Baseline Study for the Pacific Hazardous Waste Management Project - Healthcare Waste

The collection, collation and review of data on the management of healthcare waste and best-practice options for its disposal in participating Pacific Island Countries

Solomon Islands

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This document is issued in confidence to Secretariat of the Pacific Regional Environment Programme (SPREP) for the purposes of collection and collation of information on the regional management of healthcare waste and its disposal, as part of their broader strategy of improving hazardous waste management in Pacific Island countries, and specifically to assist in establishing sustainable healthcare waste management. This report presents the findings of this assessment. It should not be used for any other purpose.

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Executive Summary

Introduction

The Secretariat of the Pacific Regional Environment Programme (SPREP) is the Pacific region's major intergovernmental organisation charged with protecting and managing the environment and natural resources. SPREP works with and on behalf of its 21 member countries and territories to promote cooperation in the Pacific islands region, providing assistance to protect and improve the Pacific environment and to ensure sustainable development for present and future generations.

SPREP is implementing the Pacific Hazardous Waste Management (PacWaste) Project, a four year, €7,850,000 (2013 – 2017) project funded by the European Union and administered through SPREP. The project will provide fundamental on-ground improvement in the way priority high risk wastes are managed in Pacific island countries to help build a healthy, economically and environmentally sustainable Pacific for future generations. The PacWaste project is funded by the European Union under its 10th European Development Fund (EDF 10). The project focuses on three priority hazardous waste streams including asbestos, E-waste and healthcare waste.

ENVIRON was engaged by SPREP to collect and collate information on the regional management of healthcare waste and its disposal, as part of their broader strategy of improving waste management in Pacific Island countries, and specifically to assist in establishing sustainable healthcare waste management. This report presents the findings of the assessment conducted for the Solomon Islands.

Current Healthcare Waste Management in the Solomon Islands

Six hospitals were assessed in Solomon Islands. Information regarding the waste management process occurring, from ward-level waste generation through to ultimate treatment and disposal was collected during an audit of the hospital conducted between 1-7 April 2014.

A minimum standards framework has been developed to set a benchmark for the sustainable management of healthcare waste in the Pacific Island region. This framework is drawn from the *Industry code of practice for the management of biohazardous waste (including clinical and related) wastes*, Waste Management Association of Australia (2014), Draft 7th edition, taking into account the Pacific Island hospital and environmental context.

Using information obtained from the audits, the healthcare facilities in the Solomon Islands were assessed against this framework. Table ES1 highlights the key areas of concern in terms of health services delivery by hospital, as part of this assessment.

A full description and definitions of minimum standards applicable for healthcare waste management, as well as a comprehensive assessment against each of the criteria is presented in **Appendix C**.

Target areas have been rated as follows:

	Meets minimum standards assessment criteria
	Partially meets minimum standards assessment criteria.
	Does not meet minimum standards assessment criteria.

Table ES1: HEALTHCARE WASTE – KEY ISSUES SOLOMON ISLANDS

Scale	Category	Item	Minimum Standard Criterion	Honiara National Referral Hospital	Gizo Hospital	Goldie Hospital	Kilu'ufi Hospital	Atoifi Hospital	Kirakira Hospital	Overall
Healthcare Facility	Policy	Infection Control	Infection control policy incorporates principles of waste management within it							
Healthcare Facility	Policy	Waste Management Plan	Has been developed by the hospital and is based on a review of healthcare waste management and is current (within 5 years)							
Healthcare Facility	Management Committee		A waste management committee has been formed that has representatives from a broad range of departments and meets at least twice per year. A clear set of objectives has been developed for this committee. It reports to the senior management of the hospital.							
Healthcare Facility	Signage		Signs are located in all wards/department areas where waste bins are located indicating the correct container for the various waste types							
Healthcare Facility	Segregation		Waste are correctly segregated in all wards/departments with use of containers that are colour coded for the different waste types							
Healthcare Facility	Containers		All areas have dedicated waste containers are suitable for the types of waste generated. All waste containers are colour coded and have correct wording on them. Sharps are deposited into containers that reduce potential for needle-stick injury							
		Storage before treatment	Meets the stated standards							

Table ES1: HEALTHCARE WASTE – KEY ISSUES SOLOMON ISLANDS

Scale	Category	Item	Minimum Standard Criterion	Honiara National Referral Hospital	Gizo Hospital	Goldie Hospital	Kilu'ufi Hospital	Atoifi Hospital	Kirakira Hospital	Overall
Healthcare Facility	Internal Handling	Transport Trolley	A dedicated trolley is used for waste transport. The trolley is designed so that any spills are contained.							
Healthcare Facility	Training	Follow-up & refresher courses	All staff receive waste management education during induction. All staff receive refresher training annually. Waste management training is delivered following an adverse incident to the relevant staff/ward/department.							
Healthcare Facility	Training	Training responsibility	A hospital officer has responsibility for ensuring all training occurs as required and that records are maintained of all training and attendance.							
Healthcare Facility	Waste Audits		A program has been implemented to ensure waste audits are conducted of all waste materials/systems in all wards/departments on an annual basis and reports are provided to the waste management committee. Effective systems are in place to ensure that any non-conformances (with the hospital waste management strategy) are remedied.							
Healthcare Facility	Transport - External		A dedicated vehicle is used to transport untreated healthcare waste. This load carrying area of the vehicle is enclosed and constructed so that any spilt material is contained within this area. A split kit is provided.							
Healthcare Facility	Treatment	Suitability of treatment for healthcare waste	The method for treating healthcare waste is in accord with required standards - this includes operating parameters and location of the treatment unit.							
Healthcare Facility	Economics	Cost Effectiveness	A process has been developed that cost all aspects of waste management and these costs are reported annually to the waste management committee.							

Table ES1: HEALTHCARE WASTE – KEY ISSUES SOLOMON ISLANDS

Scale	Category	Item	Minimum Standard Criterion	Honiara National Referral Hospital	Gizo Hospital	Goldie Hospital	Kilu'ufi Hospital	Atoifi Hospital	Kirakira Hospital	Overall
Healthcare Facility	Occupational Health and Safety	PPE	All waste handlers are provided with and use appropriate PPE including overalls/protective clothing, gloves and eye protection. Incinerator staff are provided with additional PPE such as face masks and noise protection. A system is in place to monitor correct use of PPE.							
Healthcare Facility	Occupational Health and Safety	Staff risk	Waste containers, locations, storage and management procedures for healthcare waste incorporate identified risks to staff in accessing the waste and/or having needle-stick injuries.							
Healthcare Facility	Occupational Health and Safety	Patient/Visitor risk	Waste containers, locations, storage and management procedures for healthcare waste incorporate identified risks to patients and visitors in accessing the waste and/or having needle-stick injuries.							
Healthcare Facility	Healthcare waste management emergencies	Spill Prevention and Control	Spill kits are provided or all types of healthcare waste in all wards/departments, storage areas and on trolleys and vehicles. Staff are trained on the use of spill kits. All incidents of spills of healthcare waste are investigated and where appropriate remedial actions implemented.							
Healthcare Facility	Future Planning	Planning for change	Hospitals have developed a process to benchmark waste generation so as to (amongst other requirements), plan of future hospital development in terms of services and numbers of patients.							
Local Council	Waste Treatment Facility	Landfill	Healthcare waste is disposed of at a dedicated location and covered immediately on arrival. Scavengers cannot access untreated healthcare waste.							

Key Issues

Common key issues observed in the Solomon Islands were:

- With the exception of Kilu'ufi Hospital, none of the hospitals were aware of Infection Control Policy – Guidelines for Health Facilities, Solomon Islands (2004).
- Segregation and containment practices are generally below minimum standard in that there is virtually no signage present, the only segregation regularly practiced is for sharps, colour coded bags (liners) and bins were limited in supplies and storage is not adequate.
- There is no structured training or waste segregation auditing program in place
- The method for treatment of healthcare waste is not in accord with required standards at any of the hospitals visited.
- The wood-fired incinerators (Gizo, Kilu'ufi, Atoifi and Kirakira) do not get to the temperature required to adequately burn the healthcare waste.

Analysis of Options for Sustainable Healthcare Waste Management in Solomon Islands

Where non-treatment waste management aspects were observed to be performing below the Minimum Standards Framework, this framework is referenced for recommended actions.

For treatment of healthcare waste, various options used around the world were considered in the Pacific Islands context, via a two stage process:

- Stage 1: High-level costs and benefits (cost, lifespan, technical feasibility and how that relates to the Pacific Island regional context); and
- Stage 2: A Solomon Islands -specific feasibility assessment, using an analysis of 10 criteria (**Appendix D**)

Treatment options that rated best for Solomon Islands were:

- ***High Temperature Incineration*** is the promoted disinfection practice where units are modern, maintained, have sufficient waste volumes and locked in supplier maintenance and training contracts.
- ***Medium Temperature Incineration*** is acceptable in the medium term to remedy current unacceptable practices at sites too small to justify costs of expensive equipment.
- ***Low temperature burning*** is a borderline practice which can only be acceptable in the short term, in low population density environments, to remedy current unacceptable practices.
- ***Autoclaving*** is an acceptable disinfection practice where units with shredder are affordable and locked in supplier maintenance and training contracts are in place, but borderline beyond Port Vila due to lack of lined landfills and increased complexity of machinery.

Recommendations

Table ES2 provides a summary of the recommendations for Solomon Islands.

Table ES2: Recommendations for Solomon Islands **Applicable to:**	**Honiara National Referral Hospital**	**Gizo Hospital**	**Helena Goldie Hospital**	**Kilu'ufi Hospital**	**Atoifi Hospital**	**Kirakira Hospital**
Recommendation 1: Develop a Waste Management Framework						
Description	• Review, update and make available to all hospitals the Infection Control Policy – Guidelines for Health Facilities, Ministry of Health, Solomon Islands (2004). • A Healthcare Waste Management Plan, specific to each healthcare facility and in line with the Infection Control Policy. • Appoint an officer responsible for the development and implementation of the Healthcare Waste Management Plan (most likely to be the infection control officer). The hospitals visited had an Infection Control Officers who would be suitable candidates for the responsibility of the implementation of the Healthcare Waste Management Plan • A waste management committee, appropriate to the scale of each facility and across all the hospitals nationwide.					
Output	• An agreed Healthcare Waste Management Plan, specific to each healthcare facility outlining procedures and guidelines, waste definitions and characterisation, segregation techniques, containment specifications and storage practices, collection and transport, treatment and disposal and emergency procedures • Accountability for healthcare waste management through clearly defined roles and responsibilities					
Monitoring & Evaluation Indicators	• Plan approved by Ministry of Health (all facilities) • Approved budget for implementation of Healthcare Waste Management Plan • The Plan should be regularly monitored, reviewed, revised and updated. • Annual assessment of 'Responsible Officer's' or Waste Management Committees' performance against key healthcare waste management competencies.					
Costs ($US)	• Establishment – Low, if existing systems (such as those for Fiji) are used as a starting points and document drafting assistance is provided • Ongoing – Low					
Recommendation 2: Procurement of Consumables (Segregation & Storage)						
Description	• Supply of colour-coded waste bins and plastic liners in quantities sufficient to serve all wards/departments for a period of time sufficient to allow bedding down of the segregation process. • Supply of small number of colour-coded wheelie bins (where required) per hospital to act as both in-ward/department storage and internal transport trolleys.					

Table ES2: Recommendations for Solomon Islands **Applicable to:**	**Honiara National Referral Hospital**	**Gizo Hospital**	**Helena Goldie Hospital**	**Kilu'ufi Hospital**	**Atoifi Hospital**	**Kirakira Hospital**
	• Supply of signage to explain the colour-coded segregation system as well as posters to promote it.					
Output	Adequate supply of consumables to bed down more rigorous segregation practices					
Monitoring & Evaluation Indicators	• Wastes are segregated at their place of production. • Infection wastes, general wastes and used sharps are stored in separate colour coded containers and locations within medical areas. • Zero Needle Stick Injuries.					
Costs ($US)	Establishment – Low; Ongoing - Low, sustainably funded by country					
Recommendation 3: Provide a Sustainable Training Program						
Description	• Development and delivery of a structured healthcare waste training program to all hospital personnel as well as personnel from other stakeholders (e.g., government health and environment agencies) • This could be facilitated/ delivered by SPREP staff, or outside trainers, or a combination of both, as no competent healthcare waste management training capability exists in the Solomon Islands. • The Infection Control Officers (John Richardson and Rolly Vigar) at Honiara National Referral Hospital has had training and work experience in relation to infection control and could be good candidates to assist in in leading the training program. • Training should be coordinated with other countries' needs in the region					
Output	• Improvement of personnel skills and competency in managing healthcare waste • Promotion of the advantages of sustainable segregation and storage techniques for the different waste streams and an understanding of the health and safety risks resulting from the mismanagement risks of healthcare waste.					
Monitoring & Evaluation Indicators	• Competency Assessments • Refresher Training • No/very little cross contamination between waste streams demonstrated by waste audits.					
Costs ($US)	• Establishment – Low-medium per facility if regional synergies are utilised • Ongoing – Low-medium per facility if regional synergies are utilised					
Recommendation 4: Repair and Maintain Treatment Infrastructure						
Description	• Identify siting location for new incinerators Honiara National Referral Hospital and Kirakira Hospital. Given the limited spacing at both hospitals and proximity to residents it may be preferable for the incinerators to be operated from the local the landfills of the respective					

Table ES2: Recommendations for Solomon Islands **Applicable to:**	**Honiara National Referral Hospital**	**Gizo Hospital**	**Helena Goldie Hospital**	**Kilu'ufi Hospital**	**Atoifi Hospital**	**Kirakira Hospital**
	hospitals. • Procurement of a new incinerator for Honiara National Referral Hospital and Kirakira Hospital to treat the appropriate amount of waste generated. • Identify contractor that is able repair the incinerators as well as offer training to incinerator operators on proper use and maintenance of incinerators. • Repair of existing incinerator for Gizo, Helena Goldie (Munda) and Atoifi hospitals as well as the development of an incinerator operations area (fenced off, roofed, paved etc.). • Establish maintenance support contract. • Develop incinerator operation and maintenance procedure specific to each incinerator.					
Output	All incinerators are working and located in a safely designed area; relevant staff are trained to operate and maintain the incinerator; an maintenance support contract established.					
Monitoring & Evaluation Indicators	Assessment of the following should be regularly undertaken for new and existing incinerators: • Operations and construction (e.g. pre-heating and not overloading the incinerator and incinerating at temperatures above 800ºC only) • Maintenance program – are maintenance issues dealt with promptly? • Ensure burn times are sufficient to reduce waste ash volumes					
Costs ($US)	• Establishment – High (approx.. $50-100,000 for high temperature unit (Honiara and Kirakira) plus siting, $10-15,000 for maintenance repair and construction of incinerator operating site; • Ongoing – medium (fuel and maintenance)					
Recommendation 5: Appropriate Storage Facilities						
Description	• As a high priority procure contractors to design and develop a healthcare waste storage facility as per Appendix C and Appendix E at the Honiara National Referral Hospital, Gizo Hospital and Kirakira hospital. • As a high priority procure contractors to design and develop a healthcare waste storage facility as per Appendix C and Appendix E at the Atoifi Hospital, Kilu'ufi Hospital and Munda hospital.					
Output	A disposal system that reduces the potential hazard posed by health-care waste, while endeavoring to protect the environment (**meet minimum standards outlined in** Appendix C and Appendix E).					
Monitoring & Evaluation Indicators	Suitability of storage areas regularly assessed by 'responsible officer' of waste management committee.					
Costs ($US)	• Establishment - Medium$US5-15,000 per health storage facility. • Ongoing – low – monitoring and maintenance.					

Recommendation 6: Procurement of Consumables (PPE)	
Description	• Supply appropriate PPE, in particular overalls/protective clothing, and eye protection for all waste handlers. • Incinerator staff are provided with additional PPE such as face masks and noise protection.
Output	Adequate supply of PPE for protection of waste handlers
Monitoring & Evaluation Indicators	• PPE is provided to all staff and staff are aware on how to protect themselves from injuries and infectious wastes • Zero Needle Stick Injuries.
Costs ($US)	Establishment – Low; Ongoing - Low, sustainably funded by country

Implementation actions are suggested for each recommendation, classified as short, medium and long-term priorities.

1 Introduction and Background

The Secretariat of the Pacific Regional Environment Programme (SPREP) is the Pacific region's major intergovernmental organisation charged with protecting and managing the environment and natural resources. SPREP works with and on behalf of its 21 member countries and territories to promote cooperation in the Pacific islands region, providing assistance to protect and improve the Pacific environment and to ensure sustainable development for present and future generations.

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1.1 Project Scope

This report covers the approach specified in the Request for Tender AP 6/5/6/2 '*The collection, collation and review of data on the management of healthcare waste and best practice options for its disposal in selected Pacific Island communities'* as it specifically relates to the Solomon Islands and includes:

- Collection and collation of data on the current practice(s) used to dispose of hazardous healthcare waste in the Solomon Islands. Data collected includes:
  - Basic background data on the operation of the site (number of beds, population served, current and projected rates of hazardous healthcare waste generation;
  - Healthcare waste separation and infection control practices;
  - Adequacy of supply of hazardous healthcare waste collection equipment;
  - Hazardous healthcare waste storage;
  - Hazardous healthcare waste transportation;
  - Hazardous healthcare waste disposal practice and annual operating costs;
  - Frequency and adequacy of infection control training;
  - Frequency and adequacy of waste disposal training;
  - Adequacy of supply of personnel protective equipment.
- Consultation with national authorities to review and identify best-practice option(s) and preferences for national hazardous healthcare waste management by considering

technical feasibility within the existing health infrastructure (including review of existing local institutional, policy and regulatory arrangements).

- Identification of local contractors who may have the expertise and capacity to potentially partner with regional or international expert's in future hazardous healthcare waste management including infection control training.

1.2 Report Structure

This report is structured as follows:

- an introduction to the project (**section 1**)
- discussion of current healthcare waste management in the Solomon Islands, including the current regulatory framework and hospital details (**section 2**)
- a summary of existing waste management practices, waste streams and quantities, waste management and infection control framework, the waste management process that were reviewed, training and education programs and identified healthcare waste management issues (**section 3)**
- key healthcare waste management issues and any county-wide or regional themes that were identified (**section 4**)
- a summary of hospital and national authority consultation outcomes (**section 5**)
- an assessment of contractor roles and their capacity to sustainably manage and treat healthcare waste, including any training or education capacity (**section 6)**
- an analysis of the healthcare waste management and treatment options available, both regionally and specific to the Solomon Islands, to address the key issues identified (**section 7**)
- recommendations and prioritization of actions necessary to enable sustainable hazardous healthcare waste management and disposal in the Solomon Islands (**section 8**)

2 Healthcare Waste Management in Solomon Islands

2.1 National Regulatory Framework

The Ministry of Health and Medical Services is responsible for the regulation of healthcare waste in the Solomon Islands however the generally the management of healthcare lies with the individual hospitals with little intervention from the Ministry of Health and Medical Services. Ministry of Environment, Conservation and Meteorology is responsible for waste disposal and waste disposal facilities.

ENVIRON discovered during the audit at Kilu'ufi (Auki) Hospital that there is an *Infection Control Policy – Guidelines for Health Facilities*, Ministry of Health, Solomon Islands (2004) which was developed by the Solomon's Islands Ministry of Health in consultation with the Australian Government as well as assistance from PNG, Fiji and Queensland (Australia) Departments of Health. The Policy is comprehensive however none of the other hospitals were aware or able to produce a copy on site of the Policy.

From the desktop research and hospital audits, information on healthcare waste regulations was not identified or known to exist, aside from the *Infection Control Policy – Guidelines for Health Facilities*, Ministry of Health, Solomon Islands (2004).

Table 1: National Environmental Legislation Summary

Legislation	Type	Summary	References to Solid/HCW	Regulator/ Agency
Environment Act 2008	Act	The Act makes provisions for the protection and conservation of the environment. With regards to waste control and management, section 3c of the Act specifies the following: 'to reduce risks to human health and prevent the degradation of the environment by all practical means.	None	Ministry of Environment, Conservation and Meteorology
Environmental Regulations 2008	Regs	Not viewed.	N/A	Ministry of Environment, Conservation and Meteorology
The Environmental Health Act 1980	Act	An act to make provisions for securing and maintaining environmental health and for matters connected therewith or incidental thereto.	None	Ministry of Health and Medical Services
Infection Control Policy – Guidelines for Health Facilities, Solomon Islands (2004)	Guidelines	The guidelines were developed by the Solomon's Islands Ministry of Health and Medical Services in consultation with the Australian Government as well as assistance from PNG, Fiji and Queensland (Australia) Departments of Health. The Guidelines is comprehensive however not hospital specific. It references waste segregation, handling, appropriate PPE, treatment and storage requirements.	Yes	Ministry of Health and Medical Services

Table 1: National Environmental Legislation Summary				
Legislation	**Type**	**Summary**	**References to Solid/HCW**	**Regulator/ Agency**
The Honiara (Refuse Disposal) By-law 1995	By-law	The By-Law is supposed to provide for the use old standard receptacles as approved by the council and the means of disposal. The receptacles must be in good condition and taken care of. Fines are also incurred for offenders to the By-law. Currently, this is not enforced effectively.		Honiara Local Council

2.2 Hospitals Assessed

It has been reported that there is only six hospitals in the Solomon Islands and a number of 'mini hospitals' is the various provinces. This section summarises the six hospitals that were assessed in Solomon Islands, key contact personnel and key hospital administrative statistics.

ENVIRON audited the following hospitals whilst Solomon's Islands.

2.2.1 Honiara National Referral Hospital, Honiara

Honiara National Referral Hospital is national referral hospital and the largest hospital in the Solomon Islands. The hospital is located within Honiara and is limited in space with building, roads and parking occupying most of the site. The area is surrounded by residential and commercial shops as well as the ocean. Over the past decade rising sea levels have washed away the beach buffer at the hospital (**Photo 3**) and there is concerns that rising sea levels may mean a new hospital location will need to be identified.

Wards at the hospital include: paediatric ward; medical ward; gynaecology ward; anti-malaria ward; post natal ward; surgical ward; emergency ward; TB ward; rehabilitation ward; orthopaedic ward; standby isolation ward; dental clinic; diabetic clinic.

2.2.2 Gizo Hospital, Gizo

Gizo Hospital is a newly constructed hospital by JICA as a result of the former hospital being damaged beyond repair by the tsumami in 2007. The hospital opened in 2013 and is well resourced. The incinerator area is located separately to the main hospital adjacent to the beach and on the siting of the former hospital.

Gizo is the Solomon Islands third largest town and is the referral hospital for not only the Western Province but also some of the other neighboring provinces.

Wards at the hospital include: male/children ward; female/gynaecology ward; and maternity ward.

2.2.3 Helena Goldie Hospital, Munda

Helena Goldie Hospital is run with financial assistance from the Solomon Islands Government, overseas church partners, and many other 'friends of Helena Goldie Hospital'. The hospital is quite old and run down however there is space for development and buffer from the residents.

Helena Goldie Hospital looks after 15 clinics as well as the nearby College of Nursing, which has 16 intakes every year.

Wards at the hospital include: general ward; maternity ward; children's ward.

2.2.4 Kilu'ufi Hospital, Auki

Auki is the Solomon Islands second largest town and is the referral hospital for not only the Malaita Province. Currently no planes fly to Auki and therefore access is restricted to ferry.

The hospital is in reasonable good condition and is well set up with the incinerator at the rear of the facility surrounded by thick vegetation. There is room on the hospital for further development.

Wards at the hospital include: maternity ward; male ward; female ward; children ward; isolation ward (TB) ward; outpatients ward. In addition there is an emergency care unit; laboratory; eye department; dental clinic; physiotherapy unit; mental unit.

2.2.5 Atoifi Adventist Hospital, Atoifi

Atoifi hospital is very remote in location with no vehicle roads. There is an airstrip where planes fly in twice a week. The actual hospital is located on hilly terrain and surrounded by dense vegetation.

The hospital is run by the Seventh day Adventist Church with financial assistance from the Solomon Islands Government, overseas church partners, and general donations. The hospital is located on a compound which includes a school and nursing college.

Wards at the hospital include: maternity ward; male ward; female ward; children ward; TB ward; nursery theatre; HDU ward. In addition there is an emergency room; outpatients ward; eye services; dental clinic; pathology services; pharmacy services.

2.2.6 Kirakira Hospital, Kirakira

Kirakira hospital is located in the town centre. The hospital is very run down and free space at the hospital is limited. The hospital is surrounded by residents and a school.

Wards at the hospital include: medical ward (female and male); post natal ward; surgical/medical (male and female); emergency ward; TB Ward (male and female); post natal ward

Table 2: Hospital Details – Solomon Islands						
Hospital/Region	**Honiara National Referral Hospital, Guadalcanal Province.**	**Gizo Hospital, Ghizo Island, Western Province**	**Helena Goldie (Munda) Hospital, New Georgia Island, Western Province**	**Kilu'ufi (Auki) Hospital, Malaita Province**	**Atoifi Hospital, Malaita Province**	**Kirakira Hospital, Makira-Ulawa Province**
Contact Name **Position**	Rolly Vigar, Infection Control Officer	Infection Control Officer	Andrew Telo, Hospital Manager	Nixon Olofisau, Infection Control Officer	Peggy Kendall, Hospital Director.	Marcel Weape, Infection Control Officer
Pop Served	93,000	6,154 -Gizo town. Western Province - 76,649	5,000 –Munda. Western Province - 76,649	Malaita Province - 132,00	Eastern Region of Malaita Province - 23,000	45,000
No. of Beds	360	82	65	148	45	70
Annual Average Occupancy Rate (%)	97%	40%	30%	40%	50%	50%
Occupied Bed Days (OBD)	127,458	11,972	7,117	21,608	8,212	12,775
No. Operations	4.329	Not provided	Not provided	900	293	24
No. of Births	5.600	660	433	908	255	1,159
Emergency Patients Attended	28.203	Not provided	Not provided	Not known	Not known	130
Out-Patients Attended	53.000	Not provided	8680	19,741	15,547	1,300
No. of staff	533	69	59	101	65	58
No. of staff per function						
Nursing/ Medical	284	41	39	72	64	45
Infection Control	4	1	1	1	1	2
Dedicated Waste Management – Internal	6	15	0	15	Not provided	5

Management						
Dedicated Waste Management – Treatment Operation	0	2	0	2	Not provided	1
Administration	13	6	19	11	Not provided	5
Other	3	3	0	0	Not provided	0

Notes:

1. OBDs = Occupied Bed Days (previous 12 months)
2. Infection Control staff are also included in Nursing/ Medical numbers.

3 Existing Waste Management Practices

This section describes waste management practices observed during the hospital audits. Information regarding the waste management process occurring, from ward-level waste generation through to ultimate treatment and disposal is described in Table 3.

Audit observations are then elaborated upon further for the remaining issue headings:

- Waste streams, Treatment Constraints and Costs
- Waste Management and Infection Control Framework and
- Training.

A comprehensive list of all data collected from the site audit of the Republic of Nauru Hospital is located in **Appendix B**.

Table 3: Waste Management Process - Observations

	Hospital Name	Honiara National Referral Hospital			Gizo Hospital (opened 2013)			Helena Goldie Hospital			Kilu'ufi (Auki) Hospital			Atoifi Hospital			Kirakira Hospital		
Generation & Segregation	Dedicated Containers/ Bags	Y			Y			N			Y			N			N		
	Colour Coding	Y			Y			Y			N			N			N		
	Sharps segregated & secure	Y			Y			Y			Y			Y			Y		
	Signage Present	N			Y			N			N			N			N		
Internal Handling	Degree of manual handling of bags	High			Medium			High			High			High			High		
	Internal Transport Mode	Wheelie Bin			Trolley			Manual			Manual			Manual			Manual		
	Spill Kit Present	N			Y			N			N			N			N		
Storage	Dedicated & Appropriate Area	N			N			N			N			N			N		
	Loading/unloading acceptable	N			N			N			Y			Y			N		
	Spill Kits Present	N			Y			N			N			N			N		
	Monitoring & record keeping occurs	N			N			N			N			N			N		
Treatment	Treatment per Waste Stream		Tech. Type	Volume (kg/wk)		Tech. Type	Volumes (kg/wk)		Tech. Type	Volume(kg/wk)		Tech. Type	Volumes (kg/wk)		Tech. Type	Volumes (kg/wk)		Tech. Type	Volumes (kg/wk)
	Healthcare Waste	✓	Landfill (w/o treat)	2,500[1]	✓	Incinerate (internal)	600	✓	Landfill (w/o treat)	250[2]	✓	Incinerate (internal)	250[3]	✓	Incinerate (internal)	150[4]	✓	Bury off site	450[5]
	Sharps	✓	Landfill (without	As above	✓	Incinerate (internal)	600[6]	✓	Landfill (without	As above	✓	Incinerate (internal)	17.5	✓	Incinerate (internal)	As above	✓	Incinerate	As above

[1] Not weighed as no scale at hospital – based on estimates by John Richardson (Infection Control Officer).
[2] Not weighed as no scale at hospital. Based on estimates.
[3] Based on estimated incinerator size and number of times it is used a week.
[4] Not weighed as no scale at hospital – based on estimates of weekly use of the incinerator of about a 100kg load.
[5] Not weighed as no scale at hospital – based on estimates of weekly use of the incinerator of about a 100kg load.
[6] Based on the incinerator burning once daily (weekdays only) holding approximately 120kg

Table 3: Waste Management Process - Observations

	Hospital Name	Honiara National Referral Hospital			Gizo Hospital (opened 2013)			Helena Goldie Hospital			Kilu'ufi (Auki) Hospital			Atoifi Hospital			Kirakira Hospital		
			treatment)						treatment)									(internal)	
	Pharmaceutical	✓	Crush and dilution	Not known	✓	Incinerate (internal)	189[7]	✓	Landfill (without treatment)	Not known	✓	Incinerate (internal)	Not known	✓	Landfill (without treatment)	Not known	✓	Crush and dilution	Not known
	Cytotoxic	×	Landfill	NA	×	NA	NA	×	N/A	NA	×	NA	NA	×	NA	NA	×	NA	NA
	General	✓	Landfill (without treatment)	Not known	✓	Landfill (without treatment)	Not known	✓	Landfill (without treatment)	Not known	✓	Landfill (with treatment)	250[8]	✓	Incinerate (internal)	Not known	✓	Landfill (without treatment)	Not known
	If incinerator present																		
	Make, Model, Year commissioned	Medi Burn, Elastec, American Marine, Serial No: MBQ469			UHT-300 II 0 UCHIMURAGUM CO. LTD (Made in Japan. Diesel.			No name.			Locally made - iron			Locally made - iron			Wood fired - no name		
	Operating Temp (^{0}C)	~1000			Not known			Not known			Not known			Not known			Not known		
	No. chambers	2			1			1			1			1			1		
	Condition	Broken down			Reasonable			Poor			Poor			Poor			Reasonable		
	Comments	The incinerator is from Gizo Hospital (**Photo 6**). Hospital maintenance staff identified cracking inside as well 'general' damage from the flooding			Two incinerators present. One used for sharps and vials and one for health care waste (**Photos 8-9**).			The wood fired incinerator stopped operation in 2011 due to the public accessing on a regular basis (**Photo 14**).			The current incineration is a temporary incinerator built because the old (mediburn) incinerator broke down (**Photo 20**). The hospital has budget to purchase a new			The incineration (**Photo 26**) is to be replaced by a new incinerator which was built on site in the workshop (**Photo 27**).			The incinerator (**Photo 32**) is only used for the treatment of sharps as residents complain about the fumes.		

[7] The hospital reported that 9 sharps boxes are sent to the incinerator every day weighing approximately 3kg a box.
[8] General waste estimates are based on visual assessment and hospital staff interviews and general waste is approximately double medical waste

Table 3: Waste Management Process - Observations

	Hospital Name	**Honiara National Referral Hospital**	**Gizo Hospital (opened 2013)**	**Helena Goldie Hospital**	**Kilu'ufi (Auki) Hospital**	**Atoifi Hospital**	**Kirakira Hospital**
					incinerator in the 2013/2014 budget.		
	Operational statistics	Per year					
	Waste Throughput (kg)	N/A	400kh	100kg/per load	Not known	100kg/per load	
	Operating Hours (hr)	NA	4hrs	Approx 2 hours	Not known	Approx 2 hours	Approx 2 hours
	Fuel	Diesel	Diesel	Wood	Wood	Wood	Wood
	Fuel use (kg/litres)	Not known	Not known	Not known	Not known	Not known	
	Fuel use per kg waste burnt	N/A	Not known	Not known	Not known	Not known	Not known
	Technology siting and operation issues	Not known. Believed to be tsunami related issues.	Wet, windy, uncovered and close to residents.	Public are able to access the incinerator area. The area has now become overgrown and derelict.	Incinerator does not get hot enough and fumes enter the hospital due to low heat and low stack.	Incinerator does not get hot enough and fumes enter the hospital due to low heat and low stack.	Wet, uncovered and close to residents and hospital ward.
	Offsite transport assessment	Fair	Fair	Poor	Fair	Poor	Poor

3.1 Honiara National Referral Hospital

3.1.1 Waste streams, Treatment Constraints and Costs

Honiara National Referral Hospital generates general waste and healthcare wastes (including, infectious waste, sharps and pharmaceutical wastes). Volumes of waste generated are generally not measured however some estimates were made by the Infection Control Officer at the hospital prior to the site audit (refer to Table 3).

Waste is transported to landfill and, although no landfill levy is applied, the estimated cost of transporting all general waste and healthcare waste to the local landfill (approximately 3km) is $100,000 per year, which is equivalent to truck hire costs.

3.1.2 Waste Management and Infection Control Framework

The following summarises the waste management and infection control framework at Honiara National Referral Hospital:

- Infection Control Officers at Honiara Hospital were not aware of any waste management or infection control framework that has been developed for the hospital.
- ENVIRON discovered during the audit at Kilu'ufi (Auki) Hospital that there is an *Infection Control Policy – Guidelines for Health Facilities*, Ministry of Health, Solomon Islands (2004) which was developed by the Solomon's Islands Ministry of Health in consultation with the Australian Government as well as assistance from PNG, Fiji and Queensland (Australia) Departments of Health. The Policy is comprehensive however none of the other hospitals were aware or able to produce a copy on site of the Policy.
- In addition, no formal auditing framework has been established and no auditing has been undertaken in relation to waste management and infection control at Honiara National Referral Hospital.
- There is dialoged between the Infection Control Officers at each hospital visited which forms an informal committee.
- No internal hospital committee relating to healthcare waste management has been developed.

3.1.3 Training

There are no known training courses within Solomon Islands which specifically relate to infection control or healthcare waste management. The infection control offices in Honiara and Auki have received infection control training in Taiwan and Japan which were sponsored by the respective countries aid programs. The course in Taiwan was three months and the course in Japan was for one month.

None of the hospitals audited in Solomon Islands have a formal training program in place for infection control, waste segregation and/or incinerator use/maintenance. The following training has taken place:

- Training is received during the three year diploma course to be a registered nurse.

- Honiara hospital was previously presented the findings of the infection control course in a two hour workshop to nursing staff and are looking to expand the workshop into a regular training program for staff.

3.2 Gizo Hospital, Gizo

3.2.1 Waste streams, Treatment Constraints and Costs

Gizo Hospital generates general waste and healthcare wastes (including, infectious waste, sharps and pharmaceutical wastes). Quantities provided by hospital staff in Table 3 - there is no formal quantification of waste volumes undertaken.

No costs information was obtained; since waste disposal costs are internally borne by the hospital it is not directly measured. Wood is sold to the hospital for a small fee (figures not provided) and there is no waste dump levy.

3.2.2 Waste Management and Infection Control Framework

The following summarises the waste management and infection control framework at Gizo Hospital:

- Gizo Hospital staff were not aware of any waste management or infection control framework that has been developed for the hospital.
- ENVIRON discovered during the audit at Kilu'ufi (Auki) Hospital that there is an *Infection Control Policy – Guidelines for Health Facilities*, Ministry of Health, Solomon Islands (2004) which was developed by the Solomon's Islands Ministry of Health in consultation with the Australian Government as well as assistance from PNG, Fiji and Queensland (Australia) Departments of Health. The Policy is comprehensive however Gizo Hospitals was not aware of the Policy.
- There is dialoged between the Infection Control Officers at each hospital visited which forms an informal committee.
- No internal hospital committee relating to healthcare waste management has been developed.

3.2.3 Training

There are no known training courses within Solomon Islands which specifically relate to infection control or healthcare waste management.

None of the hospitals audited in Solomon Islands had a formal training program in place for infection control, waste segregation and/or incinerator use/maintenance. The following training has taken place:

- Registered nurses receive basic training on waste segregation and infection control during the three year training course to be a registered nurse which is undertaken in Honiara, Atoifi, and Munda.
- Anecdotally, waste management training and incinerator operation is communicated informally upon new staff employment at a hospital.

3.3 Helena Goldie Hospital, Munda

3.3.1 Waste streams, Treatment Constraints and Costs

Helena Goldie Hospital generates general waste and healthcare wastes (including infectious waste, sharps and pharmaceutical wastes). Quantities of waste were not measured by the hospital and records were not kept. Additionally because the waste is not segregated and dumped on the nearby off-site landfill it was especially difficult to make estimates. Estimates were provided by the hospital manager prior to the hospital visit however were considered high based on hospital visit (refer to Table 3).

No costs information was obtained; since waste disposal is taken by foot directly to an off-site dump site which does not incorporate a levy.

3.3.2 Waste Management and Infection Control Framework

The following summarises the waste management and infection control framework at Helena Goldie Hospital:

- Helena Goldie Hospital staff were not aware of any waste management or infection control framework that has been developed for the hospital.
- In addition, no formal auditing framework has been established and no auditing has been undertaken in relation to waste management and infection control at Helena Goldie Hospital.
- There is dialoged between the Infection Control Officers at each hospital visited which forms an informal committee.
- No internal hospital committee relating to healthcare waste management has been developed.

3.3.3 Training

There are no known training courses within Solomon Islands which specifically relate to infection control or healthcare waste management.

None of the hospitals audited in Solomon Islands had a formal training program in place for infection control, waste segregation and/or incinerator use/maintenance. The following training has taken place:

- Registered nurses receive basic training on waste segregation and infection control during the three year training course to be a registered nurse which is undertaken in Honiara, Atoifi, and Munda.
- Anecdotally, waste management training is communicated informally upon new staff employment at a hospital.

3.4 Kilu'ufi Hospital, Auki

3.4.1 Waste streams, Treatment Constraints and Costs

Kilu'ufi Hospital generates general waste and healthcare wastes (including infectious waste, sharps and pharmaceutical wastes). Quantities of waste were not measured by the hospital

and records were not kept. The Infection Control Officer provided estimates on quantities of waste (refer to Table 3) as well as costs.

Costs include an estimated $US267 per week (including sharps) to treat healthcare waste and $US80 per week for general waste.

3.4.2 Waste Management and Infection Control Framework

The following summarises the waste management and infection control framework at Kilu'ufi Hospital:

- ENVIRON discovered during the audit at Kilu'ufi (Auki) Hospital that there is an *Infection Control Policy – Guidelines for Health Facilities*, Ministry of Health, Solomon Islands (2004) which was developed by the Solomon's Islands Ministry of Health in consultation with the Australian Government as well as assistance from PNG, Fiji and Queensland (Australia) Departments of Health. The Policy is comprehensive however Helena Goldie Hospital was not aware of the Policy.
- There was no evidence that the *Infection Control Policy – Guidelines for Health Facilities*, Ministry of Health, Solomon Islands (2004) is consistently followed by hospital staff in relation to auditing framework.
- There is dialoged between the Infection Control Officers at each hospital visited which forms an informal committee.
- No internal hospital committee relating to healthcare waste management has been developed.

3.4.3 Training

There are no known training courses within Solomon Islands which specifically relate to infection control or healthcare waste management.

None of the hospitals audited in Solomon Islands had a formal training program in place for infection control, waste segregation and/or incinerator use/maintenance. The following training has taken place:

- Registered nurses receive basic training on waste segregation and infection control during the three year training course to be a registered nurse which is undertaken in Honiara, Atoifi, and Munda.
- Anecdotally, waste management training and incinerator operation is communicated informally upon new staff employment at a hospital.

3.5 Atoifi Hospital, Atoifi

3.5.1 Waste streams, Treatment Constraints and Costs

Atoifi Hospital generates general waste and healthcare wastes (including infectious waste, sharps and pharmaceutical wastes). Quantities of waste were not measured by the hospital and records were not kept. Estimates are provided by Table 3.

No costs information was obtained; waste disposal is taken by foot directly to the wood-fired incinerator or off-site dump site which does not encompass a levy.

3.5.2 Waste Management and Infection Control Framework

The following summarises the waste management and infection control framework at Helena Goldie Hospital:

- Atoifi Hospital staff were not aware of any waste management or infection control framework that has been developed for the hospital.
- In addition, no formal auditing framework has been established and no auditing has been undertaken in relation to waste management and infection control
- There is dialogue between the Infection Control Officers at each hospital visited which forms an informal committee.
- No internal hospital committee relating to healthcare waste management has been developed.

3.5.3 Training

There are no known training courses within Solomon Islands which specifically relate to infection control or healthcare waste management.

None of the hospitals audited in Solomon Islands had a formal training program in place for infection control, waste segregation and/or incinerator use/maintenance. The following training has taken place:

- Registered nurses receive basic training on waste segregation and infection control during the three year training course to be a registered nurse which is undertaken in Honiara, Atoifi, and Munda.
- Anecdotally, waste management training and incinerator operation is communicated informally upon new staff employment at a hospital.

3.6 Kirakira Hospital, Kirakira

3.6.1 Wastestreams and Quantities

Kirakira Hospital generates general waste and healthcare wastes (including infectious waste, sharps and pharmaceutical wastes). Quantities of waste were not measured by the hospital and records were not kept. Estimates on waste quantities are provided in Table 3.

Costs estimates were not provide and no information was obtained during the site audit. Costs are considered low however contractors are used to pick up the healthcare waste and bury it off site (**Photo 33**).

3.6.2 Waste Management and Infection Control Framework

The following summarises the waste management and infection control framework at Kirakira Hospital:

- Kirakira Hospital staff were not aware of any waste management or infection control framework that has been developed for the hospital.
- ENVIRON discovered during the audit at Kilu'ufi (Auki) Hospital that there is an *Infection Control Policy – Guidelines for Health Facilities*, Ministry of Health, Solomon

Islands (2004) which was developed by the Solomon's Islands Ministry of Health in consultation with the Australian Government as well as assistance from PNG, Fiji and Queensland (Australia) Departments of Health. The Policy is comprehensive however Helena Goldie Hospital was not aware of the Policy.

- In addition, no formal auditing framework has been established and no auditing has been undertaken in relation to waste management and infection control at Kirakira Hospital.
- There is dialoged between the Infection Control Officers at each hospital visited which forms an informal committee.
- No internal hospital committee relating to healthcare waste management has been developed.

3.6.3 Training

There are no known training courses within Solomon Islands which specifically relate to infection control or healthcare waste management.

None of the hospitals audited in Solomon Islands had a formal training program in place for infection control, waste segregation and/or incinerator use/maintenance. The following training has taken place:

- Registered nurses receive basic training on waste segregation and infection control during the three year training course to be a registered nurse which is undertaken in Honiara, Atoifi, and Munda.
- Anecdotally, waste management training and incinerator operation is communicated informally upon new staff employment at a hospital.

4 Key Healthcare Waste Management Issues in Solomon Islands

This section takes the collected information from Section 3 and summarises and critically assesses it, for each hospital surveyed, in the context of a Minimum Standards Framework.

A key issues summary is also provided.

4.1 Minimum Standards Framework

A minimum standards framework has been developed to set a benchmark for the sustainable management of healthcare waste in the Pacific Island region. This framework is drawn from the *Industry code of practice for the management of biohazardous waste (including clinical and related) wastes*, Waste Management Association of Australia (2014), Draft 7th edition, taking into account the Pacific Island hospital and environmental context.

A full description and definitions of minimum standards applicable for healthcare waste management, as well as a comprehensive assessment against each of the criteria is presented in **Appendix C**. Target areas have been rated as follows:

Table 4: Assessment criteria rating system	
	Meets minimum standards assessment criteria
	Partially meets minimum standards assessment criteria.
	Does not meet minimum standards assessment criteria.

Table 5 highlights the key areas of concern, both per hospital, and in terms of health services delivery across Solomon's Islands hospitals, as part of this assessment.

The sub-sections below discuss these key areas of concern further.

Table 5: HEALTHCARE WASTE – KEY ISSUES SOLOMON ISLANDS

Scale	Category	Item	Minimum Standard Criterion	Honiara National Referral Hospital	Gizo Hospital	Goldie Hospital	Kilu'ufi Hospital	Atoifi Hospital	Kirakira Hospital	Overall
Healthcare Facility	Policy	Infection Control	Infection control policy incorporates principles of waste management within it							
Healthcare Facility	Policy	Waste Management Plan	Has been developed by the hospital and is based on a review of healthcare waste management and is current (within 5 years)							
Healthcare Facility	Management Committee		A waste management committee has been formed that has representatives from a broad range of departments and meets at least twice per year. A clear set of objectives has been developed for this committee. It reports to the senior management of the hospital.							
Healthcare Facility	Signage		Signs are located in all wards/department areas where waste bins are located indicating the correct container for the various waste types							
Healthcare Facility	Segregation		Waste are correctly segregated in all wards/departments with use of containers that are colour coded for the different waste types							
Healthcare Facility	Containers		All areas have dedicated waste containers are suitable for the types of waste generated. All waste containers are colour coded and have correct wording on them. Sharps are deposited into containers that reduce potential for needle-stick injury							
		Storage before treatment	Meets the stated standards							
Healthcare Facility	Internal Handling	Transport Trolley	A dedicated trolley is used for waste transport. The trolley is designed so that any spills are contained.							
Healthcare Facility	Training	Follow-up & refresher courses	All staff receive waste management education during induction. All staff receive refresher training annually. Waste management training is delivered following an adverse incident to the							

			relevant staff/ward/department.							
Healthcare Facility	Training	Training responsibility	A hospital officer has responsibility for ensuring all training occurs as required and that records are maintained of all training and attendance.							
Healthcare Facility	Waste Audits		A program has been implemented to ensure waste audits are conducted of all waste materials/systems in all wards/departments on an annual basis and reports are provided to the waste management committee. Effective systems are in place to ensure that any non-conformances (with the hospital waste management strategy) are remedied.							
Healthcare Facility	Transport - External		A dedicated vehicle is used to transport untreated healthcare waste. This load carrying area of the vehicle is enclosed and constructed so that any spilt material is contained within this area. A split kit is provided.							
Healthcare Facility	Treatment	Suitability of treatment for healthcare waste	The method for treating healthcare waste is in accord with required standards - this includes operating parameters and location of the treatment unit.							
Healthcare Facility	Economics	Cost Effectiveness	A process has been developed that cost all aspects of waste management and these costs are reported annually to the waste management committee.							
Healthcare Facility	Occupational Health and Safety	PPE	All waste handlers are provided with and use appropriate PPE including overalls/protective clothing, gloves and eye protection. Incinerator staff are provided with additional PPE such as face masks and noise protection. A system is in place to monitor correct use of PPE.							
Healthcare Facility	Occupational Health and Safety	Staff risk	Waste containers, locations, storage and management procedures for healthcare waste incorporate identified risks to staff in accessing the waste and/or having needle-stick injuries.							

Healthcare Facility	Occupational Health and Safety	Patient/Visitor risk	Waste containers, locations, storage and management procedures for healthcare waste incorporate identified risks to patients and visitors in accessing the waste and/or having needle-stick injuries.							
Healthcare Facility	Healthcare waste management emergencies	Spill Prevention and Control	Spill kits are provided or all types of healthcare waste in all wards/departments, storage areas and on trolleys and vehicles. Staff are trained on the use of spill kits. All incidents of spills of healthcare waste are investigated and where appropriate remedial actions implemented.							
Healthcare Facility	Future Planning	Planning for change	Hospitals have developed a process to benchmark waste generation so as to (amongst other requirements), plan of future hospital development in terms of services and numbers of patients.							
Local Council	Waste Treatment Facility	Landfill	Healthcare waste is disposed of at a dedicated location and covered immediately on arrival. Scavengers cannot access untreated healthcare waste.							

4.2 Honiara National Referral Hospital (NRH) – Key Issues

The most significant healthcare waste management issues observed at Honiara NRH were:

- There was evidence that medical was being separated and although colour coding and signage was present it was not consistent throughout.
- The waste storage facility for both medical waste and general waste is not fenced off, enclosed or bunded (**Photo 2**). The public is able to access the waste prior to transportation to the municipal landfill as well as feral animals. Runoff is also possible as the waste storage area is not paved or bunded. The NRH has commissioned a feasibility study into the development of a new waste storage facility.
- Medical waste is disposed of the offsite municipal dump site with the general waste. Both wastes (including sharps) are reportedly burnt together and the public regularly access the dumpsite rummaging the waste for items of value.
- The former incinerator has been decommissioned and taken off site however there is a diesel incinerator stored at the NRH which is from Gizo (**Photo 6**). The incinerator reportedly broke down during the tsunami in 2012.The incinerator was assessed by the hospital maintenance staff who identified cracking inside as well 'general' damage from the flooding. The maintenance staff does not think it would be a cost effective option to repair the incinerator.
- There is no documented waste management planning system in place.
- There is no structured training or waste segregation auditing program in place.

4.3 Gizo Hospital – Key Issues

The most significant healthcare waste management issues observed at Gizo Hospital were:

- Both incinerators are woodfired with one incinerator which was believed to be formerly a diesel fired incinerated is used for sharps and vials. The other incinerator is a simple open wood fired incinerator used for dressing and other healthcare wastes (**Photos 8-9**). Both incinerators do not get to the temperate required to adequately burn the medical waste (vial and syringes still visible in the ash post burn). The incinerators are not covered which could be a contributing factor in a high rainfall area. The ash from the incinerator is disposed of at the landfill adjacent to the incinerator and usually not fully burnt with visible signs of sharps and vials. The ash is not buried.
- There is a large stockpile of empty vials and used sharps boxes at the incinerator which need to be treated (**Photo 10**).
- The healthcare waste storage facility does not meet the minimum standard (**Photos 8-9**).
- Shortage of colour coded waste disposal bins as well as yellow baggage supplied for the hospital.
- Limited training is available to nursing staff in relation to infection control and medical waste management.
- There is no documented waste management planning system in place.
- There is no structured training or waste segregation auditing program in place.

4.4 Helena Goldie Hospital – Key Issues

The most significant healthcare waste management issues observed at Helena Goldie Hospital were:

- All waste is taken to an offsite landfill which is burnt once weekly. The landfill is not fenced and can be accessed by feral animals and the public (**Photo 15**).
- Former incinerator was decommissioned (**Photo 14**).due to public regularly accessing and using the incinerator which was creating additional problems for the hospital.
- Shortage of colour coded waste disposal bins as well as yellow baggage supplied for the hospital (**Photo 17**).
- Limited training is available to nursing staff in relation to infection control and waste management.

4.5 Kilu'ufi – Key Issues

The most significant healthcare waste management issues observed at Kiluffi Hospital were:

- The current incinerator is poorly designed and does not properly burn the waste and the fumes impact the hospital (**Photo 22**).There is budget allocated for a new incinerator which the hospital at the time of the audit was currently procuring.
- Shortage of colour coded waste disposal bins as well as yellow baggage supplied for the hospital.
- Limited training is available to nursing staff in relation to infection control and waste management.

4.6 Atoifi – Key Issues

The most significant healthcare waste management issues observed at Atoifi Hospital were:

- The current incinerator is poorly designed and does not properly burn the waste and the fumes impact the hospital area (**Photo 26**). A new woodfired incinerator has been built but identifying a suitable location has been difficult (**Photo 27**).
- Shortage of colour coded waste disposal bins as well as yellow baggage supplied for the hospital.
- Limited training is available to nursing staff in relation to infection control and waste management.

4.7 Kirakira – Key Issues

The most significant healthcare waste management issues observed at Kirakira Hospital were:

- The neighbors have previously complained about the woodfired incinerator which has meant the use is now limited to burring of sharp boxes every 2-3 months (**Photo 32**).The incinerator is also in close proximity to one of the hospital wards and has a low stack therefore is also a hazard to staff and patients.

- Subsequently medical waste was taken to the municipal dumpsite (1 km from the hospital), however placentas and waste contaminated with blood was targeted by feral dogs and the practice was stopped due to complaints.
- Medical waste (aside from sharps) is buried off site adjacent to a village burial grounds located next to the hospital boundary (**Photo 33**). The area has limited space with approximately 6-12 months before a new location will need to be identified. Placentas are buried on hospital grounds.
- The waste storage area is roofed and is fenced three quarters of the way around however its original purpose was a hanging area for the laundry and is still used for this purpose which presents a health risk (**Photo 34**). Medical waste can be stored at this area for up to one to two weeks posing a health risk and generating obnoxious odours.
- There is no suitable area for an incinerator at the hospital that generated fumes due to limited open space and the close proximity to the village and school. Previously the landfill has been proposed as a possible site but this was rejected by the local police who have accommodation compound close by. The island has limited public land and negotiation will need to be made for a new incinerator as well as one that will minimize the impact of any fumes.
- Significant shortage of waste disposal bins (let alone colour coded waste bins) as well as yellow baggage supplied for the hospital (refer to Appendix A Photos).

5 Consultation

Apart from hospital staff across all five hospitals, no other discussions were held with any of the government departments. ENVIRON was not able to make contact with any of the Solomon Island's government departments.

6 Contractor Roles and Capacity

Currently, all healthcare waste management services are managed by the hospital and Ministry of Health with no in-country contractors identified as providing or having the capacity to provide healthcare waste management support services.

Honiara has a reasonable service industry and although no specific incinerator service contractor were known by hospital staff or identified during the visit, there are electrician, mechanics and general engineers that may be able to service to perform repair work on electronic/diesel/gas incinerators.

No waste contractor were identified that treat medical waste to the minimum standard.

In terms of educational and consulting services, no locally based services were known to occur. Training is often provided aid agencies (both government and non-government). However this appears to be informal in scheduling and no directional planning in relation to health care waste.

7 Analysis of Options for Sustainable Healthcare Waste Management in Solomon Islands

Section 4 identifies key issues that need to be addressed in improving healthcare waste management in the Solomon Islands. This section evaluates the potential options that could be employed to respond to these key issues.

Table 6 categorizes these key issues (A – F) against potential options that could be adopted to tackle them, as a collated list of high-level responses.

Table 6: Options for Sustainable Healthcare Waste Management in Solomon Islands

Key Issue Category	Key Issue	Options to address the issue
A. Waste Management Framework	There is no documented **waste management** planning system in place and limited evidence of waste management committees.	Establish a waste management framework including: • Waste Management Plan • Responsible officer for implementation of waste management plan • Waste management committee, appropriate to the scale of each facility and to work between other hospitals in the Solomon Islands.
B. Signage, Segregation & Containers	**Segregation and containment** practices are generally below minimum standard in that: • There is virtually no wall signage present. Signage is limited to bins and not always present. • Waste segregation is intended however is generally poorly implemented. • Colour coded bags (liners) were rarely available. • Some colour coded bin were available but usually there was a shortage which prevented consistency across the individual hospital.	Improve segregation practices by: • Supply of colour-coded waste bins and plastic liners in quantities sufficient to serve all wards/departments for a period of time sufficient to allow bedding down of the segregation process. • Supply of small number of colour-coded wheelie bins (where required) per hospital to act as both in-ward/department storage and internal transport trolleys. • Supply of signage to explain in words and illustrations the colour-coded segregation system as well as posters to promote it.
C. Training & Audit	There is no structured **training** or waste segregation **auditing** program in place	Development and delivery of a structured healthcare waste training program to all hospital personnel as well as personnel from other stakeholders (e.g., government health and environment agencies). This could be facilitated/ delivered by: 1. SPREP staff, **or** 2. International technical training providers (or a combination of both), - as no competent healthcare waste management training capability were identified in the Solomon Islands
D. Healthcare Waste Storage	Healthcare waste storage facilities generally did not meet minimum standard.	• Ensure there is a waste storage facility that meets the requirements detailed in Appendix E. • Regular checks and maintenance of waste

Table 6: Options for Sustainable Healthcare Waste Management in Solomon Islands		
Key Issue Category	**Key Issue**	**Options to address the issue**
Facility		storage facilities.
E. Treatment	**Treatment** is intended to be completed at the hospitals visited (except Honiara).	Treatment using one (or a combination) of the following for each hospital: 1. Rotary kiln (highest temperature) 2. Incineration (high, medium temperature) 3. Low temperature burning (single chamber incinerator/ pit/ drum/ brick enclosure/ land) 4. Autoclave 5. Chemical 6. Microwave 7. Encapsulation 8. Landfill (without disinfection) 9. Onsite burial 10. Shredding
F. Occupational Health and Safety	Waste handlers generally wore appropriate **PPE** including, gloves and face masks. Generally overalls /protective clothing and eye protection was not worn. **Spill control kits** were not observed anywhere.	Procurement of Consumables (PPE): • Supply spill kits and appropriate PPE including overalls/protective clothing, gloves and eye protection for all waste handlers. • Incinerator staff are provided with additional PPE such as face masks and noise protection.

7.1 Options for (Non-Treatment) Waste Management Aspects

Those options that do not relate directly to the waste treatment process tend to have limited alternatives that can address their respective key issue, given they typically relate to the fundamentals of hazardous waste management. These are:

- The waste management (and infection control) framework, including policies, plans, procedures, responsibility for implementation and audit of the functioning of the framework (A in Table 6)
- The waste management process, from generation to transport up to the treatment location (B in Table 6)
- Training systems for sustainable healthcare waste management (C in Table 6)
- Healthcare Waste Storage Facility (D in Table 6)
- OHS related protection for waste handlers (F in Table 6)

These areas have not been subjected to an options analysis, because the minimum standards framework has clear requirements with limited variation options.

7.2 Options for Treatment of Healthcare Waste

Healthcare waste treatment (key issue category E) has a range of alternative approaches, as summarized in Table 6. These have strengths and weaknesses that need to be considered in the context of criteria such as performance and cost of the technology itself, the waste types and volumes it is required to process, the environment it would be operating in and a range of factors specific to the Pacific Islands region and in some cases an individual country's circumstances.

Treatment solutions may involve a single technology, more than one technology for sub-categories of healthcare waste or combination of the technologies listed in Table 6. These alternatives have been assessed using a two stage process:

Stage 1: High-level costs and benefits

- Cost (capital, operating, maintenance)*
- Lifespan
- Technical feasibility (advantages and disadvantages) and how that relates to the Pacific Island regional context

* Costs are estimated at a high level for relative comparison purposes. Detailed quotations, particularly for equipment purchase and associated operating and maintenance costs will be required as part of any future procurement process to be managed by SPREP.

Stage 2: Local feasibility assessment (per country)

- comparative cost to implement
- comparative effectiveness across all HCWs
- health and safety considerations
- sustainability
- institutional and policy fit
- cultural fit
- barriers to implementation
- environmental impact
- durability and
- ease of operator use

The stage 1 treatment technology options assessment is generic to the Pacific region so is included in the *Whole of Project – Summary Report*, Appendix E. This analysis highlights the following technologies as worthy of consideration for Solomon Islands Stage 2 assessment:

1. Incineration (high temperature: >1,000^{0}C [9])
2. Incineration (medium temperature: 800 – 1,000^{0}C [4])

[9] As defined in *Management of Solid Health-Care Waste at Primary Health-Care Centres - A Decision-Making Guide*, WHO (2005)

3. Low temperature burning (single chamber incinerator/ pit/ drum/ brick enclosure/ land: <400^{0}C [4])
4. Autoclave
5. Encapsulation (of sharps only, in combination with a form of disinfection).

7.2.1 Waste Treatment Systems Relevant for the Solomon Islands

The Stage 2 local feasibility assessment (for the Solomon Islands) took these first four[10] technologies and assessed them against the ten dot point criteria listed in 7.2.

These criteria are explored qualitatively in **Appendix D**. Table 7 takes these qualitative descriptions and assigns a quantitative score from 1 – 5, to prioritise local applicability of technology options to the Solomon Islands context, on a relative basis as follows:

1. Very low
2. Low
3. Moderate
4. High
5. Very High.

The treatment technologies suitable for the Solomon Islands context are ranked in order of preference in Table 7:

Table 7: <u>QUANTITATIVE</u> Treatment Technology Options Assessment (Stage 2) - Local Feasibility Assessment (Solomon Islands)

Stage 1- Approved Technology Options	Local Feasibility										Total Score out of 50	Rank
	Comparatively low cost to implement	Comparative effectiveness across all HCWs	Health & safety to workers & community	Sustainability of solution	Institutional and policy fit	Cultural fit	Implementation barriers can be overcome?	Receiving environment protected	Durability	Ease of operation		
Incineration at high temperature (>1000^{0}C)	1	5	4	4	4	4	3	3	3	3	34	1
Incineration at med. temperature (800 - 1000^{0}C)	4	4	3	3	3	4	4	2	2	4	32	2
Low temperature burning (<400^{0}C)	5	3	1	2	2	3	4	1	5	5	31	3
Autoclave with shredder	2	4	4	3	4	3	3	4	2	2	31	3

Notes:
- Scored on a scale of 1-5, where 1= very low; 2 = low; 3= moderate; 4 = high and 5 = very high
- Criteria given equal weighting
- Possible maximum score: 50

[10] Encapsulation is assessed separately as its potential applicability is only for sharps that have already been treated to remove the infection risk, whereas all other technologies have a wider application and are fundamentally standalone options.

In support of Table 7's ranking:

- ***High Temperature Incineration*** is the promoted disinfection practice where units are modern, maintained, have sufficient waste volumes and locked in supplier maintenance and training contracts.
- ***Medium Temperature Incineration*** is acceptable to remedy current unacceptable practices at sites too small to justify costs of expensive equipment.
- ***Low temperature burning*** is a borderline practice which can only be acceptable in the short term, in low population density environments, to remedy current unacceptable practices.
- ***Autoclaving*** is an acceptable disinfection practice where units with shredder are affordable and locked in supplier maintenance and training contracts are in place, but borderline beyond Port Vila due to lack of lined landfills and increased complexity of machinery.

Based on the qualitative assessment in **Appendix D**, ***encapsulation*** ranks as an effective way to deal with the residual risk from already disinfected sharps: i.e., the risk of needle stick injury by healthcare workers or the community (waste disposal area) due to the fact that sharps are disinfected but not physically destroyed by the low-medium temperature of open burning (or non-destruction of autoclaving). Encapsulation is never recommended as an isolated form of treatment, as it does not disinfect or otherwise treat the hazard of the waste.

A substantial amount of data exists on the emissions generated from incinerators, but conversely, little studies have been conducted on all aspects of alternate technologies performance. While the literature is inconclusive on the requirements needed to effectively manage the blood and body fluid contaminated and infectious components of the waste streams, there does seem to be consensus that hazardous components such as pharmaceuticals and cytotoxic wastes do need to be treated prior to final disposal to ensure there is no risks to the environment or health of humans and other species. No publication from a government environmental or health agency, or any article reviewed advocated any other preferred form of treatment for pharmaceuticals and cytotoxic wastes than incineration. In most instances the preference for anatomical waste was also incineration.

Since the Solomon Islands does not currently generate cytotoxic wastes and typically returns anatomical waste to the family of the patient for cultural reasons, limitations regarding these wastes are not particularly relevant for healthcare waste treatment choices in the Solomon Islands.

7.2.2 Treatment Investment Options for individual Solomon Island Hospitals

Wastes should be treated and disposed of accordingly to ensure the infectious hazard is destroyed. Three out of the six referral hospitals in Solomon Islands require some investment in either replacement or maintenance of infrastructure to achieve this, as described by their respective treatment weaknesses in sections 4.1.1 – 4.1.6.

Table 7 determines 'intervention' options that are suggested to improve treatment of healthcare waste in each hospital visited. Shading in green indicates where investment is proposed, while orange shading shows where a technology consideration is also relevant.

Table 8: Technology Options Applicable for Each Hospital in Solomon Islands	
Remaining Technology Options	**Technology Applicability**
Honiara National Referral Hospital	
Disinfection & Encapsulation (only sharps assessed)	A low cost option that should be employed in the short term until an appropriate healthcare waste system is implemented. The hospital could use its on-site autoclaves to disinfect the sharps. Disinfected sharps should be placed within high-density plastic containers or metal drums and when full an immobilizing material such as plastic foam, sand, cement or clay is added.
Incineration at high temperature (>1000^{0}C)	This is the preferred option due to the types of waste generated and the status of the existing incinerator. ENVIRON recommends to: *Procure the new incinerator* – the incinerator will need to be capable of burning high volumes of was which should be around the 500kg/day range. Additionally the incinerator would be required to come with a large stack (greater then 6metres) given the people density of the location in Honiara.
Incineration at med. temperature (800 - 1000^{0}C)	Given the size of the hospital and it is the nation's referral hospital a high temperate incineration is preferred
Autoclave with shredder	Option may need to be considered given fumes will be an issue at the hospital due to limited spacing. However this option may be difficult due to the amount of waste generated.
Low temperature burning (<400^{0}C)	Given the size of the hospital and it is the nation's referral hospital a high temperate incineration is preferred
Gizo Hospital	
Disinfection & Encapsulation (only sharps assessed)	Not applicable when the current incinerator is operating.
Incineration at high temperature (>1000^{0}C)	The site currently has two incinerators however they are both wood fired and do not get to the temperatures required to burn vials and sharps. Option to procure the new incinerator that can reach >10000C (such as the MediBurn 30) should be considered.
Incineration at med. temperature (800 - 1000^{0}C)	It is not clear what temperatures the current incinerator get to but they are capable of burning healthcare waste but sharps and vials are still visible. Improvement to the incinerators stack height and storage area (i.e. roofed and protection from coastal elements) would improve the incinerators functionality.
Autoclave with shredder	The existing incinerator, when working is a with a functional treatment option.
Low temperature burning (<400^{0}C)	The existing incinerator, when working is a with a functional treatment option.
Helena Goldie (Munda) Hospital	
Disinfection & Encapsulation (only sharps assessed)	A low cost option that should be employed in the short and medium term until an appropriate healthcare waste system is implemented. The hospital could use its on-site autoclaves (refer to Appendix A photos) to disinfect the sharps. Disinfected sharps should be placed within high-density plastic containers or metal drums and when full an immobilizing material such as plastic foam, sand, cement or clay is added.
Incineration at high temperature	Long-term option to plan for.

(>1000^{0}C)	Would be preferable option to treat healthcare waste however costs would be high for the hospital resources in terms of implementation and ongoing operation may not be feasible in the short term. Currently the hospital does not employ any genitors or ground staff and there is limited skilled expertise in Munda to service or repair any mechanical incinerator.
Incineration at med. temperature (800 - 1000^{0}C)	Not applicable when the current incinerator is operating.
Autoclave with shredder	Not applicable when the current incinerator is operating.
Low temperature burning (<400^{0}C)	The site has a disused old woodfired incinerator (refer to Appendix A photos) that could be restored to treat healthcare waste such as used dressing. Resources will need to allocated for the incinerator area to be fenced off, paved and roofed.
Kilu'ufi (Auki) Hospital	
Disinfection & Encapsulation (only sharps assessed)	Autoclaves and encapsulation should be an option employed in the short term until the incinerator new incinerator is operating
Incineration at high temperature (>1000^{0}C)	Currently Kilu'ufi Hospital is in the process of procuring a new incinerator that will reach >1000^{0}C. Budget has been set aside and the hospital is looking at getting a Mediburn 30.
Incineration at med. temperature (800 - 1000^{0}C)	Plan to purchase a higher temperature incinerator (refer to above).
Autoclave with shredder	The existing incinerator, when working is a with a functional treatment option.
Low temperature burning (<400^{0}C)	Current incinerator (refer to Appendix a photos) is likely to operate at less than <400^{0}C.
Atoifi Hospital	
Disinfection & Encapsulation (only sharps assessed)	Autoclaves and encapsulation should be an option employed in the short term until the incinerator new incinerator is operating
Incineration at high temperature (>1000^{0}C)	It may not be justified to purchase a new incinerator for the investment required given Atoifi hospital recently constructed a new woodfired incinerator and the limited resources the hospital has. In addition, given the remoteness of Atoifi, skilled technicians are in limited supply and diesel/electricity/gas is relatively expensive.
Incineration at med. temperature (800 - 1000^{0}C)	It is hoped that the newly constructed wood fired incinerator (refer to Appendix A photos) will reach temperatures above 800^{0}C. the hospital is currently identifying a suitable location for the incinerator.
Autoclave with shredder	The existing incinerator, when working is a with a functional treatment option.
Low temperature burning (<400^{0}C)	The current woodfired incinerator is estimated to operate at <400^{0}C however it is due to be decommissioned.
Kirakira Hospital	
Disinfection & Encapsulation (only sharps assessed)	Autoclaves and encapsulation should be an option employed in the short term until an appropriate treatment option is identified.
Incineration at high temperature (>1000^{0}C)	*Procure a new incinerator* – a diesel MediBurn 30 model has a manufacturer's claimed throughput of 200 kg/day of healthcare waste.
Incineration at med.	The hospital requires higher tech incinerator that generates less fumes and

temperature (800 - 1000^{0}C)	more heat..
Autoclave with shredder	This option is feasible if a new incinerator (>1000C) is not purchased or a site cannot be agreed upon due to complaints from the community surrounding fumes. Autoclave with shredder can assist with the current incinerator of sharps.
Low temperature burning (<400^{0}C)	The hospital requires higher tech incinerator that generates less fumes and more heat.

Timing considerations for these options, in the context of other (non-treatment) options, is provided in the Section 8 (Recommendation).

8 Recommendations

The following section outlines recommendations and a proposed implementation plan for each recommendation to achieve sustainable management of healthcare waste in the Solomon Islands. Further details and guidance on each recommendation are provided in **Appendix E**.

Table 9 provides a summary of the recommendations for the Solomon Islands. A colour coding system is used to describe the degree of applicability of each recommendation to each hospital as follows:

	Fully Applicable
	Partially applicable
	Not applicable

In terms of relative priorities of the five recommendations, they are all high, based on the deficiencies addressed against the minimum standards framework. They are also highly inter-related, for example: segregation practices cannot be sustainably improved without the requirements and responsibility of the waste management framework; which in turn cannot be turned into active policies and procedures without the understanding and reinforcement that comes from training. Effective treatment and use of PPE cannot be sustained without the reinforcement of training, effective segregation and the procedures and monitoring spelled out in the waste management framework.

However, the staggered timing of actions required to implement the recommendations, as outlined for each hospital in section 8.1, and their different short, medium and long term approaches give an indication of priority of the recommendation actions themselves.

*Where a recommendation is **unique** to the circumstances of a particular hospital, because of issues identified that are **unique** to that hospital, the recommendation (and associated implementation action) is appended with the annotation* ***U2H***

Table 9: Recommendations for Solomon Islands Applicable to:	Honiara National Referral Hospital	Gizo Hospital	Helena Goldie Hospital	Kilu'ufi Hospital	Atoifi Hospital	Kirakira Hospital
Recommendation 1: Develop a Waste Management Framework						
Description	• Review, update and make available to all hospitals the Infection Control Policy – Guidelines for Health Facilities, Ministry of Health, Solomon Islands (2004). • A Healthcare Waste Management Plan, specific to each healthcare facility and in line with the Infection Control Policy. • Appoint an officer responsible for the development and implementation of the Healthcare Waste Management Plan (most likely to be the infection control officer). The hospitals visited had an Infection Control Officers who would be suitable candidates for the responsibility of the implementation of the Healthcare Waste Management Plan • A waste management committee, appropriate to the scale of each facility and across all the hospitals nationwide.					
Output	• An agreed Healthcare Waste Management Plan, specific to each healthcare facility outlining procedures and guidelines, waste definitions and characterisation, segregation techniques, containment specifications and storage practices, collection and transport, treatment and disposal and emergency procedures • Accountability for healthcare waste management through clearly defined roles and responsibilities					
Monitoring & Evaluation Indicators	• Plan approved by Ministry of Health (all facilities) • Approved budget for implementation of Healthcare Waste Management Plan • The Plan should be regularly monitored, reviewed, revised and updated. • Annual assessment of 'Responsible Officer's' or Waste Management Committees' performance against key healthcare waste management competencies.					
Costs ($US)	• Establishment – Low, if existing systems (such as those for Fiji) are used as a starting points and document drafting assistance is provided • Ongoing – Low					
Recommendation 2: Procurement of Consumables (Segregation & Storage)						
Description	• Supply of colour-coded waste bins and plastic liners in quantities sufficient to serve all wards/departments for a period of time sufficient to allow bedding down of the segregation process. • Supply of small number of colour-coded wheelie bins (where required) per hospital to act as both in-ward/department storage and internal transport trolleys. • Supply of signage to explain the colour-coded segregation system as well as posters to promote it.					

Table 9: Recommendations for Solomon Islands Applicable to:	Honiara National Referral Hospital	Gizo Hospital	Helena Goldie Hospital	Kilu'ufi Hospital	Atoifi Hospital	Kirakira Hospital
Output	Adequate supply of consumables to bed down more rigorous segregation practices					
Monitoring & Evaluation Indicators	• Wastes are segregated at their place of production. • Infection wastes, general wastes and used sharps are stored in separate colour coded containers and locations within medical areas. • Zero Needle Stick Injuries.					
Costs ($US)	Establishment – Low; Ongoing - Low, sustainably funded by country					
Recommendation 3: Provide a Sustainable Training Program						
Description	• Development and delivery of a structured healthcare waste training program to all hospital personnel as well as personnel from other stakeholders (e.g., government health and environment agencies) • This could be facilitated/ delivered by SPREP staff, or outside trainers, or a combination of both, as no competent healthcare waste management training capability exists in the Solomon Islands. • The Infection Control Officers (John Richardson and Rolly Vigar) at Honiara National Referral Hospital has had training and work experience in relation to infection control and could be good candidates to assist in in leading the training program. • Training should be coordinated with other countries' needs in the region					
Output	• Improvement of personnel skills and competency in managing healthcare waste • Promotion of the advantages of sustainable segregation and storage techniques for the different waste streams and an understanding of the health and safety risks resulting from the mismanagement risks of healthcare waste.					
Monitoring & Evaluation Indicators	• Competency Assessments • Refresher Training • No/very little cross contamination between waste streams demonstrated by waste audits.					
Costs ($US)	• Establishment – Low-medium per facility if regional synergies are utilised • Ongoing – Low-medium per facility if regional synergies are utilised					
Recommendation 4: Repair and Maintain Treatment Infrastructure[U2H]						
Description	• Identify siting location for new incinerators Honiara National Referral Hospital and Kirakira Hospital. Given the limited spacing at both hospitals and proximity to residents it may be preferable for the incinerators to be operated from the local the landfills of the respective hospitals. • Procurement of a new incinerator for Honiara National Referral Hospital and Kirakira Hospital to					

Table 9: Recommendations for Solomon Islands Applicable to:	Honiara National Referral Hospital	Gizo Hospital	Helena Goldie Hospital	Kilu'ufi Hospital	Atoifi Hospital	Kirakira Hospital
	treat the appropriate amount of waste generated. • Identify contractor that is able repair the incinerators as well as offer training to incinerator operators on proper use and maintenance of incinerators. • Repair of existing incinerator for Gizo, Helena Goldie (Munda) and Atoifi hospitals as well as the development of an incinerator operations area (fenced off, roofed, paved etc.). • Establish maintenance support contract. • Develop incinerator operation and maintenance procedure specific to each incinerator.					
Output	All incinerators are working and located in a safely designed area; relevant staff are trained to operate and maintain the incinerator; an maintenance support contract established.					
Monitoring & Evaluation Indicators	Assessment of the following should be regularly undertaken for new and existing incinerators: • Operations and construction (e.g. pre-heating and not overloading the incinerator and incinerating at temperatures above 800ºC only) • Maintenance program – are maintenance issues dealt with promptly? • Ensure burn times are sufficient to reduce waste ash volumes					
Costs ($US)	• Establishment – High (approx.. $50-100,000 for high temperature unit (Honiara and Kirakira) plus siting, $10-15,000 for maintenance repair and construction of incinerator operating site; • Ongoing – medium (fuel and maintenance)					
Recommendation 5: Appropriate Storage Facilities						
Description	• As a high priority procure contractors to design and develop a healthcare waste storage facility as per Appendix C and Appendix E at the Honiara National Referral Hospital, Gizo Hospital and Kirakira hospital. • As a high priority procure contractors to design and develop a healthcare waste storage facility as per Appendix C and Appendix E at the Atoifi Hospital, Kilu'ufi Hospital and Munda hospital.					
Output	A disposal system that reduces the potential hazard posed by health-care waste, while endeavoring to protect the environment (**meet minimum standards outlined in** Appendix C and Appendix E).					
Monitoring & Evaluation Indicators	Suitability of storage areas regularly assessed by 'responsible officer' of waste management committee.					
Costs ($US)	• Establishment - Medium$US5-15,000 per health storage facility. • Ongoing – low – monitoring and maintenance.					
Recommendation 6: Procurement of Consumables (PPE)						

Table 9: Recommendations for Solomon Islands **Applicable to:**	**Honiara National Referral Hospital**	**Gizo Hospital**	**Helena Goldie Hospital**	**Kilu'ufi Hospital**	**Atoifi Hospital**	**Kirakira Hospital**
Description	• Supply appropriate PPE, in particular overalls/protective clothing, and eye protection for all waste handlers. • Incinerator staff are provided with additional PPE such as face masks and noise protection.					
Output	Adequate supply of PPE for protection of waste handlers					
Monitoring & Evaluation Indicators	• PPE is provided to all staff and staff are aware on how to protect themselves from injuries and infectious wastes • Zero Needle Stick Injuries.					
Costs ($US)	Establishment – Low; Ongoing - Low, sustainably funded by country					

8.1 Recommendation 1: Develop a Waste Management Framework

1. Develop a **Healthcare Waste Management Plan** specific to each hospital, including technical guidelines and procedures relating to waste management and if not already present, infection control.

2. Appoint an **officer responsible (Infection Control Officer)** for the development and implementation of the Healthcare Waste Management Plan

3. Establish a **waste management committee**, appropriate to the scale of the facility.

A **Healthcare Waste Management Plan**, specific to each healthcare facility outlining waste definitions and characterisation, segregation techniques, containment specifications and storage practices, collection and transport, treatment and disposal and emergency procedures should be developed as an overarching document to guide healthcare waste management processes and procedures at each healthcare facility.

The Management Plan should be developed in accordance with any waste strategies the Solomon Island government has developed or is planning to develop. Ministry of Commerce, Industry and Environment and the Ministry of Health and Medical Services should be consulted on the drafting of the waste management plan, to ensure policy and legislative needs are considered.

A responsible officer or **waste management officer** would be responsible for the day-to-day operations and monitoring of the waste management system and is usually established as a separate post in larger hospitals (however, one appointee could be responsible for the waste management performance for a number of hospitals with a stated time fraction allocated to each hospital). It is important that the waste management officer be adequately resourced to enable them to undertake their role as well as supported by hospital management to ensure that all staff recognise the importance of adopting waste management practices that are in accord with all requirements.

A **waste management committee** has representatives from a broad range of departments and meets at least twice per year. A clear set of objectives has been developed for this committee. It reports to the senior management of the hospital.

8.1.1.1 Short Term (0-6 months)

- Identify existing documents and systems that may have been used in the past
- Responsible officer or healthcare waste management committee set up as part of infection control.
- Definitions of responsibilities and key accountabilities of responsible officers and Waste Management Committee developed for inclusion in Waste Management Plan.

8.1.1.2 Medium Term (6 months-1 year)

- Formulate a Draft Waste Management Plan drawing on the results of this ‘Baseline Assessment’ (i.e. present situation, quantities of waste generated, possibilities for waste minimization, identification of treatment options, identification and evaluation of

waste-treatment and disposal options, identification and evaluation of record keeping and documentation and estimations of costs relating to waste management)

- The draft discussion document would be prepared in consultation with hospital staff, and officials from the relevant government agencies.

8.1.1.3 Long Term (1year-3 years)

- Finalise the Waste Management Framework
- Continually improve the mandatory standards of healthcare waste management
- Implement a program to ensure waste audits are conducted of all waste materials/systems in all wards/departments on an annual basis and reports are provided to the waste management committee. Effective systems are in place to ensure that any non-conformances (with the hospital waste management strategy) are remedied.

8.2 Recommendation 2: Procurement of Consumables (Segregation & Storage)

Waste should be collected in accordance with the schedules specified in the Waste Management Plan (Recommendation One).The correct segregation of healthcare waste is the responsibility of the person who produces each waste item, whatever their position in the organisation. The healthcare facility is responsible for making sure there is a suitable segregation, transport and storage system, and that all staff adhere to the correct procedures. Labeling of waste containers is used to identify the source, record their type and quantities of waste produced in each area, and allow problems with waste segregation to be traced back to a medical area.

8.2.1.1 Short Term (0-6 months)

- Procurement of in-hospital healthcare waste management consumables including:
    - Colour coded bins and bin liners (even though Honiara, Gizo have colour coded bin it would be more beneficial if all the hospital had the same bins to assist in developing guidelines and management plans).
    - Wheelie bins ((even though Honiara, Gizo have colour coded bin it would be more beneficial if all the hospital had the same bins to assist in developing guidelines and management plans).
    - Classification and segregation signage as well as instructional posters to promote good healthcare waste management practices (all hospitals)
- Procurement plan developed to ensure the sustainable supply of healthcare waste management resources.

8.2.1.2 Medium Term (6 months-1 year)

As per short term above.

8.2.1.3 Long Term (1-3 years)

Consumables to be supplied from in-country health agency budgets.

8.3 Recommendation 3: Provide a Sustainable Training Program

Development and delivery of a structured healthcare waste training program to all hospital personnel as well as personnel from other stakeholders (e.g., government health and environment agencies).

This could be facilitated/ delivered by SPREP staff, or outside trainers, or a combination of both, as no competent healthcare waste management training capability exists in the Solomon Islands.

Training should be coordinated with other countries' needs in the region.

All staff and contractors should attend a waste management training session. This is to be conducted during all induction programs in the first instance. For those staff and contractors currently employed on-site, they will be required to attend a dedicated training session so that they are fully aware of their roles and responsibilities in respect to waste management. Records shall be maintained of all staff and contractors attendance at a training session to ensure that all personnel attend.

8.3.1.1 Short Term (0-6 months)

- Identify potential trainers and build training skills
- Develop a budget for long term training delivery
- Identification and prioritization of employees that need to be trained
- Defining the specific learning objectives for each target audience
- Develop a detailed curriculum specifying the training plan for each session.

8.3.1.2 Medium Term (6 months-1 year)

- Explore incentives for training (e.g. training in collaboration with a health professional society or university that can award certificates or professional credentials)

8.3.1.3 Long Term (1 year-3 years)

- Continually improve the mandatory standards of healthcare waste management
- A continuing audit program be implemented to identify incorrect waste management practices and results of such audits communicated to staff in all wards/departments. Results from these audits and corrective actions to be reported to the facility waste management committee

8.4 Recommendation 4: Improved Treatment Infrastructure

Wastes should be treated and disposed of accordingly to ensure the infectious hazard is destroyed. Given the varying sizes in hospital and resources available, each hospital should be approached differently in terms of the way healthcare waste is treated.

• Procurement of a new incinerator for **Honiara National Referral Hospital** and **Kirakira Hospital.**

• Repair of existing incinerator for **Gizo, Helena Goldie (Munda) and Atoifi hospitals** as well as the development of an incinerator operations area (fenced off, roofed, paved etc.).

All Hospitals with incinerators – Provide training, maintenance contracts and operation procedures for all incinerators.

8.4.1.1 Short Term (0-6 months)

- Identify siting location for new incinerators Honiara National Referral Hospital and Kirakira Hospital (high priority)
- Procurement of a new incinerator for Honiara National Referral Hospital and Kirakira Hospital (high priority)

(a) Medium Term (6 months-1 year)

- Repair of existing incinerator for Gizo, Helena Goldie (Munda) and Atoifi hospitals as well as the development of an incinerator operations area (fenced off, roofed, paved etc.) (high priority).
- *Using appropriate PPE*, immediately gather up and treat backlog of sharps and medical waste at the Gizo Hospital (high priority).
- Develop procedure for the training, maintenance and operation of the incinerator as well as contacts should a problem occur (medium priority).

(b) Long Term (1-3 years)

- Ongoing incineration system maintenance support
- Recording of waste treatment quantities and operating conditions (e.g. burn temperatures per batch)
- Maintain training of operators as required.

8.5 Recommendation 5: Appropriate Storage Facilities

Storage areas for healthcare waste should be designated within the healthcare facility. Storage facilities should be labeled in accordance with the hazard level of the stored waste and should be designed to prevent the risk of infection risk and environmental harm. Spill Kits for healthcare and cytotoxic waste should also be located in the storage areas.

It was evident from the hospitals visited in the Solomon Islands that public access is generally unrestricted and feral animals and vermin such as dogs and rats are common therefore it is important that waste is storage is kept in a manner that restricts access to such beings.

The storage areas are fenced, lockable, paved and suitably designed and isolated from patients, public and animals (as described in **Appendix E**).

8.5.1.1 Short Term (0 – 6 months)

- Procure contractors to design and develop a healthcare waste storage facility at the Honiara, Gizo and Kirakira Hospital as a high priority.

8.5.1.2 Medium Term (6 months – 1 year)

- Procure spill kits for each central storage area.

8.5.1.3 Long Term (1 year – 3 years)

- Procure contractors to design and develop a healthcare waste storage facility at the Helena Goldie and Atoifi hospital as a medium priority.
- Monitoring and maintenance of waste storage facilities.

8.6 Recommendation 6: Procurement of Consumables (PPE)

All waste handlers are provided with and use appropriate PPE including overalls/protective clothing, gloves and eye protection. Incinerator staff are provided with additional PPE such as face masks and noise protection.

8.6.1.1 Short Term (0-6 months)

- Procurement of in-hospital healthcare waste management PPE including overalls/protective clothing, gloves and eye protection
- Incinerator staff are provided with additional PPE such as face masks and noise protection
- Procurement plan developed to ensure the sustainable supply of healthcare waste management resources.

8.6.1.2 Medium Term (6 months-1 year)

- A system is set up to monitor correct use of PPE.

8.6.1.3 Long Term (1-3 years)

Nil.

Appendix A

Photo Log

Appendix B

Collected Data from Hospital Audits in Solomon Islands

Hospital Name	Honiara National Referral Hospital		Gizo Hospital (opened 2013)		Helena Goldie Hospital		Kiluufi (Auki) Hospital		Atoifi Hospital		Kirakira Hospital	
Contact Name & Position	Rolly Vigar	Infection Control Unit	Hugo Loseni	Infection Control	Andrew Telo	Hospital Manager	Nixon Olofisau	Infection Control Officer	Peggy Kendall	Hospital Director	Marcel Weape	Infection Control Officer
Email	vigarolly@gmail.com		hfloseni@gmail.com		Not provided		nolofisau@gmail.com		peggykendall9@gmail.com		Not provided	
Phone	+677 7775441		+677 7466753		'+677 62019		+677 7480781.		8619289		00677 50100.	677 7592496.
Summary of Services Provided	Paediatric Ward; Medical Ward; Gynaecology Ward; Anti-Malaria Ward; Post Natal Ward; Surgical; Emergency Ward; TB Ward; Rehabilitation Ward; Orthopaedic ward; Standby Isolation Ward; dental clinic; diabetic clinic.		Male/children ward; female/gynaecology ward; and maternity ward.		General Ward; maternity ward; children's ward.		Maternity ward; male ward; female ward; children ward; isolation ward (TB) ward; outpatients ward. Plus - emergency care unit; laboratory; eye department; dental clinic; physiotherapy unit; mental unit.		Maternity ward; male ward; female ward; children ward; TB ward; nursery theatre; HDU ward; emergency room; outpatients ward; eye services; dental clinic; pathology services; pharmacy services.		Medical Ward (female and male); Post Natal Ward; Surgical/medica (male and female); Emergency Ward; TB Ward (male and female); Post Natal Ward;	
Pop Served	93,000		6,154 (Gizo town). Referral Hospital for the Western Province - 76,649		Western Province - 76,649		Malaita Province - 132,00		Eastern Region of Maliaita Province - 23,000		45,000	
No. of Beds	360		82		65		148		45		70	
OBD's [1]			40%		30%		40%		50%		50%	
No. Operations							900		293		24	
No. of Births[2]			660		433		908		255		1,159	
Emergency Patients Attended[2]							Not known		Not known		130	
Out-Patients Attended[2]					8680		19,741		15,547		1,300	
No of Staff	310		69		58		101		65		58	
Estimates	Volumes (kg/wk)	Cost ext. ($US)	Volumes (kg/wk)	Cost ext. ($US)	Volumes (kg/wk)	Cost ext. ($US)	Volumes (kg/wk)	Cost ext. ($US)	Volumes (kg/wk)	Cost ext. ($US)	Volumes (kg/wk)	Cost ext. ($US)
Healthcare Waste	2,500	Not known	600	Not known	Not known	Not known	250	$ 235.00	1,050	Not known	450	Not known
Sharps	refer above	Not known	189	Not known	Not known	Not known	17.5	$ 32.00	10	Not known	25	Not known
Pharmaceutical	refer above	Not known	Not known	Not known	Not known	Not known	Not known	$ -	Not known	Not known	Not known	Not known
Cytotoxic	Not known	Not known	0	N/a	0	N/A	0	N/A	0	N/A	0	N/A
General	Not known	Not known	600	Not known	Not known	Not known	250	$ 80.00	Included in Medical waste	Not known		Not known
Recycling	N/A	Not known	20	Not known	Not known	Not known	10	$ -	Not known	Not known		Not known
TOTAL	2500	$ -	1409	$ -	0	$ -	527.5		#NAME?	$ -		
Dedicated Containers/ Bags	Y		Y		N		Y		N		N	
Colour Coding	Y		Y		Y		N		N		N	
Sharps segregated & secure	Y		Y		Y		Y		Y		Y	
Signage Present	N		Y		N		N		N		N	
Degree of manual handling of bags	High		Medium		High		High		High		High	
Internal Transport Mode	Wheelie Bin		Trolley		Manual		Manual		Manual		Manual	
Spill Kit Present	N		Y		N		N		N		N	
Dedicated & Appropriate Area	N		N		N		N		N		N	
Loading/unloading acceptable	N		N		N		Y		Y		N	
Spill Kits Present	N		Y		N		N		N		N	
Monitoring & record keeping occurs	N		N		N		N		N		N	
Treatment per Waste Stream	Tech. Type	Int/Ext	Tech. Type	Int/Ext	Tech. Type	Int/Ext	Tech. Type	Int/Ext	Tech. Type	Int/Ext	Tech. Type	Int/Ext
Healthcare Waste	Landfill (without treatment)	External	Incinerate (internal)	Internal	Landfill (without treatment)	External	Incinerate (internal)	Internal	Incinerate (internal)	Internal	Bury off site	Internal
Sharps	Landfill (without treatment)	External	Incinerate (internal)	Internal	Landfill (without treatment)	External	Incinerate (internal)	Internal	Incinerate (internal)	Internal	Incinerate (internal)	Internal
Pharmaceutical	Chemical/Maceration	External	Incinerate (internal)	External	Landfill (without treatment)	External	Incinerate (internal)	Internal	Chemical/Maceration	Internal	Chemical/Maceration	Internal
Cytotoxic	Burn off site	External										
General	Landfill (without treatment)	External	Landfill (without treatment)	External	Landfill (without treatment)	External	Landfill (with treatment)	Internal	Incinerate (internal)	Internal	Landfill (without treatment)	External

If incinerator present	Yes but it is a broken down incinerator from Gizo Hospital		Two incinerators		Yes - stopped using in 2011 due to the public access the incinerator to regularly.		Yes		Yes		Yes	
Make, Model, Year commissioned	Medi Burn, Elastec, American Marine, Serial No: MBQ469		UHT-300 II 0 UCHIMURA GUM CO. LTD (Made in Japan. Diesel.		No name.		Locally made - iron		Locally made - iron		Wood fired - no name	
Operating Temp (^{0}C)	~1000		Not known		Not known		Not known		Not known		Not known	
No. chambers	2		1		1		1		1		1	
Condition	Broken down		Reasonable		Poor		Poor		Poor		Reasonable	
	Per week	Per year	Per week	Per year	Per week	Per year	Per week	Per year	Per week	Per year	Per week	Per year
Waste Throughput (tonnes)	~150kg		400kg				300kg		300kg			
Operating Hours (hr)	N/A		4		N/A		2		2		4hrs	
Fuel	Electric		Wood		Wood		Wood		Wood		Wood	
Fuel use (kg/litres)	Not known		Not known		Not known		Not known		Not known		Not known	
Fuel use per kg waste burnt	Not known		Not known		Not known		Not known		Not known		Not known	
Technology siting and operation issues	Not known. Believed to be tsunami related issues.		Wet, windy, uncovered and close to residents.		Public are able to access the incinerator area. The area has now become overgrown and derelict.		Incinerator does not get hot enough and fumes enter the hospital due to low heat and low stack.		Incinerator does not get hot enough and fumes enter the hospital due to low heat and low stack.		Wet, uncovered and close to residents and hospital ward.	
Offsite transport assessment	Fair		Fair		Poor		Fair		Poor		Poor	
Waste Management Policy	N		N		N		N		N		N	
Waste Management Plan	N		N		N		N		N		N	
Waste Management Procedure	N		N		N		N		N		N	
Waste Management Committee	N		N		N		N		N		N	
Infection Control Policy	N		N		N		Y		N		N	
Infection Control Procedures	N		N		N		N		N		N	
Audit Program	N		N		N		N		Y		N	
What is audited	Segregation	N	Segregation	N	Segregation	N	Segregation	N	Segregation	N	Segregation	N
	Compliance P&P	N	Compliance P&P	N	Compliance P&P	N	Compliance P&P	N	Compliance P&P	N	Compliance P&P	N
	Int. transport	N	Int. transport	N	Int. transport	N	Int. transport	N	Int. transport	N	Int. transport	N
	Storage	N	Storage	N	Storage	N	Storage	N	Storage	N	Storage	N
	Treatment/ disposal	N	Treatment/ disposal	N	Treatment/ disposal	N	Treatment/ disposal	N	Treatment/ disposal	N	Treatment/ disposal	N
Frequency	N/A		N/A		N/A		N/A		N/A		N/A	
Training Program	Y		N		Y		N		Y		Y	
Curricula	Infection Control	Y	Infection Control	N	Infection Control	Y	Infection Control	N	Infection Control	Y	Infection Control	N
	Waste Mgt	Y	Waste Mgt	N	Waste Mgt	N	Waste Mgt	N	Waste Mgt	N	Waste Mgt	Y
	PPE	Y	PPE	N	PPE	N	PPE	N	PPE	Y	PPE	N
	Treat. Tech operation	Y	Treat. Tech operation	N	Treat. Tech operation	N	Treat. Tech operation	N	Treat. Tech operation	N	Treat. Tech operation	N
Duration / frequency of training	2 hours	Quarterly (or as required	N/A		1	Quarterly (or as required	N/A		Weekly		2 hours (occureced once 1 month ago from JICAR contracted infection control officer	
Records of who has been trained	Y		N		Y		N		Y		N	
Monitoring or refresher courses	N		N		N		N		N		N	
10 year projections for waste management	Feasibility study into waste storage facility.		Gizo is yet to build a permanent landfill.		Looking at a private ward.		Funding in the Hospital budget set aside to buy a new incinerator (US$27,000). Plans to implement a waste management policy. Plans to contruct a new on site landfill in a new location.		Constructed a new wood fired incinerator. Looking at a suitable location. Expaning infection control auditing to waste management.		Applying for funding for an incinerator.	
Barriers to change	Space		Space, financial resources.		Space, financial (charity funded hospital), education.		Technical advice and assistance (i.e. type of incinerator to purchase). Funding		Funding - hospital predominatley relies on donations with some Government assistance.		No suitable location. No room at hospital, residents complain and negoiations with land owners	
Other issues	Limited space. Hospital is located adjacent to the sea has been rising noticable over the last 10 years.		Rain and exposed waste storage facility is making burning of the waste difficult.		Remote location		Rain and exposed waste storage facility is making burning of the waste difficult.		Limited space for the landfill due to no available public space. Remote location (no road access) makes supplies difficult.		Diesedl is expensive for disel incinerator	
Potential in-country contractors	Who	Key Capability	Who	Key Capability	Who	Key Capability	Who	Key Capability	Who	Key Capability	Who	Key Capability
	BioMed services in Honiara (incinerator servicing)	Treatment	BioMed services in Honiara (incinerator servicing)	Treatment	BioMed services in Honiara (incinerator servicing)	Treatment	BioMed services in Honiara (incinerator servicing)	Treatment	BioMed services in Honiara (incinerator servicing)	Treatment	BioMed services in Honiara (incinerator servicing)	Treatment

Appendix C

Minimum Standards Assessment

HEALTHCARE WASTE - MINIMUM STANDARDS FRAMEWORK & ASSESSMENT FOR SOLOMON ISLANDS										
Scale	**Category**	**Item**	**Minimum Standard Criterion**	**Honiara National Referral Hospital**	**Gizo Hospital**	**Goldie Hospital**	**Kilu'ufi Hospital**	**Atoifi Hospital**	**Kirakira Hospital**	**Overall**
National Authority	National Legislation	Definitions	A clear definition of hazardous healthcare wastes and its various categories has been developed and used by generators.							
National Authority	National Legislation	Annual Compliance Reporting	Hospitals required to annually report on waste generation and management							
	National Legislation	Technical Guidelines	Practical and directly applicable technical guidelines							
National Authority	Regulations	Annual Compliance Reporting								
National Authority	Policy	National healthcare waste management plan	A national strategy for management of healthcare waste has been published and is up to date (ie., within 5 years) and hospitals required to adhere to its requirements							
Healthcare Facility	Policy	Infection Control	Infection control policy incorporates principles of waste management within it							
Healthcare Facility	Policy	Waste Management Plan	Has been developed by the hospital and is based on a review of healthcare waste management and is current (within 5 years)							
Healthcare Facility	Responsible Person		An officer has been appointed to assume responsibility for waste management within the hospital, and has been allocated sufficient time and resources - this person could have waste management as part of other duties							
Healthcare Facility	Management Committee		A waste management committee has been formed that has representatives from a broad range of departments and meets at least twice per year. A clear set of objectives has been developed for this committee. It reports to the senior management of the hospital.							
Healthcare Facility	Signage		Signs are located in all wards/department areas where waste bins are located indicating the correct container for the various waste types							
Healthcare Facility	Segregation		Waste are correctly segregated in all wards/departments with use of containers that are colour coded for the different waste types							

Healthcare Facility	Containers		All areas have dedicated waste containers are suitable for the types of waste generated. All waste containers are colour coded and have correct wording on them. Sharps are deposited into containers that reduce potential for needle-stick injury							
Healthcare Facility	Storage	Interim storage in healthcare facility	Storage areas at ward/department level should be secure and located away from public areas. Storage areas should be sufficient in size to allow waste to be segregated and so as to avoid waste of different classifications being stored together.							
		Storage before treatment	Meets the standards stated in Appendix E, Recommendation 2, *Correct Storage*.							
Healthcare Facility	Internal Handling	Transport Trolley	A dedicated trolley is used for waste transport. The trolley is designed so that any spills are contained.							
	Internal Handling	Routing	Healthcare waste is not transported where clean linen and/or food are transported							
Healthcare Facility	Training	Planning and implementation	A structured waste management education program has been developed with a clear delivery structure							
Healthcare Facility	Training	Curricula	A structured waste management training program has been developed that targets the different roles within the hospitals.							
Healthcare Facility	Training	Follow-up & refresher courses	All staff receive waste management education during induction. All staff receive refresher training annually. Waste management training is delivered following an adverse incident to the relevant staff/ward/department.							
Healthcare Facility	Training	Training responsibility	A hospital officer has responsibility for ensuring all training occurs as required and that records are maintained of all training and attendance.							
Healthcare Facility	Waste Audits		A program has been implemented to ensure waste audits are conducted of all waste materials/systems in all wards/departments on an annual basis and reports are provided to the waste management committee. Effective systems are in place to ensure that any non-conformances (with the hospital waste management strategy) are remedied.							

Healthcare Facility	Transport - External		A dedicated vehicle is used to transport untreated healthcare waste. This load carrying area of the vehicle is enclosed and constructed so that any spilt material is contained within this area. A split kit is provided.								
Healthcare Facility	Treatment	Suitability of treatment for healthcare waste	The method for treating healthcare waste is in accord with required standards - this includes operating parameters and location of the treatment unit.								
Healthcare Facility	Economics	Cost Effectiveness	A process has been developed that cost all aspects of waste management and these costs are reported annually to the waste management committee.								
Healthcare Facility	Occupational Health and Safety	PPE	All waste handlers are provided with and use appropriate PPE including overalls/protective clothing, gloves and eye protection. Incinerator staff are provided with additional PPE such as face masks and noise protection. A system is in place to monitor correct use of PPE.								
Healthcare Facility	Occupational Health and Safety	Staff risk	Waste containers, locations, storage and management procedures for healthcare waste incorporate identified risks to staff in accessing the waste and/or having needle-stick injuries.								
Healthcare Facility	Occupational Health and Safety	Patient/Visitor risk	Waste containers, locations, storage and management procedures for healthcare waste incorporate identified risks to patients and visitors in accessing the waste and/or having needle-stick injuries.								
Healthcare Facility	Healthcare waste management emergencies	Spill Prevention and Control	Spill kits are provided or all types of healthcare waste in all wards/departments, storage areas and on trolleys and vehicles. Staff are trained on the use of spill kits. All incidents of spills of healthcare waste are investigated and where appropriate remedial actions implemented.								
Healthcare Facility	Future Planning	Planning for change	Hospitals have developed a process to benchmark waste generation so as to (amongst other requirements), plan of future hospital development in terms of services and numbers of patients.								
Local Council	Waste Treatment Facility	Landfill	Healthcare waste is disposed of at a dedicated location and covered immediately on arrival. Scavengers cannot access untreated healthcare waste.								

* The minimum standards framework is drawn from the *Industry code of practice for the management of biohazardous waste (including clinical and related) wastes*, Waste Management Association of Australia (2014), Draft 7th edition, taking into account the Pacific Island hospital and environmental context

Appendix D

Qualitative Local Feasibility Assessment – Treatment Technology

Table D1: QUALITATIVE Treatment Technology Options Assessment - Local Feasibility (Solomon Islands)

Remaining Technology Options	Comparatively low cost to implement	Comparative effectiveness across all HCWs	Local Feasibility							
			Health & safety to workers & community	Sustainability of solution	Institutional and policy fit	Cultural fit	Implementation barriers can be overcome?	Receiving environment not impacted	Durability	Ease of operation
Incineration at high temperature (>1000^{0}C)	$211,460 USD over 10 years (ref Whole of Project – Summary Report, Appendix E)	Most effective – can treat all waste types and achieves complete sterilization, complete combustion and destroys waste	Some issues for operators (requires training & PPE); some potential issues for community (potential for smoke, some controlled emissions)	Equipment lifespan ~ 10 years plus; sustainability dependant on maintaining operator skills plus proper operation and maintenance	No legal barriers to incineration; loses a point for potential for smoke nuisance and the potential for minor contribution to combustion derived POPs – The Solomon Islands is a party to Stockholm	Burning of rubbish is historically accepted & widely practised in The Solomon Islands. Incinerators are/ have been previously used in hospitals	Equipment breakdown and lack of local skills to maintain equipment – real barrier but can be managed through skills training & supplier support	Emissions of air pollutants and leaching from ash disposal to receiving environment are potential impacts. High temp operation minimises pollution & proper landfilling of ash restricts leaching.	Equipment lifespan ~ 10 years plus but will only last if maintained. High temperature equipment is prone to require a moderate level of maintenance	Requires skilled operators but modern equipment combined with training simplify operation
Incineration at med. temperature (800 - 1000^{0}C)	$69,820 USD over 10 years (ref Whole of Project – Summary Report, Appendix E)	Can treat all waste types, achieves complete sterilization, incomplete combustion, may not destroy needles	Some issues for operators (requires training & PPE); potential issues for community (smoke, emissions not fully controlled)	Equipment lifespan ~ 5 years; sustainability dependant on maintaining operator skills plus proper operation and maintenance	No legal barriers to incineration; potential for smoke nuisance is med - high and the potential for contribution to combustion	Burning of rubbish is historically accepted & widely practised in The Solomon Islands. Incinerators are/ have	Equipment breakdown and lack of local skills to maintain equipment – real barrier but can be managed through skills training & supplier support. Simpler	Emissions of air pollutants/ smoke and leaching from ash disposal to receiving environment are potential impacts. Med. temperature	Equipment lifespan typically less ~ 5 years but will only last if maintained. Equipment is prone to require a moderate level	Requires less skilled operators than high temperature equipment - training simplifies operation

Table D1: QUALITATIVE Treatment Technology Options Assessment - Local Feasibility (Solomon Islands)										
Remaining Technology Options	**Comparatively low cost to implement**	**Comparative effectiveness across all HCWs**	**Local Feasibility**							
			Health & safety to workers & community	**Sustainability of solution**	**Institutional and policy fit**	**Cultural fit**	**Implementation barriers can be overcome?**	**Receiving environment not impacted**	**Durability**	**Ease of operation**
					derived POPs & other pollutants is high – The Solomon Islands is a party to Stockholm	been previously used in hospitals	infrastructure.	operation increases risks of air pollution, but not likely to be an issue in isolated small communities.	of maintenance	
Low temperature burning (<400^{0}C)	$6,485 USD over 10 years (ref Whole of Project – Summary Report, Appendix E)	Not applicable for all waste types, relatively high disinfection efficiency, incomplete combustion, will not destroy needles	Some issues for operators (requires training & PPE); issues for community (smoke, emissions not controlled at all)	No equipment; sustainability dependant government & community acceptance which would be expected to decline with time	Potential for smoke nuisance is very high and the potential for contribution to combustion derived POPs & broader range of other pollutants is very high – The Solomon Islands is a party to Stockholm	Burning of rubbish is historically accepted & widely practised in the Solomon Islands.	No equipment operation reliability barrier; burning rubbish common practice in the Solomon Islands.	Emissions of air pollutants/ smoke and leaching from ash disposal to receiving environment are potential impacts. Low temperature operation provides no controls on air pollution. Risk of fire impact.	Simple, zero technology so there is nothing that can break down	Simple, zero technology so there is nothing that can break down and no specific training is required other than health and safety.

Table D1: QUALITATIVE Treatment Technology Options Assessment - Local Feasibility (Solomon Islands)

Remaining Technology Options	Comparatively low cost to implement	Comparative effectiveness across all HCWs	Local Feasibility							
			Health & safety to workers & community	Sustainability of solution	Institutional and policy fit	Cultural fit	Implementation barriers can be overcome?	Receiving environment not impacted	Durability	Ease of operation
Autoclave with shredder	$158,000 USD over 10 years (ref Whole of Project – Summary Report, Appendix E)	Cannot treat all waste types, achieves complete sterilization when correctly operated, no combustion required, shredder destroys needles	Some issues for operators (requires training & PPE); small potential for odours and wastewater discharge (community)	Equipment lifespan ~ 10 years; sustainability dependant on maintaining operator skills plus longevity of equipment use given technology complexity	No legal barriers; no potential for smoke nuisance; some potential for odour nuisance; no air pollution (no combustion-POPs) and some potential for waste water management issues	Not familiar with use of sterilisers for waste – potential community issue with waste appearance if steriliser not operated correctly or shredder not used	Equipment breakdown and lack of local skills to maintain equipment – real barrier but can be managed through skills training & supplier support. Increased complexity of equipment (compared to incineration) increases barrier	No emissions of air pollutants/ smoke; some potential for odour impacts; still requires landfill or dump disposal so some potential for leaching on burial; some potential for waste water management issues. Larger residual waste compared to burning .	Equipment will only last if maintained. Adding shredder to autoclave technology increases mechanical parts that can go wrong. May require moderate level of maintenance	Requires skilled operators to achieve best level of disinfection.

Table D1: QUALITATIVE Treatment Technology Options Assessment - Local Feasibility (Solomon Islands)

Remaining Technology Options	Comparatively low cost to implement	Comparative effectiveness across all HCWs	Local Feasibility							
			Health & safety to workers & community	Sustainability of solution	Institutional and policy fit	Cultural fit	Implementation barriers can be overcome?	Receiving environment not impacted	Durability	Ease of operation
Encapsulation (only post-disinfection sharps assessed)	Virtually zero additional cost to disinfection system costs	Not applicable to non-sharps waste. In the context of pre-sterilised sharps only: no combustion required and completely removes downstream needle injury risk	Encapsulation has handling issues for operators (requires training & PPE) and no community issues	No equipment; sustainability dependant burial space available.	No legal barriers; no smoke nuisance; no odour nuisance; no air pollution and some potential for leachate to groundwater, although limited inherent hazard	No particular cultural fit concerns	Lack of public land available for burial. Limited space on the most of the hospitals already. .	Encapsulation itself poses no smoke nuisance; no odour nuisance; no air pollution and some potential for leachate to groundwater, although limited inherent hazard.	Highly durable due to its simplicity.	Simple procedure once operator understands and manages the risk of sharps handling and knows how to mix cement correctly.

Legend: Descriptions equate to the following scores:

	1. very low agreement with feasibility criteria
	2. low agreement with feasibility criteria
	3. moderate agreement with feasibility criteria
	4. high agreement with feasibility criteria
	5. very high agreement with feasibility criteria

Appendix E

Recommendation Guidelines

Recommendation 1: Develop a Waste Management Framework

Healthcare Waste Management Plan

Hospital waste management plans should incorporate strategic objectives of the national medical waste management strategy as well as the following information:

- Location and organisation of collection and storage facilities
- Overview of the purpose of, and design specifications:
  - Drawing showing the type of waste container to be used in the wards and departments (eg., sizes, colours and wording)
  - Drawing illustrating the type of trolley or wheeled container to be used for bag collection
  - Minimum specifications of sharps containers
- Required Material and human resources
- Responsibilities:
  - Including definitions of responsibilities, duties and codes of practice for each of the different categories of personnel of the hospital who, through their daily work, will generate waste and be involved in the segregation, storage and handling of the waste.
  - Definitions of responsibilities of hospital attendants and ancillary staff in collecting and handling wastes, for each ward and department.
- Procedures and practices
- Training
  - Description of the training courses and programs to be set up and the personnel who should participate in each.
- Implementation Strategy

It is important that it also is compatible with any National Waste Management Strategies to ensure consistency of approaches such as with external transport and disposal of treated residues.

Appointment of a Responsible Officer

A responsible officer or waste management officer would be responsible for the day-to-day operations and monitoring of the waste-management system and is usually established as a separate post in larger hospitals (however, one appointee could be responsible for the waste management performance for a number of hospitals with a stated time fraction allocated to each hospital).

It is important that the waste management officer be adequately resourced to enable them to undertake their role as well as supported by Hospital management to ensure that all staff recognise the importance of adopting waste management practices that are in accord with all requirements.

Appointment of a Waste Management Committee

A waste management committee should also be established to provide guidance and support to the waste management officer and assist in implementation of developed actions. In larger hospitals, a separate waste management committee should be formed. For smaller hospitals, such a committee could be either part of the responsibility of another related committee (eg., infection control or quality assurance), or a sub-committee reporting back to this related committee.

This Committee should not necessarily undertake all activities themselves, but by the nature of the members and the professions/departments represented will ensure that there is a balanced approach to the investigations and analysis to ensure that patient and staff safety will not be compromised.

In addition, the Committee approach will enable advocates for such factors as environmental and economic performance to be heard in a balanced manner.

Waste Management Committee Members should serve for a minimum period of 2 years, with the option of reappointment.

The Waste Management Committee will work with hospital staff, stakeholders and the wider community to develop a culture of environmentally responsible waste management through information sharing and education.

Its members will ensure that waste management issues are considered on committees that deal with product evaluation, infection control and occupational health and safety, and in user groups such as Unit/Department Managers.

The Waste Management Committee should:

- Develop a waste management policy that meets current environmental legislation “due diligence” requirements. This policy is to include strategic directions for correct waste minimisation and management.
- Ensure that the hospital is meeting due-diligence requirements as specified by the Waste Management Team.
- Develop and implement a system to document waste and recyclable quantities on a spreadsheet to evaluate these quantities and therefore the waste minimisation programs that have been implemented, ensuring the results are circulated to all Unit managers/department managers on a regular basis.
- Review and submit subsequent reporting to Unit managers/department managers of the results of all implemented programs and trials.
- Work on implementing the most appropriate waste minimisation/management recommendations as agreed with hospital management and the Waste Management Team.

- Target in order the waste items that are contributing the most significant quantities of waste being generated and in particular waste segregation methods.
- Agree on the Waste Reduction targets for the hospital and outline the key objectives of the committee
- Review current work and waste management practices and develop waste management/minimisation initiatives.
- Conduct mini audits to review progress.
- Visually inspect waste and recycling containers to ascertain if staff are depositing appropriate items into them.

Recommendation 2: Procurement of Consumables (Segregation & Storage)

The correct segregation of healthcare waste is the responsibility of the person who produces each waste item, regardless of their position in the organisation. The healthcare facility is responsible for making sure there is a suitable segregation, transport and storage system, and that all staff adheres to the correct procedures.

Ideally, the same system of segregation should be in force throughout a country, and many countries have national legislation that prescribes the waste segregation categories to be used and a system of colour coding for waste containers. Colour coding makes it easier for medical staff and hospital workers to put waste items into the correct container, and to maintain segregation of the wastes during transport, storage, treatment and disposal. Colour coding also provides visual identification of the potential risk posed by the waste in that container.

Labeling of waste containers is used to identify the source, record they type and quantities of waste produces in each area, and allow problems with waste segregation to be traced back to a medical area.

Waste containers specification and siting

Containers should have well-fitting lids, either removable by hand or preferably operated by a foot pedal. Both the containers and the bags should be of the correct colour for the waste they are intended to receive and labeled clearly.

All containers should be able to adequately contain the wastes deposited into it – to prevent the possibility of spills.

Sharps should be collected in puncture proof and impermeable containers that are difficult to open after closure.

The appropriate waste receptacle (bags, bins, sharps containers) should be available to staff in each medical and other waste-producing area in a healthcare facility. This permits staff to segregate and dispose of waste at the point of generation, and reduces the need for staff to carry waste through a medical area. Posters showing the type of waste that should be disposed of in each container should be displayed on the walls to guide staff and reinforce good habits.

Segregation success can be improved by making sure that the containers are large enough for the quantities of waste generated at the location during the period between collections, as well as a collection frequency that ensures no container is overfilled.

Setting and Maintaining Segregation Standards

Segregation requirements and methods should be clearly set out in the waste-management policy of a healthcare facility. It is important that the waste-management policy is supported and enforced by senior staff and managers. Managers and medical supervisors should know the relevant legislation and understand how to implement waste audits.

The 'Responsible Person' or Waste Management Committee should be responsible for seeing that segregation rules are enforced and waste audits are carried out to quantify the amount of waste produced.

Correct Signage

Signage indicating correct waste segregation practices is a valuable tool to provide ongoing guidance to staff. The success of the waste/recycling system will depend on having a clearly identified container for each type of material. This is achieved by the use of colour coded containers, symbols and wording. In addition, signage must be placed so that those wanting to dispose of materials can clearly and readily identify which container to deposit such materials into.
Once designed, signs should be located on walls above all waste containers as well as on the container itself.

Correct Storage

The storage area should be signposted with the bio-hazard symbol and other labeling appropriate to the types of waste stored in the area (eg healthcare) and includes the following:

- The base should be an impervious surface (eg. concrete) surrounded by a bund appropriate to contain any spill.
- All loading/ unloading takes place within the bunded area in such a manner to ensure any spills are appropriately managed.
- The base and walls of bunded areas are free of gaps or cracks.
- No liquid waste, wash down waters or stormwater contaminated with biohazardous wastes are disposed of via the stormwater drainage system; and
- The bunded area drains to a sump or sewer to collect spills and wash waters. Cut-off drains, which drain to a sump, should be used instead of bunds if approved by the relevant authority.
- Loading/ unloading of waste is carried out in accordance with designated safe procedures, and relevant records are completed and maintained.
- Containers in which biohazardous waste are stored secured when loading/unloading is not taking place.

- Spill Kits for biohazardous waste located in the storage areas.

Storage for larger generators may involve a dedicated room that is constructed specifically for waste management, or could be via the use of appropriately sized mobile garbage bins (eg., 240 or 660 litre).

Conditions related to security of healthcare waste include the following:

(a) The operator shall ensure that loading/ unloading of waste is carried out in accordance with designated safe procedures, and relevant records are completed and maintained.

(b) Containers in which healthcare waste are stored shall be secured when loading/unloading is not taking place.

Spill Kits for healthcare and cytotoxic waste shall be located in the storage areas.

Recommendation 3: Provide a Sustainable Training Program

All waste management strategies (particularly resource management programs), rely on all staff to participate and co-operate in order to ensure that objectives are met. Staff therefore should receive appropriate training/education to understand the inherent hazard and risks posed of healthcare waste, and the importance of its management from generation to final treatment and disposal.

The Waste Management Committee (apart from ensuring staff education programs are developed and implemented), should also address other methodologies in order to ensure that staff receive information on waste reduction programs (eg., signage, information sheets and flow charts).

One of the initial steps for developing a structured training program is to gain management support from hospital administration. The development of a training program can be facilitated by establishing core competencies related to healthcare waste management.

In the development of a training program, the following should be considered:

- Conduct of a training needs analysis
- Identification and prioritisation of employees that need to be trained.
- Defining the specific learning objectives for each target audience.
- Develop a detailed curriculum specifying the training plan for each session.
- Incorporate pre-evaluation and post evaluation of learners, evaluation of trainers, follow-up activities, and documentation into the training program.
- Develop training content or adapt available training materials, tailor training content to specific target audiences.
- Identify potential trainers and build training skills
- Develop a budget and secure funding

- Explore incentives for training (e.g. training in collaboration with a health professional society or university that can award certificates or professional credentials)

The following is an outline of a Staff Waste Management Education Program that could be developed:

- Introduction to the session
- Importance of good waste/environment management/ infection control
- Waste management hierarchy
- Waste minimisation principles
- Brief overview of legislation pertaining to waste management
- Hospital policies on environment/waste management/ infection control/ needle stick injuries
- Overview of waste types
- Issues relating to waste reduction
- Management responsibilities
- Identification of, and hazards associated with the different types of wastes generated Importance of effective waste segregation
- Infection control and sharps management
- Waste, handling, packaging and disposal routes for the different types of wastes generated
- Questions

All staff and contractors should attend a waste management training session. This should be conducted during all induction programs in the first instance.
For those staff and contractors currently employed on-site, they should attend a dedicated training session so that they are fully aware of their roles and responsibilities in respect to waste management. Records should be maintained of all staff and contractors attendance at a training session to ensure that all personnel attend.

At a national and regional level, training programs could be in the form of train the trainer. The training of trainers approach allows rapid capacity building and widespread training outreach.

Training of Waste Disposal Treatment Operators

Incinerator/ healthcare waste treatment system operators should receive training in the following:

- Overview of healthcare waste management including risks and management approaches
- General functioning of the incinerator, including basic maintenance and repair training.

- Health, safety and environmental implications of treatment operations
- PPE, its correct use and removal and cleaning (if appropriate)
- Technical procedures for operation of the plant.
- Recognition of abnormal or unusual conditions
- Emergency response, in case of equipment failures.
- Maintenance of the facility and record keeping
- Surveillance of the quality of ash and emissions.
- Disposal of residues

Recommendation 4: Improved Treatment Infrastructure

The healthcare waste stream is diverse in that it contains a variety of chemical substances, organic materials, plastics, metals and materials that are potentially contaminated with pathogenic substances. The primary aim of treating this waste stream is to ensure that there is no potential negative impact to human health or the environment as a consequence of the components of this waste not being treated adequately.

This means that the treatment process should render the waste material so that there are no pathogens likely to cause harm as well as be conducted in a manner that reduces any environmental consequences.

There are a number of treatment processes for healthcare waste. However, not all of these are able to treat all types of healthcare wastes. Materials such as pharmaceuticals, cytotoxic and anatomical wastes can only currently be treated by incineration. Therefore, when selecting a process to treat healthcare wastes, the generator must be aware of the capabilities and limitations of each of the various treatment processes and ensure that only those wastes that can be thus treated are actually sent to such a facility, and the remainder sent to an incineration facility. This is part of any facilities due diligence process.

There are a number of means of treating healthcare waste that are in commercial use around the globe. The question arises as to what type of technology is best suited to meet the various waste categories/quantities generated, environmental requirements and that treatment is done safely and in a cost-effective manner. Treatment of healthcare wastes should achieve a change in the wastes biological or chemical hazard so as to reduce or eliminate its potential to cause disease or other adverse consequences, by meeting acceptable biological standards and to ensure that there is minimal adverse environmental impact in respect to water, soil, air and noise.

Management of wastes should be based on the **precautionary principle** in that a lack of data should not mean that options be undertaken when there is still a perceivable risk of damage (to human health or the environment). The literature and other sources of information have clearly demonstrated a need for maintaining incineration as the most preferred option for at least the treatment of pharmaceutical and cytotoxic wastes – if not other components such as microbiological specimens and body parts. Only one technology has been demonstrated to be able to effectively treat all categories of healthcare waste.

This technology is incineration (at high temperature, with sufficient residence time and appropriate air pollution control equipment).

A substantial amount of data exists on the emission generated from incinerators, but conversely, little studies have been conducted on all aspects of alternate technologies performance. While the literature is inconclusive on the requirements needed to effectively manage the blood and body fluid contaminated and infectious components of the waste streams, there does seem to be consensus that these hazardous components such as pharmaceuticals and cytotoxic wastes do need to be treated prior to final disposal to ensure there is no risks to the environment or health of humans and other species.

It is also very clear that there is little work been undertaken on the consequences of landfilling untreated healthcare waste, and in particular pharmaceuticals and cytotoxic wastes. The literature does relate to impacts resulting from untreated pharmaceuticals being discharged into the environment from hospital sewers and wastewater treatment plants and does indicate that there are potential negative environmental and health consequences. The implications of these studies could legitimately be applied to discharge of waters such as leachate or surface water runoff from landfills should these wastes be deposited untreated. According to the World Health Organization[11, 12], incineration is the preferred method for treating pharmaceutical and cytotoxic wastes. This is further supported by the United Nations[13, 14] in that they have also recommended incineration as the preferred method for treatment prior to disposal of pharmaceuticals and cytotoxic wastes. These recommendations are generally standard throughout the world in relation to these two specific waste types[15, 16].

There are other studies that have been conducted on what is referred to as “alternate treatment technologies”, and these have demonstrated that all of these technologies cannot effectively treat pharmaceutical and cytotoxic waste, with many also unable to treat anatomical waste.. Some jurisdictions do allow alternative means of treating anatomical waste prior to disposal to landfill, but these are by far in the minority and mostly related to ethical or religious rationales.

In Australia as an example where there is allowed a variety of treatment technologies for the range of clinical and related wastes, without exception, jurisdictions do not allow treatment

[11] World Health Organization Regional Office for Europe, EURO Reports and Studies 97, Management of Wastes from Hospitals and other Health Care Establishments, 1983.
[12] World Health Organization, Safe management of Wastes from healthcare Facilities, Geneva, 1999.
[13] United Nations Environment Programme – Technical Working Group on the Basel Convention, Draft Technical Guidelines on Biomedical and Health Care Wastes, 1999.
[14] Environment Australia, Basel Convention – Draft Technical Guidelines on Hazardous Waste: Clinical and Related Waste (Y1), March 1998.
[15] Health care Without Harm, Non-Incineration Treatment Technologies, August 2001.
[16] London Waste Regulation Authority, Guidelines for the Segregation, Handling, Transport and Disposal of Clinical Waste, 2nd Edition, 1994.

other than incineration for anatomical waste, pharmaceuticals and cytotoxic wastes[17, 18, 19, 20, 21, 22]. This is also quite evident in a review of Australian State/Territory environmental agency licence conditions for approved clinical and related waste treatment technologies. In countries that do allow landfilling of clinical and related wastes, often these two specific waste categories are specifically excluded from this option[23].

In summary, no publication from a government environmental or health agency, or any article reviewed advocated any other preferred form of treatment for pharmaceuticals and cytotoxic wastes than incineration. In most instances the preference for anatomical waste was also incineration.

Recommendation 5: Appropriate Storage Facilities

The following guiding principles should be applied for healthcare waste storage facility:

- Minimises the threat to health, safety or the environment. In particular preventing public and wildlife access and prevention and containment of any spills.

Specifically the following measures should be implemented

- Storage areas prior to disposal or treatment should be secure, lockable, hygienic and appropriately sign posted.
- Storage area is paved and bunded.
- Weather elements such as rain is prevented from making contact with healthcare waste. This could be in the form of a roofed facility or bins with lids.
- Siting is strategically selected to minimize any health risks. I.e. away from patients, the general public and healthcare activities such as laundry and the kitchen.
- Ensure all necessary equipment required to clean and disinfect the area in case of accidental spillage is easily available and accessible.

Recommendation 6: Procurement of Consumables (PPE)

Personnel Protective Equipment

The use of Personal Protective Equipment (PPE) should be a condition of employment for employees with waste management responsibilities. PPE is one aspect of a multifaceted

[17] National Health & Medical Research Council, National Guidelines for Waste Management in the Health Industry, Commonwealth of Australia, 1999.
[18] EPA Victoria, Draft Guidelines for the Management of Clinical and Related Waste, July 2003.
[19] NSW Department of Health, Waste Management Guidelines for Health care Facilities, August 1998.
[20] Queensland Government, Environmental Protection (Waste Management) Regulation, 2000.
[21] Australian/New Zealand Standard 3816:1998, Management of Clinical and Related Wastes.
[22] Australian and New Zealand Clinical Waste Management Industry Group, Industry Code of Practice for the Management of Clinical and Related Wastes, 3rd edition July 2000.
[23] Provincial Government of Gauteng (South Africa), Draft Health Care Waste Regulations, 11 September 2003.

program, designed to protect employees from injuries and unnecessary exposure to hazardous substances.

Other aspects of this program are:

- employee training
- engineering controls to reduce or eliminate known hazards
- administrative controls

The following is a list of the personal protective equipment that should as a minimum to be supplied for all waste handlers:

- Gloves
- Masks
- Safety glasses/eye shields
- Overalls/aprons
- Safety boots