Samoa Waste Audit Report

Samoa Waste Characterization and Situation Analysis Report

Analysis of Waste Generation and Disposal Data and a Review of the Current Waste Management Systems in Samoa

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WORLD BANK GROUP

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Executive summary

Waste is a global issue and is increasingly recognized as a major challenge for world communities. Proper waste management is essential for thriving societies, livable cities, and robust economies. In addition to the ongoing waste management issues of mainland countries, Pacific Island countries (PICs) are faced with a unique set of challenges – such as geographic isolation, vulnerability to climate change, high cost of transporting waste, limited availability of suitable land, and a small consumer base.

In 2018, the Pacific Region Infrastructure Facility (PRIF)[1] researched the benefits and challenges of establishing a regional recycling network[2] as Pacific Island Countries (PICs) move from a linear to a circular economy. Opportunities to improve social, environmental, and economic outcomes were identified. However, the absence of reliable data was a key constraint to both the design phase and to attracting public–private partnerships. As a result, a Pacific wide auditing program is being funded by a range of agencies including the United Nations Environment Programme (UNEP) and the South Pacific Regional Environment Programme (SPREP) (through the EU-funded PacWaste Plus Programme), with support from the Australian-funded Pacific Ocean Litter Project and the Pacific Regional Infrastructure Facility (PRIF). The aim of the series of audits is to gather data that is robust, reliable, current, and comparable across the region.

As part of this Pacific wide activity, The World Bank has been involved in waste data collection in Samoa, Kiribati, and Tonga. Asia Pacific Waste Consultants (APWC) was engaged to undertake this activity in 2020–2021. This technical report presents the results of the data gathering exercise in Samoa and is one of three reports.

The report presents the findings of the study and includes:

- An overview of the Samoan waste sector
- Regulations, strategies, and agreements
- Results of the 2020 waste audit
- Estimates of quantities and composition of waste generated across Samoa
- Current resource recovery
- Institutional arrangements, private sector engagement, and available infrastructure for both waste management and recycling.

1 https://theprif.org/what-we-do

2 https://www.sprep.org/attachments/Publications/Presentation/cprt-2018/resource-recycle-pacific-prif.pdf

The work was conducted in March 2020, immediately prior to the closing of Samoa's borders due to COVID-19, and continued after the reopening of borders in May 2020. This technical report completes Phase 1 of a three-phase process. Phase 2 comprises of an Institutional Capacity Assessment and Phase 3 comprises of a Feasibility Assessment of Establishing a Recycling Hub. It is anticipated the findings will provide the basis for future policy work, feasibility studies, and other waste management treatment options in Samoa.

Key findings

- Approximately 27,057 tonnes of waste are generated annually in Samoa
- Paper/cardboard and organic waste make up the largest categories of waste generated annually
- Waste generated greatly exceeds the amount reaching landfills
- Recycling activities are constrained by the country's remote location and lack of economies of scale
- A large proportion of organic waste is sustainably self-managed in rural communities, but remaining waste is burnt, buried, or dumped
- Systematic waste separation at source is generally non-existent
- Tafaigata landfill will require expansion
- Facilities for recovery and processing of recyclable or compostable materials are inadequate
- Samoa has the potential to contribute recyclable material to future recycling activities at a regional level.

Summary of audit activities

- 201 household samples collected and sorted
- 47 commercial samples collected and sorted
- Eight local government staff trained
- Data collected from two islands (Upolu and Savai'i)
- Landfill audit completed over the course of 14 days
- Data collected for:
  - › Household and commercial waste
  - › Stockpiles
  - › Recyclers
  - › Producers.

Waste generation rates – Upolu

- Waste generation in households:
  › 0.28 kg/person/day
- Waste generated by households:
  › 1.9 kg/household/day
- Waste disposed of at Tafiagata Landfill:
  › 0.27 kg/person/day.

Stockpiles in Upolu

- Most stockpiles are very small compared to the quantities reported to have been recovered and the quantities found to be imported
- 1–10+ years of used lubricating oil is currently stockpiled
- Stockpiled materials include 139 m^3 tires, 264 m^3 used lubricating oils, 3m^3 each of PET bottles and e-waste.

Materials of interest – generation

- Almost 27,057 tonnes of waste are generated annually in Samoa
- Paper and carboard make up the largest total at 6,258 tonnes per year, followed by end-of-life vehicles at 5,880 tonnes per year, and organics at 4,674 tonnes per year
- Hygiene waste accounts for 1,939 tonnes per year, followed by flexibles and film at 1,138 tonnes per year, and textiles at 1,085 tonnes per year
- Glass bottles and PET account for 724 and 577 tonnes per year respectively.

Landfill life

- 180,000 m^3 of waste resides in the landfill
- Engineered waste cells are full and waste is disposed in areas without a lining in place
- Without recovery of recycled materials, Tafaigata Landfill will reach capacity by 2032
- Recovering all recyclable material from the landfill may extend the lifespan by 18 years to 2050.

Reduction in waste going to landfill – bans

- Banned single-use plastic shopping bags represent 0.67 percent of the material currently entering the waste stream and approximately 180 tonnes per annum of material that will not be required to be managed at the landfill
- The MNRE strategy to not collect green waste from outside the main town areas is encouraging households to manage green waste at source and is successfully reducing waste to landfill.

Challenges for Samoa

- Separating recyclables at source generally does not occur
- Up to 50 percent of waste generated is not deposited at landfill
- Only 50 percent of households use the free collection services provided by the government
- Current market conditions have forced the closure of two recyclers in Samoa
- Data is not being captured for all incoming waste at Tafaigata Landfill.

Potential future interventions

- There is opportunity to recover recyclables through source separation. Estimates have been provided for 60 percent, 80 percent, and 100 percent recovery rates
- Existing recyclers could implement their own collection services for waste of interest and have appropriate infrastructure in place to conduct these collections
- Pending policy measures, such as a CDL, could increase the quantity of materials separated by 11,157 tonnes at a 60 percent recovery rate.

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List of acronyms

ADB	Asian Development Bank
APWC	Asia Pacific Waste Consultants
CDL	Container Deposit Levy
CDS	Container deposit scheme
DEC	Division of Environment and Conservation
EDF 11	Environment Development Fund
E-waste	Electronic waste
FAO	Food and Agriculture Organization of the United Nations
GPA	Global Programme of Action for the Protection of the Marine Environment from Land-based Activities
HDPE	High-density polyethylene
IFC	International Finance Corporation
JICA	Japan International Cooperation Agency
J-PRISM	Japanese Technical Cooperation Project for Promotion of Regional Initiative on Solid Waste Management
LDPE	Low-density polyethylene
LPB	Liquid Paper Board
MNRE	Ministry of Natural Resources and Environment
MoF	Ministry of Finance
NOAA	National Oceanic and Atmospheric Administration
OEC	Observatory of Economic Complexity
OLSSI	O Le Siosiomaga Society Inc.
PET	Polyethylene terephthalate
PICs	Pacific Island countries
POPs	Persistent organic pollutants
PP	Polypropylene
PPE	Personal protective equipment
PRIF	Pacific Region Infrastructure Facility
PS	Polystyrene

PUMA	Planning and Urban Management Agency
PVC	Polyvinyl chloride
SDGs	Sustainable Development Goals
SIDs	Small Island Developing States
SPREP	South Pacific Regional Environment Programme
SRWMA	Samoa Recycling and Waste Management Association
SWM	Solid waste management
SWOMP	Samoa Waste Oil Management Program
UN	United Nations
UNEP	United Nations Environmental Programme
UNCRD	United Nations Centre for Regional Development
USD	United States dollar
SAT	Samoan tala (local currency)

1. Introduction

1.1 Pacific waste management challenges

Waste is a global issue and is increasingly recognized as a major challenge for world communities. Proper waste management is essential for thriving societies, livable cities, and robust economies.

In addition to the ongoing waste management issues of mainland countries, Pacific Island countries (PICs) are faced with a unique set of challenges. PICs are extremely vulnerable to the impacts of climate change and severe weather events that can generate shock loads to normal waste levels. PICs have particularly challenging circumstances relevant to solid waste management and recycling networks, including:

- High costs of transporting waste to processing and disposal facilities from geographically isolated areas such as islands, including the high cost of skilled labor
- Limited availability of environmentally suitable land for the construction of waste management infrastructure
- High costs of servicing small and largely dispersed populations
- An inability to achieve critical mass (for efficiency and economic viability) due to a relatively small consumer base
- Relative financial disadvantage, where eight of the 15 countries studied are in the lower to middle Gross National Income (GNI) bracket.

PICs are also particularly vulnerable to the impacts of marine pollution as their economies, tourism, and way of life are intrinsically entwined with the health of the ocean. Addressing land-based and marine-based sources of pollution is therefore an ecological, social, and economic priority.

Globalization has had a substantial impact on the amount and diversity of waste generated within PICs, fueled by increasing affluence and consumer-based lifestyles. Many PICs have become heavily reliant on international development assistance and imported goods such as electronics, white goods, and vehicles that need to be disposed of safely at the end of the product's life cycle. Additionally, PICs import a significant proportion of their food, such as pasta, poultry, and tinned food, which require single-use packaging for transport. These imports are pricing locally produced, healthier foods out of the market and impacting on the health of islanders.[3]

[3] FAO. (2014). Pacific island countries urged to produce more healthy local foods at competitive prices [online], Available at www.fao.org/news/story/en/item/216189/icodeAccessed 13 July 2020.

Recycling is an important tool in combating the increasing volume and complexity of imported waste in island communities. Although it is possible to reclaim recyclable materials from the waste stream in PICs, the economic viability of shipping small quantities of low-value commodities over long distances for processing is a crucial challenge, with marine transportation costs accounting for as much as 30 percent of the commodity market value. Often extreme trade imbalances exist, with exports far outweighed by imports (SPREP, 2016),[4] leading to costly container repositioning (Asian Development Bank, 2007).[5] Poor segregation, especially in outer island communities, coupled with an absence of local demand for local recyclable goods, has resulted in a lack of available markets for recyclables across the Pacific.

Although solid waste management and specifically recycling and material recovery often require higher government expenditures and greater revenue collection from waste producers, the health and environmental costs of not collecting waste are many times higher than the cost of developing and operating simple, adequate waste management systems (Kaza et al., 2018). Therefore, there is a strong motivation to explore whether recycling systems can be developed for PICs.

1.2 Project background and objectives

Pacific Region Infrastructure Facility (PRIF)[6] is a multi-agency coordination mechanism aimed at improving the delivery of development assistance from donors and development partners to the infrastructure sector in the Pacific region.[7]

As part of its technical assistance activities, PRIF has been investigating the benefits, challenges, and feasibility of establishing a regional waste management and recycling network for the Pacific. It is expected that such an initiative would reduce the risk of plastic and toxic pollution from solid waste, which would lead to health improvements of PIC populations and have benefits for the economy.

A regional waste management and recycling network would also provide numerous opportunities for public–private partnerships. It aims to assert the efficiencies of treating waste through a regional-level intervention to increase economies of scale that could attract private sector investment and generate local employment.

4 SPREP. (2016). Cleaner Pacific 2025, Pacific Regional Waste and Pollution Management Strategy 2016–2025. SPREP.

5 Asian Development Bank. (2007).

6 PRIF supports infrastructure development and maintenance in Pacific Island Countries (PICs) through coordination and technical assistance. The PRIF Coordination Office (PRIF CO) is hosted by the ADB Pacific Liaison Coordination Office (PLCO) in Sydney, Australia. It follows procurement procedures and financial management in accordance with ADB practices.

7 Current PRIF partners are Asian Development Bank (ADB), Australian Department of Foreign Affairs and Trade (DFAT), European Investment Bank (EIB), European Union (EU), the Japan International Cooperation Agency (JICA), New Zealand Ministry of Foreign Affairs and Trade (NZMFAT), United States Department of State (US) and the World Bank Group.

An initial investigation conducted by PRIF identified several benefits of a regional waste management and recycling network, in addition to existing regulatory constraints of each PIC. This study informed the publication of Pacific country profiles regarding solid waste management and recycling.[8] A shared methodology was developed as a model for future common audits and data collection with PICs and regional partners such as PACWASTE Plus, UNEP, JPRISM, SPREP, and PRIF partners.

The waste audits using this methodology will provide crucial and important data to scope a tailored regional recycling network and other national and regional recycling initiatives based on actual quantities of recycling material available in the region.

A series of comprehensive waste audits is being funded by UNEP, SPREP (through PacWaste Plus), PRIF, and The World Bank. The scope of the audits is as follows:

- Audits were undertaken on household waste, commercial waste, and landfill
- A systems gap analysis was undertaken to understand the current status of waste management in Samoa, including the institutional arrangements, private sector involvement, and infrastructure available to effectively manage waste and recycling outcomes, as well as participate in regional recycling activities.

As part of this collaboration, PRIF has commissioned waste audits in Cook Islands, Fiji, and Tuvalu. PacWaste Plus has commissioned audits in Nauru, Niue, Vanuatu, Solomon Islands, PNG, Timor Leste, Republic of Marshall Islands (RMI); UNEP commissioned waste audits in Palau; and The World Bank commissioned APWC to undertake audits in Kiribati, Samoa, and Tonga. This technical report presents the outcomes of the audit conducted by the project team in Samoa from 16 March to 19 June 2020. It is anticipated the findings will provide the basis for further work on waste management policy, feasibility of recycling opportunities, and other waste management treatment options in Samoa and the wider Pacific region. See Appendix S for 'Key assumptions and limitations of the study'.

[8] https: //www.theprif.org/documents/regional/urban-development-waste-management/pacific-region-solid-wastemanagement

2. Overview of Samoa

Samoa (officially the Independent State of Samoa) lies in the South Pacific Ocean, approximately halfway between New Zealand and Hawaii. Most of the population lives on the island of Upolu and 80 percent of the population lives in rural communities.

Table 1: Samoa overview

Feature	Description
Official name	Independent State of Samoa, (Malo Sa'oloto Tuto'atasi o Samoa)
Total land area	2,831 km^2
Capital	Apia
Border countries	None
Climate	Tropical
Population	201,316
Language(s)	Samoan (Polynesian) (official); Samoan/English; English (official)
Ethnicity	Samoan; Samoan/New Zealander, other
Government	Parliamentary republic
Currency	Tala
GDP	US$820 million
HID	0.713
Exports	Fish, coconut oil and cream, copra, taro, automotive parts, garments, beer
Signed international agreements	Biodiversity, Climate Change, Climate Change – Kyoto Protocol, Desertification, Hazardous Wastes, Law of the Sea, Ozone Layer Protection, Ship Pollution, Wetlands

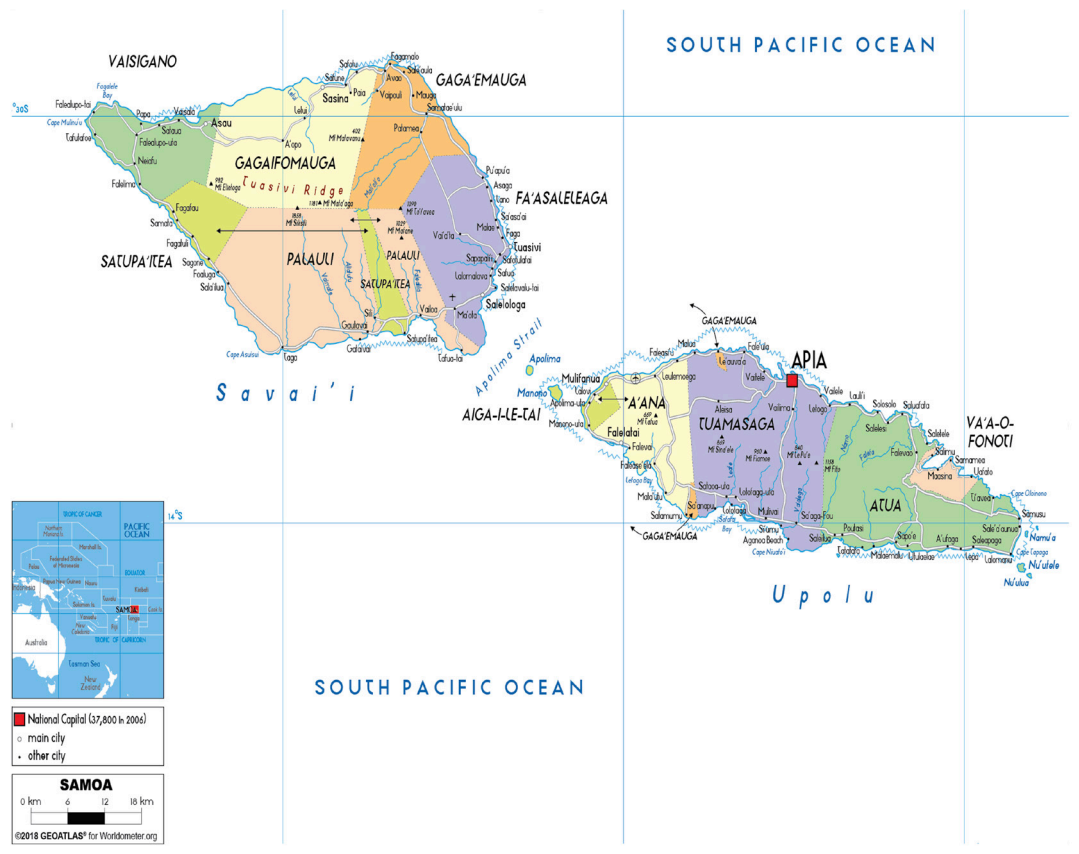

Figure 1:
Map of Samoa

2.1 Socioeconomics

Approximately 43 percent of Samoa's landmass is arable. The most densely populated region is northwest Upolu, followed by the remainder of Upolu Island, and then Savai'i Island, with 80 percent residing in rural areas. More than 80 percent of the land is held under customary ownership and this is one of the main sources of identity and security (FAO, 2019).[9] Samoan culture and language have remained relatively strong and Samoan villages tend to be hierarchically organized into tight-knit communities consisting of a number of extended families.

After more than 100 years of modern development and economic diversification, agriculture and fisheries remain the backbone of the economy and are deeply embedded in the village economy and the fa'asamoa – the Samoan way of life.

9 FAO. (2019). Country Gender Assessment of Agriculture and the Rural Sector in Samoa [online] Available at http://www.fao.org/3/ca6156en/ca6156en.pdf

Nearly half of the employed population in Samoa is engaged in agricultural or fishery-related occupations (Samoa Bureau of Statistics, 2018).[10]

2.1.1 Imports and exports

Samoa imports significantly more goods than it exports, with a negative trade balance of -US$388 million. The Observatory of Economic Complexity (OEC) reported Samoa imported US$454 million of goods in 2018, primarily from New Zealand and Singapore, as well as China, Australia, and the United States. The most commonly imported products were refined petroleum (14 percent), coated flat-rolled iron (4.8 percent), vehicles (5.3 percent), poultry meat (3.7 percent), gas turbines (1.9 percent), processed fish (1.7 percent), plastic lids (1.6 percent), and pasta (1.4 percent).

The most commonly exported goods in 2018 were non-filleted frozen fish, refined petroleum, fruit juice, beef, and fish fillets to American Samoa, New Zealand, United States, Australia, and Tokelau. Samoa is not a major manufacturing economy, although it does process a few agricultural commodities, such as fruit juice and coconut products. No global retailers are present, but the retail sector has a well-developed import chain offering many international brands.

The import and export of goods, including the transport of hazardous materials, is by air or sea, and primarily serviced by the state-owned Samoa Shipping Corporation.

[10] Samoa Bureau of Statistics. (2018). Population dynamics and trends. 2016 Census Brief No.2. Samoa Bureau of Statistics.

3. Samoan institutional framework

3.1 National government

Samoa is a parliamentary republic with two levels of government: the national government, based on a modern state system; and the village local government, based on traditional structures.

Nationally, the government is a representative democratic parliamentary system, with a head of state, a prime minister (head of government), and a cabinet of ministers who are also the 51 members of the legislative assembly (Government of Samoa, 2020).[11]

Local village government is determined entirely by the customs and traditions of each village, but the governing body, the village *fono* (council), is composed of village chiefs or *matais* (representatives of extended family groups). The village *fono* manages local community affairs by making rules, laws, and important decisions for the village. Areas of responsibility include education, agriculture, fisheries, law and justice, public health/village hygiene, the construction of plantation roads, water supplies, sports and recreation, religion, and family welfare. Decisions by the *fono* are implemented by the village residents, who are organized into clearly defined sub-groups such as young men, women, and wives of council members (Commonwealth Local Government Forum, 2018).[12] The government is represented by *pulenuu* (village liaison officers), who liaise and disseminate information between the national and local levels.

Samoa has more than 342 local government areas, of which 286 are traditional villages and 56 are non-traditional villages. These include new settlements, large residential compounds, and suburban areas in Apia (National University of Samoa, 2016).[13] Each of the 286 traditional villages has its own system of local government which is separate and independent of others.

In Samoa, waste collection and disposal is the joint responsibility of the national and village governments.

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11 Government of Samoa. (2020). Samoa [online]. Available at http://www.samoagovt.ws/about-samoa/, Accessed March 15, 2020.

12 Commonwealth Local Government Forum. (2018). The local government in Samoa – Country profile. [online] Available at https://www.clgf.org.uk/default/assets/File/Country_profiles/Samoa.pdf, Accessed March 20 2020.

13 National University of Samoa. (2016). Village government in Samoa: do women participate? [online] Available at https://www.pacwip.org/wp-content/uploads/2017/11/Political-Representation-and-Women's-Empowerment-in-Samoa.pdf, Accessed June 9, 2020.

3.1.1 Establishing new laws and by-laws

For a bill to become law in Samoa, it must be passed by the Legislative Assembly and then assented by the Head of State. It then becomes an Act of Parliament, coming into force either immediately on the date it was assented to or on a specified date (Government of Samoa, 1960).[14]

Unlike establishing new Acts, regulations can be developed by different government agencies and their legal representatives in collaboration with the Office of the Attorney General. After a public consultation process, it is endorsed in a Cabinet meeting, and signed by the minister of the responsible agency, without the need to be tabled in parliament.

The *Village Fono Act 1990* recognizes village by-laws which give traditional village *fonos* the authority over the management of village affairs, either alone or in partnership with government ministries. Village fonos have the power to levy taxes in line with village usage to support community activities, churches, school buildings, plantation roads, sea walls, or water supplies. However, there is no legal provision for compliance or enforcement, rather, a strong sense of loyalty to the community and the weight of community opinion. As such, village *fonos* do not have a budget but raise funds when required. The national government is increasingly assuming responsibility for the provision of infrastructural services, often with a local contribution (usually in-kind), and therefore the levying of such taxes, except for cultural matters, is rare (Commonwealth Local Government Forum, 2018).

The pathway outlined above will be required for the development of any new national waste management legislation or regulations. The existing Waste Management Act 2010 is the logical pathway to implementing any proposed levies for materials or waste streams, or an e-waste product stewardship process (Leney, 2013).[15]

3.2 International agreements

Samoa has ratified numerous international and regional commitments and remains in general compliance with the spirit of such commitments.

Table 2: Multilateral agreements and conventions ratified by Samoa

Multilateral agreements and conventions	Status
Stockholm Convention on Persistent Organic Pollutants	Ratified
Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal	Ratified

[14] Government of Samoa, 1960. Constitution of the Independent State of Samoa [online]. Available at http://www.samoagovt.ws/wp-content/uploads/2014/07/Constitution-of-the-Independent-State-of-Samoa-1960.pdf. Accessed March 15, 2020.

[15] Leney, A. (2013). Review of regional e-waste recycling including 'A Model Product Stewardship Approach For Pacific Island Nations'. SPREP.

Multilateral agreements and conventions	Status
Waigani Convention to Ban the Importation into Forum Island Countries of Hazardous and Radioactive Waste and to Control the Transboundary Movement and Management of Hazardous Waste within the South Pacific Region 1995	Ratified
Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade	Ratified
Montreal Protocol	Ratified
Minimata Convention	Signed
MARPOL 73/78: International Convention for the Prevention of Pollution from Ships, 1973 as modified by the Protocol of 1978 (Annexes I, II, III, IV, V, and VI)	Ratified
International Convention on Civil Liability for Oil Pollution Damage 1969 (CLC 92)	Ratified
International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage (FUND 92)	Ratified
International Convention on Oil Pollution, Preparedness, Response and Co-operation (OPRC 90)	Ratified
International Convention for The Compensation for Damage in Connection with the Carriage of Hazardous and Noxious Substances By Sea Convention (HNS 1996)	Ratified
International Convention on Civil Liability for Bunker Oil Pollution Damage (BUNKER 2001)	Ratified
Noumea Convention for the Protection of the Natural Resources and Environment of the South Pacific Region (SPREP) (1986)	Ratified
• Dumping Protocol	Ratified
• Emergencies Protocol	Ratified
• Oil pollution Protocol	Signed
• HNSP Protocol	Signed
Small Island Developing States Accelerated Modalities of Action (Samoa Pathway)	Signed
Vienna Convention for the Protection of the Ozone Layer	Ratified
The Kyoto Protocol to the United Nations Framework Convention Climate Change	Ratified

Source: Various

3.3 Regional agreements

In addition to international agreements, Samoa has several strong bilateral and multilateral relationships.

Table 3: Regional agreements and memberships

Regional agreements	Status
Pacific Islands Forum	Member
Secretariat of the Pacific Community (SPC)	Member since 1965
South Pacific Regional Environment Programme (SPREP)	Member

Regional agreements	Status
Cleaner Pacific 2025: Pacific Regional Waste and Pollution Management Strategy 2016–2025	Member
National Implementation Plan for the Stockholm Convention on POPs	Current 2007

3.4 National regulation and strategy

The environment is considered a national priority in Samoa, with a focus on the sustainable management of natural resources and climate and disaster resilience (MoF, 2017).

The most important environmental legislation dealing with waste management is:

- The *Waste Management Act 2010*, which covers the collection and disposal of solid wastes and the management of all wastes in Samoa, including hazardous wastes
- The *National Waste Management Strategy 2019–2023*, which governs solid waste management from households and businesses, including chemical and hazardous waste
- The *Lands, Surveys and Environment Act 1989,* which covers littering on land and the pollution of marine environments
- The *Marine Pollution Prevention Act 2008,* which covers pollution of the marine environment, including disposal or incineration of wastes at sea and discharging of ballast water
- The *Water Resources Management Act 2008*, which covers pollution of water supplies such as rivers, lakes, and boreholes.

Most recently, Samoa has introduced a plastics ban through the Waste (Plastic Bag) Management Regulations, signed in 2018 (MNRE, 2018),[16] which takes effect over several stages. This regulation prohibits the import, manufacturing, or sale of plastic shopping bags, plastic packaging, and straws (from June 2019), and styrofoam food containers and cups (from June 2020). Other plastic materials will follow in the ban in a staged process to give businesses and members of the public adequate time to prepare. Exemptions to the ban are currently granted for food safety packaging for frozen meat, ice cubes, locally produced chips, kava, repacked coffee, tea, sugar, flour, cocoa, and local biscuits, such as the traditional savory keke saina.

A comprehensive list of policies, legislation, strategies, and multilateral agreements addressing solid waste management and pollution control in Samoa is provided in Appendix A.

16 MNRE. (2018). Waste (Plastic Bag) Management Regulations 2018. Ministry of Natural Resources and Environment. Government of Samoa.

3.5 Stakeholders – Roles and responsibilities

The following table outlines the roles and responsibilities of each stakeholder managing municipal solid waste in Samoa, including decision-making, implementation, compliance, and monitoring.

Table 4: Stakeholder roles and responsibilities

Stakeholder	Responsibility
Government of Samoa	
Ministry of Natural Resources and Environment (MNRE)	The largest government agency in Samoa with 10 divisions, responsible for environmental and natural resource management, including waste management.
Ministry of Finance (MoF)	Allocates national budgets to support waste management services and coordinates funds received from overseas donors (for solid waste, sewage, and sludge) projects and programs.
Ministry of Health (MoH)	Responsible for the regulation and operation of the medical waste management system.
Ministry of Women, Community and Social Development	Plays a vital part in the development of Samoa's 300-plus villages. Village representatives meet ministry officials monthly to discuss development concerns and learn about government strategies. SWM is often one of these concerns. The ministry's Family and Community Wellbeing Program promotes village, household, and general environmental cleanliness, including composting, in more than 200 villages.
Other ministries	In addition to the government stakeholders in this table, Samoa has taken a multi-sectoral approach to waste management, as can be seen from the list of 34 ministries and stakeholders identified to be members on the National Strategy for Solid Waste Management steering committee (MNRE, 2019),[17] listed in Appendix B.
Subordinated agencies	
The Division of Environment and Conservation (DEC)	The DEC is the waste management unit of the Ministry of Natural Resources and Environment, tasked with the overall planning and management of sector activities. It is also responsible for procurement and management of Samoa's six private companies who are contracted to provide waste collection and disposal services.
Local government	
Village *fono* (council)	Responsible for village-level affairs, including public health and village hygiene, and enforcing waste management laws at the community level.

[17] MNRE. (2019). National Waste Management Strategy 2019–2023. Ministry of Natural Resources and Environment.

Stakeholder	Responsibility
Committees and associations	
Samoa Recyclers and Waste Management Association	Established as a platform for coordination among recyclers and to strengthen collective engagement with government agencies and international donors. The Samoa Recyclers and Waste Management Association Strategic Plan 2019–2023 was launched in October 2018, and it is hoped that it will lead towards realizing a Pacific Region Recycling Association (SPREP, 2017[18] and SRMWA, 2017). Samoa was the first PIC to have a recycling association.
Private sector	
Collection contractors	Six private companies that provide collection services to Samoa, subcontracted by the government or by commercial businesses: Blue Bird Transport Co. Ltd Jaffa Sanitary System Ltd Apia Lua Co. Ltd Tama ole Mau LA painters Jed's Star Ltd

Key findings:

- Samoa has an active waste management strategy; multiple stakeholders are responsible for its delivery.
- *Waste Management Act 2010* provides a comprehensive legal framework for waste management and recycling activities.
- Bans on the import, manufacturing, or sale of numerous single-use plastic items including shopping bags have commenced.
- Samoa is a signatory to the Basel Convention. International movement of waste material must comply with the standards of the convention and requires prior written consent from import and transit countries. The Waigani Convention, which controls the transboundary movement of hazardous waste, has also been ratified.

[18] SPREP. (2017). New Recycling Association Targets A Pollution-Free Pacific. [online] Available at https://www.sprep.org/news/new-recycling-association-targets-pollution-free-pacific

4. Situation analysis - Waste management

4.1 Waste management services overview

Samoa has implemented significant measures to improve solid waste management over the past decade, such as incrementally improving collection systems and disposal sites, as well as developing a National Solid Waste Management Strategy (SPREP, 2010).[19] The Ministry of Natural Resources and Environment (MNRE) is the lead agency for delivering solid waste management (SWM) services in Samoa, which is a joint responsibility between the national government and village-level governments.

In 2005, waste policy in Samoa allowed for the provision of collection services for households only. The government funding that was previously used to collect commercial waste was diverted to extend collection coverage into rural areas and three outer islands (SPREP, 2018). As a consequence, the commercial sector is responsible for disposal of the waste it generates, either transporting it directly to landfill or by using private contractors.

Households are not charged for waste collection and disposal. The government partners with the private sector to deliver household collection services. The MNRE conducts a tender process every three years for private contractors to collect household solid waste.

The recycling sector in Samoa is limited, with operations carried out by private operators only. Although the *Waste Management Act 2010* provides a comprehensive legal framework for waste management and recycling, little progress has been made in drafting or implementing the required legal, regulatory, financing, coordinating, and other institutional mechanisms (Sagapolutele and Binney, 2017).[20]

19 SPREP. (2010). Pacific Regional Solid Waste Management Strategy 2010-2015.

20 Sagapolutele and Binney. (2017). Samoa Scrap Metals Baseline Assessment Report. SPREP.

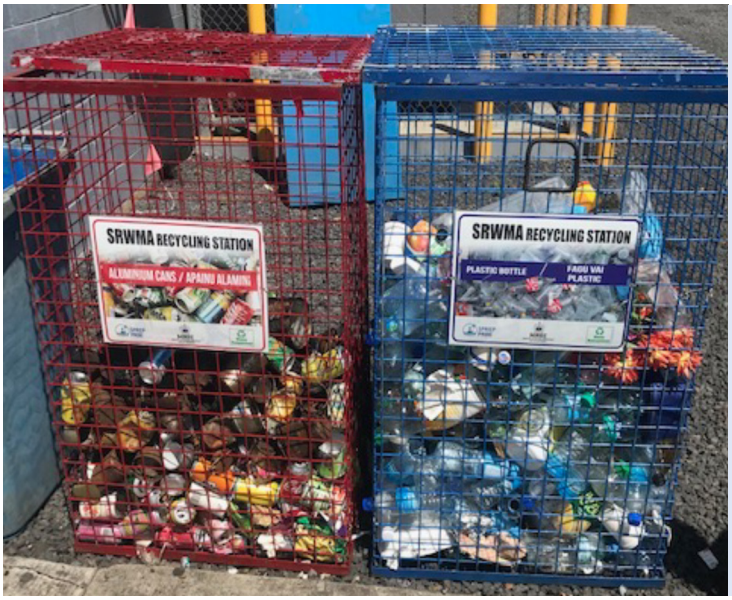

Figure 2:
Example of recycling cages installed by Samoa Recycling and Waste Management Association (SRWMA)
(Source APWC, 2020)

No national recycling or reprocessing facilities are available in Samoa. Systematic separation at source does not take place and there are no transfer stations (with the exception of a number aluminum can collection cages in Apia, see Figure 2). Most recyclable materials (with the exception of glass and aluminum cans) are disposed of in general waste and transported to the landfill site. At the landfill, registered waste-pickers reclaim valuable materials. Recyclers purchase these materials from the waste-pickers. There are more than 10 registered waste-pickers with permission to collect waste within the landfill area. Occupational health and safety measures must be adhered to, and children are not allowed to work on the landfill. When these conditions are not met, MNRE can enforce a ban of waste-picking activities and can prevent the entry of waste-pickers to the site. Waste-pickers operate in an unregulated, marginalized space. The decision to formalize these arrangements or halt waste-picking directly from the landfill sits with the Samoan Government. Future approaches, such as advanced recovery fees (ARFs) and container deposit legislation (CDL) may reduce the feedstock available for waste-pickers and reduce the likelihood of formal recognition.

Recycling activities for material currently collected, such as plastic and aluminum, are limited to compacting and shipping to a facility located in another country or stockpiled in Samoa. Stockpiling occurs until larger quantities are accumulated or because it is a problematic waste stream with no clear solution for disposal or reuse.

There is a segregation and storage area for recyclable materials and a composting yard at the main Tafaigata Landfill site on Upolu Island. Due to a lack of skilled staff, it is currently not fully functional (MNRE, 2019). A number of authorized contractors operate at the site, including machine drivers and scrap-metal segregators. Land is leased to six recycling companies, four of which have facilities on-site. Samoa also has a policy of developing working relationships with the waste-pickers on the landfill, providing ID badges, and encouraging sanitary work practices (SPREP, 2014).

Table 5: Summary of the public–private approach in Samoa

What the government provides	What the private recycling company provides
Government leases land to recycling companies at a very low annual rate within the waste disposal site.	Recycling facilities including equipment, buildings, fences, trucks, etc.
Full access to the waste landfill to recover any disposed recyclable waste.	Collaboration only with approved waste-pickers at the waste landfill.
Collection of bulky waste.	Receiving and processing scrap metals for shipping overseas, as a strategic waste-reduction measure to divert the entry of waste to the landfill and promote recycling.
Review and consider any support for import duties for specialized waste equipment.	Procurement of appropriate equipment and facilities.
Monitor export of hazardous waste and support shipping documentation in line with Basel Convention.	Submitting information on any potentially hazardous waste as identified under international conventions.
Monitor illegal recycling operations and OSH aspects.	Fulfilling their obligations on using acceptable recycling and OSH practices.

Source: SPREP, 2018[21] and Sagapolutele, 2020

4.1.1 Collection schedule

Waste collection on Upolu Island is divided into 15 service zones (see Appendix F), which are concentrated around the capital Apia and the coastal regions where most of the population lives. Waste collection on Savai'i Island is divided into four zones (see Appendix F). Each of the five private contractors operating in Samoa is responsible for specific collection zones. Zone A covers the main town area, which is serviced twice a day (morning and evening), while all other areas are collected twice a week (MNRE, 2019). There are specific collection points within each zone. Waste from households without a collection point is only collected when residents are waiting out the front upon arrival of the truck.

Private operators agree to performance standards and the national government uses village *sui ole malo* (male and female representatives) to check waste services are provided.

Based on the time and motion survey conducted in 2017, out of the 6,260 collection points on Upolu Island, 84 percent contained waste, 15 percent were empty, and 4 percent of pick-ups were from households without a collection point (MNRE, 2017).[22] The survey found that approximately 60 percent of households had their rubbish collected and the remaining 40 percent were not located along the length of the designated road. Contractors were also found to collect waste predominately from their 'regular' route – not necessarily covering all official designated areas.

21 SPREP. (2018). Practical guide to Solid Waste Management in PICs. Apia, Samoa.

22 MNRE. (2017). Time and Motion Survey. Ministry of Natural Resources and Environment.

The 2013 State of the Environment report indicated that 11 percent of the estimated total volume of generated waste actually reached Samoa's landfills. Samoa's Bureau of Statistics also found that between the years of 2015 and 2016, there was a 32 percent decline in the tonnes of solid waste collected. Both reports indicated this disparity may arise from private contractors dumping collected waste illegally at unapproved sites, inconsistent collection coverage for households, and households failing to put waste out for collection (MNRE, 2013).[23] This disparity between waste generated and waste reaching the landfill aligns with the data collected for this project and is discussed in the results section.

4.1.2 Waste types

Plastics

There has been no significant progress toward increasing plastic recycling in Samoa, which is in line with other PICs. This is due mainly to low trade volumes and low international market values. In recent years, there has been a pronounced increase in the presence of PET in Samoa's waste stream, as reported by Coca-Cola South Pacific, possibly correlated with a surge in local water production and the establishment of more than ten bottling plants (PRIF, 2017).[24]

While several pilot projects and initiatives have collected plastic bottles in the past, these recovered plastics are often stockpiled for future use or eventually end up in landfill disposal sites. After the establishment of the Samoa Recyclers and Waste Management Association (SRWMA), there has been impetus to find solutions for plastic waste in line with the National Waste Management Strategic Plan 2019–2023. J-PRISM II is also working with SRWMA to pilot initiatives that use plastic waste. In addition, Manino Waters (also known as Pacific Pure Waters) is planning a pilot project in partnership with a Costa Rican developer for plastics-to-concrete products. Manino Waters has been stockpiling plastics for this purpose.

[23] MNRE. (2013). State of the Environment Report. Ministry of Natural Resources and Environment. Government of Samoa.

[24] PRIF. (2017). Pacific Country Profiles. [online], Available at: https://www.theprif.org/documents/regional/urban-development-waste-management/pacific-region-solid-waste-management-and Accessed February 18, 2020.

Green waste

Green waste is often segregated and composted in households but no statistical data is readily available. Green waste from rural areas is used as mulch on bananas, taro, and other root crops. Organic waste from food scraps and green waste from households in urban areas goes to landfill, comprising a significant proportion of municipal solid waste collection (MNRE, 2019). There are currently three small-scale composting programs operating in Samoa.

Table 6: List of green-waste recyclers in Samoa

Company	Materials recycled
Falelauniu Biogas	Sewage and toilet waste to cooking gas production
Women in Business Composting	Green and organic waste for production of compost for their own organic food crops
Jotta Company	Composting incoming green and organic waste (including noni juice waste, kitchen waste, etc.) at Tafaigata Landfill

Glass

Glass is one of the few materials recycled in Samoa, as it is reused by some beer and soft drink facilities. Vailima Breweries and Taula Breweries operate a deposit return system on 750 ml, 660 ml, 355 ml, and 330 ml beer bottles. Vailima beer bottles exported to American Samoa are also shipped back to Samoa for reuse. A pilot program is being developed by Waste Management Co. Ltd in collaboration with Vailima Breweries, with old beer bottles crushed for use as a gravel or sand replacement for road construction.

Other glass recycling options have been investigated, including recycling bottles through the international market. A basic economic analysis on the export of recycled glass from Samoa to New Zealand indicated that costs would not be recovered (a loss of more than US$1,400 per shipment) (SPREP, 2009).[25]

Scrap metals and bulky waste

Bulky waste and scrap metals are collected by private companies once every three months (four times a year), free of charge under the government-run waste collection service. The bulk of these materials is disposed of at the landfill, with white goods, vehicles, and furniture diverted to the recycling operations at the landfill entrance. These items are taken for reuse by the community (PRIF, 2017).

25 SPREP. (2009). Glass Management SREP. 2009. [online] Available at http://archive.iwlearn.net/sprep.org/solid_waste/documents/Solid%20Waste/Guidelines/Glass%20Management%20.pdf, Accessed March 27, 2020.

Three scrap metal recyclers operate on the main island of Upolu. These operators source aluminum cans, steel, and non-ferrous materials from the landfill and abandoned vehicles (Table 7). Pacific Recyclers offers collection points around Apia (2 m^3 steel cages) for aluminum and tin cans, as well as PET bottles (Leney, 2013). Waste-pickers operating at Tafaigata Landfill are reported to recover and sell aluminum cans to the recycling companies for US$0.90 per kilogram (PRIF, 2017). This figure is known to fluctuate depending on the international market rate. Overall, waste-pickers and recyclers operate without direct involvement or assistance from the government.

Table 7: List of scrap metal recyclers in Samoa

Company	Materials recycled
Pacific Recyclers	Scrap metals only (aluminum, copper, car batteries, steel including car bodies, etc.)
Waste Management Co. Ltd (previously known as West End)	Scrap metals only (copper, car batteries, aluminum, other valuable metals)
One Metal	Scrap metals including e-waste
Metal Man*	No longer in operation, but operations planned to resume when the market improves

Source: Sagapolutele, 2020
* Not operating at the time of the audit

Pacific Recyclers is Samoa's largest commercial-scale private recycler with regular operations. It exports 20-foot shipping containers averaging 20 containers per month, weighing 20 tonnes each to Australia, Korea, and New Zealand for resale (ADB, 2014). Used lead-acid batteries are shipped to India, Fiji, New Zealand, or Singapore. Waste Management Co. Ltd exports at less regular intervals, at approximately every three to four months.

Of note is a unique arrangement between the island of Tokelau and Samoa to recycle aluminum cans. Materials from Tokelau are shipped to Samoa, consolidated with Samoa's waste cans to fill a container, and shipped off the island regularly and efficiently, making the operation more economically viable (SPREP, 2010).[26]

In the absence of appropriate institutional arrangements, scrap metal and e-waste operations tend to lack direction, coordination, monitoring, and control. This results in ad-hoc recycling activities and ill-equipped operations. Most of the existing recycling operations in Samoa are small or family-owned businesses, with only two or three companies operating consistently for the past decade. Others operate opportunistically. Recyclers lack the technical training to safely dismantle and process scrap metals, particularly bulky waste items such as end-of-life vehicles (EVLs) or white goods, resulting in health risks and environmental contamination. Recyclers receive little to no information on correct procedures

[26] ADB. (2014). Solid Waste Management in the Pacific: Samoa Country Snapshot. Manila: Asian Development Bank. 2014 (accessed February 2020).

for transporting hazardous waste such as car batteries in their shipping containers. Consequently, for the past five years, an average of 50 containers per year have been shipped without the appropriate papers in direct violation of Samoa's legal obligations under the Waigani and Basel Conventions (Sagapolutele and Binney, 2017).[27]

Healthcare waste

Incineration is commonly used to dispose of medical waste, unused chemicals, and other combustible hazardous materials. A waste audit conducted in two of Samoa's hospitals (SPREP, 2014)[28] indicated that healthcare waste is collected from wards by cleaning staff and transported to a central storage area. It is then taken to the landfill and the incinerator by a dedicated collection vehicle (which also collects from other hospitals on the island).

Figure 3:
Healthcare waste in the Pacific
(Source: SPREP, 2014)

Stockpiles of 200 kilograms of out-of-date donated pharmaceuticals were located in 2014 and in Malietoa Tanumafili II Hospital (Savai'i Island), a waste storage area contained between 1,500 and 2,500 kilograms of stockpiled healthcare waste (predominantly sharps) in small containers and 240-liter bins. Healthcare training for the safe handling and disposing of waste and PPE was provided under the PacWaste programme during 2014–2017.

All hospitals now have segregation systems in place and two vehicles conduct collection services of medical waste in Upolu and Savai'i islands. Needles are now disposed of in designated sharps bins and collected for incineration at either of two facilities in Upolu and Savai'i.

27 SPREP. (2010). Pacific Regional Solid Waste Management Strategy 2010–2015. SPREP.

28 SPREP. (2014). Baseline Study for the Pacific Hazardous Waste Management Project – Healthcare Waste. Prepared by ENVIRON Australia Pty Ltd for Secretariat of the Pacific Regional Environment Programme (SPREP).

E-waste

E-waste is considered a significant problem in Samoa and there are no clear solutions or pathways for the government or the private sector (Levey, 2013). Current e-waste disposal across the wider Pacific region is not keeping pace with generation rates. Quantities are rapidly increasing due to changes in technology, more affordable consumer electronics, and better access to electricity.

Household e-waste is collected four times a year in Samoa and is mixed with other bulky waste from construction materials and car parts. There are no appropriate storage facilities for collected e-waste and most of the materials are taken to landfill after the valuable metals are removed.

Figure 4:
Stockpiled e-waste at One Metal e-waste dismantling facility, Vailoa, Faleata.
(Source APWC, 2020)

No e-waste recycling facilities exist but two operators (One Metal, and Samoa Stationery and Books Electronics [SSAB Electronics]) collaborated to recover reusable and recyclable materials for overseas recycling. SSAB Electronics has a takeback system for toners in partnership with New Zealand HP (NZ HP), who pays to ship this e-waste to Singapore (Jackson, 2019).[29] Pacific Recyclers also reclaims copper metal from air conditioners. Two shipping containers of e-waste were exported to Singapore in 2019, with more e-waste materials currently accumulating in shipping containers (Sagapolutele, 2020).[30] At the time of writing, One Metal was stockpiling bags of valuable materials recovered from e-waste, waiting for stockpiles to reach levels to fill a container for export.

Recyclers in Samoa cannot efficiently and safely extract valuable materials from e-waste without systematic support and a technical skills base. Some training on dismantling end-of-life electrical equipment was carried out, including SPREP's production of a manual (funded by USAID in June 2016). Video instructions were shared with the recyclers, with One Metal using the video as a guide for its e-waste dismantling operation.

29 Jackson. (2019). Samoa Launches Public-Private Partnership on E-Waste [online]. Available at https://sdg.iisd.org/news/samoa-launches-public-private-partnership-on-e-waste. Accessed June 16 2020.

30 Sagapolutele, F. (2020). Personal communication, June 2020.

There is potential to initiate solutions. A key entry point would be to use the existing IT repair industry to recover any useful components for spare parts. E-waste could be sorted into categories for on-sale to an exporting recycler, providing recyclers with e-waste at a minimal cost. The valuable parts of e-waste (e.g. copper from CRTs) need to be passed on to the exporter and not 'cherry-picked' from materials, leaving behind low-value e-waste that is potentially dumped or stockpiled in PICs (Leney, 2013). The status of e-waste logistics remained unchanged in 2020.

Waste oil (used lubricating oil)

There is no recycling or collection program for used lubricating oil in Samoa. The current solution is to stockpile it in backyards (Haynes and Vanderburg, 2013[31]; SPREP, 2019a[32]). A Product Stewardship System (Figure 5) has been proposed and developed in the 2014 Draft Used Oil Management Plan for Samoa. The plan has not been finalized (MNRE, 2014).[33]

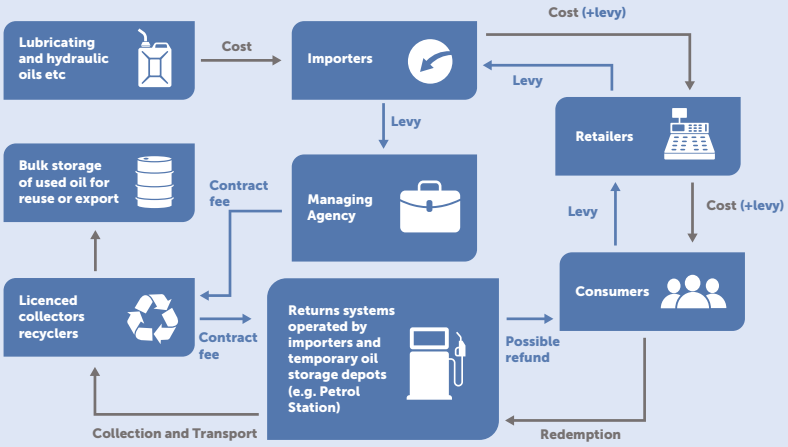

Figure 5: Stewardship system flow diagram
(Source MNRE, 2014)

The SRWMA announced the launch of the Samoa Waste Oil Management Program (SWOMP) in August 2019 (SPREP, 2019b).[34] One of its members, Nissan Samoa, is constructing a transfer station at Tafaigata Landfill, within the designated recycling area, with support from development partners. Under the program, used lubricating oil will be exported to the BlueScope Steel Factory in Fiji for use as an alternative energy source to smelt large volumes of scrap steel. COVID-19 has had an impact on BlueScope's visit to Samoa to initiate this project. Potential options are also being investigated by the SRWMA and J-PRISM II for a small to medium refining facility, if current arrangements with BlueScope do not go ahead.

31 Haynes and Vanderburg. (2013). Cost-benefit analysis of used oil management options for Samoa. Apia: SPREP.

32 SPREP. (2019a). J-PRISM ll newsletter, issue 7 [online] Available at https://www.sprep.org/attachments/Publications/Newsletters/j-prism-buzz-issue7.pdf

33 MNRE. (2014). Used Oil Management Plan. [online] Available at https://www.sprep.org/attachments/Publications/WMPC/afd-used-oil-management-plan-samoa.pdf, Accessed 20 March 2020.

34 SPREP. (2019b). Samoa Waste Oil Management Programme (SWOMP) Launched. [online] Available at https://www.sprep.org/news/samoa-waste-oil-management-programme-swomp-launched, Accessed 15 June.

Used oil stockpiles could be located at several sites across Samoa, including the Electric Power Corporation station at Tanugamanono, Hyundai workshop in Vaitele, Samoa Shipping Company, mechanic workshops, transportation companies, and several oil importers and suppliers. An estimated 500,000 liters has accumulated over many years in Samoa, with reports of some illegal dumping.

Figure 6:
Samoa receiving 2,000 liters of waste oil from the government of Tokelau for the second phase of the Samoa Waste Oil Management Program
(Source: Samoa Recycling & Waste Management Association, 2020)

Other waste

Waste (used) tire management has received little attention in Samoa and the wider Pacific region. With little domestic and international demand, used tires are mostly stockpiled, exacerbating issues with disposal space on small atolls and islands. Although not yet operative, a tire recycling center was proposed to operate adjacent to the existing metal recycler (ADB, 2014). The generation of used tires is accelerated in most PICs and territories due to the practice of importing second-hand tires, with little control over the quality of imports. Used tires are imported by small businesses and resold at reduced prices. While this trade is seen as benefitting those interested in second-hand parts, the concern is that most of these products have a short lifespan and are disposed of after a short period. Samoa currently has 139 m^3 of stockpiled tires. Without safe recycling or disposal of tires, SPREP suggests costs be recovered through a tire stewardship program.

The recovery process of disaster waste is expensive and often delayed. Disaster waste rates can be as much as ten times the average of waste generation rates (SPREP, 2019c).[35] The Regional Disaster Waste Management Guidelines have been developed by J-PRISM II, in collaboration with SPREP. The goal of the guidelines is to strengthen the capacity of PICs in handling waste when natural disasters strike, by improving the skills and knowledge of local officials and staff.

[35] SPREP. (2019c). Guidelines For Disaster Waste Management In The Pacific To Be Launched In 2020. [online] Available at https://www.sprep.org/news/guidelines-for-disaster-waste-management-in-the-pacific-to-be-launched-in-2020 Accessed 17 June 2020.

4.2 Equipment and maintenance

Municipal solid waste (MSW) is collected in standard waste compactor trucks and open-top trucks. Most households store waste for collection on a raised platform or stand to deter scavenging animals. Platforms range from flimsy wooden structures, to well-designed steel constructions. Commercial waste is often stored in steel containers.

Figure 7:
Examples of wooden and metal raised platform structures
(Source APWC, 2020)

Table 8: Landfill equipment and staff, 2020

	Tafaigata Landfill	Vaiaata Landfill
Equipment	3 excavators 2 trucks 1 bulldozer	2 excavators 2 trucks 1 bulldozer
Staff	7 MNRE staff 9 contractor staff	1 MNRE staff 10 contractor staff

All recycling undertaken in Samoa is run by private recyclers. A list of equipment is supplied in Appendix D. With no licensing system to standardize recycling operations, some recyclers invest heavily in equipment to recover valuable metals through appropriate dismantling practices, while others use heavily polluting practices such as burning (Sagapolutele and Binney, 2017).

In terms of litter management, a temporary floating boom was set up in 2016 to help reduce litter and debris entering Apia Harbour and the marina. The boom was 120 meters long and had a buoyant top with a net suspended below to capture waste (UN, 2016).[36]

[36] UN. (2016). Global Partnership on Marine Litter (GPML), [online] Available at https://sustainabledevelopment.un.org/partnership/?p=7471, Accessed June 05, 2020.

4.3 Waste-data collection and monitoring

The Ministry of Natural Resources and Environment (MNRE) is responsible for ongoing data collection, monitoring, and compliance. The trend to outsource most operations, relating to collection and disposal, to private contractors in PICs is based on a general belief that this gives the lead waste management agency the opportunity to focus on regulatory and monitoring roles (SPREP, 2018). However, the effectiveness of this monitoring depends on the way this is managed.

The MNRE has identified that there is a real need for establishing regular monitoring systems across their SWM service provision (MNRE, 2019), such as:

- Establishing a rubbish collection monitoring system
- Establishing a landfill operation monitoring system
- Enforcing a waste disposal fee by weight at Tafaigata Landfill
- Monitoring fee collection based on weighbridge records
- More strict controls on the collection waste disposal fees.

Steps have been taken to develop a monitoring framework, taking guidance from the Regional Waste Monitoring System. Table 9 presents the indicators being tracked and the goals over an eight-year period.

Table 9: Solid waste management indicators

No.	Indicator	Baseline (as of 2017)	Forecast in 2023 (without strategic actions)	Target by 2023 (with strategic actions)
1	Household waste discharged amount (g/person/day)	387	394	367
2	Organic waste in discharged waste from household (g/person/day)	165	168	140
3	Recycling ratio of aluminum cans from household in Upolu (%)	44	44	61
1	Collection coverage for household in Upolu by amount (%)	38	39	61
	Collection coverage for Upolu by track (%)	61	61	80
6	Ratio of unmanaged waste in Upolu (%)	58	58	47
7	Ratio of SWM revenue in cost (%)	3	3	5
8	Newly available or updated performance indicator during 2018–2023	0	0	8
9	Number of legal frameworks developed or enhance enforcement during 2018–2023	0	0	5
10	Number of accidents at landfill	2	2	0

No.	Indicator	Baseline (as of 2017)	Forecast in 2023 (without strategic actions)	Target by 2023 (with strategic actions)
11	Number of complaints for waste collection service	100	100	50
12	Ratio of plastics in discharged waste from households (%)	16	16	8
13	Number of schools involved in Clean School program	0	0	10

Source: MNRE, 2019

According to Samoa's Ministry of Finance (MoF), a key priority is improving the performance of waste management service provision through better procurement and contract management, particularly in the areas of monitoring and enforcement (MoF, 2017).[37]

[37] MoF. (2017). National Environment Sector Plan (NESP) 2017-2021. [online] Available at https://www.mof.gov.ws/wp-content/uploads/2019/09/NESP-2017-2021-_Final-Final-Master.pdf, Ministry of Finance. Government of Samoa.

4.3.1 Waste department staff

Figure 8 outlines the institutional structure at MNRE and staff employed for waste management.

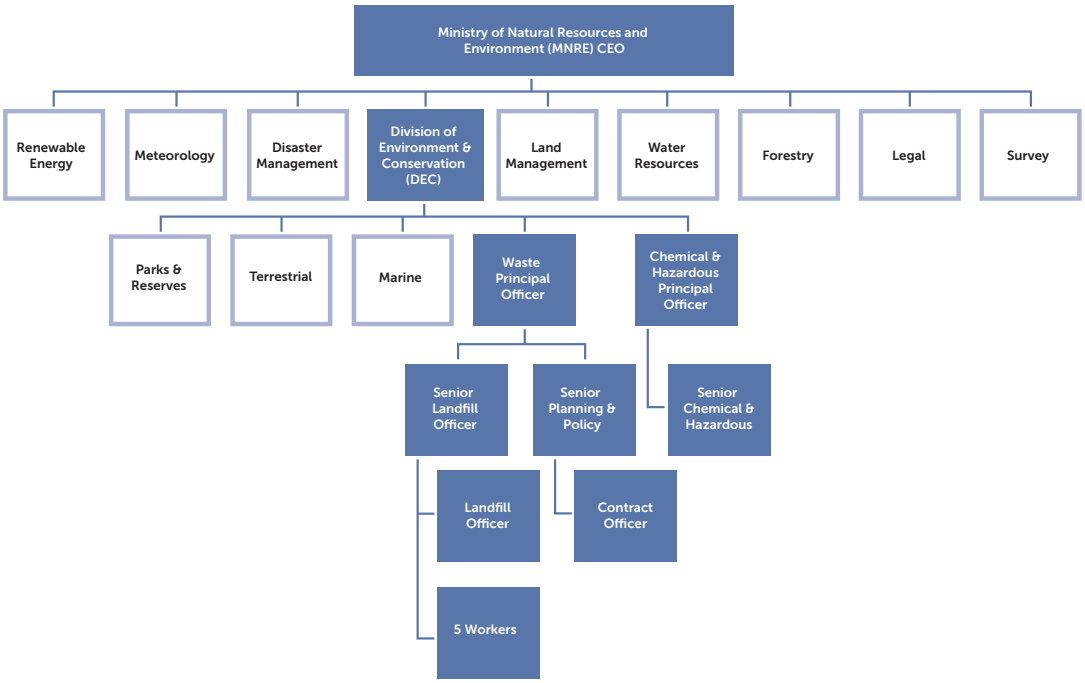

Figure 8:
Waste management institutional structure
(Source: Sagapolutele and Binney, 2017)

As can be seen, staffing is limited, with collection, disposal, and maintenance of the landfill outsourced to contractors. A priority identified in the NSWMS is to enforce a code of practice for contractors and staff.

4.4 Current financial mechanisms

The Samoan economy is constrained by several factors, including its remote location and lack of economies of scale. Samoa has no service fee for waste collection and no taxes for waste management. The cost per month for MNRE to deliver waste management services to each collection zone on Upolu, Savai'i, and the outer islands of Manono and Apolima is shown in Appendix F.

Legal fines are in place under the *Waste Management Act 2010* for non-compliance with waste regulations, yet fines are rarely enforced. Appendix E outlines fines for various offences including street littering, illegal dumping, illegal dumpsites, and inappropriate disposal practices by the public or waste contractors.

4.4.1 MNRE waste budgets

In Samoa, SWM is managed by MNRE, with the revenue covered by tax, grants, and other sources from the national government. The MNRE's solid waste budget for 2017 was SAT 3,262,997 million, which funds landfill operations, maintenance works and cleaning of public areas. The cost of waste management in Samoa represented 12 percent of MNRE's annual budget and 0.47 percent of the national budget in 2019.[38] The tipping fees collected at the Tafaigata Landfill are currently the only source of revenue for the government from SWM and, as outlined in Table 10, it is far less than expenditure, covering only 3 percent of the waste management budget.

Table 10: Collection and maintenance costs (Source MNRE, 2019)

Fees (SAT/year)	Tafaigata Landfill (SAT)	Vaiaata Landfill (SAT)
	REVENUE	
Tipping fee at landfill	102,959	N/A
	EXPENDITURE	
Cost for waste collection service	1,686,966	433,638
Cost for landfill maintenance	299,805	144,000
Revenue from weighbridge	102,959	
Cost for lawn maintenance	25,450	
Cost for litter maintenance	433,638	
Total	3,262,997	

The cost of waste management based on the estimated amount of collected waste under MNRE's government program (MNRE, 2019), including the daily operations of two national waste landfills, is estimated at US$164 per tonne. This is outside of the developing countries' range when compared to The World Bank findings (World Bank, 2018). This could be due to the large proportion of uncollected waste from the designated collection areas, or as a result of unrecorded collected waste. In terms of cost per capita per annum, Samoa sits at US$2.60, which is in line with the expectations from developing countries.

[38] Government of Samoa. (2020). 2020 Budget address. [online]. Available at https://www.samoagovt.ws/2020/05/2020-21-budget-address/. Accessed 11 August, 2020.

Sustainable financing systems for waste management are not currently in place because Samoa continues to be highly dependent on other sources of revenue and the issue has been recently exacerbated by increasing costs. There is ongoing discussion within the government about increasing revenue collection through a 'user-pays system' (MNRE, 2019) and to frame regulations to impose fees or charges, including any special levies or additional charges for effective and efficient waste management.

The government pays approximately SAT 4 million every year to private contractors to manage both collection and disposal services (Sagapolutele, 2020), which are paid on a monthly basis (ADB, 2017).[39] A private contractor is paid approximately SAT 79,000 per month to provide maintenance at Tafaigata for daily waste compaction, soil coverage, and lawn maintenance. Private collection companies charge for commercial and institutional collection services and are in turn charged tipping fees on entry to Tafaigata, providing additional government revenue (PRIF, 2017).

4.4.2 Development partners

JICA and SPREP have been active in Samoa's waste sector, providing support and targeted investments for MSW, for example:

- JICA provided financial and technical assistance to upgrade urban dumps and construct new sanitary landfills in many PICs including Samoa. Several home-composting pilot projects using different methodologies were implemented between 1999 and 2015. The first aluminum cans facility was piloted in 2003–2004 at the current recycling area at Tafaigata Landfill. Under J-PRISM I and II, the landfill was rehabilitated in 2002. JICA also funded a 2013 study to assess the potential of implementing a reverse-logistics network to support and enhance recycling activities in Fiji, Samoa, Tonga, Tuvalu, and Vanuatu.[40]
- SPREP, through the PacWaste Project, funded baseline e-waste assessments in nine PICs including Samoa in 2013 (Leney, 2013), and conducted an inventory of e-waste in 2009 supported by the Basel Convention Secretariat. SPREP also donated intermediate bulk containers for storing used lubricating oil to support SRWMA's initiatives.
- The scrap metal assessment in Samoa included training for recyclers and the development of a Scrap Metal Operation Guideline funded by USAID in 2016.
- The EU supported the improvement of sewage and sludge disposal through the construction of proper sewage and sludge lagoons in Upolu and Savai'i islands.

[39] ADB. (2017). Case studies in Private Sector Participation: Solid Waste Management. Asia Development Bank.

[40] JICA. (2013). Data Collection Survey on Reverse Logistics in the Pacific Islands. Final Report. Tokyo: Japan International Cooperation Agency.

4.4.3 User-pays options

Senior government officials from Samoa have visited Vanuatu and Tonga to observe the user-pays systems operating in those countries. J-PRISM II is assisting the MNRE with development of a system, which requires further investigation and information-gathering to ensure smooth operations and long-term sustainability (Sagapolutele, 2020).

There are two local brewery companies (Vailima Breweries Limited and Taula Beverage Company Ltd) operating a deposit system for the return of glass bottles for reuse through their distributors. Both companies adjust their deposit rates periodically, depending on their requirement for glass bottles. For example, distributors pay 5 cents (SAT) for the small bottles and 20 cents (SAT) for 750 ml bottles (PRIF, 2017). The Taula Beverage Company Ltd also collects from the public by driving trucks throughout the main islands of Upolu and Savai'i to pick up empty bottles and make payments directly to consumers. An interview with Vailima Brewery indicated 88 percent of all bottles are returned and that bottles can be reused up to eight times (APWC, 2020).

4.5 Waste management infrastructure

Samoa has two designated waste disposal sites – one sanitary dump on the more populated island of Upolu (Tafaigata) and one semi-aerobic landfill on the island of Savai'i (Vaiaata). The number of temporary unregulated dumps in Samoa is unknown (SPREP, 2018).[41] Samoa's landfill sites are owned and managed by the government, but the daily operations of waste treatment, storage, and disposal are contracted to private companies.

Tafaigata Landfill occupies 62,322 m^2 (15.4 acres) on Upolu Island, 10 kilometers from Apia, in a relatively remote agricultural area at an elevation ranging from 110 to 140 meters above sea level. It has been operational since 2003. A significant amount of financial and technical support has been provided by JICA, including upgrades to the landfill, strengthening of landfill operations, and the development of an operations training program. Tafaigata has a gatehouse where tipping fees are paid, a recycling-materials segregation and storage area, a hazardous waste incinerator, and wastewater lagoons. The existing engineered waste cells are full, and waste currently goes to areas of landfill that have no lining system. The lack of lining and poor leachate monitoring (Table 11) increases the risk of leachates seeping into surface and ground water, as well as other environmental risks. Waste is currently delivered to the site both compacted and loose. Waste is compacted at the landfill site daily, during operational hours. The landfill has a total footprint of 40,000 m^2.

41 SPREP. (2018).

The original landfill design was expected to have a maximum depth of 10 meters, with capacity estimated to be reached in approximately 2032. If a depth of 20 meters is achieved, the capacity may be extended to 2050 (see Figure 9).

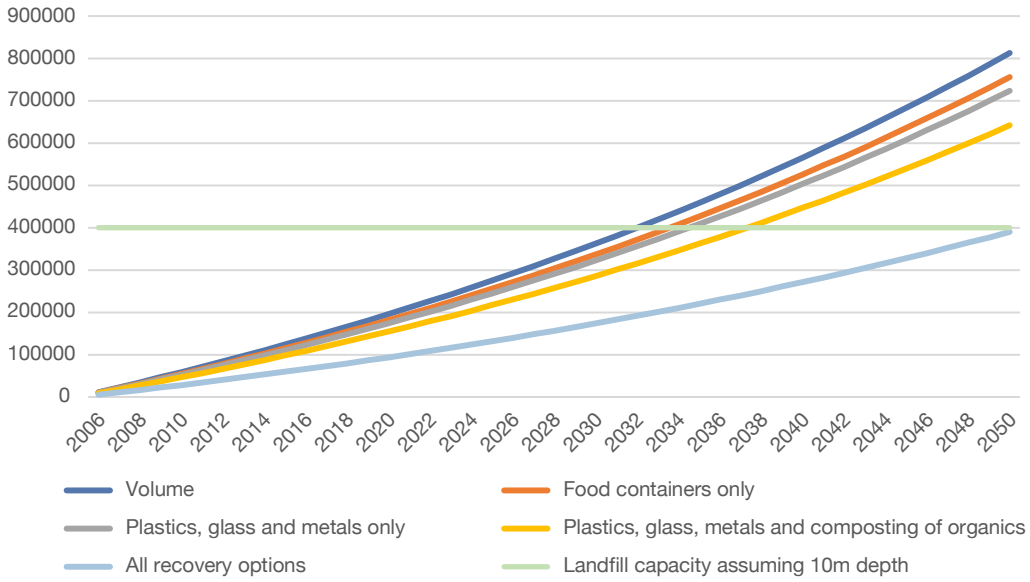

Figure 9:
Tafaigta Landfill lifespan vs waste generation in Samoa

In comparison, Vaiaata Landfill is located on Savai'i Island, covering an area of 38,000 m^2 (9.4 acres), with fewer facilities and little monitoring.

Table 11:Landfill functions at Tafaigata and Vaiaata

	Tafaigata Landfill	Vaiaata Landfill
Separation and collection	Recyclables such as aluminum cans, aluminum, glass bottles, white goods are separated by waste-pickers and recycling companies	N/A
Compost	N/A – There is a compost yard but it is currently not operating	N/A
Disposal	General waste from households and businesses is accepted	General waste from households and businesses is accepted
Incinerator for healthcare waste	Healthcare waste is incinerated	Healthcare waste is incinerated
Leachate pond	Quality of the leachate is inconsistently monitored	Quality of the leachate is not monitored
Environmental monitoring	Leachate collection and testing, gas monitoring (CO2, methane), and surface or groundwater quality*	Leachate collection
Remaining capacity **	50,000 m^2 however, designated waste cells are filled and need extension	80,000 m^2

Source: MNRE, 2019 * SPREP, 2010 **APWC, 2020

The following improvements relating to landfill disposal in Samoa were cited as priority areas in the National Solid Waste Management Strategy 2019–2023:

- Establishing a rubbish collection monitoring system, such as collecting weighbridge data
- Establishing a landfill operation monitoring system, including developing landfill operation manuals and recycling regulations
- Implementing a feasibility study on expansion of Tafaigata with further public–private partnerships or the possibility of a landfill relocation.

4.6 Initiatives and opportunities

Samoa has recently achieved the following in relation to waste management and recycling:

- Ban on plastic shopping bags, straws (2019), and styrofoam cups and food containers (2020)
- Establishment of a Recyclers and Waste Management Association (SRWMA)
- Glass bottle return system established for two local beer breweries
- Commencement of the Samoa Waste Oil Management Programme (SWOMP)
- SRWMA & Samoa Pure Water's Plastics to concrete aggregate initiatives
- SSAB e-waste takeback system
- Provision of land at landfill site to support private recycling operators
- National Beautification Programme (villages and roadsides) (Ministry of Women and Community Developments)
- Hotel Waste Management initiative

Key findings

- Recycling activities are constrained by Samoa's remote location and lack of economies of scale.
- Opportunities to finance waste collection through service fees, taxes, and fines are not implemented.
- The private sector plays a major role in the delivery of waste management services in Samoa, including waste collection, recycling, and landfill management.
- No source separation of recyclables – except for green waste and food scraps in rural areas.
- Two local breweries operate a deposit system for the return of glass bottles for reuse through their distributors.
- The largest landfill (Tafaigata) is expected to reach capacity by 2032.

5. Waste audits

5.1 Sampling methodology

The Secretariat of the Pacific Regional Environment Program (SPREP) implemented the Waste Audit Methodology: A common Approach Audit (SPREP, 2020) to undertake waste sample collection and waste sorting. The full breakdown of the methodology and the project-planning process is provided in the Appendix G to Appendix Q.

An integrated management system was used during audits, which covers quality, health, safety, and environment (QHSE). This system has been developed to be consistent with the requirements of the international standards ISO9001 (Quality), ISO14001 (Environment), and AS4801 (Occupational Health and Safety). No injuries or incidents were reported during the audit.

A training session was conducted with local MNRE staff in relation to collecting waste samples, conducting waste audits, conducting interviews, and landfill assessments (Appendix I).

5.1.1 Waste sampling distribution and collection

During the waste data sample collection undertaken over the period March to May 2020 in Samoa, the project team collected a wide range of data from households and commercial premises through audits and interviews. In addition, landfill and stockpile audit assessments were also undertaken, as summarized in Table 12. The sampling plan was designed to ensure that the samples were collected from at least one outer island and spread between low-, medium-, and high-income households on both islands.

Table 12: Samoa household sampling distribution

Urban/ Rural		Income category	Samples required	Samples collected	Total	Collection systems	Collection frequency
Urban	Apia (Upolu Island)	Low	20	20	82	Yes – Door-to-door at set collection points	Twice a week (Zone A twice daily)
		Middle	25	28			
		High	25	25			
		High sub		2*			
		Low sub		7*			

Urban/ Rural		Income category	Samples required	Samples collected	Total	Collection systems	Collection frequency
Rural	Upolu Island	Low	40	79**	119	Yes – Door-to-door at set collection points	Twice a week
	Savai'i Island	Low	40	40***			

* (2+7=9) were substitutes collected during COVID-19 period ** Of which 39 were substitutes collected during COVID-19 period *** Of which 40 were post COVID-19 period

The project plan (see Appendix G) was discussed with MNRE to ensure the smooth implementation of the waste audit operations. Samples were collected on Upolu and Savai'i islands, both of which have collection systems in place. All samples were collected as per the collection methodology.

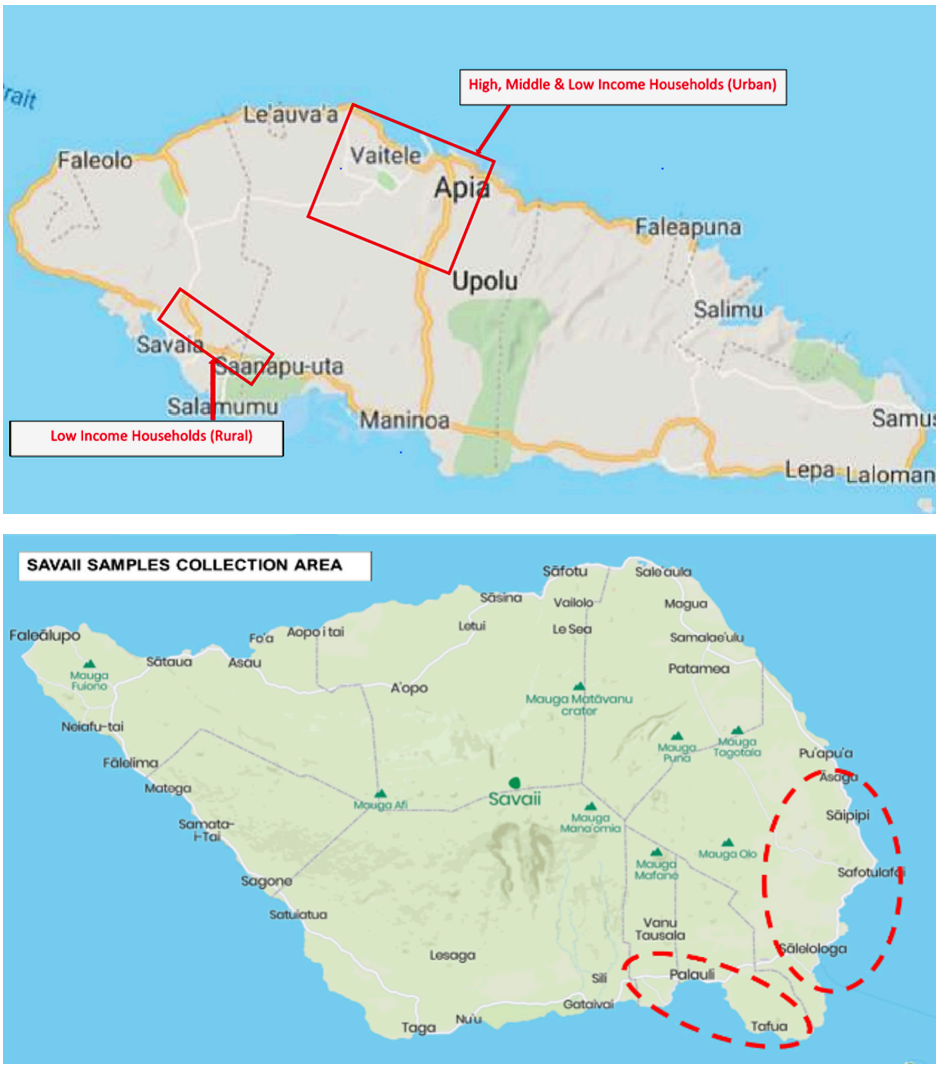

Figure 10:
Map of collection area on Upolu Island (top). Map of collection area on Savai'i Island (bottom).

An online tool was used to capture all data as the samples were collected. A collection sheet is provided in Appendix J.

Impact of COVID-19

At the commencement of the COVID-19 pandemic, 113 household samples had been collected and all 47 commercial samples. The team had conducted 47 commercial interviews. Upon the lifting of lockdown restrictions on 1 May 2020, two of the project team remaining in Samoa worked with the MNRE team to collect 40 rural household samples and conduct 120 household interviews.

Due to two months passing since the initial household sampling, most of the ribbons used to mark households for the follow-up assessment had been removed from the platforms, so the exact household was unable to be identified. In these instances, new waste samples were collected, audited, and households marked for follow-up interviews using the same methodology. As a result of the lessons learned from the COVID-19 shutdown and the challenges faced when attempting to complete interviews after this period, the methodology used in commercial interviews – collection in tandem with interviewing – was subsequently used for the outstanding household samples (see Appendix R).

Figure 11:
Sample collections from a rural area household.
(Source: APWC, March 2020)

Commercial premises

A total of 47 commercial premises were sampled simultaneously with households in Apia. The methodology for commercial collection is descriptive in Appendix I.

Table 13: Commercial samples collected

Sample type	Samples required	Samples collected	Interviews	Waste pickup frequency	Destination
Food outlet	10	10	10	Twice per week	Waste disposal site
Admin/office	10	10*	2		
Supermarket	10	10	10		
Hotel	10	10	10		
Retail	10	7	7		
TOTAL	50	47	39		

* Ten individual samples (large bags) were collected from communal waste bins servicing over 20 offices in one building

Landfill samples

Although the household waste generation audit covers the waste generated through everyday consumption of products, a landfill audit was also undertaken to collect data on materials that are not usually found in household bins, for example, bulky, commercial, and construction waste.

Table 14: Landfill samples collected

	Sampling days	
Minimum	7 days	
Desirable	14 days	
Collected	**Pre COVID**	**COVID**
	9 days	5 days

Figure 12:
Household waste unloaded at Tafaigata Landfill
(Source: APWC, March 2020)

The landfill at Tafaigata is open from Monday to Saturday, 9.00am to 4.30pm. As the project team was in Samoa for four weeks, it was agreed a full week of sampling would be conducted. However, data was collected over 14 days because the team auditors could continue auditing during the COVID-19 shutdown. The team members followed stringent health and safety requirements and were equipped with appropriate personal protective equipment (PPE) (see Appendix I).

Figure 13:
Tip face at Tafaigata Landfill (left). Scrap metal separated by waste-pickers to take to Pacific Recyclers at Tafaigata Landfill (right).
(Source: APWC March 2020)

Figure 14:
Truck from local hospital disposing of non-hazardous waste at Tafaigata Landfill
(Source: APWC, March 2020)

5.2 Interviews

5.2.1 Household and commercial

Interviews were conducted with households and commercial operators to assess self-reported waste disposal behavior. Interviews also sought to understand what happens to uncollected waste, why certain waste is disposed using municipal waste collections, and the reason for these behaviors. Further information can be found in Appendix I.

Figure 15:
MNRE staff conducting interview in a rural area

5.2.2 Producers

There are numerous producers and water refilling companies located in Samoa (Table 14). A number of these companies were interviewed to obtain a more accurate understanding of plastic waste generation rates.

Table 15: List of producers on Upolu and Savai'i islands

Producers		
Vailata Spring Water (Savai'i)	Wright Water	Water Express
Toleafoa/Olo Water	Icy Water	Ocean Blue
Somemore Water	Clear Water	Serenity Water
Olivia Refill	R/J Water Refill	Natural Food Ltd
Tara Crystal	Organic Water	Vaitele Spring Water
Samoa Pure Water	Apia Bottling Water	Samoa Natural Water
Paradise Water	Le Vai Company	South Pacific Water

As well as collecting data from the producers, interviews were also conducted with recyclers that are currently operational, to determine the amount of recyclable material collected in Samoa. An audit of all current stockpiled material was also carried out. The size and location of each stockpile was audited and the data was recorded for analysis.

5.3 Sample analysis

All samples from Upolu Island were transported to an area at the entrance to Tafaigata Landfill for sorting. The building is the property of the MNRE and was approved for use for sample sorting. All Savai'i Island samples were taken to a site provided by MNRE on Savai'i Island, and all necessary equipment was ferried across with the project team from Upolu and taken back to Tafaigata Landfill for storage.

Bag tags were used to identify all samples to avoid misidentification. The collected samples were lined up to ensure none were missing. All samples were cross-referenced with the collection sheet to ensure consistency between sample collection and sorting. Each waste sample was opened and the individual materials within each bag sorted into different trays according to the pre-defined categories. Separated materials were weighed using an electronic scale and the weight measurement recorded in a sorting sheet on KoBoToolbox using digital tablets. To maintain the high level of accuracy required, pre-calibrated electronic scales from Australia were used.

Figure 16:
Waste separation by Mr Setu Viliamu (MNRE)
(Source APWC, March 2020)

A separate count of beverage containers for all general waste samples was also undertaken. Beverage containers from the samples were stored and counted separately. Containers were stored and labelled to ensure no cross-contamination took place. Containers were sorted by size, packaging material, and product type.

All plastic bags were sorted into different types. Cigarette butts, coffee cups, and takeaway containers were segregated. All sort data was added to the sorting form on the digital tablet using the categories listed in Appendix K.

5.4 Results of 2020 waste audit

During the waste audit in Samoa between March and May 2020, a wide range of data was collected. See Appendix R in relation to challenges collecting data.

Table 16: Data collected for Samoa audit

Sample type	Number of samples from Apia	Number of samples from Savai'i
Household samples	201 in total, 82 in Apia (9 of which were COVID-19 substitutes), 79 in rural areas on Upolu Island (of which 39 were COVID-19 substitutes), and 40 in rural areas of Savai'i Island (of which 40 were COVID-19 substitutes)	40 rural area
Commercial samples	47	0
Landfill samples	14 days (416 samples)	Site-visit only
All island stockpiles	All stockpiles are located at multiple sites around the island	

5.4.1 Waste generation

The aim of the waste audit was to determine the total amount of material being generated in various parts of the country so the quantities to be collected, compacted, and moved could be projected as accurately as possible. A model of waste generation rates was constructed based on the household and commercial data collected. It also included available disposal data to determine what the data revealed about waste generation characteristics and how it varies with households or the commercial sector. The following features were investigated as predictors of household waste disposal:

Household-level predictors:

- Total monthly household income (from all employed members of the household)
- Monthly household spending on groceries
- Number of people in the house
- Number of children in the house
- Household rating of collection service.

Town-level predictors:

- Whether or not there is a collection service in the house area
- How often waste is collected if there is a service
- Average household income for the town where the house is located

- Average grocery spending for the town where the house is located
- Population of the town where the house is located.

The Samoan city of Apia and the district of Fa'asaleleaga generates household waste at a similar rate to other centers with similar population density, where the city and district population respectively were used as a measure of population density, as shown in Figure 17.

$$\text{Household waste generation}\left(\frac{\text{kg}}{\text{hh}\cdot\text{day}}\right) = 0.36\ \ln(\text{settlement population}) - 1.8$$

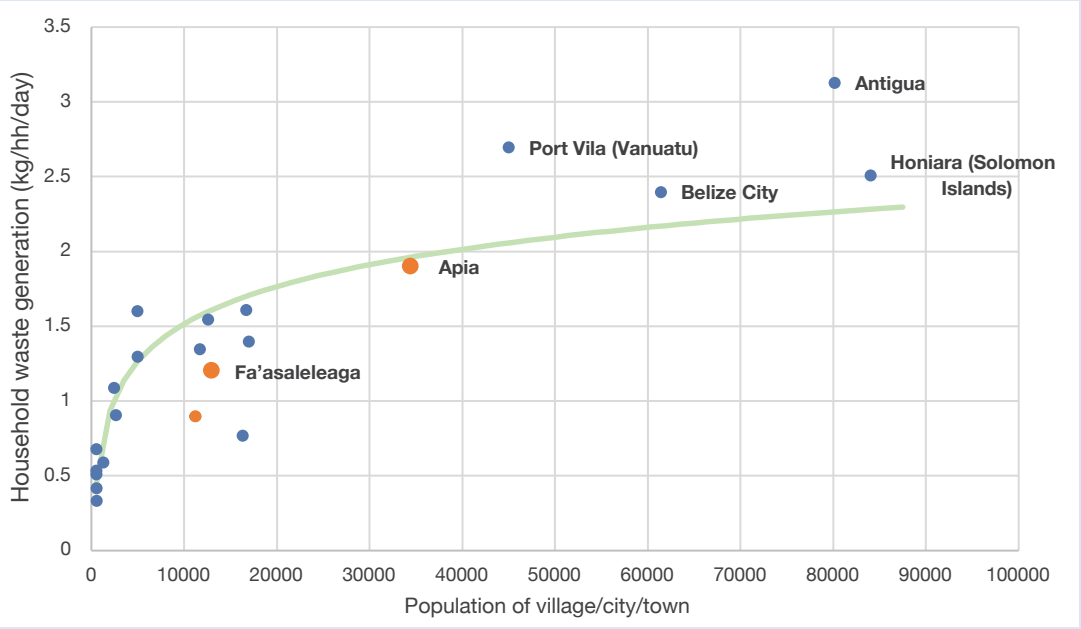

Figure 17:
Household waste and population density comparison to other SIDS (Samoa population centers highlighted in orange)

Figure 17 outlines the household waste generated and population density of Apia and Fa'asaleleaga in Samoa (plotted in orange) compared to other cities within the Pacific Region, Caribbean Region, and South Africa where similar audits have been conducted. Appendix Q contains the names of each plot for comparative purpose.

The total waste generated (as opposed to just the household waste) was found to be closely related to GDP per capita and was modeled by the following equation:

$$\text{Total waste}\left(\frac{\text{kg}}{\text{person}\cdot\text{day}}\right) = 0.0001\ \text{GDP per capita (US\$)} + 0.51$$

Figure 18 suggests that non-household waste generation is more closely related to a country's GDP than the amount of waste generated by households.

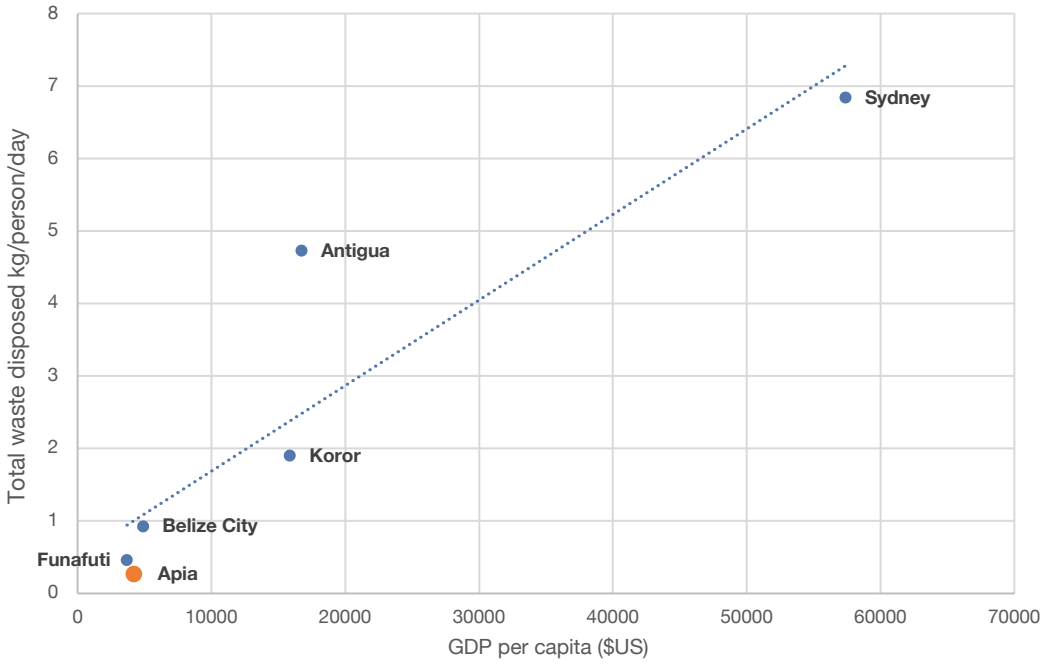

Figure 18:
Total waste generation vs GDP per capita*

* The waste generation rate in Apia is around one-quarter of what would be expected given Samoa's GDP

The overall waste generation rate in Samoa, when compared with the generation rate in other island nations, shows that:

- The household waste generation rate depends strongly on the population density of the area where the household is situated
- The overall waste generation rate depends strongly on the GDP per capita of the country.

Interestingly, however, the generation rate of household waste was not closely related to GDP per capita. Countries with higher GDP tend to produce much more non-household waste.

While the quantities of waste generated by households in Samoa are comparatively in line with expectations, the total quantity of waste dumped at the Tafaigata Landfill is much lower than expected.

Table 17: Average waste generation, disposal, and household numbers in Samoa

Area	Average waste generation* (grams/capita/day)	Average waste disposal at landfill** (grams/capita/day)	Generation 80% credible interval (grams/capita/day)	Average number of people in a household
Upolu	336	217	260–487	6.8
Savai'i	199	NA	126–271	6.8
Manono	163	NA	81–228	7.0
Apolima	163	NA	81–228	8.7

* Waste generation from all sources ** Waste disposal from all sources

An 80 percent credible interval means that, accounting for sampling error and uncertainty about extrapolation, there is an 80 percent chance the true value lies in the interval given.

Analysis of audit data found the overall household waste generation rate on Upolu is 0.28 kg/person/day. The analysis also attempted to determine waste generation rates from all municipal sources via weighbridge records of waste arriving at Tafaigata Landfill, which was calculated at 0.27 kg/person/day. These results show that the amount of waste generated by households alone is slightly larger than the waste generated by all sources accounted for by weighbridge receipts at the landfill. This supports a conclusion that only a proportion of the waste generated is entering the landfill at Tafaigata.

5.4.2 Waste generation by volume

Waste generation by volume is shown in Table 18. Two levels of compaction are reported: loose (200 kg/m^3, about the compaction that might be expected on a flatbed truck) and landfill (800 kg/m^3, the density that might be expected from a combination of landfill compaction and settling). The landfill compaction is simply the volume of compacted waste divided by two.

Table 18: Waste generation by compaction, m^3/year

	Upolu loose	Upolu landfill	Savai'i loose	Savai'i landfill	Loose total	Landfill total	Manono loose	Manono landfill	Apolima loose	Apolima landfill
Used lead-acid batteries*	236	71	42	13	278	83	0.7	0.2	0.1	0.0
Lithium-ion batteries	5	2	3	1	8	2	0.0	0.0	0.0	0.0
Other batteries	0.5	0.1	0.0	0.0	0.5	0.1	0.0	0.0	0.0	0.0
E-waste	152	76	28	14	180	90	0.5	0.2	0.0	0.0
Fishing	0	0	0	0	0	0	0.0	0.0	0.0	0.0
Glass bottles	2,591	833	629	202	3,220	1,035	7.8	2.5	0.7	0.2
Glass, other	716	230	200	64	916	294	2.1	0.7	0.2	0.1
Hazardous	28	12	0.0	0.0	29	12	0.1	0.0	0.0	0.0
Hygiene	22,245	4,580	5,449	1,122	27,694	5,702	66.7	13.7	6.1	1.2
Aluminum cans	3,579	994	327	91	3,906	1,085	10.7	3.0	1.0	0.3
Aluminum, other	3,244	901	307	85	3,551	987	9.7	2.7	0.9	0.2
Steel cans	9,503	1,827	1,752	337	11,255	2,164	28.5	5.5	2.6	0.5
Other metal	3,063	851	533	148	3,596	999	9.2	2.6	0.8	0.2
Organics	21,116	7,164	3,488	1,183	24,604	8,348	63.3	21.5	5.8	2.0
End-of-life vehicles *	3,499	658	617	116	4,116	774	10.5	2.0	1.0	0.2
EOL PVC Cells	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
White goods	166	55	30	10	196	64	0.5	0.2	0.0	0.0
Wood	519	87	93	16	613	102	1.6	0.3	0.1	0.0
Paper and cardboard	96791	20,475	16,995	3,595	113,786	24,070	290.4	61.4	26.4	5.6
PET	19,566	2,718	3,528	490	23,094	3,208	58.7	8.2	5.3	0.7
HDPE	5,381	747	803	112	6,184	859	16.1	2.2	1.5	0.2
LDPE	6,560	911	244	34	6,805	945	19.7	2.7	1.8	0.2
PP	8,949	1,243	300	42	9,249	1,285	26.8	3.7	2.4	0.3
PS	11,474	1,275	2,301	256	13,775	1,531	34.4	3.8	3.1	0.3
PVC	369	51	218	30	587	81	1.1	0.2	0.1	0.0
Flexibles and film	49,002	5,445	10,135	1,126	59,137	6,571	147.0	16.3	13.4	1.5
Single-use plastic bags	**7,655**	**510**	**1,336**	**89**	**8,991**	**599**	**23.0**	**1.5**	**2.1**	**0.1**

	Upolu loose	Upolu landfill	Savai'i loose	Savai'i landfill	Loose total	Landfill total	Manono loose	Manono landfill	Apolima loose	Apolima landfill
Plastic bags, reusable	695	46	15	1	710	47	2.1	0.1	0.2	0.0
Other plastic	4371	728	646	108	5,016	836	13.1	2.2	1.2	0.2
Textiles	10,249	2,306	1,810	407	12,058	2,713	30.7	6.9	2.8	0.6
Construction	150	45	27	8	177	53	0.5	0.1	0.0	0.0
Used oil*	67	67	3	3	70	70	0.2	0.2	0.0	0.0
Tires	112	28	20	5	133	33	0.3	0.1	0.0	0.0
Other	1,728	324	306	57	2,034	381	5.2	1.0	0.5	0.1
Total	291,813	54,864	51,835	9,694	343,648	64,557	875	165	80	15

* Some figures were estimated from import quantities instead of waste quantities as no waste of this category was observed being disposed of during audits. These quantities are marked with an asterisk (*) and should be interpreted cautiously (i.e. the number of cars imported in 2019 will not be the same as the number of cars reaching the end of their life in 2019).

5.4.3 Waste generation share

Figure 19 presents the share of total waste generated in Upolu versus Savai'i. It is important to note that fishing waste is not represented due to non-servicing of fishing communities.

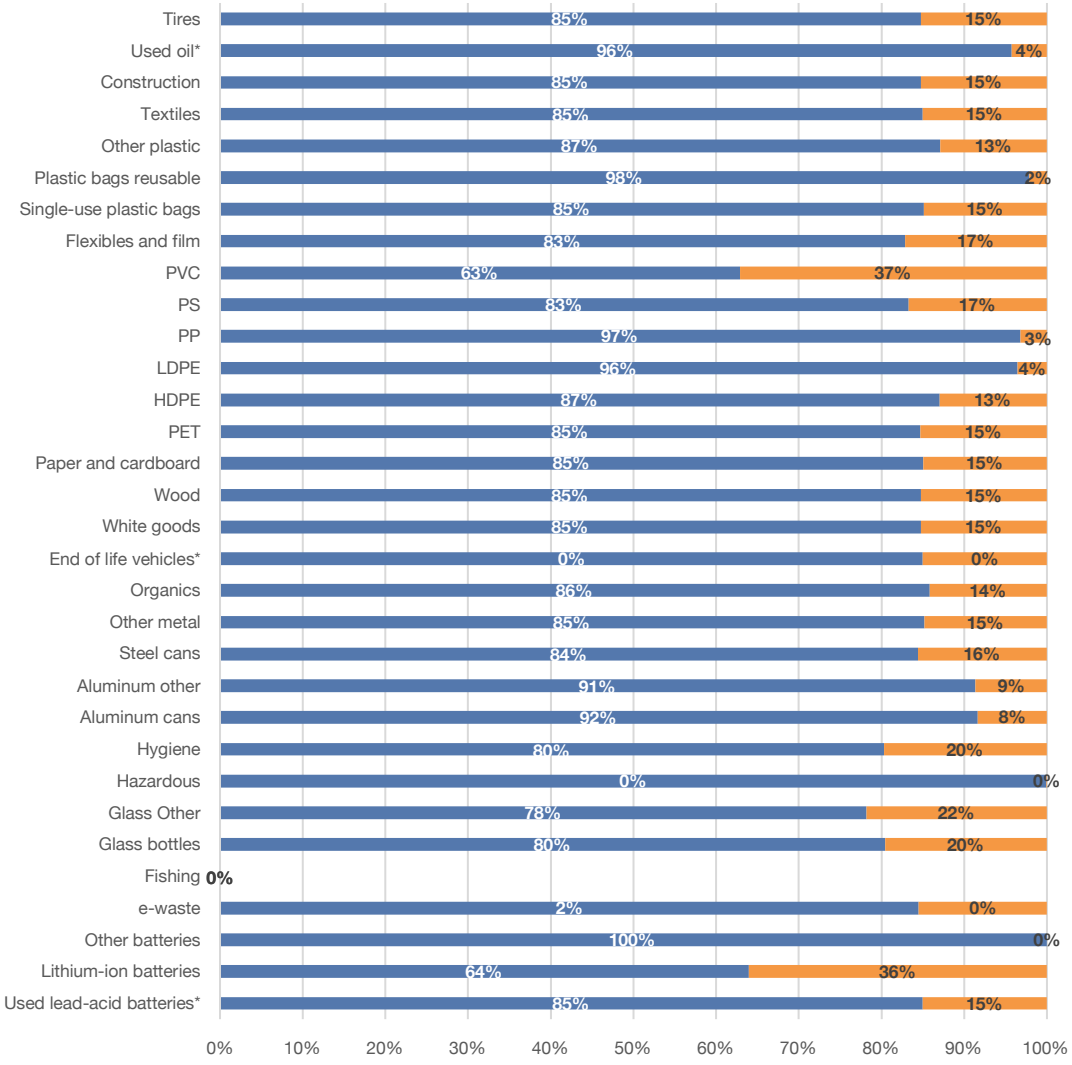

Figure 19:
Waste generation share

5.4.4 Household waste composition

Data analysis from household audits in Samoa shows the composition of waste by weight in Apia, rural Upolu, and Savai'i (Figure 20). Organics (food, planets, and timber), hygiene waste, and paper and cardboard are consistently the largest percentage of the waste composition across all three sample locations.

More than half (56 percent) of the total composition of waste by weight in Apia (urban area) was organic material. Paper and cardboard accounted for 23 percent

and hygiene waste accounted for 9 percent. The composition of waste in rural areas (Savai'i and Upolu) is highly similar. This however is substantially different from that found in Apia, which is to be expected. Although the same three waste streams remain dominant, organic waste is a much higher proportion of the waste placed out for collection in the urban areas when compared with rural areas. It is noted that often rural areas have larger houses and more open green spaces that can be used for composting and mulching practices.

Hygiene waste contributed the largest percentage for rural areas in both Savai'i and Upolu (31 percent and 32 percent, respectively). Paper and cardboard contributed 15 percent and organic waste was almost half that of Apia at 12 percent in Savai'i. Paper and cardboard contributed 11 percent and organic waste contributed 15 percent in Upolu's rural communities. Household interviews conducted in all areas provide further insights into disposal behaviors for households in both urban and rural communities.

Previous audits using the same methodology found outlying islands tended to generate lower quantities of plastic, paper, and metal waste in comparison to organics (Tuvalu, PRIF, 2019). This pattern was not evident from the audit in Samoa, as Upolu appeared to have similar waste compositions to the less densely populated Savai'i. As the population of Savai'i is greater than the outlying islands of Tuvalu, and is well connected through a ferry system, it may be that residents of Savai'i have greater access to imported and packaged goods.

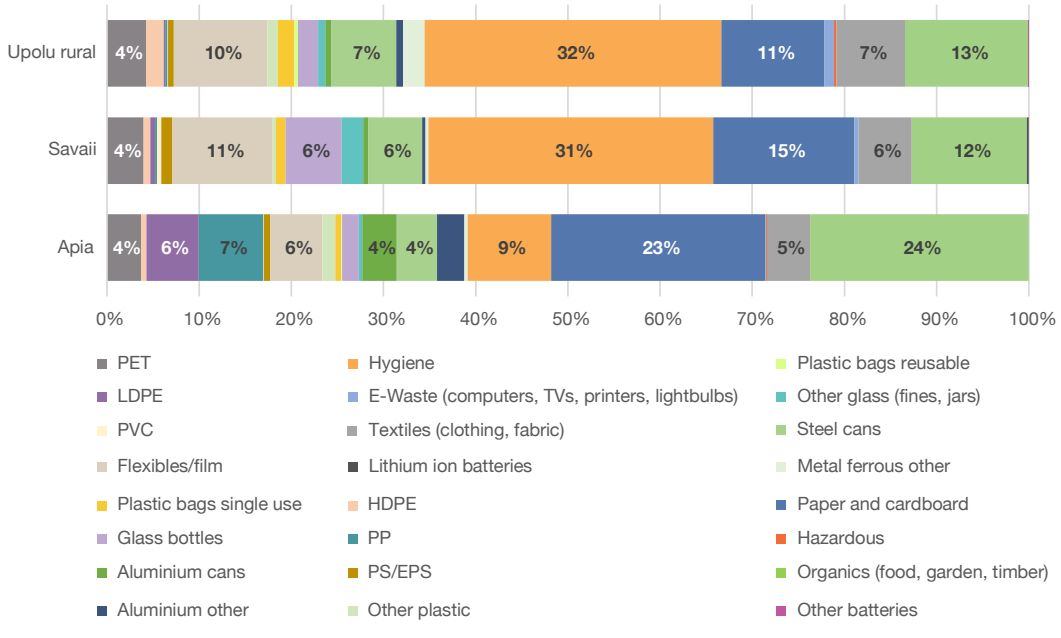

Figure 20:
Composition of household waste by weight (chart displays % share of 4% and above)

5.4.5 Household behavior

Household interviews conducted with residents in Upolu and Savai'i provide insights to waste management practices in Samoa. In Upolu, 99 percent of households and 100 percent of households in Savai'i reported disposing of waste properly via general waste collection services provided by the MNRE.

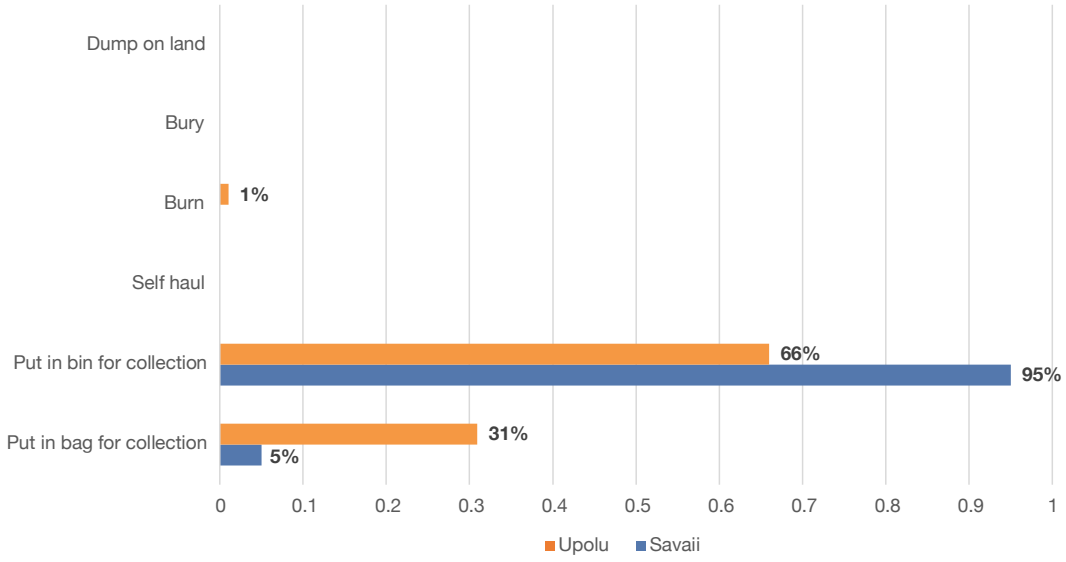

Figure 21:
Household waste disposal practices in Upolu and Savai'i

Households are encouraged to recycle organic waste by using green waste as mulch for gardens and food scraps for animal feed. Regular public awareness campaigns promote this philosophy within the communities. Obligations of MNRE contractors outline that green waste should not be collected, with the exception of the main town area. The project team reported that compacted waste arriving at the landfill generally has very low levels of green waste. The largest contributors to green waste at the landfill are self-haulers and commercial operators (for example, resorts).

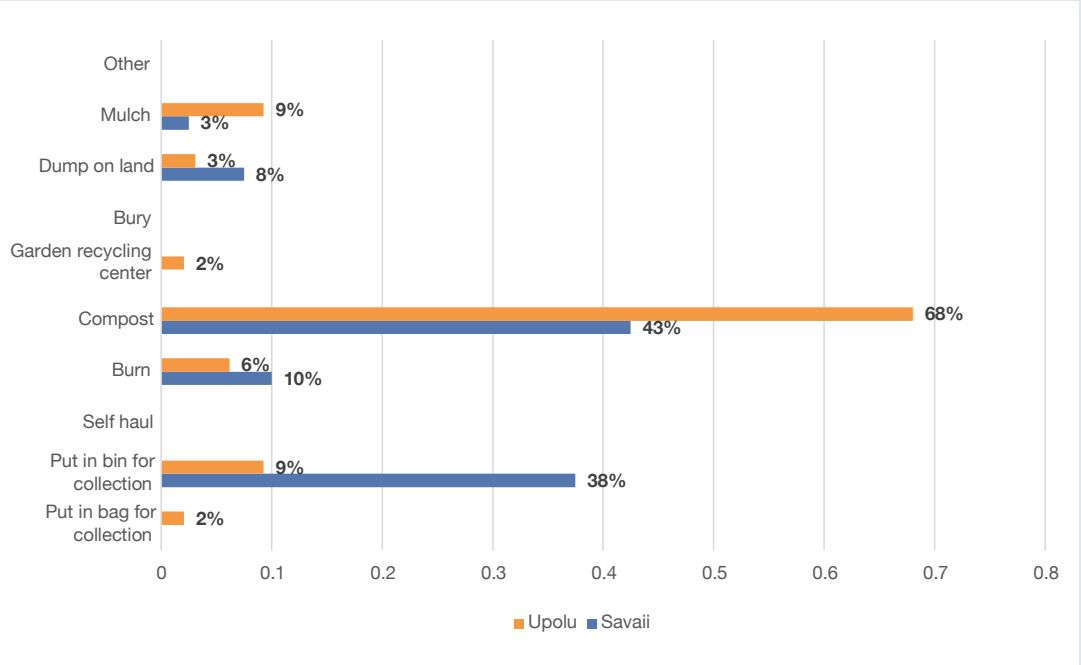

Figure 22:
Green waste disposal practices (households)

5.4.6 Stockpile audit results

An audit of current stockpiles situated on Upolu was undertaken. The quantities stockpiled were estimated through visual audits and interviews with two current recycling facility operators. It was considered important to conduct an analysis of current stockpiles because if measures are implemented to extract recyclable materials of interest, as a result of this study, stockpiles represent immediately available material. This would mean no additional measures would be required to extract the quantities of materials presented below.

Table 19: Type and quantity of materials found in stockpiles around Samoa*

Material	Units	Volume (m^3)	Weight (kg)	Annual generation (m^3)	Percentage of annual generation found in stockpile
Tires	6,155	139	27,700	2,034	6.81%
Ferrous metals (e-waste frames)	NA	10	5,000	11,255	0.09%
Aluminum (radiators)	200	5	900	3,551	0.14%
Copper	NA	0.12	60	NA	NA

Material	Units	Volume (m^3)	Weight (kg)	Annual generation (m^3)	Percentage of annual generation found in stockpile
Other metals (valuable metals from e-waste)	NA	4	2,000	3,596	0.11%
Toner cartridges	NA	3	315	104	2.88%
E-waste	NA	3	315	180	1.67%
PET plastic bottles	5,000	3	250	5,563	0.05%
Mixed items	NA	5	750	NA	NA
Waste oils	NA	264	224,400	83	318%

*All stockpiles on Upolu. GPS locations provided in Samoa datasheet.

Key findings

- Organic matter dominates waste composition.
- A large proportion of organic waste is self-managed in rural communities and low levels of compacted green waste is arriving at landfill.
- Overall household waste generation rate on Upolu is 0.28 kg/person/day.
- Waste generated on Upolu from all sources is 0.337 kg/person/day.
- Waste disposed at the Tafaigata Landfill from all sources is 0.27 kg/person/day.
- Data shows that all municipal waste generated is not being deposited at the landfill and if deposited, it is not being recorded.
- Green waste is reused as mulch or feedstock at a household level. Low levels of compacted green waste are arriving at landfill.
- Waste generation equates to 0.9 kg/hh/day on Upolu vs 1.1 kg/hh/day on Savai'i.

6. Conclusion

Onsite visits, meetings with officials, audits, and a review of the current legislative framework suggest Samoa has the potential to contribute clean recyclable material for potential recycling activities at the regional level. Additional technical, monetary, and human resource support will be required for this participation to be efficient and effective. In addition, if pending policy measures are legislated, the quantity of materials separated at source is expected to increase by 11,157 tonnes per year at a 60 percent recovery rate.

To ensure the private and public sectors in Samoa can successfully undertake the activities associated with recycling at a regional level, current challenges must be factored into decision-making, including land barriers, the small private sector presence, limited technical capacity, and a number of regulatory constraints. Modifications to current infrastructure and implementation of additional appropriate equipment and other resources will also need to be investigated. A needs assessment should be undertaken to determine if Samoa is able to participate in any regional waste management initiatives.

In 2019, Samoa introduced a ban on the import, manufacturing, and sale of plastic shopping and packing bags, and straws. A ban on styrofoam food containers and cups followed in June 2020. It is anticipated, when waste deposit regulations are implemented, these mechanisms will aid in the recovery of materials while providing a financial basis for the movement of material out of Samoa for recycling. It is also understood that SPREP and MNRE are currently investigating a comprehensive waste levy to be implemented on a range of materials.[42]

Several options are available for consideration toward increased resource recovery for Samoa and its development partners. The potential pathways are early concepts only and require careful evaluation and detailed technical and financial feasibility reviews.

6.1 Value-adding to plastics

Opportunity exists for Samoa to consider a plastic-to-product initiative for recyclable waste materials, turning plastics such as PET bottles into products such as roofing and road-sealing materials. More than 10 beverage and bottling companies in Samoa currently use plastic bottles for packing their products, such as noni juice and coconut oil. At present, this material is not recycled, therefore the volume of PET bottles generated would suggest that a recycling initiative such as plastics-to-products would be viable. Producing a reprocessed product such as flaked PET may achieve improved export market results.

[42] https://www.sprep.org/sites/default/files/documents/tenders/SamoaWaste_Deposit_Reg.pdf

In addition, Samoa is expected to integrate waste deposit regulations in the near future. It is anticipated these regulations may include plastic waste materials such as beverage containers, thereby increasing the recovery of clean plastic waste. Long-term governmental subsidies could be integrated within the proposed waste deposit regulation design.

Many of the available opportunities make an investment in this area worthwhile. Numerous upcoming plastics-to-products technologies such as roofing materials, concrete, and road sealing materials would be fit for purpose in Samoa. Members of the Samoa Recyclers and Waste Management Association (SRWMA) and other businesses currently investing in waste recycling would be best positioned to invest in these programs in conjunction with ongoing support from the Samoan government. It is recommended that stringent planning and a thorough investigation is undertaken (as part of a feasibility study) to identify, address, and overcome current challenges such as shipment to overseas markets, if such a project is to be considered (See Appendix U).

6.2 Green-waste composting, potentially with paper and cardboard

Organic waste is responsible for a large proportion of waste generated by households in Samoa. An organic composting development would address the expensive local price of imported fertilizers and the associated environmental and health consequences. It would also promote organic farming using green waste for composting. The Ministry of Natural Resources and Environment has already provided land space within the main National Waste Disposal Facility for such purposes. Due to the large amount of potential landfill space and the greenhouse gas saving that can be achieved by removing paper and cardboard from landfill, any composting project should consider the inclusion of paper and cardboard.

The program could be subsidized initially through the Waste Deposit Regulation to generate supporting revenue by introducing a levy on imported fertilizers or weedicides. In the long term, it will make any generated compost cheaper for public use and will contribute to the improvement of soil conditions by reducing chemical inputs. A cost-benefit analysis of such investments and appropriate recommendations should be undertaken.

6.3 Landfill life

A range of policies will have an impact on the future lifespan of the landfill. As the design of landfill depth is unknown at the time of writing this report, two estimates (10 meters and 20 meters) of the total landfill capacity have been analyzed and provided.

- With no resource recovery of recyclable materials, the current landfill life will expire in 2032, 26 years after it opened

- Recovery of materials dealt with under current legislation (single-use plastic shopping bags, straws, and styrofoam cups and food containers), in addition to materials under consideration for waste deposit regulations (PET, HDPE, glass, and cans), would extend the current lifespan by approximately two years, to 2034
- Recovering all recyclable materials (except for cardboard) would extend the lifespan by six years, to 2038
- Recovering all recyclable materials from the landfill may extend the lifespan by 18 years, to 2050.

6.4 Waste management, disposal, and collection

Despite the free public collection service provided by the government, not all households are being effectively covered. Data shows that approximately half of the potentially recoverable materials entering the country through imports are currently not being collected. Improvement of collection services across Samoa will require investment in waste collection logistics and transport, as well as capacity building for systems management and monitoring.

There is also a need to establish sustainable sources of financing for waste management, such as incentivizing efforts to recycle and reuse, setting up a user-pay system, and introducing import levies for plastic packaging.

Strong governmental support suggests any needed expansion of the existing services can potentially be organized in partnership with several collection initiatives implemented by the private sector.

6.5 Key conclusions

- Approximately 27,057 tonnes of waste are generated annually in Samoa
- Paper/cardboard and organic waste make up the largest categories of waste generated annually
- Waste generated greatly exceeds the amount reaching the landfills
- Recycling activities are constrained by the country's remote location and lack of economies of scale
- A large proportion of organic waste is sustainably self-managed in rural communities, but remaining waste is burnt, buried, or dumped
- Systematic waste separation at source is generally non-existent
- Tafaigata landfill will require expansion
- Facilities for recovery and processing of recyclable or compostable materials are inadequate
- Samoa has the potential to contribute to regional recycling activities.

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8. Appendices

Appendix A: Samoa solid waste regulations and policies

National Chemical Management Strategy 2007–2017	Provides a framework for sustainable management of all chemicals. It includes the activities of procurement, transportation, storage, distribution, use, and disposal.
Land Surveys and Environment Act 1989	Division 6 and 8 of Part VIII; Division 6 makes it an offence to throw, discharge or deposit into Samoan waters (broadly defined) any refuse matter of any kind, from any place or vessel, or to deposit material in a place from where it may be washed into Samoan waters with polluting effect; Division 8 applies to the control of litter on land. It is an offence to deposit litter (widely defined to include refuse, rubbish and animal remains) in a public place and the offender may be ordered to clear up and remove the litter.
Planning and Urban Management Act 2004	Regulates the use of land, conservation and development of land in Samoa.
Quarantine (Biosecurity) Act 2005	Discharge of ballast water from vessels. Also regulates soil, garbage, litter, animals, animal products including the discharge of ballast water.

Appendix B: Ministries and stakeholders on NSWMS steering committee

Ministries and stakeholders on NSWMS steering committee
Samoa Chamber of Commerce
Scientific Research Organisation of Samoa
Ministry of Public Enterprises
Ministry of Agriculture and Fisheries
Ministry of Commerce Industry and Labour
Ministry of Foreign Affairs and Trade
Ministry of Justice and Courts Administration
National Health Services
Ministry of Works and Transport and Infrastructure
Ministry of the Prime Minster & Cabinet
Attorney General
Public Service Commission
National University of Samoa
Electric Power Corporation
Samoa Bureau of Statistics
Samoa Land Corporation
Land Transport Authority
University of South Pacific/Alafua
Samoa Umbrella of Non-Governmental Organisation Secretariat of the Pacific Regional Environment Programme Ministry of Police
Samoa Airport Authority
Samoa Port Authority
Samoa Shipping Corporation
Samoa Fire Emergency Services Authority
Samoa Water Authority

Appendix C: Recyclers and producers in Samoa

Recyclers

Company name	Contact name	Contact email	Contact phone
Samoa Stationery & Books	Nancy Vito	nancy@ssab.ws	(685) 7527786
Waste Management Limited	Marina Keil	wastemanagementapia@gmail.com	(685) 7524939
Pacific Recyclers	John Sio	precycle@lesamoa.net	(685) 22117

Producers

Company name	Contact name	Contact email	Contact phone
Vailata Spring Water (Savai'i)		richard.wetzell@hotmail.com	685 845 6169/685 724 8910
Somemore Water			7792975. 26781
Olivia Refill			7746773
Tara Crystal		accts@taraice.com	21217
Samoa Pure Water	Siliva Ugapo	moala.siliva@gmail.com	
Paradise Water Refill		contact@hotelelisa.ws	20355
Wright Water Refill			29014
Icy Water			7788477
Golden Samoa Company		Zlfysb@ sina.com	7207895
R/J Water			7745361
Organic Water		organicicett@gmail.com	7589580/7602084
Living Water Refill			7603714 & 7656440
Aliki Investor		talaa@ahliki.com	7778585
Le Vai Company			
Water Express		Nesalsnclair@gmail.com	00166
Ocean Blue		422320249@qq.com	7238000
Serenity Water			7613773
Natural Food Ltd/H2O		naturalfood@samoa.ws	24177
Vaitele Spring Water		vsw1993@gmail.com	25504
Tropical Island Bottling			212510
Natural Samoa Water		asionea@ahliki.com	7712814
Vailima Brewery			
Taula Beverages Company			

Appendix D: Recycling facilities owned by private recycling companies

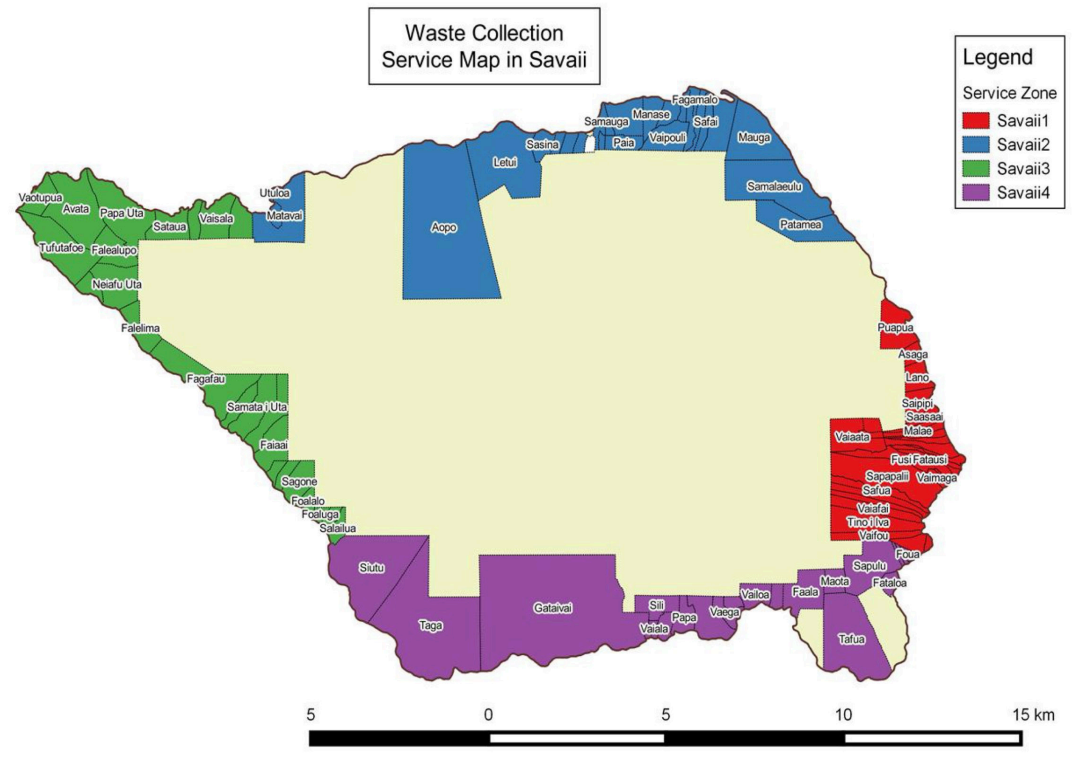
Recycling operator	Status	Land area (acres)	Location	Building floor and roof area	Transport equipment	Baling & other equipment	Cutting tools
Pacific Recycler Co. Ltd	Currently operating	4	Within the recycling area at Tafaigata Landfill	More than 1,000 m^2 of concrete and roof coverage area	1 Hiab 10-tonne truck 6-tonne truck Folk lift	Heavy-duty metals baler Aluminum cans baler Plastic and cardboard baler	Oxyacetylene gas LPG Others
Waste Management Co. Ltd	Currently operating	0.5	Within a residential area	More than 1,000 m^2 of concrete and roof coverage	6-tonne truck Excavator	Heavy-duty metals baler	Oxyacetylene gas LPG Others
Cash for Metals	Not currently operating	0.25	Within a residential area	Less than 500 m^2 of concrete and roofing area	3-tonne truck 3-tonne fork-lift	250-tonnes Metals baler Wire stripper machine	Oxyacetylene gas Others
One Metal	Not currently operating	2	Within a residential area	Less than 100 m^2 concrete and roofing area	Mostly hire when needed	Mostly hire when needed	Mostly hire when needed
Metal Man	Not currently operating	2.25	Within a residential area	Less than 500 m^2 concrete and roofing area	4-tonne Hiab truck 3-tonne truck Excavator 4-tonne fork-lift	No equipment	LPG Oxyacetylene Others

Appendix E: Fines for waste regulation offences

Act	Item	Fine
Waste Management Act 2010	Unauthorized operation of a landfill site or waste dump.	• 100 penalty units and/or up to 1-year imprisonment (corporation or individual who is a previous or multiple offender)
	Failure to comply with environmental and public health standards by approved waste management operators or contractors.	• 20 penalty units • Potential suspension or revoking and future refusal of registration or license • Contract termination
	Not complying with import/ export prohibitions and regulations, deposit schemes or manufacturing regulations for regulated waste.	• 100 penalty units and/or • 6 months imprisonment (corporation or individual)
	Providing all information, statistics and records of waste operations.	• 50 penalty points
	Disposing of undisclosed waste at a landfill, or failing to store, transport or safely dispose of waste covered under international conventions.	• 50 penalty units (individual); • 100 penalty units (corporation or individual)
	Failing to comply with waste authorities' directives to transport, storage, dispose or recycle waste.	• 20 penalty units (individual); • 50 penalty units (corporation or individual)
	Disposal of e-waste and white goods for filling land or land reclamation.	• 50 penalty units (individual); • 100 penalty units (corporation or individual)
	Incinerating waste which contains plastic or hazardous materials or causes public nuisance or unintentionally causing out of control fires.	• 5 penalty units (individual); • 10 penalty units (corporation or individual)
	Starting landfill fires.	• 100 penalty units (individual); • 500 penalty units (corporation or individual).
	Dumping undisclosed waste at a landfill, and failing to store, transport or safely dispose of waste covered under international conventions.	• 50 penalty units (individual); • 100 penalty units (corporation or individual).
	Illegal dumping of waste – public land or areas.	• 50 penalty units (individual) • 100 penalty units and/or • up to 6 months imprisonment (corporation or individual)
	Illegal dumping of waste – roadway, vacant land, foreshore, rivers, streams, pools, wells, lakes, mangroves, or the sea.	• 50 penalty units (individual); • 100 penalty units (corporation or individual).
	Inappropriate waste disposal in public waste bins.	• 5 penalty units (individual); • 20 penalty units (corporation or individual)

Act	Item	Fine
	Damaging or unlawfully entering landfill property.	• 10 penalty units
	Hindering waste management staff in their duties.	• 1,000 penalty units and/or • up to 5 years imprisonment
	Importing hazardous waste.	• 1,000 penalty units and/or • up to 5 years imprisonment
	Transporting, importing, exporting, storing, or disposing of hazardous waste.	• 100 penalty units and/or • up to 2 years imprisonment
Water Resources Management Act 2008	Discharging pollutants into Samoan waters or not complying with laws in waster protection zones.	• 250 penalty units (individual) • 500 (corporation or individual) and/or • up to 1-year imprisonment
	Failure to comply with environmental and public health standards by approved waste management operators or contractors with regards to water bodies and water quality.	• 20 penalty units • Potential suspension or revoking and future refusal of registration or license

Appendix F: Collection schedule and cost per month



(Source MNRE, 2019)

Collection route and distance covered during the time and motion survey (Source MNRE, 2019)

ID	Zone	Schedule	Route (m)	Actual track (m)	Coverage (%)
1	A	Twice daily	27,208	21,392	79
2	B1	Tuesdays and Fridays	41,996	29,539	70
3	B2	Tuesdays and Fridays	55,998	28,683	51
4	B3	Tuesdays and Fridays	67,271	26,625	40
5	C1	Tuesdays and Fridays	37,862	24,403	64
6	C2	Mondays and Thursdays	63,848	52,223	82
7	D1	Twice a week	40,491	18,331	45
8	D2	Twice a week	117,533	72,999	62
9	E1	Twice a week	54,215	20,346	38
10	E2	Twice a week	49,737	19,456	39
11	E3	Twice a week	91,087	55,577	61

ID	Zone	Schedule	Route (m)	Actual track (m)	Coverage (%)
12	F1	Twice a week	56,693	48,870	86
13	F2	Twice a week	81,961	56,044	68
14	Fagaloa	Twice a week	20,833	20,833	100
15	N/A	Twice a week	N/A	N/A	N/A
16	Savai'i 1	Twice a week	61,517	34,911	57
17	Savai'i 2	Twice a week	191,075	74,089	73
18	Savai'i 3	Twice a week	76,626	56,349	74
19	Savai'i 3	Twice a week	106,323	69,999	66

Household collection zone and waste collection costs per month for MNRE 2020 (Source MNRE, 2020)

Island	Collection Zone	Number of villages	Number of HH	Waste collection kg/ day	Cost/month
Upolu	A	28	1,183	3,080	$24,581.25
	B1	13	2,050	2,700	$8,050.00
	B2	15	2,385	7,390	$8,050.00
	B3	11	2,272	8,990	$8050.00
	C1	12	719	3,100	$8050.00
	C2	18	2,463	7,310	$8050.00
	D1	15	1,334	1,310	$8,165.00
	D2	26	1,382	2,000	$9,238.80
	E1	8	1,832	5050	$11,496.55
	E2	8	1,791	5,700	$11,500.00
	E3	31	2,222	2,620	$11,508.00
	F1	14	659	2,640	$8,193.75
	F2	25	1,895	2,640	$8,193.75
	Fagaloa	7	141	2,090	$6,037.50
Manono and Apolima	Manono & Apolima Island	7	133	1,960	$9,680
Savai'i	Savai'i 1	30	1,654	4,812	$7,743.30
	Savai'i 2	25	1,383	4,910	$9,836.90
	Savai'i 3	24	1,618	3,215	$9,876.60
	Savai'i 4	23	1,731	4,202	$9,731.10

Appendix G: Project Plan for Samoa

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Project Plan – Samoa – World Bank

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Samoa points of contact for the following:

Overall point of contact
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KEY GOVERNMENT OFFICIALS IN SAMOA

Name	Official Designation	Contacts
Mr Ulu Bismarck Crawley	Chief Executive Officer	bismarck.crawley@mnre.gov.ws
Mr Seumalo Afele Faiilagi	Assistant Chief Executive Officer	afele.faiilagi@mnre.gov.ws
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Ms Fiasoso Siaosi	Principal Hazardous Waste Management Officer	fiasoso.siaosi@mnre.gov.ws
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Name	Official Designation	Contacts
Mr Darren Viliamu	Senior Hazardous Waste Management Officer	darren.viliamu@mnre.gov.ws
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STAKEHOLDERS FOR APPOINTMENTS

Agency	Contact person	Contacts
Samoa Tourism Authority	Mr Faamatuainu Soifua, Chief Executive Officer Mr Anthony Tumua	faamatuainu@samoa.travel anthony@samoa.travel
Customs Division, Ministry of Revenues	Mr Alvin Onesemo	aonesemo@revenue.gov.ws
Ministry of Health	Mr Lucie Isaia Principal Healthcare Waste Officer	Lucieisaia18@gmail.com
Electric Power Corporation	Mr Tauiliili Fauolo, Operations Manager	epc.info@epc.ws
Ministry of Finance	Ms Abigail Lee Hang	Abigail.leehang@mof.gov.ws
Samoa Recyclers and Waste Management Association	Ms Marina Keil, President (Waste Management Ltd) Mr Asiata Potoi, Member (One Metals Recyclers). Ms Nancy Fuimanono, Member (SSAB Co.Ltd).	wastemanagementapia@gmail.com nanz@ssab.ws
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SAMPLING PLAN – DATA REQUIRED TO BE COLLECTED IN SAMOA

Households (collect and sort waste – conduct same number of interviews)

Scheme	Error at 80% Confidence	Interviews
75 Apia, 75 rural	30%	75 – 75
70 Apia, 40 at two separate rural sites	27%	70 – 40 – 40
100 Apia, 50 at two separate rural sites	25%	100 – 50 – 50
50 Apia, 50 regional, 50 at two separate rural sites	23%	50 – 50 – 50 – 50
50 Apia, 50 regional, 33 at three separate rural sites	22%	50 – 50 – 33 – 33 – 33

Note: grey shaded is the chosen sample split

Urban samples – split evenly between high (25) /medium (25) /low (20) households

Businesses (collect and sort waste – conduct requested interviews)

Note: Sample size for resorts to be provided.

	Samples	Interviews
Admin/office	10	10
Food outlet	10	10
Supermarket	10	10
Hotel	10	10
Retail	10	10

Landfill (collect and sort waste, conduct requested interviews)

Understandable	7 days
Desirable	14 days

Bottling companies – local manufacture of plastic (gather data around plastics manufacturing – use data sheet provided)

List of bottling/water refill companies in Samoa

Vailata Spring Water (Savai'i)	Organic Water
Toleafoa/Olo Water	Apia Bottling Water
Somemore Water	Le Vai Company
Olivia Refill	Water Express
Tara Crystal	Ocean Blue
Samoa Pure Water	Serenity Water
Paradise Water	Natural Food Ltd
Wright Water	Vaitele Spring Water
Icy Water	Samoa Natural Water
Clear Water	South Pacific Water
R/J Water	

Recyclers (gather data around materials recycled currently and current recycling markets – use data sheet provided)

1) Samoa Recycling and Waste Management Association
Contact: Ms Marina Keil, President

2) One Metals Recyclers
Contact: Mr Asiata Potoi, Member

3) Samoa Stationery and Books (SSAB)
Contact: Nancy Fuimanono, Member

4) Pacific Recyclers
Contact: John Sio, CEO

Customs (Request data around import and export of materials)

Data requests sent to Mr Alvin Onesemo at Ministry of Customs and Revenue – will follow up.

Municipal services Provision Sheet (request data around current legislation, collection and disposal services)

Interview with Mr Setoa Apo – question sheet has been provided to him to be filled in

Collection of waste and sorting arrangements

Sort site

Tafaigata Landfill

Contact: Mr. Setoa Apo

APWC team to bring

Sorting sheets

- Printouts of high-level sort sheets
- iPads with all sorting and collection sheets loaded on them
- First-aid kits
- APWC waste audit code of conduct
- Printed copies of SWMS
- Scales
- Gloves
- Overalls
- Sorting baskets

MNRE team to bring

- Tables
- Pickup truck for collections

Work schedule

WEEK	TASK	Location	Day/ date	Category TBC	Team
1	BRIEFING DAY				
	COLLECTIONS/ SORTING LANDFILL	Apia	MON 16th	High/middle income	Tai, Erin, John, Siliako + local team Berry
	COLLECTIONS/ SORTING INTERVIEWS LANDFILL	Remaining Apia Rural area 1 Apia	TUES 17th	Low income	Tai, John, Siliako + local team Erin + local team Berry
	INTERVIEWS LANDFILL	Apia	WED 18th		Erin + local team Berry
	INTERVIEWS LANDFILL	Apia	THURS 19th		Erin + local team
	INTERVIEWS LANDFILL	Rural area 1	FRI 20th		Tai + local team
2	COLLECTIONS/ INTERVIEWS SORTING		MON 23rd	Commercial businesses/ tourism	Tai + local team John, Siliako + local team
	COLLECTIONS/ INTERVIEWS SORTING		TUE 24th	Commercial businesses/ tourism	Tai + local team John, Siliako + local team
	RURAL COLLECTIONs	Savai'i	WED 25th		John, Setoa
	RURAL SORTING	Savai'i	THURS 26th		John, Setoa + local team
	RURAL SORTING	Savai'i	FRI 27th		John, Setoa + local team
3	INTERVIEWS	Savai'i	MON 30th		John, Setoa + local team
	Wrapping up anything left	Apia – Upolu	TUES 31st		WHOLE TEAM + local team

WORK HEALTH AND SAFETY

Safety while travelling and reaching Samoa:

a) **PRE-DEPARTURE MISSION BRIEF:** Project team provided with mission brief. Team members arriving from countries other than Australia to be provided with a copy of the mission brief, all documents and safety while travelling briefing. Signed copy of attendance and reading of pre-departure mission brief obtained and saved by Project Manager. BRIEF AND SIGNED COPY OF ATTENDANCE SAVED IN PROJECT DROPBOX.

b) **IN-COUNTRY BRIEFING:** After arrival, team briefed of all in-country requirements, safety, local conditions and data to be collected. In-country briefing to include details on accommodation, transport, money and timekeeping. The In-country briefing sheet to be signed by all country staff and copy saved in project dropbox.

c) **POST-MISSION BRIEFING:** After completion of in-country mission, review of all processes and learnings. All learnings to be recorded by PM and reflected in future project planning. A copy of the review process to be saved in project dropbox.

Project Team

Collections	
Faafetai Sagapolutele	Collection supervisor
Erin Cooney	Collections
Fualaga Pemita	Collections
Darren Viliamu / Matangi	Collections
Setu Viliamu	Collections
Sorting team	
John Tofaeono	Sorting supervisor
Siliako Letueti	Sorter 1
Berry Mahau	Sorter 2
Setu Viliamu	Sorter 3
Fualaga Pemita	Sorter 4
Darren Viliamu	Sorter 5
Setoa Apo	Sorter 6
Interview team	
Erin Cooney	Interview supervisor
Darren Viliamu	Interviewer 1
Patisepa	Interviewer 2
Fiasoso Siaosi	Interviewer 3
Faatamaii Meredith	Interviewer 4

Emergency contacts

MEDICAL: 685 66506 / +685997

Paramedic Ambulance:
Samoa Search and Rescue: +685 22222/685 911

EMERGENCY DENTAL: 685 66506 / +685997

ELECTRICAL FAULTS:

FIRE: +685 911

MEDICAL EMERGENCIES: +685 66506 / +685997

POLICE: - +685 22222

OFFICE OF DISASTER PREPAREDNESS: +685 67200 / +685 27307

Appendix H: Revised Mission Plan – During COVID-19, May 2020

Date	Task	Who
Thurs 7/5/20	Visit bottling companies and do interviews, stockpile assessments	Berry, Siliako, Fualaga
Fri 8/5/20	Visit Pacific Recyclers site and do stockpile assessments and interview Have a meeting with the MNRE staff to discuss the plan for work for the following week	Berry, Siliako, Fualaga Setoa, Fualaga, Darren, Setu, Berry & Siliako
Date	**Task**	**Who**
Tues 12/5/20	Complete 40 interviews in rural area where samples were collected • Separate into teams of two, 20 interviews one team and 20 interviews the other. Aim to spend the day out in the community in order to complete all interviews in one day	Fualaga, Setu, Darren, Siliako & Berry
Wed 13/5/20	Complete remaining 44 interviews in Apia region. Separate into teams of two to complete these • 18 high income • 12 middle income • 14 low income Aim to return to original houses if possible to remember exact house. If not, please select random houses from areas that are considered high, middle and low income households in order to get appropriate spread	Fualaga, Darren, Siliako & Berry
Thurs 14/5/20	Travel to Savai'i – 8am ferry • Take all equipment necessary across to Savai'i – sort site will be arranged by Setoa • Collect as many samples as possible, aim to collect all 40 • If the resident of the house is there at the time of collection and you engage with them, please complete the interview at the same time • Sort as much material as possible	Setoa, Fualaga, Darren, Setu, Berry & Siliako
Fri 15/5/20	• Complete remaining sorting that is to be done • Once sorting complete, continue interviews until time to return home	Setoa, Fualaga, Darren, Setu, Berry & Siliako
Sat 16/5/20	Complete all remaining interviews Travel to Upolu – 2pm ferry	Setoa, Fualaga, Darren, Setu, Berry & Siliako

Appendix I: Project methodology

Data collection

Household samples

This section provides information on how the waste data collection works were undertaken over the period March to May 2020 in Samoa.

Household samples to be collected

Scheme	Error at 80% Confidence	Error at 90% Confidence
75 Apia, 75 rural	30%	38%
70 Apia, 40 at two separate rural sites	27%	35%
100 Apia, 50 at two separate rural sites	25%	32%
50 Apia, 50 regional, 50 at two separate rural sites	23%	30%
50 Apia, 50 regional, 33 at three separate rural sites	22%	28%

* Schemes highlighted in orange represent the targeted samples prior to commencing the audit

Using the calculations provided above, it was assumed that the minimum number of samples required is 150 and the maximum number is 200. A total of 82 urban samples were collected in Apia (nine of which were COVID-19 substitutes), 79 rural area on Upolu Island (of which 39 were during COVID-19), and 40 rural on Savai'i Island (of which 40 were during COVID-19). Therefore, the total sample size in Samoa was 201, bringing the number to an acceptable level of confidence needed for decision-making purposes.

Samoa household sampling distribution

Urban/ Rural		Income category	Samples required	Samples collected	Total	Collection systems	Collection frequency
Urban	Apia (Upolu Island)	Low	20	20	82	Yes – door-to-door at set collection points	Twice a week (Zone A twice daily)
		Middle	25	28			
		High	25	25			
		High sub		2*			
		Low sub		7*			
Rural	Upolu Island	Low	40	79**	119	Yes – door-to-door at set collection points	Twice a week
	Savai'i Island	Low	40	40***			

* Of which nine were substitutes collected during COVID-19 ** Of which 39 were substitutes collected during COVID-19 *** Of which 40 were during COVID-19

Samoa household areas sampled

Samoa islands	Low	Middle	High	Total samples
Apia (Upolu Island)	Falelauniu	Ululoloa, Siusega, Vaiusu, Tulaele, Vailoa, Lalovaea, Maluafou, Aai o Niue	Tuaefu, Ululoloa, Tuanaimato, Vaitele, Tulaele, Vailima	82
Upolu island	Salamumu, Mata'utu, Gagaifo, Savaia, Tafagamanu, Safaatoa			79
Savai'i Island	Salelologa to Asaga, Maota to Puleia			40
Total				201

Household samples collected

Income category	Urban (pre-COVID)	Urban (COVID)	Rural (pre-COVID)	Rural (COVID)	Total
Low income	20	7*	40	79**	146
Middle income	28				28
High income	25	2*			27
Total	73	9	40	79	201

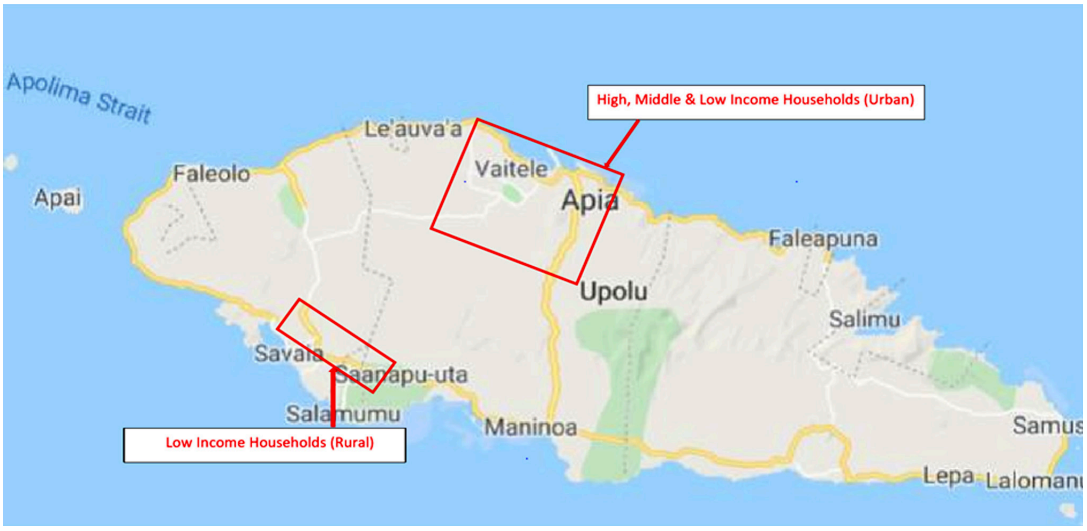
* Substitute households ** 39 of which were substitute households on Upolu Island

The project team created a project plan (See Appendix G). The plan was discussed with the MNRE, the agency responsible for waste management in Samoa, to

ensure the smooth implementation of the waste audit operations. Samples were collected on Upolu and Savai'i islands, both of which have collection systems in place. All samples were therefore collected as per the collection methodology below.

Household waste samples were collected from Upolu and Savai'i islands based on the required samples. The methodology required collection of household samples across the low-, medium- and high-income streams.

The location of the households where samples were collected were marked using the GPS coordinates and/or colored ribbons for follow-up interviews. The sample collection team arrived prior to the arrival of the waste collection truck on the day of the collection and procured the sample before the truck could visit the households.



Map of collection area on Savai'i Island

The collection team consisted of the three key members with separate functions. The project team engaged up to eight waste management staff, kindly provided by the MNRE, to undertake the in-country work for this project. Local team members used their knowledge and experience in the waste industry to develop collection routes on each island. Knowing the areas well, the team members were able to answer questions posed by locals regarding why they were collecting waste from their household bins instead of the regular contractor. The team used an online tool to capture all data as the samples were collected. A collection sheet is provided in Appendix J.

Collections were carried out in the following way:

- A collection supervisor and recorder marked the location of a sample using the GPS coordinates, photographed the premises for follow-up interviews and inserted notes on the nature of the collected samples (e.g. bin fullness, how much waste collected for sampling, what proportion and contents description of was left behind, types of waste, etc.).
- The second member(s) of the team assessed the types of waste and provided information to the recorder. Samples were collected using garbage bags by emptying the contents of the bins into these bags and placing them in the truck for transportation to the sorting area at the landfill.
- The third member of the team marked the household premises using ribbons (as tags) tied to the platform at the front of the property, property fence or gate for easier identification later during follow-up interviews. The household numbers recorded by the recorder corresponded to numbers written on the garbage bags and the ribbons (tags).

Impact of COVID-19

At the commencement of the global COVID-19 pandemic, 113 household samples had been collected and all commercial samples had been collected and interviewed. Forty rural household samples and 120 household interviews were . Upon the lifting of lockdown restrictions on 1 May 2020, two team members remained in Samoa and worked with the MNRE team to complete the remaining household collections and interviews.

Due to two months passing since the initial household sampling, most of the ribbons used to mark households for the follow-up assessment had been removed from the platforms, so the exact household was unable to be identified. In these instances, new waste samples were collected, audited and households marked for follow-up interviews using the same methodology. As a result of the lessons learned from the experience of the national shutdown caused by COVID-19 and the challenges faced when attempting to complete interviews after this period, the methodology used in commercial interviews – collection and interview in tandem – was subsequently used in the outstanding household samples.

Commercial premises

Commercial samples were required to be distributed as follows:

Commercial samples collected

Sample type	Samples required	Samples collected	Interviews	Waste pickup frequency	Destination
Food outlet	10	10	10	Twice per week	Waste disposal site
Admin/office	10	10*	2		
Supermarket	10	10	10		
Hotel	10	10	10		
Retail	10	7	7		
TOTAL	50	47	39		

* Ten individual samples (large bags) were collected from communal waste bins servicing over 20 offices in one building

A total of 47 commercial premises were sampled simultaneously with households in Apia. The offices and small shops, including restaurants, are collected twice a week. The supermarkets and hotels in Samoa are collected daily.

The business name and location of each of the commercial premises sampled are presented in Appendix R for food outlets, administration/offices, supermarkets, hotels, and retailers.

The commercial samples from small shops, offices, businesses, and hotels were collected at the same time as the household samples, although the methodology used was slightly different for commercial samples. The team member was

required to directly speak to the person in charge of waste management at the premises in order to collect a sample, therefore the interview was completed at the same time rather than the team member returning at a later date.

Landfill samples

The landfill at Tafaigata is open from Monday to Saturday, 9.00 am to 4.30 pm. As the project team was in Samoa for four weeks, it was agreed that a full week's sampling would be conducted. Due to some members of the project team being in the field during the COVID-19 shutdown, data for 14 days was able to be collected.

Landfill audit statistics

Landfill visual audit	Statistics
Number of days of visual audit	9 consecutive days (March, 2020); 5 consecutive days (May, 2020)
Number of vehicles audited	416

Since 2018, the MNRE records all vehicles coming into the landfill, therefore data is available for the total amount of waste coming into the landfill over time. A snapshot audit was also undertaken by the project team so that the composition of the different types of materials could be understood. This composition could then be applied to the overall volume of incoming material to determine the content.

Auditors were equipped with mobile phones, high-visibility safety vests, gloves, protective glasses, sunscreen, wet-weather gear and safety boots (with steel base to prevent any penetration). Paper data sheets were used at the landfill instead of tablets, as multiple entries often had to be made at once. These sheets were then scanned and sent to the data-entry office based in Australia to be entered into KoboToolbox. The categories and information recorded for each vehicle is provided at Appendix O.

All data was recorded in a consistent manner (in liters) on a standard data sheet. Space was provided on the form so that if significant quantities of any other items were found they could be appropriately recorded. Sheets were pre-numbered to ensure all recording sheets are accounted for after the audit.

The following information was recorded on each load:

- Date and time of vehicle arrival
- Registration number
- Vehicle type
- Volume of vehicles load in liters
- Composition and volume of load in liters

- Degree of compaction
- Photographs of specific loads of interest.

Interviews

Household and commercial

The methodology assesses the amount of waste requiring immediate management, that is, the general municipal waste being placed in bags. It also assesses self-reported household behaviors based on interviews in order to understand what happens to uncollected waste or why certain waste is not placed in bags, including the reason for these behaviors.

All interviews were conducted by the project team with assistance from MNRE staff. The team was able to return to the same household sampled using the GPS location and/or the colored ribbon tag, which easily identified and matched it with its respective collection and sorting information (as described in the collection methodology). As the team members often had to meet with the business owner in order to collect a waste sample for commercial premises, interviews were conducted immediately in order to precisely match samples.

The interviews cover the following areas:

- Demographic information
- Income levels
- Disposal behavior by material type
- Willingness to pay for collection/disposal systems
- Current recycling behaviors including further source separation
- Level of awareness about the current waste service
- Type of premises
- Access to amenities (electricity, sanitation, stormwater infrastructure, etc.)
- Consumption habits.

The questionnaires were designed specifically for each country and are based on the local conditions, language and culture (if they cover the above criteria). The questionnaires were in English and interpreters were used when required. The use of interpreters was chosen over local language translation because it had been previously demonstrated that translated questionnaires can be misleading and answers may not reflect the questions asked.

As surveys are widely used by the government in Samoa to gather the opinion of the general public, all residents approached to take part in the interviews were very interested and engaged willingly.

Producer interviews

There are seven producers and water refilling companies across Samoa. A number of these companies were interviewed to obtain a more accurate understanding of plastic waste generation rates.

List of producers on Upolu and Savai'i Islands

Producers		
Vailata Spring Water (Savai'i)	Wright Water	Water Express
Toleafoa/Olo Water	Icy Water	Ocean Blue
Somemore Water	Clear Water	Serenity Water
Olivia Refill	R/J Water Refill	Natural Food Ltd
Tara Crystal	Organic Water	Vaitele Spring Water
Samoa Pure Water	Apia Bottling Water	Samoa Natural Water
Paradise Water	Le Vai Company	South Pacific Water

As well as collecting data from the producers, interviews were also conducted with recyclers currently operational to determine the amount of recyclable material collected in Samoa. The project team conducted an audit of all current stockpiled material. The size and location of each stockpile was audited, and the data was recorded for analysis.

Sample sorting

All Upolu Island samples were transported to an area at the entrance to Tafaigata Landfill for sorting. The building is the property of the MNRE and was approved for the use of the team for sorting of the samples. All Savai'i Island samples were taken to a site provided by MNRE on Savai'i Island, and all necessary equipment was ferried across with the team from Upolu and taken back to Tafaigata Landfill for storage.

The bag tags were used to identify all samples to avoid misidentification. The collected samples were lined up to ensure none were missing. All samples were cross-referenced with the collection sheet to ensure consistency between sample collection and sorting.

Each waste sample was opened and the individual materials within each bag sorted into different trays according to the pre-defined categories. Separated materials were weighed using an electronic scale and the weight measurement recorded in a sorting sheet on KoBoToolbox using digital tablets. In maintaining the high level of accuracy, pre-calibrated electronic scales from Australia were used.

A separate count of beverage containers for all general waste samples was also undertaken. Beverage containers from the samples were stored and counted separately. Containers were stored and labelled to ensure no cross-contamination

took place. Containers were sorted by size, material (e.g. plastic, aluminum) and product type (e.g. milk, juice).

All plastic bags were sorted into different types and all containers were further sorted by size, material type and product type. Cigarette butts, coffee cups and takeaway containers were also segregated. All sort data was added to the sorting form on the tablet using the categories listed in Appendix K.

Work health and safety

The study has an integrated management system used during audits covering quality, health, safety, and environment (QHSE). The system has been developed to be consistent with the requirements of the international standards ISO9001 (Quality), ISO14001 (Environment) and AS4801 (Occupational Health and Safety).

The following steps were undertaken to ensure the safety of personnel:

- Site-specific safe work method statements (SWMS) were developed
- A pre- and post-work commencement risk assessment was undertaken
- A collection and sorting supervisor undertook QHSE inductions for project staff
- All staff were trained in the Waste Audit Code of Conduct developed by APWC, which includes a requirement to sign a confidentiality agreement prohibiting staff from removing anything from the material they sort or from revealing any information they might obtain while sorting or auditing
- Adjustments were made to ensure safety of staff based on local conditions. The collection and sorting supervisor had full control over local safety requirements to ensure all work was being conducted in a manner protecting the health and safety of the staff.

Once the COVID-19 restrictions had been lifted and the team continued with the remaining fieldwork, more stringent safety measures were put in place. The teams were required to abide by the nationally implemented social-distancing rules and to be vigilant about their personal health as well as that of the public. The in-country team was given an extra briefing on safety and hygiene during a pandemic by the project manager before commencing work.

Staff training

As much as possible during the project, training was provided to local MNRE staff in collecting waste samples, conducting waste audits, conducting interviews, and in landfill assessments.

Training received by MNRE staff in Samoa

Staff name	Training received
Mr Setoa Apo	Collection of samples; sorting waste; interviews using digital form
Mr Fualaga Pemita	Collection of samples; sorting waste; interviews using digital form; visual assessment of waste received at landfill
Mr Darren Viliamu	Collection of samples; sorting waste; interviews using digital form
Mr Setu Viliamu	Collection of samples; sorting waste
Mr Matagi Toma	Collection of samples; sorting waste
Ms Fiasoso Siaosi	Conducting waste management interviews
Ms Faatamaii Meredith	Conducting waste management interviews
Ms Patisepa Maugata	Conducting waste management interviews
Mr Sinuu Taisi	Sorting waste
Mr Maeli Tafeaga	Sorting waste
Mr Sakalia Tiatia	Sorting waste
Mr Niko Aso	Sorting waste
Mr Falaniko Tino	Visual assessment of waste received at landfill
Mr Filiki Utaileuso	Visual assessment of waste received at landfill

Appendix J: Collection sheet

	Date[43]	**Auditor**		**Weather**			
	Sample number	GPS location recorded?	Photo?	Interview sheet provided?	Interview sheet returned?	Bags provided?	Comments
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							

[43] Please note that the consultant team used an online tool but collected the below information.

Appendix K: Sorting categories

Material categories, definition, and source of data

C	Category	Description	EOL Source	Incoming
Metal	Aluminum cans	Alcoholic sodas and spirit-based mixers, beer and soft drink, food cans, pet food cans, aerosols, industrial cans	H, C, L	Cu, D
	Aluminum recyclable	Steel packaging	H, C, L	Cu, D
	Steel containers	Alcoholic sodas and spirit-based mixers, beer, soft drink, food cans, pet food cans, aerosols, industrial cans, clean/empty paint cans	H, C, L	Cu, D
	Metal other	100 percent ferrous items that are not cans/tins/packaging materials, any other steel, beer bottle tops, jar lids, composite ferrous items for which the weight of the ferrous metal is estimated to be greater than the other material items, foils, 100 percent aluminum items that are not cans/tins/or packaging materials, any other aluminum	H, C, L	Cu, D
Fishing	Fishing/seafood, metal		H, C, L	
	Fishing/seafood, plastic		H, C, L	
	Fishing/seafood, wood		H, C, L	
Paper and Cardboard	Cardboard	Cardboard without corrugation (glossy and non-glossy), cereal boxes, business cards	H, C, L	
	LPB	Soy milk cartons, some fruit juice cartons, UHT/long-life milk	H, C, L	
	Composite	Composite paper items for which the weight of the paper is estimated to be greater than the weight of the other materials	H, C, L	
	Paper	Office paper, writing pads, letters, envelopes, books, newspapers, newspaper-like pamphlets, paper, magazines, brochures, wrapping paper, labels, paper packaging (no plastic or wax coating)	H, C, L	
Plastic	PET containers	(Polyethylene) – soft drink, flavored water, fruit juice, sports drinks, plain water (carbonated/non-carb), food containers, mouthwash containers, detergent bottles	H, C, L	Cu, D
	HDPE containers	(High-density polyethylene) milk and flavored milk bottles, bleach bottles, oil containers, food containers	H, C, L	Cu, D
	LDPE containers	(Low-density polyethylene) squeeze bottles	H, C, L	Cu, D
	PVC containers	(Polyvinyl chloride) clear cordial and juice bottles, detergent bottles	H, C, L	Cu, D
	PP	Bottles and containers	H, C, L	Cu, D
	EPS	Yoghurt and dairy containers, vending cups, clam shells	H, C, L	Cu, D
	PS	Meat and poultry trays, vending cups, fragile-item packaging	H, C, L	Cu, D
	PP	Bottles and containers	H, C, L	Cu, D
	Flexibles/film	No shopping bags, just chip packets and other MLM packaging	H, C, L	Cu, D
	Other plastic		H, C, L	Cu, D

C	Category	Description	EOL Source	Incoming
Single-use plastic items	Beverage containers	Total count from the beverage container sort	H, C, L	Cu, D
	Cigarette butts		H, C, L	Cu, D
	Cigarette packets		H, C, L	Cu, D
	Straws		H, C, L	Cu, D
	Coffee cups		H, C, L	Cu, D
	Bags – heavy, glossy typically branded carry bags		H, C, L	Cu, D
	Bags – supermarket-type light-weight carry bags		H, C, L	Cu, D
	Takeaway containers plastic other than EPS		H, C, L	Cu, D
	Takeaway containers styrofoam		H, C, L	Cu, D
	Takeaway containers paper		H, C, L	Cu, D
	Takeaway container lids		H, C, L	Cu, D
	Bottle lids		H, C, L	
Batteries	Non-rechargeable batteries	Common batteries, AAA, AA, etc. single-use	H, C, L	
	Rechargeable Batteries	Common batteries (rechargeable), AAA, AA, etc. rechargeable	H, C, L	
	Lead-acid batteries	Large batteries used in vehicles or other machinery	H, C, L	Cu, D
	Mobile phone batteries	Batteries used in mobile phones	H, C, L	Cu, D
	Power tool batteries	Batteries used in power tools	H, C, L	
	Lithium batteries	Small lithium batteries	H, C, L	
	Lithium ion batteries	Batteries used in electric cars	H, C, L	Cu, D
	Other batteries	All other battery types	H, C, L	Cu, D
E-Waste	Computer equipment	Keyboard, monitor, hard drives, printers, etc.	H, C, L	Cu, D
	TVs	TVs	H, C, L	Cu, D
	Mobile phones	Mobile phones, phones, pads, charges, car kits, Bluetooth	H, C, L	Cu, D
	Electrical items & peripherals	Radio, iPod, Gameboys, stereos, speakers, VCR, DVD players, power tools, wiring and cables, small electrical items (toaster, blender, etc.), computer discs, cassettes, DVDs, CDs	H, C, L	Cu, D
	Toner cartridges	Printer and toner cartridges	H, C, L	Cu, D

C	Category	Description	EOL Source	Incoming
Glass	Glass bottles	Recyclable (all colors) – beer bottles, wine bottles, spirit cider/fruit-based, flavored water, fruit juice, sports drinks, plain water	H, C, L	Cu, D
	Glass jars	Non-beverage containers (all colors) – sauce bottles, jam jars, vegetable oils, other food containers	H, C, L	Cu, D
	Glass fines	Mixed glass or glass fines < 4.75 mm	H, C, L	Cu, D
	Glass other	Plate glass (window and windscreen), Pyrex, mirror glass, Corning ware, light globes, laboratory and medical glass, white opaque glass (e.g. Malibu alcohol bottles)	H, C, L	Cu, D
Hygiene	Feminine hygiene	Used disposable feminine hygiene products	H, C, L	
	Pharmaceutical		H, C, L	
	Nappies	Used disposable nappies/diapers	H, C, L	
	Medical waste	Sharps, human tissue, bulk bodily fluids and blood, any blood-stained disposable material or equipment	H, C, L	
	Other sanitary waste		H, C, L	
Organics	Food	Vegetable/fruit/meat scraps	H, C, L	
	Wood/timber		H, C, L	
	Garden organics	Grass clippings, tree trimmings/prunings, flowers, tree wood (< 20 mm diameter)	H, C, L	
	Other organics	Animal excrement, mixed compostable items, cellophane, kitty litter	H, C, L	
Hazardous	Paint	Containers containing paint (dry or wet)	H, C, L	
	Fluorescent tubes	Fluorescent tubes; compact fluorescent lamps (CFLs)	H, C, L	
	Household chemicals	Containers containing bleach, cleaning products, unused medical pills	H, C, L	
	Asbestos	Asbestos and asbestos-containing products or building materials	H, C, L	
	Clinical (medical)	Sharps, human tissue, bulk bodily fluids and blood, any blood-stained disposable material or equipment	H, C, L	
	Gas bottles	Gas bottles	H, C, L	
	Mercury	Mercury used in medical applications	H, C, L	Ministry of Health, hospitals
	Hazardous other	Any other hazardous material	H, C, L	
	Textiles	Wool, cotton and natural fiber materials	H, C, L	
	White goods		H, C, L	Cu, D
	Ceramics		H, C, L	
	Containerized used oil		H, C, L	Cu, Retail
	EOL renewable energy equip	Includes EOL solar panels	H, C, L	Cu, Power company, installers
	End-of-life vehicles		H, C, L	Cu
	Tires		H, C, L	Cu
	Please describe			

Codes used:

H = Household audit

C = Commercial audit

L = Landfill audit

Cu = Customs

D = Distributors

Appendix L: High level sorting sheet

APWC: HOUSEHOLD_____
Collection date: _____
Sorting Date: _____

		Material Type	Grams	Volume	Count (where possible)
Metals	Aluminum cans				
		Aluminum recyclable			
		Steel containers			
		Metal other			
		Fishing/seafood metal			
		Fishing/seafood plastic			
		Fishing/seafood wood			
		Paper			
		Cardboard			
		Composite (mostly paper)			
		Liquid paperboard			
		PET containers			
		HDPE containers			
		LDPE containers			
		PVC containers			
		PP			
		EPS			
		PS			
		PP			
		Flexibles/Film			
		Other plastic			
		Beverage containers			
		Cigarette Butts			
		Cigarette Packets			
		Straws			
		Coffee cups			
		Bags – heavy glossy typically branded carry bags			
		Single use plastic items			
		Bags – supermarket light weight carry bags			

		Material Type	Grams	Volume	Count (where possible)
		Takeaway containers plastic other than EPS			
		Takeaway containers paper			
		Takeaway container lids			
		Bottle lids			
		Glass			
		Glass bottles			
		Glass jars			
		Glass fines			
		Glass other			
		Hygiene			
		Feminine hygiene			
		Pharmaceutical			
		Nappies			
		Medical waste			
		Other sanitary waste			
		Organics			
		Food			
		Wood/timber			
		Garden organics			
		Other organics			
		Textiles			
		Ceramics			
		Hazardous			
		Paint			
		Fluorescent tubes			
		Household chemicals			
		Asbestos			
		Clinical (medical)			
		Gas bottles			
		Hazardous other	specify		
		Batteries			
		Non-rechargeable batteries			
		Rechargeable batteries			
		Lead acid batteries			
		Mobile phone batteries			
		Power tool batteries			

		Material Type	Grams	Volume	Count (where possible)
		Lithium batteries			
		Lithium ion batteries			
		Other batteries			
		E-waste			
		Computer equipment			
		TVs			
		Mobile phones			
		Electrical items & peripherals			
		Toner cartridges			
		Other (specify)	specify		

Appendix M: Detailed list of container categories

BEVERAGE CONTAINER ONLY FURTHER SORT			
	<500	500-1500	>1500
Alumimium			
Alcoholic sodas & spirit-based mixers			
Beer/cider			
Water			
flav water/soft drink (carbonated)			
flav water/soft drink (non-carb)			
Food (human)			
Food (dog and cat)			
Other			
Steel			
Alcoholic sodas & spirit-based mixers			
Beer			
cider/fruit based etc			
flav water/soft drink (carbonated)			
flav water/soft drink (non-carb)			
Other			
LPB			
milk			
flavoured milk			
fruit juice (>90% fruit &/or Veg juice)			
fruit drink			
flav water/sports drink, non-carb			
Beauty and personal care			
Home care (including cleaning)			
Other			
PET			
milk			
drink pouches			
flav. Milk			
flav water/ sports drink etc (non-carb)			
flav water/soft drink (carbonated)			
plain water (carbonated or non-carb)			
fruit juice (>90% fruit &/or Veg juice)			
fruit drink			
Beauty and personal care			
Home care (including cleaning)			
Other			

HDPE			
milk			
drink pouches			
flav. Milk			
flav water/ sports drink etc (non-carb)			
flav water/soft drink (carbonated)			
plain water (carbonated or non-carb)			
fruit juice (>90% fruit &/or Veg juice)			
fruit drink			
Beauty and personal care			
Home care (including cleaning)			
Other			
Other Plastic			
milk			
drink pouches			
flav. Milk			
flav water/ sports drink etc (non-carb)			
flav water/soft drink (carbonated)			
plain water (carbonated or non-carb)			
fruit juice (>90% fruit &/or Veg juice)			
fruit drink			
wine bladders			
Beauty and personal care			
Home care (including cleaning)			
Other			
Glass			
Alcoholic sodas/spirit-based mixers			
Beer			
Cider/fruit based etc			
Flav water/soft drink (carbonated)			
Plain water (carbonated or non-carb)			
fruit juice (>90% fruit &/or Veg juice)			
fruit drink			
Wine (glass only)			
Wine cooler			
Spirit			
Beauty and personal care			
Home care (including cleaning)			
Other			

Appendix N: Landfill gate entry sheet

Date							
Time	**Type of vehicle**	**Waste type**	**Company**	**Premises type**	**Location**	**Size**	**Plate#**
	F/P/V/C/S/O	Tr/W/M/Mat/Ti/WG/Gr/B/O		Hhl/Shop/Acc/C&D/Of/Caf/PWC/Ch/E/M	1/2/3		
	F/P/V/C/S/O	Tr/W/M/Mat/Ti/WG/Gr/B/O		Hhl/Shop/Acc/C&D/Of/Caf/PWC/Ch/E/M	1/2/3		
	F/P/V/C/S/O	Tr/W/M/Mat/Ti/WG/Gr/B/O		Hhl/Shop/Acc/C&D/Of/Caf/PWC/Ch/E/M	1/2/3		
	F/P/V/C/S/O	Tr/W/M/Mat/Ti/WG/Gr/B/O		Hhl/Shop/Acc/C&D/Of/Caf/PWC/Ch/E/M	1/2/3		
	F/P/V/C/S/O	Tr/W/M/Mat/Ti/WG/Gr/B/O		Hhl/Shop/Acc/C&D/Of/Caf/PWC/Ch/E/M	1/2/3		
	F/P/V/C/S/O	Tr/W/M/Mat/Ti/WG/Gr/B/O		Hhl/Shop/Acc/C&D/Of/Caf/PWC/Ch/E/M	1/2/3		
	F/P/V/C/S/O	Tr/W/M/Mat/Ti/WG/Gr/B/O		Hhl/Shop/Acc/C&D/Of/Caf/PWC/Ch/E/M	1/2/3		
	F/P/V/C/S/O	Tr/W/M/Mat/Ti/WG/Gr/B/O		Hhl/Shop/Acc/C&D/Of/Caf/PWC/Ch/E/M	1/2/3		
	F/P/V/C/S/O	Tr/W/M/Mat/Ti/WG/Gr/B/O		Hhl/Shop/Acc/C&D/Of/Caf/PWC/Ch/E/M	1/2/3		
	F/P/V/C/S/O	Tr/W/M/Mat/Ti/WG/Gr/B/O		Hhl/Shop/Acc/C&D/Of/Caf/PWC/Ch/E/M	1/2/3		
	F/P/V/C/S/O	Tr/W/M/Mat/Ti/WG/Gr/B/O		Hhl/Shop/Acc/C&D/Of/Caf/PWC/Ch/E/M	1/2/3		
	F/P/V/C/S/O	Tr/W/M/Mat/Ti/WG/Gr/B/O		Hhl/Shop/Acc/C&D/Of/Caf/PWC/Ch/E/M	1/2/3		
	F/P/V/C/S/O	Tr/W/M/Mat/Ti/WG/Gr/B/O		Hhl/Shop/Acc/C&D/Of/Caf/PWC/Ch/E/M	1/2/3		
	F/P/V/C/S/O	Tr/W/M/Mat/Ti/WG/Gr/B/O		Hhl/Shop/Acc/C&D/Of/Caf/PWC/Ch/E/M	1/2/3		
	F/P/V/C/S/O	Tr/W/M/Mat/Ti/WG/Gr/B/O		Hhl/Shop/Acc/C&D/Of/Caf/PWC/Ch/E/M	1/2/3		
	F/P/V/C/S/O	Tr/W/M/Mat/Ti/WG/Gr/B/O		Hhl/Shop/Acc/C&D/Of/Caf/PWC/Ch/E/M	1/2/3		
	F/P/V/C/S/O	Tr/W/M/Mat/Ti/WG/Gr/B/O		Hhl/Shop/Acc/C&D/Of/Caf/PWC/Ch/E/M	1/2/3		

F = Flatbed **P** = Pickup **V** = Van **C** = Compactor (dump truck) **S** = Sedan **O** = Other **Hhl** = Household self-haul
Shop = Any commercial store including shopping centers **Acc** = Resort, hotel, apartments **C&D/Of** = Office **Caf** = Food outlet
PWC = Private waste collector **Ch** = Charity **E** = Educational institution **M** = Municipal waste **Tr** = Trash **W** = Wood **M** = Metal
Mat = Mattresses **Ti** = Tires **Gr** = Green waste **WG** = White goods **B** = Batteries

Appendix O: Landfill audit sheet

Date	Time	Location		
Time				
Plate number				
Type of Vehicle	F/P/V/C/S/O	F/P/V/C/S/O	F/P/V/C/S/O	F/P/V/C/S/O
Size of load				
Source	Hhl/Shop/ Acc/C&D/ Of/Caf/PWC/ Ch/E/M	Hhl/Shop/ Acc/C&D/ Of/Caf/PWC/ Ch/E/M	Hhl/Shop/ Acc/C&D/ Of/Caf/PWC/ Ch/E/M	Hhl/Shop/ Acc/C&D/ Of/Caf/PWC/ Ch/E/M
Compaction (Circle)	**H M L**	**H M L**	**H M L**	**H M L**
Green bags of rubbish				
Other bags of rubbish				
Paper - recyclable				
Paper - non-recyclable				
Cardboard				
Food / kitchen				
Nappies				
Dead animals				
Vegetation / garden				
Stumps, logs (10 cm diameter +)				
Wood - furniture, painted wood				
Wood - chipboard, MDF				
Wood - pallets				
Wood - board/pole, untreated				
Wood - board/pole, treated				
Covered furniture				
Carpet & underlay				
Textiles - clothing / cloth				
Textiles - composite (shoes, bags)				
Mattresses - spring				

Rubber - tires				
Rubber / foam				
Glass - containers recyclable				
Glass - plate / other				
Plastic - containers recyclable				
Plastic - plastic bags & film				
Plastic - polystyrene foam				
Plastic - other				
Metals - recyclable containers				
Metals - ferrous (steel)				
Metals - non-ferrous				
Concrete / cement				
Bricks				
Tiles				
Plasterboard				
Clean fill				
Rock / dirt / soil/ sand				
Asphalt				
Sludge				
Toner cartridges vol				
Electrical large i.e. white goods				
Electrical medium i.e. televisions				
Electrical small i.e. blender				
Insulation				
End-of-life vehicles				
EOL renewable energy equip				
Paint				
Gas bottles				
Containerized used oil				
Other - organic				

Appendix P: Stockpile Assessment Sheet

Date :

Location of stockpile :

Photo taken :

Material type	☐ Cars ☐ Heavy machinery ☐ Solar Panels ☐ Boats ☐ Gas bottles – acetylene ☐ Gas bottles – oxygen ☐ Gas bottles – cooking ☐ 44 gallon drums ☐ Containers (20 ft) ☐ Containers (40 ft) ☐ Used oil ☐ Iron roofing material ☐ Aluminum cans ☐ Plastic water tanks
Volume of stockpil	
Number of items in stockpile	
Weight of one item (if possible)	
Comments	

Appendix Q: Commercial premises audited

Food outlets sampled in Apia

Business name	Location
Coffee Bean	Motootua, Apia
Roko's Restaurant	Tamaligi, Apia
Asian Delights	Lalovaea, Apia
Chickalicious	Lalovaea, Apia
Unknown	Fugalei, Apia
Fugalei Market Stall	Fugalei Market, Apia
Fugalei Market Stall	Fugalei Market, Apia
Fugalei Market Stall	Fugalei Market, Apia
SMDA BBQ & Takeaway	Vailoa, Apia
Chinese Restaurant	Vaitele, Apia

Admin/office outlets sampled

Business name	Location
Samoa National Provident Fund	Beach Rd, Apia
Tatte Building – Government Offices	Apia

Supermarkets sampled

Business name	Location
TJ Minimart	Maluafou, Apia
Leihonara's Co Ltd	Lotopa, Apia
Happy Shopping Supermarket	Ululoloa, Apia
GM Bakery & Mari's Bake Shop	Tamaligi, Apia
Taogaga's Minimart	Apia
HJ Keil Co Ltd Auto/Minimart	Malifa, Apia
Foodland	Lalovaea, Apia
Princessa Shop	Pesega, Apia
Ioana's Store	Pesega, Apia
Dream Mart	Lotopa, Apia

Hotels sampled in Apia

Business name	Location
Le Sanita Hotel	Sogi, Apia
Hotel Elisa	Sogi, Apia
Amanaki	Sogi, Apia
Millenia	Sogi, Apia
Insel Fehmarn Hotel	Fatealili, Apia
Lynn's Getaway	Salenesa, Apia
Vaea Hotel	Lalovaea, Apia
Apia Central Hotel	Savalalo, Apia
Motel Tatiana	Fugalei, Apia
Tradition Resort	Ululoloa, Apia

Retail outlets sampled in Apia

Business name	Location
Pharmacy	Sogi, Apia
Laundromat	Lotopa, Apia
Agriculture Store Co	Savalalo Rd, Apia
Print & Copy Centre	Lotopa, Apia
Garden Centre	Lotopa, Apia
NIU Pharmacy	Apia
Tailor	Salefufi, Apia

Appendix R: Continuous improvement and lessons learned

The audits conducted in Samoa were a trial of the methodology proposed by the project team. As a result, this report not only presents data but also commentary on modifications to the methodology that could potentially be made for future audits.

COVID-19 data challenges

Contingency assessment plan

In order to complete the outstanding project activities interrupted by COVID-19, the original project methodology was modified through a contingency assessment plan. When the assessment was suspended after two weeks of data collection, the project team engaged local waste staff to complete remaining activities instrumental to the project. For local staff to effectively deliver field assessment tasks, comprehensive instruction manuals (including how-to guided videos) were produced and presented during online training sessions. Going forward, this will be part of waste assessment contingency plans in other countries in the absence of on-site consultants. In addition, remote gathering of other data and information should be encouraged to take advantage of the local support staff. Online and remote interview and approaches (for example, Survey Monkey and webinar) should be included in the contingency assessment plan for stakeholder consultations. The waste audit data presented in this report was collected pre-COVID-19 lockdowns and only interviews were conducted during the COVID-19 period. The island of Savai'i was audited only after all internal restrictions had been lifted and life returned to normal for households. The tourism and fisheries sector, however, will remain affected for some time.

Tourism activities related to waste information

The impact of the COVID-19 pandemic on tourism-related activities in Samoa and other countries has created favorable conditions for investigating tourism-driven waste and generation rates. By assessing waste generated during the lockdown period at hotels and other accommodation, the results could be compared with any available existing data from normal conditions. If such data does not exist, a subsequent survey of the same sources during normal conditions could be undertaken. This could generate useful data and information relating to the impact of tourism waste generation within country. Data could also be useful for other countries with a high dependency on tourism, such as Fiji and the Cook Islands.

Household consumption patterns

The closure of shops due to COVID-19 affected the access of members of the public to daily goods. Such a situation is crucial in investigating the impact of imported goods to the generation of waste. The information gathered during the lockdown of shops can also indicate potential variations in consumption patterns during this period. This should also reveal if consumption of local produce from farming, gardening, and fishing activities increases.

Litter and other waste assessment

Litter and mismanaged waste carry negative environmental and economic impacts. Due to the nature of this assessment, requiring the project team to determine the quantity and status of recyclable materials present in Samoa, a litter study was not undertaken and therefore is not a component of this technical report. Any future studies should consider incorporating a thorough litter assessment with analysis of social behaviors relevant to littering to address knowledge gaps in this area.

The waste from organizations, institutions, retailers, and other businesses is a major component of the generated waste in Samoa. Waste data information generated during the lockdown period relates to aberrant business conditions. It is useful to understand these conditions in order to juxtapose with normal conditions from these commercial sources.

Challenges for data collection

Attaining statistical information

Sourcing information and data directly from customs agencies is preferable. This can present challenges due to the ambiguity of HS codes and delays receiving data, both of which have been noted during projects conducted in Tuvalu and Samoa. Using information from National Statistics Agencies may provide a more useful alternative to avoid delays.

Use of focal point for guidance and support

Connecting with national waste agencies during project assessments is strongly recommended and has proven to be a positive experience to date. Their in-depth knowledge and understanding of the waste management practices in country and established relationships with other stakeholders can provide useful insights and connections to assist in the assessment progress and receipt of applicable data and information.

Practical suggestions

The project team made a range of practical suggestions throughout the report around the collection and sorting of materials, as well as for data recording for the consideration of the technical committee.

Appendix S: Key assumptions and limitations of the study

Time frame	• The audits were carried out to cover one week's waste from selected areas and two weeks at the landfill as a minimum. The data was then extrapolated using mathematical models to obtain the waste disposal and generation rate for the whole of the country. • Seasonal trends (e.g. Easter, Christmas) and weather events (e.g. high rainfall leading to grass growth) may change waste generation over time. • The results of this audit should be treated with caution when comparing the results with reports based on data taken at different times of year. Where weighbridge data was available, the changes in material quantities and times were used to ensure seasonal influences were taken into account.

Representation sample	• APWC audits are carried out using strict random sampling, stratified by geographic area, and population distribution to minimise the chance of this situation occurring. There is always a small probability of inadvertently collecting waste from atypical households, resulting in non-representative data. • The sample for this audit is necessarily small due to the high per-capita cost and resource-intensive nature of waste auditing. However, based on waste audits undertaken across the Pacific, three sample sizes with an estimated error range were provided by the statistician to the field team. The team chose the sample plan that could be achieved with the most success based on operational limitations of time and funds. • Substantial variation was found between disposal rates between rural and urban areas even after accounting for factors like income and consumption. This adds additional uncertainty when using the data collected to estimate disposal rates for regions the report was unable to cover. Modelling has been undertaken and where higher than expected sampling error was found, it was reported.
Sample size limitations	• All surveys carry an element of sampling error, which is the mathematical error associated with using a sample to represent a total population. The error rates associated with sampling are presented in the report.

Weight-based analysis and results

- The collection of data for this audit was recorded by weight. Weight-based analysis has been used in this audit because it is a standard procedure and is the most accurate way to collect data on a number of different types of materials.
- This type of collection may cause some materials to appear to be present in quite small proportions due to their comparatively low densities (e.g. plastic beverage containers). They, however, take up a large volume of the waste stream. Volumetric data has been provided in the supporting spreadsheets.
- This study used waste auditing to determine the amount of material imported, waste generated, material recycled and exported. Leakage estimates have not been made but can be undertaken with further analysis of existing data.

Collection method

- For areas with collection services, a household's regular rubbish load was picked up. If households were disposing of any rubbish via other means, this was not picked up in the survey. The numbers collected may be a reasonable estimate of waste going to landfill, but are unlikely to be a reasonable estimate of waste generation rates.
- For areas without collection services, the households were given a bag into which to put three days worth of rubbish. Some households may have taken this opportunity to dispose of extra rubbish, with nappies (diapers) being a particular concern.

Model assumptions

- The study estimates the waste disposal rates for different islands based on the audit data collected. In order to do so, it was assumed that they displayed a similar pattern of variation to sites sampled.
- Relationships between variables were assumed to be linear.

Customs data

- Customs data was used to understand the total amount of material arriving in the country. The lifespan of materials was then used to determine the quantities that should be found in waste. This was benchmarked against the waste audit results to ensure accuracy and robustness of analysis as well as the sample collection methodology.

Assumptions

To determine the total amount of household waste potentially available for recovery, the following assumptions and estimates were made, assuming all household waste in Samoa is collected within a formal waste management system:

- Unserviced households are probably located in areas with a lower population density than serviced households and it is very likely that these households generate less waste than serviced households.
- The audit assumed unserviced households generate 1.1 kg/household/day, which corresponds to an average settlement size of 2,500 people.
- Combined with the figure of 62 percent of households unserviced by collection routes, this suggests that 35 percent of household waste generated on Upolu does not arrive at landfill.
- If waste from the outer islands of Manono and Apolima is sent to Tafaigata Landfill, a lower household generation rate of 0.8 kg/household/day was assumed for these locations. When combining this with the relative population sizes, these locations contribute 0.3 percent and 0.03 percent of Upolu's waste generation, respectively.
- The audit assumed that the per-capita generation rate on Savai'i is 60 percent of the generation rate on Upolu, consistent with the difference in household generation rates (1.9 kg/hh/day on Upolu vs 1.1 kg/hh/day on Savai'i, taking into account household size and waste generation per person per day).

Waste generation by source (2020)

Waste Type	Waste arriving at Tafaigata Landfill 2020 (tonnes)	Total generated waste Upolu 2020 (tonnes)	Total generated waste Savai'i 2020 (tonnes)	Total waste Manno 2020 (tonnes)*	Total waste Apolima 2020 (tonnes)*
Household self-haul	1,042	1,600	288	NA	NA
Private contractor (incl. roadside collection)	4,139	6,367	1,144	NA	NA
Church	246	378	68	NA	NA
Construction and demolition	13	19	3	NA	NA
Office	3,011	4,632	832	NA	NA
Commercial premises	2,502	3,850	691	NA	NA
Education	108	166	29	NA	NA

Waste Type	Waste arriving at Tafaigata Landfill 2020 (tonnes)	Total generated waste Upolu 2020 (tonnes)	Total generated waste Savai'i 2020 (tonnes)	Total waste Manno 2020 (tonnes)*	Total waste Apolima 2020 (tonnes)*
Medical	163	250	45	NA	NA
Accommodation	335	515	92	NA	NA
Total (excluding sewage)	**11,500**	**17,800**	**3,200**	**53**	**5**

* Individual sources are not identified for Manono and Apolima as direct data was unavailable, and they are likely to be significantly different from the more populated islands.

Sources of data

APWC data from March-May 2020 waste audits	Other sources of data
• Household audit results • Commercial audit results • Landfill audit results • Interview results (household, commercial premises, recyclers, producers) • Stockpile audit results	• Data available from MNRE for overall household waste collection in m^3 • Import data • Weighbridge data from the landfill

The composition of waste entering the landfill was determined through a combination of visual audits of trucks arriving at landfill and detailed audits of the contents of bagged waste. This composition was combined with the estimates of generation rates to give an estimate of the total quantity of waste generated in each category.

For the following assessment, waste figures for Upolu were used 'as if all waste was collected'. This ensures they are directly comparable to the Savai'i estimates. The results are in Table 18. For all quantities not marked by an asterisk, the values were calculated as follows:

- Detailed audits of household and commercial/office premises waste were conducted to find the composition of bagged waste from each of these locations.
- Visual audits were conducted of incoming waste for 14 days to determine the composition of waste entering the landfill.
- The volumetric data from visual audits was converted to weights using density figures for many categories of waste provided by the US EPA, APWC data from past audits, and the Western Australian Waste Authority.
- Overall weight compositions determined from visual audits were combined with detailed compositions of bagged waste to get an overall waste composition figure for each source of waste.

- Weighbridge data was used to determine how much waste was received into the landfill from each source, and the composition for each source was multiplied by this number to determine the total quantity of waste entering the landfill.
- The quantity entering the landfill was scaled up as discussed above to account for the fact that much of Upolu is not served by waste collection services.

Some figures were estimated from import quantities instead of waste quantities, as it is believed these materials may not arrive at the landfill at the end of their lifecycle. These quantities are marked with an asterisk and should be interpreted cautiously, as the number of cars imported in 2019 will not be the same as the number of cars reaching the end of life in 2020. However, information was received to indicate many cars imported to Samoa have a lifespan of three to five years, so errors introduced by using import figures for these categories may be manageable.

Generation of waste in Samoa by material, tonnes per year

	Tonnes per year				
Material	**Upolu**	**Savai'i**	**Manono**	**Apolima**	**Total**
Used lead-acid batteries*	212.50	37.50	0.64	0.06	250
Lithium-ion batteries	5	3	0.01	0.00	7
Other batteries	0	0	0.00	0.00	0
E-waste	34	6	0.10	0.01	40
Fishing	0	0	0.00	0.00	0
Glass bottles	583	142	1.75	0.16	724
Glass, other	161	45	0.48	0.04	206
Hazardous	9	0	0.03	0.00	9
Hygiene	1,557	381	4.67	0.42	1,939
Aluminum cans	179	16	0.54	0.05	195
Aluminum, other	162	15	0.49	0.04	178
Steel cans	475	88	1.43	0.13	563
Other metal	1,531	267	4.59	0.42	1,798
Organics	4,012	663	12.04	1.09	4675
End-of-life vehicles *	4,998	882	14.99	1.36	5,880
End-of-life renewable energy equipment*	0	0	0	0	0
White goods	17	3	0.05	0.00	21
Wood	52	9	0.16	0.01	61
Paper and cardboard	5,324	935	15.97	1.45	6258

	Tonnes per year				
PET	489	88	1.47	0.13	577
HDPE	135	20	0.40	0.04	155
LDPE	164	6	0.49	0.04	170
PP	224	7	0.67	0.06	231
PS	229	46	0.69	0.06	276
PVC	9	5	0.03	0.00	15
Flexibles and Film	980	203	2.94	0.27	1,183
Single-use plastic bags	153	27	0.46	0.04	180
Plastic Bags Reusable	14	0	0.04	0.00	14
Other Plastic	262	39	0.79	0.07	301
Textiles	922	163	2.77	0.25	1,085
Construction	72	13	0.22	0.02	85
Used oil*	14	3	0.04	0.00	17
Tires	22	4	0.07	0.01	27
Other	137	24	0.41	0.04	161
Total	**22,888**	**4,094**	**69**	**6**	**27,057**

* These figures were taken from import data as none were observed being disposed of at the landfill

Appendix T: Materials available for recovery

A large proportion of waste generated in Samoa is not captured within formal or semi-formal waste streams. A number of factors may explain this, such as waste dumped at the landfill outside opening hours not being recorded (including household, self-haul, and commercial waste), current infrastructure not being efficient or effective for completing waste collections, and households self-managing waste on their own land. This has implications for recyclable material, as only half of the waste is available for recovery from the formal waste management system. Approximately 50 percent of potentially recoverable imported materials is currently leaked, mismanaged, or incorrectly recorded.

Materials imported, waste generated, and materials recycled

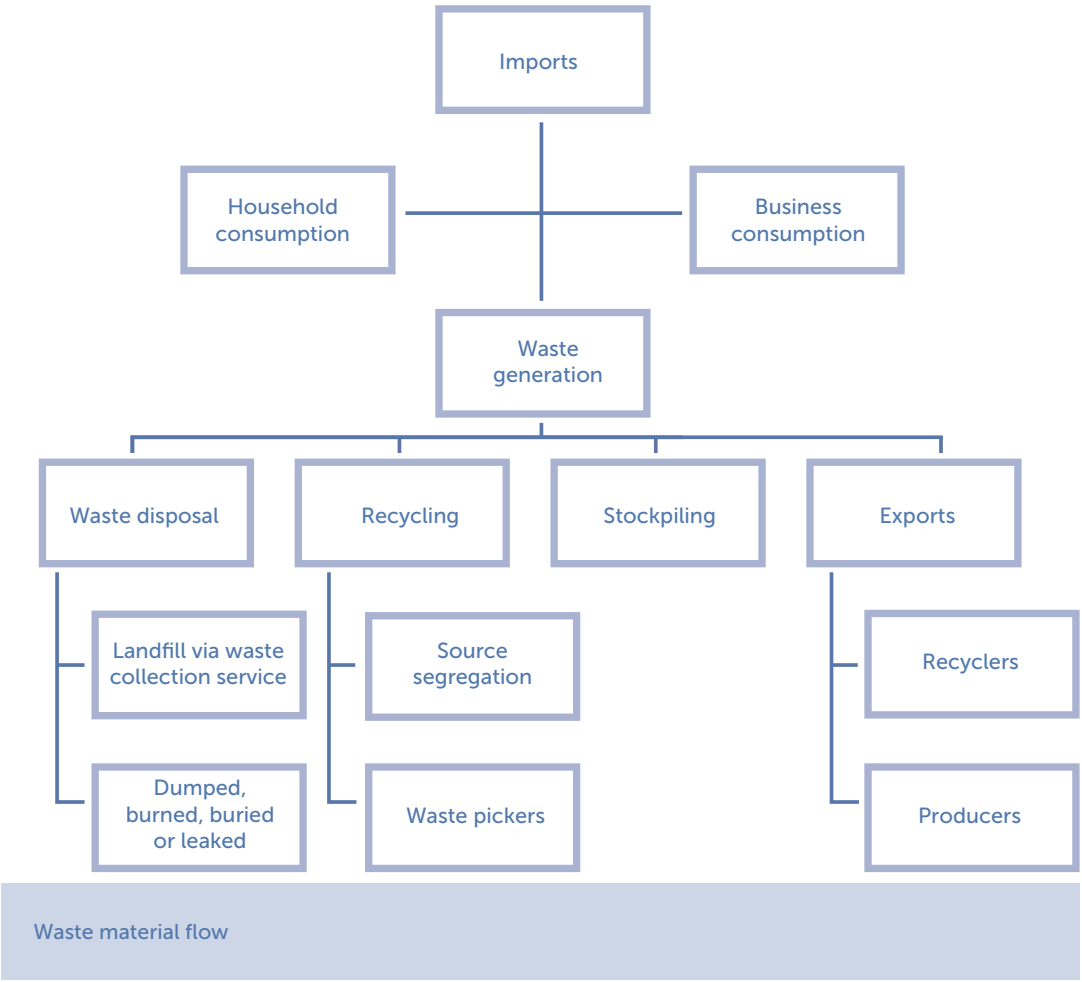
Customs data was investigated to benchmark waste generation, recycling, and recovery figures. However, customs exports do not differentiate between exports of recyclables and exports of goods, so this was considered an inadequate measure of the quantity of recyclables exported. The quantities imported via customs data were calculated as follows:

- Several hundred HS codes were assigned to around 30 broad categories representing more than 80 percent of imports by value. Details of import data are provided in the data uploaded to the INFORM database
- For each broad category, the proportion of the imported material eventually ending up as waste was estimated, including what proportion was consumable (for example, it was estimated that PET water bottles are 99.5 percent consumable and 0.5 percent PET waste).

A combination of predictive models and educated guesses was used to convert all import records that were in volumes or units into weights, and to detect outliers in the raw customs data. Even after this, it is believed some figures were unreliable. In particular, imports of aluminum cans were far too low and imports of tires were far too high. Import quantities in other categories are credible and it appears the high imports of tires can be explained anecdotally.

Most stockpiles were very small compared with the quantities reported to have been recovered and the quantities imported. The exception was used oil, which appears to have a stockpile of approximately four years.

For all types of items (except lead-acid batteries and aluminum cans), imported quantities were much larger than the reported recovery rates. The imported number for aluminum cans appears to be around one-tenth of the annual generation rate of aluminum can waste. It is expected there are also substantial numbers of aluminum cans not recovered and therefore the import data is unreliable and is currently being investigated.



Recycling, exports, stockpiles, waste generation, and imports

	Total recycled, survey** (tonnes/y)	Exports, customs data (tonnes/y)	Stockpiles found (tonnes, estimate)	Waste generation (tonnes/y)	Imports (tonnes/y)
Lead-acid batteries	244	4			251
Lithium-ion batteries		1			19
Other batteries		52			592
E-waste	9	49	5	40	1,578
Toner cartridges	0.2	0.1	0.3		26
Glass bottles		283		724	359
Hazardous			15	9	2,561
Aluminum cans	26	8		195	32*
Aluminum other	28	22	1	178	1361

	Total recycled, survey** (tonnes/y)	Exports, customs data (tonnes/y)	Stockpiles found (tonnes, estimate)	Waste generation (tonnes/y)	Imports (tonnes/y)
Metal ferrous	46	815	5	563	14,587
Brass	5				
Copper	18				
Lead	1				
Other metals	23	2,401	2	1,798	13,103
End-of-life vehicles^		16	143		5,880
White goods		48		21	977
Paper and cardboard		18		6,258	2,138*
PET – other	11	2.0	0.3	124	135
PET – packaged food and drink		2.0		139	151
PET – preforms and empty containers		0.8		314	343
HDPE		16		155	592
LDPE		1		170	110
PP		1		155	418
PS		3		170	527
PVC		11		15	1,187
Single-use plastic bags		0.1	2.5	180	119
Plastic bags, reusable		0.0		14	36
Flexibles, film, and other plastic		157		1,484	2,397
Used oil	17	21.8	224	17	71
Tires		35	27.7	27	582
Mixed items			1		

* Indicates unreliable estimates. Cardboard is such a ubiquitous packaging material that the imports model is currently unable to capture all imported material. It is not clear as to why the figure for aluminum cans is unreasonably low

** All recycled quantities indicate quantities recovered for potential recycling

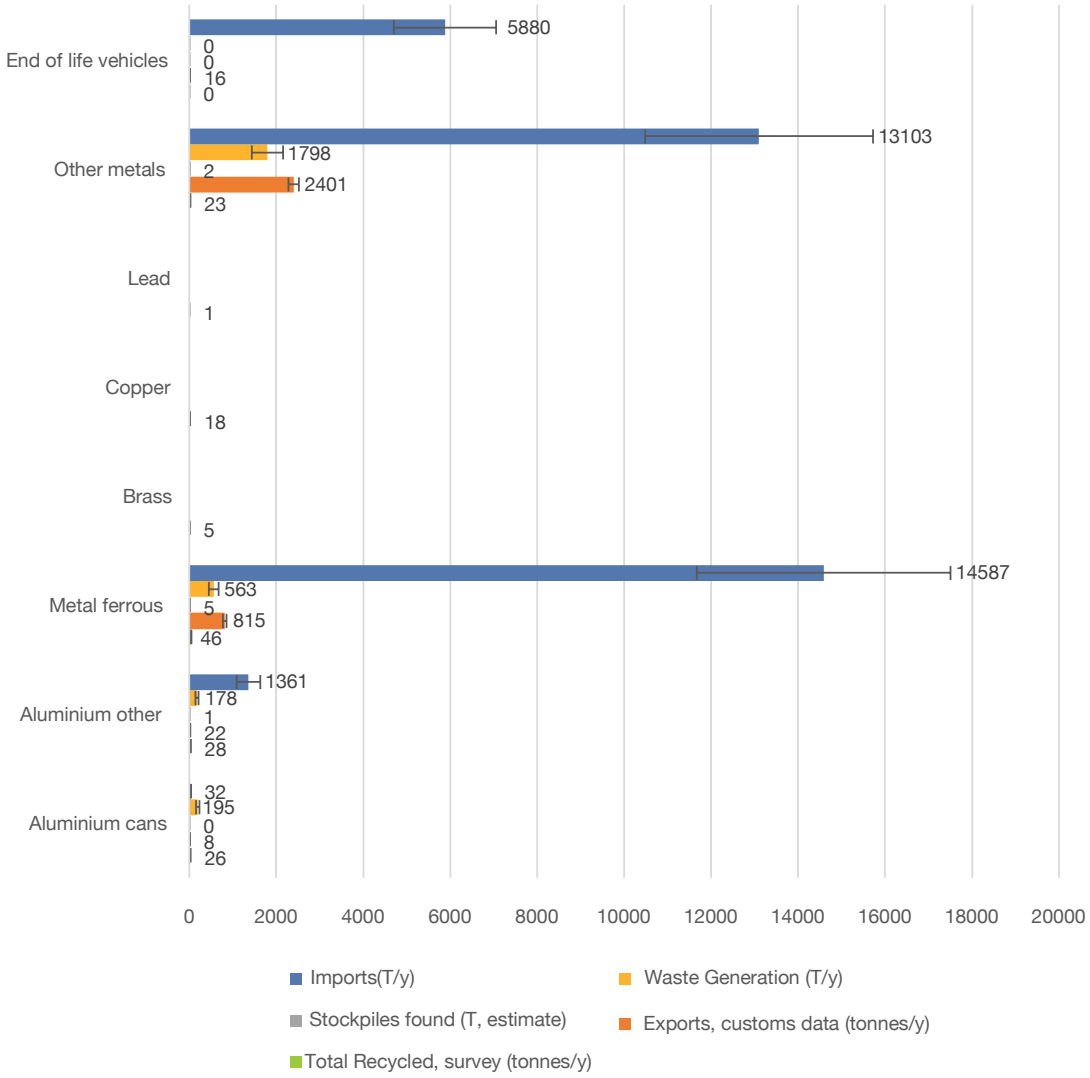
^ End of Life vehicles are a category of waste generation. Import figures indicate vehicles being imported

Metals import, generation, and recovery

There are significantly more metals imported than those found in the waste stream which, in turn, is much larger than the quantity reported to be recovered.

Many imported metals are used in construction and therefore may not enter the waste stream for a number of years. A similar analysis in Palau (UNEP, 2019)

found that metals were also imported in quantities much larger than are present in the waste stream. Large differences between imports and disposal likely indicate that metals have a long lifespan within the economy. Even when the waste stream estimates of generation are used, it appears that there are substantial quantities of ferrous metal and aluminum not currently being recovered.

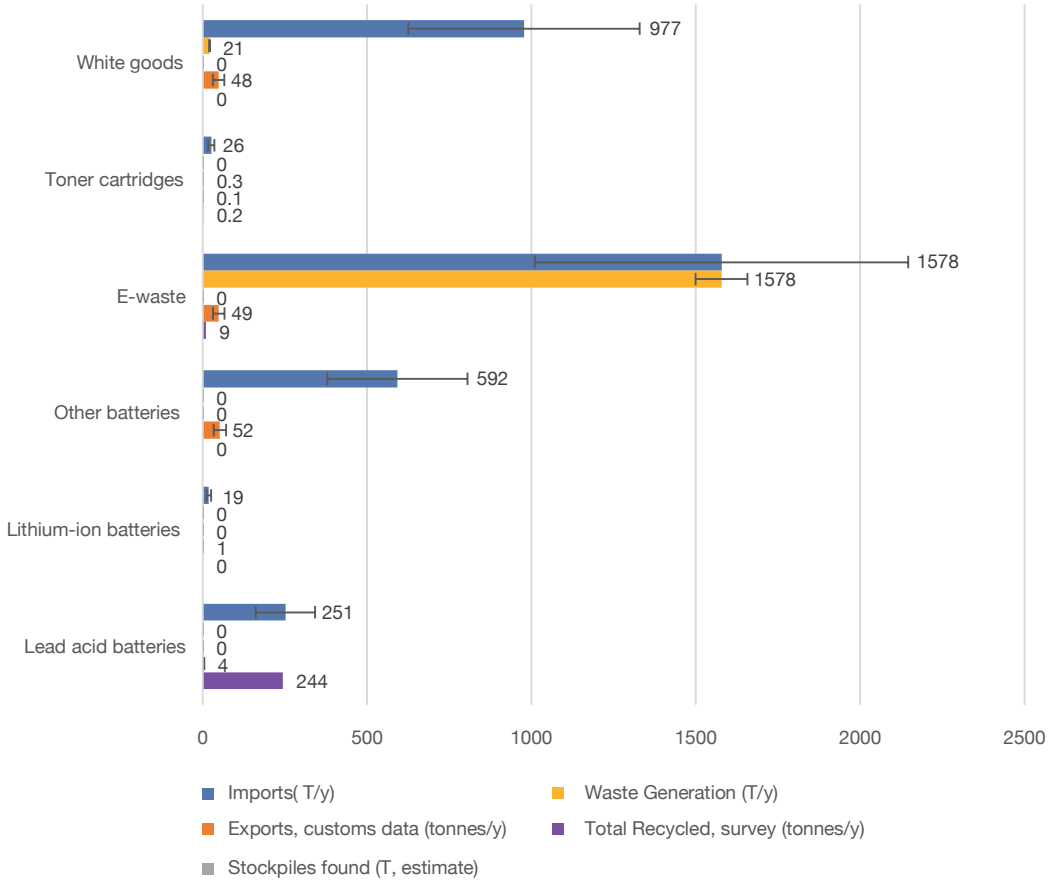


Metal imports, stockpiles, recovery, and disposal*

* The black lines on the bar graphs refer to error bars on imports and exports and reflect educated judgements about uncertainty in assumptions made to derive numbers. Error bars on waste generation reflect uncertainty from sampling and volume to weight conversion; both are 80 percent credible intervals.

Recovery of e-waste, white goods, and batteries

Although large quantities of e-waste, including white goods and batteries, are imported into Samoa, comparatively small amounts are disposed of, recovered, or stockpiled.



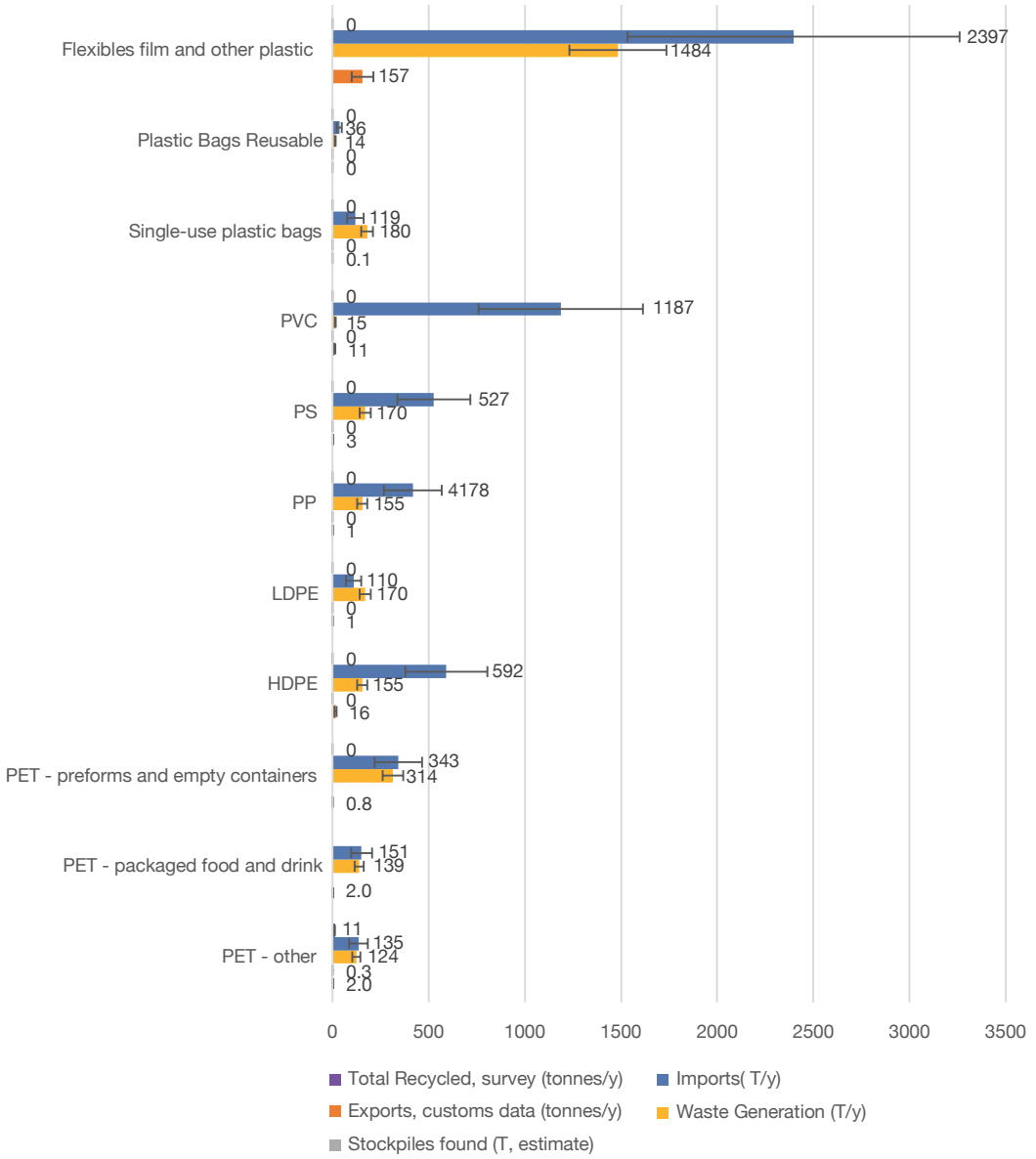
E-waste, white goods, batteries imports, stockpiles, recovery, and disposal*

* The black lines on the bar graphs refer to error bars on imports and exports and reflect educated judgements about uncertainty in assumptions made to derive numbers. Error bars on waste generation reflect uncertainty from sampling and volume to weight conversion; both are 80 percent credible intervals.

Electrical items have shorter lifespans than metals used for construction, so it is unclear as to why such large discrepancies exist between imports and waste generation. It is anticipated there may be a higher amount of reuse within the communities or that illegal dumping is higher amount than expected. Notably, lead-acid batteries are reported to be recycled at a rate of almost 100 percent.

Recovery of plastics

Waste generation of plastics is around 50 percent of the rate of imports across all categories. PVC items are notably long-lived among the plastic types (PVC plumbing can last 70 years), and it was found they are present in much smaller quantities than other plastic items. A fraction of other plastics is also used in the manufacture of longer-lived items, so the residual 50 percent is not all leakage.



Plastics imports, stockpiles, recovery, and disposal*

* The black lines on the bar graphs refer to error bars on imports and exports and reflect educated judgements about uncertainty in assumptions made to derive numbers. Error bars on waste generation reflect uncertainty from sampling and volume to weight conversion; both are 80 percent credible intervals.

Single-use plastic bags, which are banned in Samoa, are entering the landfill in larger quantities than they are imported. This could be due to residual plastic bags in circulation before the ban was introduced in June 2019.

Appendix U: Potential recovery of additional recyclable materials

Potential recovery of additional recyclable materials

	Recovery 60% (tonnes / year)	Recovery 80% (tonnes / year)	Recovery 100% (tonnes / year)	Annual saving in landfill space, 80%, m^3/y	Savings as a % of total waste volume	Already recovered (tonnes / year)
Container deposit on PET drinks	277	369	461	1,739	3.2%	11
Container deposit on PET cleaning and beauty products	12	16	20	73	0.15%	0
Container deposit on HDPE beauty, personal care and detergent bottles*	58	78	97	376	0.7%	0
Container deposit on aluminum cans	117	156	195	844	1.5%	28
Container deposit on glass bottles	434	579	724	707	1.3%	652
Paper and cardboard	3,754	5,006	6,258	16,380	30%	0
Used oil**	35	47	59	4	0.01%	17
Ban on single-use plastic bags (20% substitution)	NA			408	0.7%	NA
Composting of organics	2,804	3,739	4,675	5,731	10%	Unknown
E-waste**	946	1,262	1,578	60	0.1%	9
Hazardous**	1,536	2,048	2,561	10	0.02%	0
Ferrous metal	1,078	1,438	1,798	1,553	2.83%	46
Aluminum other than cans	106	142	178	720	1.32%	
Tires**	349	465	582	259	0.5%	17
All of the above	11,157	14,880	18,604	12,225	52%	763
Plastics, glass, metals, and tires	2,431	3,243	4,055	6,271	11%	754
Plastics, glass, metals, tires, and composting of organics	5,235	6,982	8,730	12,002	22%	754
Food containers only (PET, HDPE, glass bottles and aluminum cans)	898	1,198	1,497	3,739	7%	691

* The listed bottle types make up 63 percent of HDPE containers found in the garbage ** Using import figures rather than landfill figures to calculate recovery. For used oil, assume a weight reduction of 20 percent through use. Landfill records used to estimate landfill space usage as although items are brought into the country in large quantities it appears they are currently ending up somewhere other than the landfill at the end of their lives