representative to oversee works to ensure quality, safety and commercial requirements are complied with.
- Rates do not allow for any costs relating to disruption of the usual activities undertaken in the building being worked on – eg moving furniture in and out.
- A 10% contingency has been allowed for tidying up any damaged or inadequate framing.
- Rates are approximate only and there will be country specific variances depending on the availability of resources and materials.
- Rates assume asbestos waste secure wrapping and disposal to a suitable nearby local landfill. If the waste needs to be exported or if sea disposal is being considered, then this will need to be costed as an extra.

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

Remediation Method	Cost per 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 costed as an extra.

10.3 Local Contractors

Possible Contractors

The contacts of four contractors in Port Vila, Efate were obtained through an informal contact.

First Name	Last name	Phone	Mobile	e-mail address	Company	Title
Tony	Care	+678 24934	+678 774 3439	fletcher@telsat.vu	Fletcher Construction Company	Construction Management
Greg	Lee			xtsea@vanuatu.com.vu	Construction Works	Construction Management
Danny	Amanaki	+678	+678		Kramer	Engineering

First Name	Last name	Phone	Mobile	e-mail address	Company	Title
		23457 +678 23403	557 5075		Ausenco	
Manasseh	Tary	+678 23457 +678 23403		Manasseh.tary@kramerAusenco.com	Kramer Ausenco	Engineering

The details of one contractor in Luganville, Santo were obtained - Patrick Bill. Mr Bill's references are appended in Appendix 2. Patrick advised that the price for a labour worker is about 3,000 Vatu per person per day at Luganville.

Local Cost Information

The costs associated with the remediation and removal of ACMs and a plan of action were discussed with the representatives of the Department of Environment Protection and Conservation on 1 July 2014. These were the points that were raised during this meeting:

- We were advised not to engage companies but to contract individuals. The reason for this is that most companies are not to be trusted to pay their employees and often go bankrupt after a few years.
- A team of one supervisor and five workers would be ideal to undertake the works. Allow 4,000 VUV (41.20 USD) per day per labour worker. Allow 6,000 VUV (61.79 USD) per day per supervisor. (Private companies are likely to charge less, approximately 2,000 VUV-20.26 USD per day per labour worker).
- The works should be paid "danger money" to give an incentive when working at more dangerous sites, i.e. when friable asbestos would be present.
- Because there is no weighbridge at the Bouffa Landfill, the disposal costs are defined by the vehicle size. Allow 1,000 VUV (10.30 USD) per pick-up and 3,000 VUV (30.90 USD) for a large truck.
- Work weeks in Vanuatu are from Monday to Saturday.
- The price to rent a large truck per day would be approximately 15,560 VUV (150 USD) per day. The office truck from the Department of Environment Protection and Conservation would be available without charge.
- The instalment of a fence to exclude the area for asbestos disposal from the rest of the landfill would be advisable.
- Training should be paid to give an incentive to the officers. The cost would be around 3,000 VUV (30.90 USD) to 5,000 VUV (51.49 USD) per person per day.
- The cost for petrol and personal protection equipment should be taken into account.

Media cost; to place an advertisement in the paper and play an add on the radio, would be around 20.000 VUV (206 USD)

11.0 Review of Relevant Local Issues

11.1 Relevant National Laws and Regulations

Discussions with representatives from the Department of Environment Protection and Conservation indicated that no regulations specific to asbestos have been developed and that no laws or regulations are in pace to prevent the import of ACMs in Vanuatu.

The Pollution (Control) Act no. 10 of 2013 was published in the Republic of Vanuatu Official Gazette 27 June 2014. This Act aims to control the discharge and emission of pollution in Vanuatu. Although asbestos is not literally named, this act describes a hazardous substance as “any substance which is, or which had the potential to be, toxic or poisonous, or which may cause injury or damage to human health or to the environment, including all persistent organic pollutants”. Asbestos could therefore potentially be regulated through this Act as it characteristics corresponds to the definition of a hazardous substance provided in the Act.

The representatives of the Department of Environment Protection and Conservation expressed their interest in explicitly including asbestos into the Pollution Control Act and to add ACMs to the Customs declaration list in order to control and discourage the use of ACMs in Vanuatu. Ideally, laws and regulations should be put in place to forbid the import of ACMs.

International Conventions

Vanuatu has ratified the Waigani Convention to ban the importation into Forum Island Countries of Hazardous and Radioactive Wastes and to Control the Trans-boundary Movement and Management of Hazardous Wastes within the South Pacific Region.

Vanuatu is party of the London Convention and Protocol, the Convention on the prevention of marine pollution by dumping of wastes and other matter.

Vanuatu is not party to the Rotterdam Convention, the Basel Convention or the Noumea Convention.

11.2 Relevant National Programmes and Policies

Several governmental officials indicated that both the government and the general public of Vanuatu are mostly ignorant of the potential danger that ACMs present. Several government officials, especially the representatives of the Department of Environment Protection and Conservation, expressed their interest in launching a public information campaign.

12.0 Recommended Actions for Minimising Asbestos Exposures

12.1 Discussion

Depending on the condition of the ACMs, encapsulation and / or specialist removal are proposed remediation options. Suitable replacement materials will be necessary if removal is undertaken. The ACMs need to be disposed at the Bouffa Landfill (Efate) or at the Luganville Waste Disposal Site (Santo). Ideally a separate, closed off area within these landfills should be designated to asbestos disposal.

When remediation and disposal actions are undertaken, it would be useful this is done together with the Department of Environment Protection and Conservation. This would allow officers to gain experience to manage similar project in future. Specialist supervision is recommended to ensure that appropriate protection measures are implemented to eliminate the risks to workers, the environment and the surrounding population. As no regulations currently exist, the remediation methods can be easily implemented without the need for permits.

Ideally laws and regulations would be put in place to stop the import of new ACMs and regulate the present ACMs in Vanuatu. Compliance officers would need to be trained to recognize ACMs and to take the appropriate actions to deal with the potential hazards ACMs present.

Table 14 presents the recommended actions and indicative costs for Vanuatu.

Table 14: Prioritised Recommended Actions and Indicative Costs

Location	Building Material Type	Risk Ranking Score	Area (m2)	Total Cost ($)
Presbyterian College	Cladding	25	2000	142,000
Malapoa College	Bitumen Roof	23	600	50,400
Malapoa College	Cladding	21	1000	71,000
Manganese Mine, Forari	Cladding and Roofing	21	7000	231,000
Paonangisu Health Centre	Cladding	19	2000	142000
Port Vila Central Hospital	Pipe Lagging	19	250	25000
Port Vila Central Hospital	Cladding	18	2400	170400
Port Vila Central Hospital	Vinyl Flooring	18	1333	106640
Ministry of Lands and Natural Resources	Cladding, gables, soffits	16	300	21300
Northern Provincial Hospital	Underground Pipes	15	Length Unknown	N/A

Location	Building Material Type	Risk Ranking Score	Area (m2)	Total Cost ($)
Chinese Hardware Store	Cladding	N/A	N/A	N/A

In March 2015 Vanuatu experienced the very severe Tropical Cyclone Pam, which caused extensive damage to Efate and several other islands. This cyclone is known to have damaged buildings that were covered by this survey including the some of the above buildings. This damage will have very likely made the asbestos situation worse than described in this report. Exposure levels will have been worsened and considerable asbestos debris will have been generated. A further visit is now needed to re-assess the situation in light of the cyclone and also to carry out any emergency asbestos relief that is needed. The report in Appendix 6 was prepared to assist with dealing with asbestos exposure during the cyclone relief work.

12.2 Recommendations

The following recommendations are therefore made:

a. Before any asbestos remediation work is carried out in Vanuatu a reassessment of the situation is needed in light of the damage caused by Cyclone Pam.
b. The high and moderate priority locations identified by this report should be remediated as well as lower priority ones if Cyclone Pam has increased the risk.
c. About 79 houses may have asbestos roofs and about 158 houses may have asbestos cladding in Vanuatu. Houses with asbestos cladding and/or roofing may also have been affected by Cyclone Pam and this also needs to be assessed. It is recommended that all houses with PACM on Vanuatu are tested for asbestos and that all the houses tested positive are notified and included in an awareness campaign. They should be remediated (i.e. the asbestos removed or encapsulated) where resources permit. If they have been damaged by Cyclone Pam then the damaged asbestos needs to be carefully dealt with.
d. If a large number of undamaged houses are found to contain asbestos cladding then encapsulation would probably be the most cost-effective option for remediation although ongoing management procedures then would be needed and re-encapsulation (i.e. re-painting) would probably be needed 10-15 years later. If a small number of houses are found to contain asbestos cladding then removal and replacement of the cladding should be considered. Damaged cladding should be removed.
e. Any asbestos roofs found on houses in Vanuatu should preferably be removed rather than encapsulated as encapsulation of roofs costs only a little less than removal and removal is a permanent solution.
f. Asbestos waste should be disposed of at the Bouffa Landfill in Efate and the Luganville Waste Disposal Site in Santo. Special provision should be made at each landfill for the receipt and management of asbestos waste, including setting up of special landfill cells for asbestos and establishing the procedure to immediately cover up asbestos wastes as they are received.
g. When remediation and disposal actions are undertaken, it is recommended that this is done together with the Department of Environment Protection and Conservation. This would allow officers to gain experience to manage similar project in future.
h. Specialist supervision is also recommended to ensure that appropriate protection measures are implemented to eliminate the risks to workers, the environment and the surrounding population.

i. Suitable legislation should be enacted to prevent any further importation of asbestos into Vanuatu.

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, Palau
- 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 Vanuatu took place from the 29th of June to the 9th of July 2014. The consultants were Dirk Catterall and Ellen Clara. Both the islands Efate and Santo were visited during this survey.

The primary agency for liaison was the Ministry of lands and Natural Resources, Department of Environment and Conservation, and the following personnel were involved:

Michel Leodoro, Environmental Officer

Shem Kissel Lauko, Town Planning Manager Luganville Municipal Council

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

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

A2.2. List of Contacts

Efate - Government

Michel Leodoro, Environmental Officer
Ministry of Land and Natural Resources, Department of Environment and Conservation
Phone: (678) 77 44 197, Email: mleodoro@vanuatu.gov.vu

Pakoa Lawo Rarua, Environmental Health Officer
Ministry of Health, Department of Public Health, Environmental Health Unit
Phone: (678) 59 22 204, Email: raruap@gmail.com prarua@vanuatu.gov.vu

Amos Matias, Bouffa Landfill Manager

Efate – Contact Persons Inspected Sites

Michel Dervillez, Manager/Responsable Magasin
VilaDistribution HARDWARE (no samples collected)
Phone: (678) 77 15 408 Email: hardware@viladistribution.com

(678) 22 069 Fax: (678) 23 264
Postal Address: PO Box 197, Port Vila, Efate, Republic of Vanuatu

Haward Mala, Principal
Vila East School (Sample 26)
Phone: (678) 59 52 583 Email: malahaward@yahoo.com
(678) 22 902 Fax: (678) 22 902
Postal Address : PO BOX 849, Port Vila, Efate, Republic of Vanuatu

Pasto Peter Isi'Egho, Pastor in Charge of Province
The redeemed Christian Church of God (Sample 34)
Phone: (678) 59 52 583 Email: malahaward@yahoo.com
(678) 22 902 Fax: (678) 22 902
Postal Address: PO BOX 849, Port Vila, Efate, Republic of Vanuatu

Lycee Bougainville (Samples 11, 12 and 13)
Phone: (678) 22 856 Email: glunabek@yahoo.fr
(678) 24 095

Reginal Garoleo, Principal
Malapoa College (Samples 6, 7 and 8)
Phone: (678) 22 840 Email: nshereedegaroleo@gmail.com
(678) 22 841
(678) 59 19 779

Espiritu Santo – Government

Shem Kissel Iauko, Town Planning Manager
Luganville Municipal Council
Phone: (678) 75 00 067 Email: shemiauko@gmail.com
(678) 36 637 siauko@vanuatu.gov.vu
(678) 53 34 430

Gina Buletare, Waste Manager
Luganville Municipal Council
Phone: (687) 59 49 283 Email: gina.tari@gmail.com

Prosper Buletare, Senior Development Planner

Sanma Provincial Government Council
Phone: (687) 55 36 719 Email: prosperbuletare@yahoo.com
Postal Address: PO BOX 239, Luganville, Santo, Republic of Vanuatu

Espiritu Santo – Contact Persons Inspected Sites

Radalfo Fernandez, Operations Supervisor
Luganville Power Plant (Sample 52)
Email: Rodolfo.fernandez@vui.vu

Toru Mochizuki, Managing Director
Nitchiku (Vanuatu) Ltd, Santo Meat Packers Ltd, South Pacific Meat Supplies Ltd (Sample 51)
Phone: (678) 36 759 Email: toru.smpltd@vanuatu.com.vu
(678) 36 139 Fax: (678) 7752-112
Postal Address: PO BOX 229, Luganville, Santo, Republic of Vanuatu

Appendix 3: Summaries of in-Country Discussions

Michel Dervillez, Manager VilaDistribution Hardware, 30/06/2014

Michel Dervillez reported that he does not import or sell any products containing asbestos. His building products are predominantly imported from Australia. Mr Dervillez was well informed of the potential risk associated ACMs. He was not aware of any hardware stores selling ACMs in Port Vila and to his knowledge not much ACMs are present in Vanuatu.

Michel Leodoro and H. Ari, Department of Environment and Conservation, 1/07/2014

A plan of action was discussed regarding remediation works. Michel and his colleague stated that they would like SPREP to help them to include asbestos as a hazardous product in the newly issued Pollution Control Act. This act is currently in its "grace-period". It was stated during the meeting that the import of ACMs should be banned and awareness should be raised with the general public. Michel informed us that he has a cousin working in construction. This cousin had told him told him that fibro cement sheets are not commonly used now.

Pakoa Rarue, Environmental Health Officer, National Environmental Health Unit, Ministry of Health

Mr Rarue reported that to his knowledge not much ACMs are present in Vanuatu, however he expected more to have been present in the past. He considered that controlling the use of ACMs would be the task of the Environment and Biodiversity Department.

Gina Buletare, Waste Manager Luganville Municipality

Gina expressed her interest to receive some information about asbestos that she could distribute among colleagues and municipal workers.

Prosper Buletare, Senior Development Planner, Sanma Provincial Government Council

We discussed issues associated to the current absence of an import ban for ACMs in Vanuatu. Mr Buletare expects a lot of investors to start building projects in Vanuatu during the years to come. These investors are likely to import the buildings materials required themselves. Mr Buletare therefore foresees the problem that if no import ban for ACMs were to be put in place in Vanuatu and no officers were to be trained to enforce the ban, large amounts of ACMs could be brought into the country.

Appendix 4: Copies of Laboratory Reports

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

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

CUSTOMER:	Geoscience Consulting 124 Montreal St, Sydenham Christchurch, 8023 New Zealand	PAGE #:	1 of 6
		REPORT #:	0161869
		PROJECT:	PLM ANALYSIS
CONTACT:	David Robotham	DATE COLLECTED:	06/29/2014
REFERENCE:	Vanuaka	COLLECTED BY:	
METHOD:	EPA 600/R-93/116	DATE RECEIVED:	07/08/2014
		ANALYSIS DATE:	07/16/2014

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	(%)
0161869-001 1	LAYER 1 Floor Tile, Blue, Homogeneous, Solid, melt, non-friable Note: 24°C, 1.55	LAYER 1 95%	None Detected		Non-Fibrous Material	100%
	LAYER 2 Mastic, Black, Homogeneous, Sticky, melt, non-friable Note: 24°C, 1.55 Oil	LAYER 2 5%	None Detected		Cellulose Fiber Non-Fibrous Material	10% 90%
0161869-002 2	Cement Cladding, Gray, Non-homogeneous, Solid, tease, non-friable Note: 24°C, 1.55	LAYER 1 100%	Chrysotile	15%	Non-Fibrous Material	85%
0161869-003 3	LAYER 1 Floor Tile, Blue, Homogeneous, Solid, melt, non-friable Note: 24°C, 1.55	LAYER 1 95%	None Detected		Non-Fibrous Material	100%
	LAYER 2 Mastic, Yellow, Homogeneous, Sticky, melt, non-friable Note: 24°C, 1.55 Oil	LAYER 2 5%	None Detected		Non-Fibrous Material	100%
0161869-004 4	Vinyl Floor Tile, Gray, Homogeneous, Rubbery, ash, non-friable Note: 26C, 1.55	LAYER 1 100%	None Detected		Non-Fibrous Material	100%

CUSTOMER:	Geoscience Consulting 124 Montreal St, Sydenbam Christchurch, 8023 New Zealand	PAGE #: REPORT #: PROJECT:	2 of 6 0161869 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	(%)
0161869-005 5	Vinyl Floor Tile, Blue, Homogeneous, Solid, melt, non-friable Note: 26°C, 1.55	LAYER 1 100%	None Detected		Non-Fibrous Material	100%
0161869-006 6	Gray, Non-homogeneous, Solid, tease, non-friable	LAYER 1 100%	Chrysotile Amosite	10% 10%	Non-Fibrous Material	80%
0161869-007 7	White/Gray, Non-homogeneous, Fibrous, tease, non-friable Note: 26°C, 1.55	LAYER 1 100%	Chrysotile Crocidolite	15% 5%	Non-Fibrous Material	80%
0161869-008 8	Black/White, Non-homogeneous, Fibrous, melt, non-friable Note: 26°C, 1.55 Oil	LAYER 1 100%	Chrysotile	60%	Non-Fibrous Material	40%
0161869-009 9	Floor Tile, Beige, Homogeneous, Sold, melt, non-friable Note: 26°C, 1.55	LAYER 1 100%	None Detected		Non-Fibrous Material	100%
0161869-010 10	Vinyl, Red, Homogeneous, Rubbery, ash, non-friable Note: 26°C, 1.55 Oil	LAYER 1 100%	None Detected		Non-Fibrous Material	100%
0161869-011 11	Black/tan, Non-homogeneous, Tar-Like, melt, non-friable Note: 27°C, 1.55 Oil	LAYER 1 100%	None Detected		Fibrous Glass Non-Fibrous Material	10% 90%
0161869-012 12	Vinyl Floor Tile, Gray, Homogeneous, Solid, melt, non-friable Note: 27°C, 1.55	LAYER 1 100%	None Detected		Non-Fibrous Material	100%

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

CUSTOMER:	Geoscience Consulting 124 Montreal St, Sydenbam Christchurch, 8023 New Zealand	PAGE #: REPORT #: PROJECT:	3 of 6 0161869 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	(%)
0161869-013 13A	Floor Tile, Gray, Homogeneous, Solid, melt, non-friable Note: 27°C, 1.55 Oil	LAYER 1 100%	None Detected		Non-Fibrous Material	100%
0161869-014 14	Blue/Gray, Non-homogeneous, Fibrous, tease, non-friable Note: 27°C, 1.55 Oil	LAYER 1 100%	None Detected		Cellulose Fiber Non-Fibrous Material	15% 85%
0161869-015 15	Gray, Homogeneous, Fibrous, tease, non-friable Note: 27°C, 1.55 Oil	LAYER 1 100%	None Detected		Cellulose Fiber Non-Fibrous Material	20% 80%
0161869-016 16	Gray, Homogeneous, Fibrous, tease, non-friable Note: 27°C, 1.55 Oil	LAYER 1 100%	None Detected		Cellulose Fiber Non-Fibrous Material	15% 85%
0161869-017 17	Gray, Non-homogeneous, Fibrous, tease, non-friable Note: 27°C, 1.55	LAYER 1 100%	Chrysotile	15%	Cellulose Fiber Non-Fibrous Material	15% 70%
0161869-018 18	Floor Tile, Beige, Homogeneous, Solid, melt, non-friable	LAYER 1 100%	None Detected		Non-Fibrous Material	100%
0161869-019 19	Green, Homogeneous, Solid, melt, non-friable Note: 27°C, 1.55	LAYER 1 100%	Chrysotile	2%	Non-Fibrous Material	98%
0161869-020 20	Vinyl Floor Tile, Gray, Homogeneous, Rubbery, ash, non-friable Note: 27°C, 1.55	LAYER 1 100%	None Detected		Non-Fibrous Material	100%
0161869-021 21	Floor Tile, White, Homogeneous, Solid, melt, non-friable Note: 27°C, 1.55	LAYER 1 100%	None Detected		Non-Fibrous Material	100%

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

CUSTOMER:	Geoscience Consulting 124 Montreal St, Sydenham Christchurch, 8023 New Zealand	PAGE #: REPORT #: PROJECT:	4 of 6 0161869 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	(%)
0161869-022 22	Floor Tile, Gray, Homogeneous, Solid, melt, non-friable Note: 27°C, 1.55	LAYER 1 100%	None Detected		Non-Fibrous Material	100%
0161869-023 23	Gray, Homogeneous, Fibrous, tease, non-friable Note: 27°C, 1.55 Oil	LAYER 1 100%	None Detected		Cellulose Fiber Non-Fibrous Material	40% 60%
0161869-024 24	LAYER 1 Floor Tile, Tan, Homogeneous, Solid, melt, non-friable Note: 27°C, 1.55	LAYER 1 95%	None Detected		Non-Fibrous Material	100%
	LAYER 2 Mastic, Yellow, Homogeneous, Sticky, melt, non-friable Note: 27°C, 1.55	LAYER 2 5%	None Detected		Non-Fibrous Material	100%
0161869-025 25	LAYER 1 Floor Tile, Gray, Homogeneous, Solid, melt, non-friable Note: 27°C, 1.55	LAYER 1 95%	None Detected		Non-Fibrous Material	100%
	LAYER 2 Mastic, Yellow, Homogeneous, Sticky, melt, non-friable Note: 27°C, 1.55 Oil	LAYER 2 5%	None Detected		Non-Fibrous Material	100%
0161869-026 26	LAYER 1 Gray, Homogeneous, Solid, melt, non-friable Note: 28°C, 1.55	LAYER 1 95%	None Detected		Non-Fibrous Material	100%
	LAYER 2 Mastic, Black, Homogeneous, Sticky, melt, non-friable	LAYER 2 5%	None Detected		Non-Fibrous Material	100%
0161869-027 27	Gray, Non-homogeneous, Fibrous, Solid, non-friable Note: 28°C, 1.55	LAYER 1 100%	None Detected		Cellulose Fiber Non-Fibrous Material	30% 70%

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

CUSTOMER:	Geoscience Consulting 124 Montreal St, Sydenbam Christchurch, 8023 New Zealand	PAGE #: REPORT #: PROJECT:	5 of 6 0161869 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	(%)
0161869-028 28	Gray, Homogeneous, Fibrous, tease, non-friable Note: 28°C, 1.55	LAYER 1 100%	None Detected		Cellulose Fiber Non-Fibrous Material	30% 70%
0161869-029 29	Vinyl Floor Tile, Brown, Homogeneous, Rubbery, ash, non-friable Note: 28°C, 1.55	LAYER 1 100%	None Detected		Cellulose Fiber Non-Fibrous Material	20% 80%
0161869-030 30	Black, Homogeneous, Solid, crush, non-friable Note: 28°C, 1.55 Oil	LAYER 1 100%	None Detected		Cellulose Fiber Non-Fibrous Material	65% 35%
0161869-031 31	Gray, Homogeneous, Solid, tease, non-friable Note: 28°C, 1.55	LAYER 1 100%	Chrysotile	20%	Non-Fibrous Material	80%
0161869-032 32	Gray, Non-homogeneous, Solid, tease, non-friable Note: 28°C, 1.55 Oil	LAYER 1 100%	Chrysotile	20%	Non-Fibrous Material	80%
0161869-033 33	Gray, Homogeneous, Fibrous, tease, non-friable Note: 28°C, 1.55 Oil	LAYER 1 100%	Chrysotile	20%	Cellulose Fiber Non-Fibrous Material	20% 60%
0161869-034 13B	Gray, Non-homogeneous, Solid, tease, non-friable Note: 28°C, 1.55	LAYER 1 100%	Chrysotile	20%	Non-Fibrous Material	80%

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

CUSTOMER:	Geoscience Consulting	PAGE #:	6 of 6
	124 Montreal St, Sydenbam Christchurch, 8023	REPORT #:	0161869
	New Zealand	PROJECT:	PLM ANALYSIS

Analyst - Wosene Sebhat **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: 101218-0

EMS LABORATORIES INC 117 W Bellevue Drive / Pasadena CA 91105-2548 / 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:	Geoscience Consulting 124 Montreal St, Sydenham Christchurch, 8023 New Zealand	PAGE #:	1 of 4
		REPORT #:	0161913
		PROJECT:	PLM ANALYSIS
CONTACT:	Ellen Clara	DATE COLLECTED:	07/07/2014
REFERENCE:		COLLECTED BY:	
METHOD:	EPA 600/R-93/116	DATE RECEIVED:	07/11/2014
		ANALYSIS DATE:	07/22/2014

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	(%)
0161913-001 34	New cladding, Gray, Homogeneous, Fibrous, tease, non-friable Note: 27°C, 1.55 Oil	LAYER 1 100%	None Detected		Cellulose Fiber Non-Fibrous Material	25% 75%
0161913-002 35	cement sheet, green/gray, Non-homogeneous, paint/granular, ash, crush, acid, non-friable Note: 27°C	LAYER 1 100%	None Detected		Cellulose Fiber Non-Fibrous Material	<1% 100%
0161913-003 36	LAYER 1 Floor Tile, Blue, Granular, melt, non-friable Note: 27°C, 1.55 Oil	LAYER 1 95%	None Detected		Non-Fibrous Material	100%
	LAYER 2 Mastic, Brown, Homogeneous, Granular, crush, non-friable Note: 27°C, 1.55 Oil	LAYER 2 10%	None Detected		Cellulose Fiber Non-Fibrous Material	<1% 100%
0161913-004 37	Cement pipe, Gray/white, Homogeneous, granular/fibrous, crush, non-friable Note: 27°C, 1.55 Oil	LAYER 1 100%	Chrysotile	20%	Non-Fibrous Material	80%
0161913-005 38	new cement sheet, white/gray, Non-homogeneous, paint/fibrous, ash, tease, non-friable Note: 27°C, 1.55 Oil	LAYER 1 100%	None Detected		Cellulose Fiber Non-Fibrous Material	55% 45%

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

CUSTOMER:	Geoscience Consulting 124 Montreal St, Sydenbam Christchurch, 8023 New Zealand	PAGE #: REPORT #: PROJECT:	2 of 4 0161913 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	(%)
0161913-006 39	Cement sheet, Gray/white, Homogeneous, granular/fibrous, crush, non-friable Note: 27°C, 1.55 Oil	LAYER 1 100%	Chrysotile Amosite	15% 2%	Non-Fibrous Material	83%
0161913-007 40	Roofing, Tan/white, Homogeneous, granular/fibrouws, crush, non-friable Note: 27°C, 1.55 oil	LAYER 1 100%	Chrysotile Amosite	20% 2%	Non-Fibrous Material	78%
0161913-008 41	Ceiling, Gray, Homogeneous, Fibrous, tease, non-friable Note: 27°C, 1.55 oil	LAYER 1 100%	None Detected		Fibrous Glass Cellulose Fiber Non-Fibrous Material	50% 30% 20%
0161913-009 42	Insulation, Yellow, Homogeneous, Fibrous, tease, non-friable Note: 27°C, 1.55 oil	LAYER 1 100%	None Detected		Fibrous Glass Non-Fibrous Material	98% 2%
0161913-010 43	Cement sheet, Gray, Homogeneous, Fibrous, tease, non-friable Note: 27°C, 1.55 oil	LAYER 1 100%	None Detected		Cellulose Fiber Non-Fibrous Material	60% 40%
0161913-011 44	Floor Tile, Tan, Homogeneous, Granular, melt, non-friable Note: 27°C, 1.55 oil (insufficient mastic)	LAYER 1 100%	None Detected		Non-Fibrous Material	100%
0161913-012 45	Vinyl Floor Tile, Gray, Homogeneous, Rubbery, ash, non-friable Note: 27°C, 1.55 oil	LAYER 1 100%	None Detected		Non-Fibrous Material	100%

CUSTOMER:	Geoscience Consulting 124 Montreal St, Sydenham Christchurch, 8023 New Zealand	PAGE #: REPORT #: PROJECT:	3 of 4 0161913 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	(%)
0161913-013 46	LAYER 1 Drywall, White, Homogeneous, Granular, crush, non-friable Note: 27°C, 1.55 oil	LAYER 1 80%	None Detected		Cellulose Fiber Cellulose Fiber Non-Fibrous Material	1% 2% 97%
	LAYER 2 White/brown, Non-homogeneous, solid/fibrous, crush, tease, non-friable Note: 27°C, 1.55 oil	LAYER 2 20%	None Detected		Cellulose Fiber Non-Fibrous Material	50% 50%
0161913-014 47	Cement sheet, Gray, Homogeneous, Granular, crush, non-friable Note: 27°C, 1.55, 1.68 oil	LAYER 1 100%	Chrysotile Amosite	15% 2%	Non-Fibrous Material	83%
0161913-015 48	Cement cladding, Gray, Homogeneous, Fibrous, tease, non-friable Note: 28°C, 1.55 Oil	LAYER 1 100%	None Detected		Cellulose Fiber Non-Fibrous Material	35% 65%
0161913-016 49	Cladding, Gray, Homogeneous, Granular/fibrous, crush, non-friable Note: 28°C, 1.55 Oil	LAYER 1 100%	Chrysotile	20%	Non-Fibrous Material	80%
0161913-017 50	LAYER 1 Floor Tile, Gray, Homogeneous, Granular, melt, non-friable Note: 28°C, 1.55 Oil	LAYER 1 95%	None Detected		Non-Fibrous Material	100%
	LAYER 2 Mastic, Yellow, Homogeneous, solid, melt, non-friable Note: 28°C, 1.55 Oil	LAYER 2 5%	None Detected		Cellulose Fiber Non-Fibrous Material	2% 98%
0161913-018 51	Insulation, White, Homogeneous, Fibrous, tease, non-friable Note: 28°C	LAYER 1 100%	None Detected		Fibrous Glass	100%

CUSTOMER:	Geoscience Consulting 124 Montreal St, Sydenbam Christchurch, 8023 New Zealand	PAGE #: REPORT #: PROJECT:	4 of 4 0161913 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	(%)
0161913-019 52	Gasket, Black, Homogeneous, Fibrous, tease, non-friable Note: 28°C, 1.55 Oil	LAYER 1 100%	None Detected		Cellulose Fiber Fibrous Glass Non-Fibrous Material	60% 10% 30%

Analyst - JEFF WAN

Approved Signatory Laboratory Director

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

NVLAP Lab Code: [illegible]

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

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 timber roof framing.	350.00	280.00	254.55

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

Appendix 6: Vanuatu Report on Asbestos – Prepared for the Cyclone Pam Clean-Up

Asbestos Inventory

Vanuatu

The survey only investigated buildings on the Islands of Efate and Santo. The 2009 Vanuatu Census stated that there are 47,373 private households throughout the nation with 21,055 on Efate and Santo. The Asbestos survey covered approximately 600 residential households over the two Islands, and potential asbestos-containing materials (ACMs) were identified at some of the properties on both islands. Seven samples were collected from selected houses and five of these returned positive ACM results. Overall it was estimated that approximately 1 out of every 20 - 30 residential dwellings on Efate and 1 out of every 30 - 40 residential dwellings on Santo contained asbestos. If we assume an average rate of 3.5% of all houses contained ACMs, there would be approximately 1660 ACM houses across the whole country.

53 samples were collected from various type of structures covering a range of different uses (hospitals, schools, government buildings, commercial buildings and the houses noted above). Of the 53 samples 15 (ie. 28%) returned a positive result for asbestos. Asbestos was detected in cement sheeting, 'super 6' roofing, vinyl flooring, bitumen roofing material, pipe lagging and cement service pipes, and more specific information on each of these is given below. Information on the most significant sites identified in the survey is also given in the attached table.

Fibre-Cement Sheeting

The most abundantly encountered AC building material was fibre-cement sheeting. This material is mostly applied as wall cladding and can also be encountered in soffits, gables, pathways connecting buildings, etc. Out of the 23 collected cement sheeting samples 11 returned positive. The positive samples were mostly collected from what appeared to be older cement sheets.

New Fibre-Cement Sheeting

A total of eight hardware stores (five in Port Vila and three in Luganville) were visited and a sample of the cement sheeting available for purchase was collected at most of them. AC cement sheeting was only identified at one of these stores - Chinese Hardware store in Port Vila – and their current stocks were very limited. However, this finding reflects the continuing availability of ACMs on the world market, and it will be important to ensure that measures are put in place to prevent new ACMs entering the country as part of the rebuild.

Super-6 Roofing

This was only encountered at two places; at the Manganese Mine at Forari (Efate), and on one residential dwelling in Luganville where Super 6 roofing and cement cladding had been scavenged from an old WWII structure. The survey results showed that Super 6 roofing was not abundantly present in Vanuatu.

Vinyl Flooring

This was abundantly present and a total of 20 samples were collected. However, only one sample returned a positive result: sample S19 collected at the Port Vila Central Hospital, which contained 2% chrysotile. This suggests that only a limited amount of the vinyl flooring used in Vanuatu contains asbestos.

Bitumen Roofing Material

Asbestos-containing bitumen roofing material was only encountered at the Malapoa College on Efate. Another bitumen roof was identified at the Lycee Bougainville in Port Vila, but the sample tested negative for asbestos. The survey results indicate that AC bitumen roofing is not abundantly present at Vanuatu.

AC Pipe Lagging

This was only encountered at the Port Vila Main Hospital and was not seen at any other inspected sites. The material at the hospital was only visually assessed as being asbestos-based, and no samples were collected.

AC Service Pipes

These are mainly used for wastewater pipes. Only one service cement pipe was sampled as it was exposed at the surface. It showed 20% chrysotile to be present. It is therefore possible that there could be a significant number of asbestos service pipes in the subsurface throughout Vanuatu, although this would needed to be checked through additional testing. The presence of ACM service pipes may be an issue if significant earthworks are required in the rebuild of Vanuatu.

Conclusion

Based on the information from the survey, the most common material on Vanuatu to contain asbestos is fibre-cement sheeting. Many of the other types of materials that have asbestos appear to be specific in location or limited with regard to volume (some of which have been identified in the table below). It is therefore important to highlight to people involved in the clean-up and associated rebuild of Vanuatu, that while care should be taken with any building material that may contain asbestos, all fibre cement sheeting should be handled with caution and assumed to have asbestos present unless analytical tests prove otherwise.

Table 1 below presents the relevant survey information (NB the GPS coordinates were also supplied but have been deleted for the purposes of this appendix.)

Table 1 – Relevant Survey Information

Site Name	Asbestos	Material	Location	Approx	Risk	Comments

	Confirmed	Type		Quantity (m²)	(prior to cyclone)	
Efate						
Pang Pang	Visual	Super 6 Roof	Residential dwelling	25	Medium	Only one dwelling in Pang Pang
Port Vila Residential Area	Visual	Cement sheeting	Demolition site in residential area	100	High	Assessment based on asbestos identified at demolition site
Chinese Hardware Store	20% Chrysotile	Cement sheeting	Elluk Rd	Unknown	Medium	
Ministry of Land and Natural Resources	15% Chrysotile	Cement sheeting	Mainly gable and soffits, some cladding	300	Medium	
Paonangisu Health Centre	20% Chrysotile	Cement sheeting	Reception area	2,000	Low	1 sample showed ACM so assume all 5 buildings positive
Port Vila Central Hospital	15% Chrysotile	Cement sheeting	Covered walkways	2,400	Medium	
	2% Chrysotile	Vinyl flooring	Theatre corridor	< 4,000		3 vinyl types sampled but only 1 positive
	Visual	Pipe lagging	Pipes the length of covered walkways	Unknown		
Presbyterian College	20% Chrysotile	Cement sheeting	Soffits surrounding most classrooms	2,000	Low	
Malapoa College	10% Chrysotile/10% Amosite 15% Chrysotile/5% Crocidolite	Cement sheeting	Outside cladding	1,000	Medium	
	60% Chrysotile	Bitumen roof	4 building on site	600		
Manganese Mine Forari	20% Chrysotile	Super 6 roof	Cladding & roof on 4 structures	7,000	High	ACM badly damaged
Santo						
Residential Dwelling 1, Luganville	10% Chrysotile/2% Amosite	Cement sheeting	All through structure	25	Medium	

	20% Chrysotile/2 % Amosite	Super 6 roof		50		
Residential centre, **West Luganville**	20% Chrysotile	Cement sheeting	Shed next to church	40	Medium	Damaged
Northern Provincial Hospital	20% Chrysotile	Cement pipe	Western part of hospital grounds	Unknown	Low	The cement pipe was mainly under-ground. Only a small piece was exposed at the surface
Residential Dwelling 2, Luganville	15 % Chrysotile/2 % Amosite	Cement sheeting	All through structure	100	High	