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PacWastePlus
PACIFIC WASTE MANAGEMENT

This initiative is supported by **PacWastePlus**-a 85 month project funded by the European Union (**EU**) and implemented by the Secretariat of the Pacific Regional Environment Programme (**SPREP**) **to sustainably and cost effectively improve regional management of waste and pollution.**

Disposal of Asbestos Waste in Pacific Island Countries/Territories

A Position Paper

March 2025

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Cover Photo

The cover photo was taken at the project to remove asbestos from the Ministry of Infrastructure (MOI) Building, Vaololoa, Tonga in 2023. The work was carried out by Morecroft Contractors Ltd, and the asbestos was disposed of at the nearby Tapuhia Landfill.

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Our vision: A resilient Pacific environment sustaining our livelihoods and natural heritage in harmony with our cultures.

About PacWastePlus

The Pacific – European Union (EU) Waste Management Programme, PacWastePlus, is a 72-month programme funded by the EU and implemented by the Secretariat of the Pacific Regional Environment Programme (SPREP) to improve regional management of waste and pollution sustainably and cost-effectively.

About PacWastePlus

The impact of waste and pollution is taking its toll on the health of communities, degrading natural ecosystems, threatening food security, impeding resilience to climate change, and adversely impacting social and economic development of countries in the region. The PacWastePlus programme will generate improved economic, social, health, and environmental benefits by enhancing existing activities and building capacity and sustainability into waste management practices for all participating countries.

Countries participating in the PacWastePlus programme are: Cook Islands, Democratic Republic of Timor-Leste, Federated States of Micronesia, Fiji, Kiribati, Nauru, Niue, Palau, Papua New Guinea, Republic of Marshall Islands, Samoa, Solomon Islands, Tonga, Tuvalu, Vanuatu.

Key Objectives

Outcomes & Key Result Areas

The overall objective of PacWastePlus is “to generate improved economic, social, health and environmental benefits arising from stronger regional economic integration and the sustainable management of natural resources and the environment”.

The specific objective is “to ensure the safe and sustainable management of waste with due regard for the conservation of biodiversity, health and wellbeing of Pacific Island communities and climate change mitigation and adaptation requirements”.

Improved Data Collection

- Improved data collection, information sharing, and education awareness
- Policy & Regulation
- Policies and regulatory frameworks developed and implemented.
- Best Practices
- Enhanced private sector engagement and infrastructure development implemented
- Human Capacity
- Enhanced human capacity

Executive Summary

1. The Primary Issue

This Position Paper has been developed to highlight the problem of asbestos in the Pacific and to look at ways to dispose of asbestos waste in managed landfill facilities throughout the Pacific and Timor-Leste. The incidence of Asbestos Containing Materials (ACM) in the Pacific has been well surveyed and numerous remediation and removal projects have already been undertaken. Despite these activities, there remains a significant amount of legacy ACM to be managed and safely disposed to remove the risk to human health. ***The safe disposal of ACM waste is a major issue in the Pacific and is the focus of this paper.***

Human health impacts from asbestos can be severe, causing lung malfunction and serious cancers. The main types of ACM that arise in the Pacific are various building products in conjunction with cement, and numerous other common products in conjunction with other materials. Asbestos can also contaminate soils if fibres are released.

Asbestos removal (remediation) requires careful procedures and properly trained personnel. The waste materials have to be disposed of safely so that no-one can breathe in the hazardous fibres during remediation, transport, and disposal. Once landfilled or entombed, the ACM should not be disturbed.

2. ACM Management to Date

A 2014 SPREP survey assessed ACM in 13 Pacific Island countries. The survey identified ACM distribution, risks to human health, and management strategies. Key findings indicated widespread ACM presence, particularly in Nauru, Niue, Cook Islands, Tonga, Vanuatu, and Solomon Islands, with lower levels in Tuvalu, Fiji, and Samoa. While primarily non-friable (i.e. locked up in another material such as cement), deteriorating ACM poses increasing risks. Some forms of ACM remain under-reported, including residential asbestos, particularly in vinyl flooring, and asbestos-cement water pipes.

Numerous SPREP-led remediation projects since 2014 have targeted schools, hospitals, and government sites in Cook Islands, Fiji, Nauru, Tonga, Kiribati and Niue. In some cases the ACM waste was exported to New Zealand for disposal and in the other cases, local landfill disposal was arranged. Other independent satisfactory removals also occurred and there have no doubt been many other removals, including numerous residences, churches and schools, which may have been to a lesser standard.

Local landfilling is preferred if environmental safety can be ensured and there are numerous examples in several countries. Three countries can at present deal with ACM waste – Fiji, PNG and Tonga.

3. The Reasons that Local ACM Waste Management Does Not Occur

Efforts to establish local landfilling for asbestos-contaminated materials (ACM) in the Pacific have often encountered resistance. Key concerns raised across the region include:

- ***Perception of External Responsibility*** **-** There is a belief in some countries that asbestos was introduced by external parties and should therefore be removed and managed by those responsible for its introduction.
- ***Environmental and Health Concerns*** **-** Communities express concerns about potential contamination of groundwater and the broader environment, despite evidence that properly managed ACM landfilling poses minimal risk.
- ***Resistance to Permanent Hazardous Waste Storage*** - There is general opposition to establishing a dedicated landfill for hazardous waste, with concerns that it will create long-term environmental and social liabilities.
- ***Cultural and Traditional Considerations*** **-** Land and water hold deep cultural significance in Pacific societies, and waste disposal is sometimes perceived as an act of disrespect toward these natural resources.

- ***Land Tenure Issues*** **-** Many Pacific islands have complex land ownership structures, with land being privately owned or held in customary tenure.
- ***Limited Land Availability*** **-** Some Pacific nations have very small land areas available, making waste disposal a significant challenge. Existing landfills may be close to the coast, and climate change-driven coastal erosion poses additional risks of releasing buried ACM into the ocean.

4. ACM Waste Management Options

There are technologies involving the destruction of asbestos, but they are complicated and expensive. None are available in the Pacific or in nearby countries such as Australia and New Zealand. The main such technologies are thermal treatment, chemical treatment and mechanical treatment.

The two main options that do not involve destruction of asbestos are "Management in Place" and Landfilling as follows:

- ***Management in place*** involves encapsulation of ACM using specialised paints or encapsulants to prevent fibre release. It is cost-effective compared to removal and reduces the risk but does not remove the hazard. It is not a permanent solution and requires long-term ongoing management which can be difficult.
- ***Landfilling*** involves placement of ACM waste in a dedicated landfill cell to contain fibres and prevent exposure. This does not destroy the ACM waste but removes the risk and is a permanent solution if left undisturbed.

For landfilling asbestos in the Pacific there are two options available. Both should be carried out in well managed landfills with proper supervision and long term security. The options are:

- ***Co-disposal*** – ACM waste is mixed with other waste in the landfill. This approach can be used if landfill space is limited, good landfill management practices are used, and very little cover material is available. The ACM waste is to be placed in the landfill with other waste, ensuring the waste containment is not compromised and the ACM waste is well covered (at least 300mm) by other waste. Any compaction should avoid disturbing the waste covering the ACM.
- ***ACM Waste Cell*** **-** A separate landfill cell is developed for ACM waste. As asbestos is a natural mineral, and is only being contained to ensure no fibre release, it is not necessary to have an expensive liner system although the base of the cell should be lined with inert material (such as clay) and compacted, and the cell should be permanently capped.

For both options, the ACM waste should be brought to the landfill using proper notification and reception procedures and it should be secure from any leakage of fibres.

As well as local landfilling, the ACM waste can also be exported overseas for landfill disposal. ACM waste is regarded as a hazardous waste, so overseas export is governed by detailed conventions that need to be followed, which can be time consuming and complicated. The freight and associated costs, and landfilling costs at the export destination are all expensive.

One other much less common option of non-destructive ACM waste disposal is "Disposal at Sea" which is governed by two international conventions which have conditions that are difficult and expensive to follow.

Disposal or end-of-life management of ACM waste in the Pacific is generally managed by one of the following methods:

- Placed in a local landfill not designed or prepared to receive ACM waste and often managed in an unsatisfactory way.
- Placed in a local landfill that can, by virtue of its design and/or management, properly receive ACM waste. Currently three Pacific countries have such facilities – Fiji, PNG and Tonga. Some disposal of asbestos waste has also been undertaken in landfills in other Pacific countries, including Samoa, Solomon Islands and Kiribati.
- Export the asbestos waste overseas for landfill disposal. In all cases to date, the export destination was Auckland, New Zealand.
- In a few cases, ACM waste has been disposed in the sea.

- Store the waste for an indefinite period which sometimes results in the waste reaching the environment again to become a difficult problem to resolve.

5. PESTLE Assessment

PESTLE is a strategic analysis tool that can be used to examine options being considered, in the light of six factors – Political, Economic, Social, Technological, Legal and Environmental. It can therefore be used to assess the options for managing the disposal of ACM wastes as follows.

Political Factors

- SPREP has a 2011 regional asbestos strategy that has been adopted by member countries as political goals. The Policy Goals of this strategy include minimising the adverse effects of asbestos on the environment and health of Pacific Island people and building capacity of stakeholders to promote effective asbestos management.
- If ACM waste is exported the relevant international Conventions must be followed.
- There is likely to be political resistance to local landfilling if voters indicate they are not in favour of local disposal of asbestos due to such issues as land tenure, or historical perceptions that asbestos is an imported problem.

Economic Factors

- A detailed Nauru Case Study has shown that it is clearly much more expensive (by a factor of about five times) to export ACM waste than to dispose of it locally.
- There are also local financial implications of local landfill construction and long-term management.
- The extra cost of providing for the local landfilling of ACM waste is not large as it can be combined with other necessary landfilling. If the procedure for landfilling ACM waste is kept simple, then the additional cost can be kept quite low.
- Limited financial and technical resources in many Pacific countries constrain effective waste management solutions – there is often reliance on aid financing.
- There may be other economic benefits of local disposal, such as local employment opportunities.

Social Factors

- Public perception and cultural resistance to hazardous waste landfills are considerations. This can be manifested as a general aversion to having a hazardous waste landfill situated locally, and is related to the need to respect land and water in Pacific cultures.
- Influence of historical narratives (e.g. New Zealand's role in introducing asbestos to Niue and the British Phosphate Commission (BPC) introducing asbestos to Nauru and Banaba Island).
- Community concerns about environmental and health impacts. These concerns can be addressed by proper controls and effective techniques for disposal, including preparing the ACM waste before disposal.

Technological Factors

- Landfilling of ACM waste must be carried out so that this waste is not exposed to human contact again after landfilling, through fibres released for inhalation.
- The landfilling should take place at a location where ongoing management and monitoring will occur, such as an existing well-managed landfill. A permanent cap is needed over the ACM waste and the waste needs to be located clearly in records that are available in future.
- Containment of the waste in a landfill can be obtained by compaction of the base and exclusion of groundwater, but asbestos is not a serious water pollutant.
- ACM waste should be placed at a location where it will not later be affected by coastal erosion.
- The destruction options (thermal, chemical and mechanical), all have very significant and complex technical issues that take them out of consideration.
- The option of “management in place” (in its original location) is technically feasible but offers only a temporary solution and requires careful ongoing management.

Legal Factors

- The need to comply with international conventions adds complexity and costs to transboundary movements of ACM waste.
- Legal requirements for public liability insurance and environmental safety standards increase the administrative burden of ACM waste management.
- Land ownership is predominantly private in many Pacific countries, creating legal challenges in securing land for landfills that can receive ACM waste.
- There is a need to enact a ban on importing new ACM products into Pacific countries and to enforce that ban.

Environmental Factors

- Potential environmental impacts of local landfilling, including groundwater contamination, raise concerns. Asbestos is not, however, a serious contaminant in water.
- Natural disasters such as cyclones have real potential to generate ACM waste as part of disaster waste. If local solutions are readily available to manage ACM waste arising from disasters, then the ACM waste from disasters can be dealt with promptly and effectively.
- There are environmental concerns about disposal to sea because turbulent conditions may open the asbestos containment, thus freeing loose ACM. Furthermore, any approved disposal to sea sets a bad precedent.
- Local landfilling has a smaller carbon footprint, compared with exporting which involves sea transport of dense and heavy ACM waste over long distances.

6. PESTLE Analysis

In consideration of the information compiled on each of the options, a decision matrix analysis based on the PESTLE criteria has been carried out on the three destruction technologies, management in place, local landfilling, disposal at sea, and export for disposal. This was in order to select the best technology suitable in the Pacific for managing ACM waste using a scientific, evidence-based, decision framework. A summary decision matrix is set out below, with scores assigned up to 10.

Summary Decision Matrix

Option	Political	Economic	Social	Technical	Legal	Environmental	Total Score
Local Landfilling	7	9	5	8	7	7	**43**
Management in Place	6	7	6	5	6	6	**36**
Export for Disposal	5	3	5	7	7	5	**32**
Disposal at Sea	5	4	3	6	3	2	**23**
Thermal Treatment	3	1	4	3	6	5	**22**
Chemical Treatment	3	1	4	2	6	5	**21**
Mechanical Treatment	3	1	4	2	6	4	**20**

The Decision Matrix assessment above clearly indicates that ***local landfilling is the most logical and practical option*** for ACM waste management in Pacific Island countries. This conclusion is supported by:

- The high cost of exporting asbestos waste to Pacific Rim countries, making overseas disposal financially less viable, and the high carbon footprint,.
- Technical feasibility, as controlled landfill operations can be effectively implemented with existing waste management techniques.
- Environmental safeguards, ensuring that proper containment and monitoring strategies minimize potential risks.
- Legal and regulatory alignment, as local landfilling can comply with international ACM waste management frameworks when properly carried out.

However, some challenges remain, including political and community resistance, cultural concerns, and securing adequate funding for infrastructure. These must be addressed for successful implementation.

7. Conclusion and Next Steps

The PESTLE Analysis strongly supports local landfilling as the preferred option for asbestos disposal in the Pacific.

In terms of the PESTLE criteria, it is:

- Politically viable if supported by public engagement and policy development
- Economically the most cost-effective solution (5 x cheaper than export)
- Socially viable if community acceptance is gained through public engagement, transparency, and cultural sensitivity.
- Technically feasible with proper landfill design and management.
- Legally compliant if aligned with acceptable procedures.
- Environmentally safe when containment measures are properly implemented.

The recommended next steps are:

1. Secure policy commitment from national governments to advance asbestos landfill projects.
2. Conduct feasibility studies to identify suitable landfill disposal locations and infrastructure needs.
3. Establish regional cooperation mechanisms for knowledge exchange.
4. Develop funding proposals to secure financial support from national, regional, and international sources.
5. Launch community engagement programs to address public concerns and increase acceptance.

By following this roadmap, Pacific Island nations can transition towards a safe, sustainable, and cost-effective solution for managing legacy asbestos waste.

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1. Introduction

1.1 What is the Issue

This Position Paper has been developed to highlight the problem of asbestos in the Pacific and to look at ways to dispose of asbestos waste in managed landfill facilities throughout the Pacific and Timor-Leste. The incidence of Asbestos Containing Materials (ACM) in the Pacific has been well surveyed and numerous remediation and removal projects have already been undertaken. Despite these activities, there remains a significant legacy of ACM to be managed and safely disposed in order to remove the risk to human health. ***The safe disposal of this ACM is a major issue in the Pacific and is the focus of this paper.***

Human health impacts from asbestos can be severe. Diseases from asbestos are caused by inhalation of asbestos fibres, which penetrate the lungs and may initially cause diseases like asbestosis, a reduction of lung function due to lung damage. Cancers can follow later and in the case of mesothelioma, it can be 20-50 years later. Mesothelioma is a cancer of the mesothelium, a thin layer of tissue that covers most of the internal organs including the lungs and abdomen. The type associated with the lungs and chest is pleural mesothelioma, primarily caused by asbestos. It is generally fatal and can be caused by a relatively short exposure to asbestos.

The main types of ACM that arise in the Pacific are in conjunction with cement to make roofing and cladding (external and internal) for buildings, and in asbestos-cement piping used for water and wastewater. Asbestos was also used historically to reinforce other materials, including vinyl flooring, mastic-based roofing, rubber waterproofing for buildings, plastic backing for switchboards, and brake pads in vehicles. These uses are all referred to as non-friable asbestos as the asbestos is locked up in the material matrix. Asbestos has often been used, too, in its pure or near-pure form to aid heat retention in pipes, boilers and other heat insulating applications. It has been widely used for sound insulation. These pure-form uses generally involve asbestos in a loose form that can be crushed or broken up by hand to release fibres. This is known as friable asbestos, a form of asbestos not common in the Pacific.

Asbestos can contaminate soils if fibres are released, which commonly occurs after a building fire, poor demolition practices that release asbestos fibres, and general weathering of structures with external ACM.

Asbestos removal (remediation) requires careful procedures and properly trained personnel. For many asbestos remediation projects, the question arises as to how to dispose of the asbestos waste. The waste materials must be disposed of safely, ensuring that no-one can breathe in the hazardous fibres during remediation, transport, and disposal. Once landfilled or entombed, the ACM should not be disturbed.

1.2 ACM Management in the Pacific to Date

A 2014 Secretariat of the Pacific Regional Environment Programme (SPREP) survey, funded by the European Union through the PacWaste Project, assessed ACM in 13 Pacific Island countries. The survey identified ACM distribution, risks to human health, and management strategies.

Key findings indicated widespread ACM presence, particularly in Nauru, Niue, Cook Islands, Tonga, Vanuatu, and Solomon Islands, with lower levels in Tuvalu, Fiji, and Samoa. While primarily non-friable, deteriorating materials pose increasing risks. Some forms of ACM remain under-reported, including residential asbestos, particularly in vinyl flooring, and asbestos-cement water pipes.

SPREP-led remediation projects since 2014 have targeted schools, hospitals, and government sites, including:

- *Cook Islands, Fiji, Nauru, Tonga, Vanuatu* – ACM remediation, with ACM waste sent to local landfills.
- *Tonga* – Workshop and government sites remediated; waste disposed at Tapuhia Landfill.
- *Nauru & Banaba Island (Kiribati)* – ACM removed and exported to New Zealand for disposal.

- *Niue* – ACM stored from earlier remediation also exported to New Zealand.

Additional independent satisfactory removals include the Suva Civic Centre Auditorium (Fiji), the International School Suva, and New Zealand High Commission buildings in Solomon Islands and Fiji. There have no doubt been many other removals, including numerous residences, churches and schools, which may have been to a lesser safety standard.

Local landfilling is preferred if environmental safety can be ensured. Examples include:

- *Fiji* – Naboro Landfill near Suva accepts ACM; many areas still rely on unregulated dumps.
- *Vanuatu* – Bouffa Landfill in Port Vila has improved waste management.
- *Tonga* – Tapuhia Landfill effectively handles ACM; other islands face disposal challenges.
- *Samoa* – Managed landfills like Tafaigata exist and have taken ACM waste, but open dumping persists.
- *Kiribati* – Limited landfill space in Tarawa, with three well-managed sites. ACM waste has been disposed of in Tarawa.
- *Solomon Islands* – ACM disposed in Honiara and Gizo landfills, but most remain unmanaged dumps.
- *PNG* – Predominantly unregulated dumps, although the TWM Facility at Roku provides a sound hazardous waste disposal option for ACM waste.

1.3 What are the Reasons that Local ACM Waste Management Does Not Occur

Efforts to establish local landfilling for asbestos-contaminated materials (ACM) in the Pacific have often encountered resistance. Key concerns raised across the region include:

1. ***Perception of External Responsibility***
   There is a belief in some countries that asbestos was introduced by external parties and should therefore be removed and managed by those responsible for its introduction.
2. ***Environmental and Health Concerns***
   Communities express concerns about potential contamination of groundwater and the broader environment, despite evidence that properly managed ACM landfilling poses minimal risk. Many Pacific islands rely on groundwater as their primary drinking source, heightening sensitivity to contamination fears. Asbestos in drinking water is not a health concern, however, as asbestos causes health issues only through inhalation.
3. ***Resistance to Permanent Hazardous Waste Storage***
   There is general opposition to establishing a dedicated landfill for hazardous waste, with concerns that it will create long-term environmental and social liabilities.
4. ***Cultural and Traditional Considerations***
   Land and water hold deep cultural significance in Pacific societies, and waste disposal is sometimes perceived as an act of disrespect toward these natural resources.
5. ***Land Tenure Issues***
   Many Pacific islands have complex land ownership structures, with land being privately owned or held in customary tenure. Assigning land permanently for hazardous waste disposal can be viewed as an unacceptable restriction on land use.
6. ***Limited Land Availability***
   Some Pacific nations have very small land areas available, making waste disposal a significant challenge. Existing landfills may be close to the coast, and climate change-driven coastal erosion poses additional risks of releasing buried ACM into the ocean.

It should be noted that unmanaged waste dumps are common in many Pacific locations, and the controlled landfilling of a non-putrescible inert material like ACM is much less harmful to human health and the environment than such unmanaged dumps.

2.0 ACM Waste Management Options

2.1 Options that Involve Destruction of Asbestos

There are technologies involving the destruction of asbestos, but they are complicated and expensive. None are available in the Pacific or in nearby countries such as Australia and New Zealand. The main such technologies are presented in Table 1 below.

Table 1: Destruction Technologies

Technology	Description	Applicability for the Pacific
Thermal Treatment	Thermal treatment involves heating asbestos materials to extremely high temperatures (above 1,000°C) to transform the fibrous structure into a stable, non-hazardous, glass-like material which completely destroys asbestos fibres, rendering the material inert. The resulting vitrified material can sometimes be reused (e.g., as aggregate in construction).	Thermal treatment has very high energy consumption and management costs, and the specialised facilities required are only available in limited locations. Strict controls on the emissions are required to prevent release of hazardous gases and fibres.
		For these reasons, Thermal treatment is impractical in the Pacific.
Chemical treatment	Chemical processes destroy asbestos fibres using strong acids or other reactive agents, thus neutralising the hazard.	Chemical treatment requires careful handling of hazardous chemicals and their by-products. Given this issue and the very large costs to expand the technology for large scale use, such processes are considered impractical for use in the Pacific.
	These processes have limited scalability and mostly occur in laboratory or pilot-scale applications.	
Mechanical Treatment	Processes such as milling and grinding are used to destroy the fibrous structure of asbestos, thus reducing the hazard.	Mechanical processes are energy-intensive and typically not standalone solutions, as they cannot be guaranteed to destroy all fibres.
	Mechanical treatment is very expensive, and generates fine dust residues to be managed. Strict controls are therefore needed to prevent exposure during processing.	The capital investment, and additional actions therefore required for safeguarding make these processes impractical for the Pacific Region.

2.2 Options that Do Not Involve Destruction of Asbestos

The two main options that do not involved destruction of asbestos are “Management in Place” and “Landfilling” and these are compared in Table 2 below:

Table 2. Management in Place and Landfilling

Management Approach	Description	Key Considerations
Management in Place	Encapsulation of ACM using specialised paints or encapsulants to prevent fibre release.	• Reduces risk but does not eliminate hazard.
		• Cost-effective compared to removal.
		• Not a permanent solution (e.g. special paints degrade in 10-20 years).
		• Requires ongoing monitoring and controls.
		• Requires an Asbestos Management Plan (AMP) for proper oversight.
Landfilling	ACM waste is placed in a dedicated landfill cell to contain fibres and prevent exposure.	• Does not destroy asbestos fibres but removes risk if undisturbed.
		• Considered a hazardous waste due to fibre release risks.
		• Needs permanent recording and active management.
		• Ensures no fibre release if properly buried.

For landfilling asbestos in the Pacific there are two options available as shown in Table 3 below. Both should be carried out in well managed landfills with proper supervision and long term security.

Table 3. Options for Managing ACM Waste in the Pacific

Option	Description
Co-disposal	Co-disposal describes the situation when ACM waste is mixed with other waste in the landfill. This approach can be used if landfill space is limited, good landfill management practices are used, and very little cover material is available.
	The ACM waste is to be placed in the landfill with other waste, ensuring the waste containment is not compromised and the ACM waste is well covered (at least 300mm) by other waste. Any compaction should avoid disturbing the waste covering the ACM.

Option	Description
ACM Waste Cell	A separate landfill cell is developed for ACM waste. As asbestos is a natural mineral, and is being contained to ensure no fibre release, it is not necessary to have an expensive liner system. The base of the cell should be lined with inert material (such as clay) and compacted. ACM waste cells should be at least 1m above groundwater. When the cell is complete, the final cap should be permanent (e.g. concrete).
	The size of the landfill cell is governed by the waste volume. It should be at least 3–5 meters deep and at least one metre above groundwater. The waste should be immediately covered with 300 mm of inert cover material. Any compaction should avoid disturbing the waste.

For both options, the ACM waste should be brought to the landfill using proper notification procedures and it should be secure from any leakage of fibres. This can be managed by:

- double wrapping the ACM waste in heavy duty (200 micron) plastic (high density polyethylene or HDPE),
- double bagging in plastic bags designed for ACM waste, or
- Using strong fabric bags of various sizes (known as Hazibags or similar names)

For both options, correct procedures are required for receiving the ACM waste, including staff wearing the correct Personal Protective Equipment (PPE).

As well as local landfilling, the ACM waste can also be exported overseas for landfill disposal. ACM waste is regarded as a hazardous waste, so overseas export is governed by detailed conventions. These are the international Basel Convention and the Pacific regional equivalent, which is the Waigani Convention. Both conventions are quite similar. They require the consents of the exporting county, importing country and all countries that the ACM waste transits through. Obtaining these consents can be time consuming and complicated. The freight and associated costs, and landfilling costs at the export destination, are all expensive.

One other much less common option of non-destructive ACM waste disposal is “Disposal at Sea” which is governed by two international conventions as shown in Table 4 below:

Table 4. Conventions Governing Disposal of ACM Waste at Sea

Convention	Discussion
London Convention: ***Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter 1972***	This convention is managed by the International Maritime Organization (IMO),1948. It promotes the effective control of all sources of marine pollution, and the taking of all practicable steps to prevent pollution of the sea by dumping of wastes and other matter.

Convention	Discussion
	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 is not listed in Annex 1 to the Protocol (ACM waste is included in Annex 1 by virtue of asbestos being an inert inorganic geological material). As such, any dumping of ACM waste 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. This is not, however, true of ACM waste which has alternative management options.
	The London Protocol prohibits the export of ACM waste 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 process of determining these impacts, and the resulting monitoring requirements, are typically very expensive requiring an understanding of the undersea flora and fauna. Monitoring of impacts on these flora and fauna would correspondingly be very expensive and difficult.
	If ACM waste 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: • Full consideration of alternatives • Full assessment of human health risks, environmental costs, hazards (including accidents), economics, and exclusion of future uses. The overall intent of the Convention (as amended by the Protocol), is to eliminate pollution of the sea caused by dumping and to protect and preserve the marine environment. The Protocol recognises the particular interests of Small Island Developing States (SIDS). Therefore, even if the dumping of asbestos met the requirements of the Convention and Protocol, it would probably be contrary to the overall intent of the Convention and Protocol, particularly if such dumping was initiated by SIDS.
Noumea Convention: ***Convention for the Protection of the Natural Resources and Environment of the South Pacific Region 1986***	Along with its two Protocols, the Noumea Convention is a comprehensive umbrella agreement for the protection, management and development of the marine and coastal environment of the Pacific Region. It is the Pacific regional 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.

Convention	Discussion
	To protect the environment, 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.
	The Noumea Convention *Dumping Protocol* aims to prevent, reduce, and control pollution by dumping of wastes and other matter in the sea.
	Annexes associated with the protocol would permit the dumping of ACM waste, provided such dumping did not present a serious obstacle to fishing or navigation.
	A General Permit can only be granted if the dumping is proven to have no impact on the marine environment or human health.

2.3 Current Disposal of ACM Waste in the Pacific

Disposal or end-of-life management of ACM waste in the Pacific is generally managed by one of the following methods:

a) Placed in a local landfill not designed or prepared to receive asbestos waste and often managed in an unsatisfactory way.
b) Placed in a local landfill that can, by virtue of its design and/or management, properly receive asbestos waste. Currently three Pacific countries have such facilities – Fiji, PNG and Tonga. Some disposal of asbestos waste has also been undertaken in landfills in other Pacific countries, including Samoa, Solomon Islands and Kiribati.
c) Export the ACM waste waste overseas for landfill disposal. In all cases to date, the export destination was Auckland, New Zealand. As mentioned in Section 2.2 above, this is an expensive solution with complicated logistics.
d) In a few cases, ACM waste has been disposed to the sea.
e) Store the waste for an indefinite period (in fabric bags or shipping containers). This solution has been employed in several countries and sometimes results in the waste reaching the environment again to become a difficult problem to resolve.

3.0 PESTLE Assessment

PESTLE is a strategic analysis tool that can be used to examine options being considered, in the light of six factors – Political, Economic, Social, Technological, Legal and Environmental. It can therefore be used to assess the options discussed in Section 2 above, for managing the disposal of ACM wastes. This analysis is carried out below.

3.1 Political Factors

SPREP has a regional asbestos strategy that has been adopted by member countries as political goals at the 22nd SPREP Meeting (Samoa) on 14th September 2011[1] The Policy Goals of this strategy are:

a) To minimize the adverse effects of asbestos on the environment and health of Pacific Island people.
b) To ensure the systematic replacement of asbestos materials with non-hazardous alternatives.
c) To minimize duplication of effort and maximize coordination of asbestos management activities.
d) To build capacity of stakeholders to promote effective asbestos management.
e) To ensure national policy objectives are being met.

This provides a clear set of goals agreed by all SPREP member countries.

With regard to the exporting of ACM wastes, relevant international Conventions (Basel and Waigani Conventions) are important in a political context. All Pacific Countries are Party to either the Basel or Waigani Conventions or both. Timor Leste is not a Party to the Basel Convention and is not eligible for the Waigani Convention as it is not a Pacific Country. Countries that are Parties to these International Conventions have a political obligation to honour them when hazardous wastes such as asbestos wastes are being exported. Export of ACM waste from Timor Leste would be very difficult and would require a special bilateral agreement.

There is likely to be political resistance to local landfilling if voters indicate they are not in favour of local disposal of asbestos due to such issues as land tenure, or historical perceptions that asbestos is an imported problem.

3.2 Economic Factors

Based on the Nauru Case Study set out in Appendix 1, it is clearly much more expensive (by a factor of about five times) to export ACM waste than to dispose of it locally.

There are also local financial implications of local landfill construction and long-term management. It is always necessary, however, for countries to have in place satisfactory waste disposal systems for general waste disposal. The extra cost of providing for the local landfilling of ACM waste is not large as the two services can be combined. If the procedure for landfilling ACM waste is kept simple, as appropriate for the Pacific, then the additional cost can be kept quite low.

It should be noted that limited financial and technical resources in many Pacific countries constrain effective waste management solutions – there is often reliance on aid financing.

There may be other economic benefits of local disposal, such as local employment opportunities that will also add to the skill base of local tradesmen.

3.3 Social Factors

The following social factors are relevant and should be taken into account:

[1] "An Asbestos-Free Pacific: A Regional Strategy and Action Plan" SPREP 2011

- Public perception and cultural resistance to hazardous waste landfills. This can be a general aversion to having a hazardous waste landfill situated locally, and is related to the need to respect land and water in Pacific cultures.

- Influence of historical narratives (e.g. New Zealand's role in introducing asbestos to Niue and the British Phosphate Commission (BPC) introducing asbestos to Nauru and Banaba Island).

- Community concerns about environmental and health impacts. These concerns can be addressed by proper controls and effective techniques for disposal, including preparing the ACM waste before disposal.

3.4 Technological Factors

The primary technical issue is that the landfilling of ACM waste must be carried out so that this waste is not exposed to human contact again after landfilling, through fibres released for inhalation. It must be remembered that landfilling is permanent storage of the ACM waste and not destruction.

The landfilling should therefore take place at a location where ongoing management and monitoring will occur, such as an existing well-managed landfill. A permanent cap is needed over the ACM waste and the waste needs to be located clearly in records that are available in future.

Containment of the waste in a landfill can be obtained by compaction of the base and exclusion of groundwater, but asbestos is not a serious water pollutant as the human health impacts of asbestos are related to inhalation only.

There are technical challenges in some countries related to coastal erosion, climate change (rising sea levels), and limited land space. These broad issues affect all waste disposal and not just ACM waste disposal, but care must be taken to ensure that ACM waste disposal does not exacerbate these problems. ACM waste should be placed at a location where it will not later be affected by coastal erosion.

The destruction options (thermal, chemical and mechanical), all have very significant and complex technical issues that take them out of consideration. They could not be set up in Pacific countries and do not exist in neighbouring developed countries where export is considered viable.

The option of “management in place” (in its original location) is technically feasible but offers only a temporary solution. There are also technical difficulties with meeting the requirements of the Asbestos Management Plan (AMP) that should always be prepared for management in place, to ensure that no fibres are released from activities that involve the ACM being disturbed in any way.

3.5 Legal Factors

The need to comply with international agreements (e.g., Basel and Waigani Conventions) adds complexity and costs to transboundary movements of ACM waste.

Legal requirements for public liability insurance and environmental safety increase the administrative burden of ACM waste management.

Land ownership is predominantly private in many Pacific countries, creating legal challenges in securing land for landfills that can receive ACM waste.

There is a need to enact a ban on importing new ACM products into Pacific countries and to enforce that ban. In the last few years, new ACM products have been identified in hardware stores in Vanuatu and Solomon Islands and may be being introduced into other countries. Banning the import of ACM is a process that SPREP supports and is helping countries to put in place. Several countries, PNG and Tonga included, have already set this legislative process in motion.

3.6 Environmental Factors

Potential environmental impacts of local landfilling, including groundwater contamination, raise concerns. Asbestos is not, however, a serious contaminant in water. Few countries have drinking water standards that limit asbestos fibres in drinking water, despite it being widely present in drinking water due to very commonly used asbestos-cement piping. Efforts should be made to protect drinking water with compacted landfill cell bases, but it is not considered necessary to line such cells with plastic.

Natural disasters such as cyclones have real potential to generate ACM waste as part of disaster waste. If local solutions are readily available to manage ACM waste arising from disasters, then ACM waste from disasters can be dealt with promptly and effectively, thus reducing the health and environmental impacts from such waste.

There are environmental concerns about disposal to sea because turbulent conditions may open the asbestos containment, thus freeing loose ACM. Furthermore, any approved disposal to sea sets a bad precedent as the ocean, so fundamental to Pacific culture, should be kept free of waste as much as possible.

Finally, and again, fundamentally to the Pacific, local landfilling has a smaller carbon footprint, compared with exporting which involves sea transport of dense and heavy ACM waste over long distances.

4.0 PESTLE Analysis

In consideration of the information compiled on each of the options, the following decision matrix analysis, based on the PESTLE criteria, examines the ACM disposal options available and provides a scientific, evidence-based, decision framework with separate tables for each option and a summary table. Scores are allocated out of ten for each element of these tables.

Table 5. Thermal Treatment

PESTLE Criteria	Score	Justification
Political	3	Low political support due to cost and complexity
Economic	1	Extremely high costs due to energy consumption and specialized equipment.
Social	4	Moderate acceptance, but concerns about emissions may cause resistance.
Technical	3	Requires advanced technology, high operational complexity, and maintenance.
Legal	6	Complies with international hazardous waste regulations.
Environmental	5	High energy usage and high emission control requirements.
Total Score	**22**	

Table 6. Chemical Treatment

PESTLE Criteria	Score	Justification
Political	3	Low political support due to cost and complexity.
Economic	1	High costs for chemicals, containment, and by-product management.
Social	4	Moderate acceptance, but concerns about hazardous chemicals used.
Technical	2	Advanced technology not available locally and not currently available in a scaled-up form. Requires strict safety measures.
Legal	6	Complies with international hazardous waste regulations.
Environmental	5	Risks of chemical spills and by-product pollution.
Total Score	**21**	

Table 7. Mechanical Treatment

PESTLE Criteria	Score	Justification
Political	3	Low support due to high costs and complexity.
Economic	1	Expensive to implement and maintain.
Social	4	Moderate acceptance, but concerns about dust and fibre release.
Technical	2	High complexity, strict containment, and uncertain fibre destruction.
Legal	6	Complies with international hazardous waste regulations.

PESTLE Criteria	Score	Justification
Environmental	4	High energy use and potential dust release.
Total Score	**20**	

Table 8. Management in Place

PESTLE Criteria	Score	Justification
Political	6	Moderate support as it defers costly disposal but requires monitoring with an Asbestos Management Plan (AMP).
Economic	7	Cost-effective short-term and avoids removal and replacement, but needs long-term maintenance.
Social	6	Acceptable if well-monitored, but concerns about long-term safety.
Technical	5	Feasible with inspections and proper training.
Legal	6	Compliant if AMPs are enforced.
Environmental	6	Low impact if encapsulated but risk of contamination if disturbed.
Total Score	**36**	

Table 9. Local Landfilling

PESTLE Criteria	Score	Justification
Political	7	Strong support as a cost-effective local solution, but some resistance.
Economic	9	Most cost-effective option. Lower transport costs.
Social	5	Some community resistance due to contamination fears and other factors.
Technical	8	Technically feasible with existing landfill methods.
Legal	7	Compliant if properly managed.
Environmental	7	Minimal impact if containment is effective. Some groundwater concerns.
Total Score	**43**	

Table 10. Disposal at Sea

PESTLE Criteria	Score	Justification
Political	5	Some support due to perceived convenience, but also strong opposition.
Economic	4	Moderate cost but requires expensive environmental studies.
Social	3	Highly controversial, strong public and cultural resistance.
Technical	6	Feasible but requires specialized transport and deep-sea disposal.
Legal	3	Highly restricted by international maritime laws.

PESTLE Criteria	Score	Justification
Environmental	2	High risks including marine contamination and setting a precedent for other ocean disposal.
Total Score	**23**	

Table 11. Export for Disposal

PESTLE Criteria	Score	Justification
Political	5	Mixed support due to international requirements. Seen as shifting the problem.
Economic	3	High costs due to shipping, compliance, and disposal fees.
Social	5	Moderate acceptance but ethical concerns.
Technical	7	Technically straightforward if logistics are well-managed.
Legal	7	Compliant with international regulations but has complex requirements.
Environmental	5	Minimal local impact but high carbon footprint from transportation, and more opportunities for fibre release, due to the numerous steps involved and the time the process takes.
Total Score	**32**	

Table 12. Summary Table for Quick Comparison

Option	Political	Economic	Social	Technical	Legal	Environmental	Total Score
Local Landfilling	7	9	5	8	7	7	**43**
Management in Place	6	7	6	5	6	6	**36**
Export for Disposal	5	3	5	7	7	5	**32**
Disposal at Sea	5	4	3	6	3	2	**23**
Thermal Treatment	3	1	4	3	6	5	**22**
Chemical Treatment	3	1	4	2	6	5	**21**
Mechanical Treatment	3	1	4	2	6	4	**20**

The Decision Matrix assessment above therefore clearly indicates that ***local landfilling is the most logical and practical option*** for ACM waste management in Pacific Island countries and Timor Leste. This is compared to alternative disposal methods—such as export for landfill disposal, sea disposal, or advanced treatment—local landfilling scores highest in economic feasibility, technical practicality, and legal compliance.
This conclusion is supported by:

- The high cost of exporting asbestos waste to Pacific Rim countries, making overseas disposal financially less viable, and the high carbon footprint,.
- Technical feasibility, as controlled landfill operations can be effectively implemented with existing waste management techniques.
- Environmental safeguards, ensuring that proper containment and monitoring strategies minimize potential risks.
- Legal and regulatory alignment, as local landfilling can comply with international asbestos waste management frameworks when properly managed.

However, some challenges remain, including political and community resistance, cultural concerns, and securing adequate funding for infrastructure. These must be addressed for successful implementation.

To advance local landfilling as a cost-effective, safe, and sustainable solution, the following strategic objectives are proposed:

1. Establish dedicated asbestos landfill cells in Pacific countries and Timor Leste, ensuring environmental safety and regulatory compliance.
2. Develop "management in place" solutions as a temporary measure where appropriate and where landfilling is not immediately feasible, provided proper Asbestos Management Plans (AMPs) are in place and implemented. AMP templates are needed.
3. Reduce financial burden by avoiding expensive ACM waste export costs.
4. Minimize health risks by securely containing ACM waste and preventing fibre release.
5. Gain community acceptance through public engagement, transparency, and cultural sensitivity.
6. Foster regional cooperation to share expertise, infrastructure, and financial resources for effective waste management.

A financial comparison based on the Nauru Case Study in Appendix 1 highlights the significant cost savings of local landfilling compared to export. This cost ratio of 5:1 (export vs. local landfilling) is likely broadly applicable across the Pacific, though local variations may affect the overall cost savings.

To implement ACM waste landfilling, securing sufficient funding is important. Given that ACM disposal is part of a broader waste management issue, funding packages should be developed that address general waste infrastructure, with ACM waste management as a key component. There are a range of international and regional funding sources that could be drawn upon. It is thought that by integrating ACM waste landfilling into broader waste management improvement projects, funding can be accessed through multi-sector development initiatives rather than stand-alone specific programs for ACM waste.

While local landfilling is feasible, several key risks must be managed effectively as set out in the Risk Assessment Table 13 below:

Table 13. Risk Assessment

Risk	Impact	Mitigation Strategy
Public opposition due to cultural and environmental concerns	High	Community engagement programs, transparent communication, and cultural consultations.
Legal compliance with international regulations	Medium	Align landfill operations with international norms and conduct continuous legal reviews.

Risk	Impact	Mitigation Strategy
Environmental risks (e.g., groundwater contamination)	Medium	Implement dedicated landfill cells with appropriate lining, compaction, and capping. Conduct regular environmental monitoring.
Natural disasters (cyclones, coastal erosion, etc.)	High	Strategic site selection, robust landfill design, and disaster preparedness planning.
Limited technical capacity and infrastructure	Medium	Invest in training programs, knowledge-sharing partnerships, and regional cooperation.
Lack of funding	High	Develop multi-sector funding approaches, integrating asbestos disposal into larger waste management initiatives.

By addressing these risks proactively, governments and stakeholders can ensure the safe, long-term management of ACM waste in the Pacific.

5. Conclusion and Next Steps

The PESTLE Analysis carried out in Section 4.0 above strongly supports local landfilling as the preferred option for ACM waste disposal in the Pacific.

In terms of the PESTLE criteria, it is:

- Politically viable if supported by public engagement and policy development
- Economically the most cost-effective solution (5 x cheaper than export)
- Socially viable if community acceptance is gained through public engagement, transparency, and cultural sensitivity.
- Technically feasible with proper landfill design and management.
- Legally compliant if aligned with acceptable procedures.
- Environmentally safe when containment measures are properly implemented.

The recommended next steps are:

6. Secure policy commitment from national governments to advance asbestos landfill projects.
7. Conduct feasibility studies to identify suitable landfill disposal locations and infrastructure needs.
8. Establish regional cooperation mechanisms for knowledge exchange.
9. Develop funding proposals to secure financial support from national, regional, and international sources.
10. Launch community engagement programs to address public concerns and increase acceptance.

By following this roadmap, Pacific Island nations and Timor Leste can transition towards a safe, sustainable, and cost-effective solution for managing legacy ACM waste.

Appendix 1: Nauru Case Study

A1.1 Cost of Export from Nauru

The Cost of Export of asbestos waste from Nauru to Auckland, New Zealand is shown in Table A1 below. It is based on costings obtained from Shipping Agents Australis Maritime. The New Zealand disposal rates come from Waste Management Ltd, Auckland.

Table A1. Cost of Export from Nauru

Export of Asbestos from Nauru to New Zealand	Cost (USD)
Cost to wrap asbestos and pack into container, and transport container to the Port	3350
20 ft container compliant with shipping requirements - net cost after including resale value of $2500	2345
NSL Freight Nauru to Auckland including 15% Broker Fees	5930
Bunker Adjustment Factor (BAF)	576
Dangerous Goods (DG) Surcharge	241
Admin Fee	27
Port State Control (PSC) Inspection in New Zealand	436
Transport from Port of Auckland to Waste Management	201
Based on 14T of waste asbestos in a container, cost of disposal of a container load in Redvale, Auckland	6097
Disposal Admin Charge	653
Total	**19855**

Based on the 2014 Nauru SPREP Asbestos Survey[2], the total amount of ACM in Nauru was then 2121 Tonnes.

Since 2014 ACM has been removed off a number of buildings. Most of the ACM waste from this work is, however, currently located in a former refugee camp, although some may already have been landfilled. This landfilled amount is compensated for by the fact that the 2121 Tonnes total figure may be an underestimate. There is probably ACM not covered in the 2014 survey because it was not immediately visible. For example, internal ACM may exist on buildings that were only surveyed externally.

In addition, there is probably about 200 m3 (about 300 tonnes) of contaminated soil still to be removed.

The total weight of asbestos plus contaminated soil = 2121 + 300 = 2421 tonnes.

Total cost of exporting this as waste = 2421 x 1602 = $US3,878,442

[2] "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 SPREP, 2015

If export was the long-term option, then it would be necessary to construct a staging area to safely store the asbestos before it was exported. This could be done, for example, at the former refugee camp. A concrete slab would be needed and a locked cage and a roof. All asbestos placed in there would need to be securely wrapped in plastic or put into Hazibags. Allow a PC sum of $US200,000 including the Hazibags for this work.

Including this PC sum, the export cost is therefore approximately $US4,078,000

A1.2 Cost of Local Disposal in Nauru

The **Cost for Local Disposal** is estimated as follows:

Total volume of asbestos waste and contaminated soil:

Asbestos waste: 2121/0.7 =	3030 m^3
Soil:	300 m^3
Total:	**3330 m^3**

Estimating earthworks costs is difficult, as it depends on cost of excavator, cost of truck and the type of soil, among other factors. A figure of $US40/$m^3$ has been taken, based on a typical New Zealand figure of around NZ$60/$m^3$.

Say five cells were constructed over a 10-year period, each 15m x 15m x 3m = 675m^3
Total volume = 3375m^3.

The cost of local disposal is therefore:

Cost of excavating 5 cells @ $US40/$m^3$ = 3375 x 40	=	US$135,000
Cost of concrete caps on 5 cells, to avoid the cells being re-dug in in the future	=	US$200,000
Cost of operation of the dedicated landfill and cover material over 10 years @ $US50,000/year	=	US$500,000
Total Cost of Local Disposal	**=**	**US$835,000**

The above cost does not include lining the cells. As asbestos is not a significant water pollutant, it is considered unnecessary to line the cells.

A1.3 Cost Comparison

if all asbestos in Nauru is removed. **the extra cost for export is therefore$US3,243,000,** (i.e. $US4,078,000 minus US$835,000).

The calculations described above for Nauru are for a location holding substantial amounts of asbestos, but this example is relevant to all countries in the Pacific, and it would be fair to say for all Pacific countries, that the cost of export to New Zealand is approximately five times the cost of local disposal.

It should be noted that that export to other overseas countries for disposal would be more expensive than New Zealand. The only other really viable destination is Australia, and they have prohibitive fees for the Basel/Waigani consent process.

However, this five times ratio will vary somewhat, depending to some extent on the distance to New Zealand, although distance is only one factor in the cost of shipping. Export will be a little cheaper for countries closer to New Zealand than Nauru, and more expensive for countries further away.

The five times ratio is also based on the cost of separate landfill cells. If co-disposal of asbestos wastes is used as in Tonga, the cost of export would be substantially higher than 5 times the cost of local disposal, as codisposal is much cheaper than constructing separate landfill cells.


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