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

Report for the

Republic of Nauru

Prepared for the Australian Department of Foreign Affairs and Trade (DFAT)

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Executive Summary

PacWaste (Pacific Hazardous Waste) is a four year, €7.85 million project funded by the European Union and implemented by the 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, E-waste, asbestos, and integrated atoll solid waste management.

Asbestos-containing wastes 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 the inhalation of asbestos fibres that have become airborne can cause serious lung disease or cancers.

SPREP's regional priorities for asbestos management include conducting an inventory of the distribution of asbestos-containing materials (ACMs) in thirteen Pacific island countries, 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 hazardous 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.

In conjunction with the PacWaste Baseline study in Nauru, it was decided to carry out a Risk Assessment study of asbestos in Nauru. The risk assessment was based on the following investigative work:

a) An extensive assessment of asbestos incidence and quantities and condition in Nauru.
b) Analysis of numerous bulk samples.
c) The carrying out of asbestos air sampling tests at 77 locations, followed by analysis.
d) The taking of 94 swab samples followed by analysis

All analytical testing was carried out by EMS Laboratories in Pasadena, California.

The risk assessment 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 Australian Department of Foreign Affairs and Trade (DFAT)

This report presents the information gathered for Nauru during three field visits undertaken by John O'Grady of Contract Environmental Ltd and others, as well as background research carried out in Australia and New Zealand.

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 also 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.

The Risk Assessment and Baseline work discovered that:

a) There is a substantial quantity of asbestos in Nauru. Based on the survey completed the amount is estimated to be around 212,000 square metres.
b) Most of the asbestos is in the form of asbestos-cement in roofing and cladding on houses and buildings although there are some stockpiles of waste and (in one case) unused asbestos building material.
c) All asbestos is old and in various stages of deterioration. In many cases it is in an advanced stage of deterioration.
d) Asbestos-cement roofing and cladding is normally considered to be "non-friable" with the harmful fibres locked up in a cement matrix. However when roofing and cladding deteriorate to the extent it has done on Nauru then it can be considered to be partially friable and will be releasing fibres into the air.
e) Based on the numerous bulk analyses that were carried out, most of the asbestos on Nauru is Chrysotile (White) Asbestos although some examples of Amosite (Brown) Asbestos and Crocidolite (Blue) Asbestos were also found. In the past, chrysotile has been considered less hazardous than amosite and crocidolite but many jurisdictions, including Australia, now place them on equal footing in terms of hazard.
f) The air monitoring of 77 locations that was carried out as part of this project did not pick up any asbestos in the air above the monitoring thresholds in any of the locations. It is noted that nine locations were identified as having potentially significant levels of asbestos in air when measured by the PCM (Phase Contrast Microscopy) method which does not positively identify asbestos but simply identifies asbestos-like fibres. When these nine air samples were examined further by the TEM (Transmission Electron Microscope) method, however, they were all found to be completely free of asbestos fibres, which was a reassuring result.
g) The swab testing results were, however, less reassuring, with the following exhibiting significantly high results: RON Hospital (3 locations), Seaport (1 location), Power Plant / RO Units (4 locations), Prison (2 locations including 1 very high) and Government Building (1 location).
h) In addition several swab test locations were moderately high: RON Hospital (3 locations), House 9 Air Con Unit (1 location), Seaport (1 location), Ewa Refugee Accommodation (1 location), Power Plant / RO Units (1 location), Prison (1 location), Fisheries Main Office (1 location), Menin Hotel Air Con (1 location), Jules Restaurant (1 location), Airport (2 locations), Government Building (1 location), Plant Nursery (1 location).
i) As well as the very high incidence of asbestos on Nauru, there is also extensive site and ground contamination. Many locations have ground contaminated with asbestos debris which would generate airborne fibres if disturbed and this includes many locations

around houses. For example the Aiwo School which contained asbestos was burnt down in 2007 and the now vacant site is likely to still be contaminated with asbestos fibres. Furthermore there was a fire in the Prison and old Police Station in 2007 and that would have caused asbestos debris and fibres to be widely scattered. The prison swab samples were high and the neighbouring Government Buildings (which do not contain asbestos in their building materials) also had high swab samples.

j) It is estimated that it will cost about $US17.3 Million to free Nauru of asbestos. This cost does not include cleaning up contaminated sites. It is noted that the budget has been presented in USD, but the local currency is AUD. In building up the estimated cost an exchange rate of 0.87 was used. In assessing likely costs for future works, exchange rate fluctuations should be considered.

k) There will be some money available from the SPREP PacWaste project to deal with high priority asbestos removal projects such as schools, power station and prison, and money from the Australian Government will probably be available to remove the RON Hospital asbestos as part of the hospital refurbishing. Programmes are being discussed by local Government-owned corporate entities RONPhos and NRC to deal with some or all of their asbestos eventually. Overall, however, it is likely that most of the Nauru asbestos will remain in place for a long time and continue to deteriorate, given the fact that there are likely to be higher health priorities in Nauru than the removal of asbestos.

l) Asbestos fibres in areas where people are able to inhale them do pose an on-going and real health risk of asbestos-related diseases including debilitating conditions such as asbestosis and also cancers – lung, and outer lining of lung / internal chest wall (mesothelioma). There is little epidemiological evidence to indicate that these diseases are developing in the Nauru population but health records are not detailed and were partly lost in the 2013 fire at the hospital.

In view of the above, some reassurance can certainly be taken from the fact that no asbestos was found in the air. The fact that so many asbestos fibres have, however, been found in numerous swab samples in areas of high human habitation, means that the health risk from asbestos in Nauru must be viewed with serious concern.

There is little that can be done to protect worker and resident health except to commence a detailed and coordinated programme of asbestos removal with highest risk locations dealt with first (funded by the SPREP PacWaste project). These locations include the hospital, schools, power station and prison. Then a steady and planned removal should be embarked on as funding availability permits. RonPHOS and NRC should also be encouraged to commence a steady removal programme as well, that is coordinated into the overall removal programme.

There is a vigorous and capable contracting environment in Nauru so there is local capacity to support an asbestos removal programme. Training would be needed plus the on-going presence of some overseas expertise and monitoring. The removal of asbestos from buildings that are still used would need to be accompanied by replacement with suitable non-asbestos roofing and cladding.

The issue of disposal would need to be resolved. The most acceptable disposal solution is likely to be removal off shore to Brisbane and the cost for this removal is not expected to be prohibitive, based on research carried out as part of this project. Costings indicate that disposal to Brisbane would add about 9% to the total removal and replacement cost. Disposal to Brisbane is feasible and likely to proceed without difficulty.

Until the asbestos can be removed, it is important that the presence and risk posed by the asbestos is managed as much as possible. There are a range of measures that can be put in place to minimise the generation of fibres arising from the deteriorating asbestos building materials on Nauru.

This report makes the following recommendations:

1. While some reassurance can be taken from the fact that no asbestos was found in the air samples, the fact that so many asbestos fibres have, however, been found in numerous swab samples in areas of high human habitation, should be officially acknowledged and it should be recognised that the potential health risk from asbestos in Nauru must be viewed with serious concern.
2. A detailed and coordinated programme of asbestos removal should be commenced, with highest risk locations first (funded by the SPREP PacWaste project) and then a steady and planned removal as funding availability permits.
3. RonPHOS and NRC should be encouraged to commence a steady removal programme as well that is coordinated into the overall removal programme.
4. The local contracting capability in Nauru should be used to its full capacity to support the asbestos removal programme. Training would be needed plus the on-going presence of some overseas expertise and monitoring.
5. The removal of asbestos from buildings that are still used would need to be accompanied by replacement with suitable non-asbestos roofing and cladding.
6. The issue of disposal needs to be resolved. The most acceptable disposal solution is likely to be removal off shore to Brisbane and the cost for this removal is not expected to be either prohibitive or difficult. The other options to be considered are local disposal and disposal at sea.
7. Until the asbestos can be removed, it is important that the presence and risk posed by the asbestos is effectively managed. There are a range of measures that can be put in place to minimise the generation of fibres arising from the deteriorating asbestos building materials on Nauru. These measures include:
   - When asbestos building materials are worked on, the use of power tools should be minimised, the asbestos should not be broken if possible, and the working area should be kept wet.
   - When asbestos is removed as part of building / demolition work then it should be removed in accordance with best practice techniques, encased in plastic, taken to the disposal site and buried.
   - No asbestos should be recycled.
   - Training should be provided to support the successful implementation of the above requirements.
8. Consideration should be given to encapsulation in some circumstances to preserve cladding that has not deteriorated too much. Encapsulation is not generally considered worthwhile for roofs as an alternative to removal and replacement.
9. Legislation should be drafted and enacted on an urgent basis by the Nauru Government to support the management and staged removal of asbestos in a safe and professional manner.

10. Health monitoring for asbestos disease incidence should also be conducted, based on monitoring programmes that are currently used in Australia to monitor the health of people exposed to asbestos, especially asbestos workers. Accurate data on asbestos disease incidence should also be collected.

Contents

1. Introduction

1.1 Purpose

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

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

Appendix 1 contains an edited copy of the Terms of Reference for this work.

The work was carried out by a consortium led by Contract Environmental Ltd (CEL) and Geoscience Consulting (NZ) Ltd (Geoscience), under contract to the Secretariat of the Pacific Regional Environment Programme (SPREP), with funding provided by the European Union. The majority of information relating to the distribution of ACM in Nauru was obtained during three field visits undertaken as follows:

- John O'Grady, Contract Environmental Ltd and Dirk Catterall, Morecroft Contracting Ltd: 23-26 September
- John O'Grady: 15-22 October (joined by Stewart Williams of SPREP on 20-22 October)
- John O'Grady, Martyn O'Cain, Tasman Environmental Management, and Deirdre Ni Riain, Contract Environmental Ltd: 26 November – 6 December

The work was originally intended to be solely part of the SPREP PacWaste project and was considerably expanded when the Australian Department of Foreign Affairs and Trade (DFAT) contributed to the funding in order to undertake a much more detailed study.

The background for the DFAT study was stated as follows:

"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, including Nauru. 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. The DFAT funded component will focus solely on Nauru."

DFAT later commissioned another related study to undertake a Risk Assessment of Australian Government staff and contractors working in Nauru and exposed to asbestos. A separate report has been prepared which focuses on Risk Assessment.

1.2 Scope of Work

A copy of the Terms of Reference for the PacWaste 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.*

As per the Grant Agreement the Objective and Tasks were presented as follows:

OBJECTIVE

Pacific asbestos status and management options are assessed and future intervention recommendations presented to identify prioritised areas for future intervention for Nauru.

TASKS

- Collect and collate data on the location (geographic coordinates), quantity and condition of asbestos containing building materials (including asbestos containing waste stockpiles) in Nauru.
- Review, and recommend a prioritised list of local best-practice options for stabilization, handling and final disposal of asbestos contaminated materials in Nauru (including review of existing local institutional, policy and regulatory arrangements).
- Recommend and prioritize actions necessary to minimise exposure (potential and actual) of the local population to asbestos fibres for Nauru. An approximate itemised national cost should be presented for each option identified.
- Identify any local contractors who have the expertise and capacity to potentially partner with regional or international experts in future asbestos management work.
- 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.

The requirement for the Risk Assessment Study that was added to the DFAT work was to undertake air sampling and swab sampling at numerous locations and use the resulting data, together with data in this report, to assess the risk to Australian Government staff and contractors resulting from exposure to asbestos.

1.3 Nauru - General Description

The Republic of Nauru is an island country in Micronesia in the Central Pacific. Its nearest neighbour is Banaba Island in Kiribati, 300 kilometres to the east. The current population, excluding the refugee population introduced by Australia, is about 10,000 residents. Nauru gained its independence in 1968.

Nauru is a 21 square kilometres oval-shaped island 42 kilometres south of the Equator. The island is surrounded by a coral reef, which is exposed at low tide and dotted with pinnacles. The presence of the reef has prevented the establishment of a sea-port although channels in the reef allow small boats access to the island. A fertile coastal strip 150 to 300 metres wide lies inland from the beach.

Coral cliffs surround Nauru's central plateau. The highest point of the plateau, called the Command Ridge, is 71 metres (233 ft) above sea level. The only fertile areas on Nauru are on the narrow coastal belt. The land surrounding Buada Lagoon supports various fruits and vegetables, as well as indigenous hardwoods.

Nauru is a phosphate rock island with rich deposits near the surface, which allow for strip mining. The island has been mined extensively and while significant deposits still remain, most of the easily mined deposits are exhausted, leaving a barren terrain of jagged limestone pinnacles up to 15 metres high.

There are limited natural fresh water resources on Nauru. Rooftop storage tanks collect rainwater. Fresh water otherwise comes from desalination plants housed at the Nauru Utility Corporation.

Nauru's climate is hot and very humid year-round because of its proximity to the equator and the ocean. Nauru receives monsoon rains between November and February, but does not typically experience cyclones. The annual rainfall is highly variable. The temperature on Nauru ranges between 26 and 35 °C during the day and between 22 and 34 °C at night.

Set out below is a map of Nauru and Key Locations:

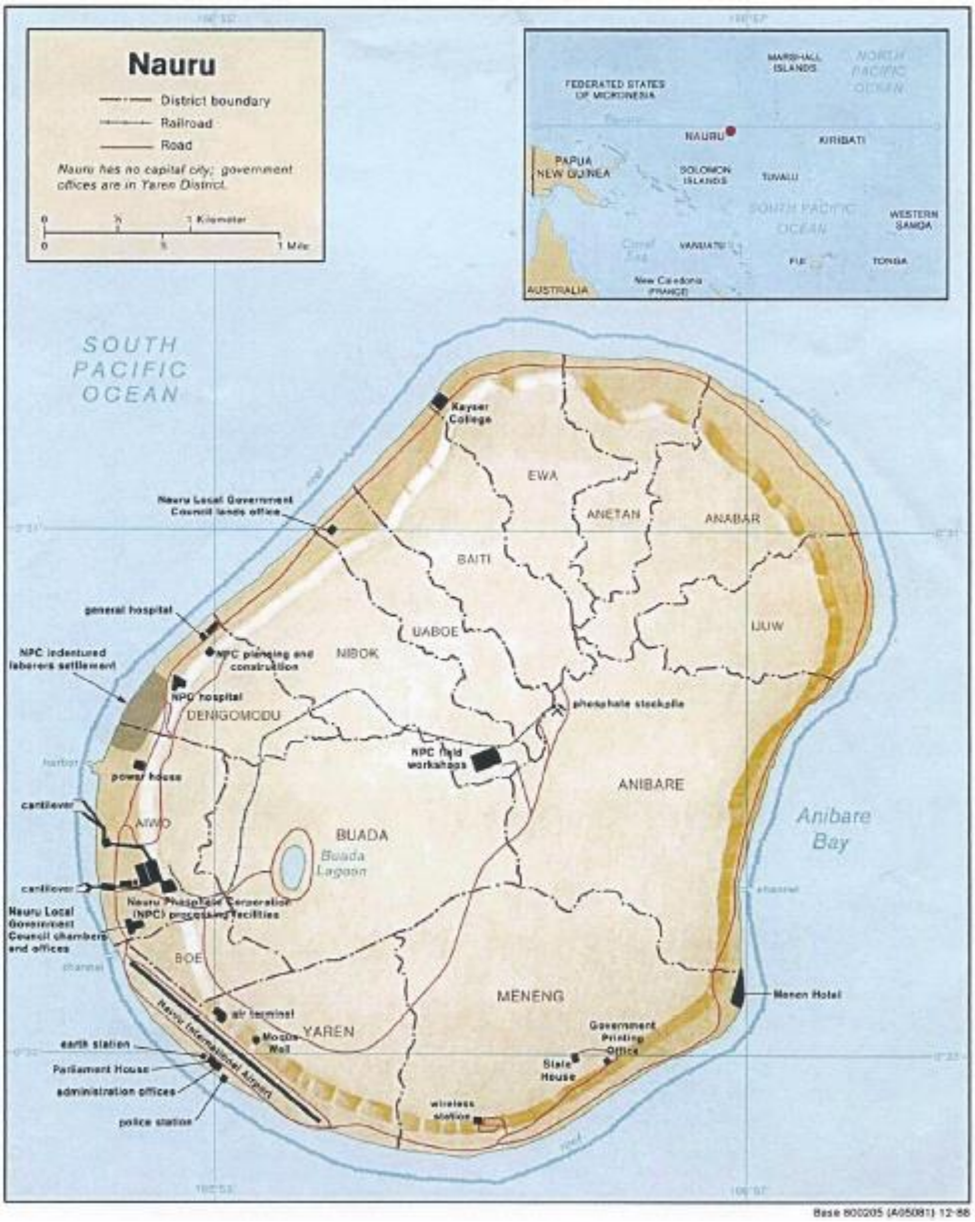

Figure 1 – Map of Nauru

Set out below is a map supplied by the Australian High Commission in Nauru showing some of the locations for the air monitoring:

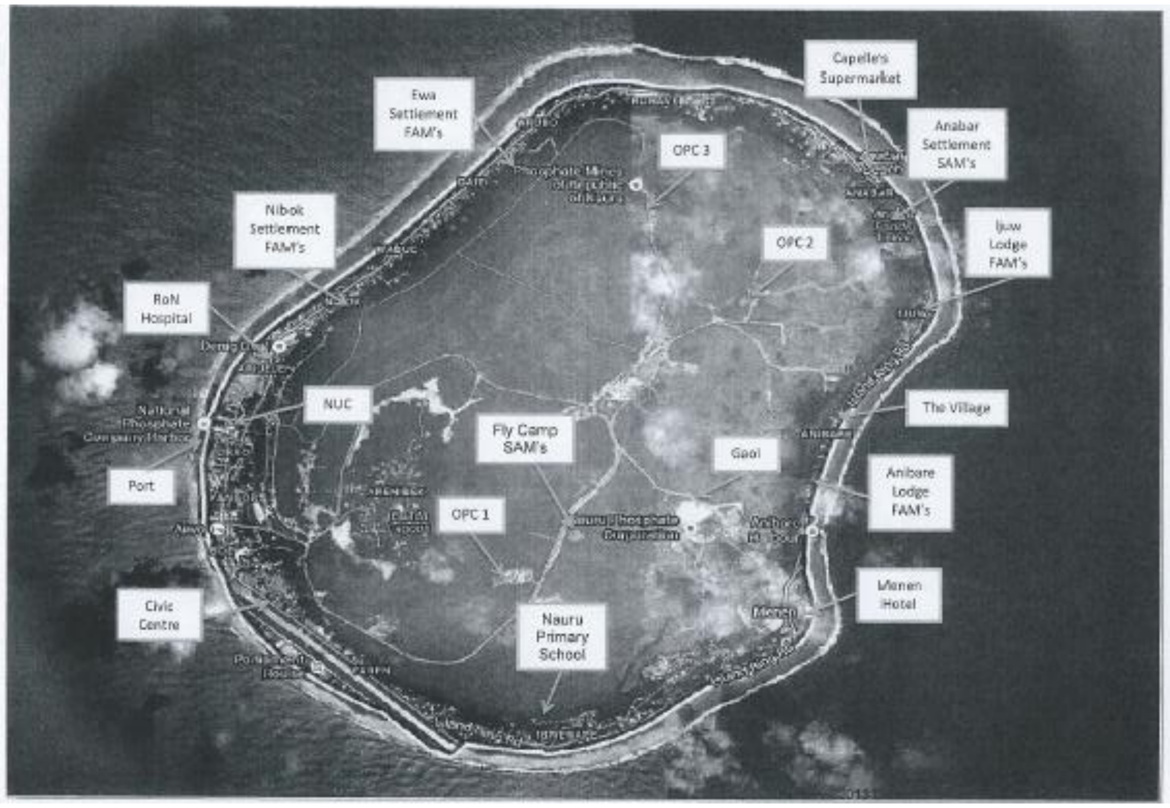

Figure 2 – Map Supplied by the Australian High Commission

1.4 Report 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

CEL: Contract Environmental Ltd

DFAT: (Australian) Department of Foreign Affairs and Trade.

PPE: Personal Protective Equipment

SMF: Synthetic Mineral Fibres

SPREP: Secretariat of the Pacific Regional Environment Programme

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

1.5 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 overall asbestos survey is described in Section 4, including the residential and non-residential coverage. The laboratory results are presented in Section 5, for the bulk samples, air filters and swab samples.

Asbestos quantity estimates are covered in Section 6, and Section 7 deals with the Risk Assessment.

Remedial and Management options are addressed in Section 8, and Section 9 addresses possible remedial options including specific options suitable for Nauru. Section 10 deals with disposal options including specific options for Nauru.

Section 11 covers cost considerations including an estimate of costs for an asbestos removal project on Nauru. Section 12 deals with a review of Nauru Policies and Legislation. Section 13 deals with on-island contracting capabilities.

Section 14 presents a discussion of the report findings and conclusions that can be drawn. Section 15 presents the recommended actions for minimising asbestos exposure on Nauru.

Additional supporting information is given in a series of appendices.

2.0 Survey Methodology

2.1 Pre-Survey Desk Study

Prior visiting Nauru, the survey team completed a desk study to enable a more targeted assessment of buildings potentially containing ACM. The desk study included contacting the relevant Government agency in advance of the trip to discuss and evaluate the level of awareness of 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.

Various reports on the distribution of asbestos, or if available on specific sites, were reviewed by the survey team. Reports relevant to this project were provided by SPREP and the Nauru Government, and these reports are detailed in Appendix 4.

A second objective of the desk study was to evaluate the population distribution in Nauru 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 for use in establishing that a sufficient statistically representative number of residential buildings were included in the survey. A detailed Census was carried out for Nauru in 2011. This Census was provided to the survey team on the third visit.

2.2 Description of Visits

The in-country work was carried out in Nauru over three visits as follows:

The first visit, undertaken by John O'Grady and Dirk Catterall, was carried out in order to obtain a broad view of the asbestos problem on Nauru and also in order to meet key personnel. This visit was for three days and the following meetings were held:

1. With Department of Commerce, Industry and Environment (DCIE) – Elkoga Gadabu, Bryan Star and Jaden Agir.
2. Eigigu Holdings Corporation (EHC) – General Manager Sean Halstead, Ravi Singh, Engineer
3. National Rehabilitation Corporation (NRC) – Phil Leeson, Production Manager
4. RON Hospital - Lee Pearce, Health Services Advisor, Marissa Cook, Director of Administration
5. Ocean Corporation – Nathan Philip, Managing Director
6. Republic of Nauru Phosphate Corporation (RONPhos) – Chelser Buraman, Acting CEO, Anthony Buraman, Production Manager, Jun Nuqui, Engineer, Bunyan Seymour, Civil Engineer
7. Australian Department of Foreign Affairs and Trade (DFAT), High Commission – Karyn Murray
8. Central Meridian – Paul Finch, Managing Director.

Jaden Agir of DCIE spent most of the three days with the survey team and took them all around the island in order to assess the incidence of asbestos.

A report of the first visit is presented in Appendix 7. One notable feature of this visit was the concern expressed about a large amount of insulating material that was reported to the survey team as powdered asbestos. The appropriate PPE was not available to satisfactorily inspect this material so it was decided to carry out an inspection on the second visit.

The second visit was undertaken by John O'Grady who stayed in Nauru for one week. One task of the second visit was to remove the burnt out portion of the hospital building and carry out a clean-up of the asbestos contamination on the hospital grounds. This clean-up was successful and is described in Appendix 8 below. This clean-up needed to be done urgently in order to remove the risk presented by the asbestos debris and friable asbestos that would have been generated by the fire and spread around the nearby area. The clean-up has also addressed a hazard that would have been a problem for the planned hospital renovation. The clean-up was carried out by the local company Central Meridian Inc under the supervision of John O'Grady.

Later in the second visit Stewart Williams of SPREP joined the visit and further meetings were held with DCIE, RON Hospital, Central Meridian, RONPhos (this time with Mr Jim Geering, CEO) and DFAT/High Commission. Numerous asbestos locations were also inspected, accompanied by Jaden Agir of DCIE, and 14 bulk samples were taken for analysis. In addition the suspected powdered asbestos was also inspected. When the inspection was made, it was discovered that several bag remnants contained the words "asbestos free". Six of the samples taken on the second visit were of the suspected powdered asbestos and later testing confirmed them to be fibreglass with no asbestos presence.

After the completion of the second visit, Stewart Williams and John O'Grady then went on to visit Canberra and had two meetings:

a) With Paul Kesby, Director and Dr Paul Starr, Assistant Director of the Hazardous Waste Section of the Environment Quality Division, Department of Environment, regarding the import of asbestos waste into Brisbane from Nauru.
b) With numerous people from DFAT lead by Fiona McKergow, Director and Neil Young, Program Manager Nauru, both from the Micronesia and Microstates Section, and also representatives of the Department of Immigration and Border Protection (DIBP). This meeting was held as a briefing meeting regarding the Nauru asbestos investigation and the clean-up at the hospital.

The third visit to Nauru was for nearly two weeks and the main focus was carrying out work for an asbestos risk assessment that had been commissioned jointly by DFAT and DIPB. A total of 77 air samples and 94 swab samples were taken. In addition the assessment work continued and a further 25 bulk samples were taken. Further meetings were also held with DCIE, the new CEO of NRC (Peter Melenewyez), the Australian High Commissioner, Ali Mohammed, Power Station Manager, Koria Tamuera, Deputy Harbourmaster, RonPHOS (Jim Geering), and Cindy Kephas of the NGO "Asbestos the Silent and Deadly Killer". In addition there were several brief meetings with contacts at the locations where the air and swab samples were taken. Also a representative of DCIE, George Dowiyogo, acted as guide for several days.

2.3 Survey Coverage

The survey work undertaken during the visits to Nauru included meetings with key government agencies, area-wide surveys across the Island and specific investigations of numerous sites. Every non-residential location that potentially contained asbestos was assessed to some extent at least.

The survey covered the whole island of Nauru. An estimate of asbestos in houses was made on the basis of a random survey of 178 houses conducted from the road. The inside of the houses were not surveyed. A total of 1652 houses were identified in the 2011 Census and any new houses built since then would not have had any asbestos in their construction materials. New houses were also not included in the 178 houses covered by the random survey. This means that about 10% of houses that may have had asbestos were covered by the random survey. This survey is discussed in more detail in Section 4.1 below.

By far the predominant industry on Nauru is the phosphate industry and all the buildings associated with this industry were assessed for asbestos (by observation and some sampling) and approximate quantities of ACMs measured. The phosphate industry is jointly controlled by the National Rehabilitation Corporation (NRC) who are responsible for mining and rehabilitation, and RONPhos who are responsible for processing, marketing and export. All the buildings involved in this industry are old and some are derelict.

All other non-residential buildings that could be observed from public roads were assessed for asbestos (again by observation and some sampling). These buildings included shops and other commercial buildings, churches, schools, the hospital and medical clinic, other government buildings including the main government offices and the power station, and some derelict buildings.

All ACM and PACM observed were non-friable, or at least were non-friable at the time of construction. In many cases the subsequent deterioration since initial construction has been sufficient to warrant assessing some of the observed asbestos as being at least partially friable. A vigilant look-out was maintained for friable asbestos. The only suspected example was some insulation rope at the power station which was sampled and later established as non-asbestos material.

No internal asbestos material was identified although it is possible that some internal wall cladding may be asbestos, possibly in private houses. Several vinyl floor tiles were tested and found to be negative for asbestos.

2.4 Identification of Target Sites

As stated above, in addition to residential households, the consultants sought to identify public and government buildings, industrial and commercial properties containing ACM. The primary focus of the survey was on residential properties and public buildings that would potentially present the most prolonged and thus significant risks for public exposure. Private commercial and industrial buildings were also included in the surveys.

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

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

As well as numerous fact-finding meetings, the survey consisted of inspecting all areas where asbestos may be found, including residential areas and government-owned facilities including (but not limited to) the phosphate industry, schools, hospitals and the health-care centre, the power station, the water treatment facility, and government administration buildings. Air and swab samples were also taken at the various refugee centres on Nauru.

2.5 Site Assessment Data Capture

Information was collected from most of the main survey sites 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 buildings relating to age, state of repairs, and any 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.

Due to the large number of PACM sites on Nauru, information was also gathered by visual inspections and driving by all the non-residential PACM sites and the residential sites were dealt with using the random residential survey covered in Section 4.1 below.

2.6 Sample Collection Methodology

2.6.1 Bulk Sampling

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

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

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

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

The samples were collected in accordance with the following procedure;

- Sampling personnel were required to wear adequate personal protective equipment (PPE), as determined by the risk assessment;
- 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 was easier to remove a small sample. The sample size collected was approximately 5 cm2
- 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 sealable polythene bag which was then sealed in a second polythene bag.
- After sampling, water was sprayed onto the sample area to prevent fibre release;
- Sampling points were further sealed by masking and PVC tape where necessary;
- Samples were labelled with a unique identifier and in the survey documentation;
- Each sample was noted on a chain of custody form provided by the laboratory, and secured in a sealable container.

Of the 76 sites where surveys were undertaken, 25 of those sites contained suspected asbestos-containing materials which could be sampled or where sampling was thought to provide useful additional information. A total of 39 bulk samples were collected from those sites. The results from an additional 17 samples taken from the Power Station in 2007 by GHD have also been taken into account in this report.

2.6.2 Air Sampling

A total of 77 air samples were taken at locations agreed with DFAT. These locations were at places where maximum exposure to people could be expected and the locations are listed in Section 4.2 below.

The air sampling pumps were hired from the New Zealand Air Monitoring Company CBL Air Monitoring Ltd. The pumps were all Gillian BDX II Abatement Air Samplers and they were set for a flowrate of 2 litres/minute. They were all run for at least four hours and a careful record of the run time was kept. The air sampling pumps were placed on tripods or at convenient locations where they could be secured with tape – see Photos 1 and 2 below. The tripod-mounted sampler shown below was at the RON Hospital and the fence-mounted sampler shown below was behind the Government Buildings. Air filter cassettes were attached to the sampling pumps and after each sampling run the cassettes were sealed and double-bagged.

Photo 1 - Air Sample Pump on Tripod **Photo 2 – Air Sample Pump on Fence**

2.6.3 Swab Sampling

A total of 94 swab samples were taken for quantitative analysis. The swab area in each case was 100 mm x 100 mm and was marked out using a template. A horizontal surface was generally chosen. Some swab samples were also taken from air conditioning units. PPE was worn where appropriate.

The swab collection procedure is as follows:

a. Mark off a 100mmx100mm square with masking tape.
b. Unfold wipe (about 150mm square)
c. Wipe the square
d. Fold in half so that any debris is retained inside the fold
e. Place in polythene sample bag, seal and label.
f. Place in another polythene sample bag.

Examples of the swabbed areas are shown in Photos 3 and 4 below. The template photo was taken on top of a container at the Port. The air conditioning photo was at the prison where the use of PPE was considered appropriate due to the fire that had occurred there in 2007 involving asbestos roofed and clad buildings.

Photo 3 – Swab Sample Template

Photo 4 – Swab Sample of an Air-Conditioner

2.7 Sample Laboratory Analysis

2.7.1 Bulk Sample Analysis

The samples were sent for analysis by courier to EMS Laboratories Incorporated (EMS) located in California in the United States of America. 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.

As with any environmental assessment, sampling of a media, in this case building material, can vary widely depending on when and where the sample is taken. Due to the wide scope of the survey including all residential, public and commercial buildings on the island, only 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 in order to draw conclusions. Also, where a large amount of PACM was identified at a single site, one sample of each main material identified was considered sufficient for this stage of the assessment. It was also evident that all asbestos-like roofing material on the island was in fact asbestos. No roofing material was used on the island that looked like asbestos but was not in fact asbestos.

The results for these samples are presented in Section 5.1, and copies of the laboratory reports are given in Appendix 5 of this report.

2.7.2 Air Sampling Analysis

The samples were sent by courier to EMS Laboratories Incorporated (EMS) located in California in the United States of America for analysis. The only exceptions were the air samples collected during the RON Hospital Clean-up described in Appendix 8. These samples were sent to Dowdell and Associates of Auckland, New Zealand and the results of these analyses are presented in Appendix 8.

The EMS results are presented in Section 5.2 and copies of the laboratory reports are given in Appendix 5 of this report.

Analysis of the samples was performed by EMS using Phase Contrast Microscopy – NIOSH Fiber Count (Method 7400, Issue 2, A Rules). A further 9 samples were analysed by Transmission Electron Microscopy.

2.7.3 Swab Sampling 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 carried out using the method described in ASTM 6480 — "Standard Test Method for Wipe Sampling of Surfaces, Indirect Preparation, and Analysis for Asbestos Structure Number Concentration by Transmission Electron Microscopy".

The EMS results are presented in Section 5.3 and copies of the laboratory reports are given in Appendix 5 of this report.

Method ASTM 6480 is used to identify asbestos in samples wiped from surfaces. The method provides the concentration of asbestos structures per unit area of sampled surface.

Asbestos is identified by transmission electron microscopy (TEM) for morphology, by electron diffraction (ED) for crystalline composition and by energy dispersive x-ray analysis (EDXA) for elemental composition. This method defines the type of asbestos present. The method incorporates all asbestos fibers equal or greater than 0.5um in length.

The analytical sensitivity is reported in asbestos structures per square centimeter is equivalent to counting one asbestos structure in the analysis. The limit of detection for a single sided distribution is 2.99 times the analytical sensitivity.

Asbestos structures are defined as isolated fibers, bundles composed of 3 or more parallel fibers closer than one fiber diameter, clusters that are intermixed fibers with no single fiber isolated from the group, and matrix in which fibers or bundles are attached or partially concealed by non-fibrous particles. In the method, the surface of known area (100 cm^2 for these samples) is wiped to collect the samples.

The sample is transferred from the wipe to a fiber-free aqueous solution of known volume. To obtain a suitable loading of particulates for TEM examination, aliquots of the suspension are filtered through a membrane filter and transferred to a TEM grid using the direct transfer method. The asbestiform structures are identified, sized and counted by TEM at 18,000X magnification and identified by ED and EDXA.

In these samples, the particulate interferences would have resulted in very poor analytical sensitivities if the analyses were made from the initial aliquots. The membrane filters from the initial aliquots were plasma ashed to remove the heavy organic constituents, washed and acid treated to remove the salts and ubiquitous calcium phosphate on Nauru and then prepared for TEM analysis

3.0 Risk Assessment Methodology

3.1 General Risk Assessment Comments

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 of which is an algorithm that provides 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), or other).

The second algorithm considers the ACM setting, likelihood of the ACM actually being disturbed and exposure to a receptor/s. The setting assessment therefore considers the normal occupant activity in that area of the site and the likelihood of disturbance. Each ACM 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, and 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 1: MDHS100 Material assessment algorithm - ACM

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

3.3 ACM Setting Assessment

The location of the ACM is as 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 was 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.

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

- 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, exterior asbestos soffits 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 internal 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 an unoccupied room has a potential for exposure that is less 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 2: HSG227 (2002) Priority Assessment Algorithm – Setting

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

Table 3: Risk Ranking Scoring

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

4.0 Asbestos Survey

4.1 Residential Survey Coverage

The 2011 Census counted 1652 houses including 1647 private houses and 5 non-private dwellings. The survey also identified that 28% of the total number of houses had asbestos roofs, namely 463 houses.

A random "drive-by" sample of 178 houses were surveyed in some detail as part of this project as shown below, although some bias was introduced into the randomness of the survey by the fact that many houses cannot be seen from the road as they are down driveways and so were excluded from the "random" survey.

43.8% of houses have no asbestos
2.8% of houses have 25% asbestos cladding only
1.1% of houses have an asbestos roof and 25% asbestos cladding
8.9% of houses have 50% asbestos cladding only
2.8% of houses have asbestos roof only
30.3% of houses have an asbestos roof and 50% asbestos cladding
0.5% of houses have 75% asbestos cladding only
0.5% of houses have an asbestos roof and 75% asbestos cladding
2.8% of houses have 100% asbestos cladding only
6.1% of houses have an asbestos roof and 100% asbestos cladding

Firstly it should be noted that this survey indicated that 40.8% (1.1+2.8+30.3+0.5+6.1)% of the houses surveyed had asbestos roofs compared with 28% in the census survey. It can be assumed that all the roofs that look like asbestos were in fact very likely to be asbestos as no roofing material similar to asbestos (but not asbestos) was used in Nauru.

Secondly the amounts of cladding that looked like asbestos did vary considerably and the above observations can be used to estimate the amount of this apparent asbestos. Problems arrive, however, from the fact that other cladding materials apart from asbestos were used that look like asbestos and these were quite common, based on the bulk sampling that was carried out. (See the results in Section 5.1 below).

Some photos of residential dwellings with asbestos are shown below (Photos 5-10):

Photos 5-10 – Six Typical Houses with Asbestos Roofs and Possibly Asbestos Cladding

Photo 11 shows a close-up of possible cladding and Photo 12 shows an abandoned house littered with asbestos debris. This abandoned house was close to other houses and children were noted playing in the asbestos debris.

Photo 11 – Possible Asbestos Cladding **Photo 12 – Asbestos Debris in Old House**

In addition asbestos debris litters sealed and grassed areas around houses, see Photos 13 and 14 below. Such asbestos litter and debris is quite common around houses on Nauru.

Photo 13 – Asbestos Debris around House **Photo 14 – Asbestos Debris in Back Yard**

4.2 Overall Coverage

After becoming familiar with Nauru the consultants identified a number of buildings that warranted a more detailed assessment. These included many buildings of sufficient age to have been constructed of ACM such as the phosphate industry buildings (NRC and RonPHOS), power plant, hospital, schools and other government owned housings. Generally, however, an attempt was made to survey, at least to some extent, almost every non-residential building on Nauru that contained exterior asbestos. The specific sites surveyed are shown in Table 4 below.

Table 4: Specific Sites Surveyed

Location	Comments	Suspected PACM	Samples collected of PACM
RON Hospital Old Block	Parapet Ceiling - may be removed anyway in hospital rebuild	Yes	Yes
RON Hospital New Block	Roof of Burnt Building - already removed but indicative of New Block	Yes	Yes

Location	Comments	Suspected PACM	Samples collected of PACM
	From Burnt Ground Area - already removed	Yes	Yes
	Vinyl Floor Burnt Building - will be removed in hospital rebuild	Yes	Yes
Prison	In 2007 Arson destroyed old Police Station and Prison. Samples taken of roof and cladding.	Yes	Yes
RONPhos Phosphate Storage Bin by Field	Very Large Roof - RONPhos to manage	Yes	Yes
RONPhos Phosphate Storage Bin by Sea	Very Large Roof - RONPhos to manage	Yes	Yes
RONPhos Main Conveyor	Roof - RONPhos to manage	Yes	No
PONPhos Conveyor Building	Roof - RONPhos to manage	Yes	No
	Cladding - RONPhos to manage	Yes	No
Old NPC Club	Roof - RONPhos to manage	Yes	No
	Cladding - RONPhos to manage	Yes	Yes
Shed next to NPC Club	Roof - RONPhos to manage	Yes	No
RONPhos Head Office	Roof - RONPhos to manage	Yes	No
2 Small RONPhos Buildings	Roof - RONPhos to manage	Yes	No
6 Small Houses near RONPhos	Roof - RONPhos to manage	Yes	No
Old NPC Bakery	Roof - RONPhos to manage	Yes	No
14 Houses near RONPhos	Presumed included in 2011 Census	Yes	No
RONPhos Training Centre	Roof - RONPhos to manage	Yes	No
Old House near Training Centre	Cladding - Presumed included in 2011 Census	Yes	Yes
Large RONPhos Workshop	Roof - RONPhos to manage	Yes	Yes
	Cladding - RONPhos to manage	Yes	No
Stacked Sheets by RONPhos	Ready for Disposal by RonPHOS	Yes	No
Two Old Buildings Behind Power Station	Roof - RONPhos to manage	Yes	No
	Cladding - RONPhos to manage	Yes	No
RONPhos Vehicle Workshops	Roof - RONPhos to manage	Yes	No
	Cladding - RONPhos to manage	Yes	Yes
RONPhos Workshop Store and Toilet	Sloped Roof small pitch - RONPhos to manage	Yes	No
RONPhos Offices and Stores	Roof - RONPhos to manage	Yes	No
	Cladding - RONPhos to manage	Yes	No
RONPhos Old Steel Phosphate Bin by Hotel	Roof - RONPhos to manage	Yes	No
	Cladding - RONPhos to manaage	Yes	No
RONPhos Phosphate Processing Area:			
Waste Pile by Road	Roof - RONPhos to manage	Yes	No
Tall Building by Road	Roof - RONPhos to manage	Yes	No

Location	Comments	Suspected PACM	Samples collected of PACM
	Cladding - RONPhos to manage	Yes	No
Siloes Cover	Roof - RONPhos to manage	Yes	No
	Cladding - RONPhos to manage	Yes	No
Conveyor Roof	Roof - RONPhos to manage	Yes	No
Processing Plant Building	Cladding Only - RONPhos to manage	Yes	No
Small Shed Roof	Roof - RONPhos to manage	Yes	No
RonPHOS B2 Bin	Suspected Stockpile of Powdered Asbestos	Yes	6 Samples Taken
Civic Centre – Aiwo	No PACM	No	No
Odn-Aiwo Hotel	No PACM	No	No
Bridge Rd Trader – Aiwo	Roof	Yes	No
Orro Church – Aiwo	Roof	Yes	No
Small Shed by Road – Denig	Roof	Yes	No
Bingo Shed – Denig	Large Roofed building with no sides	Yes	No
Power Station	Roof - GHD Survey	Yes	GHD Sampled 2007
	Ventilation Mouldings - GHD Survey	Yes	GHD Sampled 2007
	Residual in Walls after recladding - GHD Survey	Yes	GHD Sampled 2007
	Cable Shed roof and cladding - GHD Survey	Yes	GHD Sampled 2007
	Water Services Building Roof - GHD Survey	Yes	GHD Sampled 2007
	Coolstores - GHD Survey	Yes	GHD Sampled 2007
Old Laundry for Expats – Denig	Roof - now Commercial / Workshops	Yes	No
Naoero Central Minimarket	Flat Front Roof	Yes	No
C-Store Market	Shade Parapet	Yes	No
	Soffits	Yes	No
	Back Roof	Yes	No
	Side Roof	Yes	No
Old Cinema in Location	Roofed Building with no sides	Yes	No
Naoero Public Health Centre	Roof of Building at back	Yes	No
Jules Restaurant	No PACM	No	No
Conrad Restaurant – Beitsi	Flat Roof	Yes	No
Catholic Church	Roof	Yes	No
Capelles Supermarket	No PACM	No	No
3 in 1 Store Ewa	Roof	Yes	No
NPC on TopSide:			
Workshop	Roof - NRC to manage	Yes	No
	Cladding - NRC to manage	Yes	No
Shelter	Roof - NRC to manage	Yes	No

Location	Comments	Suspected PACM	Samples collected of PACM
Paint Shed	Roof - NRC to manage	Yes	No
	Cladding - NRC to manage	Yes	No
Tyre Bay	Roof - NRC to manage	Yes	No
	Cladding - NRC to manage	Yes	No
Anetan Infant School	Back Classroom Cladding	Yes	Yes
	Front Classroom Cladding	Yes	Yes
	Vinyl Floor Tiles	Yes	Yes
Boe Infant School	Cladding Back Area	Yes	Yes
	Cladding Mid Area (Old School)	Yes	Yes
Nibok Infant School	Cladding	Yes	Yes
	Vinyl Floor Tiles	Yes	Yes
Kayser College	Cladding	Yes	Yes
Nauru College, Denig	Cladding	Yes	Yes
Yaren Primary School	Vinyl Floor Tiles	Yes	Yes
Nauru Secondary School	No PACM (New School)	No	No
Nauru Primary School, Menen	No PACM (New School)	No	No
Nauru Able Disable Centre	No PACM (New School)	No	No
Meneng School	No PACM	No	No
Meage Store Nibok	Cladding	Yes	No
Leung Store Aiwo	Roof	Yes	No
	Cladding	Yes	No
Onion Store Boe	Cladding	Yes	No
Nauru Independent Church and House Boe	Roof	Yes	No
Airport	No PACM	No	No
My Store (DHL) Yaren	Cladding	Yes	No
Government Buildings	Parapet Ceiling	Yes	Yes
Government Buildings	Cladding	Yes	Yes
Kauwan - Kibaba Trading Menen	Roof	Yes	No
	Cladding	Yes	No
Petrol Station / Chinese Restaurant	Roof	Yes	No
	Under Roof	Yes	No
	Cladding	Yes	No
Menen Hotel	No PACM	No	No
I Stop Menen	Cladding - disused Shop now House	Yes	No
Tab Menen	Cladding	Yes	No
Abandoned House Menen	Roof	Yes	Yes
	Cladding	Yes	Yes
	Vinyl Tiles	Yes	Yes
Fisheries	No PACM	No	No
Bay Restaurant	No PACM	No	No
Green Tiled Building Sea Side	Cladding	Yes	No

Location	Comments	Suspected PACM	Samples collected of PACM
Menen			
I J Store	Cladding	Yes	No
Houses:		Yes	
Houses with Asbestos Roofs	Roofs in various conditions	Yes	Yes
Houses with Asbestos Roofs and Cladding	Roofs and Cladding in various conditions	Yes	Yes
Houses with Asbestos Cladding	Cladding in various conditions	Yes	Yes

The following is a photographic record, together with comments, of some of these locations:

RON Hospital

Numerous photos of the RON Hospital are shown in Appendix 8. Three more are shown below, namely part of the old Block and the parapet ceiling. Both the roofing and the parapet ceiling have been confirmed as asbestos – see Section 5 below.

Photo 15 – Old Hospital Block

Photo 16 – Hospital Parapet Roof

Photo 17 – Parapet Ceiling

Schools

All schools on Nauru were visited and inspected. All but three were found to be free of asbestos, and these three were Anetan Infant School, Boe Infant School and Nibok Infant School. Samples were taken at several schools which came back negative – namely Kayser College, Nauru College, and Yaren Primary School. The rest of the schools had no obvious PACM. We were advised that asbestos had already been removed from several schools.

In the cases of the three infant schools shown below, only the cladding (and not all the cladding) has been confirmed as asbestos). The vinyl floors were checked at the Anetan and Nibok Schools and found to be negative for asbestos.

Photos 18-22 - Boe Infant School Asbestos Cladding

Photos 23-26 – Nibok Infant School Asbestos Cladding and Suspected Ceiling

Photos 27-30 – Anetan Infant School Asbestos Cladding

The original site of the Nauru Primary School was in Aiwo and the school was burnt down in 2007. This resulted in the relocation of the school to Menen. The old school reportedly had an asbestos roof and cladding and so the site in Aiwo would probably have been contaminated with asbestos debris and fibres when the fire occurred. This site is now a vacant site opposite the Civic Centre in Aiwo – see Photo 31 below.

Photo 31 – Site of Old Aiwo School

National Rehabilitation Corporation (NRC) Area

The NRC workshops and maintenance area is up on Topside and all the buildings are clustered together in one area. Most of them have asbestos cladding, much of which is deteriorating. Photos 32-39 below show the main buildings:

Photos 32-39 – Various Buildings in NRC Workshop Area with Asbestos Roofing and Cladding

Republic of Nauru Phosphate Corporation (RonPHOS)

The RonPHOS buildings cover a wide area, including the administration and workshops and the phosphate processing area. The photos below are illustrative of the large number of buildings that have asbestos roofs and cladding.

Photo 40 - Central Office Building

Photo 41 - Old NPC Club

Photo 42 - Phosphate Storage Bin by Sea

Photo 43 - Old Phosphate Storage Bin by Sports Field

Photo 44 - Old Phosphate Storage Bin by Hotel

Photo 44 - RonPHOS Training Centre

Photo 45 - RonPHOS Workshop

Photo 46 - RonPHOS Vehicle Workshop

Photo 47 - RonPHOS Store **Photo 48 - RonPHOS Open Store**

There is also some asbestos stockpiled at RonPHOS as per Photos 49-50 below:

Photo 49 - Stacked Asbestos Sheets **Photo 50 - Broken Asbestos Sheets**

RonPHOS Phosphate Processing Area

Photos 51-56 show some of the various components of the phosphate processing plant, which is still partly operational although some sections are not used now and are falling into disrepair. The first photo shows the conveyor from the processing area to the storage area.

Photos 51-56 – The Old RonPHOS Processing Area

Photo 57 below shows the stockpile of insulating material in 2B storage area near the processing area. This material is also in a nearby storage area and both locations were sampled (three samples from each). All samples demonstrated that the insulating material was fibreglass.

Photo 57- Abandoned Insulating Material

Miscellaneous Small Buildings

Photo 58 - 3 in 1 Store Ewa

Photo 59 - Conrad Restaurant Beitsi

Photo 60 - C Store Denig

Photo 61 - Denig Bingo Hall


Photo 62 - Old Cinema Denig

Photo 63 - Store Aiwo


Photo 64 - Meage Store Nibok

Photo 65 - Old Laundry


Photo 66 - Chinese Restaurant/Petrol Station

Photo 67 - My Store / DHL

Photo 68 - Naoero Central Store

Photo 69 - Derelict Building Aiwo

Photo 70 - Abandoned Petrol Station

Churches

Photo 71 - Catholic Church

Photo 72 - Orro Church

Photo 73 - Nauru Independent Church **Photo 74 - Nauru Independent Church House**

Prison

There was a fire in the combined Prison and Police Station in 2007. The Police Station was relocated but the prison remained on the same location. Some of the burnt-out buildings are still in place together with some of the old debris. They have damaged asbestos roofing and cladding – see Photos 75-78 below.

Photos 75-78 – Prison Asbestos in Burnt Area including Asbestos Debris

Power Station

The Power Station has asbestos roofing and cladding in several locations – see Photos 79-80 below. It was the subject of a separate GHD investigation in 2007.

Photo 79-80 – Power Station Asbestos Roofing and Cladding

There was rope insulation on the exhaust from one of the generators and it was suspected of being asbestos. Subsequent testing has established that this is fibreglass – see below.

Photo 81 – Fibreglass Rope Lagging

4.3 Stockpiles

Aside from some stockpiles mentioned above, it was reported by several parties that there are some 20 foot containers full of asbestos in various locations on Nauru. Several parties reported this information but no-one was able to say exactly where the containers were. It was reported that in some cases the doors to the containers had been welded shut.

5.0 Laboratory Results

5.1 Bulk Results

Table 5 below shows the Bulk Results obtained from EMS Laboratories as well as the GHD Power Station Results.

Table 5 – Bulk Results

Sample Number	Primary Location	Secondary Location	Source of Analysis	Bulk Result
N1	RONPhos Processing Area	B2 Stockpile Lower Area 1	EMS / PacWaste	None Detected
N2	RONPhos Processing Area	B2 Stockpile Lower Area 2	EMS / PacWaste	None Detected
N3	RONPhos Processing Area	B2 Stockpile Lower Area 3	EMS / PacWaste	None Detected
N4	RONPhos Processing Area	B2 Stockpile Upper Area 1	EMS / PacWaste	None Detected
N5	RONPhos Processing Area	B2 Stockpile Upper Area 2	EMS / PacWaste	None Detected
N6	RONPhos Processing Area	B2 Stockpile Upper Area 3	EMS / PacWaste	None Detected
N7	RON Hospital	Sample from Burnt Ground Area	EMS / PacWaste	Chrysotile 20%
N8	RON Hospital	Vinyl Floor Burnt Building	EMS / PacWaste	None Detected
N9	RON Hospital	Parapet Ceiling	EMS / PacWaste	Chrysotile 10%
N10	RON Hospital	Roof of Burnt Building	EMS / PacWaste	Chrysotile 10%
N11	Menen Area	Abandoned House Cladding	EMS / PacWaste	Chrysotile 10%
N12	Menen Area	Abandoned House Roofing	EMS / PacWaste	Chrysotile 12%
N13	Menen Area	Abandoned House Vinyl Floor	EMS / PacWaste	None Detected
N14	Main Government Office	Office Parapet Ceiling	EMS / PacWaste	None Detected
N15	Main Government Office	Cladding	EMS / PacWaste	None Detected
4/28/11/14/Bulk	DFAT House 5	Outside Cladding	EMS / PacWaste	Chrysotile 10%
12/28/11/14/Bulk	DFAT House 3	Outside Cladding	EMS / PacWaste	None Detected
13/28/11/14	RONPhos Processing Area	Old Phosphate Store by Sports-ground	EMS / PacWaste	Chrysotile 10%, Amosite 5%
9/1/12/Bulk	Power Station Building	Cladding	EMS / PacWaste	None Detected
10/2/12/Bulk	RON Hospital	Old block - Vinyl Floor	EMS / PacWaste	None Detected
11/2/12/Bulk	Old NPC Club	Cladding	EMS / PacWaste	None Detected

Sample Number	Primary Location	Secondary Location	Source of Analysis	Bulk Result
12/2/12/Bulk	RonPHOS	Phosphate Storage Bin by Sea	EMS / PacWaste	Chrysotile 20%
13/2/12/Bulk	Power Station Building	Rope Lagging on Generator Exhaust	EMS / PacWaste	None Detected
14/2/12/Bulk	Prison	Old Burnt Prison Roof	EMS / PacWaste	Chrysotile 10%
15/2/12/Bulk	Naero Public Health Centre	Cladding	EMS / PacWaste	None Detected
16/2/12/Bulk	Prison	Burnt Prison Cladding	EMS / PacWaste	Chrysotile 7%
10/3/12/Bulk	Naero Public Health Centre	Soffits	EMS / PacWaste	None Detected
11/3/12/Bulk	Anetan Infant School	Vinyl Floor Tile	EMS / PacWaste	None Detected
12/3/12/Bulk	Anetan Infant School	Back Classroom Cladding	EMS / PacWaste	None Detected
13/3/12/Bulk	Anetan Infant School	Front Classroom Cladding	EMS / PacWaste	Chrysotile 10%, Amosite 5%
14/3/12/Bulk	Yaren Primary School	Vinyl Floor Tiles	EMS / PacWaste	None Detected
15/3/12/Bulk	Boe Infant School	Cladding back area	EMS / PacWaste	None Detected
16/3/12/Bulk	Boe Infant School	Old School - Cladding mid area	EMS / PacWaste	Chrysotile 7%
17/3/12/Bulk	Nauru College	Cladding	EMS / PacWaste	None Detected
1/4/12/Bulk	Kayser College	Old Block Cladding	EMS / PacWaste	None Detected
2/4/12/Bulk	Nibok Infant School	Cladding	EMS / PacWaste	Chrysotile 7%
3/4/12/Bulk	RonPHOS Workshop	Roofing	EMS / PacWaste	Chrysotile 65%
4/4/12/Bulk	Nibok Infant School	Vinyl Floor Tiles	EMS / PacWaste	None Detected
5/4/12/Bulk	Old NPC House (was Bakery)	Cladding	EMS / PacWaste	None Detected
6/4/12/Bulk	RonPHOS Workshop	Cladding	EMS / PacWaste	Chrysotile 5%
	Power Station Building	Gable / Main Eastern Entrance Cladding	GHD Survey 2007	Chrysotile, Amosite, Crocidolite
	Power Station Building	Edge of Roof, Northern Side	GHD Survey 2007	Chrysotile
	Power Station Building	West Wall, Northern End	GHD Survey 2007	Chrysotile
	Power Station Building	Wall Entrance to Switchboard Corridor, (North Side)	GHD Survey 2007	Chrysotile

Sample Number	Primary Location	Secondary Location	Source of Analysis	Bulk Result
	Power Station Building	South Wall (Resuidual AC Panels after Refurbishment)	GHD Survey 2007	Deemed Positive
	Power Station Building	Generator Set 1	GHD Survey 2007	Chrysotile
	Power Station Building	Generator Set 1	GHD Survey 2007	None Detected
	Power Station Building	Generator Set 6	GHD Survey 2007	None Detected
	Power Station Building	Generator Set 5	GHD Survey 2007	None Detected
	Power Station Building	Generator Set 4	GHD Survey 2007	None Detected
	Power Station Building	Cool Store Edge of Roof, Southern Side	GHD Survey 2007	Chrysotile
	Power Station Building	Tool Room Eastern External Wall	GHD Survey 2007	None Detected
	Power Station Building	Tool Room Floor	GHD Survey 2007	None Detected
	Power Station Building	Electrical Shop External Wall RHS of Entry Door	GHD Survey 2007	None Detected
	Power Station Building	General Utilities Building External Wall North Side	GHD Survey 2007	None Detected
	Power Station Building	Cable Shed Western Wall, Northern End	GHD Survey 2007	Chrysotile, Amosite, Crocidolite
	Power Station Building	Water Services Building Roof and Gables	GHD Survey 2007	Deemed Positive

5.2 Air Monitoring

5.2.1 Monitoring for Asbestos in Air

Airborne asbestos is monitored using NIOSH Method 7400 (NIOSH is the US National Institute for Occupational Safety and Health). The method involves drawing a measured volume of air through a 25 millimetre diameter membrane filter to collect the airborne dust and fibres. The filters are then sent to a laboratory for analysis using fibre counting by Phase Contrast Microscopy (PCM). This method will assure against “false negatives” but will not guarantee against “false positives”. In order to accurately identify asbestos fibres, examination using transmission electron microscopy (TEM) is needed. .

In the laboratory an approximately 90° wedge is cut from the filter and mounted on a microscope slide for examination at 400x magnification using phase-contrast microscopy. The eyepiece of the microscope is fitted with a standard graticule, which is illustrated in Figure 3 below. The circle on the graticule has a projected diameter of 100 microns which covers only a very small fraction (~ 1/50,000) of the exposed surface of the membrane filter. The area covered by the graticule is referred to as a ‘field’.

For fibre counting, the analyst positions the graticule near the tip of the filter wedge and then moves progressively up and down, and across the filter, while randomly selecting fields for examination. A minimum of 20 fields must be counted and the counting stops when either 100 fibres have been counted or 100 fields have been examined – whichever occurs first.

This method counts **all** fibres that are 3 times as long as they are wide and at least 5 microns in length. The marks around the edge of the graticule illustrate the different types of fibre shapes that would comply with these criteria. The results are reported as total fibres per 100 fields, which is then converted progressively by calculation to fibres per mm^2 of filter, total fibres per filter, and fibres per cubic centimetre of air sampled.

The analytical sensitivity of the method is 1 fibre per field. However, the results are subject to a degree of variability because only a fraction of the filter is being examined, and the fibres are not evenly distributed across all fields. There may also be variability between different analysts because the fibres are sometimes difficult to identify, especially in the presence of other dust particles.

Controlled studies using multiple analysts have determined that the statistical limit of detection is typically about 5.5 fibres per 100 fields, or 7 fibres per mm^2 of filter.

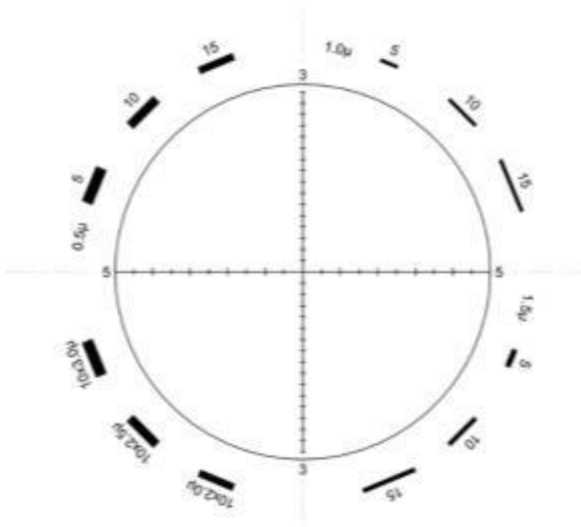

Figure 3: Eyepiece Graticule used for Asbestos Fibre Counting.

Asbestos Risk Assessment

The following assessment criteria have been taken from the *WHO Air Quality Guidelines for Europe, 2000*.

> *Several authors and working groups have produced estimates indicating that, with a lifetime exposure to 1000 F/m^3 (0.0005 F*/ml or 500 F*/m^3, optically measured) in a population of whom 30% are smokers, the excess risk due to lung cancer would be in the order of 10^{-6}–10^{-5}. For the same lifetime exposure, the mesothelioma risk for the general population would be*

in the range 10^{-5}–10^{-4}. These ranges are proposed with a view to providing adequate health protection, but their validity is difficult to judge.

The most relevant figure here is the level of 0.0005 fibres per ml, which has a lifetime exposure risk of 1×10^{-5} to 1×10^{-6} for lung cancer, and 1×10^{-4} to 1×10^{-5} for mesothelioma. In Australia the acceptable risk level is usually taken as 1×10^{-6} (ie. 1 per million), while New Zealand uses 1×10^{-5} (1 per 100,000) because of the smaller population. By the same reasoning a risk of 1×10^{-4} (or even higher) might be regarded as acceptable for a much smaller country such as Nauru.

Unfortunately, the Nauru air samples only have a detection limit of around 0.005 fibres per ml so all that can really be said is the risk levels are no more than 10 times the WHO levels given above. Alternatively, a 10-fold difference to the exposure period could be applied; ie. the above WHO risk levels would apply for 8 years' exposure at 0.005 fibres per ml. This shorter exposure period would be relevant for most expat personnel.

5.2.2 Air Monitoring Results

The Table 6 below shows the Air Monitoring Results obtained from EMS Laboratories.

Table 6 – Air Monitoring Results

Sample No	Location	Fibres Counted (Fibres / 100 Fields)	Above LOD of 5.5 Fibres/100 Fields
12/28/11/14	House 2 DFAT House - Front driveway	0	No
11/27/11/14	RON Hospital - Out patients waiting area	0	No
3/27/11/2014	***RON Hospital-Ward 5, New Wing, Rafter***	***4***	***No***
4/27/11/2014	Australian High Commission (AHC) - Top of Water tank in rear garden	1.5	No
5/27/11/2014	AHC - Front driveway of building 2	0	No
6/27/11/2014	Jules Restaurant - top of rafter	Torn Filter	N/A
1/28/11/14	***House 14 – DFAT – Outside Front Porch***	***6***	***Yes***
3/28/11/14	House 5 – DFAT – Outside Front Porch	1	No
4/28/11/14	House 9 – DFAT – Top of water tank	0	No
5/28/11/14	House 8 – DFAT – Top of water tank	0	No
6/28/11/14	***House 10 – DFAT – on water cylinder Roof in rear garden***	***3***	***No***
7/28/11/14	***RON Hospital - Acute Ward***	***6***	***Yes***
8/28/11/14	Civic Centre - Ground Floor	1	No
9/28/11/14	Civic Centre - !st Floor	1	No
10/28/11/14	House 4 – DFAT	0	No
11/28/11/14	House 3 – DFAT HK Accom and Office	0	No
1/29/11	House 6 – DFAT	0	No
2/19/11	House 1 – DFAT	0	No
3/29/11	House 13 – DFAT	0	No
4/29/11	House 16 – DFAT – Top of Generator	1	No

Sample No	Location	Fibres Counted (Fibres / 100 Fields)	Above LOD of 5.5 Fibres/100 Fields
5/29/11	House 7 – DFAT – Rear garden windowsill	0	No
6/29/11	House 12 – DFAT	0	No
7/29/11	House 15 – DFAT	0	No
8/29/11	Seaport Area 3 – Outside Area	0.5	No
9/29/11	Seaport Area 2 – Outside top Blue Container	0	No
10/29/11	Seaport Area 1 – Outside – Wall Bracket	0	No
1/30/11	Od-n-aiwo Hotel – Front Foyer	1	No
2/30/11	Nibok Refuge Accommodation - Block 2661	0	No
3/30/11	Nibok Refuge Accommodation Building 9	0	No
4/30/11	Ewa Refuge Accommodation - Red Container adj site office	0	No
5/30/11	Ewa Refuge Accommodation – 2584	0	No
6/30/11	Capelles - Top of Water tank	0	No
7/30/11	Anabare Village Staff Accom Outside	0	No
8/30/11	Anabare Staff Village Accom Ledge outside stairwell	1	No
9/30/11	Anabare Refuge Accommodation	1	No
10/30/11	Bay Restaurant	0	No
1/01/2012	***Power Plant – Office on indoor shelf***	***9***	***Yes***
2/01/2012	Power Plant - Inside Plant on top of meter box 5	2	No
3/01/2012	Power Plant - Outside on top of heater boiler box	1	No
4/01/2012	***NUC RO Units - Main Office on top of blackboard***	***3.5***	***No***

Sample No	Location	Fibres Counted (Fibres / 100 Fields)	Above LOD of 5.5 Fibres/100 Fields
5/01/2012	NUC RO Units - Yard Area blue railing around water filter	0	No
6/01/2012	Prison (Mens) - Burnt out area of compound	0	No
7/01/2012	Prison (Women's) – Pipe in courtyard on wall	2	No
8/01/2012	Fisheries Workshop – top of generator	0	No
9/01/2012	Fisheries - Admin Office main entrance	0	No
10/01/2012	***Menin Hotel Foyer***	***3***	***No***
3/02/2012	OPC 1 - Ihms - A&E Area	0	No
2/02/2012	OPC 1 - Block A Accommodation	0	No
1/02/2012	OPC 1- Block F Accommodation	1	No
4/02/2012	OPC 1 – Warehouse	1	No
5/02/2012	OPC 2 – Outside boundary of Alpha Camp	0.5	No
6/02/2012	OPC 2 - Internet Entrance	0	No
7/02/2012	OPC 2 - Indoor soccer area	0	No
8/02/2012	OPC 2 - Entrance Area (Staff Quarters)	0	No
9/02/2012	House 49 AHC	1	No
1/03/2012	OPC 3- Foxrock 50	0	No
2/03/2012	OPC 3- Echo Station	0	No
3/03/2012	***OPC 3 - Fox 2***	***4***	***No***
4/03/2012	OPC 3 - Fox 40 Area 9	0	No
5/03/2012	Nauru Secondary School - Main yard	0	No
6/03/2012	Nauru Secondary School - Door at Gym	1.5	No
7/03/2012	Nauru Secondary School - under shade pergola	2	No
8/03/2012	***Airport - Departure Area***	***8.5***	***Yes***
9/03/2012	Airport - Outside front area	2.5	No
1/04/2012	Govt Building - Block adj to prison	0	No

Sample No	Location	Fibres Counted (Fibres / 100 Fields)	Above LOD of 5.5 Fibres/100 Fields
2/04/2012	Govt Building - Entrance of prison	0	No
4/04/2012	Govt Building -outside rear WC block	0	No
3/04/2012	Govt Building - main Parliament entrance	0	No
5/04/2012	Govt Building - Rear of prison	0	No
6/04/2012	Govt Building - Front of main Govt Building	1	No
7/12/2012	Fly Camp Refugee opp station point	0	No
8/12/2012	Flycamp Refugee - Block E	0	No
9/12/2012	Nursery - Under sheltered unit	0	No
10/12/2012	Nursery - on pole in garden	0	No
1/05/2012	Ijuw Camp - outside of kitchen	0.5	No
2/05/2012	Ijuw Camp - Back of camp	1	No
3/05/2012	Romanian Hotel Camp	0	No

The nine results that tested 3 and above in Table 6 (shown in bold and italics above) were further analysed by transmission electron microscopy (TEM) to seek a positive confirmation. The resulting report is presented in Appendix 5 and shows that none of the fibres identified by the PCM method were in fact asbestos. The relevant comments in the Laboratory Reports were as follows:

- No asbestos was found in the samples.
- The samples were very lightly loaded with particles.
- Sample 7/28/2014 (RON Hospital Acute Ward) was heavier with debris than the other samples.
- Organic fibres were present in all the air samples.
- Two non-asbestos fibres (calcium sulfate and calcium phosphate) were found in 3/03/12 (OPC Fox 2).

Earlier GHD Power Station Results:

As part of a 2007 investigation by GHD, air monitoring was undertaken at three locations in the power station's generating hall.

Air sampling pumps were located as follows:

- On top of Generator Set 6 near exposed suspect insulation, at 2 m above floor level;

- On top of Generator Set 1, at 2.6 m above floor level; and
- On service platform against north wall near Generator Set 4, at 4.1 m above floor level.

Thus monitoring was undertaken at roughly each end, and in the middle, of the generating hall.

Sufficient volumes of air were sampled to enable detection of asbestos fibres, if they were present, at levels of >0.01 fibres/mL of air.

The acceptable occupational level of asbestos fibres (all types) in air is 0.1 fibres/mL.

The acceptable para-occupational (or environmental) level of asbestos fibres in air is 0.01 fibres/mL.

The results of the air monitoring were that no asbestos fibres were detected in any of the filter samples taken. On this basis the result is considered to be <0.01 fibres/mL, and therefore acceptable.

5.3 Swab Results

The ASTM 6480 method mentioned in Section 2.7.3 above does not describe procedures for the evaluation of the relationship between asbestos sampled from a surface and potential human exposure. The usual interpretation on the results of wipe testing is that below 10,000 asbestos structures/ cm^2 would be considered a low level of contamination, 10,000 to 100,000 would be considered moderate contamination, and above 100,000 asbestos structures/ cm^2 would be considered significantly contaminated. "*Settled Asbestos Dust Sampling and Analysis*" by Steve M. Hays and James R. Millette, Pages 49 — 51 discusses interpretation of the results, and this is the suggestion the authors make. James Millette was the ASTM vice-chairman on the Sampling and Analysis of Asbestos, until 2007 and chairman from 2007 to 2014.

Table 7 presents the swab results and the high swab results are presented in Table 8.

Table 7 – Swab Results

Sample No on Lab Report	Location	Chrysotile (Str/cm2)	Amphibole (Str/cm2)
1/26/11/14SWAB	House 2, air con unit	9100	<1800
1/27/11/14SWAB	Ron Hospital, NW5, rafter	210000	<2300
2/27/11/14SWAB	Ron Hospital, Teco air con	140000	<2300
3/27/11/14SWAB	Ron Hospital, Settlement Clinic Room	72000	4646
4/27/11/14SWAB	Ron Hospital, generator room	98000	<2600
5/27/11/14SWAB	Ron Hospital, air con unit	40000	<2600
6/27/11/14SWAB	Ron Hospital, Maternity	190000	<27000
7/27/11/14SWAB	AHC, main building	5300	<2700
8/27/11/14SWAB	AHC, wooden deck	2300	<2300
9/27/11/14SWAB	AHC, roof- on top of water tank	<3700	<3700
10/27/11/14SWAB	AHC,top of air con unit (outside)	2300	<2300
1/28/11/14SWAB	House 14, air con unit	<2300	<2300
2/28/11/14SWAB	House 12, air con unit	7500	<3700
3/28/11/14SWAB	House 5, air con unit	<1900	<1900

Sample No on Lab Report	Location	Chrysotile (Str/cm2)	Amphibole (Str/cm2)
5/28/11/14SWAB	House 9, air con unit	<19000	19000
6/28/11/14SWAB	House 8, air con unit	<3700	<3700
9/28/11/14SWAB	Civic Centre, stairwell	<9300	<9300
8/28/11/14SWAB	Civic Centre, food cabinet	3700	<3700
7/28/11/14SWAB	House 10, air con unit	<9300	<9300
10/28/11/14SWAB	House 4, air con unit	<9300	<9300
11/28/11/14SWAB	House 3, air con unit	<9300	<9300
1/29/11SWAB	HK6 office & accom - air con filter	<3700	<3700
2/29/11SWAB	House 1, DFAT (Min's House)	<3700	<3700
3/29/11SWAB	House 16, DFAT air con filter	<9300	<9300
4/29/11SWAB	House 7, DFAT air con filter	9300	<9300
5/29/11SWAB	House 15, DFAT air con filter	9300	<9300
6/29/11SWAB	Seaport, top surface of old car	7500	<1900
7/29/11SWAB	Seaport, window ledge (office building)	37000	<9300
8/29/11SWAB	Seaport, disused building	24000	<1900
9/29/11SWAB	Seaport, Area 3, top of red container	19000	<1900
10/29/11SWAB	Seaport, top of blue container	170000	<1900
11/29/11SWAB	Seaport, container in Ironworks	<1900	<1900
1/30/11SWAB	Odnaiwo Hotel, air con unit in foyer	9300	<9300
2/30/11SWAB	Nibok Refugee accom, 2661	<9300	<9300
3/30/11SWAB	Nibok Refugee accom, B9	<9300	<9300
4/30/11SWAB	Ewa Refugee accom, top of water tank	<9300	<9300
5/30/11SWAB	Ewa Refugee accom, 2584	19000	<9300
6/30/11SWAB	Capelle Supermarket	<1900	<1900
7/30/11SWAB	Anabare Staff accom -meter box	<1900	<1900
8/30/11SWAB	Anabare Staff accom - meter box	<1900	<1900
9/30/11SWAB	Anabare Refugee accom - key box	<1900	<1900
10/30/11SWAB	Bay Restaurant Bar	<1900	<1900
1/1/12SWAB	Power plant, metre box	3700	<1900
2/1/12SWAB	Power plant, air con	<1900	<1900
3/1/12SWAB	Power plant, boiler	<1900	<1900
4/1/12SWAB	Power Plant, corridor control room	150000	<3700
5/1/12SWAB	Power Plant , fridge	<1900	<1900
6/1/12SWAB	Power Plant, wooden box	180000	<9300
7/1/12SWAB	NUC RO units, blackboard top	160000	1900
8/1/12SWAB	NUC RO units, water filter in yard	120000	<1900
10/1/12SWAB	Prison, burnt-out compound	1400000	<9300
11/1/12SWAB	Prison, ground surface	130000	<2000
12/1/12SWAB	Prison, air con filter	<2000	<2000
13/1/12SWAB	Prison, canteen window	14000	<2000
14/1/12SWAB	Fisheries workshop – generator	<2000	<2000
15/1/12SWAB	Fisheries, main office aircon filter	30000	<10000

Sample No on Lab Report	Location	Chrysotile (Str/cm2)	Amphibole (Str/cm2)
16/1/12SWAB	Menen Hotel, air con filter	60000	<10000
1/2/12SWAB	OPC1, IHMS A&E area	2000	<2000
2/2/12SWAB	OPC1, Block A top of water tank	<2000	<2000
3/2/12SWAB	OPC1, Block F	<2000	<2000
4/2/12SWAB	OPC1, warehouse - powerbox	<2000	<2000
5/2/12SWAB	OPC2, Alfa station- top of cabinet	<2000	<2000
6/2/12SWAB	OPC2, internet point	<2000	<2000
7/2/12SWAB	OPC2, indoor soccer area	<2000	<2000
8/2/12SWAB	OPC2, entrance area	<2000	<2000
9/2/12SWAB	House 49 (Nialls), DFAT, air con filter	2000	<2000
1/12SWAB	Power Plant, Surface on top of Meter Box 5	400000	<9700
3/29/11/14SWAB	House 13 air con filter	<1900	<1900
10/27/11/2014SWAB	Jules Restaurant, top of generator	31000	<1900
1/3/12SWAB	OPC3, Echo Station	<1900	<1900
2/3/12SWAB	OPC3, Fox Station 2	<1900	<1900
3/3/12SWAB	OPC3, recreation room	<1900	<1900
4/3/12SWAB	OPC3, Fox 40, Area 9	<1900	<1900
5/3/12SWAB	Nauru Secondary School, D8	<1900	<1900
6/3/12SWAB	Nauru Secondary School, E3	<1900	<1900
7/3/12SWAB	Nauru Secondary School, B2	9700	<9700
8/3/12SWAB	Nauru Secondary Sch, C6	<1900	<1900
9/3/12 SWAB	Nauru Secondary School, Block A	<3900	<3900
10/3/12 SWAB	Nauru Secondary School, air con filter	7800	7800
11/3/12 SWAB	Airport, departures	14000	<1900
12/3/12 SWAB	Airport – air con filter, main office	58000	<9700
1/4/12 SWAB	Govt building, back power box	<9700	<9700
2/4/12 SWAB	Govt building, womens wc	490000	38000
3/4/12 SWAB	Govt building, Education Dept	77000	19000
4/4/12 SWAB	Govt building, back of prison	33000	3800
5/4/12 SWAB	Govt building, fire hose reel	1900	<1900
6/4/12 SWAB	Govt building, general office air con	<9700	<9700
7/4/12 SWAB	Nursery workshop bench	<1900	<1900
8/4/12 SWAB	Nursery bulk water tank	27000	7700
9/4/12 SWAB	Flycamp, kitchen	<1900	<1900
10/4/12 SWAB	Flycamp, power box	<9700	<9700
1/5/12 SWAB	Ijuw Lodge, kitchen, top of microwave	<1900	<1900
2/5/12 SWAB	Ijuw Lodge, surface under roof area	1900	<1900
3/5/12 SWAB	H2 House, DFAT, bedroom 2, air con	3900	<1900

Table 8 - High Swab Results

Locations	Moderate Contamination Chrysotile Str/cm2	Significant Contamination Chrysotile Str/cm2	Moderate Contamination Amphibole Str/cm2	Significant Contamination Amphibole Str/cm2
Range	**(10,000-100,000)**	**(>100,000)**	**(10,000-100,000)**	**(>100,000)**
RON Hospital NW5 rafter		210,000		
RON Hospital Teco air con unit		140,000		
RON Hospital Settlement Clinic	72,000			
RON HospitalGenerator Room	98,000			
RON Hospital, air con unit	40,000			
RON Hospital Maternity		190,000		
House 9, air con unit			19,000	
Seaport, window ledge	37,000			
Seaport, disused building	24,000			
Seaport, top of red container	19,000			
Seaport, top of blue container		170,000		
Ewa Refugee Accom, 2584	19,000			
Power Plant, control room corridor		150,000		
Power Plant, wooden box		180,000		
NUC RO units, top of blackboard		160,000		
NUC RO units, water filter	97,000			
Prison, burnt-out compound		1,400,000		
Prison, ground surface		130,000		
Prison, window in canteen	14,000			
Fisheries, main office	30,000			
Menin Hotel, air con filter	60,000			
Power plant, on top of meter box 5		400,000		
Jules Restaurant generator	31,000			
Airport Departures	14,000			
Airport, air con filter –	58,000			

Locations	Moderate Contamination Chrysotile Str/cm2	Significant Contamination Chrysotile Str/cm2	Moderate Contamination Amphibole Str/cm2	Significant Contamination Amphibole Str/cm2
office				
Govt Building - ladies wc		490,000	39000	
Govt Building - Education Dept	77,000		19000	
Govt Building - back of prison	33,000			
Nursery, bulk water tank	27,000			

6.0 Asbestos Quantities

6.1 Quantities of Asbestos in Residential Housing

Based on the survey undertaken by the consultants and discussed in Section 4.1 above, 40.8% of the houses have asbestos roofs. The 2011 census figure for the total number of houses is 1652 houses and 40.8% of this figure is 674 houses.

The average size of a house in Nauru was estimated by the consultants to be between 150-175 m2. The letter in Appendix 6 from the local Nauru contractor Central Meridian stated that the standard house in Nauru was 14m x 12m or 168 m2. These figures accord well with Table 5 of Appendix A4.3 which gives a range of house sizes for difference styles of houses.

Hence if a figure of 170m2 is taken and a multiplier of 1.15 is used to compensate for the pitch of the roof (assumes a pitch angle of about 30 degrees) then this gives 195.5 m2. If a little more is added for overhang and spouting then a figure of 200m2 is considered reasonable.

A total of ten Nauru roofing samples were analysed and all ten were positive for asbestos. It is believed that no other roofing material has been used on Nauru that looks like asbestos and is not asbestos.

Therefore the estimated total area of asbestos roofing on residential dwellings on Nauru is:
674 x 200 = 134,800 m2
The total exterior wall surface area in an average 14mx12m house about 3m high = 3 x (14x2 + 12x2) = 156m2

If 25% of the total wall surface consists of windows and doors, then the cladding are in an average housed is 156 x 0.75 = 117 m2.

Based on the CEL survey and allowing for the different percentages of asbestos cladding, the total area of asbestos cladding is therefore 58,471 m2.

However not all the cladding on Nauru buildings that looks like asbestos is in fact asbestos. A total of 23 cladding samples were analysed (excluding Nauru College which is quite a different type of cladding to most) and of those 23 samples only 11 were positive for asbestos or 44.2%. Based on this result, a reasonable estimate of the percentage of asbestos-like cladding that is in fact asbestos is probably about 45%.

Therefore the total amount of asbestos cladding on residential dwellings on Nauru is estimated to be:

58,471 x 0.45 = 26,312 m2

Therefore the total amount of asbestos (roofing and cladding) on residential dwellings on Nauru is estimated to be 134,800 + 26,312 = 161,112 m2

6.2 Overall Quantities

Overall quantities of asbestos for various sectors are shown in Table 8 below:

Table 9 – Overall Quantities of Asbestos (all quantities shown are in m^2)

Location	Area (m^2)	Condition	Public Buildings	Small Misc Buildings	RONPhos Area	NRC Area	Residences
RON Hospital Old Block	3100	Fair	3100				
RON Hospital New Block	3000	Fair	3000				
Prison	180	Poor	180				
Some debris at prison	10	Waste	10				
RONPhos Phosphate Storage Bin by Field	6030	Poor			6030		
RONPhos Phosphate Storage Bin by Sea	2350	Poor			2350		
RONPhos Main Conveyor	1200	Fair			1200		
PONPhos Conveyor Building – Roof	200	Fair			200		
Ditto – Cladding	215	Fair			215		
Old NPC Club	900	Poor			900		
Shed next to NPC Club	300	Fair			300		
RONPhos Head Office	780	Good			780		
2 Small RONPhos Buildings	220	Fair			220		
6 Small Houses near RONPhos	700	Fair			700		
Old NPC Bakery	400	Poor			400		
RONPhos Training Centre	285	Good			285		
Large RONPhos Workshop – Roof	7920	Poor			7920		
Ditto – Cladding	1710	Fair			1710		
Stacked Sheets by RONPhos	156	Good			156		
Two Old Buildings Behind Power Station - Bldg 1 Roof	260	Poor			260		
Bldg 2 – Roof	360	Poor			360		
Ditto Cladding	335	Fair			335		
RONPhos Vehicle Workshops – Roof	1300	Poor			1300		
Ditto – Cladding	240	Fair			240		
RONPhos Workshop Toilet and Store	400	Fair			400		

Location	Area (m^2)	Condition	Public Buildings	Small Misc Buildings	RONPhos Area	NRC Area	Residences
RONPhos Offices and Stores – Roof	480	Fair			480		
Ditto – Cladding	240	Fair			240		
RONPhos Old Phosphate Bin by Hotel – Roof	540	In Pieces			540		
Ditto – Cladding	150	In Pieces			150		
RONPhos Phosphate Processing Area:							
Waste Pile by Road	10	Waste			10		
Tall Building by Road - Roof	300	Poor			300		
Ditto – Cladding	1300	Poor			1300		
Siloes Cover - Roof	300	Poor			300		
Ditto – Cladding	430	Poor			430		
Conveyor Roof	350	Poor			350		
Processing Plant Building	1750	Poor			1750		
Small Shed Roof	300	Poor			300		
Bridge Rd Trader – Aiwo	140	Good		140			
Orro Church – Aiwo	785	Good		785			
Small Shed by Road – Denig	85	Fair	85				
Bingo Shed – Denig	1550	Poor	1550				
Power Station - Roof	1220	Fair	1220				
Ditto – Cladding	40	Fair	40				
Ditto – Cladding	20	Fair	20				
Ditto – Cladding	285	Fair	285				
Ditto – Roof	120	Poor	120				
Ditto – Roof	830	Poor	830				
Old Expats Laundry – Denig	480	Poor		480			
Naoero Central Minimarket	30	Fair		30			
C-Store Market - Shade Parapet	240	Fair		240			
Ditto – Soffits	50	Fair		50			
Ditto - Back Roof	810	Fair		810			
Ditto - Side Roof	150	Fair		150			
Old Cinema in Location	270	Poor		270			
Conrad Restaurant – Beitsi	120	Fair		120			
Catholic Church	615	Fair	615				

Location	Area (m^2)	Condition	Public Buildings	Small Misc Buildings	RONPhos Area	NRC Area	Residences
3 in 1 Store – Ewa	105	Fair		105			
NPC on Topside:							
Workshop – Roof	1080	Fair				1080	
Ditto – Cladding	1200	Fair				1200	
Shelter	300	Fair				300	
Paint Shed – Roof	200	Fair				200	
Ditto – Cladding	335	Fair				335	
Tyre Bay – Roof	505	Fair				505	
Ditto – Cladding	360	Fair				360	
Anetan Infant School	435	Good	435				
Boe Infant School	200	Good	200				
Nibok Infant School	685	Good	685				
Meage Store Nibok	40	Good		40			
Leung Store Aiwo – Roof	45	Fair		45			
Ditto – Cladding	10	Good		10			
Onion Store Boe	60	Fair		60			
Nauru Independent Church and House Boe	2075	Fair	2075				
My Store (DHL) Yaren	45	Good		45			
Kauwan - Kibaba Trading Menen - Roof	110	Good		110			
Ditto – Cladding	35	Good		35			
Petrol Station / Chinese Restaurant – Roof	150	Fair		150			
Ditto - Under Roof	130	Fair		130			
Ditto – Cladding	105	Fair		105			
I Stop Menen	63	Fair		63			
Tab Menen	85	Fair		85			
Green Tiled Building Sea Side Menen	75	Fair		75			
I J Store	10	Good		10			
Houses:							
Asbestos Roof Area	134800						134800
Asbestos Cladding Area	58471						58471
Total Area	**248255**		**14450**	**4143**	**32411**	**3980**	**193271**
Total Area Adjusted for 45% Cladding	**212139**		**14450**	**3769**	**29870**	**2938**	**161112**

7.0 Risk Assessment using the Risk Ranking Algorithm

Utilising the algorithms described in Section 3 of this report and based on the laboratory analysis data of ACM samples (where available) and observations of the sites visited, the risk rankings have been calculated and are presented in Table 10 below.

Table 10 – Nauru Asbestos Risk Rankings

Site Name	Building Material	Asbestos Type and Percentage	Risk Ranking Scores		
			ACM	Setting	Total Score
Public Buildings					
RON Hospital	Roof and Ceiling	Chrysotile 10%	5	20	25
Power Station Building	Gable / Main Eastern Entrance Cladding	Chrysotile, Amosite, Crocidolite	7	17	24
Power Station Building	Roof, Northern Side	Chrysotile	5	15	20
Power Station Building	West Wall, Northern End	Chrysotile	5	17	22
Power Station Building	Wall Entrance to Switchboard Corridor, (North Side)	Chrysotile	5	18	23
Power Station Building	Cool Store Edge of Roof, Southern Side	Chrysotile	5	15	20
Power Station Building	Cable Shed Western Wall, Northern End	Chrysotile, Amosite, Crocidolite	7	14	21
Power Station Building	Water Services Building Roof and Gables	Deemed Positive	6	14	20
Prison	Roof and Cladding - some burnt and some waste	Chrysotile 10%	6	22	28
Anetan Infant School	Front Classroom Cladding	Chrysotile 10%, Amosite 5%	6	16	22
Boe Infant School	Old School - Cladding mid area	Chrysotile 7%	4	17	21
Nibok Infant School	Cladding	Chrysotile 7%	4	17	21
Small Miscellaneous Buildings					
Bridge Rd Trader – Aiwo	Roof	Not Sampled Likely Asbestos	4	14	18
Orro Church – Aiwo	Roof	Not Sampled Likely	4	15	19

Site Name	Building Material	Asbestos Type and Percentage	Risk Ranking Scores		
			ACM	Setting	Total Score
		Asbestos			
Small Shed by Road – Denig	Roof	Not Sampled Likely Asbestos	4	11	15
Bingo Shed – Denig	Roof	Not Sampled Likely Asbestos	5	16	21
Old Laundry for Expats – Denig	Cladding	Not Sampled Likely Asbestos	5	14	19
Naoero Central Minimarket	Roof	Not Sampled Likely Asbestos	5	12	17
C-Store Market	Roof, Soffits	Not Sampled Likely Asbestos	5	16	21
Old Cinema in Location	Roof	Not Sampled Likely Asbestos	4	18	22
Conrad Restaurant – Beitsi	Roof	Not Sampled Likely Asbestos	4	17	21
Catholic Church	Roof	Not Sampled Likely Asbestos	4	17	21
3 in 1 Store Ewa	Cladding	Not Sampled Likely Asbestos	4	15	19
Meage Store Nibok	Cladding	Not Sampled Likely Asbestos	4	12	16
Leung Store Aiwo	Roof and Cladding	Not Sampled Likely Asbestos	4	13	17
Onion Store Boe	Cladding	Not Sampled Likely Asbestos	4	13	17
Nauru Independent Church and House Boe	Roof	Not Sampled Likely Asbestos	5	16	21
My Store (DHL) Yaren	Cladding	Not Sampled Likely Asbestos	4	12	16
Kauwan - Kibaba Trading Menen	Roof, Cladding	Not Sampled Likely Asbestos	4	14	18
Petrol Station / Chinese Restaurant	Roof and Cladding	Not Sampled Likely Asbestos	5	16	21
TAB Menen	Cladding	Not Sampled Likely Asbestos	4	14	18
Green Tiled Building Sea Side Menen	Cladding	Not Sampled Likely Asbestos	4	14	18
I J Store	Cladding	Not Sampled Likely Asbestos	4	11	15
RonPHOS Areas					
Old Phosphate Store by Sports-ground	Roof	Chrysotile 10%, Amosite 5%	7	14	22
Phosphate Storage Bin by Sea	Roof	Chrysotile 20%	6	15	21
RonPHOS Workshop	Roofing	Chrysotile 65%	6	20	26

Site Name	Building Material	Asbestos Type and Percentage	Risk Ranking Scores		
			ACM	Setting	Total Score
RonPHOS Workshop	Cladding	Chrysotile 5%	6	19	25
RONPhos Main Conveyor	Roof and Cladding	Not Sampled Likely Asbestos	5	19	24
PONPhos Conveyor Building	Roof and Cladding	Not Sampled Likely Asbestos	5	19	24
Old NPC Club	Roof	Not Sampled Likely Asbestos	5	16	21
Shed next to NPC Club	Roof	Not Sampled Likely Asbestos	5	15	20
RONPhos Head Office	Roof	Not Sampled Likely Asbestos	4	14	18
2 Small RONPhos Buildings	Roofs	Not Sampled Likely Asbestos	4	14	18
6 Small Houses near RONPhos	Roofs	Not Sampled Likely Asbestos	4	14	18
Old NPC Bakery	Roof	Not Sampled Likely Asbestos	4	18	22
RONPhos Training Centre	Roof	Not Sampled Likely Asbestos	4	15	19
Stacked Sheets by RONPhos	Stockpile	Not Sampled Likely Asbestos	4	14	18
2 Buildings Behind Power Stn	Roof and Cladding	Not Sampled Likely Asbestos	5	16	21
RONPhos Vehicle Workshops	Roof and Cladding	Not Sampled Likely Asbestos	5	20	25
RONPhos Workshop Store and Toilet	Roof and Cladding	Not Sampled Likely Asbestos	5	20	25
RONPhos Offices and Stores	Roof and Cladding	Not Sampled Likely Asbestos	5	19	24
RONPhos Old Steel Phosphate Bin by Hotel	Roof and Cladding	Not Sampled Likely Asbestos	6	18	24
RONPhos Phosphate Processing Area:					
Waste Pile by Road	Stockpile	Not Sampled Likely Asbestos	6	19	25
Tall Building by Road	Roof and Cladding	Not Sampled Likely Asbestos	6	19	25
Siloes Cover	Roof	Not Sampled Likely Asbestos	6	19	25
Conveyor Roof	Roof	Not Sampled Likely Asbestos	6	18	24
Processing Plant Building	Roof and Cladding	Not Sampled Likely Asbestos	6	19	25
Small Shed Roof	Roof	Not Sampled Likely Asbestos	6	19	25
NPC Areas on TopSide:					

Site Name	Building Material	Asbestos Type and Percentage	Risk Ranking Scores		
			ACM	Setting	Total Score
Workshop	Roof and Cladding	Not Sampled Likely Asbestos	5	19	24
Shelter	Roof	Not Sampled Likely Asbestos	5	19	24
Paint Shed	Roof and Cladding	Not Sampled Likely Asbestos	5	19	24
Tyre Bay	Roof and Cladding	Not Sampled Likely Asbestos	5	19	24
Residential Housing		Two houses sampled:			
Houses with Asbestos Roofs	Roofs	Roof - Chrysotile 12%	5	15	20
Houses with Asbestos Cladding	Cladding	Cladding - Chrysotile 10%	4	15	20

8.0 Remedial and Management Options

8.1 General

This section has been written as a general section for all the PacWaste Asbestos Reports. It will, however, be modified for each country as necessary. Based on all the visits by the consultants, however, 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. The most significant exception is the Tamavua-Twomey Hospital in Suva, Fiji where an emergency clean-up has already been performed, but where significant friable asbestos still remains. There are a few other examples but not many. *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, although several jurisdictions (including Australia and the United Kingdom) now treat them all as equally hazardous.
e. Labour rates are similar from country to country.
f. There will most likely be a need to bring in specialist supervision 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 policy and set of procedures to be developed across the Pacific for addressing Pacific asbestos problems.

8.2 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 the presence, form, condition and potential health risks associated with the ACM;
- monitor the condition of the ACM;
- establish a safe system of work to prevent exposure to asbestos.

8.2.1 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 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.

8.2.2 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.

8.2.3 ACM Safe System

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

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

8.3 Remedial Options

The management options for ACM outlined in Section 8.1 above are administration controls that can assist with effectively managing the risk ACM presents. However, in certain situations, administration controls may not be sufficient or the risk posed by the ACM by way of its damaged condition or setting sensitivity may present an unacceptable risk. Remedial measures for managing the ACM may include one or a combination of the following;

- protect/enclose the ACM;
- seal/encapsulate the ACM;
- repair of the ACM;
- removal of the ACM.

8.3.1 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.

8.3.2 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 will 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.

8.3.3 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.

8.3.4 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. For sheets of asbestos cement product they 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, to demonstrate that no potential health risks arose during the removal exercise some operators prefer to undertake such monitoring to obtain evidence that no risks to health occurred.

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

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

1. Identification:

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

2. Preparation:

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

3. Removal

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

4. Decontamination:

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

5. Waste Disposal:

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

9.0 Selection of Possible Remedial Options

9.1 General

The flow chart presented below in Figure 4 below has been adapted from that presented in UKHSE HSG227 'A comprehensive guide to Managing Asbestos in premises'. It details the decision process adopted by this study in determining the most suitable management option for the majority of sites with ACM.

Figure 4: ACM Management Flow Chart

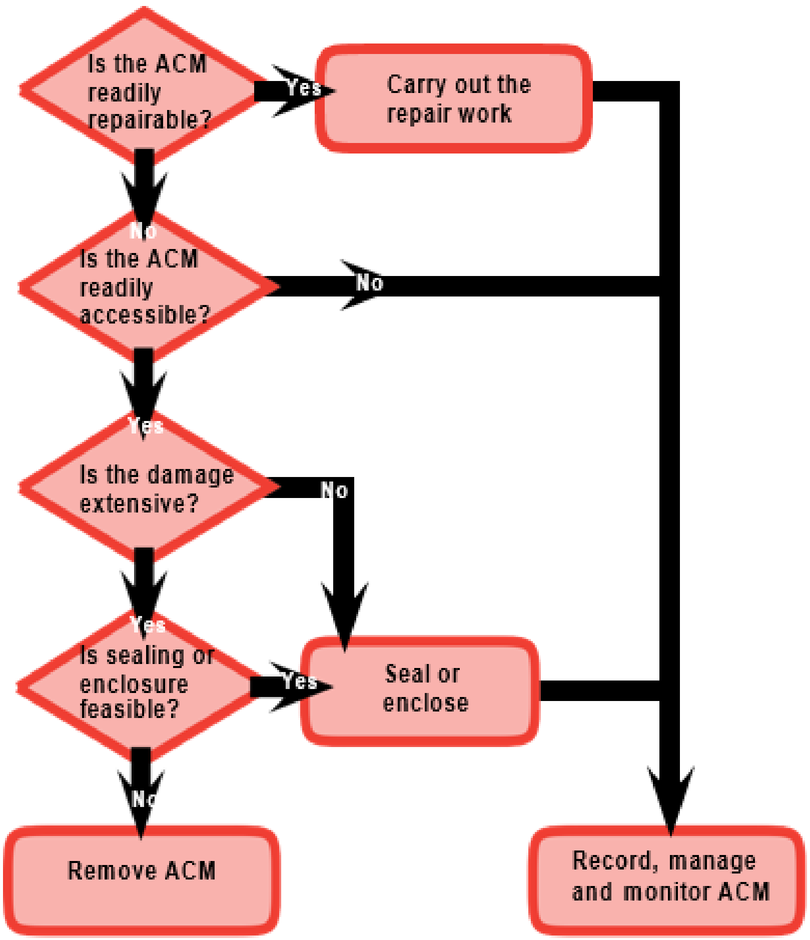

Figure adapted from; UKHSE HSG227 'A comprehensive guide to Managing Asbestos in premises'.

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 now to be considered.

9.2 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 8.2 above. The key factors in this management will be education and awareness so that minimising the generation of airborne fibres that 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 was in good condition. If there was 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 9.3 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 9.4 below.

9.3 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 floor of each room, remove all ceiling linings and place all rubbish into suitable containers (plastic lined bins or fabric bags such as "Asbags" – see 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 batten to all sheet joints & to perimeter of each room.
i) Paint with 2 coats of acrylic ceiling paint to all new ceiling sheets & perimeter battens.
j) Reposition all wiring for lights & fans and connect up all fittings as previously set out.
k) Spray 3 coats of specialist paint finish (pre-coat, undercoat and top coat) to all the exterior roof area according to painting specifications.
l) Remove, and contain for disposal, asbestos gutters and downpipes from both sides of the building and supply & install new suitable box gutters (e.g. Colourbond) with down pipe each side leading to water tank.
m) Remove asbestos boundaries and signage and decontamination area and decommission from site.

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

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

9.4 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 oceanside 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 oceanside 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.

9.5 The Nauru Situation Regarding Asbestos Management and Remediation

Many Nauru houses and buildings with asbestos roofing and cladding are in a poor and deteriorating condition and will have to be replaced soon. Many are also in situations where human contact is frequent and regular. An asbestos remediation project on Nauru is therefore appropriate for whatever funding can be arranged.

Most residences and buildings with roofs also have ceilings in place so there would probably be no financial advantage to encapsulate the roofs rather than remove and replace them. There may be a financial advantage in encapsulating cladding rather than removing it, however, especially if the cladding is covered internally. Cost considerations are developed further in Section 11 below.

Nauru has a good contracting base and a reasonable understanding of asbestos issues, but would need support with equipment, expertise and supervision.

A comprehensive asbestos management and awareness programme could also be put in place to minimise exposure to fibres, especially where regular human contact is an issue. That is true for the large number of residences with asbestos roofing and cladding which is in a deteriorating condition.

10.0 Disposal

10.1 Relevant International Conventions

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

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

These three alternatives are discussed below.

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

Table 11: 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**				Not ratified	
PNG		Y	Y	Y	Y
Samoa	Y	Y		Y	Y
Solomon Is			Y	Y	Y
Tonga	Y	Y	Y*	Y	
Tuvalu			Y	Y	
Vanuatu			Y*	Y	

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

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

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

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

The London Convention and Protocol, and the Noumea Convention and associated Dumping Protocol are both relevant to the issue of dumping at sea and hence are discussed in Section 10.3 below.

The Basel and Waigani Conventions are relevant to the issue of export of waste to another country and are hence discussed in Section 10.4 below.

10.2 Local Burial

10.2.1 Local Burial in the Pacific

In order for local burial of ACM and asbestos-contaminated material 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 program of consultation is necessary to determine if this is the case.

10.2.2 Local Burial in Nauru

The local dumpsite in Nauru is shown in Photo 82 below. It is poorly managed and largely unregulated, although some workers are stationed there during the day. Refuse is open dumped at a wide tip-face. Asbestos is currently dumped there along with all other refuse. Scavenging of all refuse is common, including asbestos. Asbestos roofing and cladding on residential dwellings is often 60-70 years old and in bad condition. Dumped asbestos is seen as a useful resource to repair deteriorating asbestos roofing and cladding.

Large amounts of asbestos are reported to have been buried in the landfill from time to time from various re-building projects including schools but no records have been kept as to how much was buried, when it was buried and where it was buried.

The NRC has recently dug a hole about 30m x 10m x 8m deep, partly to bury the asbestos and asbestos contaminated soil from the hospital clean-up reported in Appendix 8. The hole was oversized to allow for additional asbestos waste generated in Nauru and so may become the unofficial dumping location for asbestos. This hole is shown in Photo 83 below. In fact even with the asbestos waste deposited from the hospital and allowing for ample cover material and 100% voids, probably about 700 cubic metres of asbestos could be buried in this hole. A total of 1325 m3 of asbestos has been estimated by this survey to exist on Nauru so this hole could easily receive at least 50% of the total Nauru asbestos.

Photo 82 - Nauru Dumpsite **Photo 83 - Asbestos Burial Hole**

The consultants were advised by numerous parties including the DCIE that official consent to bury asbestos anywhere on Nauru was unlikely, as all land was owned privately, and the land was often owned by numerous parties jointly. This includes the dumpsite. The consultants were advised that it was very unlikely indeed that any permission to bury asbestos anywhere on Nauru would be forthcoming.

10.3 Disposal at Sea

10.3.1 General Comments about 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 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 to the Noumea Convention 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 Noumea 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.

10.3.2 The Nauru Situation Regarding Disposal at Sea

If it was decided to proceed with dumping at sea in Nauru then this could be achieved using the methodology outlined in Section 10.3.1 above as follows:

a) Asbestos waste material would be loaded into suitable sealed fabric bags such as Asbags with lifting strops and a 3 tonne maximum capacity.
b) The bags could be loaded onto the larger raft at the Port and towed by the larger Port Barge (and currently the only one operational at the time of the consultants' visit). The barge and raft can be seen in operation in Photo 84 below. The barge has a capacity to transport five 20 foot containers.
c) The bags could be loaded with the shore crane seen in operation in Photo 85 below. The bags would need to be secured to the raft with straps.

d) A crane with a 3 tonne lifting capacity would need also to be strapped onto the raft and would need to be lifted onto the raft with the shore crane, which has a 15 tonne limit. A small crane truck (Hiab) would be suitable for the raft crane or there may be a suitable small crane on Nauru. There is also a larger crane on Nauru at present which is owned by Canstruct, which could be used to lift the raft crane onto the raft.
e) The raft would need safety rails around the perimeter and a detailed Safety Plan would need to be written.
f) A suitable dumping location would need to be identified. It is understood that there is very deep water about one kilometre off shore from Nauru.
g) Consents under the London Protocol and Noumea Dumping Protocol would need to be obtained.

Photo 84 - Barge and Raft

Photo 85 - Shore Crane

The overall procedure was discussed with Koria Tamuera, Deputy Harbourmaster. Mr Tamuera advised that the barge could be hired for $US32/hr and the raft for $US32/hr. About 60 litres of diesel would be needed for the 2 km round trip @ $US1.60/litre plus $US6.5/hr for crew x 4 = $US26/hr. (The crew would consist of an engineer, skipper and two deckhands). The speed is 15 knots so the round trip could be done quickly. If the trip plus unloading could be done in one hour then the overall cost for barge, raft, crew and fuel would be around $US200.

The crane stationed at the port costs $300/hr and it has a 15T limit. The larger Canstruct crane can be hired at $600/hr and it should be assumed that the larger crane would be needed at this stage. A Hiab or smaller crane could probably be hired for $200/hr.

If 5 Asbags (15 tonnes) could be loaded onto the barge each trip and the trucking cost to get them to the port was $200, then the overall cost for sea disposal of 15 tonnes of asbestos waste would be (200+600+200+200) = $1200 for 15 tonnes. The cost of the Asbags is about $180 each landed on Nauru so the overall cost is $2100 plus say 30% contingency = $2730 for 15 tonnes or **$182 per tonne**.

This excludes the cost of obtaining the permits which may require a detailed scientific study and report if the requirements of the London Protocol and Noumea Dumping Protocol are to be met.

This could substantially increase the cost by an amount that is hard to estimate. A clear message was obtained from the initial discussions with the Nauru DCIE that they would be opposed to sea disposal. DCIE would probably be the party issuing the permits.

10.4 Export to Another Country

10.4.1 General Comments about 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 minimize the amount and toxicity of wastes generated, and 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 Waigani Convention, entered into force 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 Waigani Convention is to reduce and eliminate trans-boundary movements of hazardous and radioactive waste, to minimize 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 properly managed way. At present, however, Fiji is a party to the

Waigani Convention but not the Basel Convention so it would only be able to receive asbestos waste from Waigani Convention parties.

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

10.4.2 The Nauru Situation Regarding Export

An investigation has been carried out into exporting the waste asbestos to Brisbane. Both Nauru and Australia are party to the Basel Convention. Nauru is not party to the Waigani Convention so the Basel Convention would need to be used and not the Waigani Convention.

Matsons Shipping now run a direct shipping route from Nauru to Brisbane which reduces the cost and also means that Basel Consent would not be needed for countries in transit between Nauru and Brisbane. Brisbane is also a suitable destination for asbestos waste as the landfill rates in Brisbane are much cheaper in Brisbane that other parts of Australia because recycling levies have not been imposed there.

The method of import would be to transport asbestos in 20 foot shipping containers. The asbestos waste would need to be sealed before placement in the containers. An effective way would be to wrap the asbestos waste in plastic and place in 3 tonne Asbags. Each container could hold 5 x 3 tonne Asbags or 15 tonnes in total.

As stated in Section 10.4.1 above, discussions with the Hazardous Waste Section of the Australian Department of the Environment confirmed that, in terms of the Basel 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.

Two possible receiving landfills have been checked out in Brisbane – the Remondis Swanbank Landfill and the Transpacific New Chum Landfill.

The Remondis Swanbank Landfill has the advantage of being a Biosecurity Landfill, so sealed containers of asbestos in Asbags could be brought directly to the tipping point and emptied under controlled biosecurity conditions. The containers could then be cleaned and certified clean by a local asbestos contractor.

David Wrenn, Sales Manager for Remondis Australia, advised as follows:

- The containers could be loaded onto a "Tipping Skel Trailer" and the contents of the container would then be tipped direct into the landfill. This is the normal procedure for quarantine waste.
- The asbestos would be deep buried for a fee of $A1400 plus GST per container ($US1232 including GST per container). For a container holding 15 tonne of asbestos, this would cost $US82 per tonne.
- The disposal fee would be $A110 plus GST per tonne ($US97 including GST per tonne).
- The asbestos containment (e.g. Asbags) would need to be robust enough to ensure that they did not break when tipped.

The Transpacific New Chum Landfill can receive asbestos for placement in a specially designated area in the landfill. Jon White, Business Development Manager for the Transpacific Queensland Landfills, advised as follows:

- The special New Chum disposal rate for asbestos construction and demolition waste and sheet / bulk waste is $A54 plus GST per tonne ($US48 including GST per tonne).
- The quarantine issue would be a difficult issue for them, regarding imported asbestos waste and they would need assistance with this issue.

Both landfills are satisfactory in terms of being well run with the correct systems in place to receive asbestos waste. Remondis would be preferred over Transpacific because they have the answer to the biosecurity / quarantine issue. However the Transpacific rates are much cheaper than the Remondis rates and there may be a way to deal with quarantine waste at the Transpacific landfill if the matter was further investigated.

For this investigation the Remondis rate has been chosen, i.e. $US82 + $US97 = $US189/tonne.

Matsons Shipping have provided an all up rate of $A2751 plus GST ($US2421 including GST) to ship one 20 foot container from Nauru to Brisbane. Basel Consent costs for obtaining trans-boundary consent from both Nauru and Brisbane would add about 30% to this cost – say a total of $US3150 including GST, which, for a container holding 15 tonnes of asbestos, is about $210/tonne.

Transport and loading of the container at the Nauru end plus Nauru documentation would cost about $US2000 per container or $US133/tonne of asbestos.

Customs clearance and transport of the unloaded container at the Brisbane end would cost about $A3000 plus GST per container or $US2640 including GST per container. This is $US176/tonne.

The Asbags cost $US180 each or $900 per container, i.e. $60/tonne.

The total cost per tonne for export is therefore (189+210+133+176+60) = **$US768 per tonne**.

11.0 Cost Considerations

11.1 Encapsulation - General

A typical example of local Pacific costs has been obtained from Central Meridian Inc in Nauru, which is a contracting company who has worked for 14 years in a Pacific environment and who employ about 60 staff (see Appendix 6). Their cost structure in terms of labour and material costs would be similar to other Pacific Island countries. Their material costs may be higher than the larger Pacific Island countries as fewer materials would be available ex-stock and the costs of importing materials may be higher.

For the typical encapsulation project such as outlined in Section 8.3 above, the following cost estimates, as set out in Table 12 below, would apply, based on the Central Meridian estimates (all costs in US$) with some adjustments downwards to allow for competitive bidding. The labour component of this work includes for some imported specialist supervision.

Table 12: Typical Encapsulation Costs

Step	Item	Cost Estimate (US$)
A	Preparation - plan, boundaries, signage, PPE, decontamination area	800
B	Scaffolding and anchor points	1200
C	Foamshield ceiling space	200
D	Cover with plastic, remove ceiling etc,	1200
E	Remove electrical Items, make wiring safe	250
F	Vacuum underside of roof sheeting, timber framing and all premises	250
G	Paint underside of roof (3 coats) including access	1500
H	Reinstall electrical equipment and replace ceiling all rooms (includes for some repairs)	5000
I	Paint new ceiling	1000
J	Finalise and re-commission electrical equipment	350
K	Paint all exterior roof area (3 coats)	1700
L	Remove old gutterings and install new ones	1400
M	Decommission from site	200
	TOTAL COST	**15050**

The above costing is for a house considered to be a standard size for the Pacific, i.e. 14m x 12m = 168m2 of house area (not roof area). The above cost is therefore about $US90/m2 of house area. (For a roof pitch of 1.15, the roof area is therefore 193 m2, so the cost per metre roof area is $78/m2)

If there was no ceiling in place then items C, D, H and I could be removed, this reducing the cost to $7650 or $46/m2 of house area.

If cladding was being encapsulated with a non-asbestos lining on the inside then item B could probably be halved to $600 to allow for some scaffolding and items E, F, J and L could also be removed, thus reducing the cost to $3550 for 168m2. (The actual cladding area probably would be smaller as it is a wall surface and not a roof area). This equates to about $21/m2 of house area.

11.2 Removal and Replacement – General

For the typical removal and replacement project such as outlined in Section 8.3 above, the following costs estimates (Tables 13 and 14 below) would apply, based on the Central Meridian estimates (all costs in USD) with some adjustments downwards to allow for competitive bidding. The labour component of this work includes for some imported specialist supervision.

Table 13 – Typical Roof Removal Costs

Step	Item	Cost Estimate (US$)
A	Preparation - plan, boundaries, signage, PPE, decontamination area	800
B	Scaffolding and anchor points	1200
C	Spray roof with PVA Solution	600
D	Remove old asbestos roof, stack and enclose for disposal	2500
E	Vacuum the existing ceiling and roof space	260
F	Supply and fit heavy duty tarpaulins	240
G	Decommission from site	200
	TOTAL COST	**5800**

Table 14 – Typical Roof Replacement Costs

Step	Item	Cost Estimate (US$)
H	Supply and fit roof netting, foil coated insulation and top layer of foil	2000
I	Supply and fix Colourbond Ultra Grade roofing or similar, including ridging and barge flashings	6100
J	Supply and fix Colourbond box guttering to both sides of the roof plus one downpipe each side	800
	TOTAL COST	**8900**

The total cost for removal and replacement is therefore $14,700. Again this is for a house considered to be a standard size for the Pacific, i.e. 14m x 12m = 168m2 of house area. The above cost is therefore about $US86/m2 of house area. (For a roof pitch of 1.15, the roof area is therefore 193 m2 so the cost per metre roof area is $US76/m2)

Removal of cladding is typically about 10% cheaper than roofing due to easier access and less expense on scaffolding. This would make the cladding removal cost about $5200 for 193 m2 of cladding

There is a large variety of cladding material to replace old asbestos cladding. If a reasonably cheap and serviceable alternative was chosen as a replacement then the cost may come down by about 20% to say $7100 for supplying and fitting 193 m2 of new cladding. The total cost for cladding removal and replacement would therefore be about **$US64/m2**.

If the building or dwelling has a ceiling that needs to be removed for underside encapsulation then there is hardly any difference in cost between roof removal and encapsulation.

If the underside of the roof can be accessed without a ceiling, however, encapsulation is a much cheaper option at $US46/m2 house area instead of $US86/m2 house area for removal and replacement.

If cladding with non-asbestos internal lining is to be dealt with then encapsulation compares even more favourably at $US21/m2 house area compared with $US64/m2 house area for removal and replacement.

11.3 Cost Considerations – The Nauru Situation

The rates in Sections 10.1 and 10.2 above can be used unchanged for Nauru as they were based on information supplied by a Nauru contractor.

The cost for Item I in Table 13 above could potentially be reduced by the use of a roof roll forming machine to form the roofs locally. As indicated in Section 9.4 above, roofing materials could then be cut to suit and the purchase of the sheet metal rolls would be cheaper than the finished roofing sheets. The capital cost of the roll forming machine would need to be included in the cost calculations although RonPHOS owns one of these machines and intends to use it to replace all their asbestos. Once they have finished they have indicated they will gift it to the Government owned Eigigu Holdings Corporation, which would enable Eigigu to offer competitive re-roofing rates. RonPHOS has a very large amount of asbestos to replace, however, so this may not happen for a while.

For the purposes of determining an overall budget for dealing with asbestos on Nauru it would be best to use the disposal option of export to Brisbane. Disposal at sea is much cheaper at $182/tonne vs $768/tonne but obtaining the necessary permits for disposal at sea is looking unlikely at present and may increase the cost of sea disposal considerably. This may change, however, if there is pressure to reduce costs in order to deal with the Nauru asbestos problem.

Table 14 below presents total overall costs and cost per sector. These costs are presented as US$ costs but were originally derived from A$ costs. An exchange rate of 0.87 has been used.

It is assumed that all asbestos will be removed and none will be encapsulated as there is no difference in cost between encapsulation and removal for roofs with ceilings. There may, however, be scope for encapsulation of some cladding and some roofs where there are no ceilings, such as the Denig Bingo Hall. Some modification of Table 14 may therefore be appropriate to incorporate encapsulation.

Table 15 – Total Overall Costs and Costs per Sector

Asbestos Location	All	Public Buildings	Small Commercial / Oher	RonPHOS Area	NRC Area	Residential
Areas						
Total Area of Asbestos Roof (m^2)	180,624	12,485	3,463	27,791	2,085	134,800
Total Area of Asbestos Cladding (m^2)	31,515	1,965	306	2,079	853	26,312
Total Area of Asbestos	**212,139**	**14,450**	**3,769**	**29,870**	**2,938**	**161,112**
Weight						
Convert to Tonnes based on SG 1.6 and thickness 0.00625m	x1.6 x 0.00625	x1.6 x 0.00625	x1.6 x 0.00625	x1.6 x 0.00625	x1.6 x 0.00625	x1.6 x 0.00625
Total Weight (T)	**2,121**	**145**	**38**	**299**	**29**	**1,611**
Cost of Removal and Replacement						
Roofs						
Cost of removal and replacement of roofing @ $76/m^2$ roof area ($US)	13,727,424	948,860	263,188	2,112,116	158,460	10,244,800
Cladding						
Cost of removal and replacement of cladding @ $64/m^2$ ($US)	2,016,960	125,760	19,584	133,056	54,592	1,683,968
Cost of Disposal						
Cost of Export to Brisbane and Disposal to Remondis Landfill @ $768/T ($US)	1,591,041	108,375	28,268	224,025	22,033	1,208,340
Total Cost ($US)	**17,335,425**	**1,182,995**	**311,040**	**2,469,197**	**235,085**	**13,137,108**

The above costings are approximate only, and based on a number of assumptions as explained in the preceding sections. They may also be subject to changes depending on the Scope of Work of the specifications defining the work to be done.

It should also be noted, however, that if it is decided to undertake a substantial amount of asbestos removal then significant economies of scale may be realised and unit costs will go down.

12.0 Review of Nauru Policies and Legal Instruments

12.1 National Laws and Regulations

As already mentioned, Nauru is a party to the London Convention and Protocol and the Noumea Convention and Dumping Protocol which will regulate any disposal of asbestos to sea.

Nauru is also a party to the Basel Convention which will regulate any trans-boundary movement of asbestos waste to another country.

The Nauru Rehabilitation Corporation Act (1997) also has some relevance. This legislation established the Nauru Rehabilitation Corporation which has the responsibility for coordinating, promoting, carrying-out, managing and participating in, rehabilitation works in Nauru. The functions of the Corporation include:

- To coordinate, promote, partake in, identify, initiate and carry out projects for the rehabilitation and development of worked out phosphate lands and unworked phosphate lands as directed by the Minister;

- To implement government policy with regard to the rehabilitation and development of the worked out phosphate lands of Nauru;

- To perform and promote such other activities in relation to the rehabilitation and development as the Minister may direct, either alone or in conjunction with Australia in furtherance of the policies and objects of the Nacos Agreement and the Development Cooperation Agreement; and

- To manage and administer the moneys and assets of the Corporation.

A Board of Directors, consisting of seven members, directs the work of the Corporation.

A significant amount of old asbestos is on land controlled by the NRC and remediation of the old asbestos could be considered to be part of the rehabilitation process.

12.2 National Strategies and Policies

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

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

13.0 Contracting Capabilities

There is a lively and vigorous contracting environment on Nauru stimulated by the influx of refugees and also by the activities of the Phosphate Industry (RonPHOS and NRC) which is experiencing something of a revival.

Discussions were held with the following contractors:

Eigigu Contractors

Discussions were held with Sean Halstead GM Eigigu, and Ravi Singh, an Engineer from Fiji.

Eigigu have done quite a lot of asbestos work and have a cherry picker available (actually sourced from RONPhos), suits and masks, scaffolding, trucks etc. They do work to Australian standards.

They would charge $A30/hr for asbestos workers and $A35/hr for supervisors.

Eigigu said that disposal was an issue and that storage of the asbestos in containers was appropriate until the issue of disposal could be sorted out. There are certified containers on island and plenty of uncertified containers. Many old containers are scattered around the island.

Eigigu has removed asbestos from several schools –removing asbestos and re-cladding. This resulted in several containers of asbestos being filled and taken to the NRC area. The Department of Education subcontracted some of the work to volunteers. The asbestos in the containers was sealed in plastic and is now stored on Topside in an NHC controlled area. (NB The surveyors were unable later to find this stored asbestos.) Some asbestos was unofficially removed for re-use and repair work.

The rate for a cherry picker is $A80-120/hr and truck is $A80-100/hr.

The consultants also met David Aingimea, Executive Chairman Eigigu Holdings Corp. David Aingimea was interested in our project and offered the services of Eigigu.

Ocean Construction

Discussion was held with Nathan Philip, owner of Ocean Construction. They have been involved in several asbestos removal projects on Nauru, including the Aiwo Primary School and the Police Station (both of which were involved in fires) and some NRC offices. They have received asbestos training from the US Army in 2006.

Disposal of asbestos on Nauru is carried out by the NRC. The contractor encases the asbestos waste in sealed plastic wrapping.

Ocean Construction has some scaffolding it could hire or use.

They would charge $A8/hour for labour if the PPE was supplied. They can also hire small trucks (1.5T) and some other equipment.

Nathan Philip said that there were lots of rumours around Nauru regarding links between asbestos roofs and cancers and locals were often concerned about living under asbestos roofs.

Nathan Philip also said that as far as replacement roofs were concerned, aluminium roofs were best as steel roofs quickly corroded in the humid damp Nauru conditions.

Central Meridian Inc (CMI)

Discussion was held with Paul Finch, Managing Director of CMI.

CMI has done numerous asbestos projects on Nauru including various schools, houses and the Nauru Hospital.

Paul Finch reported:

- Lots of asbestos was stolen during the hospital project, including the breaking up of asbestos to get the timber.
- Disposal of asbestos was commonly done by wrapping up on pallets for NRC to take and place in containers.
- Most asbestos removal on Nauru was done badly with no protection, oversight or regulation.
- CMI had plenty of work and everyone was busy on Nauru. In fact there was a shortage of labour.

Paul Finch advised that we should not even think of disposing of asbestos on Nauru. The land owners are adamantly against it. CMI would support disposal off-shore and they could arrange land as staging areas for containers.

Paul Finch also said that any project to remove asbestos would require the continual presence of overseas personnel to ensure success. Otherwise standards would quickly slip and progress would slow down. Considerable planning would be needed and back-up plans would be required.

CMI would build anything on Nauru and would be keen to help with an overall asbestos removal project. They have 65 staff and have scaffolding, concrete equipment, excavators, loaders, and trucks (5T, 2x2.5T, and 1T). They would hire out workers at $A16/hour and would supply PPE. They have a wide range of skills.

DJ Construction

Discussion was held with Dugabe Jeremiah, Owner of DJ Construction. They have done numerous asbestos and other projects in the past but have recently cut down on trucks and manpower.

They are undertaking several roofing projects now. They remove asbestos roofs and replace with Colourbond / Aluminium etc, flashing etc.

They would typically charge $A10,000 to take an asbestos roof off and replace it, for a 100 m2 house (115m2 roof). (NB this works out at $A87/m2 or $US70/m2 roof area). This is cheaper than the estimated rate of $US76/m^2 in Section 11.2 above.

DJ Construction stressed that there was a large awareness of roofs on-island but more with regard to leaking roofs rather than asbestos. About 60% of houses on the island are in bad shape and many are in very bad shape.

DJ Construction's rates are $A4-6/tradesman/hour and $A70/day.

DJ Construction was not so adamant that asbestos could not be buried on Nauru. Dugabe Jeremiah considered that if landowners were paid enough money then you could bury the asbestos waste on-island. He stated that public awareness-raising would be very important for the success of any asbestos removal project.

The following discussions were also important in relation to contractor capability and available equipment.

Nauru Rehabilitation Corporation (NRC)

Discussion was held with Phil Leeson, Production Manager, NRC and the following points were made:

- NRC is short-staffed and hence would have limited resources to help with an asbestos project, although they would help where they could.
- They have cherry pickers, scaffolding and trucks they could contribute. They do not have any budget, however, to contribute to asbestos removal.
- A lot of the NRC gear is old and unreliable. There are, however, very good maintenance people available on the island.
- Most local people would prefer to see the asbestos removed from the island – easy to load into containers and barge to ship. NRC has a large forklift with forks that can easily lift containers. It would be charged out at a reasonable rate.

Discussion was also held with the New CEO for NRC Peter Melenewyez. Among other things he is responsible for the dumpsite. The following points are relevant:

- There are apparently two containers in the NRC area with asbestos in them that are overgrown. Access is difficult to them.
- There are about 6 containers of asbestos buried in the landfill.
- They are considering an encapsulation project for asbestos remediation in the NRC workshop area on Topside. Any asbestos removed will be placed in the dumpsite.
- 80% of Nauru land is under mining and 20% is for living, commercial etc. All NRC buildings are owned by RonPHOS.
- Lots of asbestos is delivered to the landfill but it just gets picked up and recycled.
- Leachate from the landfill is probably contributing to the pollution of the lagoon.

RONPhos

Discussions were held with Jim Geering, RonPHOS CEO and others and the following points are relevant to contractor capability and resources:

- RONPhos were positive and had a helpful attitude regarding any assistance with the removal of asbestos from Nauru and they said they would cooperate and help in any way they could. They would consider purchasing any equipment that was needed and they would hire this equipment to the project. They already owned two cherry pickers, a bobcat, a small digger, and a roofing profile machine that could be used to shape new aluminium roofing, although the roofing profile machine was primarily for their own use.

- They considered that it was much cheaper to form the roof components on-island. Once they have finished with their rolling machine then they will give it to Eigigu. They have 35T of Aluminium in a roll. Aluminium is preferable to steel for a rolling machine as it is softer. It is also less corrosive in the marine environment.
- Jim Geering liked the “disposal at sea” option and stated that it would take years to negotiate a practical burial option.
- Labour costs are about $A6.50/hr on Nauru.
- There would be advantages in making everything the same – standardisation is important – one sort of roofing or guttering etc.

14.0 Discussion

In order to assess the risk that asbestos poses to residents and workers in Nauru the following factors now need to be considered:

i. Based on the information in this report and as set out in Section 6 above, there is a substantial quantity of asbestos in Nauru. The amount estimated in Section 6 above is 212,139 square metres.
ii. Most of the asbestos is in the form of asbestos-cement in roofing and cladding on houses and buildings although there are some stockpiles of waste and (in one case) unused asbestos.
iii. All asbestos is old and in various stages of deterioration. In many cases it is in an advanced stage of deterioration.
iv. Asbestos-cement roofing and cladding is normally considered to be “non-friable” with the harmful fibres locked up in a cement matrix. However when roofing and cladding deteriorate to the extent it has done on Nauru then it can be considered to be partially friable and will be releasing fibres into the air.
v. Based on the numerous bulk analyses that have been carried out, most of the asbestos on Nauru is Chrysotile (White) Asbestos although some examples of Amosite (Brown) Asbestos and Crocidolite (Blue) Asbestos have also been found. In the past, chrysotile has been considered less hazardous than amosite and crocidolite but some jurisdictions, including Australia, now place them on equal footing in terms of hazard.
vi. The air monitoring of 77 locations that was carried out as part of this project did not pick up any asbestos in the air in any of the locations. Nine locations were identified as having potentially significant levels of asbestos in air when measured by the PCM (Phase Contrast Microscopy) method which does not positively identify asbestos but simply identifies asbestos-like fibres. When these nine air samples were examined further by the TEM (Transmission Electron Microscope) method they were all found to be completely free of asbestos fibres, which was a reassuring result.
vii. The swab testing results were, however, less reassuring, with the following exhibiting significantly high results: RON Hospital (3 locations), Seaport (1 location), Power Plant / RO Units (4 locations), Prison (2 locations including 1 very high) and Government Building (1 location).
viii. In addition several swab test locations were moderately high: RON Hospital (3 locations), House 9 Air Con Unit (1 location), Seaport (1 location), Ewa Refugee Accommodation (1 location), Power Plant / RO Units (1 location), Prison (1 location), Fisheries Main Office (1 location), Menin Hotel Air Con (1 location), Jules Restaurant (1 location), Airport (2 locations), Government Building (1 location), Plant Nursery (1 location).
ix. As well as the very high incidence of asbestos on Nauru, there is also extensive site and ground contamination. Many locations have ground contaminated with asbestos debris which would generate fibres and this includes many locations around houses. For example the Aiwo School which contained asbestos was burnt down in 2007 and the now vacant site is likely to still be contaminated with asbestos fibres. Furthermore there was a fire in the Prison and old Police Station in 2007 and that would have caused asbestos debris and fibres to be widely scattered. The prison swab samples were high

and the neighbouring Government Buildings (which do not contain asbestos in their building materials) also had high swab samples.

x. It is estimated in Table 15 above that it will cost about $US17.3 Million to free Nauru of asbestos. This cost does not include cleaning up contaminated sites.

xi. There will be some money available from the SPREP PacWaste project to deal with high priority asbestos removal projects such as schools, power station and prison, and money from the Australian Government will probably be available to remove the Ron Hospital asbestos as part of the hospital refurbishing. Programmes are being discussed by RONPhos and NRC to deal with some or all of their asbestos eventually. Overall, however, it is likely that most of the Nauru asbestos will remain in place for a long time and continue to deteriorate, given the fact that there are likely to be higher health priorities in Nauru than the removal of asbestos.

xii. Asbestos fibres in areas where people are able to breathe them in pose an on-going and real health risk of asbestos-related diseases including debilitating conditions such as asbestosis and also cancers – lung, and outer lining of lung / internal chest wall (mesothelioma). Based on findings mentioned in Appendix 7 below, there is little epidemiological evidence to indicate that these diseases are developing in the Nauru population but health records are not detailed and were partly lost in the 2013 fire at the hospital.

In view of the above, some reassurance can certainly be taken from the fact that no asbestos was found in the air. The fact that so many asbestos fibres have, however, been found in numerous swab samples in areas of high human habitation, means that the health risk from asbestos in Nauru must be viewed with serious concern.

In reality, however, there is little that can be done to protect worker and resident health except to commence a detailed and coordinated programme of asbestos removal with highest risk locations first (funded by the SPREP PacWaste project). These locations include the hospital, schools, power station and prison. Then a steady and planned removal should be embarked on as funding availability permits. RonPHOS and NRC should also be encouraged to commence a steady removal programme as well that is coordinated into the overall removal programme.

There is a vigorous and capable contracting environment in Nauru so there is local capacity to support an asbestos removal programme. Training would be needed plus the on-going presence of some overseas expertise and monitoring. The removal of asbestos from buildings that are still used would need to be accompanied by replacement with suitable non-asbestos roofing and cladding.

The issue of disposal would need to be resolved. The most acceptable disposal solution is likely to be removal off shore to Brisbane and the cost for this removal is not expected to be prohibitive, based on research carried out for the Baseline Investigation – see the costings in Table 15 above which indicate that disposal to Brisbane would add about 9% to the total removal and replacement cost.

Until the asbestos can be removed, it is important that the presence and risk posed by the asbestos is managed as much as possible. There are a range of measures that can be put in place to minimise the generation of fibres arising from the deteriorating asbestos building materials on Nauru. These include:

a) When asbestos building materials are worked on the use of power tools should be minimised, the asbestos should not be broken if possible, and the working area should be kept wet.
b) When asbestos is removed as part of building / demolition work then it should be removed in accordance with best practice techniques, encased in plastic, taken to the disposal site and buried.
c) No asbestos should be recycled.
d) Considerable training will be needed to support the successful implementation of the above requirements.
e) Consideration should be given to encapsulation in some circumstances to preserve cladding that has not deteriorated too much. The findings of the Baseline investigation indicate that successful encapsulation of roofing is as expensive as removal and replacement, given the need to remove and replace ceilings in order to encapsulate the underside of the roofs.
f) Legislation should be drafted and enacted on an urgent basis by the Nauru Government to support the management and staged removal of asbestos in a safe and professional manner.
g) Health monitoring for asbestos disease incidence should also be introduced, based on monitoring programmes that are currently used in Australia to monitor the health of people exposed to asbestos, especially asbestos workers. Accurate data on asbestos disease incidence should also be collected.

15.0 Recommended Actions for Minimising Asbestos Exposures

Based on the above it is therefore recommended:

I. While some reassurance can be taken from the fact that no asbestos was found in the air samples, the fact that so many asbestos fibres have, however, been found in numerous swab samples in areas of high human habitation, should be officially acknowledged and it should be recognised that the potential health risk from asbestos in Nauru must be viewed with serious concern.

II. A detailed and coordinated programme of asbestos removal should be commenced, with highest risk locations first (funded by the SPREP PacWaste project) and then a steady and planned removal as funding availability permits.

III. RonPHOS and NRC should be encouraged to commence a steady removal programme as well that is coordinated into the overall removal programme.

IV. The local contracting capability in Nauru should be used to its full capacity to support the asbestos removal programme. Training would be needed plus the on-going presence of some overseas expertise and monitoring.

V. The removal of asbestos from buildings that are still used would need to be accompanied by replacement with suitable non-asbestos roofing and cladding.

VI. The issue of disposal needs to be resolved. The most acceptable disposal solution is likely to be removal off shore to Brisbane and the cost for this removal is not expected to be either prohibitive or difficult. The other options to be considered are local disposal and disposal at sea.

VII. Until the asbestos can be removed, it is important that the presence and risk posed by the asbestos is effectively managed. There are a range of measures that can be put in place to minimise the generation of fibres arising from the deteriorating asbestos building materials on Nauru. These measures include:
- When asbestos building materials are worked on, the use of power tools should be minimised, the asbestos should not be broken if possible, and the working area should be kept wet.
- When asbestos is removed as part of building / demolition work then it should be removed in accordance with best practice techniques, encased in plastic, taken to the disposal site and buried.
- No asbestos should be recycled.
- Training should be provided to support the successful implementation of the above requirements.

VIII. Consideration should be given to encapsulation in some circumstances to preserve cladding that has not deteriorated too much. Encapsulation is not generally considered worthwhile for roofs as an alternative to removal and replacement.

IX. Legislation should be drafted and enacted on an urgent basis by the Nauru Government to support the management and staged removal of asbestos in a safe and professional manner.

X. Health monitoring for asbestos disease incidence should also be widely carried out on Nauru, based on monitoring programmes that are currently used in Australia to monitor the health of people exposed to asbestos, especially asbestos workers. Accurate data on asbestos disease incidence should also be collected.

Appendix 1: Edited Copy of the Terms of Reference

Background

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

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

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

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

Objective

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

Scope of Work

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

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

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

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

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

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

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

Project Deliverables

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

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

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

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

Project Timeframe

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

NB The TOR for the Risk Assessment Study was less formal and consisted of agreement by emails as to the locations to be assessed by the air monitoring and swab sampling. These requirements were followed.

Appendix 2: Organisational Details and List of Contacts

A2.1 Organisational Details

The work was carried out by a consortium led by Contract Environmental Ltd (CEL) and Geoscience Consulting (NZ) Ltd (Geoscience), under contract to the Secretariat of the Pacific Regional Environment Programme (SPREP), with funding provided by the European Union. The majority of information relating to the distribution of ACM in Nauru was obtained during three field visits undertaken as follows:

- John O'Grady and Dirk Catterall: 23-26 September
- John O'Grady: 15-22 October (Joined by Stewart Williams of SPREP on 20-22 October)
- John O'Grady, Martyn O'Cain and Deirdre Ni Riain: 26 November – 6 December

A2.2. List of Contacts

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Appendix 3: Summaries of in-Country Discussions

Department of Commerce, Industry and Environment (DCIE)

Discussions were held with Mr Elkoga Gadabu, Acting Secretary. Mr Gadabu gave a very useful and detailed description of conditions on Nauru relevant to the asbestos project and of his concerns for the Nauru environment. He made the following points:

- The removal of asbestos roofs should be coordinated with EU Rainwater project.
- Disposal of asbestos to land is not favoured and will be strongly resisted by the landowners. The preferred option is to take the asbestos waste off island. It can be stored in containers until this can be done.
- Disposal at sea is not favoured either and will meet strong resistance. It is unlikely that the DCIE will support this option.
- DCIE will provide full support to the PACWaste Asbestos Project on Nauru, and would also support a project to progressively remove asbestos from Nauru.
- DCIE would prefer to be in control of any project to remove asbestos from Nauru.

Mr Bryan Star, Director of Environment, DCIE and Mr Jaden Agir, Water and Waste Officer were also present at the DCIE discussions. Jaden Agir and George Dowiyogo, Officer, provided considerable assistance over the three visits to the consultants.

George Dowiyogo of DCIE (5565003) advised that the current Nauru Primary School site was the first refugee camp. When the refuges left, they set it up as a school when the Aiwo Primary School burnt down in 2007. The old school had an asbestos roof and cladding and when this was cleaned up the asbestos remains were dumped, but no record was kept as to where it was dumped.

Eigigu Contractors

Discussions were held with Sean Halstead GM Eigigu, and Ravi Singh Engineer from Fiji.

Eigigu have done quite a lot of asbestos work and have a cherry picker available (actually sourced from RONPhos), suits and masks, scaffolding, trucks etc. They do work to Australian standards.

They would charge $A30/hr for asbestos workers and $A35/hr for supervisors.

Eigigu said that disposal was an issue and that storage of the asbestos in containers was appropriate until the issue of disposal could be sorted out. There are certified containers on island and plenty of uncertified containers. Many old containers are scattered around the island.

Eigigu has removed asbestos from several schools –removing asbestos and re-cladding. This resulted in several containers of asbestos being filled and taken to the NRC area. The Department of Education subcontracted some of the work to volunteers. The asbestos in the containers was sealed in plastic and is now stored on Topside in an NHC controlled area. (NB The consultants were unable later to find this stored asbestos.) Some asbestos was unofficially removed for re-use and repair work.

The rate for a cherry picker is $A80-120/hr and truck is $A80-100/hr.

The consultants also met David Aingimea, Executive Chairman Eigigu Holdings Corp. David Aingimea was interested in our project and offered the services of Eigigu.

Ocean Construction

Discussion was held with Nathan Philip, owner of Ocean Construction. They have been involved in several asbestos removal projects on Nauru, including the Aiwo Primary School and the Police Station (both of which were involved in fires) and some NRC offices. They have received asbestos training from the US Army in 2006.

Disposal of asbestos on Nauru is carried out by the NRC. The contractor encases the asbestos waste in sealed plastic wrapping.

Ocean Construction has some scaffolding it could hire or use.

They would charge $A8/hour for labour if the PPE was supplied. They can also hire small trucks (1.5T) and some other equipment.

Nathan Philip said that there were lots of rumours around Nauru regarding links between asbestos roofs and cancers and locals were often concerned about living under asbestos roofs.

Nathan Philip also said that as far as replacement roofs were concerned, aluminium roofs were best as steel roofs quickly corroded in the humid damp Nauru conditions.

Central Meridian Inc

Discussion was held with Paul Finch, Managing Director of CMI.

CMI has done numerous asbestos projects on Nauru including various schools, houses and the Nauru Hospital.

Paul Finch reported:

- Lots of asbestos was stolen during the hospital project, including the breaking up of asbestos to get the timber.
- Disposal of asbestos was commonly done by wrapping up on pallets for NRC to take and place in containers.
- Most asbestos removal was done badly with no protection, oversight or regulation.
- CMI had plenty of work and everyone was busy on Nauru. In fact there was a shortage of labour.

Paul Finch advised that we should not even think of disposing of asbestos on Nauru. The land owners are adamantly against it. CMI would support disposal off-shore and they could arrange land as a staging areas for containers.

Paul Finch also said that any project to remove asbestos would require the continual presence of overseas personnel to ensure success. Otherwise standards would quickly slip and progress would slow down. Considerable planning would be needed and back-up plans would be required.

Meridian would build anything on Nauru and would be keen to help with an overall asbestos removal project. They have 65 staff and have scaffolding, concrete equipment, excavators, loaders, and trucks (5T, 2x2.5T, and 1T). They would hire out workers at \$16/hour and would supply PPE. They have a wide range of skills.

DJ Construction

Discussion was held with Dugabe Jeremiah, Owner of DJ Construction. They have done numerous asbestos and other projects in the past but have recently cut down on trucks and manpower.

They are undertaking several roofing projects now. They remove asbestos roofs and replace with Colourbond / Aluminium etc, flashing etc.

They would typically charge \$A10,000 to take and asbestos roof off and replace it, for a 100 m2 house (115m2 roof). (NB this works out at \$A87/m2 or \$US70/m2.

DJ Construction stressed that there was a large awareness of roofs on-island but more with regard to leaking roofs rather than asbestos. About 60% of houses on the island are in bad shape and many are in very bad shape.

DJ Construction's rates are \$A4-6/tradesman/hour and \$A70/day.

DJ Construction were not so adamant that asbestos could not be buried on Nauru. Dugabe Jeremiah considered that if landowners were paid enough money then you could bury the asbestos waste on-island. He stated that public awareness-raising would be very important for the success of any asbestos removal project.

Nauru Rehabilitation Corporation (NRC)

Discussion was held with Phil Leeson, Production Manager, NRC and the following points were made:

- NRC is short-staffed and hence would have limited resources to help with an asbestos project, although they would help where they could.
- They have cherry pickers, scaffolding and trucks they could contribute. They do not have any budget, however, to contribute to asbestos removal.
- A lot of the NRC gear is old and unreliable. There are, however, very good maintenance people available on the island.
- Most local people would prefer to see the asbestos removed from the island – easy to load into containers and barge to ship. NRC has a large forklift with forks that can easily lift containers. It would be charged out at a reasonable rate.

Discussion was also held with the new CEO for NRC Peter Melenewyez. Among other things he is responsible for the dumpsite. The following points are relevant:

- There are apparently two containers in the NRC area with asbestos in them that are overgrown. Access is difficult to them.
- There are about 6 containers of asbestos buried in the landfill.
- They are considering an encapsulation project for asbestos remediation in the NRC workshop area on Topside. Any asbestos removed will be placed in the dumpsite.
- 80% of Nauru land is under mining and 20% is for living, commercial etc. All NRC buildings are owned by RonPHOS.

- Lots of asbestos is delivered to the landfill but it just gets picked up and recycled.
- Leachate from the landfill is probably contributing to the pollution of the lagoon.

RONPhos

Discussions were held with Jim Geering, RonPHOS CEO and others and the following points are relevant to contractor capability and resources:

- RONPhos were positive and had a helpful attitude regarding any assistance with the removal of asbestos from Nauru and they said they would cooperate and help in any way they could. They would consider purchasing any equipment that was needed and they would hire this equipment to the project. They already owned two cherry pickers, a bobcat, a small digger, and a roofing profile machine that could be used to shape new steel roofing, although the roofing profile machine was primarily for their own use.
- They considered that it was much cheaper to form the roof components on-island. Once they have finished with their rolling machine then they will give it to Eigigu. They have 35T of Aluminium in a roll. Aluminium is preferable to steel for a rolling machine as it is softer. It is also less corrosive in the marine environment.
- Jim Geering liked the "disposal at sea" option and stated that it would take years to negotiate a practical burial option.
- Labour costs are about $A6.50/hr on Nauru.

There would be advantages in making everything the same – standardisation is important – one sort of roofing or guttering etc.

RON Hospital

At the hospital we met Ms Lee Pearce, Health Services Adviser, has.nauru@gmail.com Ph 5583900 and Ms Marissa Cook, Director of Administration.

Lee Pearce discussed the AusAID funded hospital rebuild about to take place with Phase 1 starting soon. The scoping team still has to submit a report. We pointed out that this work -must not commence until the fire clean-up took place. Also the renovations must give full regard to the asbestos that has to be removed. The fire happened a long time ago on 15 August 2013.

Some asbestos has already been removed from the hospital by Paul Finch of Central Meridian Inc.

We asked Lee Pearce about the incidence of asbestos-caused diseases and there is little data available, partly because of the destruction of hospital records in the fire. Also chest X-Rays don't look for asbestos lung damage.

It should also be noted that life expectancy on Nauru is quite low (age 57 for men and 63 for women) due to the high incidence of non-communicable diseases such as heart disease and diabetes. The long latency period of asbestos-related cancers may mean that people die for other reasons before the serious effects of asbestos exposure are felt. Phosphate dust related diseases may also be a significant cause of early deaths although this has not been studied either.

A recent SPC study carried out by Massey University of New Zealand did indicate that there were 15 cases of lung cancer last year and 7 deaths, although it should also be noted that 50% of the adult population smoked. Mesothelioma is not separated out in the lung (and lung related) cancer statistics.

Lee Pearce indicated that asbestos related disease data gathering would be undertaken seriously from now on.

Australian High Commission

We had a meeting with Ms Karyn Murray, the DFAT representative on Nauru, and we briefed her on the Pacwaste project and the DFAT Studies including our initial thoughts.

We also briefed Mr Martin Quinn, Australian High Commissioner, who asked to be kept informed. Also met Damien Bruckard, Officer, AHC, Nauru.

Remondis, Brisbane.

Met David Wrenn, Sales Manager (Ph +61-7-32942412) and Kent Cameron, Sales Representative (Ph +61-7-32942430).

Remondis is a Quarantine approved facility that is audited formally. The landfill is lined and the container should be lined. To quote Mr Wrenn – "Bags could be put on top of the liner, and then dispose of the liner. Get a registered asbestos company to certify the container clean and then spray with Vercon S. There needs to be air monitoring when unloading. The loads would just be dropped into the prepared hole."

Transpacific, Brisbane

Met John White and discussed the New Chum Facility. They are not taking asbestos at present but would be soon. They can receive the asbestos waste but quarantine would be an issue for them. They would charge about $60/tonne.

Department of the Environment, Australian Government

Met **Paul Kesby**, Director, Hazardous Waste Section (Ph +61-2-62741411, paul.kesby@environment.gpv.au) and **Dr Paul Starr**, Assistant Director, Hazardous Waste Section, Environmental Quality Division. They advised that there would be no problem importing asbestos into Brisbane under the Waigani Convention, provided all other Australian Government requirements are met (Customs, Biosecurity etc)

Department of Foreign Affairs and Trade

Met Neil Young, Program Manager Nauru (Ph: +61-2-6261-9902) and Fiona McKergow (Ph: +61-2-62619088), Director, Micronesia and Micro-States, Pacific Division, DFAT. Several others attended the meeting too, including representatives from the Department of Immigration and Border Control. All were briefed on the Nauru asbestos situation and the hospital clean-up.

"Asbestos the Silent and Deadly Killer"

Met Cindy Kephas – address Location Block 100, Denig District Republic of Nauru. Cindy heads the NGO "Asbestos the Silent and Deadly Killer" (5566220 sydneynr@yahoo.com). They are very concerned about asbestos in Nauru and are doing a survey in Aiwo. They gave 100 survey sheets to the hospital to fill out regarding ill health effects. They have a membership of about 15 people.

Nauru Port Authority

Met Koria Tamuera, Deputy Harbourmaster. Rental costs Barge $40/hr, Raft $40/hr. Fuel needed Diesel 60l for 2 km round trip @$2/litre plus $8/hr for crew x 3 = $24/hr. The crew consists of an engineer, skipper and deckhand. The speed is 15 knots. The hire of the crane would be an additional $300/hr and it has a 15T limit. Canstruct has another larger crane for about $600/hr. Canstruct own one raft and the other is owned by Matson. The 2 barges are owned by the Port although one is broken.

Nauru Utilities Corporation

Met Ali Mohammed, Manager, Power Station and NUC RO Units (5570510) (mohammedr720ali@gmail.com) (5574052) – also ali.mohammed@nuc.com.nr). The island has no reticulation system and therefore no asbestos reticulation piping. Water is delivered by tanker except for a small reticulation system serving the main hospital from the main tank. There are plans for a reticulation system for both fresh water and sea water. There is a RO plant with several units and also UV and chlorination. There is a water storage problem.

The domestic demand is about 300 m3/day and RonPhos (RPC) use 450-500 m3/day.

Appendix 4: Relevant Reports

A4.1 GHD - Report for Nauru Asbestos Project – Power Station Asbestos Survey (March 2007)

The following are relevant extracts from this report:

Site Description

The site of the power station faces the island's main road and backs onto the Wharf area on the western side of the island. The rear of the site is about 200m from the coast.

The main power station building houses the generating hall that has eight (8) generator bays with six (6) generators currently in place, although not all operating at present. Generators 1, 4, 5 and 6 are possibly 20 to 30 years old, while 2 and 8 are about 5 years old.

The main power station building was probably first built in the late 1950s. It is a long rectangular building running east west. The northern side of the building, off the generating hall, houses the switchboard corridor, control room and spares store. Running underneath the switchboard corridor and control room is a basement corridor carrying electrical cables. Attached to the power station building at the front (eastern end) are the tool room, engineering office and electrical shop.

On the southern side of the main building there is the old cable shed, a small toilet block, and a general utilities building for staff.

All of the above areas were inspected for asbestos containing materials.

On the northern side of the main building there are old cool stores with associated cooling ponds, water services building, water tank tower and associated plumbing and gantries. This facility is currently not operating and is in considerable disrepair.

At the south western end of the site is the desalination plant that is currently being refurbished.

Asbestos Air Monitoring

Air monitoring was undertaken at three locations in the power station's generating hall.

Air sampling pumps were located as follows:

- On top of Generator Set 6 near exposed suspect insulation, at 2 m above floor level;
- On top of Generator Set 1, at 2.6 m above floor level; and
- On service platform against north wall near Generator Set 4, at 4.1 m above floor level.

Thus monitoring was undertaken at roughly each end, and in the middle, of the generating hall.

Sufficient volumes of air were sampled to enable detection of asbestos fibres, if they were present, at levels of >0.01 fibres/mL of air.

The acceptable occupational level of asbestos fibres (all types) in air is 0.1 fibres/mL.

The acceptable para-occupational (or environmental) level of asbestos fibres in air is 0.01 fibres/mL.

The results of the air monitoring were that no asbestos fibres were detected in any of the filter samples taken. On this basis the result is considered to be <0.01 fibres/mL, and therefore acceptable.

Power Station Roof

The roof of the power station is composed of corrugated asbestos (chrysotile) cement sheeting that is likely to be 50 years old. It is, in this instance, at the end of its useful life and is in very poor structural condition. By this it is meant that although it looks intact from a distance, and may not be leaking too badly at present, the actual integral strength of the asbestos cement has almost disappeared from weathering, i.e. the gradual dissolution of the cement matrix over time by the action of rainfall and biological activity.

Rainwater is always slightly acidic (unless passing through a cloud of volcanic ash), and cement is an alkaline substance. Therefore over time the acid in the rain eats away at the alkaline cement material. Asbestos itself is entirely inert and safely bound up in the cement matrix, but over time as the cement slowly washes away the asbestos cement has the appearance of becoming 'furry', i.e. it is possible to see the bundles of fibres of asbestos protruding from the cement, and fibre shedding begins to occur.

It has been documented that fibre shedding most often occurs with heavy rainfall and that gutters and stormwater outlets can accumulate asbestos fibres as a result of this.

As the cement dissolves away over the decades the product becomes thinner and can become brittle, and no longer safe to walk on in the case of roofs.

In the case of the power station roof the highly moist climate of Nauru and the power station being on the coast has meant that the external face of the asbestos cement has become porous and sponge-like, encouraging some biological activity within it that has further deteriorated the material and further weakened its structural strength.

This was demonstrated by instead of having to apply considerable pressure to snap off a sample of the asbestos cement product at an edge (as is usually the case), the material sampled from the edge of the power station roof was soft and almost fell apart as gentle pressure was applied from a set of pliers. Three areas were investigated and all had the same soft texture with no integral strength left in the product.

The asbestos cement roof is therefore gradually becoming friable, and may be difficult to remove as intact sheets during any removal exercise.

The roof therefore should not be walked on without proper fall restraint systems in place, and preferably a 'cherry picker' or crane should be used for any work on the roof.

It is expected that the roof has little life left in it after 50 years in the Nauruan climate, and this general statement is probably applicable to all asbestos cement-roofing products that are of this age in Nauru.

If the roof had been in generally good structural condition then cleaning it with alkaline water based biocides and then painting it with special silicaeous paints to preserve it for another 10 years or so would have been an option. In its current condition it is recommended that the roof be replaced with a non-asbestos containing alternative such as galvanised iron or colorbond cladding.

The estimated quantity of ACM in the roof is 980 m^2.

Power Station Gable Ventilation

The front (eastern) gable of the Power Station has asbestos (chrysotile, amosite and crocidolite) cement mouldings fitted to provide ventilation. This product has also begun to deteriorate, and is cracked and broken in places.

It is recommended that the asbestos cement ventilation mouldings be removed and replaced with a non-asbestos containing alternative.

The estimated ACM in the ventilation mouldings is 42 m^2.

Other Residual Asbestos Cement Products in the Power Station

Some sheets of corrugated asbestos cement remain in the walls of the power station after the walls were recently reclad with a colorbond product. The total quantity of asbestos cement remaining in the walls is estimated to be 17 m^2.

A panel of flat asbestos cement sheet was also found in the entrance to the switchboard corridor. It is approximately 3 m^2 in area, and is painted and in relatively good condition. It is recommended that it eventually be replaced, but may be left intact at present. It is recommended that it be labelled as containing asbestos so that no person cuts, drills, sands, or otherwise abrades this material whilst it remains in place.

Old Cable Shed

The old cable shed is rectangular in shape and open on one of its long sides. It is covered on the other three sides and roof by corrugated asbestos (chrysotile, amosite and crocidolite) cement sheeting that is in very poor condition with many sheets broken or cracked.

It is recommended that the corrugated asbestos cement cladding be removed and replaced with a non-asbestos containing alternative such as galvanised iron or colorbond cladding if this structure is still required for the storage of cable or other plant and equipment. Otherwise the structure should be demolished and the ACM disposed of to landfill. (Refer to guidance on the removal and disposal of ACM in Sections 7 and Appendix C of this report.)

The estimated quantity of ACM in the cable shed is 284 m2.

Water Services Building

The water services' building is situated north of the power station building adjacent to the water tower and water ponds. It is consists of brick walls with a corrugated asbestos cement roof and gable, and has an internal masonite ceiling lining. The roof and associated gable is in very poor condition and is falling apart. The building appears to be derelict and to be no longer used for any purpose.

It is recommended that the asbestos cement roof and associated gables be removed and replaced with a non-asbestos containing alternative such as galvanised iron or colorbond cladding if this structure is still required. Otherwise the structure should be demolished and the ACM disposed of to landfill. (Refer to guidance on the removal and disposal of ACM in Sections 7 and Appendix C of this report.)

The estimated quantity of ACM in the roof and gables of the water services' building is 122 m2.

Cool Stores

The cool stores are situated beside the power station building on its northern side at the eastern end. The roof and gutters are composed of asbestos cement product in very poor and deteriorating condition.

It is recommended that the asbestos cement roof and guttering be removed and replaced with a non-asbestos containing alternative such as galvanised iron if the cool stores are to be recommissioned once the power station is back operating at full generating capacity.

Otherwise the structure should be demolished and the ACM disposed of to landfill. (Refer to guidance on the removal and disposal of ACM in Sections 7 and Appendix C of this report.)

The estimated quantity of ACM in the cool store roof is 830 m2.

Gaskets

The analysis of three (3) samples of different gaskets from Generator Set 1 (allegedly 20-30 years old) revealed that one of the gaskets contained asbestos (chrysotile). As the age of gaskets present within this generator set will vary depending on when they were last replaced, it will be difficult to predict with any certainty which gaskets contain asbestos and which do not - although the gaskets that were found to not contain asbestos certainly looked newer than the gasket that was positive for asbestos.

A precautionary approach should be adopted with all gaskets from the older generating sets being considered to contain asbestos and handled and managed accordingly.

Recommendations

1. It is recommended that all identified asbestos containing materials be removed by an appropriately licensed asbestos removalist prior to any refurbishment or demolition works that may impact on the identified materials.
2. If left in place, it is recommended that the condition of asbestos containing materials should be assessed by a competent person in at least three years' time, and the asbestos register updated accordingly.
3. Those materials in particularly poor condition (e.g. power station roof, cable shed, cool store roof, water services building roof) should be monitored at least yearly until they are either demolished or refurbished.
4. The roof of the main power station is of concern as it has become porous and has lost its structural strength, and possibly has only a few years of life left before it starts to fall apart. Given the investment in the refurbishment, repair and installation of new electrical generation capacity (via eight (8) diesel fired generators) within the power station building, it is recommended that the roof be replaced to protect this substantial investment in the longer term.

PRIMARY LOCATION	SECONDARY LOCATION	MATERIAL DESCRIPTION	ASBESTOS DETECTED	ANALYTICAL RESULT	MATERIAL CONDITION	ESTIMATED QUANTITY
Power Station Building	Gable and area around main eastern entrance to PS	Asbestos Cement Moulded Product	Yes	Chrysotile, Amosite & Crocidolite Detected	Deteriorated/ Damaged	42 m2
Power Station Building	Edge of roof on northern side	Corrugated Asbestos Cement Sheet	Yes	Chrysotile Detected	Deteriorated/ Damaged	1220 m2
Power Station Building	Wall, western wall at northern end	Corrugated Asbestos Cement Sheet	Yes	Chrysotile Detected	Deteriorated/ Damaged	32 m2
Power Station Building	Wall, entrance to switchboard corridor (northern side)	Flat Asbestos Cement Sheet	Yes	Chrysotile Detected	Painted AC Materials (Stable)	3 m2
Power Station Building	Wall, southern (residual AC panels after refurbishment)	Corrugated Asbestos Cement Sheet	Yes	Deemed positive	Weathered AC Materials	17 m2

PRIMARY LOCATION	SECONDARY LOCATION	MATERIAL DESCRIPTION	ASBESTOS DETECTED	ANALYTICAL RESULT	MATERIAL CONDITION	ESTIMATED QUANTITY
					(Stable)	
Power Station Building	Generator Set 1	Gasket	Yes	Chrysotile Detected	Stable	N/A
Power Station Building	Generator Set 1	Potential Thermal/Acoustic Insulation	No	No Asbestos Fibres Detected	N/A	N/A
Power Station Building	Generator Set 6	Potential Thermal/Acoustic Insulation	No	No Asbestos Fibres Detected	N/A	N/A
Power Station Building	Generator Set 5	Potential Thermal/Acoustic Insulation	No	No Asbestos Fibres Detected	N/A	N/A
Power Station Building	Generator Set 4	Potential Thermal/Acoustic Insulation	No	No Asbestos Fibres Detected	N/A	N/A
Cool Store Building	Edge of roof on southern side	Corrugated Asbestos Cement Sheet	Yes	Chrysotile Detected	Deteriorated/ Damaged	830 m2
Tool Room	Eastern external wall	Fibro Cement Sheet Product	No	No Asbestos Fibres Detected	N/A	N/A
Tool Room	Floor	Vinyl Tiles	No	No Asbestos Fibres Detected	N/A	N/A
Electrical Shop	Wall (external), RHS of entry door	Fibro Cement Sheet Product	No	No Asbestos Fibres Detected	N/A	N/A
General Utilities Building	Wall (external), northern side	Fibro Cement Sheet Product	No	No Asbestos Fibres Detected	N/A	N/A
Cable Shed	Wall, western wall at northern end	Corrugated Asbestos Cement Sheet	Yes	Chrysotile, Amosite & Crocidolite Detected	Deteriorated/ Damaged	284 m^2 (total)
Water Services Building	Roof and gables	Corrugated Asbestos Cement Sheet	Yes	Deemed positive	Deteriorated/ Damaged	122 m2

A4.2 AusAID – Report for Nauru Asbestos Project – Asbestos Management Strategy (May 2007)

The following are relevant extracts from this report:

Asbestos Management Strategy

The essential elements of an asbestos management strategy are:

1. Identification of nature, form, condition and quantity of asbestos containing materials
2. Assessment of potential risk associated with exposure to asbestos containing materials;
3. Development and implementation of risk management strategy to eliminate or reduce, as far as is practicable, the likelihood of persons being exposed to unacceptable levels of asbestos fibres in air;
4. Ensure that relevant systems and resources are in place to enable the safe and efficient implementation of the risk management strategy.

Each of these important elements is discussed below.

1. Identification and Quantification

The identification of the nature, form, condition and quantity of asbestos containing materials has been undertaken as part of the rapid assessment, and associated surveys, that occurred in January 2007. , This work serves as the baseline investigation upon which a draft asbestos management strategy may be developed.

A range of structures and premises were examined during these investigations, as follows:

Detailed survey of the power station (refer 'Power Station Asbestos Survey' report); and

Rapid assessment of all schools; some commercial structures; the Church near the Civic Centre; industrial structures associated with phosphate rock extraction, processing, transfer and storage; and domestic structures and dwellings (refer 'Rapid Assessment of Status of Asbestos Structures in Nauru' report).

This rapid assessment identified that the majority of structures in Nauru contain asbestos cement products (~65%); it is likely to be mainly white asbestos (chrysotile), considered by many to the least hazardous form of asbestos; it is non-friable, but is, in general, relatively poor condition.

2. Risk Assessment

The generic health risk assessment undertaken was based on localised sampling at premises that are known to have deteriorating and damaged asbestos cement products present. This sampling did not reveal any detectable asbestos fibres in the ambient air at the time of sampling.

It is unlikely that there is currently any discernible adverse health impact arising from the general deterioration of non-friable asbestos cement products found throughout a range of structures in Nauru.

However, it is a situation warranting some strategy for its management and some plan of action to ensure that when asbestos removal and clean-ups occur they are undertaken in a safe manner and that the materials collected are safely stowed and disposed of without generating unacceptable exposures to asbestos fibres.

The situation regarding deteriorating asbestos product will only get worse in future years and at some stage a program of 'remove and replace' should be instigated based on refurbishing the 'worst first', and/or those structures that regularly used by the community at large (e.g. schools, churches, etc).

The health risk assessment undertaken only reflects the situation at the time of sampling in the environments in which those samples were taken, but are likely to be largely representative of many other like situations in Nauru.

3. Risk Management Strategy

Given the generally deteriorating and poor condition of asbestos cement materials in Nauru, there should be a program developed to gradually remove and replace these materials over time, starting with the worst first.

On this basis the power station, some of the schools and the church near the Civic Centre should be scheduled for a 'remove and replace program'. Refer to the 'Rapid Assessment of Status of Asbestos Structures in Nauru' report for further details.

In order for a gradual program 'remove and replace' to be implemented there needs to be available suitably skilled personnel and a facility to safely dispose of asbestos containing materials.

4. Required Systems and Resources

In order to implement an asbestos risk management strategy there is the need to have available suitable systems and resources to ensure that asbestos materials can be managed and disposed of safely.

Therefore the following is required:

- Persons trained in the safe removal, and packaging of asbestos containing 'waste' materials.
- An approval process for these persons by a relevant government agency or department in order to be authorised by the GoN to remove and dispose of asbestos containing materials. This authorisation would also apply to persons under the direct supervision of approved persons. As this would largely be the removal of asbestos cement roof and wall cladding, it would be more efficient if those removing these materials were also able to replace them at the same time with a suitable alternative, if this is required, and thus be able to offer a complete refurbishment service.
- Safe work systems for asbestos removal (and replacement) works, including manual handling, working at heights, respiratory protection (where required), etc.
- A capability for air monitoring for asbestos fibres for any removal activities involving friable asbestos materials to ensure that this is being done in a safe manner.
- Suitable vehicles and waste receptacles to contain the asbestos waste during transport.
- A landfill site that has an area set aside for the disposal of asbestos wastes.

Recommendations and Conclusions

From the preliminary investigations undertaken it is concluded that the situation with respect to asbestos management in Nauru requires immediate attention as the situation will only get worse as time goes on and some forward planning and strategy development is required to proactively address this emerging issue.

From the preliminary investigations undertaken it is thus recommended that:

a. An Asbestos Management Strategy be developed for Nauru to adequately address asbestos management issues into the future in a planned and progressive manner;
b. Friable asbestos removal projects be undertaken by overseas contractors only, but that capacity be locally developed such that all non-friable asbestos removal projects can be undertaken by the NRC;
c. Training in asbestos management and removal be given to nominated staff of the NRC by bringing suitably accredited trainers to Nauru to provide both theoretical and practical training using a small project as a training exercise;
d. A simple administrative system be introduced to approve persons to undertake asbestos removal, transport and disposal work in Nauru;
e. Safe systems of work be developed and applied to all asbestos removal projects in Nauru;
f. A priority list be prepared for buildings that require refurbishment through a remove and replace program;
g. A priority list be developed for asbestos cement structures that require demolition due to their unsafe or extremely poor condition;
h. The landfill be restored to proper operating order through the acquisition (either through a donor, or from the Nauru Rehabilitation Fund) of suitable machinery and equipment;
i. The landfill develop a dedicated area for future disposal of asbestos containing materials; and Records be kept of the location and amount of asbestos wastes disposed of to the landfill.

A4.3 SPC/EU GCCA/PSIS Project 2013-2014 – Assessment of Rainwater

Harvesting Systems on Nauru – Roofing Assessment - Final Report

1.0 Introduction

This final report will include:

a. Review of water resources management projects on Nauru;
b. Further review of roofing components;
c. An overview of survey findings;
d. Costing comparison between imported and locally-manufactured metal roofing sheets;
e. Estimated costing for removal of damaged roofing (asbestos & metal) and installation of new metal roofing;

Spreadsheet on houses surveyed and repair costs for each house. This is available as a separate and workable Excel file that can be used to determine project budget.

2.0 Water Resources Management Projects

Set out below is a list of water related projects on Nauru. Some of which have been completed while most are still ongoing. The USP/ EU GCCA and SPC/ EU GCCA PSIS projects have also been included as these directly relate to the concept of water resources management.

- **Japan GGP** – Supply PVC gutters, supply of solar water pump and purifiers (19 sites), supply of solar PV to supply RO plants (USD4M), supply of 2 water tanker trucks (operated by Nauru Utilities Corporation)
- **JICA** – Supply Domestic Water Tanks
- **EU** – Supply Domestic Water Tanks
- **PACC** - Restoration of Command Ridge Seawater Reticulation
- **IWRM** – Reduce / eliminate contamination of brackish water
- **PACC**- Implementation of PACC Project
- **ROC Taiwan** – Agriculture Water Project
- **USP / EU GCCA** – Supply of non-potable water to two communities,
- **USP / EU GCCA / PSIS** – Improvement of RWHS Roofing (This report)

3.0 Roofing Types and Supports

An overview of roofing materials will be reviewed here again with the introduction of the two widely used metal roofing materials - Zincalume and Colorbond. Supporting structures such as roofing trusses and their features will also be looked at.

3.1 Materials

Asbestos

Asbestos is an extremely hazardous material that poses risk to health by inhalation when the fibres become airborne and are subsequently inhaled. Asbestos is made up of very fine fibres, but the most dangerous are those naked to the eye, yet penetrate the deepest areas of the lungs.

Exposure to asbestos fibres is known to cause *mesothelioma* - a deadly disease caused by inhaling the particles of dust as the asbestos degrades; eating away at the lining of the lungs and developing into a deadly cancer. It is known to cause diseases such as asbestosis and lung cancer.

There are two viable options to solving the issues of asbestos roofing materials. One approach is to simply remove the asbestos roofing sheets and replace it with metal roofing sheets. This however require the expertise of asbestos removal companies to reduce the risks of asbestos fibres becoming airborne. To replace with metal roofing sheets, there will likely be the need to install extra purlins for supporting purposes. There will also be the need to install *radiant barrier foil insulation* to provide effective cooling within the house and hence save energy that would otherwise be required to cool the house interior.

Regardless of the condition of the asbestos roofing to be replaced, one can always choose to do a complete roofing replacement approach. However, if asbestos roofing is known to be in good condition then the option of asbestos encapsulation will be best in terms of cost and insulation benefits. As briefed in the first report, asbestos encapsulation refers to the actual sealing of asbestos within a protective shell. This is done for a number of reasons, but the main reason is that removing all asbestos materials from some structures is nearly impossible. An added benefit includes better overall insulation provided by the asbestos roofing material and the coating.

Metal

Like asbestos roofing sheets, metal roofing sheets are believed to have a life expectancy as well depending primarily on how these are handled during installation and most important the environment that they are situated in. Metal are known to be corrosive in environments where salinity is concentrated in the atmosphere when compared to those that are installed on houses that are situated further inland. Unless maintained regularly, the life of metal roofing sheets can be extended.

The two widely used metal roofing sheets are Zincalume and Colorbond. Zincalume is steel that is dipped in a zinc based product to give a protective coating. To create Colorbond sheeting, the same procedure is carried out. This is then taken one step further. The Zinc coils are placed in an oven and the colour is then baked and bonded onto the zincalume coating. Hence the name 'Colorbond'.

Colorbond attracts more heat than Zincalume. The darker the colour the more heat it will attract. Therefore, when using Colorbond the use of insulation to compensate should be considered. Colorbond as a product is more expensive than Zincalume and insulation is required resulting in two extra costs; the product itself and the insulation.

4.0 Overview of Findings

In the first report, a total of 196 houses were surveyed by the Consulting Team. The outcome of this survey showed that 125 households use metal roofing sheets, 69 with asbestos and 2 with concrete. According to the preliminary survey that was conducted by the Community, a total of 103 households met the first criteria C1 - which strongly support the objective of this project and that is *'to improve rainwater harvesting systems on Nauru".* Criterions 2 and 3 have similar conditions where C2 are those houses without downpipes and C3 being those without gutters and downpipes. In both situations these houses will not have a complete and workable rainwater harvesting system despite repairs to their roofing.

Table 2: Selection criteria for short-listing of houses.

Criterions	Description	Houses Surveyed		Notes
		First	Second	
C1	Houses requiring roofing repairs/ replacement that have workable guttering, downpipes and catchment	95	8	
C2	Houses requiring roofing repairs/ replacement that have workable gutters and tanks, but have damaged	44	113	
C3	Houses requiring roofing repairs/ replacement that	57		
TOTAL:		*196*	*121*	**317**

During the preparation of this final report, there is a shortfall of 137 houses that will not be included in this paper as these survey results are not accessible. These will be analysed once the survey results are obtained. However, an additional 121 houses will be included in this report as indicated in Table 2 to provide a total of 317. A spreadsheet for this survey is provided on software as an Excel file. The roofing conditions of these 317 houses are tabulated below. Note that these houses include those that were presented in the first report.

Table 3: Housing conditions

	Roofing to be replaced		Ridge Cap Repairs	Require Silicon	Truss Repairs	Good Roofing	Not Occupied	Total
	All	Part						
Total	*69*	*88*	*29*	*64*	*5*	*12*	*50*	***317***
Metal Roofs	28	60	18	51	4	10	24	185
Asbestos Roofs	41	38	11	13	1	2	26	132

Roofing Material - Asbestos & Metal

This survey showed that households that utilised asbestos roofing materials are those that were constructed by the government during the early 40's. These are mainly of the housing types 1, 1A, 1B, and 2, as illustrated in the first report. However, the transition from asbestos to metal roofing as shown on the latter housing types indicate that asbestos was no longer an option for roofing material on Nauru. Table 4 below indicates the ratio of asbestos to metal roofing sheets that are covered in this survey.

Table 4: Number of Asbestos and Metal Roofing Surveyed.

	Roofing Material	No. of
1	Asbestos	130
2	Metal	187
	TOTAL	***317***

Approximate roofing areas for each housing types are provided below in Table 5.

Table 5: Roofing areas

	Housing Types	Roof Details			
		Span (m)	Width* (m)	Length (m)	Area**(m2)
1.	1	12	13.2	15	***198***
2.	1A	12	13.2	16	***210***
3.	1B	12	13.2	15	***198***
4.	2	9	10	14	***140***
5.	3	12	13.2	15	***198***
6.	4	9	10	16	***160***
7.	5	12	13.2	18	***238***
8.	6	10	11	18	***198***
9.	7	8	8.8	10	***88***
10.	PRV-1				***80***
11.	PRV-2				***120***
12.	PRV-3				***160***
13.	PRV-4				***200***
14.	LOC	6	6	10	***60***
15.	GOV	12	13.2	18	***238***

Notes: * Width = Span x 1.1
**Area = Width x Length

Other Repairs - Fascia Boards, Gutters & Downpipes

Table 6 below indicate the number of respective houses that require fascia board replacements, new gutter and downpipe installations and those that need repairs with their water tanks. The number of houses indicated is out of the 317 surveyed. For fascia board installations, 109 out of the 317 houses surveyed require this service and so forth, hence a total 420 individual repairs.

Table 6: Number of houses in need of repairs to their RWHS.

	Other Repairs/ Installations	**No.**
1	Fascia Boards	109
2	Gutters	150
3	Downpipes	142
4	Tanks	19
	TOTAL	***420***

Willingness to Pay

The outcome of this survey question indicate that 40% of home owners are willing to pay a percentage of whatever repairs or installation there is in order to improve their household's RWHS.

Table 7: Willingness to pay

	Willingness to Pay a % of Repairs	**No.**
1	Willing (Yes)	122
2	Not Willing (No)	168
3	Not available to comment	27
	TOTAL	***317***

Household Occupants

Out of the 317 households included in this report, 267 house owners provided the number of people in their respective households. The sum of people from these houses is **2,856.** The remaining 50 households include 28 of those that did not provide any data and 22 are yet to be confirmed.

5.0 Project Resource Budget Estimates

This section looks at the basic cost for replacing damaged roofing sheets which includes removal of asbestos and metal roofing sheets and replacing with Zincalume steel corrugated sheets. Cost of supplying and replacing ridge caps will be included as well as the cost of supplying silicon. Cost estimates for supply and installation of fascia boards, gutters and downpipes will be quoted also. These resource budget estimates will be used in the spreadsheet to determine the cost for maximising rainwater harvesting potentials for each household.

5.1 Building and Construction Team

For the purpose of this report, a team of six persons comprising of four tradesmen and two laborers will be considered to carry out the tasks of removing and replacing roofing sheets one household at a time. Hence, the rate for these workers will be used to determine the overall estimated budget.

Local Rate for Team of Six Workers.

- Tradesman hourly rate = $8 x 4 persons = $32
- Laborers hourly rate = $5 x 2 persons = $10
- Therefore, Team hourly rate = $42/ hour.

5.2 Material Costing

Imported Roofs

In the first report, a galvanised corrugated roofing sheet was quoted at $20 per meter. In this report the cost of two of the widely used metal roofing sheets - *Zincalume and Colorbond*, will be presented for comparison to those manufactured locally. A price list for Zincalume and Colorbond steel roofing is tabulated below in Table 8 - these costs do not include freight.

Table 8: Price list for Zincalume and Colorbond steel roofing (Source: BGC Australia Pty. Ltd)

No.	BMT	TCT	ZINCALUME Steel		COLORBOND Steel	
			Price per LM	Price per m^2 ($)	Price per LM	Price per m^2 ($)
1.	0.42	0.47	23.06	30.25	25.09	32.93
2.	0.48	0.53	28.63	28.63	30.50	40.02

(BMT - base metal thickness; TCT - total coated thickness; LM - lineal meter)

Locally Manufactured Roofs

If roofing sheets are manufactured on Nauru, the cost per meter is estimated to be **$10/ LM**. An advantage when manufacturing locally is the ability to make custom roofing lengths to suit any particular households and therefore avoid the need for roofing sheets overlapping and cutting. The lengths of imported roofing sheets are normally supplied to fit the internal length of shipping containers.

5.3 Roofing Removal Costs

Asbestos Roofing Sheets

The removal of asbestos roofing sheets requires specialised skills, safety clothing and special equipment.

Below are several estimated costs for removal and disposal of asbestos roofing sheets for different roofing areas in Australia.

Table 9: Asbestos roofing sheet removal cost in Australia

	Asbestos Roofing Area in m^2	Est. Cost (Ex-GST Australia)	
	100	\$2,500 - 3,000	Average of \$30 per cubic meter.
	150	\$3,500 - 4,000	
	200	\$4,000 - 6,000	
	250	\$5,000 - 7,500	

(Source: http://www.aztechservices.com.au/index.php/corrugated-roofing-calculator)

Iron Roofing Sheets

Removal of all iron for one house can be achieved in less time than removal of asbestos roofing sheets. This can easily be done within a day depending on size of roofing area. Based on local rates provided above, we have;

- Removal of metal roofing sheets = Up to 250 m^2 = Up to 8hrs = **\$336**

5.4 Roofing Installation Costs

Roofing Trusses

Prior to replacing roofs for households that have damaged trusses, it is necessary to have the required number of trusses manufactured before hand and transported to the site of installation.

Complete Roofing Replacement

An estimated cost to replace all damaged metal roofing sheets with Zincalume roofing sheets, say for the example of Figure 2 where the required roofing area is approximately 240 m^2. Referring to Table 5 below where the cost of locally-manufactured Zincalume roofing sheet is around \$10 per meter, the supply of sheets alone will cost around \$2,880. In this case, new purlin timbers will not be necessary. However, an additional \$1,014 will be required for new ridge cappings and screws. Total supply of materials will therefore cost around \$3,900.

Installation can be accomplished in one day, say 10 hours. Hence installation cost based on labour cost at \$42 an hour will be \$420. For the supply of materials including installation, this works out to approximately **\$4,320** or \$18 per square meter.

To replace asbestos roofing sheets with Zincalume sheets will certainly require additional purlins to be installed. Hence for this same installation, an additional \$1,008 will need to be added to \$4,320. Refer Table 10 - Price quoted for 1 is for locally-manufactured roofing sheets whereas prices for 2 to 4 are obtained from the internet from an Australian manufacturer.

Table 10: Cost of Metal Roofing Sheets & Other Components

	Materials	Qty	Cost per unit	Total Cost	Comments
1.	Zincalume-	48 sheets	$60/ sheet (local)	$2,880	Sheet = $10/ m. Area = 216
2.	Purlin Timber - 35x70mm	252 m	$4/ meter	$1,008	
3.	Ridge Capping	18 m	$22/ meter	$198	
4.	Screws	28/ 6m	$17/ 6m	$816	

Partial Roofing Replacements

Based on the above estimate of $4,320, cost for partial roofing replacements will be determined by a percentage of this amount as illustrated in Table 10.

Table 11: Full and Partial Roofing Replacement Costs

	Cost	Percent	Multiply	Full & Partial Costs
1	$4,320 (240 m^2)	100	1	$4,320
2		90	0.9	$3,888
3		80	0.8	$3,456
4		70	0.7	$3,024
5		60	0.6	$2,592
6		50	0.5	$2,160
7		40	0.4	$1,728
8		30	0.3	$1,296

5.5 Other Components Installation Cost

Fascia Boards

The fascia is a board that runs along the roof line and acts as a finishing edge or trim that connects to the ends of the rafters and trusses. It's visible from the exterior of the home and is often where gutters are attached. Most fascia boards are wooden, but they can also be made from vinyl, aluminum and plastic.

The primary function of the fascia board is to protect the roof and the interior of the home from moisture by blocking its entrance. It also plays an aesthetic role, because it creates a smooth, even appearance along the edge of the roof.

The cost for treated fascia boards varies depending on sizes. Common sizes are 180 x 19mm and 180 x 25mm. For the purpose of this report, the 180 x 19mm will be considered for budget purposes. These are available at **$4/ meter.** Therefore, when considering the example of Figure 2 where 36 meters of fascia boards is required, the average cost will be $144.

Gutters

An example of a PVC gutter that is currently being used on island for the gutter installation/ replacement project is illustrated below. The cost for these gutters is **$24 per 2.9 meters.**

6.0 Conclusion and Recommendations

The outcome of this assessment clearly indicate that majority of households on Nauru do in fact require urgent repairs to their rainwater harvesting systems - roofs, gutters, downpipes and catchment tanks. This is an illustration of poor maintenance practices from individual house-owners that is supported by the fact that in the past, the Nauru Housing Scheme not only provided new housings for the Community but also ongoing maintenance including supply of materials at no cost.

Asbestos Roofing Sheets

Despite the transition from asbestos to metal roofing occurring in the 1980's, this survey showed that majority of the roofing material type that needed repairs and replacements are metal. This is a clear indication of the robustness and life expectancies of asbestos roofing sheets. Given the high cost of contracting overseas specialists to remove asbestos roofing sheets, it is recommended that locals are properly trained to handle asbestos roofing sheets.

Where intact asbestos roofing sheets are known to be leaking, further assessment is recommended to initially determine the condition of the roofing trusses. If these are found to be in good condition, then sealing of leaks should be carried out and the entire roofing encapsulated. This should extend the life of the roofing sheets for another 20 years. Where the trusses are found to be badly damaged, then a complete truss and roofing replacement recommended with the disposal of asbestos to be replaced with new metal sheets.

Metal Roofing Sheets

The survey saw a number of different roofing profiles that needed replacements or repairs. However, to replace with the exact profile will be a tremendous task to carry out. Hence, this report will recommend the supply of corrugated metal roofing sheets only. It is further recommended that these roofing sheets be manufactured locally by Eigigu Enterprise. An advantage is not only with the cost but the ability to produce sheets at any required length.

It should be noted that reflective insulation is not included in the costing for roofing replacements. The cost for this aluminum radiant barrier is approximately $1.50/ m^2. To supply reflective insulation for a house with 240 m^2 of roofing area will cost \$360. The main purpose of reflective insulations is to block radiant heat from transferring across open spaces. Reflective insulation lowers energy bills in the summer that would otherwise be required to cool inside a house.

Ridge Caps

Metal ridge caps have also been identified as an issue contributing to leaking homes. With their simple design, it would be worthwhile to import a 2 to 3 meter manual bending machine that can fabricate these. Metal gutters can also be manufactured on island using the same bending machine. Together with the corrugated sheet rolling machine that is already on the island, all that is needed is the supply of metal rolls. The 600-meter metal roll illustrated in the first report cost approximately \$1,700 or \$3 per meter.

Local Construction Companies

There are four known building and construction companies or groups on Nauru which are listed below. However more may have been established during this write-up.

(i) RONPHOS Corporation (SOE)
(ii) Eigigu Enterprise (SOE)
(iii) Central Meridian Inc. (Private)
(iv) Ocean Constructions (Private)

Eigigu Enterprise is a building and construction company and a subsidiary of Eigigu Holdings Corporation - a former co-operative known as Nauru Co-operative Society and owned by the people of Nauru. Eigigu Enterprise manufactures concrete blocks and metal corrugated roofing sheets.

Community Engagement

The concept of engaging community members to participate not only at workshops, but actually on the field to assist with project implementation is vital in obtaining community members faith in the project and a sense of ownership to the project involved. The outcome of the "willingness to pay" survey show 40% of those surveyed are positive. The willingness amount for each respective household will differ in many ways given the different levels of incomes per household. However, it is recommended that the payment of the man-hours involved be met by the household. In this respect, all required materials shall be supplied by the project.

Project Implementation

An implementation plan should be discussed first with the Technical Working Group, then presented to the stakeholders prior to presenting the concept to Community Leaders, or whatever the Project Management see appropriate. With an objective to fulfill as many households possible, it is recommended that minor roofing repairs are carried out first while detailed repair works are planned.
The spreadsheet developed contains estimated costing for each household based on the findings from the detailed survey. This spreadsheet should be used to confirm criterions (C1, C2, C3) for each household instead of the initial list that was developed based on the Community survey.

Further Research

Given the scope and deadline for this report preparation, other initiatives mentioned in the first report that are not deliverables for this assessment have not been included in this report. These include the application and costing for asbestos encapsulation and a mapping of the houses surveyed.
Asbestos encapsulation is a proven concept that will not only eliminate the issues of airborne fibres and method of disposal, but will greatly reduce the overall cost in removing and disposing of asbestos roofing sheets and the cost for new/ additional purlins, corrugated metal roofing sheets and ridge-caps. Encapsulation product suppliers in Fiji (Dulux) have indicated verbally the huge savings that can be achieved.

Mapping of households will assist in identifying the level of vulnerabilities for certain areas on the island that houses are faced in terms of their surrounding environment and the amount of damages done to roofing materials and structures.

A4.4 GHD Letter Asbestos Roofing on Nauru Hospital

AusAID
62 Northborne Avenue
Canberra, ACT 2601

Attn: Carolyn Nimmo

Dear Carolyn,

Asbestos Roofing on Nauru Hospital

Alison Baker, Deputy Manager of our International Development Division, has asked me to provide some advice to AusAID on the appropriateness of sealing an asbestos roof to minimise any potential risks associated with asbestos fibres getting into the drinking water supply of the Nauru Hospital. We understand that at the same time it is proposed to remove the asbestos guttering and down pipes and to replace them with a galvanised metal equivalent.

It is well documented that airborne asbestos fibres when inhaled into human lungs are potentially carcinogenic, and can cause, or contribute to, a range of pulmonary diseases, dependent on the concentration and duration of exposure. Therefore, according to Australian regulatory requirements any removal, handling or disposal of asbestos containing materials requires that various procedures, precautions and respiratory protection be implemented to avoid the generation, and/or inhalation, of asbestos fibres.

Therefore, if asbestos guttering and associated pipe work is to be removed from the Nauru Hospital then these procedures (i.e. wet down product, remove in intact sections – avoid breakage of product, carefully place into plastic lined skip, roll plastic over to seal load for transport and disposal, bury in designated and approved area, etc), and protective equipment (i.e. P2-rated filter mask and disposable Tyvek-type overalls, etc) need to be applied.

The sealing of the asbestos roof also requires various precautions to be taken. Old asbestos roofs gradually become thinner over time (as the cement slowly dissolves over time from the action of rainfall which is slightly acidic) and become very brittle, and are easily cracked, or broken. Unless wire mesh has been installed under the roof as a pre-emptive fall arrest system, it will be necessary for contractors spraying the roof to wear safety harnesses attached to a fall restraint system. Workers should also avoid standing on the same asbestos sheet at the same time.

The surface of asbestos roofs also become chalky overtime and the loose material must be removed prior to sealing. **No sanding or other abrasive techniques should be used to remove loose material in preparing the surface for painting**. Medium pressure water jets and sprays are the most effective way of removing such material, but **high pressure water jets should not be used** as these are too aggressive, and can cause liberation of additional fibres bound into the cement matrix. Cleaning of the roof should be done before the guttering system is replaced.

Normal priming type paints (especially oil or mineral turps based paints) do not bind well to cement based products 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 prove very long lasting durability under extraordinarily harsh conditions, such as acid, alkaline, salt and very humid conditions. Such paint can as used as a primer coat as well.

Respiratory protection may be required depending on the type of paint used, and whether it is to be sprayed, or applied by special corrugated rollers to match the profile of the roof.

Once the roof is sealed no water should be collected for drinking until the paint is fully cured which is typically a couple of days. Thereafter water collected from the roof will be suitable for drinking provided normal first flush discard is incorporated into the rainwater collection system to avoid roof-accumulated debris being introduced into the drinking water system.

However, it is worth noting that there is little convincing evidence that small amounts of asbestos fibres ingested in drinking water supplies are carcinogenic. As a result the World Health Organisation has not established a limit for asbestos in drinking water.[1]

Developed nations for many years have distributed potable water in asbestos cement water pipes with no evidence of unacceptable health risks to consumers as a result of this. Nevertheless water authorities, when the need to replace infrastructure arises, is gradually replacing asbestos cement water pipes with non asbestos containing materials due to the potential health risks associated with maintaining such pipes (e.g. cutting them to make repairs or add outlets, etc). There is also the general view, endorsed by the Federal Government, that we should be moving towards eliminating asbestos containing materials from society at large.

Although painting is an excellent means to avoid asbestos fibres being liberated from the roof and getting into the drinking water collected from the roof, it is also adding an additional on-going maintenance task to the hospital's schedule of works, as the paint system will need to be maintained and would have a refurbishment schedule of every 7 to 10 years depending on how the paint system weathers under the prevailing climatic conditions.

We trust this information will be of use in your deliberations and planning. If you require any further advice or assistance please do not hesitate to contact the undersigned, or Alison Baker.

Yours faithfully
GHD Pty Ltd

Paul Clarey
Technical Director – OH&S, Environmental Risk and Air Quality Studies
(03) 8687 8939

[1] World Health Organisation, Guidelines for Drinking Water Quality, 2nd Edition, Vol 2. Health criteria and other supporting information, Geneva, 1996.

A4.5 Notes on Teleconference 16 Jan 14 – SPC, SPREP, MCIE, DFAT

Asbestos management in Nauru

Teleconference 16 January, 2014

Participants

- Aaron Atteridge and Gillian Cambers, SPC (Global Climate Change Alliance: Pacific Small Island States project)
- David Haynes and Stewart Williams, SPREP (PacWaste project)
- Bryan Star, Stephanie Ziersch and Claudette Wharton, Ministry of Commerce, Industry and Environment (CIE), Nauru
- Neil Young, DFAT Australia – invited but not present

Agenda

1. Brief introductions to each organisation's work (past, present, future) relating to asbestos in Nauru, and/or needs re clarity around asbestos management – CIE, SPC (Global Climate Change Alliance: Pacific Small Island States project), SPREP (PacWaste project), DFAT.

2. Coordination and funding of asbestos management in Nauru;

(a) can we table the consolidated asbestos data - 2011 census data, Ken Hardy Survey, School Survey, Power Station Survey GHD, SPC Survey: what is the confidence of this data;

(b) can the costs of replacing the 55 asbestos roofs be provided - will help with an indicative budget for the remainder (approx 400 roofs);

(c) are certified asbestos removalist present in Nauru - what training, equipment, experience - validation of this expertise?;

(d) what are DFATs planned activities and resourcing for Asbestos in Nauru;

(e) SPREPs planned activities in EDF10 PacWaste

3. Feasibility of an asbestos management strategy being developed in time to be used by SPC's GCCA:PSIS project (i.e. 2014)

4. Next steps

Summary of Discussion

1. Introductions

SPC – Implementing the GCCA:PSIS project, of which one component is a rainwater harvesting project in Nauru that hopes to remove and replace around 50 asbestos household roofs (removal is related to roof condition, and the project is working with both asbestos and metal roofs so it is not specifically an asbestos-related project). The exact number of household roofs will depend on final costs. An impediment to including these asbestos-roofed households is the absence of any clear asbestos management strategy in Nauru. SPC is seeking support from SPREP, CIE and DFAT – given their respective roles and willingness to advance the issue – to help identify a practical strategy that could be used by Nauru. Timeline for implementation of the roof works of the GCCA:PSIS project is 2014 (all work to be completed no later than mid 2015), hence looking for some workable strategy to be identified and endorsed by Nauru government first part of this year if possible.

SPREP – Implementing the PacWaste project, an EU-funded regional project covering 4 waste streams including asbestos. The first component will consist of a baseline study across the Pacific region, of asbestos quantities, conditions, country practices, etc. This will commence in early 2014. Following, the next priority component will be financial support for stabilisation activities in selected Pacific countries (not yet identified, may or may not include Nauru), which may focus on public buildings such as education facilities and hospitals in order to maximise “bang for buck”. Depending on available funding, some financial support may be available later in the project for storage/disposal of waste asbestos in selected countries.

CIE – Has been in discussion with AusAid (DFAT) for some time seeking support to progress and asbestos management strategy. The Australian government has previously offered support, and conversations were progressing on finalising a Terms of Reference for the work. To date this has not advanced, and its status is now unclear given recent changes to AusAid/DFAT. DFAT have also raised concerns about possible duplication of effort, now that SPREP’s PacWaste project might also be focusing on asbestos in Nauru.

2. Coordination and Funding

The following questions were raised by SPREP for discussion:

(a) Can data on asbestos in Nauru that is already available be shared and collated? It may be that there is already a lot of data, in which case the need for an extensive baseline survey might be reduced.

Aware of: 2011 census data, a survey by Ken Hardy, a survey of schools (presumably related to AusAid activities that have focused on asbestos removal from schools?), a survey of the power station Survey by GHD (not sure if this is different from the NUC work on asbestos at the power station?), and the recent survey funded by SPC’s GCCA:PSIS project on household roofs for around 400 households. SPC also mentioned work by Wawani (GIZ’s Energy Roadmap coordinator in Nauru) compiling data on asbestos on public buildings.

There have been several projects that have handled asbestos waste, e.g. an AusAid project on schools, the Nauru Utilities Corporation has replaced the damaged asbestos roofing of the power station (self-funded). CIE indicated that in the case of the schools projects, at least some of the asbestos waste was given to the Nauru Phosphate Corporation (NPC), however there were disputes over whose responsibility this is. Not sure what happened to this material, may have been buried at the landfill.

SPREP happy to take on the task of collating this information if others make it available.

SPC has (subsequently) provided SPREP with a copy of the roof survey finalised in November 2013, and of 2011 census data on household asbestos roofing.

CIE (Claudette) has information on certified asbestos handlers in Nauru, and will share this with SPREP/SPC.

Bryan indicated CIE has also had discussions with an NGO, “Asbestos the Silent Killer”, on their intentions to advance some of the recommendations in the Ken Hardy survey report. Bryan will share the information on what the NGO intends to do, what funding (if any) they have available, etc.

(b) Can the cost estimates for replacing the 55 asbestos roofs in the GCCA:PSIS project be shared? Will be useful for future budgeting estimates, e.g. by the PacWaste project.

SPC provided following average cost estimates, based on consultant’s roof report for Nauru. These estimates are based on removal costs for asbestos roofs in Australia (hence may overestimate local removal costs, assuming locally certified contractors are available):

> 43 households are selected for complete roof removal (selection for our project is based on roof condition and ability to function as a rainwater catchment, not related to either the presence of asbestos or possible health concerns this might create). Using these 43 houses, the following are estimated costs for complete removal of asbestos roofing and

for replacement with metal roofs (including any necessary building of internal structures – some houses will need new trusses, for example):

- Average cost for removal of asbestos roofs (rough estimate by engineering consultant, not by asbestos-certified company itself): $3516 per house
- Average cost for removal of asbestos roofs and replacement with metal roofs (including associated building repairs to support new roof): $9,794 per house.

These costs do not include transportation, storage and/or disposal of asbestos wastes.

(c) Are certified asbestos removalist present in Nauru – and if so, what training, equipment, experience do they have (i.e. validation of this expertise)?

CIE (Claudette) has identified one local company, "Ocean Construction", that has certified asbestos handlers. These received training and certification by the US Air Force Medical Service in 2007. They also have OH&S training.

(d) What are DFATs planned activities and resourcing for Asbestos in Nauru?

Unable to discuss in DFAT's absence.

(e) SPREPs planned activities in EDF10 PacWaste

Described above in Introductions. No specific activities confirmed for Nauru at this stage.

It was clarified by SPC that the GCCA:PSIS project has its own funding available for asbestos removal and disposal/storage, and that what it needs is clarity on an acceptable approach for dealing with asbestos waste that will be generated by the project. Hence, it is seeking support from SPREP and DFAT activities to help identify practical options and progress a storage or disposal strategy with the government.

3. Feasibility of an asbestos management strategy being developed in time to be used by SPC's GCCA:PSIS project

On the question of whether there are any examples of Australia or New Zealand agreeing to accept exported asbestos waste from Pacific Island countries, SPREP indicated that at one stage NZ had agreed to accept waste from Niue, although in the end this did not eventuate (i.e. the waste was dealt with in other ways).

On the question of the Nauru government's preferred approach, CIE pointed to earlier discussions within the Nauru government, particularly during the NSS project (focused on schools). Several government departments were consulted on what to do with the waste, recalls some preference for off-island disposal and then, if not possible, disposal at sea (these were the recommendations of the waste operator in Nauru). This did not eventuate, and fate of the waste is unclear.

There may be hesitation in government about supporting permanent local disposal because of, in the first instance, perceived health risks with asbestos burial. There are also likely to be difficult issues negotiating land access for this purpose, since all land is owned by communities and government would have to negotiate to use it for asbestos disposal. The current landfill is owned by private landowners (?) but is leased by government. However, there is a process for government negotiating acquisition of land, for example used to secure the airstrip, the landfill, government building sites.

In lieu of the PacWaste project not being far enough advanced at this stage to commit to developing an asbestos strategy in particular countries, and ditto for DFAT's possible contributions in Nauru, SPREP offered to provide SPC and CIE with a short briefing note on practical asbestos management options, based on the 2011 regional asbestos report. This can be used to seek some consensus within government on their preferred approach. Will aim to share this next week. Further, SPREP would be happy to assist in formal development of a national strategy over the coming months, if work on this is initiated.

Appendix 5: Laboratory Reports

Swab Sample Reports

TEM ASBESTOS RESULTS FOR SWABS

ASTM 6480M

EMS REPORT 164002

SAMPLE ID	CHRY COUNTED	AMPH COUNTED	STRUCTURES >5um COUNTED	ANALYTIC SENSITIVITY STR/CM^2	CHRY STR/CM^2	AMPH STR/CM^2	>5um STR/CM^2
1/26/11/14 SWAB	5	0	0	1816	9100	<1800	<1800
1/27/11/14 SWAB	92	0	23	2323	210000	<2300	53000
2/27/11/14 SWAB	60	0	23	2323	140000	<2300	53000
3/27/11/14 SWAB	31	2	6	2323	72000	4646	14000
4/27/11/14 SWAB	38	0	3	2581	98000	<2600	7700
5/27/11/14 SWAB	15	0	7	2647	40000	<2600	19000
6/27/11/14 SWAB	7	0	1	26658	190000	<27000	27000
7/27/11/14 SWAB	2	0	1	2666	5300	<2700	2700
8/27/11/14 SWAB	1	0	1	2323	2300	<2300	2300
9/27/11/14 SWAB	0	0	0	3671	<3700	<3700	<3700
10/27/11/14 SWAB	1	0	0	2323	2300	<2300	<2300
1/28/11/14 SWAB	0	0	0	2323	<2300	<2300	<2300
2/28/11/14 SWAB	2	0	1	3732	7500	<3700	3700
3/28/11/14 SWAB	1	0	1	1866	1900	<1900	1900
5/28/11/14 SWAB	0	1	1	18661	<19000	19000	19000
6/28/11/14 SWAB	0	0	0	3732	<3700	<3700	<3700
9/28/11/14 SWAB	0	0	0	9330	<9300	<9300	<9300
8/28/11/14 SWAB	1	0	1	3732	3700	<3700	3700
7/28/11/14 SWAB	0	0	0	1866	<1900	<1900	<1900
10/28/11/14 SWAB	0	0	0	9330	<9300	<9300	<9300
11/28/11/14 SWAB	0	0	0	9330	<9300	<9300	<9300
1/29/2011 SWAB	0	0	0	3732	<3700	<3700	<3700
2/29/11 SWAB	0	0	0	3732	<3700	<3700	<3700
3/29/11 SWAB	0	0	0	9330	<9300	<9300	<9300
4/29/11 SWAB	0	0	0	9330	<9300	<9300	<9300
5/29/11 SWAB	1	0	1	9330	9300	<9300	9300
6/29/11 SWAB	4	0	2	1866	7500	<1900	3700
7/29/11 SWAB	4	0	1	9330	37000	<9300	9330
8/29/11 SWAB	13	0	8	1866	24000	<1900	15000
9/29/11 SWAB	10	0	2	1866	19000	<1900	3700
10/29/11 SWAB	18	0	10	9330	170000	<9300	93000
2/20/11 SWAB	0	0	0	1866	<1900	<1900	<1900
1/30/11 SWAB	1	0	0	9330	9300	<9300	<9300
2/30/11 SWAB	0	0	0	9330	<9300	<9300	<9300
3/30/11 SWAB	0	0	0	9330	<9300	<9300	<9300
4/30/11 SWAB	0	0	0	9330	<9300	<9300	<9300
5/30/11 SWAB	2	0	0	9330	19000	<9300	<9300
6/30/11 SWAB	0	0	0	1866	<1900	<1900	<1900
7/30/11 SWAB	0	0	0	1866	<1900	<1900	<1900

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TEM ASBESTOS RESULTS FOR SWABS

ASTM 6480M

SAMPLE ID	CHRY COUNTED	AMPH COUNTED	STRUCTURES >5um COUNTED	ANALYTIC SENSITIVITY STR/CM^2	CHRY STR/CM^2	AMPH STR/CM^2	>5um STR/CM^2
8/30/11 SWAB	0	0	0	1866	<1900	<1900	<1900
9/30/11 SWAB	0	0	0	1866	<1900	<1900	<1900
6/30/11 SWAB	0	0	0	1866	<1900	<1900	<1900
1/1/12 SWAB	2	0	0	1866	3700	<1900	<1900
2/1/12 SWAB	0	0	0	1866	<1900	<1900	<1900
3/1/12 SWAB	0	0	0	1866	<1900	<1900	<1900
4/1/12 SWAB	39	0	20	3732	150000	<3700	75000
5/1/12 SWAB	0	0	0	1866	<1900	<1900	<1900
6/1/12 SWAB	19	0	4	9330	180000	<9300	37000
7/1/12 SWAB	84	0	6	1866	160000	<1900	11000
8/1/12 SWAB	52	0	11	1866	97000	<1900	21000
10/1/12 SWAB	148	0	54	9330	1400000	<9300	500000
11/1/12 SWAB	64	0	6	2014	130000	<2000	12000
12/1/12 SWAB	0	0	0	2014	<2000	<2000	<2000
13/1/12 SWAB	7	0	1	2014	14000	<2000	2000
14/1/12 SWAB	0	0	0	2014	<2000	<2000	<2000
15/1/12 SWAB	3	0	3	10069	30000	<10000	30000
16/1/12 SWAB	6	0	3	10069	60000	<10000	30000
1/2/12 SWAB	1	0	0	2014	2000	<2000	<2000
2/2/12 SWAB	0	0	0	2014	<2000	<2000	<2000
3/2/12 SWAB	0	0	0	2014	<2000	<2000	<2000
4/2/12 SWAB	0	0	0	2014	<2000	<2000	<2000
5/2/12 SWAB	0	0	0	2014	<2000	<2000	<2000
6/2/12 SWAB	0	0	0	2014	<2000	<2000	<2000
7/2/12 SWAB	0	0	0	2014	<2000	<2000	<2000
8/2/12 SWAB	0	0	0	2014	<2000	<2000	<2000
9/2/12 SWAB	1	0	0	2014	2000	<2000	<2000
1/12 SWAB	41	0	13	9686	400000	<9700	130000
3/29/11 SWAB	0	0	0	1937	<1900	<1900	<1900
6/27/11/2014 SWAB	16	0	2	1937	31000	<1900	3900

CHRY = CHRYSOTILE AMPH = AMPHIBOLE STR = STRUCTURES

COMMENT: ALL AMPHIBOLES WERE AMOSITE

3-23-15
DATE

Bernadine Kolk
Bernadine Kolk - Laboratory Director

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626-568-4065

TEM ASBESTOS RESULTS FOR SWABS

ASTM 6480M

EMS REPORT 164149

SAMPLE NO.	CHRY COUNTED	AMPH COUNTED	STRUCTURES >5um COUNTED	ANALYTICAL SENSITIVITY STR/CM2	CHRY STR/CM^2	AMPH STR/CM^2	>5um STR/CM^2
1/3/12 SWAB	0	0	0	1937	<1900	<1900	<1900
2/3/12 SWAB	0	0	0	1937	<1900	<1900	<1900
3/3/12 SWAB	0	0	0	1937	<1900	<1900	<1900
4/3/12 SWAB	0	0	0	1937	<1900	<1900	<1900
5/3/12 SWAB	0	0	0	1937	<1900	<1900	<1900
6/3/12 SWAB	0	0	0	1937	<1900	<1900	<1900
7/3/12 SWAB	1	0	1	9686	9700	<9700	9700
8/3/12 SWAB	0	0	0	1937	<1900	<1900	<1900
9/3/12 SWAB	0	0	0	3874	<3900	<3900	<3900
10/3/12 SWAB	2	2	0	3874	7800	7800	<3900
11/3/12 SWAB	7	0	1	1937	14000	<1900	1900
12/3/12 SWAB	6	0	3	9686	58000	<9700	29000
1/4/12 SWAB	0	0	0	9686	<9700	<9700	<9700
2/4/12 SWAB	51	4	9	9686	490000	39000	87000
3/4/12 SWAB	8	2	3	9686	77000	19000	29000
4/4/12 SWAB	17	2	3	1937	33000	3800	5800
5/4/12 SWAB	1	0	0	1937	1900	<1900	<1900
6/4/12 SWAB	0	0	0	9686	<9700	<9700	<9700
7/4/12 SWAB	0	0	0	1937	<1900	<1900	<1900
8/4/12 SWAB	7	2	0	3874	27000	7700	<3900
9/4/12 SWAB	0	0	0	1937	<1900	<1900	<1900
10/4/12 SWAB	0	0	0	9686	<9700	<9700	<9700
1/5/12 SWAB	0	0	0	1937	<1900	<1900	<1900
2/5/12 SWAB	1	0	0	1937	1900	<1900	<1900
3/5/12 SWAB	2	0	0	1937	3900	<1900	<1900

CHRY = CHRYSOTILE AMPH = AMPHIBOLE STR = STRUCTURES

COMMENT: ALL AMPHIBOLES WERE AMOSITE EXCEPT IN SAMPLE 2/4/12 SWAB WHERE ONE CROCIDOLITE AND ONE AMOSITE WAS FOUND

3-24-15
DATE

Bernadine Kolk
Bernadine Kolk - Laboratory Director

EMS LABORATORIES, INC. 117 West Bellevue Drive / Pasadena CA 91105
626-568-4065

Air Sample Reports

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

Phase Contrast Microscopy of Air Samples
NIOSH Fiber Count (Method 7400, Issue 2, A Rules)

(Aspect ratio >3:1; Fiber length >5μm; Fields counted: 20 to 100 fields)

AIHA LAB. No: 101634
Report No: **164001**
Client: Contract Environmental
Address: 119, Johnson Rd, W. Melton, RO 5, Christchurch, New Zealand

Attention: John O'Grady
Project: SPREP Asbestos
File Name: 164001 Contract.air.jw

Date Sampled: 11/26/2014
Date Received: 12/18/2014
Date Analyzed: 12/23/2014

Filter Type/Size: MCE/25mm
Filter Area (sqmm): 385
Field Area (sqmm): 0.00785
Mag: 400x

Sample I.D.	Fields Counted	Fibers Counted	Fiber/sqmm	Fiber/Filter	Vol (Lit.)	Fibers/cc	LOD (f/cc)	LOQ (f/cc)	A. S. (f/cc)
3/27/11/2014 Air	100	4	5	1962	528.0	< 0.0051	0.0051	0.0743	0.0009
4/27/11/2014 Air	100	1.5	2	736	570.0	< 0.0047	0.0047	0.0688	0.0009
5/27/11/2014 Air	100	0	0	0	560.0	< 0.0048	0.0048	0.0701	0.0009
6/27/11/2014 Air	Torn filter				484.0	N.A.			
1/28/11/14 Air	100	4.5	6	2207	500.0	< 0.0054	0.0054	0.0785	0.0010
3/28/11/14 Air	100	0.5	1	245	480.0	< 0.0056	0.0056	0.0817	0.0010
4/28/11/14 Air	100	0	0	0	480.0	< 0.0056	0.0056	0.0817	0.0010
5/28/11/14 Air	100	0	0	0	510.0	< 0.0053	0.0053	0.0769	0.0010
6/28/11/14 Air	100	2	3	981	480.0	< 0.0056	0.0056	0.0817	0.0010
7/28/11/14 Air	100	6	8	2943	490.0	0.0060	0.0055	0.0801	0.0010
8/28/11/14 Air	100	1	1	490	240.0	< 0.0112	0.0112	0.1635	0.0020
9/28/11/14 Air	100	1	1	490	240.0	< 0.0112	0.0112	0.1635	0.0020
10/28/11/14 Air	100	0	0	0	480.0	< 0.0056	0.0056	0.0817	0.0010
1128/11/14 Air	100	0	0	0	480.0	< 0.0056	0.0056	0.0817	0.0010

N.A. = Not Applicable
N.D. = None Detected
Note: NIOSH 7400 requires 2 field blanks or 10% of the set which ever is greater
Results have been corrected for the field blank or EMS blank if the analyte is detected in the blank
Samples were received in good condition unless otherwise noted.
Result only pertain to items actually tested.

f/cc = Fibers per cubic centimeter
LOD = LIMIT OF DETECTION (5.5 fiber/100 field)
LOQ = LIMIT OF QUANTITATION (80 fiber/100 field)
A. S. = ANALYTICAL SENSITIVITY (1 fiber/100 field)
INTRA-LABORATORY Sr = 0.23

Analyst
Jeff Wan

B. M. Kolk, Laboratory Director

PCM VERSION: 7 (8-2008)

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

Phase Contrast Microscopy of Air Samples
NIOSH Fiber Count (Method 7400, Issue 2, A Rules)

(Aspect ratio >3:1; Fiber length >5µm; Fields counted: 20 to 100 fields)

AIHA LAB. No: 101634
Report No: 164001
Client: Contract Environmental
Address: 119, Johnson Rd, W. Melton, RO 5, Christchurch, New Zealand

Attention: John O'Grady
Project: SPREP Asbestos
File Name: 164001 Contract.air.jw

Date Sampled: 11/26/2014
Date Received: 12/18/2014
Date Analyzed: 12/23/2014

Filter Type/Size: MCE/25mm
Filter Area (sqmm): 385
Field Area (sqmm): 0.00785
Mag: 400x

Sample I.D.	Fields Counted	Fibers Counted	Fiber/sqmm	Fiber/Filter	Vol (Lit.)	Fibers/cc	LOD (f/cc)	LOQ (f/cc)	A. S. (f/cc)
1/29/11 Air	100	0	0	0	518.0	< 0.0052	0.0052	0.0757	0.0009
2/29/11 Air	100	0	0	0	486.0	< 0.0056	0.0056	0.0807	0.0010
3/29/11 Air	100	0	0	0	496.0	< 0.0054	0.0054	0.0791	0.0010
4/29/11 Air	100	1	1	490	484.0	< 0.0056	0.0056	0.0811	0.0010
5/29/11 Air	100	0	0	0	486.0	< 0.0056	0.0056	0.0807	0.0010
6/29/11 Air	100	0	0	0	580.0	< 0.0047	0.0047	0.0676	0.0008
7/29/11 Air	100	0	0	0	480.0	< 0.0056	0.0056	0.0817	0.0010
8/29/11 Air	100	0.5	1	245	480.0	< 0.0056	0.0056	0.0817	0.0010
9/29/11 Air	100	0	0	0	480.0	< 0.0056	0.0056	0.0817	0.0010
10/29/11 Air	100	0	0	0	524.0	< 0.0051	0.0051	0.0749	0.0009
1/30/11 Air	100	1	1	490	510.0	< 0.0053	0.0053	0.0769	0.0010
2/30/11 Air	100	0	0	0	500.0	< 0.0054	0.0054	0.0785	0.0010
3/30/11 Air	100	0	0	0	490.0	< 0.0055	0.0055	0.0801	0.0010
4/30/11 Air	100	0	0	0	490.0	< 0.0055	0.0055	0.0801	0.0010
5/30/11 Air	100	0	0	0	480.0	< 0.0056	0.0056	0.0817	0.0010
6/30/11 Air	100	0	0	0	480.0	< 0.0056	0.0056	0.0817	0.0010
7/30/11 Air	100	0	0	0	480.0	< 0.0056	0.0056	0.0817	0.0010
8/30/11 Air	100	1	1	490	490.0	< 0.0055	0.0055	0.0801	0.0010

N.A. = Not Applicable
N.D. = None Detected
f/cc = Fibers per cubic centimeter

Note: NIOSH 7400 requires 2 field blanks or 10% of the set which ever is greater
Results have been corrected for the field blank or EMS blank if the analyte is detected in the blank
Samples were received in good condition unless otherwise noted.
Result only pertain to items actually tested.

LOD = LIMIT OF DETECTION (5.5 fiber/100 field)
LOQ = LIMIT OF QUANTITATION (80 fiber/100 field)
A. S. = ANALYTICAL SENSITIVITY (1 fiber/100 field)
INTRA-LABORATORY Sr = 0.16

Analyst
Jeff Wan

B. M. Kolk, Laboratory Director

PCM VERSION: 7 (8-2008)

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

Phase Contrast Microscopy of Air Samples
NIOSH Fiber Count (Method 7400, Issue 2, A Rules)

(Aspect ratio >3:1; Fiber length >5µm; Fields counted: 20 to 100 fields)

AIHA LAB. No: 101634
Report No: 164001
Client: Contract Environmental
Address: 119, Johnson Rd, W. Melton, RO 5, Christchurch, New Zealand

Attention: John O'Grady
Project: SPREP Asbestos
File Name: 164001 Contract.air.jw

Date Sampled: 11/26/2014
Date Received: 12/18/2014
Date Analyzed: 12/30/2014

Filter Type/Size: MCE/25mm
Filter Area (sqmm): 385
Field Area (sqmm): 0.00785
Mag: 400x

Sample I.D.	Fields Counted	Fibers Counted	Fiber/sqmm	Fiber/Filter	Vol (Lit.)	Fibers/cc	LOD (f/cc)	LOQ (f/cc)	A. S. (f/cc)
9/30/11 Air	100	1	1	490	480.0	< 0.0056	0.0056	0.0817	0.0010
10/30/11 Air	100	0	0	0	482.0	< 0.0056	0.0056	0.0814	0.0010
1/1/12 Air	100	9	11	4414	520.0	0.0085	0.0052	0.0755	0.0009
2/1/12 Air	100	2	3	981	508.0	< 0.0053	0.0053	0.0772	0.0010
3/1/12 Air	100	1	1	490	496.0	< 0.0054	0.0054	0.0791	0.0010
4/1/12 Air	100	3.5	4	1717	480.0	< 0.0056	0.0056	0.0817	0.0010
5/1/12 Air	100	0	0	0	480.0	< 0.0056	0.0056	0.0817	0.0010
6/1/12 Air	100	0	0	0	550.0	< 0.0049	0.0049	0.0713	0.0009
7/1/12 Air	100	0	0	0	480.0	< 0.0056	0.0056	0.0817	0.0010
8/1/12 Air	100	2	3	981	480.0	< 0.0056	0.0056	0.0817	0.0010
9/1/12 Air	100	0	0	0	480.0	< 0.0056	0.0056	0.0817	0.0010
10/1/12 Air	100	3	4	1471	480.0	< 0.0056	0.0056	0.0817	0.0010

N.A. = Not Applicable
N.D. = None Detected
Note: NIOSH 7400 requires 2 field blanks or 10% of the set which ever is greater
Results have been corrected for the field blank or EMS blank if the analyte is detected in the blank
Samples were received in good condition unless otherwise noted.
Result only pertain to items actually tested.

f/cc = Fibers per cubic centimeter
LOD = LIMIT OF DETECTION (5.5 fiber/100 field)
LOQ = LIMIT OF QUANTITATION (80 fiber/100 field)
A. S. = ANALYTICAL SENSITIVITY (1 fiber/100 field)
INTRA-LABORATORY Sr = 0.16

Analyst
Jeff Wan

B. M. Kolk, Laboratory Director

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Phase Contrast Microscopy of Air Samples
NIOSH Fiber Count (Method 7400, Issue 2, A Rules)

(Aspect ratio >3:1; Fiber length >5µm; Fields counted: 20 to 100 fields)

AIHA LAB. No: 101634
Report No: 164001
Client: Contract Environmental
Address: 119, Johnson Rd, W. Melton, RO 5, Christchurch, New Zealand

Attention: John O'Grady
Project: SPREP Asbestos
File Name: 164001 Contract.air.jw

Date Sampled: 11/26/2014
Date Received: 12/18/2014
Date Analyzed: 12/30/2014

Filter Type/Size: MCE/25mm
Filter Area (sqmm): 385
Field Area (sqmm): 0.00785
Mag: 400x

Sample I.D.	Fields Counted	Fibers Counted	Fiber/sqmm	Fiber/Filter	Vol (Lit.)	Fibers/cc	LOD (f/cc)	LOQ (f/cc)	A. S. (f/cc)
1/2/2012	100	1	1	490	490.0	< 0.0055	0.0055	0.0801	0.0010
2/2/2012	100	0	0	0	506.0	< 0.0053	0.0053	0.0775	0.0010
3/2/2012	100	0	0	0	520.0	< 0.0052	0.0052	0.0755	0.0009
4/2/2012	100	1	1	490	480.0	< 0.0056	0.0056	0.0817	0.0010
5/2/2012	100	0.5	1	245	500.0	< 0.0054	0.0054	0.0785	0.0010
6/2/2012	100	0	0	0	254.0	< 0.0106	0.0106	0.1545	0.0019
7/2/2012	100	0	0	0	480.0	< 0.0056	0.0056	0.0817	0.0010
8/2/2012	100	0	0	0	480.0	< 0.0056	0.0056	0.0817	0.0010
9/2/2012	100	1	1	490	480.0	< 0.0056	0.0056	0.0817	0.0010
11/27/11/14	100	0	0	0	480.0	< 0.0056	0.0056	0.0817	0.0010
12/28/11/14	100	0	0	0	480.0	< 0.0056	0.0056	0.0817	0.0010

N.A. = Not Applicable
N.D. = None Detected
Note: NIOSH 7400 requires 2 field blanks or 10% of the set which ever is greater
Results have been corrected for the field blank or EMS blank if the analyte is detected in the blank
Samples were received in good condition unless otherwise noted.
Result only pertain to items actually tested.

f/cc = Fibers per cubic centimeter
LOD = LIMIT OF DETECTION (5.5 fiber/100 field)
LOQ = LIMIT OF QUANTITATION (80 fiber/100 field)
A. S. = ANALYTICAL SENSITIVITY (1 fiber/100 field)
INTRA-LABORATORY Sr = 0.16

Analyst
Jeff Wan

B. M. Kolk, Laboratory Director

PCM VERSION: 7 (8-2008)

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

Phase Contrast Microscopy of Air Samples
NIOSH Fiber Count (Method 7400, Issue 2, A Rules)

(Aspect ratio >3:1; Fiber length >5µm; Fields counted: 20 to 100 fields)

AIHA LAB. No: 101634
Report No: **164147**
Client: Contract Environmental
Address: 119 Johnson Rd, W. Helton, RD 5
Christchurch, New Zealand

Attention: John O'Grady
Project: SPREP
File Name: 164147 Contract Enviro.air.jw

Date Sampled: 12/3/2014
Date Received: 12/31/2014
Date Analyzed: 1/12/2015

Filter Type/Size: MCE/25mm
Filter Area (sqmm): 385
Field Area (sqmm): 0.00785
Mag: 400x

Sample I.D.	Fields Counted	Fibers Counted	Fiber/sqmm	Fiber/Filter	Vol (Lit.)	Fibers/cc	LOD (f/cc)	LOQ (f/cc)	A. S. (f/cc)
1/3/12	100	0	0	0	590.0	< 0.0046	0.0046	0.0665	0.0008
2/3/12	100	0	0	0	576.0	< 0.0047	0.0047	0.0681	0.0009
3/3/12	100	4	5	1962	586.0	< 0.0046	0.0046	0.0670	0.0008
4/3/12	100	0	0	0	550.0	< 0.0049	0.0049	0.0713	0.0009
5/3/12	100	0	0	0	520.0	< 0.0052	0.0052	0.0755	0.0009
6/3/12	100	1.5	2	736	516.0	< 0.0052	0.0052	0.0760	0.0010
7/3/12	100	2	3	981	518.0	< 0.0052	0.0052	0.0757	0.0009
8/3/12	100	8.5	11	4169	480.0	0.0087	0.0056	0.0817	0.0010
9/3/12	100	2.5	3	1226	470.0	< 0.0057	0.0057	0.0835	0.0010
1/4/12	100	0	0	0	500.0	< 0.0054	0.0054	0.0785	0.0010
2/4/12	100	0	0	0	502.0	< 0.0054	0.0054	0.0782	0.0010
3/4/12	100	0	0	0	498.0	< 0.0054	0.0054	0.0788	0.0010
4/4/12	100	0	0	0	492.0	< 0.0055	0.0055	0.0797	0.0010
5/4/12	100	0	0	0	488.0	< 0.0055	0.0055	0.0804	0.0010
6/4/12	100	1	1	490	610.0	< 0.0044	0.0044	0.0643	0.0008
7/12/14	100	0	0	0	480.0	< 0.0056	0.0056	0.0817	0.0010
8/12/14	100	0	0	0	480.0	< 0.0056	0.0056	0.0817	0.0010
9/12/14	100	0	0	0	480.0	< 0.0056	0.0056	0.0817	0.0010

N.A. = Not Applicable
N.D. = None Detected
Note: NIOSH 7400 requires 2 field blanks or 10% of the set which ever is greater
Results have been corrected for the field blank or EMS blank if the analyte is detected in the blank
Samples were received in good condition unless otherwise noted.
Result only pertain to items actually tested.

f/cc = Fibers per cubic centimeter
LOD = LIMIT OF DETECTION (5.5 fiber/100 field)
LOQ = LIMIT OF QUANTITATION (80 fiber/100 field)
A. S. = ANALYTICAL SENSITIVITY (1 fiber/100 field)
INTRA-LABORATORY Sr = 0.23

Analyst
Jeff Wan

B. M. Kolk, Laboratory Director B M Kolk

PCM VERSION: 7 (8-2008)

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

Phase Contrast Microscopy of Air Samples
NIOSH Fiber Count (Method 7400, Issue 2, A Rules)

(Aspect ratio >3:1; Fiber length >5μm; Fields counted: 20 to 100 fields)

AIHA LAB. No: 101634
Report No: 164147
Client: Contract Environmental
Address: 119 Johnson Rd, W. Helton, RD 5
Christchurch, New Zealand

Attention: John O'Grady
Project: SPREP
File Name: 164147 Contract Enviro.air.jw

Date Sampled: 12/3/2014
Date Received: 12/31/2014
Date Analyzed: 1/12/2015

Filter Type/Size: MCE/25mm
Filter Area (sqmm): 385
Field Area (sqmm): 0.00785
Mag: 400x

Sample I.D.	Fields Counted	Fibers Counted	Fiber/sqmm	Fiber/Filter	Vol (Lit.)	Fibers/cc	LOD (f/cc)	LOQ (f/cc)	A. S. (f/cc)
10/12/14	100	0	0	0	480.0	< 0.0056	0.0056	0.0817	0.0010
1/5/12	100	0.5	1	245	480.0	< 0.0056	0.0056	0.0817	0.0010
2/5/12	100	1	1	490	480.0	< 0.0056	0.0056	0.0817	0.0010
3/5/12	100	0	0	0	480.0	< 0.0056	0.0056	0.0817	0.0010

N.A. = Not Applicable
N.D. = None Detected
f/cc = Fibers per cubic centimeter

Note: NIOSH 7400 requires 2 field blanks or 10% of the set which ever is greater
Results have been corrected for the field blank or EMS blank if the analyte is detected in the blank
Samples were received in good condition unless otherwise noted.
Result only pertain to items actually tested.

LOD = LIMIT OF DETECTION (5.5 fiber/100 field)
LOQ = LIMIT OF QUANTITATION (80 fiber/100 field)
A. S. = ANALYTICAL SENSITIVITY (1 fiber/100 field)
INTRA-LABORATORY Sr = 0.16

Analyst
Jeff Wan

B. M. Kolk, Laboratory Director B M Kolk

PCM VERSION: 7 (8-2006)

DATE:	February 8, 2015	Page 1 of 2
CLIENT:	Contract Environmental 119 Johnson Road, West Melton Rd 5 Christchurch, NZ	
ATTENTION:	John O'Grady	
REPORT NO:	164559/164560	
REFERENCE:	Letter, January 31, 2015 – Air Tests	
DATE RECEIVED:	12/18, 31/2014	TEM REQUEST:01/31/2015
DATE ANALYZED:	02/05, 06/2015	
SUBJECT:	Asbestos Analysis by TEM	
ACCREDITED:	AIHA LAP, LLC Laboratory I.D. 101634, NVLAP Lab Code: 101218-0	

TEM analysis was requested for samples originally submitted for PCM analysis (Reports 164559 and 164560). The samples were analyzed for PCM equivalent fibers (PCMe) by TEM (NIOSH 7402M) modified.

The samples were identified as: 3/27/11/2014, 1/28/11/14, 6/28/11/14, 7/28/11/14, 1/01/2012, 4/01/2012, 10/01/2012, 3/03/2012, 8/03/2012.

No asbestos was found in the samples. The samples were very light loaded with particles. Sample 7/28/2014 was heavier with debris than the other samples. Organic fibers were present in all the air samples. Two non-asbestos fibers (calcium sulfate and calcium phosphate) were found in 3/03/2012.

Respectfully submitted,

EMS LABORATORIES, INC.

Bernadine Kolk

B. M. Kolk
Laboratory Director

Note: The results of the analysis are based upon the samples submitted to the laboratory.

No representation is made regarding the sampling area other than that implied by the analytical results for the immediate vicinity of the samples analyzed as calculated from the data presented with those samples.

The laboratory is not responsible for data collected by personnel who are not part of the laboratory. Results reported in both structures/cm^3 and structures/mm^2 are dependent on the volume of air sampled and measured by non-laboratory personnel and are not covered by the laboratory's NVLAP accreditation. This report, from a NIST accredited laboratory through NVLAP, must not be used by the client to claim product endorsement by NVLAP or any agency of the U.S. Government.

Unless otherwise noted in this cover letter, the samples were received properly packaged, clearly identified and intact.

Any deviation or exclusion from the test method is noted in this cover letter.

EMS LABORATORIES, INC. 117 West Bellevue Drive / Pasadena CA 91105

RESULTS OF AIR FILTER ANALYSIS *by TEM for Asbestos Structures*

► EMS Laboratory No.	**164559 / 164560**				
► Client	**Contract Environmental**	►Date Received	**12/18/2014**	► Verbal Results	
► Location	**SPREP**	►Date Analyzed	**2/5,6/15**	► Email Results	**2/9/2015**

METHOD

___ EPA Level II
___ AHERA Rules
_X_ NIOSH 7402 M(PCM Range)
___ ISO
___ Other
_X_ Direct Preparation
___ Indirect Preparation
___ Other Preparation

ASPECT RATIO 3:1

STRUCTURE / FIBER SIZE

All Sizes (EPA) ___ PCM Range _X_
≥ 0.5 microns length ___ > 0.25 microns width
> 5.0 microns length

ASBESTOS STRUCTURES

Sample Identification	Volume	Number of fibers	Fibers / mm²	Fibers / cc	Analytical Sensitivity Fibers / cc	95% CONFIDENCE LEVELS Lower Limit Structures / cc	Upper Limit
3/27/11/2014	528	*N.D.	< 2	< 0.002	0.002	0	0.007
1/28/11/14	500	*N.D.	< 2	< 0.002	0.002	0	0.007
6/28/11/14	480	*N.D.	< 2	< 0.002	0.002	0	0.007
7/28/11/14	490	*N.D.	< 2	< 0.002	0.002	0	0.007
1/01/2012	520	*N.D.	< 2	< 0.002	0.002	0	0.007
4/01/2012	480	*N.D.	< 2	< 0.002	0.002	0	0.007
10/01/2012	480	*N.D.	< 2	< 0.002	0.002	0	0.007
3/03/12	586	*N.D.	< 2	< 0.002	0.002	0	0.006
8/03/12	480	*N.D.	< 2	< 0.002	0.002	0	0.007

☐ "Asbestos - Containing Materials in School", U.S. EPA Final Rule, 40 CFR Part 763, October 30, 1987 (AHERA) counting rules.
☐ "Methodology for the Measurement of Airborne Asbestos by Electron Microscopy," USEPA 1984 (Yamate, et al.)
X PCM equivalent range by the method described in NIOSH 7402, Issue # 2 15 August, 1994, Modified

Comments: ______ Analyst ______ QC

*N.D. No asbestos structures detected TEM -1A (10/12)

EMS Laboratories Inc. / 117 W. Bellevue Drive Ste. 3 / Pasadena, California 91105-2503

Bulk Sample Reports

EMS LABORATORIES INC.

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

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

CUSTOMER:	Contract Environmental 119 Johnson Rd. West Melton Christchurch NZ	PAGE #:	1 of 3
		REPORT #:	0163419
		PROJECT:	PLM ANALYSIS
CONTACT:	John O'Grady	DATE COLLECTED:	10/20/2014
REFERENCE:		COLLECTED BY:	
METHOD:	EPA 600/R-93/116	DATE RECEIVED:	11/04/2014
		ANALYSIS DATE:	11/11/2014

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	(%)
0163419-001 N1	White, Homogeneous, Fibrous, tease, friable Note: 25°C, acid	LAYER 1 100%	None Detected		Fibrous Glass Non-Fibrous Material	90% 10%
0163419-002 N2	White, Homogeneous, Fibrous, tease, friable Note: 25°C, acid	LAYER 1 100%	None Detected		Fibrous Glass Non-Fibrous Material	90% 10%
0163419-003 N3	Beige, Homogeneous, Powdery, acid, friable Note: 26°C	LAYER 1 100%	None Detected		Fibrous Glass Non-Fibrous Material	85% 15%
0163419-004 N4	White/Beige, Non-homogeneous, Fibrous/Powdery, tease/acid, friable Note: 25°C, acid	LAYER 1 100%	None Detected		Fibrous Glass Non-Fibrous Material	90% 10%
0163419-005 N5	Beige, Homogeneous, Granular, crush, friable Note: 26°C, acid	LAYER 1 100%	None Detected		Fibrous Glass Non-Fibrous Material	80% 20%
0163419-006 N6	White/Beige, Non-homogeneous, Fibrous/Powdery, tease/acid, friable Note: 25°C, acid	LAYER 1 100%	None Detected		Fibrous Glass Non-Fibrous Material	90% 10%

CUSTOMER:	Contract Environmental 119 Johnson Rd. West Mellon Christchurch NZ	PAGE #: REPORT #: PROJECT:	2 of 3 0163419 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	(%)
0163419-007 N7	Gray, Homogeneous, Hard, acid, non-friable Note: 26°C	LAYER 1 100%	Chrysotile	20%	Non-Fibrous Material	80%
0163419-008 N8	LAYER 1 Blue, Homogeneous, Hard, melt, non-friable Note: 25°c, 1.550	LAYER 1 95%	None Detected		Non-Fibrous Material	100%
	LAYER 2 Black, Homogeneous, sticky, melt, non-friable Note: 25°C, 1.550	LAYER 2 5%	None Detected		Cellulose Fiber Non-Fibrous Material	2% 98%
0163419-009 N9	White/Pink, Non-homogeneous, Paint/Hard, ash/acid, non-friable Note: 25°C	LAYER 1 100%	Chrysotile	10%	Cellulose Fiber Non-Fibrous Material	10% 80%
0163419-010 N10	Black/White, Non-homogeneous, Paint/Hard, ash/acid, non-friable Note: 25°C	LAYER 1 100%	Chrysotile	10%	Non-Fibrous Material	90%
0163419-011 N11	White/Gray, Non-homogeneous, Paint/Hard, ash/acid, non-friable Note: 25°C	LAYER 1 100%	Chrysotile	10%	Cellulose Fiber Non-Fibrous Material	10% 80%
0163419-012 N12	Black/White, Non-homogeneous, Paint/Hard, ash/acid, non-friable Note: 24°C	LAYER 1 100%	Chrysotile	12%	Non-Fibrous Material	88%
0163419-013 N13	White/Yellow, Non-homogeneous, Rubbery/Powdery, ash, non-friable Note: 24°C, 1.550	LAYER 1 100%	None Detected		Cellulose Fiber Non-Fibrous Material	<1% 100%
0163419-014 N14	White/Beige, Non-homogeneous, Paint/Chalky, ash/acid, non-friable Note: 24°C	LAYER 1 100%	None Detected		Non-Fibrous Material	100%

CUSTOMER:	Contract Environmental	PAGE #:	3 of 3
	119 Johnson Rd. West Melton	REPORT #:	0163419
	Christchurch NZ	PROJECT:	PLM ANALYSIS

BULK SAMPLE ANALYSIS FOR ASBESTOS CONTENT BY POLARIZED LIGHT MICROSCOPY

Laboratory ID - Sample No.	Sample Location Description	Layer No. Layer %	Asbestos Type	(%)	Non-Asbestos Components	(%)
0163419-015 N15	White/Beige, Non-homogeneous, Paint/Chalky, ash/acid, non-friable Note: 24°C	LAYER 1 100%	None Detected		Cellulose Fiber Non-Fibrous Material	2% 98%

Analyst - MEGHAN SWEENEY

Approved Signatory Laboratory Director

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

NVLAP Lab Code: 101218-0

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

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

CUSTOMER:	Contract Environmental 119 Johnson Rd. West Melton Christchurch NZ	PAGE #:	1 of 2
		REPORT #:	0164018
		PROJECT:	PLM ANALYSIS
CONTACT:	John O'Grady	DATE COLLECTED:	11/26/2014
REFERENCE:	SPREP	COLLECTED BY:	
METHOD:	EPA 600/R-93/116	DATE RECEIVED:	12/18/2014
		ANALYSIS DATE:	12/24/2014

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	(%)
0164018-001 4/28/11/14 House 5	Gray, Non-homogeneous, Granular, crush, non-friable Note: 24°C, 1.55 Oil	LAYER 1 100%	Chrysotile	10%	Non-Fibrous Material	90%
0164018-002 12/28/11/14 House 3	Gray, Non-homogeneous, Granular, crush, non-friable Note: 24°C, Acid	LAYER 1 100%	None Detected		Cellulose Fiber Non-Fibrous Material	10% 90%
0164018-003 13/28/11/14 Old Phosphate Store	Gray, Non-homogeneous, Granular, crush, non-friable Note: 24°C, 1.55 Oil	LAYER 1 100%	Chrysotile Amosite	10% 5%	Non-Fibrous Material	85%
0164018-004 9/1/12 Powerhouse	Gray, Non-homogeneous, Granular, crush, non-friable Note: 25°C, 1.55 Oil	LAYER 1 100%	None Detected		Cellulose Fiber Non-Fibrous Material	30% 70%
0164018-005 10/2/12 Ron Hospital	Floor Tile, Red, Non-homogeneous, Solid, melt, non-friable Note: 26°C, 1.55 Oil	LAYER 1 100%	None Detected		Non-Fibrous Material	100%
0164018-006 11/2/12 NDL Club	Gray/White, Non-homogeneous, Granular, acid, non-friable Note: 25°C, Acid	LAYER 1 100%	None Detected		Non-Fibrous Material	100%

CUSTOMER:	Contract Environmental 119 Johnson Rd. West Melton Christchurch NZ	PAGE #: REPORT #: PROJECT:	2 of 2 0164018 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	(%)
0164018-007 12/2/12 Storage Bin	Gray, Homogeneous, Granular, crush, non-friable Note: 25°C, 1.55 Oil	LAYER 1 100%	Chrysotile	20%	Non-Fibrous Material	80%
0164018-008 13/2/12 Power Station	Gray, Homogeneous, Fibrous, tease, non-friable Note: 25°C, 1.55 Oil	LAYER 1 100%	None Detected		Fibrous Glass Non-Fibrous Material	90% 10%
0164018-009 14/2/12 Burnt Prison Roof	Gray, Non-homogeneous, Granular, crush, non-friable Note: 25°C, 1.55 Oil	LAYER 1 100%	Chrysotile	10%	Non-Fibrous Material	90%
0164018-010 15/2/12 Naero Public Hlth Cntr	Gray, Non-homogeneous, Granular, crush, non-friable Note: 25°C, 1.55 Oil	LAYER 1 100%	None Detected		Cellulose Fiber Non-Fibrous Material	40% 60%
0164018-011 16/2/12 Burnt Prison Cladding	Gray, Non-homogeneous, Fibrous, tease, non-friable Note: 25°C, 1.55 Oil	LAYER 1 100%	Chrysotile	7%	Cellulose Fiber Non-Fibrous Material	30% 63%

Analyst - Wesene 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

NVLAP Lab Code: 101218-0

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

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

CUSTOMER:	Contract Environmental 119 Johnson Rd. West Melton Christchurch NZ	PAGE #:	1 of 3
		REPORT #:	0164150
		PROJECT:	PLM ANALYSIS
CONTACT:	John O'Grady	DATE COLLECTED:	12/03/2014
REFERENCE:	SPREP Asbestos	COLLECTED BY:	
METHOD:	EPA 600/R-93/116	DATE RECEIVED:	12/31/2014
		ANALYSIS DATE:	01/07/2015

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	(%)
0164150-001 10/3/12 Bulk	Gray/White, Non-homogeneous, Solid, crush, non-friable Note: 24°C, 1.55 Oil	LAYER 1 100%	None Detected		Cellulose Fiber Non-Fibrous Material	10% 90%
0164150-002 11/3/12 Bulk	LAYER 1 Floor Tile, Beige, Homogeneous, Solid, melt, non-friable Note: 24°C, 1.55 Oil	LAYER 1 95%	None Detected		Non-Fibrous Material	100%
	LAYER 2 Mastic, Cream, Homogeneous, Rubbery, melt, non-friable Note: 25°C, 1.55 Oil	LAYER 2 5%	None Detected		Non-Fibrous Material	100%
0164150-003 12/3/12 Bulk	Cladding, Gray, Homogeneous, Solid, crush, non-friable	LAYER 1 100%	None Detected		Cellulose Fiber Non-Fibrous Material	10% 90%
0164150-004 13/3/12 Bulk	Gray, Homogeneous, Solid, crush, non-friable Note: 25°C, 1.55 Oil	LAYER 1 100%	Chrysotile Amosite	10% 5%	Non-Fibrous Material	85%
0164150-005 14/3/12 Bulk	Floor Tile, Beige, Homogeneous, Solid, melt, non-friable Note: 25°C, 1.55 Oil	LAYER 1 100%	None Detected		Non-Fibrous Material	100%
0164150-006 15/3/12 Bulk	Gray, Homogeneous, Solid, crush, non-friable Note: 25°C, 1.55 Oil	LAYER 1 100%	None Detected		Cellulose Fiber Non-Fibrous Material	10% 90%

CUSTOMER:	Contract Environmental 119 Johnson Rd. West Melton Christchurch NZ	PAGE #: REPORT #: PROJECT:	2 of 3 0164150 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	(%)
0164150-007 16/3/12 Bulk	Gray, Homogeneous, Solid, crush, non-friable Note: 25°C, 1.55 Oil	LAYER 1 100%	Chrysotile	7%	Non-Fibrous Material	93%
0164150-008 17/3/12 Bulk	Gray/White, Non-homogeneous, Solid, crush, non-friable Note: 25°C, 1.55 Oil	LAYER 1 100%	None Detected		Cellulose Fiber Non-Fibrous Material	10% 90%
0164150-009 1/4/12 Bulk	Gray/Blue, Non-homogeneous, Fibrous, tease, non-friable Note: 25°C, 1.55 Oil	LAYER 1 100%	None Detected		Cellulose Fiber Non-Fibrous Material	20% 80%
0164150-010 2/4/12 Bulk	Gray/White, Non-homogeneous, Fibrous, tease, non-friable Note: 25°C, 1.55 Oil	LAYER 1 100%	Chrysotile	7%	Cellulose Fiber Non-Fibrous Material	20% 73%
0164150-011 3/4/12 Bulk	Gray, Homogeneous, Solid, crush, non-friable Note: 25°C, 1.55 Oil	LAYER 1 100%	Chrysotile	65%	Non-Fibrous Material	35%
0164150-012 4/4/12 Bulk	LAYER 1 Floor Tile, Gray, Homogeneous, Solid, melt, non-friable Note: 25°C, 1.55 Oil	LAYER 1 98%	None Detected		Non-Fibrous Material	100%
	LAYER 2 Mastic, Yellow, Homogeneous, Sticky, melt, non-friable Note: 25°C, 1.55 Oil	LAYER 2 2%	None Detected		Non-Fibrous Material	100%
0164150-013 5/4/12 Bulk	Gray, Homogeneous, Solid, crush, non-friable Note: 25°C, 1.55 Oil	LAYER 1 100%	None Detected		Cellulose Fiber Non-Fibrous Material	30% 70%
0164150-014 6/4/12Bulk	Gray, Non-homogeneous, Solid, crush, non-friable Note: 25°C, 1.55 Oil	LAYER 1 100%	Chrysotile	5%	Cellulose Fiber Non-Fibrous Material	30% 65%

CUSTOMER:	Contract Environmental 119 Johnson Rd. West Melton Christchurch NZ	PAGE #: REPORT #: PROJECT:	3 of 3 0164150 PLM ANALYSIS

Analyst - Wesene 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

Appendix 6: Central Meridian Letter

02.12.14

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

Quotation: 6814

Mr John O'Grady
Contract Environmental Ltd.

Cost estimates to undertake various asbestos removal work.

Dear John,

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

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

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

REMOVAL OF EXISTING ASBESTOS ROOF SHEETING.
The costing 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.

Appendix 7: Visit Summary Report from First Visit

Summary Report on Nauru Visit by John O'Grady and Dirk Catterall,

3-6 September 2014

Meeting with Nauru Department of Commerce, Industry and Environment

Met Bryan Star, Director for Environment (bryanstar007@gmail.com) , and Elkoga Gadabu, Permanent Secretary, Department of Commerce, Industry and Environment (elkoga28@gmail.com)

Discussed asbestos on Nauru – large amounts and a substantial project to remove it. Appropriate financial support will be critical.

Also discussed program for the three days and who we should meet. Jaden Agir, Water and Waste Officer, was assigned to help us and he accompanied us for three days. He proved to be most helpful during this time. Jaden Agir's contact details are jadenagir7@gmail.com, phone number 5580984.

It was explained that the EU Rainwater project overlaps considerably with the asbestos project. Two EU reports (Sep 2013 and Nov 2013) discuss the issue of asbestos on domestic roofs. A total of 464 houses have been identified with asbestos roofing out of 1647 houses surveyed. In addition, many houses have asbestos cladding.

The Power Station asbestos has been assessed by GHD in a March 2007 study. It has a substantial amount of asbestos.

Schools on Nauru are either new (i.e. post asbestos days) or have mostly had their asbestos removed.

The old hospital (now a clinic) and the current hospital) have large amounts of asbestos.

The old phosphate industry buildings (many still in use) have a substantial amount of asbestos. These are now controlled by the Nauru Rehabilitation Corporation (NHC) who mine the phosphate and RONPhos who store, market and ship the phosphate.

There are also many commercial and industrial facilities and churches that have asbestos buildings.

We later inspected many of these buildings – see Photos 1-4 below:

Photo 1 – PONPhos Head Office

Photo 2 – Catholic Church

Photo 3 – Power Station

Photo 4 - Old Phosphate Store

It was clearly explained that disposal on-island will be very difficult because of land ownership. All land is owned privately and usually in multiple ownership hands. In fact it was made clear by Elkoga Gadabu and later by numerous others that disposal on Nauru was never going to happen.

Houses on Nauru

Many houses with asbestos roofs were noted during the visit and a significant percentage also had asbestos cladding. (The household cladding issue still needs to be quantitatively estimated.) Asbestos debris was noted around many houses and often children were playing in the asbestos debris.

One house was visited and inspected in detail – see Photos 5 and 6 below:

Photo 5 – Old House with Broken Asbestos   Photo 6 – Asbestos on Ground Behind House

Eigigu Contractors

Met Sean Halstead GM Eigigu, and Ravi Singh Engineer from Fiji.

They have done quite a lot of asbestos work and have a cherry picker available (actually from RONPhos), suits and masks, scaffolding, trucks etc. They do work to Australian standards.

They would charge $30/hr for asbestos workers and $35/hr for supervisors.

We discussed storage of the asbestos in containers until the issue of disposal could be sorted out. There are certified containers on island and plenty of uncertified containers – see Photo 7 taken at the Port. Many old containers are scattered around the island.

Photo 7 – Containers at the Port

Eigigu has removed asbestos from several schools –removing asbestos and re-cladding. This resulted in several containers of asbestos being filled and taken to the rehab area. The Dept of Education subcontracted some of the work to volunteers.   The asbestos in the containers was sealed in plastic and is now stored on Topside in an NHC controlled area. Some asbestos was unofficially removed for re-use and repair work.

Rate for cherry picker is $80-120/hr and truck is $80-100/hr.

Also met at Menin Hotel David Aingimea, Executive Chairman Eigigu Holdings Corp. Ph: 557-8011, david.aingimea@gmail.com. David Aingimea was interested in our project and offered the services of Eigigu.

Nauru Rehabilitation Corporation (NRC)

Met Phil Leeson, Production Manager, NRC. Ph 5573202, phil.leeson@nrurehab.org

Tekohi Rivera is the CEO of NRC (New Zealander) but we didn't meet him as he was unavailable. (NB He resigned soon after this visit.)

NRC is short-staffed and hence would have limited resources to help with an asbestos project, although they would help where they could. They have cherry pickers, scaffolding and trucks they could contribute. They do not have any budget, however, to contribute to asbestos removal.

Jim Geering of RONPhos has a steel rolling machine to make replacement roofing and Eigigu was reported to have another one.

Old containers are for sale at around $1000.

A lot of the NRC gear is old and unreliable. There are, however, very good maintenance people available on the island.

Most local people would prefer to see the asbestos removed from the island – easy to load into containers and barge to ship. NRC has a large forklift with forks that can easily lift containers. It would be charged out at a reasonable rate.

Phil Leeson confirmed that the asbestos taken off schools was mostly re-used by Nauruans for recladding and repairs.

Hospitals

We visited both hospitals. The old hospital was being used as a clinic. It still had quite a lot of asbestos – roofs and walkway panels.

The newer hospital (still old) had a large amount of asbestos roofing and walkway panels (Photos 8 and 9). There had been a fire at this hospital in Aug 2013 which would have caused the distribution of large amounts of asbestos fibres around the hospital grounds (Photos 10 and 11). Also some burnt asbestos-contaminated debris was still in place. The fire also destroyed lots of medical records.

Photo 8 – Asbestos Hospital Parapet Ceiling

Photo 9 – Asbestos on Hospital Roofs

Photo 10 – Burnt Part of Hospital

Photo 11 - Debris from Fire on Hospital Grounds

At the hospital we met Lee Pearce, Health Services Advisor, has.nauru@gmail.com Ph 5583900 and Marissa Cook, Director of Administration.

Lee Pearce advised that there is an AusAID funded hospital rebuild about to take place and Phase 1 may be starting in a few weeks. The scoping team still has to submit a report. We pointed out that this work must not commence until the fire clean-up has taken place. Also the renovations must give full regard to the asbestos that has to be removed.

Some asbestos has already been removed from the hospital by Paul Finch of Central Meridian Inc.

We asked Lee Pearce about the incidence of asbestos-caused diseases and there is little data available, partly because of the destruction of hospital records in the fire. Also chest X-Rays don't look for asbestos lung damage.

It should also be noted that life expectancy on Nauru is quite low (age 57 for men and 63 for women) due to the high incidence of non-communicable diseases such as heart disease and diabetes. The long latency period of asbestos-related cancers may mean that people die for other reasons before the serious effects of asbestos exposure are felt. Phosphate dust related diseases may also be a significant cause of early deaths although this has not been studied either.

A recent SPC study carried out by Massey University of New Zealand did indicate that there were 15 cases of lung cancer last year and 7 deaths, although it should also be noted that 50% of the adult population smoked. Mesothelioma is not separated out in the lung (and lung related) cancer statistics.

Lee Pearce indicated that asbestos related disease data gathering would be undertaken seriously from now on.

Ocean Construction

We met Nathan Philip, owner of Ocean Construction. They have been involved in several asbestos removal projects on Nauru, including the Aiwa Primary School, the Police Station and some NRC offices. They have received asbestos training from the US Army in 2006.

Disposal of asbestos on Nauru is carried out by the NRC. The contractor encases the asbestos waste in sealed plastic wrapping. Then the NRC collects the waste and stores it in containers behind the large old workshop on Topside.

(NB – we visited this large old workshop, which is itself an asbestos clad building) but we did not see the containers of asbestos waste. This should be checked on the next visit.)

Ocean Construction has some scaffolding it could hire or use and would charge $8/hour for labour if the PPE was supplied. They can also hire small trucks (1.5T) and some other equipment.

Nathan Philip said that there were lots of rumours around Nauru regarding links between asbestos roofs and cancers and locals were often concerned about living under asbestos roofs.

Nathan Philips also said that as far as replacement roofs were concerned, aluminum roofs were best as steel roofs quickly corroded in the humid damp Nauru conditions.

Nauru Landfill

We visited the only landfill on Nauru, where open dumping was conducted. No attempt was being made to manage the dumping, control what was dumped, or cover refuse – see Photo 12.

Photo 12 – Nauru Landfill

Waste asbestos was observed being dumped in several locations at the landfill. It was also noted that wastes were being dumped at several other locations adjacent to roads around Topside, including asbestos wastes.

Controlled landfilling of asbestos wastes could certainly take place at the Nauru landfill in lined mono-fills and this could be accompanied by improvement in the management of the overall landfill. The clear message was received from most people, however, that here would be considerable land-owner resistance to this happening.

Republic of Nauru Phosphate (RONPhos)

We had a meeting with:

Chelser Buraman, Engineering Manager and Acting CEO,

Anthony Bussian, Production Manager (contact details anthony.bussian@gmail.com, phone number 5573321.)

Jun Nuqui, Engineer,

Bunyan Seymour. Assistant Civil Engineer.

RONPhos advised that the phosphate industry on Nauru was prospering and that they could easily sell all the phosphate that NRC could produce. They sold to Australia, New Zealand, Thailand and India and they had at least 10 years reserves left and possibly more with new mining techniques.

RONPhos were positive and helpful regarding any assistance with the removal of asbestos from Nauru and they said they would cooperate and help in any way they could. They were prepared to purchase any equipment that was needed and they would hire this equipment to the project. They already owned two cherry pickers, a bobcat, a small digger, and a roofing profile machine that could be used to shape new steel roofing.

They stressed, however, that disposal was the big problem. Export to Australia was a good option in their view and one that the community would widely support.

They had numerous buildings with asbestos roofing and cladding and would be prepared to pay for removal themselves, provided the problem of disposal could be resolved.

They also reported that they had a serious problem with many deteriorating bags of reportedly 100% pure powdered asbestos that was left behind by the British Phosphate Commission. The BPC used to mould asbestos sheeting and roofing and there were large amounts of the old pure powdered asbestos left in what used to be called the 2B Bin near the football oval. It was noted that anyone could easily walk into this area but RONPhos had decided not to put up warning signs as they believed that this would only encourage everyone to go there to have a look.

We all went to inspect this stockpile of reported pure asbestos and found it to be a potentially serious issue. There was a large pile of bags in a building in very poor condition (see Photos 13-15 below). We were also advised that there was a nearby tunnel that contained an even large number of such bags (see Photo 16 below). Possibly around 100 tonnes is stored there.

A sample was not taken of the material as that would have been too dangerous without proper protection. RONPhos advised, however, that before the bags deteriorated, the labels were clearly visible saying that the material in the bags was powdered asbestos and that it was chrysotile (white asbestos).

Photo 13 – Bags of Reported Asbestos Powder

Photo 14 – Another View of the Bags

Photo 15 – Lump of Reported Asbestos

Photo 16 – Tunnel Reported to Contain More Bags

DFAT Australia Representative

We had a meeting with Karyn Murray, the DFAT representative on Nauru, and we briefed her on our visit and finding so far, including our initial thoughts.

We advised that we would need to return to Nauru to complete our investigations.

Central Meridian Inc

We met with Paul Finch, Managing Director of Meridian. He is a New Zealander and his contact details are: paulfinch@centralmeridianinc.com, Phone Number 5573731.

Meridian has done numerous asbestos projects on Nauru including various schools, houses and the Nauru Hospital.

Paul Finch reported:

- Lots of asbestos was stolen during the hospital project, including the breaking up of asbestos to get the timber.
- Disposal of asbestos was commonly done by wrapping up on pallets for NRC to take and place in containers.
- Most asbestos removal was done badly with no protection, oversight or regulation.
- Meridian had plenty of work and everyone was busy on Nauru. In fact there is a shortage of labour.

Paul Finch advised that we should not even think of disposing of asbestos on Nauru. The land owners are adamantly against it. They would support disposal off-shore and would provide land as staging areas for containers.

He also said that any project to remove asbestos would require the continual presence of overseas personnel to ensure success. Otherwise standards would quickly slip and progress would slow down. Considerable planning would be needed and back-up plans would be required.

Meridian would build anything on Nauru and would be keen to help with an overall asbestos removal project. They have 65 staff and have scaffolding, concrete equipment, excavators, loaders, and trucks (5T, 2x2.5T, and 1T). They would hire out workers at $16/hour and would supply PPE. They have a wide range of skills.

Looking Ahead

A second visit is now required to:

- Carry out a more detailed survey of asbestos arisings and types
- Determine preferred methodologies – i.e. stabilization and/or removal
- Determine preferred methodologies for replacement of roofing and cladding
- Prepare detailed cost estimates
- Determine a preferred programme and sequence
- Assess waste stockpile quantities and locations
- Examine more closely the disposal options including visiting Brisbane to assess export to Brisbane.
- Review in more detail the local institutional, policy and regulatory arrangements
- Firm up on the assessment of local contractors
- Firm up on local schedules of rates for labour and equipment
- Examine immediate requirements for protecting local people from exposure, including dealing with emergency situations such as the hospital fire and the large stockpile of powdered pure asbestos.

John O'Grady
Director, Contract Environmental Ltd

Appendix 8: RON Hospital Clean-up

The fire at the hospital occurred in August 2013. Several buildings burnt down before the fire was put out and some buildings were partially burnt – see photos below:

In addition asbestos debris was spread over the hospital grounds by the fire which would have generated loose asbestos fibres and small pieces of asbestos. This debris was evident on the ground even a year after the fire – see photo below:

It was decided to spend part of the DFAT grant towards the Nauru Asbestos Assessment on removing the remaining part of the burnt structure and cleaning up the ground. The local company Central Meridian was commissioned to undertake the removal and clean-up work, and this work was supervised by John O'Grady from Contract Environmental Ltd.

The work was undertaken over four days from 23-26 October 2014. The area was cordoned off with signage and barriers and a decontamination zone was established. A team of five Central Meridian workers removed most of the burnt part of the existing buildings although unfortunately it could not all be removed without affecting the usability of the existing buildings. A 200 micron plastic ground covering was put in place and all removed debris was double wrapped in 200 micron plastic. Training was provided in the correct procedures for protecting workers and the public. A water cart was kept on site for watering down the work area and preventing the creation of dust.

The photos below show the removal work. All packaged waste asbestos was removed to the Nauru Dumpsite for disposal






At the same time as the burnt structures were being removed, the ground was being cleaned, as shown in the photos below. The contaminated soil was loaded onto a truck and taken to the Nauru Dumpsite for disposal. The contaminated soil was covered with 200 micron plastic and taken to the Nauru Dumpsite. The excavator was cleaned before it left the site. The photos below show the remove of the soil and the wetting down of the soil.

All waste material was placed in a large hole specially excavated for the purpose by the NRC. This hole was substantially oversized to allow for future disposal of asbestos on Nauru. Once the waste hospital asbestos and the contaminated soil had been placed in the hole it was covered up with domestic refuse, see photos below:

Finally the remaining floor slabs had some remnants of vinyl flooring – see photo below. A sample of this vinyl flooring was sent away for analysis and found to be free of asbestos.

Three air monitoring samples were taken downwind of the work area for three days on 24-26 October. The air monitoring report from the New Zealand company Dowdell and Associates Ltd is shown below, and no fibres were identified in this report. The air sampling pump was run for 6 hours on each day and the pre-set flowrate was 2 litres/minute.

DOWDELL & ASSOCIATES LTD

OCCUPATIONAL HEALTH ANALYSTS & CONSULTANTS

4 Cain Rd, Penrose, PO Box 112-017 Auckland, Phone (09) 5260-246. Fax (09) 5795-389.

3rd November 2014

Contract Environmental Ltd
14 Wookey Lane
Kumeu
Auckland 0810

Attention: John O'Grady
Director

Re: Airborne Fibre Concentration

Place of Measurement	:	**Ron Hospital Project, Nauru**
Monitoring Conducted By	:	Contract Environmental
Sampling Date	:	17th to 19th October 2014
Laboratory No.	:	58549
Sample Type	:	Static Background Air Monitoring
Asbestos Type	:	Unspecified
Method	:	[NOHSC: 3003 (2005)] – *Guidance Note on the Membrane Filter Method for Estimating Airborne Asbestos Fibres* – 2nd Edition

Reg No. – Measuring Positions : K8846 – Sample 16934105:17/10/14 K8848 – Sample 16934124:19/10/14
K8847 – Sample 16934126:18/10/14

Sample Registration No.	**K8846**	**K8847**	**K8848**
Sample Time (minutes)	360	360	360
Flow Rate (mL/min) *2	2000	2000	2000
Fibre Counts (fibres/100 fields) *	0	0	0
Respirable Fibre in Air (fibre/mL) *1	**<0.01**	**<0.01**	**<0.01**
Detection Limit (fibres/mL) (based on a count of 10 fibres/100 fields)	0.01	0.01	0.01

* The laboratory's *Scope of Accreditation* covers the fibre count results (fibres/100 fields).
*1 OSH - *Guidelines for the Management and Removal of Asbestos* – Revised March 2011, Clearance Testing 0.01fibres/mL.
*2 The calibration status of monitoring agent's sampling equipment is unknown.

Yours faithfully
DOWDELL & ASSOCIATES LTD

Kerry Pellett BE (Hons)
Analyst

Laura Sands
Occupational Hygienist

NOTE: This report must not be altered, or reproduced except in full.