Pacific Region Infrastructure Facility

Waste Audit Report Tuvalu

Consultants' Final Report

This report was prepared by PRIF consultants Amardeep Wander, Faafetai Sagapolutele, Anne Prince, and Geoffrey Thompson in December 2019, with the support of the Pacific Region Infrastructure Facility (PRIF).

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Abbreviations

DWM	Department of Waste Management
EDF	European Development Fund
EU	European Union
GDP	Gross domestic product
HDPE	High density polyethylene
J-PRISM	Japanese Technical Cooperation Project for Promotion of Regional Initiative on Solid Waste Management
PET	Polyethylene terephthalate
PRIF	Pacific Region Infrastructure Facility
SPREP	Secretariat of the Pacific Regional Environment Programme
DSW	Department of Solid Waste
TIWPAP 2017–2026	Tuvalu Integration Waste Policy and Action Plan: Towards Cleaner and Healthier Islands 2017–2026
UNEP	United Nations Environment Program

Executive Summary

About PRIF

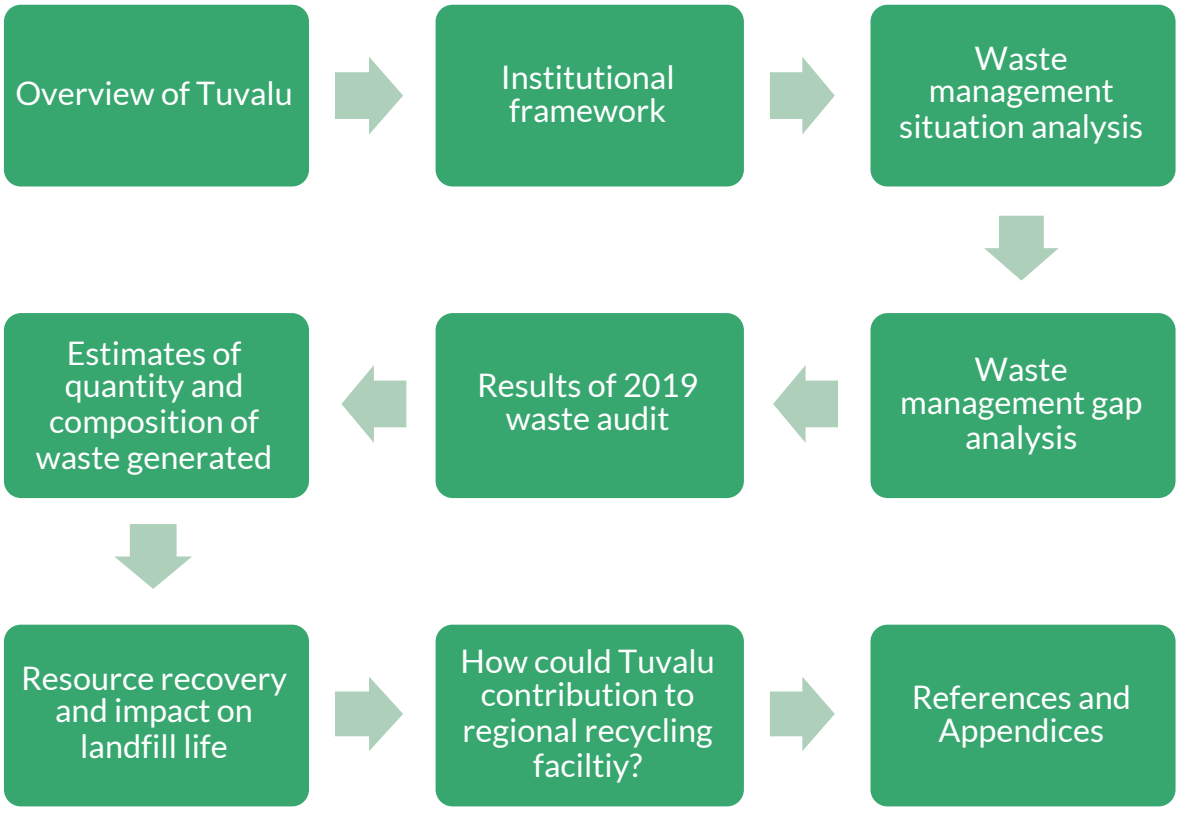
PRIF is a multi-agency coordination mechanism aimed at improving the delivery of development assistance from donors and development partners to the infrastructure sector in the Pacific region. PRIF partners comprise the Asian Development Bank, the Australian Department of Foreign Affairs and Trade, the European Investment Bank, the European Union, the Japan International Cooperation Agency, the New Zealand Ministry of Foreign Affairs and Trade, the United States Department of State, and the World Bank Group.

About this project

As part of its applied research activities, the PRIF has been researching the benefits and challenges of establishing a regional recycling network for the Pacific. Among the benefits considered is a gradual evolution of Pacific countries from linear economies to more sustainable circular economies.[1] Circular economies also foster community engagement, stimulate more responsible behavior related to environmental impacts, and provide numerous opportunities for public–private partnerships and employment.

In 2019, PRIF engaged the consultants Anne Prince, Amardeep Wander, Faafetai Sagapolutele, and Geoffrey Thompson to collect waste data in Funafuti and Vaitupu and to do a scoping study to ascertain the potential contribution of materials from Tuvalu in establishing a recycling network hub in the Eastern Pacific.

This report presents the findings of the study and includes the following:



[1] A linear economy is one in which resources are taken, used, then disposed of, in contrast to a "circular" economy.

Summary of Study Results

Summary of audit activities

- 197 household samples collected and sorted
- 25 commercial samples collected and sorted
- 8 local government staff trained
- Data collected from two islands—Funafuti and Vaitupu
- Landfill audit completed over the course of 6 days covering Monday—Saturday
- Data collected for the following:
  - Nappies
  - Green waste
  - Food waste
  - Stockpiles

Waste generation rates- Funafuti

- Between 6–10 cubic meters (m3)of household waste entering the landfill per day
- 750–1,000m^3 of non-household entering the landfill per day
- Almost 3,000 kilograms (kg) of waste generated in Funafuti daily

Stockpiles in Funafuti

- 240 pieces of materials amounting to 1,126 m3 and weighing approximately 220 tonnes are currently stockpiled in Funafuti
- Data shows that this accounts for 96% of end-of-life vehicles, 40% of electronic (e)-waste, and 86% of lead acid batteries generated annually
- The e-waste and lead acid batteries are stockpiled at the TS leading to ease of recovery when transport options are available

Materials of interest-generation

- Almost 1,642 tonnes and 7,000 m3 of materials of interest are generated in Tuvalu (all islands) each year.
- Please note this is subject to change with more customs data

Reduction in waste going to landfill-bans

- The banned single use plastic items represent 6% of the material currently entering the waste stream and approximately 253 to 421 m3 of material that will not be required to be managed at the landfill

Two potential projects

- Cardboard recycling/local reuse (composting/briquettes)
- Compostable nappy trial

Recovery of recyclables – levies

- If 100% of the levied items are able to be recovered, 14% of the current waste stream will be diverted from landfill for resource recovery. This represents between 781 m3 (at 75% recovery rates) to 1,042 m3 of uncompacted materials that Tuvalu will need to store, compact and process before making it available for shipping overseas for recycling

Recovery of recyclables- potential future projects

- Recyclable materials not currently considered in any recycling or recovery scheme account for almost 30% of the waste stream. Future projects involving recovery of cardboard offer the highest savings in landfill space and more than 20% diversion from landfill

Landfill life

- Given no recovery and a density of 400 kg/m3, an additional estimated 11,000 m3 landfill opened in January 2020 would be full by 2025, or 5 years after it opened
- Recovering all identified additional materials not currently covered by legislation extends this life by another 1.5 years, or until mid-2026
- Compaction to 600 kg/m3 under the existing recovery regime yields a lifespan extension about 0.5 years longer than additional recovery
- At the extreme end, recovering all identified materials and compacting the landfill to 800 kg/m3 extends the lifespan until around 2032, an extra 7 years

Challenges for Tuvalu

- Lack of landfill space and
- Inability to move or transport materials to appropriate markets.
- Lack of financial and human resources and capacity to successfully implement activities including enforcement and collection of data.
- Lack of proper equipment to deliver new initiatives and high costs of equipment procurement and maintenance.
- Transportation of recyclable materials from outer islands .
- No proper storage facility for hazardous waste.

Tuvalu's ability to contribute to recycling network

Based on site visits, meetings with officials, audits and a review of the current legislative framework, the consultants believe that Tuvalu is ready and will be able to contribute fully to the operation of a regional recycling network. The key reasons are as follows:

- A legislative framework is already in place to recover recyclable materials;
- Pressure to undertake recycling activity due to diminishing landfill space;
- Capable staff who are committed to better waste management outcomes and can be trained to participate in recycling network activities; and
- A framework of infrastructure reforms currently underway that will allow for the collection and compaction of materials effectively.

1. Introduction

1.1 Project need

Capacity building within Pacific communities is crucial for dealing with the growing problem of waste management and the prevention of land- and marine-based litter. The implications of pollution on marine ecosystems have been widely studied, but the impact on human health remains poorly characterized. Human health impacts are perceived to be an emerging problem, requiring increased scrutiny and attention (Seltenrich 2015; Ocean Conservancy and International Coastal Clean Up 2014). Urgency is increasing among industry, government, nongovernment organizations and environmental groups to develop tools and policies to track, capture, and recycle waste (particularly plastics) before it reaches the oceans.

Pacific countries face unique and significant obstacles developing and implementing sustainable waste management solutions to combat litter in terrestrial and marine environments. Organic waste, waste oils, and waste from ships and cruise liners also produce a unique challenge for the area. Globalization has substantially increased waste generated within communities. Waste challenges for island communities are considerable, due in large part to their isolated geography and small size, coupled with a lack of available land for waste management solutions such as transfer stations, waste treatment and disposal sites, and recycling and reuse facilities. Other obstacles, including the topography and location of some communities, and resourcing and infrastructure limitations, mean that many communities have limited or no access to sustainable waste management, especially those in remote locations. As a result, waste is often dumped, burned or buried, leaving it susceptible to dispersal into the environment.

Recycling on Pacific countries is of great importance. Lack of space is hugely problematic for them, with many countries unable to extend current landfills or dumping sites or develop new sites. Yet, immediate improvements in solid waste management systems are crucial to ensuring the health of island residents and the environment. Recycling initiatives in countries such as Palau and Kiribati have had a positive impact, reducing the waste-to-landfill volume and relieving pressure on limited end-of-life landfill space. Encouraging the 3Rs plus return (reduce, reuse, recycle, and return) prevents and minimizes waste generation and pollution.

Additionally, several factors combine to make shipping services to and from Pacific countries relatively expensive, including long distances between ports and low trade volumes, which make it difficult to take advantage of economies of scale. Port facilities vary widely, with a general lack of major cargo-handling infrastructure, which mandates use of relatively expensive, geared container vessels (i.e., with on-board cranes). Often, extreme trade imbalances exist, with imports far outweighing exports (SPREP 2016), leading to costly container repositioning (ADB 2007). These challenges combine to raise the costs of goods and of returning recyclable commodities to foreign recycling facilities. In addition, poor segregation, especially in outer island communities and an absence of local demand for local recyclable goods, has resulted in lack of market for recyclables in Tuvalu.

As an atoll island with limited land resources, Tuvalu faces several challenges delivering and expanding current waste management systems. In addition to land barriers and space restrictions, there are several complications for a waste management industry in Tuvalu. The private sector is small and has limited capacity in equipment and other resources. Like many of its neighboring Pacific countries, it is at a critical point, with landfill space close to capacity and limited systems for recycling and recovery of recyclable materials, especially plastics, glass, and bulky waste. Although Tuvalu receives funding for waste management initiatives, there is no guarantee that this funding will continue. The government has limited revenue to invest in waste management infrastructure developments. It is anticipated that the introduction of a waste levy to cover beverage containers, some bulky waste such as large appliances and cars, and other source-separated recyclables should provide an income stream and create a continuing market for recyclables, reducing dumping of waste and relieving the pressure on landfill space.

1.2 The Pacific Region Infrastructure Facility regional recycling hub study

The Pacific Region Infrastructure Facility (PRIF) has been researching the benefits and challenges of establishing a regional recycling network for the Pacific with a possible hub located in the region as Pacific countries move from "linear" to "circular" economies. Opportunities to improve social, environmental and economic outcomes have been identified, but the absence of reliable data constrains both the design phase and attraction of public-private partnerships.

In 2017–18, the PRIF commissioned a research study to identify and quantify the opportunity to improve the resource recovery of 15 primary recyclable commodities in the solid waste stream in 15 Pacific countries and territories. The recommendations of the project were a pre-feasibility study to determine the viability of establishing a regional network to allow for recovery, consolidation, processing, and shipment of recyclables from a network of surrounding islands.

Whereas the PRIF (2018) study focused mostly on the export and import material flows of Pacific countries, more information on standardized country data for solid waste production, collection, treatment, and disposal is required, along with more detailed analysis of institutional readiness and the infrastructure required in each country to make the recycling network viable.

The pre-feasibility study has now been approved, with the first stage of the assignment required to collect and assess the information from detailed waste audits to inform the viability of the broader PRIF's "Scoping Study for the Regional Recycling Network for the Eastern Pacific Region".

This pre-feasibility study will establish the viability of the pilot recycling network in the eastern region, using Suva, Fiji as the regional recycling hub. The pilot recycling network will be planned and implemented in one region to prove viability and sustainability. This would require the establishment of a regional processing, transhipment, and recycling hub, suitable urban center facilities, and scaled outer island storage facilities in each of the Pacific countries associated with the regional hub. Within the context of this proposal, the PRIF report recommends the eastern region, with a Fiji-based regional recycling hub in Suva. This proposal is based on assessment of port facilities, capacity, shipping networks, and other economic aspects. Under the pilot program, Suva would receive a selected range of recycled waste materials from Cook Islands, Kiribati, Niue, Samoa, Tonga, Tuvalu, and Vanuatu to supply current/future remanufacturing enterprises and to aggregate and add value to shipments of recyclables to other destinations.

The pilot project will require development partner investment to construct infrastructure and implement regional institutional capacity and economic development programs to support the recycling network. The program will enable a proof of concept to build confidence in the Pacific countries, private sectors, and donors. It will aim to transform linear economies to circular economies, relying on extensive community engagement and behavioral change, including the development of public-private partnerships.

Overall, the study looks into the establishment of a first node of a regional recycling network in the Pacific and recommends the infrastructure and policy interventions required. The first phase will collect all information and datasets necessary to propose preliminary arrangements, detail the socioeconomic benefits of the hub and the network, and will propose a roadmap of activities that may receive support or funding from PRIF members and stakeholders.

This pilot project seeks to devise a waste audit methodology to capture consistent, reliable, robust data that can be used to inform future decisions across the region and within Tuvalu. It will aim to increase recycling and recovery of used materials and reduce the reliance on landfill.

1.3 This report

The consultants were engaged to conduct a scoping study to assess current waste management practices in Tuvalu to establish a first hub for a regional recycling network in the Pacific. The consultants were also employed to recommend the infrastructure and policy interventions required and to undertake an audit of the materials being generated. Tuvalu is the first of six Pacific countries where this program aims to deliver direct results. The project deliverables were focused in two areas:

i. Waste audits

Waste audits were required to inform the feasibility of a recycling network, and assess the institutional capacity of the Pacific countries to play an effective role in this network. The Tuvalu audit was a pilot, where the waste audit methodology developed by the consultants was being used to ascertain if it is an appropriate model for all future waste audits across the other Pacific countries and to ensure comparable data. In addition, a data collection system was employed which incorporated external agency requirements to facilitate data sharing between all stakeholders and Pacific countries. All data were uploaded to SPREP's INFORM database.

ii. Institutional assessment

An assessment of the capacity of public institutions and the private sector for establishing a regional recycling network was completed, including a review of the regulatory framework and assessment-ready matrix. This involved extensive consultations with government departments and the private sector to determine the appetite for the initiative. Perspectives on the benefits, risks, and challenges of a regional recycling solution were gathered and included in this report.

The report starts with a brief literature review summarizing the current waste management practices in Tuvalu. It comments on the infrastructure available and analyzes the waste being generated and disposed of. Table 1 lists sections of the report and relevant content to help the readers determine the most relevant section for their pursual.

Table 1: Report Sections

Section	Heading	Detail
1 and 2	Introduction and summary	These sections summarize project need and background and provide a country profile for Tuvalu.
3	Institutions, projects, and challenges	This section describes the institutional arrangement in Tuvalu and lists projects under way and the potential challenges for waste management.
4	Method	This section details the methodology for data collection.
5	Summary	Snapshot of the overall data collected as a result of the audit.
6	Results	This section summarizes total generation rate of waste in Tuvalu for households and commercial premises.
7	Total quantities of materials generated	This section lists the total quantities (in tonnes and cubic meters) that generated on each island in Tuvalu based on current consumption trends as well as the audit of the current waste generation habits.
8	Capturing available material	This section summarizes the quantities captured for recycling based on the current legislative regime and with available infrastructure, and provides suggestions for projects that could possibly improve resource recovery.
9	Landfill life	How will the quantities of waste currently generated impact on the life of the landfill? The analysis has been performed based on the availability of compaction or lack thereof.
10	Potential future projects	Identified two projects that could lead to a high level of waste diversion from landfill and that can be undertaken independent of the recycling hub study.

Source: Authors

The final section of the report uses data and information gathered in-country to ascertain the amount of recyclable materials that can be captured and transported to a regional recycling hub for international markets. Tuvalu's ability to capture and move this material through legislative reform has also been assessed using a readiness matrix. The results section also comments on the use of the proposed methodology to undertake future waste audits in Pacific countries.

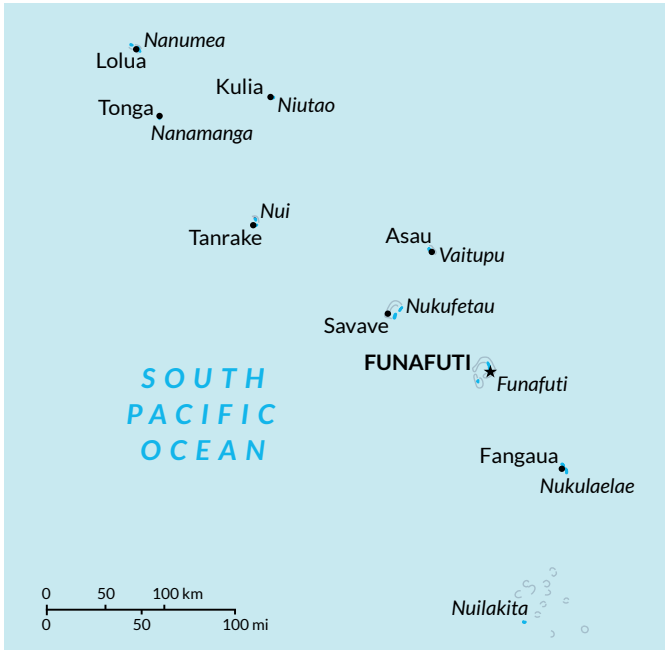
2. Overview of Tuvalu

The consultants were able to draw upon previous work completed by Secretariat of the Pacific Regional Environment Programme (SPREP), the Japanese Technical Cooperation Project for Promotion of Regional Initiative on Solid Waste Management (J-PRISM) project and European Development Fund (EDF) 11 projects to understand the current state of waste management for all islands in Tuvalu and the literature review draws heavily on the baseline report for Tuvalu prepared in 2017.

2.1 Background

Formally known as the Ellice Islands or Lagoon Islands, Tuvalu is situated in the Polynesian region of the Western Pacific Ocean, nestled between Fiji, 1,100 kilometers (kms) to the north and Kiribati, 250 kms to the south. The country's nine islands spread across a 676-kilometer arch in the central Pacific (three reef islands and six low-lying atolls). The fourth smallest nation in the world, the total coastline extends 24 kilometers, encompassing a combined total land area of 25.6 square kilometers (Tonkin and Taylor 2005).

Figure 1: Map of Tuvalu



Source: Wikipedia. https://en.wikipedia.org/wiki/Geography_of_Tuvalu#/media/File:Tv-map.png

"Tuvalu", meaning "eight standing together" (one of the island groups has very little land at sea level), has no point higher than 4.5 meters above sea level across the entire nation. The effects of climate change thus pose a real risk of complete submergence, with Tuvalu becoming the world's first nation to be faced with such risk. In 1989, the United Nations (UN) said the country was at risk and most likely to disappear beneath the sea in the 21st century due to climate change.

Tuvalu gained independence on 1 October 1978 and its capital, Fongafale Islet, is on the main island of Funafuti. Its nine islands, from north to south, are Nanumea, Niutao, Nanumaga/ Nanumanga, Nui, Vaitupu, Nukufetau, Funafuti, Nukulaelae, and Niulakita.

Its exclusive economic zone reaches 259,000 square kilometers (km2), nearly 200% larger than its landmass.

2.1.1 Climate

Average daytime temperature ranges between 29°C and 31°C.

The country is said to be among the most fragile and vulnerable environments in the Pacific. It is at high risk from cyclones, rising sea level, and rising ocean temperature and ocean acidification. In 2015, Cyclone Pam caused significant damage to agricultural land and infrastructure across the country. Flooding affected seven of the nine islands, almost all of its 10,000 people.

Tuvalu has no streams or rivers, therefore dependence on rainwater is critical. Higher sea levels have threatened the underground water table. The government called a state of emergency in 2011 after a 6-month period of no rainfall led to extreme water shortages. After this event, 10,000-liter water tanks were installed to capture rainfall and prevent further water shortages.

2.2 Socioeconomic background

Languages spoken include Tuvaluan (a Polynesian language close to Samoan) and English. According to the latest census conducted in 2012, the total population of Tuvalu is 10,837 (423 per km2), with a consistent increase of 0.2% annually, 57.2% it in Funafuti. But a 2017 mini census found the national population was 10,507 (excluding 138 visitors or non-residents), a decrease of -1.3%, for annual decline of -0.3% a year. Population density decreased to 410 per km2 in 2017 (Table 2).

Funafuti Atoll is under severe population pressure, with urbanization increasing significantly over the past 25 years. The population density of the atoll increased from 1,600 in 2002 to more than 2,220 per km2 in 2012.[2] Ninety-eight percent (98%) of the population of Funafuti resides on Fogafale islet; here, the population density rises to 4,225 per km2.

Two-thirds of the population relies on subsistence farming and traditional fishing. Coconuts, bananas, and breadfruit are the main local products. According to government statistics (2017), 26% (or 2,800 people) live below the poverty line.

Currently, 50% of electricity is derived from renewables and the country is committed to achieving 100% renewable energy for power generation by 2025.

Table 2: Population of Tuvalu, 2012 and 2017

Island	Area (km2)	2012 Population	2017 Population
Nanumea	3.87	1,676	1,603
Nanumaga	2.78	1,217	1,229
Niutao	5.53	1,450	1,402
Nui	2.83	1,054	1,034
Vaitupu	5.6	2,086	1,860
Nukufetau	2.99	1,399	1,322
Funafuti	2.79	1,171	1,340
Nukulaelae	1.82	537	568
Niulakita	0.42	247	31
Other			118
Total	**28.63**	**10,837**	**10,507**

Source: Tuvalu Census 2012 and Mini-Census 2017.

2.2.1 Imports and exports

Tuvalu has a small and fragile economy and relies on the goodwill and generosity of aid donors.

The Tuvalu currency is the Australian dollar and the Tuvaluan dollar. The Observatory of Economic Complexity reports that during 2017 Tuvalu exported $4.02 million worth of goods to Japan, France, Bosnia and Herzegovina, the United States, and Australia.[3] Fifty percent (50%) of exports during this period were non-filleted (whole) frozen fish totaling $2.01 million (99.3% to Japan and 0.66% to Oceania), followed by aqueous paints, polyacetals, and laboratory reagents. In the same year, imports of $35.6 million resulted in a negative trade balance of $31.6 million. Imports decreased from $54.2 million in 2012 to $25.6 million in 2017. The top import origins include the People's Republic of China, Fiji, the Republic of Korea, Chile, and South Africa. Refined petroleum ($8.41 million) is the most popular import, followed by iron structures, fishing ship, gravel, and crushed stone. The import and export of goods is by air or sea. One shipping company operates services for Tuvalu through Fiji.

Gross domestic product (GDP) in 2017 was $39.7 million, for GDP per capita of $3,920. According to the Tuvalu government's 2019 national budget, the nation is experiencing an unprecedented number on consecutive years of economic growth. This may be a direct result of the large number of infrastructure projects currently funded by the government and co-funded and administered by development partners. GDP for 2019 is expected to rise from $44.9 million to $46.9 million in 2020 and remain above 4% until 2021 (Minister for Finance and Economic Development 2018).

[2] Government of Tuvalu (2017).TE KAKEEGA: *National Strategy for Sustainable Development 2016–2020.*
[3] *OEC.world*. n.d. OEC—Tuvalu (TUV) Exports, Imports, and Trade Partners. https://oec.world/en/profile/country/tuv/

3. Institutional Framework (Tuvalu)

3.1 National government

Tuvalu is a parliamentary representative democratic monarchy. Her Majesty, Queen Elizabeth II of Great Britain, is head of state and represented by a governor-general. The prime minister of Tuvalu is the head of government and is elected by parliament. There are no political parties. Fifteen members of parliament are elected for a 4-year term.

The country is divided into seven island councils and one town council, each consisting of six elected members known as the *Falekaupule*, including a president. Customary law continues and has an important role within the institutional framework of Tuvalu. It has effect as law under the Laws of Tuvalu Act 1987, except where it is inconsistent with an act of applied law or legislation.

Eight of the nine islands are ruled by a traditional Council of Chiefs. Niutao represents the inhabitants of Niuakiat as the least populated island and 2% of the overall population of Tuvalu. *Falekaupule* is the traditional assembly in each island and composed of the *Aganu* (traditional local customs and usages of an island). The *Kaupule* acts as the executive arm of the *Falekaupule* on each island.[4] Comprised of six members, the *Kaupule* performs all the functions conferred on the *Falekaupule* (SPREP, Environmental Defenders Office NSW 2018). Meetings are conducted in community meeting houses known as the maneapa.

The *Tuvalu Integration Waste Policy and Action Plan: Towards Cleaner and Healthier Islands 2017–2026 (TIWPAP 2017–2026)* suggests that for the government to achieve the strategic goals of the plan, it must ensure that the institutional and organizational structure of the waste section is properly set up to create, amend, and update laws, regulations, and policies to ensure orderly delivery of waste services (Government of Tuvalu 2016).

A recent review of *TIWPAP 2017–2026* found that a new organizational structure had been agreed and implemented. In addition, the government has implemented three new regulations to prohibit the importation of single-use plastics to address littering and implement a waste levy deposit regulation.

To further strengthen the institutional system to address gaps in waste management, each outer island has either passed or is processing the passing of new waste bylaws based on the national waste law. Several court cases are pending relating to illegal dumping and littering. A waste management budget allocation has secured an increase of at least 2.5% per year, and land leases for waste facilities have been achieved.

3.1.1 Establishing new laws and bylaws

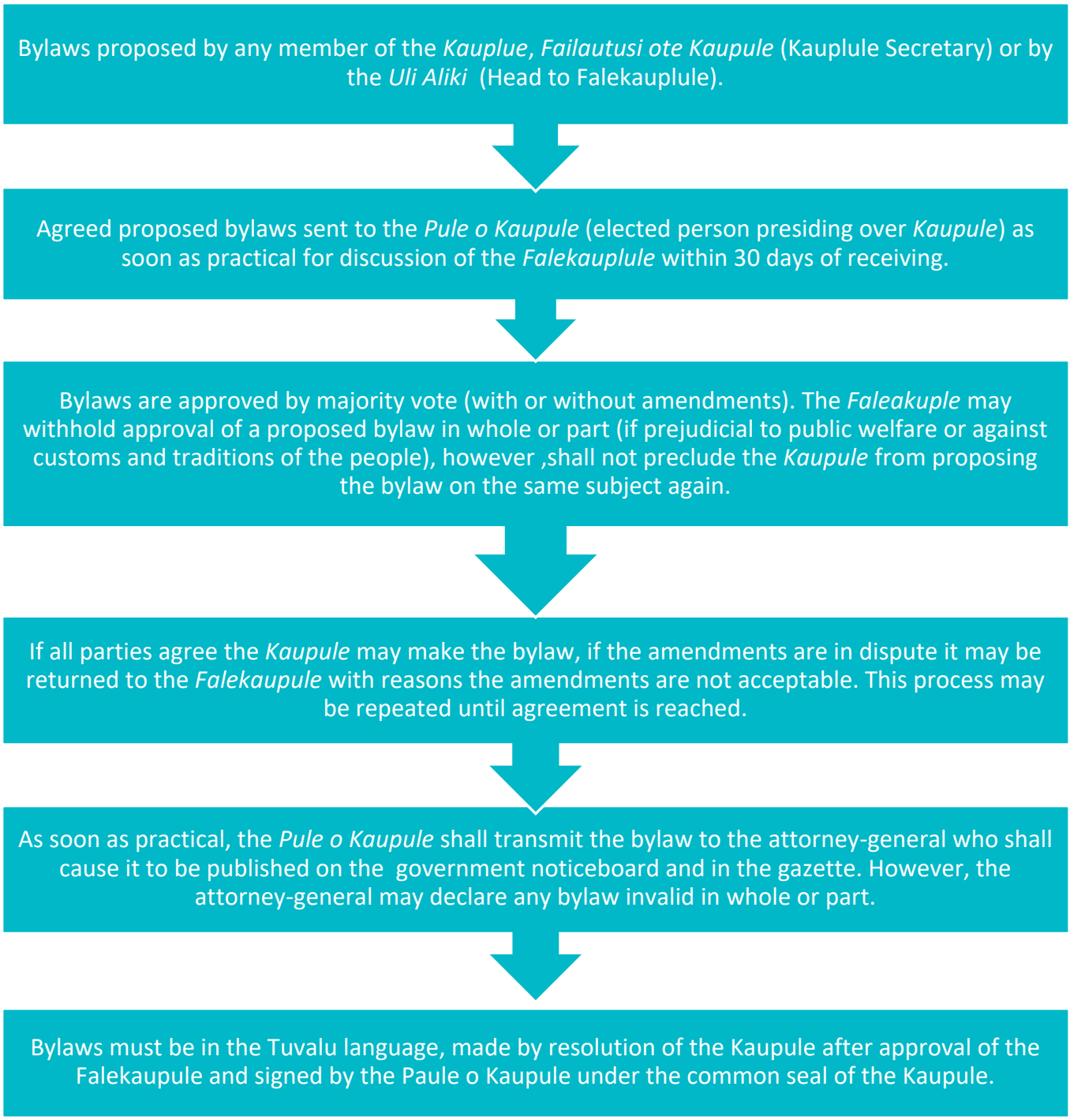
Proposed laws or bills may be introduced by any member of parliament. Once introduced, the bill has its first reading at the following session of parliament. The Clerk of Parliament then circulates the bill to the *Falekaupule* or *Kaupule* for consideration and comment. However, on the advice of the cabinet, the prime minister can circumvent this process in the case of urgency or if the bill is deemed of little public importance.

Bills are passed through a majority vote; the speaker has the casting vote. Upon presentation to the head of state, the bill becomes an Act of Parliament. Related policies, action plans, and strategies are written by the relevant government department.

[4] Kaupule is the executive arm of island assembly of elders, similar to a local council.

Under the *Falekauple Act 1997*, the *Kaupule* can make bylaws in relation to any matter and perform the function under section 15(2) of the *Waste Operations and Services Act 2009*. The process for proposing a bylaw is illustrated in Figure 2.

Figure 2: Kaupule Bylaw Proposal Process



Source: Authors.

3.1.2 International agreements

Tuvalu has ratified numerous environmentally related international and regional commitments and remains in general compliance with the spirt of such commitments. Table 3 highlights the multilateral agreements significant to waste management in Tuvalu.

Table 3: Multilateral Agreements and Conventions Ratified by Tuvalu

Multilateral Agreements and Conventions	Status
Stockholm Convention on Persistent Organic Pollutants	Ratified
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 (Waigani Convention), 1995	Ratified
The Kyoto Protocol to the United Nationals Framework Convention Climate Change	Ratified
Montreal Protocol	Ratified
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
Protocol 1973	Ratified
Protocol to the International Convention on Civil Liability for Oil Pollution Damage of 29 November 1969 (1976)	Ratified
International Convention on Civil Liability for Oil Pollution Damage 1969 (renewed 1992)	Ratified
International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage	Ratified
Protocol on Preparedness, Response and Co-operation to Pollution Incidents by Hazardous and Noxious Substances, 2000 (	Ratified
International Convention on Civil Liability for Bunker Oil Pollution Damage 2001	Ratified
International Convention on the Control of Harmful Anti-fouling Systems in Ships 2001	Ratified
Small Island Developing States Accelerated Modalities of Action (Samoa Pathway)	Ratified
Nairobi International Convention on the Removal of Wrecks 2007	Ratified
Noumea Convention for the Protection of the Natural Resources and Environment of the South Pacific Region (1986) • Protocol converting Cooperation in Combating Pollution Emergencies in the South Pacific Region • Protocol for the Prevention of Pollution the south Pacific Region by Dumping	Ratified
Vienna Convention for the Protection of the Ozone Layer	Ratified

Sources: Compiled by authors.

3.1.3 Regional Agreements

Tuvalu has several strong bilateral and multilateral relationships (Table 4).

Table 4: Regional Agreements and Memberships

Regional Agreements	Status
Pacific Islands Forum	Tuvalu hosted August 2019
Pacific Community (SPC)	Member since 1978
South Pacific Regional Environment Program	Current member
Cleaner Pacific 2025: Pacific Regional Waste and Pollution Management Strategy 2016–2025	Current member
Regional **Unintentional Persistent Organic Pollutants** Action Plan	Current 2018–2022
National Implementation Plan for the Stockholm Convention on **Persistent Organic Pollutants**	Current 2008

Source: Authors.

3.1.4 National regulation and strategy

The Government of Tuvalu recently focused on environmental protection and management of its natural resources, developing and implementing several polices to protect its fragile environment. Two important environmental legislations dealing with waste management include:

- *Environment Act 2007*
- *Waste Management and Services Act 2009 and related regulations*

Most recently, Tuvalu has implemented a waste management levy and has banned the importation of single-use plastic (Figure 3) under *Waste Management (Prohibition on the Importation of Single-Use Plastic) Regulation 2019*. These two regulations, in addition to the *Litter Waste Management (Littering and Disposal) Regulation 2018*, are set to significantly change the way Tuvalu manages waste (see Appendixes 1 and 2).

The policies, legislations, strategies, and multilateral agreements that address solid waste management and pollution control in Tuvalu are provided in Appendix 3.

Figure 3: Plastics. Items Banned in Tuvalu in 2019.

Source: Government of Tuvalu

3.2 Stakeholders—Roles and Responsibility

Table 5 outlines the roles and responsibilities of each stakeholder managing municipal solid waste in Tuvalu, including decision-making, implementation, and compliance and monitoring, such as ongoing data collection.

Table 5: Stakeholder Roles and Responsibilities

Stakeholder	Responsibility
Government of Tuvalu	
Ministry of Home Affairs and Rural Development	The ministry is the governing body for waste management. Provides financial support for waste management activities through the government's annual budget. Under the Waste Operations and Services Act (2009), the minister may: i. Make regulations imposing a special levy on particular goods which have an adverse effect on the environment; ii. Impose additional charges on commercial premises where waste operators maintain a public service ensuring the surrounding areas (streets, parks, etc., are clear of waste and litter); iii. Impose any other type of special levy relating to waste management services for recovering costs incurred in the management of waste.
Ministry of Health	The ministry is responsible for health care waste including collection, treatment, and disposal of all medical waste and monitoring and enforcement of the approved standards of Section 7(2) of *the Public Health Act 2008*. The ministry is also responsible for the island's incinerators.
Subordinated Agencies	
Solid Waste Agency of Tuvalu	The agency was established in June 2010. It sits under the Ministry of Home Affairs and Rural Development and oversees and manages the overall handling of wastes. The agency is responsible for: i. Management and operation of waste disposal facilities if needed to provide "additional technical and operational capacity to ensure the proper processing and disposal of wastes". This function is exercised by the agency in Funafuti; ii. Handling the collection and disposal of waste that cannot be managed by Kaupule or designated waste management operators—including the storage and disposal of hazardous and bulky wastes. This function is exercised by this agency in the collection of green wastes, recyclable waste and hazardous waste in Funafuti; iii. Ensuring the proper siting, development, and management of landfill areas and approved dumping and waste storage sites; iv. Provision of other appropriate waste treatment, storage and disposal facilities; v. Formulation and implementation of policies, programs and initiatives to reduce the generation of wastes; vi. Public awareness on effective management of waste to ensure waste reduction and prevention of health and environmental risks; vii. Audit of waste being generated or disposed of in Tuvalu; and viii. Preparation and issuance of reports and compilation of statistics relevant to management of waste in Tuvalu. Agency field workers collect and submit data to the Waste Operations Officer daily (loads and type of waste including green, scrap metal, and nappies).
Department of the Environment	The department is responsible for ensuring proper regulation and control of pollution, littering, waste (including hazardous wastes), and for taking measures to minimize the impacts of pollution, litter, and waste on the environment. This includes tasks such as monitoring pollution, licensing polluting industries, regulating the disposal of wastes, and raising public awareness related to waste management. Specifically, in accordance with Part VII of the *Environment Protection Act* (2008), the department is responsible for the implementation of international conventions relating to the management of hazardous wastes; and in accordance with section 19(2)(g) of the Environment Protection Act 2008, the department is responsible for regulatory control over waste dumps and waste disposal sites based on environmental impact assessment procedures.

Table 5: Stakeholder Roles and Responsibilities (continued)

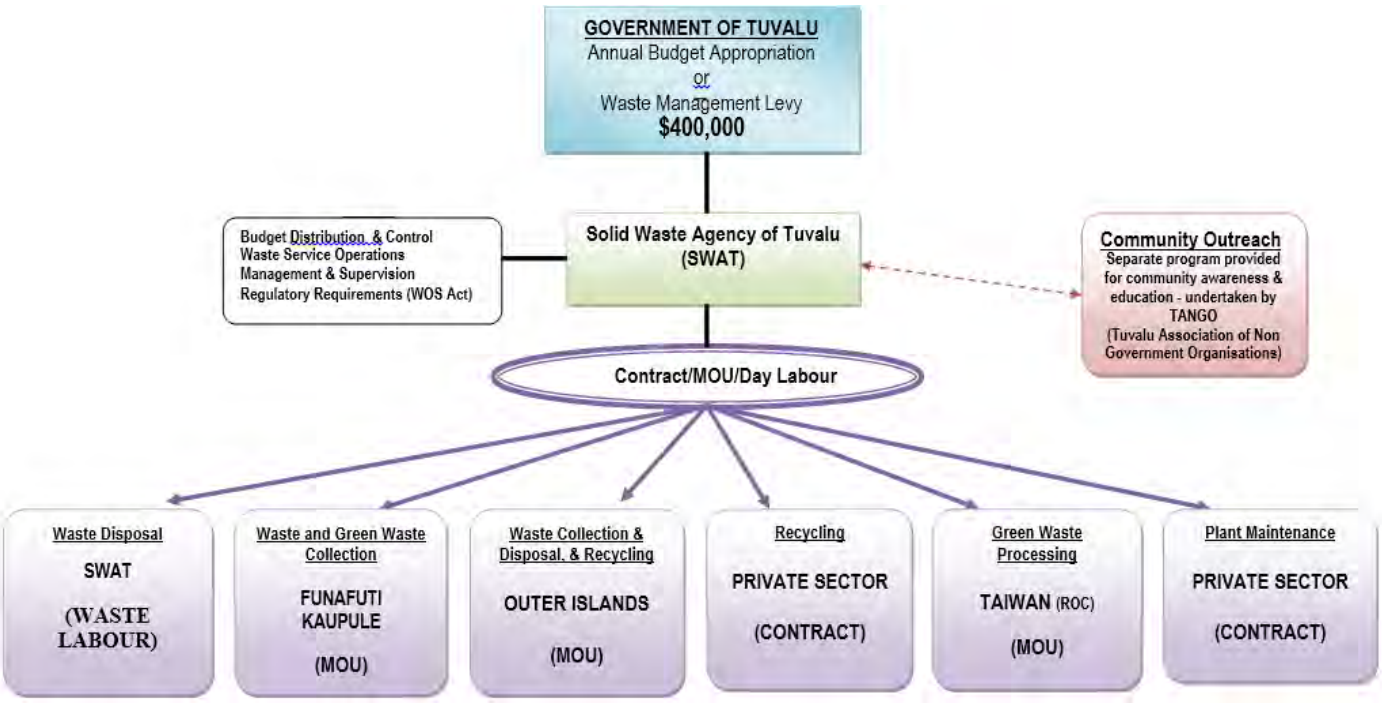
Stakeholder	Responsibility
Department of Waste Management	The department and *Kaupule* are the official designated waste management agencies under the *Waste Management Act 2017* and consequently have legal obligations to the implementation of the Act and the Policy. The department is responsible for overseeing and monitoring the progress of the levy deposit system including: i. Reconciliation of waste levy deposits, performance of the transfer station collection point staff, reviewing rates where necessary; ii. Conduct public awareness and consultation to promote participation; iii. Conduct training and prepare monthly reports; and iv. Provide updates on the progress of the system.
Department of Works	The Department of Works provides a collection service for sewage and sludge from septic tanks. It is anticipated that the demand for this service will increase with update building codes requiring proper septic tank construction. the department also collaborates with the Department of Waste Management and has contributed to clearing bulky waste along the roadside in Funafuti and provided heavy equipment for use at dump sites.
Department of Marine and Ports	The Department of Marine and Ports is responsible for the regulation of waste disposal at sea under the *Marine and Pollution Act 1991* and together with the Department of th Environment, implements relevant international conventions. It is also responsible for managing ship-generated waste.
Local Government	
Falekaupule	*Falekaupule* is the traditional assembly on each of the eight inhabited islands and acts as the local government. Members are appointed by governance customs, only members of the Cultural *Falekaupule* can vote. Proceedings of the *Falekaupule* are chaired by the *Ulufenua* (Head Chief). The functions of the *Falekaupule* are to: i. Establish, maintain, and carry out services for the removal and destruction of, or otherwise dealing with, all kinds of rubbish, refuse, or excreta and by bylaws to require households to contribute to such services. ii. Prohibit bylaw activities detrimental to the sanitary condition of the *Falekaupule* area. iii. Prevent pollution of any water and prevent access to any polluted source of water. iv. Safeguard and promote public health, prevent and deal with any outbreak or prevalence of any disease. v. Exterminate and prevent the spread of mosquitoes, rats, bugs and other vermin. vi. Prepare and implement development plans and programs in consultation with the community government agencies, nongovernment organizations and other development partners and coordinate and monitor these programs.
Kaupule	The *Kaupule* sits under the Department of Rural Development within the Ministry of Home Affairs and Rural Development and serves as an executed arm or secretariat to the *Falekaupule.* Kaupule officers are elected by universal suffrage. The local government unit designate as the waste management operator may make, vary or cancel by-laws at any time under the Falekaupule Act 1997 relating to any matter (fines relating to by-laws must not exceed $400 or 6-weeks' imprisonment). Specifically, the *Kaupule* is responsible for community obligations such as: i. Management of waste dumps; ii. Provision of compulsory collection services to residential and commercial premises; iii. Cleaning of streets and public areas; iv. Provision of waste receptacles in public areas and other facilities to assist in the reduction of littering and waste in public areas, roads and reserves; v. Provision of waste management services to aircraft, ships and other vessels; vi. Implementation of litter and waste control measures such as promotion of recycling and other waste minimization programs,· vii. Preparation, adoption and enforcement of rules, operating manuals, codes of practices and standards relating to the waste management services; and viii. Preparation of reports and maintenance of statistical records relating to its waste management activities submitted to Department of Solid Waste. Data is collected and submitted daily and is categorized into types of waste and marked as household, community bins or commercial waste. There are eight *Kaupules* in the country.

Table 5: Stakeholder Roles and Responsibilities (continued)

Stakeholder	Responsibility
Committees and associations	
Various committees	Waste Management Levy Committee—established to explore potential waste levies for Tuvalu. Committee members include representatives from DWM, Treasury, Customs, Department of Environment etc). Used Lubricating Oil Committee—established as part of a regional project coordinated by Secretariat of the Pacific Regional Environment Programme. Committee continues to meet regularly to discuss all matters associated with used lubricating oil despite the end of the regional initiative. Waste Management Coordinating Committee—overall coordinating committee required under the policy review and monitoring mechanisms. Developing Coordinating Committee—consisting of all government agencies' Permanent Secretaries, this committee reviews and approves any proposed waste management initiatives including annual reports.
Private Sector	
Waste Recycling Operator	Collection, processing and export of items. Currently undertaken by sole private recycler licensed and contracted by Department of Solid Waste.
Private sector	It is hoped that the private sector will have a greater role following the implementation of the Waste Management Association (as above). Recycling and plant maintenance is usually delegated to the private sector. Reverse logistics (shipping of waste and recyclables after dropping off imported goods).

Figure 4 below from TIWPAP 2017–2026 outlines the day-to-day operational structure of waste management stakeholders in Tuvalu.

Figure 4: Functional Structure of Waste Management in Tuvalu



SWAT = Solid Waste …., MOU = , WOS = TANGO

Source: Government of Tuvalu. 2016. Tuvalu Integrated Waste Policy and Action Plan: Towards Cleaner and Healthier Islands 2017–2026. p. 15.

To date, the private sector has played a very small role in solid waste management and recycling in Tuvalu. In 2013, the Japanese International Cooperation Agency said that greater involvement of the private sector would be needed for waste management and recycling reverse logistics to work successfully in Tuvalu. It is anticipated that with the introduction of the new waste levy opportunities will emerge for the private sector to work with the government of Tuvalu and its subordinate departments to deliver successful and profitable recycling programs.

Under the coordination and initiative of DWM, a Waste Management and Recyclers Association consisting of shops, supermarkets, mechanic workshops, importers, and a recycler is going through the legal setup process. An Acting Executive Team has been appointed and a draft constitution was developed for members to finalize. The main objectives of the association are to:

- promote and create opportunities for private sector participation in waste management;
- explore financial support for potential successful initiatives driven by the private sector;
- equip members with the appropriate skills and knowledge on waste management; and
- promote appropriate waste management practices for management of waste at their businesses/ activities in line with the policy.

Tuvalu`s Recyclers and Waste Management Association would be the 4th association in the Pacific, following Samoa, Solomon Islands, and Vanuatu, and will receive similar regional and international benefits such as specialized training, exposure to international related waste management meetings and conferences, funding, and future partnership with government waste management initiatives and programs, among others.

3.3 Waste service provision

3.3.1 Waste management services overview

Prior to 2015, municipal solid waste collection across Tuvalu charged an annual service fee of A$40.00 per household and between A$110 to A$410 for commercial collections. Services are now undertaken free of charge. The *Kaupule* are responsible for collecting municipal solid waste from households, schools, government buildings, churches, commercial establishments, and other institutions across Funafuti. A memorandum of understanding is in place which addresses the responsibly for waste management between the *Kaupule* and Department of Solid Waste on the outer islands. Generally, one service that covers the collection of bulky waste, green waste, and nappies on the outer islands. Once collected, waste is taken directly to the local dumpsite (Figure 5). In Tuvalu, 100% of food waste, green waste, and nappies is separated at source.

Figure 5: Equipment in Funafuti. The only functional equipment at the Funafuti landfill.

Source: provided by the consultants

In Funafuti, household waste is stored in either 80-liter or 120-liter plastic bins for weekly collection. Municipal solid waste is collected on two flat-tray vehicles and taken directly to the Department of Solid Waste (DSW) dumpsite. Commercial and institutional waste are stored in 240-liter to 1,100-liter bins prior to collection. Green waste collection is the responsibility of DSW and is processed through a shredder. DSW also collects bulky waste and scrap metals. Nappies are collected separately and disposed of within a designated area of the dumpsite. Bulky waste, electronic € waste, green waste, used oils and the like are collected and stored at the newly constructed transfer station. The Department of Health collects and incinerates health care waste. Collection points for metal can recycling established by the local recycler are in Funafuti, but there is no segregation of other recyclables.

Previously, mechanical issues often interrupted collection services, but a mechanical engineer now maintains equipment and has improved services, with a regular maintenance schedule in place for all equipment.

In 2017, it was reported that some outer island households found the schedule of waste collection services inconvenient, as people were not at home during collection times. It was also found that, in Funafuti, most waste was improperly packed before put in bins for collection, requiring collection crews to handpick the waste or lift bins, creating health and safety risk (Sagapolutele and Binney 2017).

Table 6 summarizes collection services.

Table 6: Collection Services Delivered across Tuvalu

Waste Types	F/futi	N/Mea	N/Maga	N/tao	Nui	V/tupu	N/Fetau	N/laelae
Household	✓	✓	✓	✓	✓	✓	✓	✓
Commercial	✓	✓	✓	✓	✓	✓	✓	✓
Institutional	✓	✓	✓	✓	✓	✓	✓	✓
Ships	✓	Ship-generated waste is recovered at the main wharf in Funafuti, and the Department of Waste Management transports and disposes this at the Funafuti dumpsite.						
Coastal litter	The *Kaupule* arranges periodic community cleanups.							
Bulky	✓	Waste is collected with other waste under available services delivered by the *Kaupules* in the islands.						
Health care	This waste is collected and disposed of by the Ministry of Health, which is understaffed and lacks the appropriate knowledge. It is seeking to work with the Department of Waste Management to create a process that allows for safe disposal of hospital waste.							
Used lubricating oil	A program was recently introduced to recover and collect used oil from the outer islands. Some of the collected oil containers are shipped to Fiji under a partnership with one of the importers of petrol and oils in the country.							
Electronic and electrical waste	✓	All included in the only collection services available in the islands. No special collection service but mixed up in the same service						

Source: Sagapolutele and Binney 2017; Pacific Region Infrastructure Facility consultants' visit, 2019.

3.3.2 Collection Schedule

Tuvalu is one of a minority of Pacific nations with waste collection services provided to approximately 90% of the population (Figure 6) successfully through support from European Development Fund—EDF 10. A recent review of the deliverables of TIWPAP 2017–2020 found that collection on Funafuti had 100% coverage while the outer islands had 80% coverage. In 2016, the Tuvalu Integrated Waste Policy highlighted the waste collection schedule for Funafuti.

Funafuti has two collection services for general solid waste, a collection for bulky waste, and two special weekly collections for green waste. The remaining outer islands have two collection services for general waste. Table 7 outlines collection frequency, storage, and estimated household coverage across Funafuti and the outer islands, and Table 8, provide collection services provided.

Table 7: Collection Schedule of Waste in Funafuti

Type of waste	Schedule	Responsible
Household waste	Monday–Friday	Kaupule
Green waste	Monday, Tuesday, Thursday, and Friday	Department of Solid Waste (DSW)
Recycled metals	Wednesday	DSW
Nappies	Monday and Friday	DSW

Source: Government of Tuvalu (2016).

Figure 6: Solid Waste Collection Map, Funafuti

Table 8: Collection Services Provided, Frequency and Coverage

Waste Type	Waste Storage at Source	Weekly Collection Frequency	Estimate Household Coverage (%)
Funafuti Island			
General mixed waste	80–120 liter wheelie bins for households 240/1,100 liter bins for institutions and businesses, sack and plastic for households without bins and extra waste	Schedule since Jan 2017 Monday and Wednesday—Block 1 and 2 Tuesday and Thursday—Block 3 and 4 Friday—Main road covering Bock 1–4	90–95
Green waste	Sacks and plastic bags for leaves and lawn As loose waste placed along the collection routes	Same as above	45–50
Bulky waste and hazardous waste	As loose waste placed along the collection route or approved pick-up points	Friday (8:30 am–12:00 pm)	30–35
Nappies	Pack in plastic bags or sacks then transported to central drop-off bins at the hanger. Another bin is located at the hospital for patients which is utilized by hospital staff and nearby families who have 24-hour access to communal bins.	Monday and Friday Note: Bins are emptied when full, regardless of the day.	90–95
Outer Islands			
Mixed waste **No special service or segregation for green, bulky or nappy waste.**	Wheelie bins	2–3 times per week	95–100 for Nukufetau and Nukulaelae Islands 75% for Vaitupu 80% for the other islands

Source: Sagapolutele and Binney 2017; confirmed for Funafuti and Vaitupu by Pacific Region Infrastructure Facility consultants, 2019.

In July 2016, SPREP reported that the "level of understanding of appropriate waste collection, processing and disposal systems was very low" and "poor waste practices such as burning, littering and dumping of wastes" were considered socially acceptable (SPREP 2016). Illegal dumps were scattered along road sides, on the coasts, and in bodies of water. In their September 2019 visit consultants assessed and recorded all illegal dumps, including location and quantities of material.

In 2019, an evaluation through EDF 11 of the current achievements of the Waste Policy and Action Plan 2016–2026 was found to be working towards identifying the top-three bad public behaviors, such as burning waste, dumping in waterways, littering, and so forth. Under these efforts a list of offenders was recorded and they are now awaiting prosecution. It is anticipated that the prosecutions warn other potential offenders and help reduce bad waste management.

3.3.2.1 Bulky waste and scrap metal

A study completed in August 2014, recorded 85 items of bulky waste beside homes, along roadsides, and in disposal sites in Funafuti. Bulky and hazardous waste is to be placed either along the collection route or at approved pick-up points for collection. As of 2016, the DSW is responsible for the collection of bulky waste and scrap metal across Tuvalu. In November 2017, it was reported that bulky waste collection service was being provided to about 35% of the population of Funafuti. Ownership of white goods, vehicles, and motorbikes is increasing across Tuvalu, increasing generation of bulky waste. A dump truck and trailer are used to collect bulky waste, but dumping of waste, particularly of cars, is common. The consultant team assessed all bulky waste and scrap metal dumped in Tuvalu, the records in the results section below.

3.3.2.2 Health care waste

The TIWPAP 2017–2026 reports that the amount of health care waste generated per occupied bed in Tuvalu was about 0.3 kilogram, below the Pacific average of 0.8 kilogram (TIWPAP 2016).

In 2017, it was found that stockpiling on Funafuti over several days was not uncommon, allowing for enough waste to be incinerated. Health care waste generated on the outer islands is also frequently stockpiled in incinerators, sometimes weeks before incineration. The incinerator the consultant team viewed on Vaitupu was basic, with no emission control (see Figure 7). It did not comply with the international requirements for incineration of medical waste. The outer islands generate about 840 liters of health care waste monthly and Funafuti 100–160 kilograms.

Health care waste is the responsibility of the Department of Health, but in Funafuti, health care waste is managed by the hospital itself. In the 2018 budget, the Department of Health was allocated $10,000 for the operation of a health care incineration facility. A new incinerator was installed near the Princess Margaret Hospital through the European Union funded PacWaste Project in 2016. Hospital staff were trained in proper handling of waste and operation of the incinerator. However, during the consultants' visit in 2019, the incinerator was non-operational and the staff trained in appropriate disposal of health care waste no longer working at the hospital. Ongoing collaboration is needed between the DSW and the hospital to ensure medical waste is appropriately and safely disposed.

Figure 7: Incineration. A small incinerator at the Vaitupu waste dump.

Source: provided by the consultants.

3.3.2.3 Recyclables

i. Scrap metal and cans

Figure 8: Stockpile. Stockpile of aluminum cans at the transfer station in Funafuti.

Source: provided by the consultants.

Only one local recycling operator currently collects scrap metal across Funafuti. The 2019 consultants' visit revealed that the recycling operator has passed away and the business is on hold. Scrap metal and cans are collected from drop-off points established by the recycler; however, the capture of recyclable cans is ad hoc. Metals are stockpiled at the transfer station awaiting shipment to international buyers. During 2016–2017, no shipment was made, due to expensive shipping costs and a low global return rate for metals. Recycling of aluminum cans exists but is not fully addressed as expected. Many reports exist of recyclable metal items, including aluminum cans at disposal sites. Since the introduction of deposits on cans and bottles, DWM staff have been collecting, washing, and storing aluminum cans from specific areas around the island (Figure 8).

ii. Plastics

PET bottles are often reused for homemade drinks; however, no formal plastic recycling is or was previously in place. Larger containers are often reused for gardening and pig food storage before being sent to dump sites.

The Tuvalu Waste Management (Levy Deposit) Regulation 2019 was recently established to provide a mechanism for revenue collection and administration and a legal framework that encourages waste avoidance and resource recovery behavior.

iii. Green waste

Figure 9: Collecting Waste. Green waste ready for collection in rice bags.

Source: provided by the consultants.

Numerous studies have identified that up to 50% of the total municipal solid waste in Tuvalu consists of green waste (mostly pandanus, breadfruit, and other trees) seen in Figure 9. In 2016, a study estimated green waste collection at 2.5 cubic meters (m3) per household, per year, or a total for Funafuti of 2,265 m3/ year, of which, 788 m3 of this waste is mulched. Green waste is generally left beside bins for collection and is partially segregated. Smaller waste, such as leaf litter, is placed in sacks and larger items such as palm fronds left loose. The DSW collects this and deposits it at a central location for processing through a shredder at the transfer station. Shredded green waste is deposited into composting units at the Happy Garden facility before being used as bedding for vegetable planting.

In 2017, it was reported that the collection and conversion of compostable materials in Funafuti was the only recycling activity undertaken in Tuvalu. In 2019, composting of green waste was continuing in Funafuti with The Republic of China owned farm taking all the mulched material for use as organic fertilizer. It was also noted that informal composting and mulching of green waste was occurring organically across about 50% of Funafuti and 90% of the outer islands. Recycling green waste through mulching to control weeds and cool agricultural crops is common across the islands.

3.3.2.4 Other waste streams

Funafuti has several drop-off points for nappy collection, which are well used by the community (see Figure 10). The consultant team inspected and weighed nappies from several bins and reports a 100% source separation of nappies. Nappies are collected Mondays and Fridays and deposited at a specific site at the Funafuti landfill.

Figure 10: Disposing Diapers. Nappy Bin for Communities in Tuvalu.

Source: provided by the consultants.

Electronics waste (e-waste) and used oils are collected and stored at a transfer station awaiting processing and shipment from Tuvalu. Waste oil continues to be shipped to Fiji under the Used Lubricant Oil Project in partnership with Pacific Energy, importer of petrol and oils into Tuvalu. As there is no storage facility for hazardous waste such as asbestos or chemicals in Tuvalu, such waste is not collected.

Ship-generated waste is the only quarantine waste in Tuvalu and falls under the responsibility of the Department of Marine and Ports. The waste is collected in drop-off waste cages at Funafuti Wharf and emptied and collected by the DWM and taken to the dumpsite.

3.4 Equipment and maintenance

The condition of waste collection equipment is generally good. In April 2017, a mechanical engineer was employed and had commenced a maintenance program including a stock taking of spare parts needed to ensure equipment servicing is undertaken in a timely manner and equipment remains well maintained. Table 9 outlines the equipment used to manage municipal solid waste across Tuvalu.

Table 9: Waste Management Equipment

Island	Waste equipment	Designated use	Comments	Donated	
				Year	Party
Funafuti	2 Tractors with trailers (8.5 cubic meters [m3])	General waste collection delivered by *Kaupule*	In good operational condition. One of the tractors experienced a problem and was fixed by the mechanical engineer.	. . .	
	1 tractor with a trailer (no cage). Previously used for the recyclable waste collection	Green waste and bulky waste and nappies	In good operational conditions. Was used to cover for one of the tractors used for the mixed waste collection in June 2017.	2013	European Union (EU)
	1 dyna truck	Assists with the green waste, bulky, and nappies collection	Some maintenance works were conducted at the hangar.		
	1 pickup	Assists with the green waste, bulky, and nappies collection	In operational but deteriorating condition,		
	New dump truck (6 m3)	Bulky waste and green waste collection	Good condition and was used for the green waste collection when the tractor for green waste was used for the mixed waste service in June 2017.		

Table 9: Waste Management Equipment (continued)

Island	Waste equipment	Designated use	Comments	Donated	
				Year	Party
Funafuti (continued)	Excavator	Dumpsite maintenance	A spare part was ordered from Fiji and had already been installed.		
	Loader	Green waste compound	In good operational condition.		
	Forklift	Lifting heavy items including the large bins when unloading the nappies onto the tractors	New		
Namumea	Tractor and trailer	Collection of general waste (mixed waste collection)	In good operational condition. Rust observed.	2013	EU
Namumaga	Tractor and trailer	Collection of general waste (mixed waste collection	In good operational conditions. Front tires are worn out. Rusting conditions observed.	2013	EU
Nui	Tractor and trailer	Collection of general waste (mixed waste collection)	Front end loader mechanism broken. Broken left front mirror. Broken front engine protection.	2013	EU
Niutao	Tractor and trailer	Collection of general waste (mixed waste collection)	The 4WD function of the tractor not working. Rusting conditions observed.	2013	EU
Vaitupu	Tractor and trailer	Collection of general waste (mixed waste collection)	Broken down and at the hanger for repair. Trailer side cage loose and needs to be fix—falling apart. Rust observed.	2013	EU
Nukufetau	Tractor and trailer	Collection of general waste (mixed waste collection)	Good operational condition. Rust observed.	2013	EU
Nukulaelae	Tractor and trailer	Collection of general waste (mixed waste collection)	Tractor in operational condition. Roofing is broken. Trailer side cage has been removed so the volume of waste collected reduced to 1.5 m3.	2013	EU

... = not available. Source: Sagapolutele, F. and Binney, J. 2017. Tuvalu Waste Baseline Information Report.

Most of Tuvalu's waste equipment has been provided through donations or funding via international partners and donors. About $1.26 million is needed for replacement of waste management assets.

3.5 Waste data collection and monitoring

The following agencies (Table 10) are responsible for ongoing data collection, monitoring, decision making, and waste management implementation and compliance in Tuvalu.

Table 10: Waste Data Collection Agency

Data Collection	Decision Making	Implementation and Compliance
• Department of Solid Waste (DSW)—Daily data collection and analysis. • Kaupule—Daily data collection template provided by DSW	• Ministry of Home Affairs and Rural Development—Overall governing body • Waste Management Levy Committee —Development of waste levies to support waste management • Used Lubricating Oil Committee—Discuss all matters pertaining to used lubricating oil • Waste Management Coordinating Committee—Overall coordinating committee • DCC—Reviews and approves waste management intitatives including annual reports • Falekaupule—Approval of bylaws submitted by Kaupule	• DSW—Implement monitoring and reporting programs to ensure more informed decisions in the waste sector

Source: Personal communication with the Tuvalu Department of Solid Waste Management

A data management system, the Tuvalu Waste Information System, was recently developed to input, store, and process waste information collated by the DSW and *Kaupule* to assist in monitoring the performance of solid waste management in Tuvalu. This includes an asset register, waste collection statistics, budget information, and enforcement register (for further information see Appendix 4). For these systems to be successful, data must be collected and recorded daily, and is currently done by field workers. Previously, field workers had issues reporting daily data recordings due to communication and internet issues. There are provisions for ongoing monitoring and evaluation, which is implemented yearly as part of the annual review the EU requires. The last review was implemented in April 2019.

3.5.1 Department of Solid Waste staff

According to the 2019 budget, the DSW employs 13 staff to deliver solid waste management services for the Government of Tuvalu. Table 11 describes employee positions.

Table 11: Number of Staff, Solid Waste Agency of Tuvalu, 2019

Position	Number of Staff, 2019
Director	1
Waste Regulatory Officer	1
Waste Operation Officer	1
Outer Islands Waste Operation Officer	1
Administration Support Officer	1
Equipment/Transport Supervisor and Driver	1
Waste Site Operators	3
Waste Collection Labourers	3
Security Officer	1

Source: Ministry of Finance and Economic Development, 2019.

3.6 Current financial mechanisms

Several factors constrain the Tuvalu economy, including remote location and lack of economies of scale. Prior to 2015, solid waste management collections were charged annually at A$40 per household, but collections are now provided free. Commercial collections are charged between A$110 and $410. Despite previous collection of a solid waste management fee, the revenue was insufficient to fully cover services provided in Funafuti. Funding is a major constraint to sustaining solid waste management programs. Since 2019, a levy was introduced on several materials imported into the country, which will possibly provide funding for the management of these materials at the end of life. Since its introduction in August 2019, A$5,000 has been collected through the levies.

3.6.1 Department of Waste Management Budget

Waste collection and disposal services for the eight islands are fully funded by the government through annual budget provisions to the DWM. The 2019 budget allocated $444,671 to the solid waste management strategic plan for Tuvalu. It is anticipated the budget will increase to about $462,636 in 2021. Figure 11 shows budgeted priority activities of the Ministry of Home Affairs and Rural Development in 2019.

Figure 11: Ministry of Home Affairs and Rural Development 2019 Budget Priorities

TIWPAP = Tuvalu Integration Waste Policy and Action Plan, M & E = monitoring and evaluation, EDF = European Development Fund. Source: Tuvalu Integration Waste Policy and Action Plan: Towards Cleaner and Healthier Islands 2017–2026

Table 12 highlights the ministry's funding allocations for solid waste management in 2019.

Table 12: New Funding Approved in 2019 Budget

Funding Amount	For	Why
$182,750	Department of Waste Management Transfer Station Phase	To cater for the segregation of waste and diversion of green waste for composting as well as diversion of recyclable and hazardous waste for recycling
$180,000	To build tractor sheds for the outer islands	No proper storage shed for the tractors to avoid exposure to sea spray that will eventually corrode and shorten the tractors' lifespan
$141,540	Outer island hazardous waste storage shed	Based on the increasing volume of hazardous waste in Tuvalu, which triggered the construction of the transfer and recycling station to be based on Funafuti and be treated as the main hub for all hazardous waste collection point for the whole country
$59,678	Dumpsite security sheds (all islands)	To serve as a proper security shed to manage and control all island dump sites
$2.9 million (European Union Support to Waste Sector)	$198,723 for expenses (dumpsite security houses, hazardous waste shed, etc.) $215,811.20 officer's salary	To successfully implement the operation of the project's equipment

Source: Tuvalu Department of Solid Waste Management

At the time of the budget, the ministry was seeking development partner support of $62,000 for a transfer and recycling station feasibility study to aid improvement of recycling programs and overall waste management systems in relation to recycling.

3.6.2 Development partners

Appendix 5 lists previous and ongoing projects in Tuvalu being developed and/or funded by development partners. The largest and most current funding is being provided by the EU through the EDF 11. Table 13 summarizes the activities within EDF 11.

Table 13: Current Development Partner Assistance Provided for Waste Management in Tuvalu

Project: European Development Fund 11 cycle (EDF11)	• Funding: €6.8 Million • Objective: To reduce waste related environmental degradation • Key activities: – Waste reduction and resource recovery programmes including exporting of recyclables. – Improve waste disposal system and infrastructure. – Establish public private partnerships. – Improve waste collection. – Strengthen community awareness and education

The 2nd Annual Review of the implementation status of Tuvalu National Waste Management Policy and Action Plan 2017–2026 suggested several opportunities for Tuvalu to work with international partners to improve management of challenging wastes. Assistance from contributing partners would include technical, financial, and capital assistance and support through participation in field monitoring and advice. Table 14 outlines the proposed partnerships in the management of challenging waste.

Table 14: Proposed Partnerships for Management of Challenging Waste

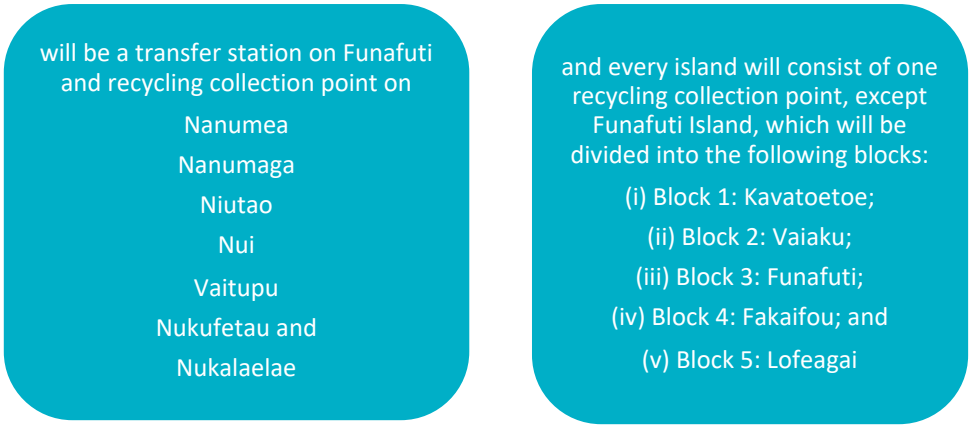
Waste	Responsible Agency	Proposed Potential Partnership		
		Area of focus	Contributing partners	Potential assistance
Health care waste	Department of Health (DOH)	Improving storage, collection, and disposal facilities Training of workers	DWM, DOE	Pacific Regional Environment Programme (SPREP) (PacWaste) plus/ILO
Marine litter	Department of Mxxxx	Improvement of ship waste management/ Marine Litter Management Plan, enforcement of coastal illegal dumping practices	DWM, Department of Environment (DOE)	SPREP
Asbestos	DWM	Educational materials Training	DOE	SPREP (PacWaste/AFD/ GEFPAS)
Expired goods	DOH	Enforcement and awareness	DWM, Customs	Industry
Sewage and sludge	PWD	Development of management plan Proper disposal facility plan and development	DWM, DOE, DOH	Donor
Disaster waste	DWM	Development of DWM contingency plan temporary disposal site	NDMO—Fire Emergency— PWD - Kauplule	SPREP (PacWaste)/AFD)

DWM = Department of Solid Waste Management, PWD = Public Works Department, DOE = Department of Environment, DOH = Department of Health, NDMO = National Disaster Management Office, AFD = Agence Francaise de Developpment, GEFPAS = Global Environment Facility Pacific Alliance for Sustainability, PacWaste = Pacific Waste Management programme.
Source: F. Sagapolutele. 2019. The 2nd Annual Review of the Implementation Status of Tuvalu's National Waste Management Policy and Action Plan, 2017—2026.

The Pacific Waste Programme Plus, funded by the Agence Francaise de Developmment through SPREP also have provisions for Tuvalu to use.

3.6.3 Waste Levy

In 2019, the Waste Management (Levy Deposit) Regulation was introduced to support Tuvalu's recycling program. From 1 August 2019, all aluminum cans, PET bottles, vehicles, nappies, white goods, and construction equipment, will be levied when imported into the country. It is anticipated that the generated deposits will support a recycling program for the levied waste items and support appropriate in-country treatments and disposal if and where the goods are unable to be exported overseas. Levy ranges from 0.5 cents per nappy to $2,000 for heavy construction equipment more than 10 tonnes. A complete list of all products and goods to be levied, including the deposit amount, refund amount, recycling operations subsidy, and administration and management support for each item can be found in Appendix 2. The levy also explicitly states the set minimum number of waste items allowed for PET bottles from water, sweetened drinks and cooking oils, aluminum cans from sweetened drinks and alcohols, glass bottles from sweetened drinks, alcohols, and cooking and other waste items. It also importantly outlines that any waste that is old, buried cans, PET, and glass bottles either imported or collected prior to the start of the levy deposit system will not be accepted. Finally, the levy establishes that there:



A study in 2017 indicated 100% support for the introduction of a container deposit levy for recycling and willingness to fully participate if such initiative was introduced (Sagapoulutele and Binney 2017). The introduction of the levy provides an opportunity for private business to participate in recycling on a larger scale than is currently undertaken.

3.6.4 User-pay options

User-pay options such as prepaid bags have successfully been introduced in other Pacific countries such as Vanuatu and Kiribati. These options have previously been examined and recommended to the government of Tuvalu as an efficient waste management method, in addition to establishing an income stream. In 2017, significant support was reported from all eight islands to support the use of a prepaid rubbish bag for collection services where the cost of a bag is below 50 cents (Sagapoulutele and Binney 2017). The 2019 survey for PRIF indicates that 99% of the community on Funafuti and 85% in Vaitupu support a prepaid bag system. People were willing to pay 5 cents per bag in Funafuti and 15 cents per bag in Vaitupu.

Tipping fees have also been discussed as another income initiative. However, due to the recent national initiatives implemented by the government, such as the Waste Management Levy and plastics ban, the Department of Environment has decided to hold any decision until these programs are sufficiently implemented.

3.7 Waste management infrastructure

Waste dumps are located on each of the islands of Tuvalu. There is little to no control relating to the types of waste dumped—they are non-engineered and have no pollution control measures in place. On the main island group of Funafuti, there is currently only one dump site located at the northern end. The DSW is responsible for managing the site.

In addition to a lack of available land for moving/establishing/expanding dumpsites, land lease issues are proving problematic. The previous government was in negotiations with the Native Land Board and landowners to secure land for waste disposal development. A lease rate was approved by cabinet of $3,000–$3,500, however, landowners were yet to agree on the new rate and negotiations were at a standstill. Recent changes in the government may renew negotiations. The new the government, headed by a Funafuti prime minister and ministers may consider higher funds. The Funafuti people have proposed a land lease rate at $5,000, which had also been previously proposed.

In April 2017, an assessment at the Funafuti disposal site (Table 15) reported that there was approximately eight months for the site to remain operational (Sagapolutele and Binney 2017). According to DWM records, monthly incoming waste is 262 m3, 50% of which is low-density waste such as plastics, paper and cardboard, ferrous and non-ferrous cans, textiles, nappies, and white goods.

TIWPAP 2016–2025 aims to rehabilitate the national landfill sites. The consultant team (2019) found that this was partly achieved. However, construction had been put on hold at the time of the review due to equipment breakdown, and was set to continue once new equipment was received on procurement from overseas. Improvements to the dump sites located on the outer islands are also under way, including fencing works.

Storage for hazardous waste was located at the transfer station awaiting transportation to a disposal facility in another country.

Table 15: Waste Disposal Sites across Tuvalu

ITEM	Ffuti	Vtupu	Nmea	Nmaga	Ntao	Niu	Nfetau	Nlaelae
				Status				
Area	------	2.8acre	0.5acre	0.5acre	0.24acre	0.49acre	0.46acre	0.50acre
Type	OD/WSM	OD/WSM	OD	OD	OD	OD	OD	OD
D-status	PTR	AR	PTR	PTR	PTR	PTR	PTR	PTR
				Suitability for waste disposal				
Less than 50 meters from coastline	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Less than 5m soil profile depth (m)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Soil conditions	Sandy – porous	Sandy – porous	Sandy – porous	Sandy – porous	Sandy – porous	Sandy – porous	Sandy – porous	Sandy – porous

OP = open dumping (meaning no soil cover); WSM = with some maintenance; PTR = plan to rehabilitate
Source: Sagapolutele, F. and Binney, J. 2017. Tuvalu Waste Baseline Information Report 2017.

An integral component of the Waste Management (Levy Deposit) Regulation 2019 is the development and implementation of a transfer station for Funafuti and recycling collection points on the outer islands. The transfer station is in the final stages of construction, with the supporting office for waste management staff to be completed in 2020. It will act as a recycling collection point and operate on the last five working days of the year to receive levied recyclable items. The transfer station was partially operational at the time of

the consultants' visit. The supporting office is to be located next to the transfer station, where the payment of the 5 cents deposit was expected to be processed once the National Recycling Programme commences sometime in early 2020 once the construction of the office is completed. The materials for the building are being procured from Fiji. The challenges now are to get the staff and workers trained with the basic skills and knowledge required. The Transfer Station Supervisor spent a week with the Samoa Scrap Metals operators in October 2019, who are dismantling and shipping e-waste overseas. During this visit, they were also able to observe the daily operations involved in the processing of incoming scrap metals, dismantling and baling, as well as packing and loading to containers.

3.8 Challenges delivering waste management services

Tuvalu as an atoll island with limited land resources faces several challenges delivering and expanding current waste management systems and the waste management industry, summarized as follows:

- Lack of financial, human resources, and capacity to implement activities, including enforcement and collection of data.
- No recycling systems in place for plastics and glass.
- Lack of proper equipment to deliver new initiatives and high costs of equipment procurement and maintenance.
- Cost is high for exporting recyclable materials to overseas markets
- Transportation of recyclable materials from outer islands.
- No proper storage facility for hazardous waste.
- Increasing cost of delivering waste management.
- Limited land space for 3Rs recycling facilities.
- Enforcement of legislation and regulations.
- Lack of proper equipment to assist with waste management and Recycling programs due to high costs in procuring equipment as well as maintenance.
- Behavior change of communities and adapting to new practices.
- Lack of capacity on outer islands to deal with waste management issues and transportation problems to those islands.
- Challenges of insuring the waste to be exported.

3.9 Initiatives and opportunities

Tuvalu is preparing to sign the Basel Convention on the Transboundary Movement of Waste in 2020. The Waigani Convention allows Tuvalu to ship items to Fiji.

Tuvalu has the opportunity to develop waste legislation and other initiatives, including:

Tuvalu's plastics ban follows several other Pacific countries that have banned single-use plastics, including Marshall Islands, Samoa, and Vanuatu. In addition to the recent ban, Tuvalu recently achieved the following:

- Development of waste levy regulation
- Green Waste Composting Programme (85%)
- Establishment of new transfer and recycling station
- Constant waste oil exportation program to Fiji
- Building outer island hazardous waste storage facilities
- Pilot project under Pacific Regional Infrastructure Facility
- Equipment donated by World Bank for metal recycling
- New equipment funded by EU, EDF 11
- Endorsement of waste bylaws for all outer islands
- Trashion Show 2018
- Development of Waste Database System 2018

In addition to the achievements above, Tuvalu has major plans and projects for waste management including:

- Improve transportation of recyclable materials from outer islands
- Establishment of new recycling facilities in outer islands
- Provide more waste management equipment for outer islands
- Utilise local boats for exportation of recyclable materials to Fiji
- Recruit more staff for waste management and awareness programs
- Conduct more awareness and National training on 3Rs targeting preschool and primary schools
- Tuvalu becoming a part of the PRIF pilot project
- Promote green waste composting at home and commercially

4. Waste Audits: Details of Method

4.1 Waste sampling distribution

4.1.1 Households

This section provides information on how the waste data collection (Table 16) works were undertaken in September 2019 in Tuvalu (Funafuti and Vaitupu). Advice was sought from a statistician to determine the sample size required to provide reliable and robust data.

Table 16: Households Sample to be Collected

Scheme	Error at 80% Confidence	Error at 90% Confidence
90 houses Funafuti, 60 houses Vaitupu (or other)	20%	25%
140 houses Funafuti, 60 houses Vaitupu (or other)[a]	17%	21%
90 houses Funafuti, 60 houses Vaitupu, 50 houses other	15%	19%

[a]Target scheme aiming for a sample size of 200.
Source: Authors

Table 17 shows the minimum and maximum number of household samples required. Using the calculations provided above, it was assumed that the minimum number of samples required was 150 and the maximum number 200. A total of 136 samples were collected from Funafuti and 59 samples from Vaitupu. Total sample size in Tuvalu was thus 197, bringing the number to an acceptable level of confidence needed for decision making.

Table 17: Tuvalu Household Sampling Distribution

Tuvalu Islands	Population	Percent	Samples Required	Samples Collected	Collection Systems	Collection Frequency
Funafuti	6,152	57.1	140	136	Yes—door to door/ wheelie bins	1/week—General 1/week—Bulky 2/week—Green Nappies as required
Vaitupu	1,555	14.4	60	59	Yes—door to door/ wheelie bins	Twice a week
Total	**7,707**	**71.5**	**220**	**197**		

Source: Authors

Funafuti has around 57% of Tuvalu's population as it also accommodates people from the outer islands who migrate to Funafuti for employment, business, health care, and education. Vaitupu is next to Funafuti with 14.4% of the population. The remainder of the population (28.5%) resides on the other remote outer islands. Funafuti and Vaitupu islands were selected for this waste assessment as more appropriate and representative of the population.

4.1.2 Commercial premises

Table 18 show the commercial samples were required to be distributed as shown.

However, Funafuti does not have a total of 50 commercial premises that could be sampled, so the team collected as many samples as possible based on the commercial activity on the island.

A total of 25 commercial premises were sampled simultaneously with households in Funafuti. From the collected samples, there were ten shops, six restaurants and five offices. Table 19 demonstrate the samples that were collected twice a week from offices and small shops, including restaurants in Funafuti and Vaitupu. Supermarkets and wholesalers in Funafuti provide their own collection services and disposal services.

Table 18: Tuvalu Commercial Samples Required

Sample type	Minimum	Desired
Admin/office	7	10
Food outlet	9	13
Retail	9	12
Hotel	9	12
Supermarket	9	13
Manufacturing	7	10
	This would yield a (crude) estimated error of 1.0 kilogram (kg)/business/day or 17% at 80% Confidence interval.	This would yield a (crude) estimated error of 0.87 kg/ business/day or 15% at 80% Confidence interval.
Total	**50**	**70**

Source: Authors

Table 19: Commercial Sample and Collection Systems in Place

Type of Commercial Premises	No. of Samples	Waste Pickup Frequency	Destination
Administration offices	5	Twice per week	Waste disposal site
Schools	4		
Hotel/motel, accommodation	6		
Supermarkets/wholesalers	10	Self-haul	

Source: Authors

4.1.3 Landfill samples

The landfill at Funafuti is open from Monday to Saturday, 9 am to 5 pm. Given the consulting team was in Funafuti for almost three weeks, it was agreed with DWM staff that a full week's sampling would be conducted. Therefore, all trucks entering the landfill over the course of a week were assessed for their contents.

4.1.4 Other data

The following organizations were contacted to provide further data to get a complete understanding of the waste generation rates:

a) Tuvalu Electrical Corporation—To gather data for the number of end-of-life renewable energy equipment. Tuvalu started installing solar panels in 2008. Consultants were able to collect data for all solar panels/batteries installed since 2008.

b) Department of Customs—Direct contact was made with staff from the customs department and a request for data was made while in the country (next time we suggest requesting this data earlier).

c) DSW, Department of Environment, and Kaupule—Staff directly engaged with providing waste management services were asked to confirm the consultants' observations before proceeding to finalize data collected. This included assessments on infrastructure and collection systems.

d) All stockpiles for metals, used oil, batteries, and e-waste were assessed independently by assessors.

4.2 Sample collection

The consultant team created a project plan (Appendix 6) and discussed and planned the collection of the samples with DWM and the island Kaupule, the responsible agencies for waste management in Tuvalu, to ensure the smooth implementation of waste audit operations. The two islands selected for waste sample collection were Funafuti and Vaitupu. Both islands have collection systems in place, so all samples were collected as per the collection methodology below.

4.2.1 Household waste samples

Household samples were collected from Funafuti island (140) and Vaitupu island (60) across the low-, medium- and high-income streams. Due to the small size of the islands, the 140 domestic samples in Funafuti were collected randomly from both sides of the main road that stretches 13 kms from the northern end to the southern end of Funafuti island. The sampling covered the entire stretch of the island (Figure 12).

The 60 samples for Vaitupu island were collected from the main community settlement area that had a collection day 3 days prior to the arrival of the team on the island. The location of the households where samples were collected in Funafuti and Vaitupu were marked using the GPS coordinates for follow-up assessments. The sample collection team arrived prior to the arrival of the waste collection truck on the day of the collection and obtained the samples before the truck could visit the households. The spread of the samples is shown in Figure 13.

Figure 12: Collecting Samples. Consultant team collecting household waste samples with support from local staff

Source: Authors

Figure 13: Household Samples Collected in Vaitupu and Funafuti

Source: Authors

The collection team consisted of the three waste management staff kindly provided by DWM and Kaupule to support the project. Having local people in the team, especially the workers and staff involved with the collection service, proved to be extremely helpful. They knew the area well and were able to answer any questions locals posed regarding the consultant team collecting waste from their household bins instead of the council. The consultant team used an online tool to record all data as the samples were collected. A collection sheet is provided in Appendix 7. Collections were carried out in the following way:

- A collection supervisor and recorder marked the location of a sample using the GPS coordinates and at the same time taking photos of 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, how much was left, types of waste, etc.).
- The second member of the team assessed the nature of the waste and provided information to the recorder as well as collecting the samples using the 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 marked the households or commercial premises using ribbons (as tags) tied to a nearby tree, property fence or gate for easier identification later during follow-up interviews. The household numbers recorded must be the same as the numbers written on the garbage bags and the ribbons (tags). This task was done by a local staff or worker.

Figure 14: Tagging Households. Household being tagged for interview at a later stage and sample collection in Vaitupu.

Source: Authors

During the fieldwork, the recorder entered the required information, Figure 14 show the premises covered and the filling-out of sheets into a tablet device. The information is stored and sent at the end of each day to the statistician for analysis. In situ electronic recording of information in the field was an improvement from the standard manual filling and scanning of the completed survey sheets, which then requires data entry off site.

Figure 15: Transporting. Samples being transported to the sorting facility.

Source: Authors

In Vaitupu, all samples were collected in the same manner but collected samples were loaded onto a boat and brought back to Funafuti for sorting (Figure 15).

4.2.2 Commercial samples

The smaller commercial samples from small shops, offices and businesses were collected along with the household samples. The sampling methodology was the same for both households and commercial premises. The survey team did not collect from larger commercial sources such as supermarkets, wholesalers, and hotels. An assessment was conducted at the waste disposal site when these waste streams entered the site. These audits became a part of the landfill audits.

4.3 Interviews (households and businesses)

The interviews were conducted by the consultants with assistance from DWM staff and two local workers hired to translate when needed. An e-copy of the survey questionnaire was used to record responses from households and businesses using tablets, laptops, or phones. All the filled questionnaires were automatically stored remotely (in the cloud) and sent later at the end of the day to Sydney for analysis.

The interviews were the most time-consuming task of the fieldwork in Tuvalu, with an average of 20–30 minutes per household. To mitigate this, two to three survey teams were used to expedite the interview process.

Data collected - summary

- 197 household samples collected and sorted
- 25 commercial establishment samples collected and sorted
- 8 local government staff trained
- Data collected from two islands – Funafuti and Vaitupu
- Landfill audit completed over the course of 6 days covering Monday to Saturday
- Data were collected for the following:
  - Nappies
  - Green waste
  - Food waste

The interviews covered the following master list of questions. Further questions were added or deleted based on local assessment by the consultants:

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

The questionnaires were in English but designed to Tuvalu conditions, practices, and culture. Interviews were undertaken with the help of interpreters.

4.4 Sample sorting

All collected samples from Funafuti and Vaitupu were transported to the Funafuti waste disposal site for sorting. The building is the property of DWM, and was approved for the use of the consultant team for sample sorting. 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.

It is general practice for the consultant team to purchase the tubs and baskets required for sorting (Figure 16). However, in Tuvalu an inspection of the landfill site revealed the presence of many buckets and tubs that had been disposed of at the landfill. The team decided to salvage materials from the landfill to construct the sorting table and to use the tubs and baskets for sorting.

Figure 16: Tuvalu Site. Set up using salvaged materials from the landfill, including tubs and buckets.

Source: Authors

The sorting area consisted of a raised platform (not ground level) to facilitate ease and speed of sorting. Each waste bag was opened and the contents carefully spread and sorted into different waste items. Waste containers recovered and collected from the waste disposal site were used for easier sorting of the different waste items.

Figure 17: Samples ready for sorting.

Source: Authors

Separated materials were weighed using an electronic scale and the weight measurement recorded in the electronic forms. To maintain a high level of accuracy, the consultant team brought its own pre-calibrated electronic scales from Australia.

Beverage containers from the samples were counted, labelled, and stored separately to ensure no cross-contamination took place. Containers were sorted by size, material (e.g., plastic, aluminum) and product type (e.g., milk, juice).

Further, all plastic bags were sorted into different types (Figure 17) and all containers were further sorted by size, material type, and product type. Cigarette butts, coffee cups, and takeaway containers were also segregated (Figure 18). All data were recorded in the sorting form on the tablet using categories listed in Appendix 8.

Figure 18: Sample. Sorted waste.

Source: Authors

4.5 Landfill audit

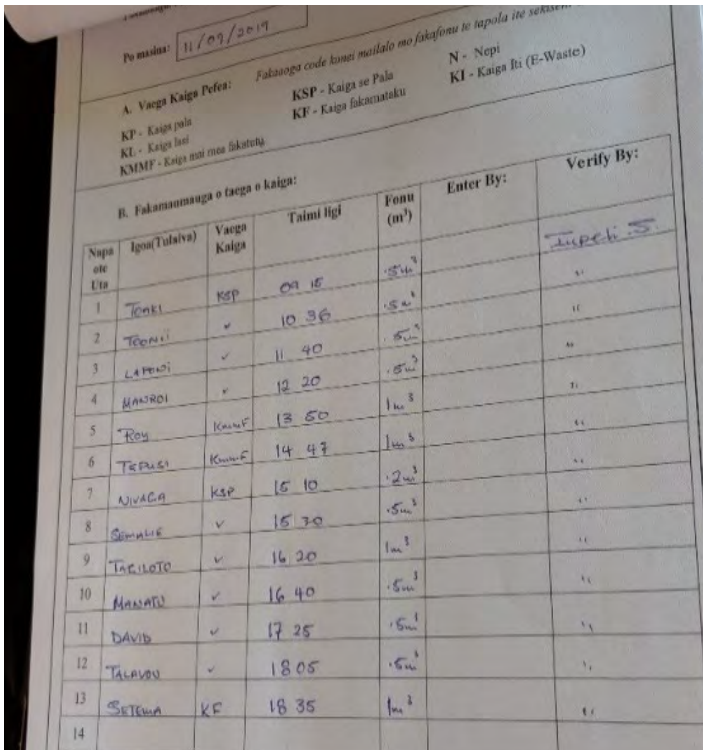
Although the household waste generation audit covers the waste generated through everyday consumption of products, a landfill audit was also undertaken to collect data on materials not usually found in the household bins, such as bulky, commercial, and construction wastes. Since January 2019, DWM records all vehicles coming into the landfill, therefore data is available for the total amount of waste coming into the landfill over time. The consultants undertook a snapshot audit so that the composition of the different types of materials can be understood. This composition was then applied to the overall volume of material coming in.

Data from the landfill gatekeeper indicated that, on average, 4 to 15 vehicles arrive at the landfill each day. However, the consultant team also noticed that some members of the community drive up to the landfill with household garbage, which was not recorded in the gatekeeper's logbook (Figures 19 and 20). Due to the small number of vehicles entering the landfill each day and because the sorting site was co-located at the landfill, the consulting team decided to undertake a landfill audit for each day of the week and 67 vehicles were audited in the process over 6 days.

The waste audit supervisor, Geoff Thompson, was in attendance from opening to closing time each audit day at each site. Every effort was made to record every load, but the audit staff noticed that some vehicles entered from sites other than the main landfill entrance gate. We also believe that a few vehicles may have been missed during staff amenity breaks. Due to the lack of a weighbridge, the exact number could not be recorded but we believe that more than 90% of all vehicles entering the landfill were audited.

Auditors were equipped with mobile phones, high-visibility safety vests, sunscreen, wet weather gear and safety boots (with steel base to prevent any penetration). Data sheets were loaded on tablets in weatherproof cases and all data were entered directly onto the tablet to be assessed by the statistician. Appendix 9 shows the list of container categories. The categories and information recorded for each vehicle is provided in Appendix 10.

Figure 19: Vehicles. Record of vehicles entering the landfill for a day at the Tuvalu landfill site.



Source: Authors

Auditors recorded the following information:

- Date and time of the vehicle arrival
- Registration number
- Vehicle type
- Vehicle volume
- Composition of the load
- Degree of compaction
- Photographs of specific loads of interest taken by the assessors.

Figure 20: Hauling Waste. Commercial premises self-hauling waste and a mixed construction load.

Source: Authors

All measurements were done by weight and a volume-to-weight conversion calculator was used to convert these weights to volumes (and vice versa), so all data were recorded 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 were accounted for after the audit. The consulting team used an online system to record data, circumventing the need to use paper recording sheets.

4.6 Work health and safety

The consulting team used an integrated management system during audits, which covers quality, health, safety, and environment. The system was developed to be consistent with the requirements of the international standards ISO9001 (quality), ISO14001 (environment) and AS4801 (occupational health and safety).

The following safety steps were undertaken for the consultant team and those trained to undertake the work:

- site-specific safe work method statements were developed;
- a pre- and post-work commencement risk assessment was undertaken;
- the collection and sorting supervisor undertook quality, health, safety, and environment inductions for project staff; and
- all staff were trained in the waste audit code of conduct developed by the consulting team which includes an 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 the safety of staff based on local conditions. The collection and sorting supervisor had full control over local safety requirements to ensure all work was conducted to protect staff health and safety.

4.7 Staff training

The consultant team trained staff from the DWM and *Kaupule* in the process of undertaking the audits. The list of staff trained and the training undertaken are provided in Table 20.

Table 20: Staff Trained from Tuvalu

	Waste Characterization	Data Entry	Interviews
Siliaco Letueti (Waste Education Officer)	✓	✓	
Saluu Tilaima	✓		
Jonah	✓		
Salusalu Vaguna	✓		
Kitasi Sioni	✓		
Khan Tel Bruce			✓
Epu Felenga			✓
Mataliki Lesaa (Vaitupu)	✓	✓	✓

Source: Author provided

Although staff have been trained to undertake the audits, DWM scales are not accurate for local staff to undertake audits on their own. This is something that could possibly be covered through a donor fund.

5. Summary of Data Collected

The consultants collected a wide range of data during the 3-week mission to Tuvalu in September 2019 (Table 21). At the time of report writing, data from customs was still being requested.

Table 21: Data Collected for Tuvalu Audit

Sample Type	Number of Samples from Funafuti	Number of Samples from Vaitupu	
Household samples	136	59	
Commercial samples	25	2	
Landfill samples	6 days (67 samples)	Visual audit only—dumpsite	
Litter samples	5 sites on Funafuti (twice, 1 week apart)	Not applicable 1 litter audit number 6 on one of the conservation islet—**Sualopa** Litter audit 7: On the litter audit submission	Same five sites, sampled 1 week apart. Pins for sites 3, 4, 5 dropped during the first sampling. Pins for site 1, 2 dropped during the second sampling.
Nappies	10 x 15L buckets were weighed and nappy numbers counted Household interviews to determine number of nappies per household per week		
Green waste	Estimate of stockpile at the transfer station and 9 months data of green waste generated through DWM.		
Batteries Electronic waste Aluminum cans (separate entries for compacted and non-compacted) Engine oil Old machinery	Stockpile at the transfer station.		
All island stockpiles	All stockpiles of metal, electronic goods, and white goods on the island.		

6. Results of 2019 Waste Audit

6.1 Household and commercial audit results

The aim of the waste audit is to determine the total amount of material generated in various parts of the country so that the quantities to be collected, compacted, and moved can be projected as accurately as possible. A model of waste generation rates was constructed based on the household and commercial data collected, including the disposal data available, to determine waste generation characteristics and how it varies between household and the commercial sector. The following features were investigated as predictors of household waste generation:

- total monthly household income (from all employed members);
- 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; and
- population of the town where the house is located.

The best results were obtained using only a single predictor: the town population. The models that best fit the generation data are different, based on the variability of waste generated versus the characteristics measured. Therefore, the model that fits the data will be different for each town but can be easily determined by modelling the data collected versus the potential predictors of generation. The generation rates were then checked against actual disposal rate data made available through the landfill/dumpsite audits.

Household generation rates in Vaitupu and Funafuti were in line with a broader pattern observed across other developing countries the consulting team has done waste audits. Settlement population is highly predictive of household generation rates across countries. Household generation rates are well approximated by the formula:

$$HH\ Generation\ \left(\frac{kg}{hh \cdot day}\right) = 0.4 \ln(population) - 2$$

Table 22 shows the waste generation rates for Funafuti and Vaitupu.

Daily waste generation rates for Funafuti

- Between 6–10 m3 of household waste enter the landfill per day
- 750–1,000 m3 of non-household waste enter the landfill per day
- Almost 3,000 kg of waste is generated in Funafuti per day

Table 22: Waste Generation Rates

	Predicted Generation (kg/hh/day)	Measured Generation (kg/hh/day)
Funafuti	1.51	1.34
Vaitupu	0.80	0.51

hh = household, kg = kilogram

Source: Authors

6.1.1 Estimating household and commercial waste generation: Funafuti and Vaitupu

6.1.1.1 Funafuti

Extrapolating generation rates from household audits, waste generated by households only for the whole of Funafuti is around 1,144 kg/day (1.1 tonnes).

From January 2019, DWM started recording incoming waste volumes at the landfill and data showed an average of 5.5 m3 per day of household waste entered the landfill, which corresponds to a density of 208 kg/m3.

The analysis also attempted to compare household waste generation rates with the amount of waste being offloaded at the landfill from household waste collection trucks (see Table 23). The collected waste is subject to some compaction, whereas the unsorted waste is not. The landfill audit recorded 9.7 m3 per day of household waste over a 10-day period, which corresponds to a density of 117 kg/m3. Both figures are broadly compatible with densities for mixed, uncompacted waste.

Further, the data was used to estimate the contribution of other sources. For commercial samples, a per-employee generation rate was derived, then extrapolated based on the estimated number of workers in Funafuti. This yielded a non-household generation rate of 935 kg/day, compared with 744 kg/day estimated from trucks arriving at landfills using the same density figure of 120 kg/m3. The figure from the landfill is deflated because only large commercial establishments undertake their own waste disposal and the smaller shops and offices are collected through the DWM. In cases where landfill audits are not possible, commercial sampling is highly accurate in its prediction of waste generation.

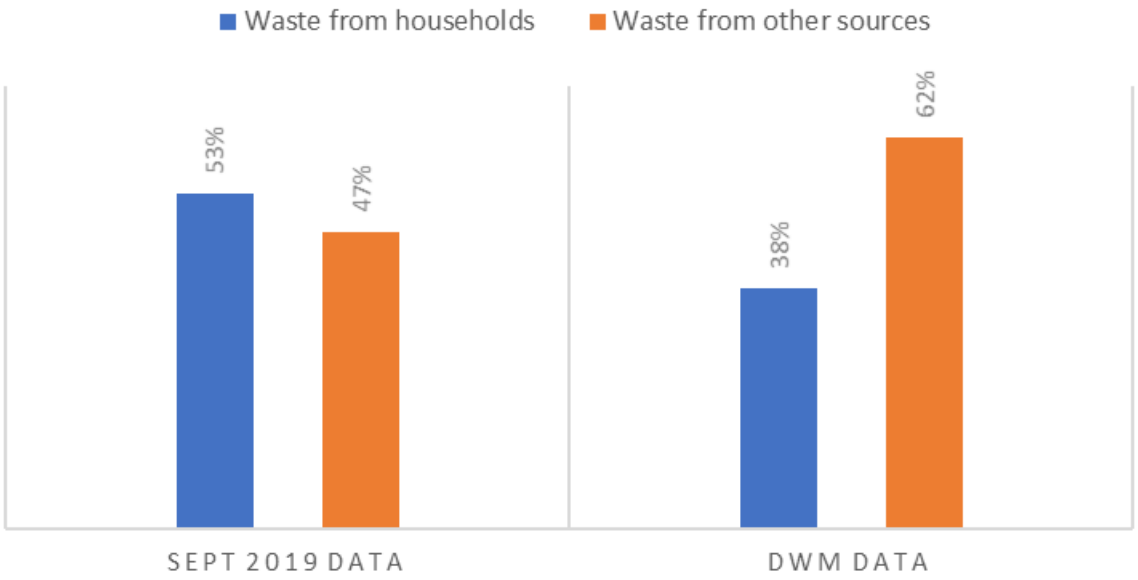
Table 23: Waste Generation Rate for Tuvalu, September 2019

Household Generation Rate	Non-Household Generation Rate	Overall Generation Rate
1,144 kg/day	1,760 kg/day	2,904 kg/day

Kg = kilogram
Source: Authors

The overall generation rate of 2,904 kg/day is higher than the 2,478 kg/day found in the 2017 Tuvalu waste survey (Sagapolutele and Binney 2017). However, it is believed that this represents a genuine increase in the total amount of waste generated, as this data corresponds with that collected over 9 months by DWM.

Figure 21: Sources of Incoming Waste in Tuvalu



DWM = Department of Waste Management
Source: Authors

In the 2017 and 2019 waste surveys, only small quantities of food among waste products were found, as food was overwhelmingly fed to pigs.

Based on DWM data, 38% of incoming waste is from households and 62% from other sources, including green waste (Figure 21). The September 2019 waste audit of 6 days placed the ratio at 53% from households and 47% from other sources, and featured much less construction waste than DWM data. Construction work in preparation for the Pacific Islands Forum meeting significantly impacted the DWM data. The impact of events on waste generation cannot be discounted and any future waste management decision should endeavor to include the increased rate of waste generation from activities arising from events and natural disasters.

The standard error of the total sample weight for household surveys was 107 kg/day, corresponding to an 80% confidence interval of 1,007–1,280 kg/day total household generation. The median standard error for individual materials was 20%.

6.1.1.2 Vaitupu

In Vaitupu, only a household and commercial premises audit was conducted and Vaitupu generates 100 kg/day of waste, excluding green waste, as it is placed separately in sacks or bundles for collection. Assuming other sources of waste such as commercial waste account for 40% of incoming waste, the overall waste generation rate on Vaitupu is 157 kg/day (Table 24).

Table 24: Waste Generation Rate in Vaitupu 2019 vs. 2017

	2019 survey (kg/day)	2017 Tuvalu waste survey (kg/day)
Plastics	35.3	21.2
Glass	20.0	21.2
Metal	14.7	21.2
Paper and cardboard	21.4	14.1
Green waste	48.5	535.0

Kg = kilograms.
Source: Authors.

This is far below the 2017 Tuvalu waste survey estimate of 704 kg/day. However, if packaging materials were added, the 2019 audit figures, while lower, would be closer to results of the 2017 waste survey.

This difference is expected because, during the 2019 survey, green waste was not picked up daily for analysis due to operational constraints, so a figure of 0.32 kg/person/day of green waste generation for outlaying islands (an average from Sagapolutele and Binney 2017) was used to calculate.

Standard error for total sample weight was 15 kg/day, giving an 80% confidence interval for household generation of 81–119 kg/day, or 135–199 kg/day for total generation. The median standard error for individual materials was 20%.

6.2 Stockpile audit results

The consultant team conducted an audit of stockpiles situated on Funafuti. Several bulky items not found in other waste streams were found in significant quantities in stockpiles including shipping containers, end-of-life vehicles, fuel drums, and lead-acid batteries (Table 25). The team was unable to estimate generation rates from stockpiles, but able to compare the stockpiles found with the estimated annual generation rates.

Table 25: Type and Quantity of Materials Found in Stockpiles around Tuvalu

	Count	Volume (m3)	Weight (T)	Annual Generation (m3) Funafuti	% Annual Generation Found in Stockpile
Aluminum boats	2	6	0.6	-	-
Aluminum cans	-	15.25	2.2875	102.1758	14.9%
E-waste	1	30.25	4.5375	72.96996	41.5%
End-of-life vehicles	35	160.28	80.14	167	96.0%
Fiberglass boats	3	9	0.9	-	-
Glass	-	0.5	0.1125	181.1662	0.3%
Green waste	-	360	72	872.5501	41.3%
Lead-acid batteries	-	5.5	20.9	6.4	85.9%
Metal drums	140	24.164	3.26214	-	-
Metal ferrous	10	1.33	0.266	-	-
Plastic water tanks	16	11	1.65	-	-
Shipping containers	13	495	29.19231	-	-
Used oil	-	2.4	2.4	28	8.6%
White goods	20	5.06	0.5566	104.3904	4.8%

e-waste = electronic waste.
Source: Authors.

Close to 1-year-worth of vehicles in various stockpiles were found around the island as well as about 1-years-worth of lead-acid batteries. Around three months' worth of e-waste and green waste were also found in stockpiles, and around 1-month's-worth of aluminum cans. These figures, combined with the estimated rates of outflow from stockpiles, would give an indication of recovery rates from landfill as well as accumulation rates. Rate of outflow information can be acquired from Customs.

Apart from green waste, the most prevalent material in stockpiles was ferrous metal—from end-of-life vehicles, metal drums, metal ferrous and shipping containers—680 m3 of ferrous materials weighing 113 tonnes. By volume, this represents around 6% of Tuvalu's annual waste generation and 8% of annual waste generation by weight.

7. Waste Materials in Tuvalu

Compiling the household and commercial waste data was only the first step in estimating the total amount of material being generated in various parts of the country so that the quantities of materials to be collected, compacted and moved can be projected as accurately as possible. A number of other data sources were used to generate the quantities of materials available and being landfilled or stockpiled on Tuvalu's islands.

Stockpiles in Funafuti

- 240 pieces of materials amounting to 1,126 m3 and weighing approximately 220 tonnes
- Consisting of 96% of end-of-life vehicles, 40% e-waste, and 86% lead acid batteries generated annually.
- The e-waste and lead acid batteries were stockpiled at the transfer station, leading to ease of recovery when transport options were available.

7.1 Total quantity of materials available in Tuvalu

The waste generation rates for household and commercial premises, stockpile data and data collected from other sources such as the Tuvalu Electrical Corporation and Customs Department allows the consultant team to estimate annual waste generation per island in tonnes and cubic meters (m3) per year.

September 2019 waste audits	**Other sources of data**
• Household audit results • Commercial audit results • Landfill audit results • Litter audit results • Nappies audit and interview results • Transfer station stockpile audit results • Other island stockpile audit results	• Nine (9) months' data available from DWM for green waste, nappies, overall household waste, household clean-up and household and commercial collection in m3. • Import data: bulky and long-lived waste • Solar panel installation records. Note: awaiting updated figures. • Engine oil data requested from suppliers.

7.2 How the estimates were developed

7.2.1 Estimating bulky and long-lived items

To estimate waste generation of long-lived, bulky, or hazardous items found in stockpiles (rather than at the landfill), the average rate of imports from 2010 to 2018 was used to get the average rate of waste generation (Table 26).

Table 26: Average Import Quantities for Bulky and Long-Lived Items[a]

	Average Imports	Unit	Period
Cars (used and new)	24	Units	2010–2017
Motorcycles	531	Units	2016–2017
Cans, soft drink and beer	296,402	liters	2018–2019
Soft drink bottles	115,643	Liters	2018–2019
Water	226,305	Liters	2016–2019
Beer bottles	3,674	Liters	2018–2019
Refrigerators	247	Units	2010–2016
Washing machines	202	Units	2010–2016
Car tires	236	Units	2016–2017
Motorcycle tires	2,934	Units	2016–2017
Motorcycle tubes	2,745	Units	2016–2017
Lead acid batteries	4,116	Units	2016–2019
Lithium ion batteries	6	Units	2016–2019
Lubricating oil	21,416	Liters	2016–2019

[a] Some data not up to date; consultants are acquiring this data from the Tuvalu customs department.

Source: Authors

7.2.2 Estimating waste from renewable energy installations

Based on information obtained by the consultant team, Tuvalu intends to generate 3,557 kilowatts (kW) of solar power between 2008 and 2019. This is combined with 14,762 kWh of battery storage systems and 3,722 kilo-volt-amperes (kVa) of generator capacity. Solar panels typically last 25 years (Lombardo 2014), so renewable energy equipment from these installations may be part of the waste materials beginning in 2033.

The weight of 10 kWh of battery storage can be between 60 and 600 kg and a volume of 60 to 500 liters.[5] A solar panel of 6 kW typically has a volume of around 80 liters and weighs 18 kilograms.[6] A 100 kVa diesel generator has a volume of 3.5 cubic meters and weighs 1,730 kg.[7]

Putting these figures together (choosing the middle of the range for battery systems) yields the following table (27) for installation rates of renewable energy systems.

Table 27: Installation Rates of Renewable energy Systems in Tuvalu, 2018

	Installation (kilograms/year)	Installation (cubic meters/year)
Solar panels	970	4.3
Storage systems[a]	44,300 (6,500–80,000)	36 (6.5–65)
Generators	5,800	12

[a] This figure is likely to be captured by import data for sealed lead-acid batteries and does not count it separately.

Source: Authors

[5] See https://www.solarquotes.com.au/battery-storage/comparison-table/ for information.
[6] See https://news.energysage.com/ average-solar-panel-size-weight/ for information.
[7] See https://www.bluedm.com.au/denyo-100kva-diesel-generator-3-phase-dca-100esi/ for information.

7.2.3 Applying estimates to other islands

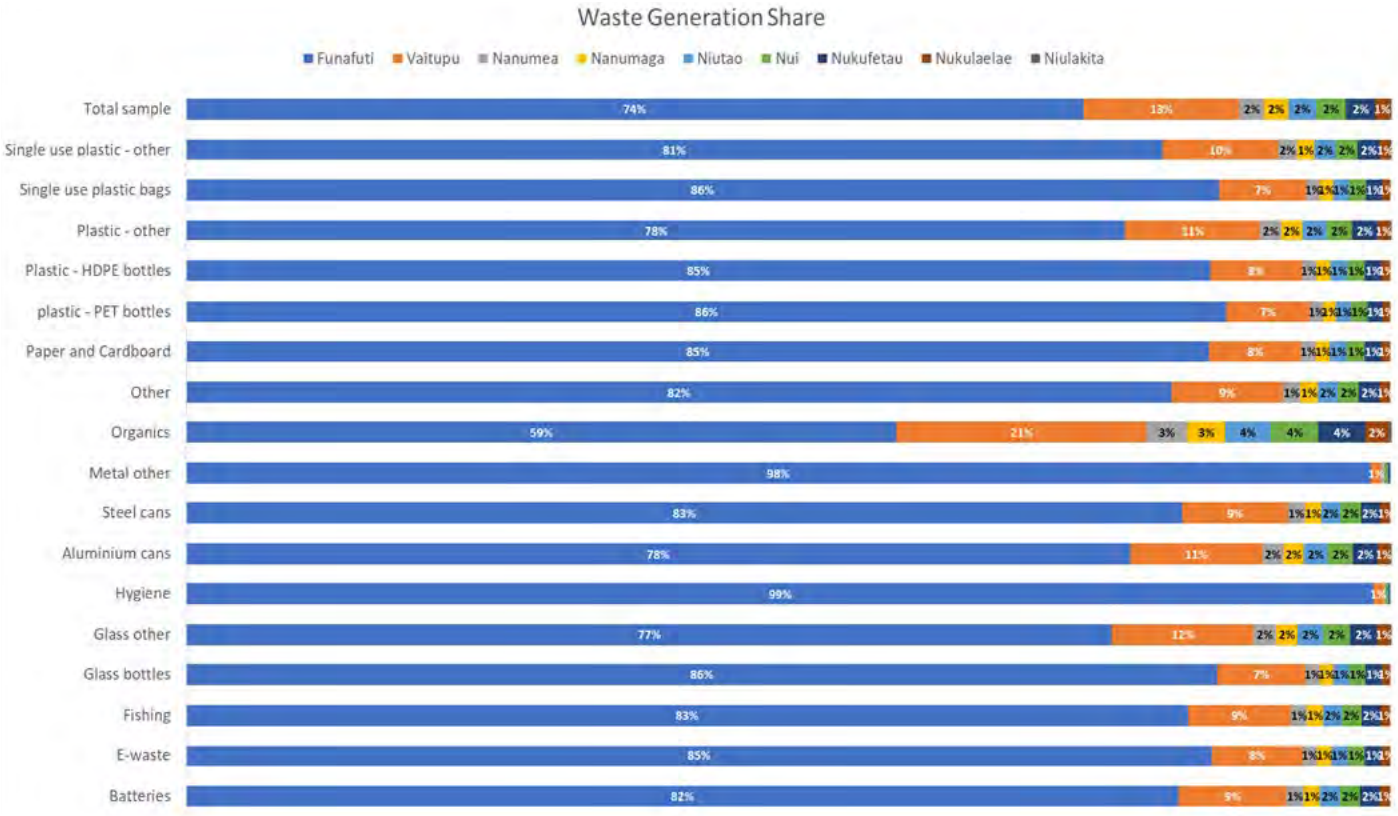
The consultant team assumed that the outer islands shared the same waste generation rate and composition as Vaitupu.

Materials of interest – generation rate

- Almost 1,642 tonnes and 7,000 cubic meter of materials of interest are generated in Tuvalu (all islands) each year.

Funafuti's average share of waste, excluding organics, was 77% and across a wide variety of materials the estimated share was close to this figure. "Metal other" was the only exception, which was minimally present on Vaitupu (the largest source of this type of waste on Funafuti was commercial and industrial waste arriving at the landfill). For bulky items not found in household audits, such as white goods and vehicles, it is assumed that Funafuti's share of the waste was again 77%. This figure informed the estimated waste generation rates across the various islands of Tuvalu shown in Figure 22.

Figure 22: Share of Waste for Each Island of Tuvalu



Source: Authors

7.3 Quantity of materials available in Funafuti and islands of Tuvalu

Using the data from household audits, commercial audits, landfill audits, customs department and stockpiles and applying the assumptions and calculations noted in section 9.2, the consultant team was able to estimate the quantity generated for each type of waste material on each island and these are shown by weight in Table 28 and by volume in Table 29. These figures provide the basis for undertaking the next stages of analysis for the pre-feasibility study, as required by the terms of reference of this assignment.

Please note that the data presents the total quantities of materials being generated and does not include the actual ability of the material to be recovered depending on operational on-ground realities like household behavior, collection infrastructure, transport, equipment, shipping etc. The next section provides an estimate on potential recovery rates for some materials.

Table 28: Type and Quantity of Materials Produced on Islands of Tuvalu (tonnes/year)

	Funafuti	Vaitupu	Nanumea	Nanumaga	Niutao	Nui	Nukufetau	Nukulaelae	Niulakita	Total
Used lead-acid batteriesa	23.6	3.1	0.5	0.5	0.6	0.6	0.6	0.3	0.0	**29.7**
Lithium-ion batteriesa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
Other batteries	1.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**1.2**
Electronic waste	21.9	1.9	0.3	0.3	0.4	0.4	0.4	0.2	0.0	**25.7**
Fishing	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.1**
Glass bottles	31.5	2.7	0.4	0.4	0.5	0.5	0.5	0.3	0.0	**36.8**
Glass other	50.0	7.6	1.2	1.2	1.4	1.5	1.4	0.7	0.1	**65.1**
Hazardous	2.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**2.8**
Hygiene	44.7	0.3	0.1	0.1	0.1	0.1	0.1	0.0	0.0	**45.4**
Aluminum cans	8.2	1.1	0.2	0.2	0.2	0.2	0.2	0.1	0.0	**10.4**
Steel cans	52.5	5.6	0.9	0.9	1.0	1.1	1.0	0.5	0.1	**63.5**
Other metal	93.5	0.8	0.1	0.1	0.1	0.2	0.2	0.1	0.0	**95.2**
Organics	349.0	123.2	19.7	18.9	22.4	23.4	22.9	11.5	1.3	**592.3**
End-of-life vehiclesb	98.0	17.0	2.7	2.6	3.1	3.2	3.2	1.6	0.2	**131.6**
End-of-life renewable equipmenta	5.0	0.9	0.1	0.1	0.2	0.2	0.2	0.1	0.0	**6.8**
White goods	13.8	1.6	0.3	0.2	0.3	0.3	0.3	0.1	0.0	**16.9**
Other	101.8	11.5	1.8	1.8	2.1	2.2	2.1	1.1	0.1	**124.5**
Paper and cardboard	122.0	11.0	1.8	1.7	2.0	2.1	2.1	1.0	0.1	**143.8**
PET bottles	35.7	2.9	0.5	0.4	0.5	0.5	0.5	0.3	0.0	**41.3**
HDPE bottles	8.3	0.7	0.1	0.1	0.1	0.1	0.1	0.1	0.0	**9.8**
Other plastic	96.8	11.9	1.9	1.8	2.2	2.3	2.2	1.1	0.1	**120.3**
Single-use plastic bags	23.4	2.0	0.3	0.3	0.4	0.4	0.4	0.2	0.0	**27.3**
Other single-use plastic	6.0	0.7	0.1	0.1	0.1	0.1	0.1	0.1	0.0	**7.4**
Tiresa	12.6	2.2	0.3	0.3	0.4	0.4	0.4	0.2	0.0	**16.9**
Used oila	20.0	3.5	0.6	0.5	0.6	0.7	0.6	0.3	0.0	**26.9**
Total	1223.0	212.4	33.9	32.5	38.6	40.4	39.6	19.9	2.3	**1642.6**

[a] Data from Tuvalu Customs Department.

[b] Includes cars and motorcycles. Data from Tuvalu Customs Department.

HDPE - High density polyethylene

Source: Authors.

Table 29: Type and Quantity of Materials Produced on the Islands of Tuvalu (m3/year)

	Funafuti	Vaitupu	Nanumea	Nanumaga	Niutao	Nui	Nukufetau	Nukulaelae	Niulakita	Total
Used lead-acid batteries[a]	5.5	0.8	0.1	0.1	0.2	0.2	0.2	0.1	0.0	**7.1**
Lithium-ion batteries[a]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
Other batteries	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.2**
Electronic waste	73.0	6.5	1.0	1.0	1.2	1.2	1.2	0.6	0.1	**85.7**
Fishing	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.6**
Glass bottles	70.1	6.0	1.0	0.9	1.1	1.1	1.1	0.6	0.1	**81.9**
Glass other	111.1	17.0	2.7	2.6	3.1	3.2	3.2	1.6	0.2	**144.6**
Hazardous	12.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**12.7**
Hygiene	149.1	1.1	0.2	0.2	0.2	0.2	0.2	0.1	0.0	**151.3**
Aluminum cans	102.2	14.3	2.3	2.2	2.6	2.7	2.7	1.3	0.2	**130.4**
Steel cans	350.1	37.2	5.9	5.7	6.8	7.1	6.9	3.5	0.4	**423.6**
Other metal	389.8	3.4	0.5	0.5	0.6	0.7	0.6	0.3	0.0	**396.5**
Organics	872.6	307.9	49.2	47.2	55.9	58.6	57.4	28.8	3.3	**1480.8**
End-of-life vehicles[b]	124.8	21.7	3.5	3.3	3.9	4.1	4.0	2.0	0.2	**167.6**
end-of-life renewable energy equipment[c]	38.9	6.8	1.1	1.0	1.2	1.3	1.3	0.6	0.1	**52.3**
White goods[d]	104.4	14.5	2.3	2.2	2.6	2.8	2.7	1.4	0.2	**133.1**
Other	339.4	38.3	6.1	5.9	7.0	7.3	7.1	3.6	0.4	**415.1**
Paper and cardboard	1109.5	100.2	16.0	15.3	18.2	19.1	18.7	9.4	1.1	**1307.4**
PET bottles	357.0	28.6	4.6	4.4	5.2	5.4	5.3	2.7	0.3	**413.5**
HDPE bottles	44.6	4.0	0.6	0.6	0.7	0.8	0.7	0.4	0.0	**52.5**
Other plastic	754.6	108.1	17.3	16.6	19.6	20.6	20.1	10.1	1.1	**968.2**
Single-use plastic bags	271.6	23.0	3.7	3.5	4.2	4.4	4.3	2.2	0.2	**317.0**
Other single-use plastic	59.7	7.1	1.1	1.1	1.3	1.3	1.3	0.7	0.1	**73.7**
Tiresa	111.7	19.4	3.1	3.0	3.5	3.7	3.6	1.8	0.2	**150.0**
Used oil[a]	20.8	3.6	0.6	0.6	0.7	0.7	0.7	0.3	0.0	**28.0**
Total	**5473.7**	**769.4**	**122.9**	**117.9**	**139.7**	**146.5**	**143.3**	**72.0**	**8.2**	**6993.7**

[a] Data from Tuvalu Customs Department.

[b] Includes cars and motorcycles. Data from Tuvalu Customs Department.

[c] The renewable energy equipment considered in the data is expected to begin decommissioning around 2033 and includes solar panels and supporting diesel generators. Data from solar installation plans, 2018–2019.

[d] Includes refrigerators and washing machines. Data from Tuvalu Customs Department.

HDPE = High density polyethylene.

Source: Authors

7.3.1 Capturing Available Material

Among the difficulties that both the private and public sectors have to successfully move material to a proposed recycling hub and have it accepted are land barriers, a small private sector, limited technical capacity, and lean infrastructure, including appropriate equipment and other resources.

Tuvalu recently implemented several bans and levies. These mechanisms will aid recovery of materials while providing a financial basis for its movement out of Tuvalu for recycling. This section discusses the impact of these levies and bans on the amount of material available for recovery from Tuvalu and the potential materials that the country can target for increased resource recovery.

The section deals with the amount of material that might be available for compaction, storage, and shipping based on current levies, available infrastructure, and deposit scheme.

Once collected, the materials will need to be consolidated for shipping for recycling. Shipping is a major issue since there is only one shipping company serving Tuvalu through Fiji. As a result, there is no competition for securing better shipping or handling costs. At present, freight is A$2,000+ for a 20-foot container. Knowledge of proper dismantling of e-waste is limited and a visit to Samoa and Fiji was undertaken to improve the knowledge and skills of basic scrap-metal processing and preparation.

The potential recycling network and hub would therefore provide a much-needed outlet for the materials that will start accumulating at the Transfer Station from 2020 onwards, with aggregation with other Pacific countries recyclables to gain access to either export markets or to create economies of scale for local value-added solutions.

7.4 Waste reduction through bans

Tuvalu on 1 August 2019 implemented bans on the import of several items (Table 29), the ban allowing existing stockpiles of materials to be utilized while there is an active ban on the import of new materials. The waste audits were conducted between 19 and 27 September 2019 and the bans are therefore likely to have had some impact on behavior, but the full impact is unknown. This audit is very timely and can act as a baseline to measure and determine how the waste stream changes over time as the bans and levies are implemented. The banned items will not enter the waste stream and will therefore not be available for recovery.

Banned items are often substituted for other items at some rate. In Australia, the Australian Capital Territory Commissioner for Sustainability and the Environment (2018) suggests that plastic shopping bags are substituted at a 5:1 ratio for heavier bags. As the heavier bags are typically twice the weight, this suggests that a shopping bag ban may reduce overall plastic bag waste by about 60%.

Waste reduction—bans

- The banned single-use plastic items represent 6% of the material entering the waste stream and about 253 to 421 m3 of materials that will not be required to be managed at the landfill. be managed at the landfill.

There are two possible levels of reduction to waste due to banned items: (i) a 60% reduction (with 40% substitution); and (ii) a full reduction (with no substitution). The “no substitution’ estimate may be particularly relevant for plastic bottles less than 1.5 liters, as larger bottles are subject to a levy and are likely to be recovered from the waste stream at high rates. Tuvalu is believed to have high ability to control the flow of substitutes into the country and can restrict the use of the thicker bags, therefore controlling household behavior.

The following identifications were made between consultant sort categories and banned items (Table 30):

Table 30: Newly Banned Items Currently Found in the Waste Stream

Sort Categories	Banned Item
Single-use plastic bags—lightweight	Shopping bags, wholly or predominantly made of or lined with plastic or plastic blend and designed to be given out to consumers
Single-use plastic beverage containers, PET drink pouches	Plastic water pouches and plastic bags used to produce ice blocks
Single-use plastic straws	Straws which are made, in whole or in part, of plastic
Single-use plastic takeaway containers, single-use polystyrene takeaway containers, single-use plastic takeaway container lids, single-use plastic coffee cups	Single-use plastic and polystyrene plates, cups and takeaway container
PET containers water, juice, flavored milk or soft drink < 1500 milliliters (ml), HDPE containers for water, juice or soft drink < 1500 ml, liquid paperboard containers for flavored milk, juice or soft drink < 1500 ml	Plastic water bottles less than 1.5 liters and plastic beverage bottles less than 1.5 liters

HDPE = high density polyethylene

Source: Authors.

Table 31 shows that of the total waste generated on Funafuti annually, 421 m3 could avoided if no substitution of bags and bottles occurs. The banned items represent 6% of the material entering the waste stream and about 253 to 421 m3 of that will not be required to be managed at the landfill. The ban will have a beneficial impact on the availability of landfill space in Tuvalu as the current landfill is at full capacity.

Table 31: Estimated Annual Saving in Waste Arising from the Bans

Banned Item	Estimated Annual Saving in Plastic Waste with 40% Substitution (m3)	Estimated Annual Saving in Plastic Waste with No Substitution (m3)	Percentage of Total Waste Volume Represented by ITEMS in the Category
All single-use plastic bans	168	280	4%
Plastic bottles less than 1.5 liters	85	141	2%
Total	**253**	**421**	**6%**

Source: Authors

7.5 Material recovery through levies

Several items are subject to levies which will be applied upon point of entry into the country into a fund administering the implementation and recycling of these items. Palau have recovered 90% of these selected materials due to refundable deposits. Table 32 shows waste materials subject to levies to support recovery and (if applicable) recycling operations.

Table 32: Items in the Waste Stream Subject to Levies

Waste Category	Levied Item
PET carbonated water, soft drink, fruit juice, vegetable oil —all sizes	Mineral water, sweetened drinks and cooking oils in PET bottles
Aluminum alcoholic sodas, mixers, beer, cider, soft drink —all sizes	Sweetened drinks and alcohols in aluminum cans
Glass beer, fruit juice, spirits, wine—all sizes	Sweetened drinks, alcohols and cooking oil in glass bottles
Containerized used oil	Lubricating oil
Hygiene—nappies	Nappies
White goods	Large white goods, medium white goods, small white goods
End-of-life vehicles	Construction heavy, medium, small equipment
End-of-life vehicles	Office and family vehicles
End-of-life vehicles	Motorbikes
Batteries, lead-acid	Batteries—motorbike, vehicle/ equipment, solar panel

Sources: Authors.

Table 33 shows the amount of material available for recovery if 75% to 100% of levied items can be recovered. If 100% of the levied items are able to be recovered, 14% of the current waste stream can be diverted from landfill for resource recovery. This represents between 781 (at 75% recovery rates) to 1,042 m3 (100%) of uncompacted materials that Tuvalu will need to store, compact, and process before making it available for shipping overseas for recycling.

Table 33: Potential Materials Available for Recycling due to Levies

Levied Item	Annual Saving if Recovered at 75% (m3)	Annual Saving with Full Recovery (m3)	Percentage of Total Waste Represented by Items in This Category
PET beverage and oil containers > 1.5 liters	268	357	5%
Glass beverage containers	37	49	0.7%
Aluminum beverage containers	132	176	2.5%
White goods	80	107	1.5%
End of life vehicles	125	167	2%
Hygiene—nappies	113	151	2%
Batteries, lead-acid	5.6	7.5	0.1%
Used lubricating oil	21	28	0.4%
Total	**781**	**1042**	**14%**

m3 = cubic meter
Source: Authors

7.6 Future options for increased resource recovery

AS number of recyclable items present in the waste stream are not currently subject to a levy or a recovery scheme (Table 34).

Cardboard is the most significant item (by volume) that may be targeted for a future resource recovery program or project, followed by paper and liquid paperboard. Steel cans, glass bottles and e-waste are also substantial categories. Recyclable aluminum includes aluminum foil, food containers, and deodorant cans. PET cleaning product bottles, polypropylene packages and high density polyethylene (HDPE) personal care and cleaning bottles offer some savings, while polyvinyl chloride (PVC) bottles were quite rare in Tuvalu waste.

Table 34: Potential Recyclable Items That Could Be Targeted for Recovery

Current Category	
PET cleaning products —all sizes	Glass water carbonated or non-carbonated
HDPE personal care, cleaning—all sizes	Steel cans
Polypropylene	Cardboard
Polyvinyl chloride (PVC)	Paper and liquid paperboard
Aluminum, human food —all sizes	Electronic waste
Aluminum, recyclable	

HDPE = High density polyethylene.
Source: Authors.

Table 35: Potential Recovery of Additional Recyclable Materials

Recyclable Item	Annual Saving if Recovered at 75% (m3)	Annual Saving with Full Recovery (m3)	Percentage of Total Waste Volume Represented by Items in this Category
Glass water bottles	2.6	3.5	0.05%
Glass jars, fines, other	89	119	1.7%
Steel cans	317	423	6%
Aluminum recyclable	55	73	1%
PET cleaning products	26	35	0.5%
HDPE bottles	32	43	0.6%
Polypropylene	28	37	0.5%
PVC bottles	0.1	0.14	-
Cardboard	711	949	14%
Paper and liquid paper board	268	358	5%
Electronic waste	64	85	1%
Total	**1,593**	**2,126**	**30.4%**

HDPE = High density polyethylene.
Source: Authors.

Data shows that cardboard, paper, and liquid paper board account for almost 20% of the current waste stream and should therefore be considered for a future project. Pacific countries present a number of examples of successful recovery of cardboard to use in composting, make briquettes, or use as weed cover. The next most populous category is steel cans, which can possibly be included in future expansion of the bans/levies. However, steel cans are difficult to recycle and therefore have low market value. Any project for recovery of these materials must consider all options carefully.

Please note that Table 35 does not include ferrous metals (iron and steel) that are recyclable and were found in substantial quantity in stockpiles in the form of shipping containers, end-of-life cars, and fuel drums. The consultant team does not have a reliable estimate on the rate at which these items enter the stockpiles due to lack of customs data, but since stockpiles represent 6% of Tuvalu's annual waste generation, the quantity is deemed substantial.

8. Landfill Life

This section presents a range of policy options, and all of them will have an impact on the lifespan of the landfill. Current landfill is at capacity. All calculations in this figure assume that the additional 1,100 m3 of landfill space will be made available from January 2020.

8.1 Funafuti landfill life vs rate of waste generation

Figure 23 shows the rate of growth of the Funafuti landfill under different policy legislations and compaction rates. Compaction rates have been chosen as a criterion because it can have a huge impact on the lifespan of a landfill, especially one as small as in Tuvalu.

Waste is currently delivered to the Tuvalu landfill uncompacted at an estimated density of 208 kg/m3. This density is likely to increase in the landfill even without compaction, due to settling, though exactly how much the density rises is unknown. In addition, the Funafuti landfill is being compacted by a 6–8 tonne excavator without proper compaction wheels. The report estimates the average weight deposited at the landfill each day. Monitoring the rate of growth in landfill volume could provide an estimate of the density achieved in the landfill, which could be valuable in determining how much compaction is possible with proper equipment summarized in Table 36.

Table 36: Waste Compaction Possibilities with Different Equipment

Waste and Compaction Type	Density
Delivered to Funafuti landfill	208 kg/m3
Commingled waste compacted in rear-end loader truck	400 kg/m3
Landfill compacted with steel tooth drums[a]	800–1,100 kg/m3

[a] Owusu-Nimo, Oduro-Kwarteng, Hellen, Farida & Mohamme (2019).
Source: Authors.

Two potential projects for increased resource recovery:

- Cardboard recycling/ reuse-locally (composting/ Briquettes)
- Compostable nappy trial

Given the different waste policies and bans coming into effect and with the potential new equipment being made available, the landfill lifespan can be extended. The following four scenarios have been explored:

- No recovery and a density of 400 kg/m3, it is estimated that an additional 11,000 m3 landfill to be opened in January 2020 would be full by 2025, or 5 years after it opened.
- Recovering all identified additional materials not currently covered by legislation extends this life by another 1.5 years, or until mid-2026.
- Compaction to 600 kg/m3 under the existing recovery regime yields a lifespan extension about 0.5 years longer than additional recovery.
- Recovering all identified materials and compacting the landfill to 800 kg/m3 extends the lifespan until around 2032, an extra 7 years.

The effect of the four scenarios on the growth of Funafuti landfill is also shown in Table 24.

Waste generation rates are also likely to increase over time, so with a conservative estimate of 2% yearly increase—around double the population growth rate of Tuvalu (which has been 1% per year since around 1980), the lifespan of 12 years is not particularly sensitive to the rate of growth. The increase is likely to be significant over a period of 2 decades or more.

9. Potential Projects to Increase Resource Recovery

Several options could increase resource recovery. However, two present the biggest value for money:

9.1 Recovery of paper and cardboard

Data shows that cardboard, paper, and liquid paper board account for almost 20% of the current waste stream and should therefore be considered for a future project. This is not surprising given that all materials that arrive in Tuvalu via sea or air freight are almost always packaged in cardboard boxes. Cardboard and paper can be considered for future source separation projects with local small-scale, low-tech solutions.

Given that the green waste is being successfully composted and used by local vegetable farms, cardboard could potentially also be considered part of the composting process. A feasibility study on practical options for the local reuse and recycling of cardboard and paper should be considered.

9.2 Nappies

There is 100% source separation for nappies in Tuvalu for some years now and the new legislation that came into force in August 2019 puts a 5 cents levy on each nappy. This will give alternatives such as completely compostable nappies more cost edge and provide DWM with funds to undertake a trial that requires the use of compostable nappies.

For any waste management trial to be successful, the biggest challenge is source separation and education. Tuvalu is well ahead in both instances and can serve as a case study and, possibly, a success story in this area.

10. Is Tuvalu Ready to Contribute to a Regional Recycling Facility?

10.1 Readiness for participation

Based on site visits, meetings with officials, audits, and a review of the legislative framework, the consultants believe that Tuvalu is ready (Table 37) and will be able to contribute fully to the operation of a regional recycling network. The key reasons are as follows:

i) A legislative framework is already in place to recover recyclable materials.

ii) There is pressure to undertake recycling activity due to diminishing landfill space.

iii) Capable staff who are committed to better waste management outcomes and can be trained to participate in recycling network activities.

iv) A framework of infrastructure reforms is under way that will allow effective collection and compaction of materials.

Table 37: Regional Hub: Tuvalu Readiness Assessment

Theme	Requirement	Tuvalu Readiness Assessment
Policy/legislation	Signatory to international treaties allowing movement of waste	Tuvalu already signed the Waigani Convention to allow to ship waste to Fiji, which might be the regional hub location. The process for signing the Basel Convention has commenced.
	In-country deposit legislation and its extent	Tuvalu has recently endorsed (on 1 August 2019) its Waste Management Levy Deposit, a combination of CDL and disposal fee systems. It covers beverage containers usually covered under CDL, vehicles, motorbikes, white goods, car batteries, engine oil, nappies, etc. The first year of enforcement covers beverage containers, the second year others. Refer to the regulation e-copy.
	Ability to legislate swiftly if required	Compared with Samoa and other Pacific countries, Tuvalu's legislative framework is less complex and processes to introduce regulations are not as involved.
	Local by-laws and implementation	Six out of eight islands have waste bylaws. However, there is little progress with the implementation because of the capacity of local councils (Kaupule) to enforce. Part of the visit to Samoa by Tuvalu waste management staff in October 2019 is to look at how village chiefs deal with littering and illegal dumping in the Samoa communities without by-laws. This helps Samoa to maintain cleanliness in rural communities. The proposal from the outer islands to have transfer stations is being considered by the Department of Waste as the beginning of future on going collaboration in recovering recyclable wastes.
	Responsibilities and power of implementation and compliance	
	EPR schemes	The responsibilities on waste management is shared between the Department of Waste and Islands Kaupule. The Island Kaupule has more authority to enforce compliance at the island level. This is the issue as the capacity at the local councils is weak and the Department of Waste is now recruiting waste staff to be based at the councils to be directly responsible for waste management. Vaitupu and Funafuti now have their waste management staff at the councils. There is a waste oil collection and return shipment implemented by the Pacific Energy from Fiji.

Table 37: Regional Hub: Tuvalu Readiness Assessment (continued)

Theme	Requirement	Tuvalu Readiness Assessment
Data collection and decision making	Responsible entities for ongoing data collection	Department of Waste.
	Responsible entities for decision making	Department of Waste at the national level. Kaupule authorities at the island level. Island chiefs at the community level.
	Responsible entities for implementation and compliance	Department of Waste at the national level. Kaupule authorities at the island level. Island chiefs at the community level.
Economic instruments	Financial instruments for collection of different materials	Tuvalu has enforced the Waste Management Levy Deposit covering beverage containers including plastic bottles, vehicles, motor bikes, heavy machinery, white goods and electronics, batteries, nappies, etc. The revenue generated will support the recovery, processing and shipment of recovered waste items covered.
	Local laws supporting/inhibiting import/export of materials	The ban of plastics regulation, which covers more plastic items, helps to control the entry of plastic items. The waste levy deposit supports the export of potential recyclable items and shipment of low-value items overseas.
	Bans or phase outs in place	Current bans on single-use plastic items as well as a control on importing of white goods with chlorofluorocarbons to control ozone-depleting substances. Without approval, any imported refrigerator without appropriate document cannot enter.
Collection services	Availability and effectiveness of waste collection service	The collection service covers all the eight islands. Funafuti as the main island has a very good collection system for the general waste, bulky waste, green waste and nappies. There are separate collection services for these items. The general waste collection is provided twice a week, twice a week for the green waste, once for the bulky waste and the nappies. Communal bins are accessible to all households 24 hours to drop off their nappies.
	Ability to expand/diversify to multiple collection types	With the current separate collection systems available and the waste recycling program to be supported by the waste levy deposit, Tuvalu can diversify its collection system and expand
	Recyclers and small-scale players for possible future collections	This is in the pipeline, with the recent establishment of the Waste Recyclers and Management Association. The plan for the implementation of the Recycling Programme supported by the Waste Levy is for the Department of Waste to establish and implement the recycling processes initially 2 years, until the private sector is ready to take over.

Source: Authors.

11. Continuous Improvement

The Tuvalu audit was a trial of the methodology proposed by the consulting team. As a result, this report presents data and commentary on the modifications to the methodology that could be made for future audits.

A quick summary is provided below:

i) **Support from local government is crucial:** The audits cannot be undertaken successfully without the full support of the local government. The Department of Waste Management and the Kaupule were instrumental in ensuring data was collected within the tight timeframe of the consultant visit. The DWM supported the audit process though the provision of equipment, staff and transport. DWM also acted as a liaison with all other government departments and helped collect data after the consultants had left the country.

ii) **Customs data is important but time consuming:** As raised in the inception report by the consultant team, customs data is crucial in developing the overall material flow for individual materials. Although the Customs Department has been highly supportive in providing the data, the extraction of data is a tedious, time-consuming process. The consultant team has been slowly receiving this information and suggest contacting the Customs Department at the time of contacting the country for mission clearance.

iii) **Categories review:** Based on the analysis performed so far, one of the most important improvements that could be made to the methodology is in the "single-use plastics" category. During analysis, it was found that the categories into which the material was sorted were not always an exact match to the categories in which the material was imported. Given the bans and levies on single-use plastic items are being implemented at the point of entry into the country, it would be most beneficial to match the single-use plastic categories to the categories in the HS system for imports.

iv) **Practical suggestions:** The consultants made a range of practical suggestions throughout the report around the collection and sorting of materials and data recording for consideration of the technical committee.

v) **Timeline:** This report was produced within 13 days of arriving back to base from the country. There was not enough time to undertake all required work and produce a good quality report. It is proposed that at least 2 weeks' post fieldwork be allocated for data checking and entry, 2 weeks for analysis, and another 2 weeks for report writing.

References

ADB. 2017. Trade Facilitation for a More Inclusive and Connected Asia and Pacific Region: Progress and Way Forward. Manila.

Government of Tuvalu. 2016. Tuvalu Integrated Waste Policy and Action Plan: Towards Cleaner and Healthier Islands, 2017–2026. Funafuti.

Japan International Cooperation Agency. 2013. Data Collection Survey on Reverse Logistics in the Pacific Islands. Tokyo.

Ministry of Finance. n.d. Tuvalu Population and Housing Mini-Census 2017: Preliminary Report. Tuvalu, Central Statistics Division, Economic Planning and Industries. Funafuti.

Minister for Finance and Economic Development. 2018. Government of Tuvalu: 2019 National Budget. Funafuti.

Oec.world. n.d. OEC—Tuvalu (TUV) Exports, Imports, and Trade Partners. https://oec.world/en/profile/country/tuv/

Sagapolutele, F. and J. Binney. 2017. Tuvalu Waste Baseline Information Report.

Sagapolutele, F. 2019. The 2nd Annual Review of the Implementation Status of Tuvalu's National Waste Management Policy and Action Plan 2017–2026.

Secretariat of the Pacific Regional Environment Programme (SPREP) and EDO NSW. 2018. Tuvalu: Review of Natural Resource and Environment Related Legislation.

SPREP. 2016. Cleaner Pacific 2025. Pacific Regional Waste and Pollution Management Strategy 2016–2025

SPREP (South Pacific Regional Environment Programme 2004b.

Solid waste characterization study of Tuvalu. Apia, Samoa: South

Pacific Regional Environment Programme

SPREP (South Pacific Regional Environment Programme). 2004b.

Solid waste characterization study of Tuvalu. Apia, Samoa: South

Pacific Regional Environment ProgrammeSeltenrich 2015. New Link with the Food Chain: Marine Plastic Pollution and Seafood Safety. Environmental Health Perspectives, 123(2): A34-41

SPREP. 2014. Solid Waste Characterisation Study of Tuvalu. Apia, Samoa: South Pacific Regional Environment Program.

Legislation Documents

Waste Management (Levy Deposit) Regulation 2019. Made under Section 10 (1) in the Waste Management Act 2017.

Waste Management (Prohibition on the Importation of Single-Use Plastic) Regulation, 2019.

Waste Management (Litter and Waste Control) Regulation 2018. Made under Section 11 of the Waste Management Act 2017.

Environment Protection Act 2008 Revised Edition. CAP. 30.25 Arrangement of Sections.

Waste Operations and Services Act 2009.

Appendix 1:
Waste Management (Litter and Waste Control) Regulation 2018 Schedule 2

Waste Management (Litter and Waste Control) Regulation 2018 Schedule 2
—Table of Penalty Notice Offences

Penalty Notice Offences	Penalty to be paid
Regulation 3—Littering	$20
Regulation 5—Dumping Waste	$100
Regulation 6(1) Dumping waste which cause pollution	$250
Regulation 7(1)—Unlawful use of public waste bins	$50
Regulation 7(2)—Stealing, damaging or burning a public waste bin	$250
Regulation 8—Burning litter and wastes	$50
Regulation 9—Burning hazardous or noxious waste (including plastics, rubber, oils and polyfoam)	$500
Regulation 10—Use of banned waste for land filling (except at dumpsites)	$500
Regulation 11—Unlawful fire at dumpsites	$1,000
Regulation 12(2)(a)—Failure to disclose hazardous waste when taking to dumpsites	$250
Regulation 12(2)(b)—Providing false information about hazardous waste when taking to dumpsites	$250
Regulation 12(2)(c)—Unlawful storage or disposal of hazardous wastes	$500
Regulation 14(2)—Failure to comply with clean-up notice	$200

Appendix 2:
Waste Management (Levy Deposit) Regulation 2019

Waste Management (Levy Deposit) Regulation 2019 Schedule 2—Set Levy Amounts per Good and Committed Purposes

Table A2.1: Levy Amounts per Good and Committed Purposes

Item	Good or Product	For the Management of the Resulting Waste			
		Deposit amount	Refund amount	Recycling operations subsidy	Administration and management support
1	Mineral water, sweetened drinks and cooking oils come in PET bottles	10 cents per container	5 cents	0. 25 cent	0.25 cent
2	Sweetened drinks and alcohol come in aluminum cans	10 cents per container	5 cents	0. 25 cent	0.25 cent
3	Sweetened drinks, alcohol and cooking oil come in glass bottles	10 cents per container	5 cents	0. 25 cent	0. 25 cent
4	Lubricating oil	40 cents per liter	Nil	Nil	40 cents
5	Nappy	5 cents per unit	Nil	Nil	5 cents
6	Large white goods—refrigerators, freezers, washing machines, electric ovens (over 2 cubic meters (m3) size)	$100 per unit	$50	$25	$25
7	Medium white goods—refrigerators, washing machines, electric ovens (between 1 m3 and 2 m3 sizes)	$60 per item	$30	$15	$15
8	Small white goods—microwaves, refrigerators, washing machines, etc. (smaller than 1 m3 size)	$30 per item	$15	$7.50	$7.50
9	Construction heavy equipment—excavator, loader, trucks (more than 10 tonnes)	$2,000 per unit	$1000	$500	$500
10	Construction medium equipment—excavator, loader, truck (between 5–10 tonnes)	$1,000 per unit	$500	$250	$250
11	Construction small equipment—excavator, loader, truck (less than 5 tonnes)	$500 per unit	$250	$125	$125
12	Office and family vehicles	$400 per unit	$200	$100	$100
13	Motorbikes	$200 per unit	$100	$50	$50
14	Batteries				
	Motorbike	$10 per unit	$5	$2.50	$2.50
	Vehicle/equipment –	$30 per unit	$15	$7.50	$7.50
	Solar panel	$60 per unit	$30	$15	$15

Source: Authors

Waste Management (Levy Deposit) Regulation 2019 Schedule 3—Set Minimum Number of waste Items Allowed

Table A2.2: Set Minimum Number of Waste Items Allowed

Item	Good or Product	At the waste materials transfer station		At the collection agents	
		Set minimum number of items	Equivalent refund amount	Set minimum number of items	Equivalent refund amount
1	PET bottles from water, sweetened drinks and cooking oils	20	$1	1	5 cents
2	Aluminum cans from sweetened drinks and alcohols	20	$1	1	5 cents
3	Glass bottles from sweetened drinks, alcohol and cooking	20	$1	1	5 cents
4	Other waste items	No Limit		Not Accepted	

Appendix 3: Projects Funded by Development Partners in Tuvalu

Tuvalu has been a recipient of several international financial aid opportunities to develop and maintain waste management infrastructure.

Development partner	Year	Outcome	Areas of Assistance Provided
AusAID	1999–2002	Introduction of municipal-scale waste management system through the Tuvalu Waste Management Project	Under the Tuvalu Waste Management Project, in partnership with the Tuvalu government, the following achievements were made: 1) Setting up of a Waste Management Unit under the Department of Environment to manage the project waste activities. 2) A collection service was implemented to cover the rest of the Funafuti island, which was not included under the Kaupule collection service. The Kaupule collection at the time only covered the central area adjacent to the airport runway with an estimate of 300 households. 3) All households were provided with wheelie bins to store their waste at source. Large communal wheelie bins (1,100 liters) were located throughout the island for the public to dispose of their waste. 4) A dumpsite was prepared to dispose of the collected waste.
European Development Fund (EDF)			
8th and 9th EDF	2000–2006	• Drafting of the Waste Operations and Services Act 2009 • Provision of financial support for the initial operation of Department of Solid Waste • Solid waste survey of Nanumaga island • Provision of equipment and household bins to improve delivery of waste services • Capacity building to Department of Solid Waste	Financial support of the new waste management unit operations 1) Development of the Waste Operations and Services Act 2009 which provided the legal framework for the management of waste. This has been replaced with the *Waste Management Act 2017.* 2) Support of the establishment of a Solid Waste Agency of Tuvalu (DSW) in 2010 3) Waste characterization study on Nanumaga island
10th EDF	2007–2010	• Support to enhance awareness in the waste sector, through TANGO	
	2013	Extended to the outer islands	**Provision of waste equipment:** 1) Collection equipment—all tractors and trailers for the outer islands 2) Wheelie bins for the outer islands 3) Excavator for the Funafuti dumpsite 4) Loader for the composting/mulching project 5) Green waste shredders
11th EDF	2017–2020		The Sustainable Waste Action Programme (SWAP) has been put in place with a funding of 6.8 million euros for the period 2017–2020. This supports the implementation of Tuvalu's Integrated Waste Management Policy 2017–2026 and its Medium Integrated Waste Action Plan 2017–2020.

Appendix 3: Projects Funded by Development Partners in Tuvalu (contined)

Development partner	Year	Outcome	Areas of Assistance Provided
Asian Development Bank (ADB)	2004–2005	Development of the Integrated Solid Waste Plan 2005	Technical assistance through the Tuvalu Effective Waste Management and Recycling Project
Republic of China (Taiwan)	2009	Support for green waste processing by buying the mulch and converting to compost product for gardens	Assistance provided through a Volunteer: supply of wheelie bins to households, businesses and institutions.
	2011–2014		Under the Horticulture Project: Production of more than 470 tonnes of compost a year for gardening purposes, which has been utilising DSW-generated mulch. Setting up of a compost fund about A$1 million.
	2015–2020		Continuing the purchasing of DSW's generated mulch to produce the Horticulture Expansion Project's targeted production of 600 tonnes of compost (100 tonnes per annum) for the Funafuti Farm. Production of 600 tons of compost for the Elise Farm in Vaitupu. The process absorbs the generated green waste in Vaitupu.
World Bank	2010	Solid waste inventory for Funafuti and Nanumaga, and feasibility studies on the options for exportation of waste	Waste surveys in Funafuti and Namumaga to explore options on recyclable waste and their feasibility. Provision of the metal baler equipment.
Japanese International Cooperation Agency	2013	Provision of one training for Kaupule, through the J-PRISM project. Promotion of Regional Initiative Solid Waste Management Project aimed to build capacity and improve solid waste management.	Reverse logistics for recyclable waste shipping. Tuvalu was one of the countries included in the assessment.
	2017–2018		1) Provision of a new dump truck (6 m3). 2) Training opportunity in Japan for one Department of Solid Waste staff on waste management. 3) Waste landfill training in March 2018 4) Endorsement of the Waste Management (Litter and Waste Disposal) Regulation 2017 5) Endorsement of the Waste Management Act 2017 6) Changing of Department of Solid Waste to DWM (Department of Waste Management)
NAPA Project	2014		Provision of green waste shredder equipment for Funafuti and all the outer islands to convert the generated green waste to Compostable materials for gardening.
New Zealand –MFAT	2015	Closure of borrow pits and improvement of the Funafuti dumpsite.	Rehabilitation of open pits in Funafuti and the Funafuti dumpsite.

Appendix 3: Projects Funded by Development Partners in Tuvalu (contined)

Development partner	Year	Outcome	Areas of Assistance Provided
SPREP (Regional Projects supported by Development Partners—EU, Japanese International Cooperation Agency, etc.)	2010–2016	• Provision of waste management training • Assistance to the development of the Tuvalu Integrated Waste Policy and Action Plan • Management of health care wastes, asbestos, and e-waste through the EU-SPREP PacWaste Project • Management of chemicals through the GEFPAS Project	GEFPAS Used Lubricant Oil (ULO) Project, which has promoted the proper management of ULO by funding public awareness and educational materials, including meetings and workshops. The project has not, however, provided the funding needed for the purchasing and installation of storage containers. Under the PacWaste project, an assessment was conducted to study the generated health care waste. 1) As a follow-up to the assessment work, a new incineration facility was installed at the Funafuti Hospital for the incineration of the generated health care waste. This was officially opened in 2016. 2) Under the PacWaste project, an assessment was conducted to investigate asbestos in the country. 3) Conducting a cost-benefit analysis study and report for Green Waste Management in Funafuti in 2016. 4) Development of the Tuvalu Integrated Waste Policy 2017–2026 and Integrated Waste Plan 2017–2026. 5) Under the PacWaste Project, this assessment was initiated and commenced to investigate the status of waste management in Tuvalu (as the basis of this status report). 6) Under the J-PRISM project, some staff of Department of Solid Waste have been receiving waste management training.
UNDP		Preparation of the waste/debris component of the TC Pam Recovery and Vulnerability Reduction Plan	Assistance in Funafuti to remove cyclone debris and backlog of 1-month's-worth of uncollected municipal waste as part of Waste Management and Livelihood Recovery Initiative.

Appendix 4:
Asset Register—Equipment Used by Department of Solid Waste to Deliver Waste Services

Asset Description	Year Acquired	How Acquired
Truck (Mitsubishi)	2009	
Pick Up Mini Truck		donated by AusAid
600XL CHIPPER (VERMEER)	2014	donated by NAPA
600XL CHIPPER (VERMEER)	2010	
600XL CHIPPER (VERMEER)		
VEGETATION CHIPPER (HANSA C30)	2013	donated by EU
ALERT CAN AND METAL BALER	2013	donated by EU
LOADER (CAT)	2013	donated by EU
EXCAVATOR (CAT)	2013	donated by EU
LOADER (KOMATSU)		donated by EU
KUBOTA 4X4	2013	donated by EU
DAELIM 250CC	2010	
TRACTOR AND TRAILER (FUN KP)	2013	donated by EU
TRACTOR AND TRAILER (FUN KP)	2013	donated by EU
TRACTOR AND TRAILER (RECYCLER)	2013	donated by EU
TRACTOR AND TRAILER (NNMEA)	2013	donated by EU
TRACTOR AND TRAILER (NMGA)	2013	donated by EU
TRACTOR AND TRAILER (NTO)	2013	donated by EU
TRACTOR AND TRAILER (NUI)	2013	donated by EU
TRACTOR AND TRAILER (VTP)	2013	donated by EU
TRACTOR AND TRAILER (NKFT)	2013	donated by EU
TRACTOR AND TRAILER (NKL)	2013	donated by EU

Tuvalu Integrated Waste Policy and Action Plan: Towards Cleaner and Healthier Islands 2017–2026.
Source: Government of Tuvalu (2016)

Appendix 5: Tuvalu Solid Waste Regulations and Policies

Falekauplule Act 1997. This Act provides for the establishment of Falekaupule and Kaupule to ensure each island is appointed a Falekaupule and Kaupule forming the local government structure.	
Part V	prescribes functions for powers of public officers and enforcement functions
Schedule 3	prescribes functions of the Falekaupule exercised through their Kaupule and offices relating to environment management matters
53	states the Kaupules may make bylaws in relation to their functions
122	requires each Falekauple to prepare a Local Development Plan setting out programs and priorities for social and economic developments
129	states the Minister may make regulations applying to all or a particular Falekauple area, after consultation, to better facilitate the provisions of the Act
Environment Protection Act 2008 revised edition. The Environment Protection Act 2008 makes provision for managing the Tuvaluan environment. The Act has numerous objectives which include: • coordinate the role of government in relation to environmental protection and sustainable development; • provide a mechanism for the development of environmental policy and law; • promote a clean and healthy environment for all Tuvaluans; • prevent, control, monitor and respond to pollution; • promote public awareness and involvement in environmental issues and the preservation of Iloga as it relates to the environment; • facilitate the compliance and implementation of obligations under any regional and international agreements or conventions; • facilitate sustainable development with respect to the management of the environment and natural resources; • facilitate the assessment and regulation of environmental impacts of certain activities; • promote conservation and sustainable use of biological diversity and the protection and conservation of natural resources, on the land, air and sea; and • reduce the production of wastes, and at the same time, promoting the environmentally sound management and disposal of all wastes.	
5	sets administrative responsibilities with the Minister, who is responsible for the proper administration of the Act
7	sets responsibilities of the Director of Environment, which includes proper administration and implementation of the Act as delegated from the Minister, subject to the direction of the Permanent Secretary of the Ministry
Part III	outlines the powers of enforcement
11	Confers powers to environmental officers in order to facilitate the fulfilment of their functions.
14	Establishes a National Environment Forum and Council
16	Enables a Kaupule to establish Island Environment Committees who may identify priority areas of environmental concern, participate in programs, recommend regulations, and provide representatives to the National Environment Forum
Part VI	addresses pollution control and waste management outlining roles of the department in relation to pollution and waste including, regulations dealing with pollution control, waste management and hazardous waste and substances
Part VII	addresses international and regional environmental obligations
Part X	Provides provisions for addressing offences and sets penalties for any person who fails to comply with license, permit or approval granted under the Act.
Waste Operations and Services Act 2009. The Act defines the roles and responsibilities for waste management in Tuvalu and makes provision for the management of solid waste and environmental protection relating to the collection, recycling and disposal of waste and other waste-related operations and services in designated areas of Tuvalu. It sets a detailed legal framework for waste operations and regulates the entire sector.	
2	Identifies and defines bulk waste, hazardous waste and solid waste.
Part II	Outlines the responsibilities for waste management in Tuvalu including the regulation of waste, waste management operations, waste management planning, environmental and public health standards and auditing of waste generation and disposal.
Part III	Delegates general powers in relation to wastes.
Part IV	Outlines waste management operations including the designation of waste service areas, waste management operators and their functions, outlines the powers of waste management operators and their performance of community obligations. It also outlines the ability to impose fees and charges for waste management services, provides provisions to ensure waste management operators, prepare and submit reports to any aspect of waste management and immediately notify relevant Ministries of adverse effects to human health or the environment. In addition, it specifies control measures relating to recycling of wastes.
Part V	States control over certain wastes, offences against designated waste management operators, enforcement provisions, prosecutions under the Act and the jurisdiction of the courts to try offences.

Appendix 5: Tuvalu Solid Waste Regulations and Policies (continued)

The Environment Protection (Environmental Impact Assessment) Regulations 2014. This regulation relates to the environmental impact assessment process. It provides forms of assessment, administrative responsibilities, the application process for development, and the establishment of an environmental task force for environmental assessment.	
Part VI	Outlines pollution control and waste management including roles of the department in relation to pollution and wastes, regulations dealing with pollution control, waste management and hazardous waste and substances.
X	Offences and penalties stipulate general penalty for conviction where a person fails, refuses or neglects to remove or stop any waste or pollution of the environment.
XI	Outlines the Ministers jurisdiction to make regulations relating to the control of pollution and regulation of waste and the regulation and prohibition of the importation of goods where contributing to an increase in waste.
Waste Management (Littering and Waste Control) Regulation 2018. It outlines litter control measures and waste related measures including litter and waste compliance notices; penalty notice offences and form of penalty notices.	
Part II	Outlines litter control measures, stating that it is an offence to litter in a public place or on land belonging to another person and that every owner and occupier of land or premise must keep it free from litter or waste that may become litter.
Part III	States waste-related offences and associated fines for individuals and corporation where convictions are made, including: 1) Offence to dump waste 2) Offence to dump hazardous waste 3) Dumping waste which cause pollution 4) Offences relating to community waste bins 5) Restrictions on burning off and other activates 6) Offence to burn noxious and hazardous waste 7) Wastes not to be used for land filling or reclamation 8) Prescribes hazardous waste.
Part IV	Provides ability for Enforcement Officers to serve notice to cease certain activities concerning waste and outline remedial action and cost recovery
Part VI	States Island Counts may hear prosecutions under the regulations.
Waste Management (Levy Deposit) Regulation 2019. The purpose of this regulation is to: (a) State the principles and rules to support the recovery, processing, treatment and shipment of incoming goods at the end of their operation conditions; (b) Provide mechanism for revenue collection and administration; and (c) Provide legal framework that encourages waste avoidance and resource recovery behavior.	
10	States every officer, producer and consumer must work collaboratively to reduce and dispose of the goods and products
13	Prescribes scheme for the movement of the specified goods and products
14	Provides facility for exemptions
Part III	Outlines the administration of the system including obligation of importers, obligation of custom officers, obligation of consumers, function of designated waste operators and outlines the functions of the Department of Waste Management.
Part IV	States the number of operational days the transfer stations will be opened, and the state and quantity of waste deposited will be accepted.
Part V	Outlines the financial arrangement stating the purpose of the Levy Fund is to generate revenue for the government, support operations of the system and finance educational and marking needs of the Act. Fifty percent refund payments to collectors, twenty-five percent to operators of transfer station and twenty-five percent to the Department of Waste Management for treatment of waste to be disposed in Tuvalu, public awareness and monitoring, reporting and other administration aspects.
Part VI	Outlines offences and illegal practices and associated fines. Also states it is an offence to litter and dump waste and directs to the Waste Management (Litter and Waste Control) Regulations 2018.
Schedule 1	Provides a list of goods and products to be levied.
Schedule 2	Sets levy amounts per good and committed purposes.
Schedule 3	Sets the minimum number of waste items allowed.
Waste Management (Prohibition on the Importation of Single-Use Plastic) Regulation 2019. The regulation prohibits the importation, manufacture, sale or distribution of certain single-use plastic.	

5	Specifies prohibited items which include: • Shopping bags, wholly or predominantly made of or lined with plastic or plastic blend and designed to be given out to consumers; • Plastic water bottles less than 1.5 liters and plastic beverage bottles less than 1.5 liters; • Plastic water pouches and plastic bags used to produce ice blocks; • Straws which are made, in whole or in part, of plastic or a plastic blend and designed for one-time use (not including straws attached to packaging.); • Single-use plastic and polystyrene plates, cups and take-away container, including cups and plates with a plastic coating or lining; • Single-use plastic cutlery; • Plastic sheet or cling film glad warp used for food wrapping; • Plastic sheet used for spreading on dining table; and • Plastic flags. In addition, the regulation notifies fines for individuals up to $5,000 for the first offence, for offences committed more than once a fine of up to $5,000, or imprisonment of 2 months or both apply. For a body corporate a fine up to $10,000 may apply. If an offence is committed on more than once, fines up to $10,000 or 3-months imprisonment or both may apply.
Marine Pollution Act 1992. This is a comprehensive law providing provisions for preventing and dealing with marine pollution and the dumping and incineration of waste at sea. The Act outlines requirements for the disposal of waste including oil, pollutant reside, garbage and sewerage from ships at port reception facilities and the environmental liability in relation to the prevention and remediation of environmental damage caused by oil, sewage, garbage and other pollutants. In also incorporates the following international conventions: • International Convention for the Prevention of Pollution from Ships 1973, as supplemented by the Protocol thereto of 1978; • Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972; and • Convention for the Protection of the Natural Resources and Environment of the South Pacific Region, 1986.	
Te Kakeega III: National Strategy for Sustainable Development, 2016–2020. This document identifies the national strategic plans attuned with sustainable development goals for Tuvalu for 2016–2020. The management of solid waste and is covered in Strategic Area 5.7 and identifies a number of challenges for the solid waste sector In Tuvalu, including: • Lack of proper Funafuti dumpsite management and oversight; • Dedicated and managed land space for solid waste disposal in the outer islands; • Lack of equipment for sorting and incinerating waste; • Lack of public awareness about waste disposal and a litter-free environment; • Lack of waste management expertise of Department of Solid Waste staff. The document outlines that Department of Solid Waste will commission a new technical assistance study to investigate: • alternative ways to improve waste disposal, including waste-to-energy systems; • staff capacity building, identifying new equipment needs for waste collection, disposal and processing; • expanding and improving organic, green waste operations; • relocating the Funafuti dumpsite; and • waste disposal on the outer islands, building on the lessons learned on Funafuti over the last 15–16 months.	
Tuvalu Integrated Waste Policy and Action Plan 2017–2026. This policy strives towards cleaner and healthier islands and provides a roadmap that sets a clear direction for Tuvalu to improve waste management. Six strategic goals were established via sectoral and wider stakeholder consultations: Goal 1: Strengthened institutional systems to address gaps in waste management. Goal 2: The stakeholders fully understand the merits of proper waste management and co-share the responsibility of managing wastes. Goal 3: Established strong partnerships between the public and the private sector in the delivery of waste services. Goal 4: Delivered waste services following best practice and cost-effective approach tailored to local conditions with continuous improvement. Goal 5: Enhanced capacity of waste practitioners. Goal 6: Waste activity outcomes are reported and disseminated to relevant stakeholders.	

Appendix 6:
Waste Audit Plan for Tuvalu

Government points of contact

Overall point of contact	Collections and Disposal Services
Mr Walter Pulogo	**Ms Miriama Uluiviti**
Department of Waste Management	Funafuti Waste Collection and Disposal Operations
Ministry of Home Affairs and Rural Development,	Department of Waste Management
Government Building.	Ministry of Home Affairs and Rural Development
Funafuti, Tuvalu.	Government Building,
WPulogo@gov.tv	Funafuti, Tuvalu
	MUluiviti@gov.tv

Key stakeholders

Organization name	Stakeholders	Email
1) Ministry of Home Affairs and Rural Development	• Mr Lete Avanitele, Permanent Secretary	lAvanitele@gov.tv
	• Mr Walter Pulogo, Acting Director, Department of Waste Management	WPulogo@gov.tv
	• Mr Taualo Penivao, Secretary, Island Kaupule of Funafuti	tpenivao@gmail.com
	• Mr Ionatana Peia Secretary, Vaitupu Island Kaupule	tana.peia55@gmail.com
2) Ministry of Foreign Affairs	• Mr Fakavae Taomia, Permanent Secretary	ftaomia@gmail.com
	• Mr Soseala Tinilau, Director, Department of Environment	butchersn@gmail.com
3) Ministry of Finance	• Mr Niuatui, Acting Permanent Secretary	NNuiatui@gov.tv
	• Mr Tuilagi Teii, Director, Customs Department	Tteii@gov.tv
4) Ministry of Health	• Mr. Faivatala Lee Moresi, Permanent Secretary	aceinc337@yahoo.com
	• Dr Tuese Falesa, Acting Director, Department of Health	jiushiwo0906@gmail.com
5) Department of Works	• Mr Avafoa Irata, Permanent Secretary	avafoa@gmail.com
	• Mr Malofou Sopoaga, Acting Director, Department of Works	msopoaga@gmail.com
6) Department of Marine	• Mr Tapugao Falefou, Permanent Secretary	tfalefou@gmail.com
	• Mr Taasi Pitoi, Director, Marine Department	taasi.pitoi@gmail.com
7) Tuvalu Recyclers and Waste Management Association	• Mr Timuani Selu, President	
8) Pacific Direct Line (PDL)	• Mr Apisai Kilima, General Manager, PDL Shipping Agent	Apisai166@gmail.com

Implementation Schedule

ACTIVITY	OPERATION	12/9	13/9	14/9	15/9	16/9	17/9	18/9	19/9	20/9	21/9	22/9	23/9	24/9	25/9	26/9	27/9	28/9	29/9	30/9	1/10
Briefing Meetings and Interview	DWM and Waste Collection Crew																				
	Department of Environment																				
	Department of Customs																				
	Waste Management Committee																				
	Recyclers and Waste Association																				
	Local Importers and Suppliers																				
	Department of Health																				
	Public Works																				
	Marine Department																				
	Shipping Company																				
	Kaupule Authorities																				
Waste Audit Tasks	Identify high-, mid- and low-income areas																				
	Select samples: high-, mid- and low-income areas																				
	Distribute rubbish bags to domestic and commercial																				
	Collect and analyse the samples in Funafuti																				
	Move to Vaitupu Island																				
	Distribute bags to families and businesses																				
	Collect and analyse the samples in Vaitupu and dumpsite audit																				
	Return to Funafuti																				
	Landfill audit in Funafuti																				

Sampling Schedule

The following schedule has been provided by the Statistician based on the criteria noted in the audit methodology.

Percentage errors will be higher in places where overall generation rates are lower (0.24 kg/household error is about 20% error in Tuvalu, where we estimate 1.2 kg/household/day generation but only 10% in South Africa where we estimate 2.4 kg/hh/day). Higher rural populations have lower generation rates.

Tuvalu Scheme	Error at 80% Confidence	Error at 90% Confidence
90 houses Funafuti, 60 houses Vaitupu (or other)	20%	25%
140 houses Funafuti, 60 houses Vaitupu (or other)	17%	21%
90 houses Funafuti, 60 houses Vaitupu, 50 houses other	15%	19%

Commercial Sample Split

Sample type	Minimum	Desired
Admin/office	7	10
Food Outlet	9	13
Retail	9	12
Hotel	9	12
Supermarket	9	13
Manufacturing	7	10
	This would yield an (very crudely) estimated error of 1.0 kg/ business/day or 17% at 80% CI.	This would yield a (very crudely) estimated error of 0.87 kg/ business/day or 15% at 80% CI.
Total	**50**	**70**

Pre-Project Planning

1) Transportation:

- Boat for Vaitupu waste audit and cost for hire—by Thursday 12th
- Rental car for the team transportation in Funafuti and Vaitupu—by Thursday 12th.
- The rental vehicle belongs to the Hotel (where the team will stay).
- Vehicle arrangement and support for the collection of samples—by Thursday 12th.
- Use of the Department of Waste Management's small truck for the collection of rubbish bags—arranged and to be confirmed by Mr Walter Pulogo (Director of DWM). The small truck of DWM may carry half of the load of the UTE truck used by the team in Solomon Is and Vanuatu during the CEFAs waste audit.
- Mr Pulogo will confirm the use of a private truck and backup support from DWM including if trucks and tractors will be available on some days.

2) Accommodation

- Funafuti—already confirmed
- Vaitupu—TBC by Fri 13th

3) Meetings

- Meeting with the Waste Management Committee on Friday 13th before and after the mission. The Waste Management Committee has all representatives of key government agencies and other stakeholders. Use to confirm appointments for the proposed meetings later with the individual stakeholders.
- Meeting with the DWM collection crews on Friday 13th or Sat 14th to discuss the survey for their information—Thurs 11th
- Meeting with the Tuvalu Recyclers and Waste Management Association—Fri 13th
- Confirmation of all appointments for the listed stakeholders—Thursday 12th.

4) Collection and Sorting Preparations

- Visit the proposed sorting areas—DWM Hanger or DWM new recycling station and DWM Disposal Site Storage Facility—Friday 13th.
- Get the collection map with indicated collection routes and drive around the island to observe the collection
- Identify and select the sampling areas—by Friday 13th or Sat 14th during the meeting with DWM collection crew.

5) Audit items

- Printout of high-level sort sheets
- Printouts of container deposit scheme sort sheets
- Waste audit code of conduct
- Printed copies of safe work method statements
- Notepad with all sorting and collection sheets loaded on them
- First aid kits
- Scales
- PPE sorting baskets and tarps available locally
- Sorting tents are available at Tuvalu shops
- Disposable facial masks and gloves confirmed

Appendix 7: Collection Sheet

The consultant team used an online version of the collection sheet.

Date		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							

Appendix 8: Sorting Categories

Material categories, definition and source of data.

	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% 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% aluminum items that are not cans/tins/or packaging materials, any other aluminum	H, C, L	Cu, D
Fishimg	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	
	Liquid paper board	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, flavoured 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 flavoured 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

	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 and 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
Glass	Glass bottles	Recyclable (all colors)—beer bottles, wine bottles, spirit cider/fruit-based, flavoured 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	

	Category	Description	EOL Source	Incoming
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	
Other	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
	end-of-life renewable energy equip	Includes end-of-life 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 9: 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 10: Landfill Audit Sheet

Location		Date: _____		Auditor	
Sample Number					
Entry time					
Vehicle registration number					
Type of vehicle					
Maximum capacity (m3)					
Compaction (Circle)		H M L		H M L	H M L
Tipping point					
Source (C&I / C&D / Council / SH / MSW)					
Sector (M S H O X C T L E U G)					
Bagged waste		Bagged waste			
Metals	Aluminium cans				
	Aluminium recyclable				
	Steel containers				
	Metal other				
Fishing	Fishing/seafood metal				
	Fishing/seafood plastic				
	Fishing/seafood wood				
Paper Cardboard	Cardboard				
	LPB				
	Composite				
	Paper				
Plastic	PET containers				
	HDPE containers				
	LDPE containers				
	PVC containers				
	PP				
	EPS				
	PS				
	PP				
	Flexibles/Film				
	Other plastic				
Single-use plastic items	Beverage containers				
	Cigarette butts				
	Cigarette packets				
	Straws				
	Coffee cups				
	Bags – heavy, glossy branded carry bags				
	Bags – supermarket light- weight carry bags				
	Takeaway containers plastic not EPS				
	Takeaway containers Styrofoam				
	Takeaway containers paper				
	Takeaway container lids				
	Bottle lids				

Batteries	Non-rechargeable batteries			
	Rechargeable batteries			
	Lead acid batteries			
	Mobile phone batteries			
	Power tool batteries			
	Lithium batteries			
	Lithium ion batteries			
	Other batteries			
E-Waste	Computer equipment			
	TVs			
	Mobile phones			
	Electrical items & peripherals			
	Toner Cartridges			
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			
Hazardous	Paint			
	Fluorescent tubes			
	Household chemicals			
	Asbestos			
	Clinical (medical)			
	Gas bottles			
	Mercury			
	Hazardous other			
Other	Textiles			
	White goods (volume/count)	/	/	/
	Ceramics			
	Containerised used oil (volume/weight)	/	/	/
	EOL renewable energy equip (volume/count)	/	/	/
	End of life Vehicles (volume/ count)	/	/	/
	Tyres (volume/count)	/	/	/
	Please describe			

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