



# Tulagi Waste Characterization Report , Central Islands Province 2019



Prepared by: Environment Unit Environment and Conservation Division Ministry of Environment Climate Change Disaster Management & Meteorology P.O.Box 21 Honiara





## **MECDM Document Control**

Submitted to:	Tulagi Provincial Government
Date submitted:	
Report compiled by:	Environment & Conservation Division
Quality control by:	
Approved by and date:	
Version:	

VERSION CONTROL					
Version	Authors/Editors	Date	Comment		
Draft Version 1	Enoch Faabasu		Draft v1		
Draft Version 2	Enoch Faabasu, Wendy Beti	25/11/2019	Draft v2, inclusion of household and commercial survey data, review and edits		
Final Draft					





# **Table of Contents**

## List of Annexes

Annex 1. Household Daily Waste Generation	35
Annex 2: Daily Number of Bucketful loads of Tulagi Household waste	
Annex 3: Daily Household Waste Composition Table	
Annex 4: Daily Commercial Waste Generation	41
Annex 6: Daily Number of Bucketful loads of Tulagi Commercial waste	42
Annex 7: Daily Commercial Waste Composition for Tulagi Town	
Annex 8: Waste Characterization Audit Procedure (Steps)	
Annex 9: Household waste survey questionnaire	
Annex 10: Commercial waste survey questionnaire	

## List of Tables

Table 3.1: Audit Schedule Time –frame	15
Table 2: Domestic Waste Composition of Tulagi Town	18
Table 3: Commercial Waste Composition of Tulagi Town	23
Table 4: Recyclable Waste Composition of Tulagi Town	25
Table 5: Other Waste Composition in Tulagi Town	26
Table 6: Overall Waste composition in Tulagi Town	27

## List of Graphs

Graph 2: Daily Commercial Waste Composition of Waste Stream in Tulagi Town	25
Graph 3: Recyclable Waste Composition in Tulagi Town	
Graph 4: Other Waste Composition in Tulagi Town	27
Graph 5: Overall Waste Composition in Tulagi Town	

## **List of Figures**

Figure 1. Picture of Tulagi waste audit team 2019

- Figure 2: Map of Solomon Islands
- Figure 3: Map of Nggella
- Figure 4: Tulagi garbage house
- Figure 5: New Waste Collection Tractor
- Figure 6 Waste separation bins at Raiders Hotel
- Figure 7: Waste minimization initiative practised by Raiders Hotel
- Figure 8: Tulagi Sample area Map





# Acronyms

3Rs	Reduce, Reuse, Recycle
CPG	Central Provincial Government
ECD	Environment & Conservation Division
НСС	Honiara City Council
JICA	Japan International Cooperation Agency
J-PRISM	The Japanese Technical Cooperation Project For Promotion of Regional Initiative on Solid Waste Management
MECDM	Ministry of Environment Climate Change Disaster Management and Meteorology
NFD	National Fisheries Development
NWMPCS	National Waste Management and Pollution Control Strategy
SIG	Solomon Islands Government
SWM	Solid Waste Management
TLTC	Tulagi Local Town Council
WW2	World War 2





## Glossary

- Composting A simple method of turning organic wastes into soil.
- Dumpsite Dumping site for any generated wastes which is not properly managed or controlled by local council.
- Landfill Properly managed final disposal site for wastes controlled by the local council.
- Recyclable Able to be recovered, processed and used as a raw material for the manufacture of useful new product through a commercial process.
- Segregation Keeping the components of assorted waste stream separated.
- Waste are unwanted or unusable materials. Waste is something/anything that someone no longer have any use for it and throw away.

Waste Audit/ Characterization - A process or method of classifying different types of wastes into different categories and compositions.





## Acknowledgement

The audit team wish to acknowledge the contribution by the following institutions/organisations which contributed to the successful completion of this audit report.

Central Provincial Government (CPG) for providing human resources, transportation, venue for the workshop and active participation in the eight days wastes audit.

Honiara City Council (HCC) Team for providing human resources towards the waste management workshop and waste audit.

J-PRISM (JICA) for continuous logistics and financial support towards the waste management workshop and of the waste audit.

Ministry of Environment Climate Change Disaster Management and Meteorology for the continuous logistics support, financial support and coordination throughout the implementation of the activity

To all the individual households and commercial business sectors who have willingly participated in the survey to which enabled the team to gather the necessary data. We look forward to similar support in the future.

Lastly, like to thank the Tulagi waste audit team for successfully conducting the waste survey.



Figure 1. Picture of Tulagi waste audit team © ECD/MECDM 2019





## **Executive Summary**

Tulagi Town is one of the major tourisms destinations in Solomon Islands. It was the first administrative capital of the Solomon Islands under the British Solomon Islands Protectorate. Since 1942, Tulagi is littered with war relics, a reminder of the WW2. The serene environment is facing a major threat from poor solid waste management practices and in the long term will potentially affect the tourism industry in the province.

The town does have a designated waste dump site that is located west side of Tulagi Island. The existing waste collection service is done by the Tulagi Local town council (TLTC). The waste collection coverage is only for the provincial staff houses and offices. There are four garbage houses (waste collection points) that are located within the town centre where residential houses can dispose their wastes before collection. However, some areas within Tulagi commonly practices open burning, indiscriminate dumping in the sea and bush increasing the risk of vector borne diseases and health related issues.

Tulagi is an economic hub for surrounding villages and hosts economic activities which in turn contributes to waste generation. The ripple effect can be evident in the surrounding communities with pre-existing challenges.

The National Waste Management & Pollution Control Strategy (2017-2026) was developed to tackle the major waste management issues in the country however, lessons learnt during the period of implementation will serve as a basis to improve the strategy when it is reviewed to be more responsive to current and ongoing challenges.

The core challenges Tulagi Township is facing are that similar to other provincial townships around the country. These are lack of a sustainable waste collection system, lack of waste storage systems and proper disposal site, lack of public awareness, and attitude and behaviour of the general population.

The Tulagi Waste Characterization Study or Audit tries to capture the following issues as follows:

- To quantify the waste Generation at source (Household and Commercial sector)
- To quantify the waste composition or categories at different sectors
- To assess the waste management systems or practices
- To assess future waste management opportunities

The Tulagi waste survey concluded with the findings that the average waste generation rate for the domestic level (households) is 0.22kg/person/day and the waste generation rate for the commercial sector is 0.01kg/m3/day. The overall composition for both the household level and commercial sector indicates that the organic wastes have the highest composition and other wastes category have the lowest composition. However, organic wastes can be





minimized through home composting, pig feeding and utilized in turning waste into energy through the biogas.

## 1.0 Background

Solomon Islands is a small island developing state located in the south-eastern part of the Pacific at latitude S 8°25'14.77" and longitude E 158°21'49.51". It comprises of more than 900 islands ranging from high volcanic islands, Small Island, coral atolls and surrounded by fringing reefs (see figure 2). The economic revenue of the country depends primarily on logging, fisheries and Oil Palm production. Most of its manufactured goods are either imported from Asian region or some of the neighbouring Pacific Island Countries.



Figure 2: Map of Solomon Islands © CCD/MECDM, 2019

Tulagi Township is one of the peri-urban towns in the Province located on the island of Tulagi in the Central Province (see figure 3). It is one of the main tourist destinations of the Province that has a rich history of World War II relics and the first administrative capital of the Solomon Islands under the Solomon Islands British Protectorate. Currently, it is the main administrative centre for the entire Central Islands Province.

As a township serving the nearby islands, it has attracted various businesses from small scale canteens to wholesale and retail services, fuel depots, fisheries, offices, boat ramp to name but a few. It also has a food market selling sea food, fresh vegetables, roots crops and marine products. These are main sources of waste generation in Tulagi town.







Figure 3: Map of Nggella © CCD/MECDM, 2019

The township has a total population of 1,750 according to the statistics (National Statistics, 2009). There is no proper waste disposal site, the current disposal practise is an open dumping site situated on the western end of the island which accepts all the wastes from both households and commercial businesses. The existing waste collection service is done by the Tulagi Local town council (TLTC) and carried out using an open pick-up truck three times weekly. The waste collection coverage is only for the provincial staff houses and offices. There are four garbage houses (see figure 4) that are located within the town centre where residential houses



Figure 4: Tulagi garbage house ©ECD-MECDM 2019

Figure 5: New Waste Collection Tractor © ECD-MECDM 2019





can dispose their wastes before collection. The provincial government recently procured a tractor and trailer attachment (see figure 5) to address the waste collection service.

There are some waste reduction initiatives undertaken at the individual households level and a few commercial business. Some of these initiatives includes composting for soil improvement to grow plants and vegetables and reuse of organics for feeding pigs. One of the commercial business operations in Tulagi, Raiders Hotel practices waste segregation within their compound. Bottles are stored in baskets to be reused, organics from kitchen are reused by staff to feed pigs and leaves or grass are composted. Whilst recyclables such as beer bottles and aluminum cans are taken to Honiara to be sold to BJS and solbrew distributors. (see figures 6& 7 for example).

Figure 7: Waste minimization initiative practised by Raiders Hotel



C

ECD-MECDM 2019

The Waste characterization survey or audit took place from 1<sup>st</sup> to 7<sup>th</sup> of August 2019. This report is compiled with the following aims:

- To determine composition and quantities of waste being generated;
- To assess effectiveness of existing waste management systems (not including value for money or financial analysis);
- To identify opportunities for improving waste management systems and strategies;
- To collect baseline data for measuring the effectiveness of waste minimisation strategies.

Figure 6 Waste separation bins at Raiders Hotel © ECD-MECDM 2019





## 2.0 Institutional Arrangement

The Environment and Conservation Department under the Ministry of Environment Climate Change Disaster Management & Meteorology in collaboration with the Environmental Health Division of the HCC and JICA through the J-PRISM-II Project are committed to ensure the environment and natural resources of Solomon Islands are protected, managed and sustainably used for the maximum benefit of the Government and people of Solomon Islands and also to promote health of the human population. The Division's mission is also to improve and strengthen the national institutional and administrative capacity of the government machinery to improve and promote a sustainable solid waste management system. This is done through the enforcement of the following Acts, regulations and policies are as follows;

## i. Environment Act 1998 and Environment Regulation 2008

The Environment Act 1998 is an [a]ct which makes provision for the protection and conservation of the Environment; the establishment of the Environment and Conservation Division and the Environment Advisory Committee and for matters connected therewith or incidental thereto. The Act is enacted by the National Parliament of Solomon Islands and consisted of three parts. Part three of the Act covers Development Control, Environmental Impact Assessment, Review and Monitoring.

# ii. Wildlife Protection & Management (Amendment) Act 2017 and Regulation (Amendment) 2017

The Wildlife Protection and Management Act 1998 and Regulations 2008 makes provision for [t]he protection, conservation and management of wildlife in Solomon Islands by regulating the Export and Import of certain animals and plants; to comply with the obligations imposed upon Solomon Islands under the Convention on International Trade in Endangered Species of Wildlife in flora and fauna and for other matters connected therewith or incidental thereto. The Act comprised of five parts and was enacted by the National Parliament in 1998.

### iii. Protected Areas Act 2010 and Regulation 2012

The Protected Areas Act 2010 and Regulation 2012 was enacted by the National Parliament of Solomon Islands in 2010 and 2012. This Act makes provision for the Declaration and Management of Protected Areas or areas where special measures need to be taken to conserve biological diversity and the regulation of biological diversity and prospecting research and for matters related thereto.

### iv. National Waste Management & Pollution Control Strategy 2017~2026

The strategy describes the current waste management practices in Solomon Islands, outlines priority waste management issues, identifies key objectives, and draws the proposed way forward in the action plan. The proposed action plan details programs that are to be implemented at national, provincial and community levels. The strategy is developed to provide a mechanism from which waste management activities can be developed in the future.

Other waste related legislation and policies that are mandated under various agencies or departments includes;





#### v. Shipping Act

An Act to consolidate and amend the law relating to shipping and seaman and to control the registration, safety and manning of ships, and to give effect to certain international maritime conventions, and for other purposes connected therewith.

#### vi. Ports Act

An Act to provide for the establishment of a corporation to be known as the Solomon Islands Ports Authority, for the transfer to the authority of certain of the port and harbour undertakings of the Government, for the functions of the authority and for purposes connected with the matters aforesaid.

### vii. Quarantine Act (Cap. 106)

An act to make provisions for the prevention of introduction of disease in the Solomon Islands through the importation or landing of animals, plants and other things and preventing the introduction of pests and invasive plants; for incoming vessels and aircrafts to provide notice of entrances into Solomon Islands; and for connected purposes.

#### Vii. Environmental Health Act 1980 (Cap. 99) and Public health Regulation (1996)

An act to make provision for environmental health services to manage environmental risk factors to human health. One of the services supported by the Act is solid waste management system in local authorities inclusive are Provincial Authorities and Honiara City Council.





## 3.1 Waste Data Sample Collection Methodology

#### 3.1. Sample Collection Size

A sample size of thirty two (32) households were randomly determined and selected to participate in the waste audit as representative for Tulagi Township. The audit survey selection ranges from McMahon School to old NFD smoking area (refer to Tulagi map below). Likewise a total of seven (7) commercial sectors which includes a shop, restaurant, canteen, school, offices (2), and guesthouse were randomly selected as samples sites for the commercial waste audit in Tulagi Town. This sample size was not able to include rural population near Tulagi due to logistical and transportation constraints. In addition, because of the absence of waste collection service in the nearby rural communities, they were not part of the sample size. See Table below for number of samples collected from the sampled site.

#### Table 1: Household Samples Collected and Collection system & Final Disposal site in place

Location	Population	Total Households	Number of Samples	Collection System in place	Collection Frequency	Designated Final disposal site
Tulagi	1251	244	39	Yes -Partial ( only in the Tulagi Provincial Headquarters	Twice a week	Yes – Open dumping

Apart from the households sampling, a total of 7 commercial samples were also surveyed and assessed. The commercial premises were divided into the following categories as indicated below in Table 2.

#### Table 2: Commercial Sampling categories and Collection Frequency

Type of Commercial Sector/Business	Sample size	Collection Frequency
School	1	Twice a week
Small Canteen	1	Twice a week
Retail Trader	1	Twice a week
Wholesale Trader	1	Twice a week
Office	2	Twice a week
Rest-house	1	Twice a week
Total	7	





#### TULAGI HOUSEHOLD AND COMMERCIAL WASTE SURVEY



Figure 8: Tulagi Sampling area distribution Map (Source: MECDM, 2019)





#### 3.2 Schedule of Activities

Day/ Date	Activity
Tuesday 30 <sup>th</sup> July, 2019	Issue plastic bags for household and commercial waste audit.
Wednesday 31 <sup>st</sup> July 2019	First day of waste collection and discard, Re-issue of plastic bags.
Thursday 01 <sup>st</sup> Aug, 2019	Second day of waste collection for audit and sorting and data collection, Re-issue of plastic bags.
Friday 02 <sup>th</sup> Aug, 2019	Third day of waste collection for audit and sorting and data collection, Re-issue of plastic bags.
Saturday 03 <sup>th</sup> Aug, 2019	Fourth day of waste collection for audit and sorting and data collection, Re-issue of plastic bags.
Sunday 04 <sup>th</sup> Aug, 2019	Fifth day of waste collection for audit and sorting and data collection, Re-issue of plastic bags.
Monday 05 <sup>th</sup> Aug, 2019	Sixth day of waste collection for audit and sorting and data collection, Re-issue of plastic bags.
Tuesday 06 <sup>th</sup> Aug, 2019	Seventh day of waste collection for audit and sorting and data collection, Re-issue of plastic bags.
Wednesday 07 <sup>th</sup> Aug, 2019	Final day of waste collection for audit, sorting and data collection and analysis of data.

#### Table 3: Audit Schedule Time – frame

#### 3.3 Sample Collection Methodology

An open double cab Hilux provided by the Central's Provincial Government was used to collect the waste bags from the households and commercial areas for the duration of the audit. On the first day of audit all the Central province Environment Health officers and jointed team from Honiara were dispatched around the households and commercial areas to collect the bags to ensure that all areas and sectors are sampled.

This collection was done from each sampled house to the next house by the team from Honiara and Tulagi. Each of the sampled households and commercial premises were approached by a member of the survey team requesting for the garbage bags and upon receiving the bags a new bag was re-issued to the households and commercial premises. During the collection, GPS location and tagging was also conducted. Where households were not tagged , during the next day's collection, it was tagged. The tagging system used was a masking tape and using a permanent marker the Household or commercial code was written on it for identification purposes. For some of the commercial premises, a day was identified and floor size measurement was conducted using a 100m tape measure.

#### 3.4 Sorting

All wastes from the households and commercial areas are weighed in plastic bags . A total of fifteen samples were randomly selected for the domestic sector before all the plastic bags are tipped into a 20L bucket to record the bucketful loads. Then the wastes are tipped onto a tarpaulin where all the materials are sorted into different categories. The different waste categories are then weighed again using the 20L bucket hanged on a 20kg digital hand scale. The data was then recorded in daily data sheets for commercial and households (Refer to Annex 1 and 9).

The sorting location for both the households wastes and commercial wastes was done at the EHD/RWASH Office verandah in Tulagi. The coded bags helps in identifying the samples when





recording the sorted wastes. The wastes are sorted on a tarpaulin which was washed after every day throughout the waste survey period.



Figure 9: Waste sorting on a tarpaulin spread out on the concrete flooring by officers involved in Tulagi waste survey(c) ECD-MECDM 2019.

Below is the list of categories used to sort the household wastes and commercial wastes by waste types under each major categories as indicated by the different color codes.

Category		Category	
			Waste Types
Organic	Kitchen waste	Battery	Used Lead Acid Battery
	Wood/Timber		Other Battery
	Grass/Leaves		Feminine Hygiene (Sanitary Pad)
	Betel-Nut	Hygiene	Nappy/Diaper
	Other organic		Medical Waste
Paper/Cardboar d	Paper		Other Sanitary Waste
	Cardboard		Hazardous
	Liquid paperboard (juice box)		Contaminated used Oil
Plastic	Pet Bottle (Drink)		Textile
	Hard Plastic Bottle (HDPE)	-	Ceramics/Stone
	Expanded Polystyrene foam		White Goods
	Plastic Bag	Others	Fishing/seafood, Plastic
	Other Plastic		Fishing/seafood, wood
Metal	Aluminium Can		Tyres
	Aluminium Recyclable		Leather/Rubber
	Stool cap/Tip		Cigarette Butts
			Others
	Other Metal	E Mosto	
Glass	Glass Bottle Beer	E-Waste	Computer Equipment
	Glass Bottle Wine/Spirit		Mobile Phone
	Glass Jar		Other Electrical Device
	Other Glass		Electrical Item/Peripheral

### Table 4: Waste Sorting Categories





#### 3.5. Interview and Questionnaire

In order to gather some relevant information of the waste management situation in Tulagi, a set of questions in the form of a questionnaire was issued to households and the commercial premises by the officer that went out to issue the waste bags for the first day's collection. It was noted during the waste survey that for some households and commercial premises, some of the questions were left unanswered. One of the reasons may be because they do not understand or clear on the question being asked. The questionnaire was written in English rather than translated in pidgin and in future it would be better if interview was done using the questionnaire. See Annex for the sample questionnaire used for commercial and households.

#### 3.6. Equipment

A list of equipment used to conduct the waste characterization study or waste audit are as follows;

- Tarpaulin for sorting wastes( 1x tarpaulin)
- latex hand gloves, (5pkt x 100pieces)
- face mask, (5pkt x 25pieces)
- buckets (4x 20L),
- Digital/handing scale (20kg/50kg) for weighing the buckets,
- vehicle for logistics,
- Plastic bags for waste storage (Black plastic bags for household waste, Blue plastic bags for commercial waste)
- GPS for mapping
- Clip-board to assist person doing the data recording
- Data sheet to record commercial and household waste audits
- Stationary (pen, pencil, A4 Papers)
- Sanitize for hand washing after audit (5L sanitize)
- Calculator
- Coveralls
- Hats
- Sun glasses
- Laptop for onsite data entry





## 4.0. Waste Data Results

The waste audit methodology described above were undertaken to which the following results to be determined for the following :

- Waste stream composition by area for domestic and commercial sector.
- Average weights per household per council area.
- Average weight per commercial area of council area.
- Amount of potentially recoverable materials in the waste stream.
- Overall volume of wastes generate rate by Tulagi Town area.

The data presented in this section are based on weight unless otherwise specified. The percentages are being rounded to one decimal point as such some of the figures may be above or below 100%. This section presents the results based on the data collection over eight days.

#### 4.1. Households Waste Generation rate and Waste Composition breakdown

The results presented in this sub-section represented the waste generation rate only for Tulagi in Central Islands Province as indicated in table below:

#### Table 5 : Waste Generation rate

Country	Area/Provincial	Average waste	Average number of
	Capital	generation rate	people in household
Solomon Islands	Tulagi	0.22kg/person/day	5.5

Note: The average number of people in households is based on data from the household survey and not from the National Statistics data report.

The results of the waste audit are represented in the following charts which show the various components of the waste stream with detailed explanations. Percentages are rounded to two decimal places. All data is weight-based and the raw data are provided in detailed listed in Annexes 1-9 of this report.

Category	Total Weight (kg)	Total (%)		
Organic	86.8kg	64%		
Paper/Cardboard	7.0kg	5%		
Plastic	9.1kg	7%		
Metal	15.7kg	12%		
Glass	8.3kg	6%		
E-waste	0.2k	0%		
Battery	0.3kg	0%		
Hygiene	5.5kg	4%		
others	2.1kg	2%		
Total	135.0	100%		

#### Table 6: Domestic Waste Composition of Tulagi Town

Table 6 depicts the domestic waste composition in Tulagi according to the main waste categories which includes; organics, papers & cardboards, plastics, metals, glass, E-waste,





Battery, Hygiene and others (see annexe 4 for raw data details). The 3 major waste categories are organics, metals and plastics. Organics have the highest with 64 % and the others with the least composition in the domestic waste stream.



#### Graph 1: Daily Domestic Waste Composition of Waste Stream in Tulagi Town

The diagram above , indicated by Graph 1 illustrates the different waste composition in Tulagi .The graph above shows that organic waste is the highest, followed by metals, plastics, Glass, paper/cardboard, Hygiene and others. The remaining categories are significantly low with approximately 0%. The results show that about ~64% of the waste potentially can be turned into compost and bio-gas while ~4% has the potential to be recycled leaving about ~32% potential for disposal in the landfill.

#### 4.2. Waste Management and Disposal Practices

The following graphs presented data from households survey conducted from the same households which the waste data was collected particularly on how households managed their waste and the practices involved in disposal of wastes. In Tulagi, although it is a peri-urban area not all households have access to the waste collection service. However, majority of the households surveyed stated the importance of waste management to them and have practiced the 3Rs concept of waste minimization at the household level. Different means of information dissemination accessed by the households includes; Radio or FM, Posters, workshops/conference, newspaper and other means of sources.





Graph 2 depicts that the most common method of waste storage practised by households in Tulagi is placing waste in plastic bags followed by other storage methods. Of the different means of information accessibility, majority of households have access to waste management information during workshops/conferences and from posters/pamphlets followed by radio/FM as illustrated in graph 3 below.

Tulagi also reported that there is insufficient waste collection service for some households. The availability of the waste collection service is limited to or only covers the Provincial Headquarters compound and residential staff housing area. As illustrated in graphs 4, 5 and 6; about 28% of the population are left out of this waste collection service, more than 40% of the population receives twice a week waste collection service and majority rated 1( excellent) for the service provided.



#### Graph 2: Daily Domestic Waste Composition of Waste Stream in Tulagi Town

Graph 3: Different means to accessing information on waste management









Graph 5: Frequency of Tulagi Household Waste Collection Service





Graph 6: Household Ratings on Waste Collection Service in Tulagi





In Tulagi as presented in graph 7 noted that the most common practice for disposing food wastes is by feeding to animals mostly pigs and garden wastes which includes wood, leaves are mostly composted. For Polyurethane (PET) bottles are either burned or placed in rubbish bins or garbage houses provided in Tulagi. Plastics or plastic bags are mostly burnt as it is also commonly practiced in other provincial areas including Honiara. Glass bottles, Tins or steel cans including Aluminium cans are mostly disposed in rubbish bins or garbage house. Whilst papers or cardboards are most commonly burnt. In graph 8 it depicts that the most common disposal method practised in Tulagi is by properly disposing their wastes in rubbish bins or garbage houses provided. This practice is followed by households engaged in open burning of wastes. With only 2% of the population or households surveyed have practiced reuse of wastes and or sell beer bottles to solbrew agents.





Graph 8: Most common type of waste disposal practice in Tulagi







#### 4.3. Willingness to pay for services

Based on the household questionnaire, it was noted that most people are willing to pay for waste collection service at a rate ranging from \$5 to \$50 with one respondent stating their willingness to pay at a rate of \$400. About 91% of the households' survey supported the idea of introducing a pre-paid bag system for rubbish collection. The rate of pre-paid rubbish bag the households are willing to pay for ranges from \$0.20 to \$50 per bag. A majority of about 75% of households support the idea of introducing a Container Deposit System.

#### 4.4 Households Income & Expenditure

It was noted from the questionnaire at the household level that there were some inconsistencies in the reported income level and purchasing habits. One lesson learned from this household survey questionnaire is to ensure that future surveys had to be conducted by an interviewer to clarify questions and get as much information as possible whilst on site.



#### Graph 8: Household Income level in Tulagi

#### 4.5. Commercial Waste Management and Waste Generation rate

The results presented in this sub-section represented the waste generation rate of commercial sector only for Tulagi in Central Islands Province as indicated in table below:

	Table /T comme		ate
Country	Area/Provincial	Average waste disposal rate	Average waste
	Capital		generation rate
Solomon	Honiara	16.3kg/business/day (CEFAS	
Islands		2018)	

#### Table 7: Commercial Business Waste Generation rate





Tulagi	0.01kg/m2/day or
	0.10kg/person/day

Table 7 compares the average commercial waste generation rate in Tulagi to that in Honiara. Based on the waste data, the commercial waste generation rate is 0.01kg/m2/day (floor area) or 0.10kg/person/day (employee). The average number of business is based on data from the commercial business survey and not from the National Statistics data report. Due to the small number of commercial business audited as part of this waste survey in Tulagi , it is difficult to accurately extract the overall waste generation rate for all the business present at the site as well as the largest contributors to the waste stream in Tulagi. In comparison to household waste stream in Tulagi, there are more papers/cardboards and plastics and less hygiene, e-waste and others.

CATEGORY	TOTAL WEIGHT	Total %
Organic	15.7kg	32%
Paper/Cardboards	13.5kg	26%
Plastic	8.9kg	18%
Metal	4.7kg	9%
Glass	2.6kg	5%
E-waste	4.4kg	9%
Battery	0.1kg	0%
Hygiene	0.1kg	0%
Others	0.7kg	1%
Total	50.7kg	100%

Table 8: Commercial Waste Composition of Tulagi Town







Graph 9: Daily Commercial Waste Composition of Waste Stream in Tulagi Town

The graph 9 presented above and in table 8 represents the commercial waste stream similar to that of the domestic waste stream. Although 32% less than that of the domestic waste stream, the organic waste makes up about 32% of the waste composition followed by paper/cardboard (26%), plastics (18%), Metal (9%), E-waste (9%), Glass (5%), and Others (1%). The other categories are significantly low.

Approximately 32% of the commercial wastes types have the potential for composting and small scale bio-gas (organic waste/ grass/leaves/wood/betel nut).7% have the potential for recycling (aluminium cans & other metals). A total of29% can be potentially utilized for reuse or recycling (plastics & pet bottle (1%), paper/cardboard (26%) bottle SB beer (2%). Of the total commercial waste stream, ~68% of the waste can potentially be prevented from ending up at the dumpsite and can be a potential business opportunity. This in turn if employed can lengthen the life span of the landfill.

Category		Domestic (kg)	Commercial kg	total (Kg)	Total (%)
	Waste Types				
Organic	Kitchen waste	72.5	3.8	76.3	55.0
	Woods	0.5	0.5	1.0	0.7
	Grass/Leaves	2.2	2.4	4.5	3.2
	Betel Nut	6.1	6.3	12.4	8.9
	Other Organic	5.5	3.0	8.5	6.1
Plastic	PET Bottles	1.6	0.7	2.3	1.7
	Plastic bags	1.2	0.1	1.3	0.9
Metals	Aluminium Cans	4.2	1.3	5.5	4.0
	Other Metal	3.5	1.8	5.3	3.8
Glass	Beer bottle	0.3	1.1	1.4	1.0
Paper/Cardboard	Paper	2.9	4.6	7.5	5.4
	Cardboard	4.0	8.7	12.7	9.1

Table 9: Recyclable Waste Composition of Tulagi Town

			NOUND THE REAL OF	CONSERVATION I
Total		138.7	100	

Table 10. Other Waste Composition in Tulagi Town	Table 10: Other	Waste Composition	in Tulagi Town
--	-----------------	-------------------	----------------

Category	Waste Types	Domestic	Commercial	Total	%
Paper/Cardboard	Liquid paperboard (Juice Box)	0.1	0.3	0.4	0.8
Plastic	Expanded Polystyrene foam	0.1	2.9	3	6.3
	Hard Plastic Bottles (HDPE)	1.5	0.8	2.3	4.8
	Other Plastics	4.7	4.8	9.5	20
Metal	Steel can/Tin	8.0	1.4	9.4	19.8
Glass	Glass Bottle wine/Spirit	0.4	0	0.4	0.8
	Glass Jar	0.2	0	0.2	0.4
	Other Glass	7.4	1.7	9.1	19.2
E-waste	Other Electrical Device	0.2	0.1	0.3	0.6
	Computer Equipment	0	4.3	4.3	9.1
Battery	Lithium Battery	0.6	0.1	0.7	1.5
Hygiene	Nappy/Diaper	5.2	0	5.2	10.9
	Other Sanitary Waste	0	0.1	0.1	0.2
others	Textile	1.0	0.1	1.1	2.3
	Leather/Rubber	0.8	0.2	1.0	2.1
	Cigarette Butts	0.1	0	0.1	0.2
	Other	0.1	0.3	0.4	0.8
	Total			47.5	99.8

#### Graph 10: Recyclable Waste Composition in Tulagi Town



Table 10 & Graph 10 shows that Kitchen waste is the highest in the recyclable composition followed by cardboard, betel nut/ other organic/paper/Aluminium can/ grass & leaves/wood/beer bottle/plastic bags and pet bottles. There is indication of the potential to introduce the concept of composting, biogas and also 3R concept to reduce the amount of recyclables. The low percentage of aluminium cans and beer bottles suggest the effectiveness of individual locals and some commercial business who is collecting aluminium cans and beer bottles for reselling to recyclable companies.





#### Graph 11: Other Waste Composition in Tulagi Town



Graph 11 and Table 10 illustrated that Steel tin and other plastics make up the highest in the waste composition followed by other glass, nappy/diaper, computer equipment, expanded polystyrene foam, hard plastic bottles (HDPE), textile, lithium battery leather/rubber, liquid paperboard, other electrical device, glass bottle wine/spirit and others. The rest are significantly low. These are the waste which will end up at the dump site.

Category		Domestic (kg)	Commercial kg	Total	Total (%)
	Waste Types			(Kg)	
Organic	Kitchen waste	72.5	3.8	76.3	41
	Woods	0.5	0.5	1	1
	Grass/Leaves	2.2	2.4	4.6	3
	Betel Nut	6.1	6.3	12.4	7
	Other Organic	5.5	3	8.5	5
Plastic	PET Bottles	1.6	0.7	2.3	<mark>1</mark>
	Plastic bags	1.2	0.1	1.3	<mark>1</mark>
	Expanded Polystyrene foam	0.1	2.9	3	<mark>2</mark>
	Hard Plastic Bottles (HDPE)	1.5	0.8	2.3	<mark>1</mark>
	Other Plastics	4.7	4.8	9.5	<mark>5</mark>
Metals	Aluminium Cans	4.2	1.3	5.5	3
	Steel can/Tin	8	1.4	9.4	5
	Other Metal	3.5	1.8	5.3	3
Glass	Beer bottle	0.3	1.1	1.4	1
	Glass Bottle wine/Spirit	0.4	0	0.4	0
	Glass Jar	0.2	0	0.2	0
	Other Glass	7.4	1.7	9.1	5
Paper/Cardboard	Paper	2.9	4.6	7.5	4
	Cardboard	4	8.7	12.7	7
	Liquid paperboard (Juice Box)	0.1	0.3	0.4	0
E-waste	Other Electrical Device	0.2	0.1	0.3	0
	Computer Equipment	0	4.3	4.3	2
Battery	Lithium Battery	0.6	0.1	0.7	0
Hygiene	Nappy/Diaper	5.2	0	5.2	3

Table 11: Overall Waste composition in Tulagi Town





	Other Sanitary Waste	0	0.1	0.1	0
others	Textile	1	0.1	1.1	1
	Leather/Rubber	0.8	0.2	1	1
	Cigarette Butts	0.1	0	0.1	0
	Other	0.1	0.3	0.4	0
				186.3	100

Graph 12: Overall Waste Composition in Tulagi Town



Table 11 & Graph 12 illustrated that half of the waste composition is organic waste. It is followed by plastics, steel tin and paper/cardboard. The rest are significantly low. The graph presented that there is potential an opportunity to introduce the 3R concept. Should this be introduced, the waste disposed at the dumpsite at Tulagi will be reduced and prolongs the lifespan for the limited dumpsite area.





## 5.0. Discussion

### 5.1. Waste Generation



census is approximately 1,750 inhabitants. It is estimated that the average waste generation rate is 0.22kg/ person/day for the households sector whilst the average waste generation rate is 0.01kg/m2/day and 0.10kg/person/day for the commercial sector. The bulk waste density for the domestic household is 284.5 kg/L or 284.5 kg/m3. For the commercial sector, the average bulk density is 100 kg/L or 100 kg/m3.

The population of Tulagi as per the 2009

Figure: Tulagi dumpsite© ECD 2019.

Given the population, the waste generation per day for the whole population is 38.5 kg per day for domestic. Overall, the result also indicates that organics have the highest composition both at the household level and commercial sector, thus it can be minimized through promotion of backyard or home composting and small scale biogas. The waste composition has 9 waste categories and each have different waste types that make up the waste composition in Tulagi Town (see graph 12 for overall waste composition ).

Although there is a waste collection system in place in Tulagi, some areas are lacked access to the collection services. The areas which lacks collection services deal with their waste either by burned, buried or dumped indiscriminately in the bush, sea or beside the roads. An alarming issue is with open dumping and burning of medical wastes next to the current dump site of Tulagi that will pose long term risk to the population. Also one of the environmental issue face by the Province is the high number of shipwrecks.

On a brighter note, there are some waste reduction initiatives undertaken by individual households and a few commercial business. Some of these initiatives includes composting for soil improvement to grow plants and vegetables and reuse of organics for feeding pigs. One of the commercial business operations in Tulagi, Raiders Hotel practices waste segregation within their compound. Bottles are stored in baskets to be reused, organics from kitchen are reused by staff to feed pigs and leaves or grass are composted. Whilst recyclables such as beer bottles and aluminium cans are taken to Honiara to be sold to BJS and solbrew distributors.

The current waste disposal site for Tulagi is situated in a crown land further west of Tulagi Island. Also a proposed landfill site is located in the same area with a 0.3 hectares of land. This site will be developed into a managed landfill for Tulagi Town (see figure 10).





## 5.2 Waste Minimization (3Rs Initiatives)

There are few individuals and businesses in Tulagi who is doing composting and also collecting their own recyclables. This could be the reason why the percentage of Beer Bottles and Aluminium cans in the waste bin is less than expected. The cans are shipped to Honiara where it is sold to BJS and Solbrew. Also plastic bags and pet bottles percentage are less than expected, due to increase rate of plastic scheme in the country.



Figure 11 & 12: Composting and Pet bottle storage at Raiders Hotel

# 6.0. Challenges

### 6.1. Road Access

One of the challenges to conducting the waste audit in Tulagi is the limited road access to some of the households located inland or up on the hill which vehicles cannot reach. Staff involved in the waste survey had to walk by foot to reach the households located inland or up on the hills to collect the plastic waste bags every day.

#### 6.2. Inconsistency of data collection

It is important that data collection is consistent for the duration of the waste survey. However, this was not the case for some of the sampled households because the member of the household who have the information on the waste survey went to Honiara or other location without informing the other members of the households. Another reason would be that the household were not properly informed of their required participation throughout the eight days survey which resulted in households not placing their plastic waste bags ready for collection. Thus, resulted in missing data for some of the days during the survey for some households.

#### 6.3. Procedure for waste audit/survey

There was no in-house training conducted on the overall procedure for the waste audit/survey which resulted in some confusions on the method to conduct the survey. Another reason is that some of the team members are new to the procedure. Others who have previously involved in similar waste audit in the past need a refresher training to prepare all for the actual task.

#### 6.4. Data analysis





This is related to the limitation highlighted under subsection c on the lack of in-house training and refresher training for team members involved in the waste audit. It is important that analysing the data should be reviewed with all the team members to avoid any errors or miscalculations in the data generated. Through this process, all the staff involved will be able to understand the process of the waste survey and acquire the required skill both in conducting the survey as well as in analysing the data collected for planning and decision making process.

#### 6.5. Plastic scheme

One of the other issues faced during the waste audit conducted in Tulagi is the Plastic scheme. During the start of the survey, the plastic bags containing wastes to be collected from one household was placed at the police station without informing any other staff, this resulted in the wastes disposed and the plastic taken to be pressed in a PET bottle by another staff from the office. Another incident involved a member of a particular household not using the plastic bag that was issued for the next day's collection but cutting it up to be put into a PET bottle because they were not properly informed.

#### 6.6. Lack of Awareness

Most of the households were not aware of the waste audit survey that had to be conducted over a period of 8 days and that their continuous participation to provide wastes in the plastic bags provided is required. There was no information sheet or brochure prepared for households, thus resulted in lack of proper dissemination of information and understanding of the survey as well as inconsistency of data.

#### 6.7. Health-Care Waste (Medical Waste)

Health care waste management is a critical issues in the country and Tulagi hospital no exception. With the absence of an incinerator, managed landfill, waste segregation at health facilities is of no effect. As per the infection control guideline, it is a requirement that health care waste is managed in ways that will reduce the risk of exposure to health care workers, patients and general public. However, given the gap in the waste management system, there is a risk of exposure to infectious waste that have the potential to spread diseases and even risk to environment.

#### 6.8. Public Attitude and Awareness

Indiscriminate dumping of empty plastic wrappers, plastic bags, empty beer cans, solbrew bottles and soft drinks are seen along roadside, near buildings, along the shore and bushes is a testament of the general attitude and behaviour of the residents. On the other hand, to blame it lack of awareness is not enough. To change the attitude and behaviour requires the following:

- Frequent of public awareness and education on waste management to remind residents; and

Supportive environment which includes a waste collection system with the provision of waste bins and enforcement of the litter bylaws.

## 7.0. Recommendations

#### 7.1. Training/Awareness

In-house training for staff who are new to conducting a waste audit survey and a refresher training for staff who have previously been involved in the waste survey is recommended for future similar





programs. This will ensure all officers involved are clear on what is expected to be done and on the overall process.

#### 7.2. Information Sheet/Brochure

It is important to inform households and commercial business of the need for their continuous participation in the waste survey and to get their understanding of the activity. This can be done through development of a brochure and or an information sheet is to be distributed to the sampled households before the actual waste audit is implemented.

#### 7.3. Co-funding /Cost-sharing

It is also important and recommended that budget for future activities are continued to be co-funded or costs are shared by partners/stakeholders. This will also address the issue of lack of human resources as well as limited budget.

#### 7.4. Team collaboration & Partnership

Team work between partners /stakeholders also builds trust, collaboration and partnership. It is highly recommended that this be maintained in planning and organizing of future programs.

#### 7.5. Capacity Building

Engagement of provincial staff in the waste survey also builds capacity of staff in-terms of sharing of knowledge and skills. In addition, local/provincial staff will be trained with the required skill to conduct similar tasks in the future. Those staff conducting in the waste audit will also build their confidence and skill in training other people in waste survey in the future.

#### 7.3. 3Rs Promotion (Initiatives)

The potential for 3R is high with about ~74.9 % organic waste and around 25% with the potential for reuse or recycle (kitchen waste, plastics, grass/leaves/wood, betel-nut, glass/ceramics, aluminium cans and tins).

Organic waste can be turned into compost and sold or given to households to improve soil for planning of flowers and/or vegetables or fruit trees. This in turn will not only contribute to beautify the environment but promote nutrition among residents.

The other recyclables can be collected and sold or can be used as teaching aids in class or other materials that can be used at home such as floor mat, storage containers and so forth.

For the above to be achieved firstly training is required to transfer basic skills to the residents. Solomon Islanders are known for our creativity and combined with basic knowledge and skills, the residents can turn recyclable waste into a more useful products with value.

Secondly, waste separation at the source must be promoted. This will ensure that recyclable wastes are separated from other waste which does not have further value.

## 8.0. Conclusion

The Waste audit that was conducted from 31<sup>st</sup> July to 7th August 2019 in Tulagi, Central Province was successfully conducted despite some challenges faced.

The results from the waste survey indicates that the average waste generation rate for the domestic level (households) in Tulagi is 0.22kg/person/day. In contrast, the waste generation





rate for the commercial sector in Tulagi is 0.01kg/m<sup>3</sup>/day. Overall, the data suggests that organics have the highest composition both at the household level and commercial sector, thus it can be minimized through promotion of backyard or home composting. Other feasible ways to reduce organics includes to feed pigs or utilized in turning waste into energy through the biogas.

The waste characterisation study has identified gaps and potential opportunities to develop a comprehensive solid waste management system for Tulagi in the future.





## 9.0. References

Ministry of Agriculture & Livestock, 1996. Quarantine Act. Solomon Islands Government,

Honiara

- Ministry of Environment Climate Change Disaster Management & Meteorology, 1998. Environment Act. Solomon Islands Government, Honiara.
- Ministry of Environment Climate Change Disaster Management & Meteorology, 2010. Protected Areas Act. Solomon Islands Government, Honiara.
- Ministry of Environment Climate Change Disaster Management & Meteorology, 2017. Wildlife Protection & Management (Amendment) Act. Solomon Islands Government, Honiara.
- Ministry of Environment Climate Change Disaster Management & Meteorology, 2019. Tulagi Map. Solomon Islands Government, Honiara.
- Ministry of Finance & Treasury, 2009. National Census Data. Solomon Islands Government, Honiara
- Ministry of Infrastructure & Development, 1990. Ports Act. Solomon Islands Government, Honiara.
- Ministry of Infrastructure & Development, 1998. Shipping Act. Solomon Islands Government, Honiara.

Solomon Islands: Waste Management and Pollution Control strategy 2017-2026. Apia, Samoa: SPREP, 2017.





## List of Annexes

House	Famil	Day	1	2	3	4	5	6	7		Ava	Waste
No	y Size	Date	4/0/40							Total	Daily	Gene
		Unit	1/8/19 kg	2/8/19 ka	3/8/19 ka	4/8/19 ka	5/8/19 ka	6/8/19 ka	//8/19 ka	{	Waste	Rate
		1	3.2	2.6	2.3	1.8	2.0	1.9	6.1		2.8	0.47
1	6									19.9		
2	5	2	0.6	0.5	0.6	1.1	0.4	0.4	1.1	4.8	0.7	0.14
-	-	3	0.7	1.0	1.6	2.0	2.7	3.0	2.1	4.0	1.9	0.17
3	11									13.1		
4	6	4	0.1	1.3	1.8	1.7	1.3	0.8	5.1	12 1	1.7	0.28
-	-	5	0.7	1.1	1.0	0.5	1.6	1.8	0.4		1.0	0.11
5	9									7.1		
<b>c</b>	2	6	0.6		0.4	0.5	0.7	0.1	0.4	2.0	0.4	0.13
6	3	7	0.6		12	2.0	1.0	0.0	2.0	2.9	1.5	0.25
7	6	-	0.0		4.5	2.0	1.0	0.0	2.0	10.7		
		8	1.5	0.5	0.3	0.8	0.2	0.4	0.4		0.6	0.09
8	7	0								4.0	1.0	0.14
9	7	3	0.8	1.1	2.1	0.4	1.2	0.2	0.9	67	1.0	0.14
-	-	10		0.9	0.6	0.7	0.5	0.5	4.8	•	1.1	0.37
10	3									8.0		
44		11	0.6	1.8			3.7	4.8		10.0	1.5	0.38
- 11	4	12	0.5	3.0	1.7		1.7			10.0	1.0	0.13
12	8									6.9		
10	_	13		3.5	0.7	2.9	2.2	2.3	6.6	40.0	2.6	0.37
13	· ·	14	0.7	0.7	0.2		0.9	0.0		18.2	0.5	0.25
14	2		0.7	0.7	0.5		0.8	0.8		3.2	0.0	0.20
		15			0.7	0.7	1.2	3.2	0.2		0.9	0.90
15	1	46								6.0	0.4	0.40
16	1	10		0.8	0.8	0.6	0.1	0.4		28	0.4	0.40
	•	17	2.1		1.7	1.6	0.5	0.4	0.8		1.0	0.13
17	8									7.0		
10		18		0.7	1.5	2.5	3.2	1.6	3.2	40 E	1.8	0.16
10	11	19		2.0	0.4	0.2	0.9	0.4	27	12.5	0.9	0.13
19	7	-		2.0	0.4	0.2	0.5	0.4	2.7	6.5		
		20	1.5	0.4	0.3	0.6	0.2	0.2	1.8		0.7	0.12
20	6	21	0.6	0.2		0.4	0.0	0.5	11	5.0	0.6	0.20
21	3	~	0.0	0.5		0.4	0.5	0.5	1.1	3.9	0.0	0.20
22		22	1.6	1.4		1.2		0.8			0.7	0.18
22	4	23	1.0	2.0	0.7	1.6	2.6		11.5	5.0	2.8	0.93
23	3		1.0	2.0	0.7	1.0	2.0		11.0	19.4		
24	-	24	0.6	1.2		1.0				2.0	0.4	0.08
24	5	25	1.0	1.1	1.3	0.5	0.2	0.1	0.3	2.0	0.6	0.12
25	5									4.4		
26	5	26	0.4		0.9	11.5	6.4	2.5	7.4	29.0	4.1	0.82
20	5	27				1.7		0.9	1.5	23.0	0.6	0.20
27	3									4.1		
28	2	28	1.2	0.5	0.8	1.8	0.5	0.6	0.3	5.8	0.8	0.40
	-	29	0.4	1.4		1.1	0.6	0.1	0.3	0.0	0.6	0.10
29	6	-		0-					4-	3.9	4.0	0.00
30	6	30	0.3	0.5	7.1	1.2	0.9	1.1	1.7	12.7	1.8	0.30
L												

## Annex 1. Tulagi Household Raw Data (Daily Waste Generation)





		31			0.5	1.2	0.6	1.3	3.2		1.0	0.08
31	12									6.7		
		32			1.2	2.2	1.4	1.7	3.6		1.4	0.28
32	5									10.1		
Total	177	21.5	30.1	35.5	45.9	40.2	33.5	69.3	69.3	276.0	39.4	0.22

276.0 Total Waste 39.4 Kg/day 0.22Kg/person/day

\* Total Waste = 276.0 kg

\* Average daily Wast (ADW) = 39 kg/day

\* Waste Generation Rate = 0.22Kg/person/day

\* Waste Generation Rate = Total # of Waste Weight/days/Total family size





## Annex 2: Corresponding Weights of Household Sector (Number of Bucketful loads & Waste Volumes)

Day 1		Da	iy 2		Da	iy 3		Da	y 4		Da	ay 5		Da	y 6		Da	iy 7				
HH No.	No of Bins Loa ds	Wast e Volu me	HH No.	No of Bin Loa ds	Wast e Volu me	HH No.	No of Bin Loa ds	Wast e Volu me	HH No.	No of Bin s Loa ds	Wast e Volu me	HH No.	No of Bin s Loa ds	Wast e Volu me	HH No.	No of Bin s Loa ds	Waste Volume	HH No.	No of Bin s Loa ds	Wast e Volu me	Week ly No. of Bins	Week ly No. of Volu me (L)
1	5/4	25	24	1/2	10	10	1/4	5	17	1	20	16	1/8	3	17	1/2	10	21	1/4	5	3.88	78
3	1/4	5	30	1/2	10	30	1	20	10	3/4	15	32	1/2	10	25	1/8	3	23	1/2	10	3.63	73
5	1/4	5	8	1/4	5	16	1/4	5	25	1/8	3	5	1/4	5	16	1/8	3	9	1/8	3	1.38	29
20	1/4	5	1/	1	20	14	1/9	3	31	1/2	10	13	1/4	5	10	1/8	3	15	1/8	3	2.38	49
23	1/4	10	22	1/4	5	32	1	20	32	1	20	3	3/4	15	30	1/2	10	30	1/4	5	4.25	85
8	5/4	25	20	1/4	5	20	1/4	5	22	1/4	5	14	1/4	5	10	1/2	3	8	1/4	5	2.63	53
21	1/8	3	7	1/2	10	31	1/4	5	28	1/2	10	9	1/4	5	5	1/4	5	18	1/2	10	2.38	48
7	1/2	10	11	1/4	5	2	1/4	5	16	1/8	3	20	1/8	3	1	1/4	5	4	1/2	10	2.00	41
9	1/2	10	10	1/4	5	17	1/4	5	29	1/4	5	28	1/8	3	15	1/2	10	5	1/4	5	2.13	43
28	1/4	5	16	1/2	10	3	1	20	30	1/2	10	23	1	20	26	1	20	2	1/4	5	4.50	90
17	9/8	23	23	1/4	5	6	1/4	5	20	1/2	10	12	1/2	10	7	1/4	5	6	1/8	3	3.00	61
22	1/2	10	19	1	20	12	5/4	25	13	1	20	19	1/8	3	14	1/2	10	31	1/2	10	4.88	98
20	1/2	10	25	1/4	5	1	1/4	5	23	1/4	5	11	1/2	10	13	1/4	5	20	1/4	5	2.25	45
23	1/8	3	1	1/4	5	5	1/8	3	1	1/4	5	30	1/2	10	19	1/8	3	17	1/2	10	1.88	39
4	1/8	3	18	1/8	3	18	1/8	2	4	1/2	10	26	11/4	55	6	1/8	3	26	21/6	70	7.25	147
Total	7.50	152		6.13	123	10	6.63	134		7.5 0	151		8.00	162		4.75	98		7.88	159	48.38	979

\* The Volume of the bucket is 20 litres





## Annex 3: Daily Volume (Density) Tulagi Household Sector

	Weekly	Total	Days	1	2	3	4	5	6	7
	Individual	No. of	Date	Thu	Fri	Sat	Sun	Mon	Tue	Wed
	Waste (m3)	Persons								
			Unit	(m3)						
No of Bucketful loads*				7.50	6.13	6.63	7.50	8.00	4.75	7.88
	979	177								
Daily total volume				152	123	134	151	162	98	159
	0.97	177								
Total Waste Volume				0.15	0.12	0.13	0.15	0.16	0.10	0.16

\*Total waste 276.0kg

\*Waste Volume 0.97m3

\* Waste Density 284.5kg/m3

\*Waste Density = Total waste /waste Volume





## Annex 4: Daily Household Waste Composition Table

Category	Waste Types	Day/kg						Total	%	Sub total	
		1	2	3	4	5	6	7	Weight		
		-	-	5		, , , , , , , , , , , , , , , , , , ,	Ŭ		Weight .		
	Kitchen waste	4.8	10.7	12.0	10.6	14.3	11.1	9.0	72.5	54%	
	Wood/Timber	0.2	0.1	0.0	0.1	0.0	0.0	0.1	0.5	0%	
Organic	Grass/Leaves	0.4	0.2	0.7	0.4	0.2	0.1	0.2	2.2	2%	64%
	Betel-Nut	1.3	1.1	0.8	0.5	0.7	0.8	0.9	6.1	5%	86.8kg
	Other organic			0.7	1.4	2.8		0.6	5.5	4%	
	Paper	0.5	0.9	0.3	0.3	0.3	0.3	0.3	2.9	2%	5%
Paper/Card board	Cardboard		0.2	0.3	1.0	1.4	0.5	0.6	4.0	3%	7.0kg
	Liquid paperboard (juice box)			0.0		0.0			0.1	0%	
	Pet Bottle (Drink)	0.1	0.2	0.2	0.1	0.2	0.2	0.6	1.6	1%	
	Hard Plastic Bottle (HDPE)	0.5	0.3				0.2	0.5	1.5	1%	7%
Plastic	Expanded Polystyrene foam		0.0		0.0		0.0	0.0	0.1	0%	9.1kg
	Plastic Bag	0.1	0.2	0.1	0.2	0.3	0.2	0.1	1.2	1%	
	Other Plastic	0.8	0.2	0.5	0.9	1.5	0.3	0.5	4.7	3%	
	Aluminium Can	0.9	0.0	0.2	0.4	0.6	0.1	2.0	4.2	3%	
	Aluminium Recyclable										12%
Metal	Steel can/Tin	2.1	1.3	0.4	1.1	1.4	1.0	0.7	8.0	6%	15.7kg
	Other Metal	0.2		0.3	0.5	0.8	0.2	1.5	3.5	3%	
	Glass Bottle Beer			0.3					0.3	0%	69/
Glass	Wine/Spirit			0.4					0.4	0%	0%
	Glass Jar		0.2						0.2	0%	8.3kg
	Other Glass	3.9	1.2	1.4	0.4	0.2	0.0	0.3	7.4	6%	
	Computer Equipment										
E-Waste	Mobile Phone										0.2kg
	Other Electrical Device	0.2							0.2	0%	
	Electrical Item/Peripheral										
	Lithium Battery		0.0		0.0	0.0		0.2	0.3	0%	
Battery	Used Lead Acid Battery										0.3kg
	Other Battery										
	Feminine Hygiene (Sanitary Pad)										40/
нудіепе	Nappy/Diaper	0.2	0.0	0.8	1.5	0.6	1.3	0.8	5.4	4%	4%
	Medical Waste		0.0						0.0	0%	5.5Kg
	Waste		0.0	0.1		0.1	0.0		0.3	0%	





	Hazardous Contaminated used Oil										
	Textile	0.2	0.3	0.0	0.3	0.1	0.1	0.0	1.0	1%	
	Ceramics/Stone										
	White Goods										2%
Others	Fishing/seafood, Plastic										2.1kg
	Fishing/seafood, wood										
	Tyres										
	Leather/Rubber			0.5	0.1	0.2	0.0	0.0	0.8	1%	
	Cigarette Butts		0.0	0.0	0.0	0.0	0.0	0.0	0.1	0%	
	Others			0.1				0.0	0.1	0%	
Total Waste		16.4	17.3	20.2	19.8	25.8	16.5	19.0	135.0	100%	135.0





### Annex 5: Daily Commercial Waste Generation in Tulagi

Commercial No	No. of Employees (Person)	No. of Rooms (Rooms)	Floor Size (m2)	Days 1 kg	2 kg	3 kg	4 kg	5 kg	6 kg	7 kg	Weekly Individual Waste (Kg)	Average Daily Waste Kg/day	Waste Generation Rate Kg/m2/day	Waste Generation Rate Kg/room/day	Waste Generation Rate Kg/person/day
TuC1	20	2	99.2		1.1	0.6	8.8	0.6	0.7	0.4	12.2	1.7	0.02	0.85	0.09
TuC2	30	16	756.25	1.5	0.5	0.2			1.1	1.6	4.9	0.7		0.04	0.02
TuC3	2	2	35.75	2.3	0.1	0.7				0.4	3.5	0.5	0.01	0.25	0.25
TuC4	10	2	150				0.9	0.3	0.9	0.2	2.3	0.3		0.15	0.03
TuC5	12	6	128.8	1.2	0.9	2.3	2.3	3.5	6.9	5.3	22.4	3.2	0.02	0.53	0.27
TuC6	2	2	117	1.6	1.1	1.5	2.0		1.1	2.1	9.4	1.3	0.01	0.65	0.65
TuC7	2	2	43	0.7	0.1	0.2	0.1	0.7	0.2		2.0	0.3	0.01	0.15	0.15
Total	78	32	1,330.0	7.3	3.8	5.5	14.1	5.1	10.9	10.0	56.7	8.0	0.07	2.62	1.46

\*Waste Generation Rate for Floor area = Total waste weight/Total floor area/day

0.01 kg/m2/day = 50.7kg/1330m2/7day

\* Waste Generation Rate for employees = Total waste weight/persons/day

0.10kg/m2/day = 56.7kg/78/7

Annex 6: Average daily waste (ADW) and Waste Generation Rate (WGR) for Commercial Sector.

		Waste Generation Rate						
Average Daily Waste (ADW)	8kg/day	Kg/m2/day	Kg/person/day					
WGR		0.01	0.10					





## Annex 7: Corresponding Weights of Commercial Wastes Sector (Number of Bucketful loads).

Da	y 1		Da	y 2		Da	iy 3		Da	iy 4		Da	y 5		Da	ay 6		Da	iy 7			
HH No.	No. of Bins Ioads	Wast e Volu me	HH No.	No. of Bins loads	Waste Volum e	HH No.	No. of Bins Ioads	Waste Volum e	HH No.	No. of Bins Ioads	Waste Volum e	HH No.	No. of Bins loads	Wast e Volu me	HH No.	No. of Bins loads	Waste Volum e	HH No.	No. of Bins Ioads	Waste Volum e	Weekly waste Bins	Weekly waste volume (L)
TuC1	*	*	TuC1	1/3	7	TuC1	*	*	TuC1	2	40	TuC1	1/2	10	TuC1	1/4	5	TuC1	1/8	3	3.21	65
TuC2	1	20	TuC2	1/4	5	TuC2	1/8	3	TuC2	*	*	TuC2	*	*	TuC2	1	20	TuC2	1/8	3	2.51	51
TuC2	1	20	TuC2	1/4	5		1/2	7	TuC2	*	*	TuC2	*	*		*	*		_,_	20	2.58	52
Tues	*	*	Tues	*	*	Tues	*	*	Tues	4/4		Tues	1/0	2	Tues	1/0	2	Tues	1/0	20	0.64	14
TuC4	*	Ť	TuC4			TuC4		*	TuC4	1/4	5	TuC4	1/8	3	TuC4	1/8	3	TuC4	1/8	3	8.70	174
TuC5	1	20	TuC5	1/5	5	TuC5	1	20	TuC5	6/4	30	TuC5	2	40	TuC5	2	40	TuC5	1	20	6.75	405
TuC6	1	20	TuC6	1	20	TuC6	1	20	TuC6	1	20	TuC6			TuC6	3/4	15	TuC6	2	40	6.75	135
TC7	1	20	TC7	1/4	-	TC7	1/4	-	TC7	1/0	2	TC7	1/2	10	TC7	1/0	2	TC7	*	*	2.26	46
Total		20	TuC7	1/4	5	TuC/	1/4	5	TuC/	1/8	3	TuC7	1/2	10	TuC/	1/8	3	TUC7		*	26.65	537
B&V	5	100		2.33	47		2.71	55		4.88	98		3.13	63		4.26	86		4.39	89		

## Annex 8: Daily Volume (Density) of Commercial Waste Sector

Day	1	2	3	4	5	6	7
No of Bucketful loads*	5.00	2.33	2.71	4.88	3.13	4.26	4.39
Daily total volume	100	47	55	98	63	86	89

\* The Volume of the bucket is 20 litres

	Waste	Day/kg							Weekly Individual	%	Sub- total
Category	Types	1	2	3	4	5	6	7	Waste (kg)		
	Kitchen waste		0.7				1.4	1.7	3.8	7%	
	Wood/Timber	0.1	0.1		0.1	0.1	0.0	0.0	0.5	1%	32%
Organic	Grass/Leaves	0.0	0.1	0.4	0.0	0.7	0.5	0.6	2.4	5%	15.9kg
	Betel-Nut	0.5	0.8	0.1	2.1	0.4	0.5	1.9	6.3	12%	
	Other organic	0.1		0.8	1.8	0.3			3.0	6%	
	Paper	1.9	0.3	0.1	0.4	0.2	1.0	0.7	4.6	9%	
Paper/Ca rdboard	Cardboard	2.8	0.7	1.2	0.5	0.8	1.2	1.5	8.7	17%	26%
	Liquid paperboard (juice box)	0.0		0.1	0.0	0.0	0.1	0.0	0.3	1%	13.6kg
	Pet Bottle (Drink)	0.0	0.1	0.1	0.1	0.2	0.1	0.1	0.7	1%	100/
	Hard Plastic Bottle (HDPE)	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.8	2%	18%
Plastic	Expanded Polystyrene foam		0.1	0.0	2.4	0.1	0.0	0.2	2.9	6%	9.3kg
	Plastic Bag			0.0		0.0	0.0	0.0	0.1	0%	
	Other Plastic	0.0	0.5	0.2	2.5	0.3	0.6	0.7	4.8	9%	
		0.0	0.5		2.5	0.5	0.0	0.7	1.0	570	
	Aluminium Can Aluminium Becyclable	0.3	0.0	0.1	0.3	0.4	0.1	0.1	1.3	3%	9%
Metal	Steel can/Tin	0.2	0.2	0.0	0.5	0.2	0.2	0.1	1.4	3%	4.6kg
	Other Metal	0.0		0.1	1.1	0.3	0.2	0.1	1.8	4\$	
	Glass Bottle Beer	0.3		0.3				0.5	1.1	2%	
Glass	Glass Bottle Wine/Spirit									270	5%
	Glass Jar										2.8kg
	Other Glass			0.2	0.5	0.1	0.9		1.7	3%	
	Computer Equipment				4.3				4.3	8%	
E-Waste	Mobile Phone										9%
	Other Electrical Device	0.1							0.1	0%	4.4kg
	Electrical Item/Peripheral	0.1							0.1	0/10	
	Lithium Battery		0.1						0.1	0%	
Battery	Used Lead Acid Battery										0.1kg
	Other Battery										
	Feminine Hygiene (Sanitary Pad)										
Hygiene	Nappy/Diaper										0.1kg
	Medical Waste	0.0							0.0	0%	
	Other Sanitary Waste				0.1				0.1	0%	
	Hazardous				0.1				0.1	070	

Annex 9: Daily Commercial Waste Composition for Tulagi Town

Total Waste		6.8	3.9	4.0	16.9	4.4	7.0	8.6	51.5	100%	51.5
	Others	0.1	0.0				0.0	0.2	0.3	1%	
	Cigarette Butts	0.0				0.0		0.0	0.0	0%	
	Leather/Rubber	0.1		0.1	0.0	0.0			0.2	0%	
	Tyres										
	Fishing/seafood, wood										
Others	Fishing/seafood, Plastic										
	White Goods										0.7kg
	Ceramics/Stone										1%
	Textile	0.0	0.0			0.0	0.0	0.0	0.1	0%	
	Contaminated used Oil										

### Annex 10: Waste Characterization Audit Procedure (Steps)

**Step 1:** Issue plastic bags with code to households and commercial areas. Record the population of household on data sheet corresponding to the Household and commercial house ID code.

**Step 2:** Provide households and commercial areas with leaflets or information sheet with explanation of the purpose of the waste characterization survey.

**Step 3:** Repeat (step 1) for each sample area on each day of waste characterization survey. Record the weight of the plastic bags collected from each sampled households and commercial houses.

**Step 4:** On the first day of waste audit, discard the wastes collected from the sampled households and commercial houses after recording the weights corresponding to the ID codes.

**Step 5:** After the first day of waste audit, on the second day till the final day (eighth day) of waste audit, collect the plastic bags from all the sampled areas, record corresponding weights of each samples.

**Step 6:** For the households, a random sample of fifteen bags are selected from the 32 households' samples and recorded on the data sheet. The number of bucketful loads of wastes of each of the fifteen sampled households are then recorded on a data sheet for the volume and density. After these are recorded, the plastic bags are then sorted to record the data on the waste composition for the households.

**Step 7:** For the Commercial houses, since the sample size is small, all the Commercial areas are weighed and recorded on the data sheet. The number of bucketful loads of wastes for each commercial areas are then recorded for their volume and density. After these sampled bags are recorded then the plastic bags are then sorted on the tarpaulin for the waste composition and categories for the commercial areas.

**Step 8:** To record the different types of wastes or categories for the Commercial and households waste composition, each type of waste is sorted according to a category in accordance with an earlier waste characterization that was conducted in 2018 in Auki. Once sorted, each category is also weighed and recorded in the data sheet for households and commercial areas.

**Step 9:** At the end of each waste audit, clean all used equipment and put out the tarpaulin out in the sun to dry for the next day.

**Step 10:** Throughout the eight days of waste audit, repeat steps 1-9 until the final day of waste survey.

#### Annex 11: Sample Household Questionnaire

Name of Community/Zone:	Date:
Household ID#:	Interviewer:
Weather:	

#### A. HOUSEHOLD

- 1. Name of Head of Household:
- 2. Gender of Head of households ( Male/Female):
- 3. Type of Household :
  - 01 -Nuclear family (parents with children)
  - 02- Adults only-no children under 16
  - 03- Extended family ( with etc)
  - 04- Others ( please specify)
- 4. Total umber of people living in the households:
- 5. Total number of male living in the households:
- 6. Total number of female living in the households:
- 7. No.of adults in the households:
- 8. No.of children in the households:
- 9. Where was the household in the last five years:
  - 01- Honiara
  - 02- Isabel
  - 03- Western
  - 04- Makira-Ulawa
  - 05- Rennell-Bellona
  - 06- Central
  - 07- Malaita
  - 08- Temotu
  - 09- Other places (specify)
- 10. How long has the household been in current location ?
  - 01- 0 to 5 yrs
  - 02- 6 to 10 yrs
  - 03- 11 to 15 yrs
  - 04- 16 to 20 yrs
  - 05- 21+ yrs
- B. LEVEL OF INCOME
- 11. Source of Income :
- 12. Number of people employed in the family:
- 13. Circle the average household income level per week:
  - 01- <\$50/wk
  - 02- \$50 to \$100/wk
  - 03- \$100 to \$300/wk
  - 04- \$300 to \$600/wk
  - 05- \$600 to \$1000/wk
  - 06- >\$1001/wk

#### Daily Diet:

Preference 1	(Produce or Buy)
Preference 2	(Produce or Buy)

Preference 3 (Produce or Buy)

Weekly number of soft drinks cans consumed:

```
Weekly number of water bottle consumed:
```

Weekly expense on groceries /shopping: SBD	per _	or _		_(total)
Weekly expense on groceries Transportation: SBD		per	_or	(total)
Weekly expense on groceries Electricity: SBD	per _	or		_(total)
Weekly expense on groceries Water Bill: SBD	per _	or		_(total)

- C. CHURCHES
- 14. Which Denomination most households members belongs to ?\_\_\_\_\_
- D. COMMITTEE
- 15. Is there any committee any member of the households belongs to?\_\_\_\_\_

#### E. HOUSEHOLD HEALTH

16. What are the most common health problems of household members?

- 01- Malaria
- 02- Dengue Fever
- 03- Diarrhea
- 04- Red Eye
- 05- Respiratory Problems (coughing, breathing difficulties, asthma)
- 06- Others
- 17. How important is waste management to you and your household? Very important/Important/A little important/Not Important
- 18. Have you ever heard about 3R concept?
- 19. If yes, where did you hear about 3Rs concept? Radio/FM, Posters/Pamphlets, Workshop/Conference,Newspaper,Others
- 20. Have you practised 3R concept?
- 21. If yes, what do you practise? Waste separation/composting/reuse of cans or bottles/ use of eco-bags/ sale of cans / others
- 22. How do you store the waste? Plastic bag/ drums/ wheelie bins/ platform/ others
- 23. Is there a waste collection service provided for your area/community/town?
- 24. If yes, how often is your waste collected? Twice a week/ once a week/ fortnightly/ once a month/ less than once a month/ no collection service/ never Rate the waste collection service from a scale of 1 to 10.
  - What is the reason for your score? What is your suggestion for future improvement?
- 25. If No, why do you think there is no waste collection service?
- 26. How do you dispose of the following wastes:

Food waste-
Garden waste-
Plastic bottles-
Plastic bags /plastics-
Glass bottles ( beer)-
Tin cans-
Aluminum cans-
Paper/Cardboards-

- 27. Are you aware of the waste collection /recycling services available? If Yes, how many? Did you get /have any information about the recycling services available? How did you get this information /where did you hear about it? Do you have a radio?
- 28. Willingness to pay for services

How much you are willing to pay if the waste collection is charged weekly or monthly? Do you support an idea of introducing a rubbish bag for people to put in their waste like in NZ,etc? These rubbish bags costs between 20 cents to \$1 and how much you can afford if Tulagi council sell the rubbish bags?

#### 29. CDL for Recycling Promotion

In order for cans , plastic bottles and bulky waste to be recycled and send overseas , we need to support The cost by introducing a waste levy like other countries.Do you support such plan?

30. Any other observations/views.

## Annex 12: Sample Commercial Business Questionnaire

Name of Business Establishment:	Date:
Name of owner:	Interviewee:
Interviewer:	

#### A. BUSINESS

- 1. Which days of the week you are open?
  - 01- Mon to Fri
  - 02- Mon to Sat
  - 03- Mon to Sun
  - 04- Others
- 2. What hours you are open?
- 3. How many full time staff do you employ?