



Kosrae State  
Solid Waste Management Strategy  
2018 – 2027  
(Action Plan: 2018-2022)





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## Foreword

Waste management remains one of the most pressing environmental, social and economic issues facing sustainable development in Kosrae State, FSM. As the State continues on a trend to rely less on locally sourced and produced food products but increasingly on imported consumer goods which are packed with plastic materials, waste oil, and motor vehicles; issues of waste collection and management is rapidly increasing.


With the US Compact funding coming to an end in five years, it is significantly important to focus on self-sustaining waste management systems to extend management in a sustainable manner. User pay principles are being explored to support sustainability of waste management including an effective collection system that self sustains and works best for everyone.

There has been significant progress with minimizing wastes going into landfills, from the development of the Container Deposit Legislation (CDL) system, and with development and maintaining of public landfill that incorporates suitable and sanitary practical methods. However, even with these successes, the challenges of managing waste still remains more problematic without comprehensive implementation of all aspects of waste management.

This Solid Waste Management Strategy is a roadmap to improve management of waste in four distinct areas: 1) improvement of waste collection; 2) improvement of CDL system; 3) improvement of public landfill; and 4) proper management of waste oil.

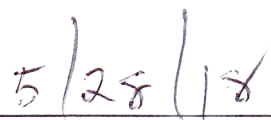
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It is my great honor on behalf of the Kosrae State Government to present to you the 2018 to 2027 Kosrae State Solid Waste Management Strategy.



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Lyndon H. Jackson  
Governor  
Kosrae State Government



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Date



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## ACRONYMS

AP	Action Plan
AWP	Annual Work Program
CDL	Container Deposit Legislation
DT&I	Department of Transportation and Infrastructure
DECCEM	Department of Environment, Climate Change and Emergency Management
FSM	Federated States of Micronesia
FY	Financial Year
JEMCO	Joint Economic Management Committee
JICA	Japan International Cooperation Agency
KIRMA	Kosrae Island Resource Management Authority
KSG	Kosrae State Government
MEC	Micronesia Eco Corporation
NIP	National Implementation Plan
NGO	Non-governmental Organization
OIA	Office of Insular Affairs pa Per annum (yearly)
PET	Polyethylene terephthalate
POPs	Persistent Organic Pollutants
SBOC	Office of Statistics, Budget and Economic Management, Overseas Development Assistance, and Compact management
SDP	Strategic Development Plan
SPREP	Secretariat of the Pacific Regional Environment Program
SSW	State Solid Waste
SSWMS	State Solid Waste Management Strategy
SWM	Solid Waste Management
SWMP	Solid Waste Management Plan
UNDP	United Nations Development Program

## **Executive Summary**

This new State Solid Waste Management Strategy (SSWMS) is formulated with the aim of enabling Kosrae State to establish a technically sound and financially sustainably solid waste management (SWM) system. To do so, this SSWMS consists of not only strategic elements but also a mid-term action plan of the first five years with technically, institutionally and financially appropriate options, which will propel realization of the SSWMS.

### **SWM issues targeted under the strategy**

SWM issues targeted under the strategy are summarized as follows based on the SWM present situation identified technically and quantitatively through waste flow analysis.

#### **Issue 1: Expansion of collection services along with step-by-step closure of community dump site**

As reiterated in previous sections, the collection services are provided by each of the four municipalities. The rate of households who receive collection service is as low as 37.5%. The reasons of this low collection rate are: (i) it is difficult to provide collection service due to the weak financial basis; (ii) lack of infrastructure development (underdevelopment of road in Utwe Municipality); and (iii) extremely high rate of direct haulage of waste to the public landfill sites in Kosrae. Expansion of the collection service will be achieved through community participation, mutual cooperation in municipalities and establishing a unified state collection system.

#### **Issue 2: Further efforts to minimize waste**

The Container Deposit Legislation (CDL) program in Kosrae, which contributes tremendously to reduction of littering and increase of peoples' environmental awareness, is one of the best-functioning CDL programs among many Pacific Island Countries. Even such a well-functioning system can be improved further to contribute more to waste minimization through restart of recycling system based on the CDL program at communities.

#### **Issue 3: Financial sustainability with sound institutional setting**

Last but not least, considering the financial sustainability of SWM is crucial at this juncture of the political economic situation faced by FSM. Both activities for expansion of collection services as well as minimization of waste shall be carried out with special attention to financial sustainability. There are many ways to secure financial sustainability of SWM such as privatization of certain activities and introduction of fee collection. Furthermore, regardless of the ways to secure financial sustainability, a responsible organization has to be set and appointed to ensure financial sustainability.

### **Strategy**

The Vision, Scope, Key Strategic Actions and Targets are set up to formulate the strategy, the new Kosrae State Solid Waste Management Strategy (SSWMS).

### **Vision**

A sustainable Kosrae State where the culture and environment are preserved for future generations through better management of Solid Waste.

### **Scope**

This new SSWMS covers the 10-year period from 2018 to 2027 with an action plan designed to be implemented for the first half of the period 2018 to 2022. A general review of the strategy will be undertaken in 2022 to update its relevance to the current needs and plan for the next activities for the remaining period of the new SSWMS.

The new strategy covers solid wastes generated in the household, institutional and commercial waste streams of the state, and those wastes are called State Solid Waste (SSW) in this strategy. The SSWMS does not cover medical waste or hazardous waste except those included in the CDL system.

### **Key Strategic Actions**

The SSWMS consists following four strategic actions:

- Improvement of waste collection system
- Improvement of the CDL program
- Proper management of public landfill site
- Proper treatment of waste oil

### **Targets**

Table 1 Targets of strategy

Item	Unit	2017	2022	2027
Recycling rate (to generation waste amount)	%	27.0	27.0	27.0
Collection rate (to discharge waste amount)	%	25.3	50.0	84.0
Inappropriate discharge rate (to generation waste amount)	%	8.9	7.3	1.0
Rate of waste transported to disposal site directly	%	71.0	43.6	14.6

### **Action Plan**

By reflecting upon the vision, the guiding principles and the identified SWM issues, the specific activities to pursue realization of the new SSWMS are articulated and presented in this chapter. This action plan, which defined the priorities in the next five years, is formulated based on the following assumptions.

### **Assumptions**

- Looking firmly ahead to “post-2023”, SWM sector in Kosrae State has to wean itself off of dependency on the Compact Fund from the U.S. Government, and pursue the establishment of a self-financing system.
- By responding to an immediate financial challenge, which is that the Small Sector Grant of the U.S. Compact Fund will no longer finance recurring costs, this action plan is formulated just like **a stand-alone project**. KIRMA will be an chief responsible agency for every component.

### **Title and components of the action plan**

The tentative title for the five-year action plan is ***“Action plan (Project) towards technically appropriate and financially sustainable SWM system in Kosrae State”***.

The action plan consists of the following four components:

- Component 1: Improvement of waste collection system
- Component 2: Improvement of CDL program
- Component 3: Proper management of public landfill site
- Component 4: Proper treatment of waste oil

**Implementation schedule for the Action Plan (the Project)**

Table 2 A schedule of the Action Plan (the Project)

Activities	Mid-term plan					Long-term plan				
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
1. Improvement of waste collection system										
1.1 Improve present collection system in each municipality and introduce station collection										
1.2 Propose integrated collection system which will be effective and low financial burden for municipalities										
1.3 Acquire collection vehicle(s) and equipment for integrated collection system										
1.4 Commencement of integrated collection system										
2. Improvement of CDL program										
2.1 Amend the Regulations pursuant to the CDL Act										
2.2 Recommence community collection										
2.3 Update equipment to increase handling efficiency										
2.4 Commencement of appropriate recycling										
3. Proper management of public landfill site										
3.1 Establish incoming waste management system										
3.2 Construction of dikes and disposal at second and third layers										
3.3 Prepare for construction of new landfill site										
4. Proper treatment of waste oil										
4.1 Prior consultation and feasibility study to incinerate waste oil generated other than power plant										
4.2 Preparation of Regulation (Ordinance) for proper treatment of waste oil										
4.3 Incinerate waste oil properly										

**Implementation cost for project**

Table 3 Project cost by components (US\$)

Components	FY2018	FY2019	FY2020	FY2021	FY2022	Total
Component1: Improvement of waste collection system	6,666	18,957	20,970	80,001	7,395	133,989
Component2: Improvement of CDL program	3,979	6,270	13,898	27,698	11,212	63,057
Component3: Proper management of public landfill site	28,545	68,848	35,214	35,700	36,063	204,370
Component4: Proper treatment of waste oil	6,626	28,907	37,215	37,701	38,427	148,876
Total	45,816	122,982	107,297	181,100	93,097	550,292

# **1 Formulation of State Solid Waste Management Strategy**

## **1.1 Objectives**

The previous State Solid Waste Management Strategy (SSWMS) of Kosrae State which covered the period of 2012 to 2017 defined certain strategic elements of managing wastes with due consideration on the issues at that time. While there were a number of initiatives undertaken and some challenges were overcome, several challenges remain. The strategic efforts have to be re-directed to focus on the remaining critical issues as well as emerging ones currently faced in the waste sector in Kosrae State.

By considering the above situation, this new SSWMS is formulated by aiming to enable Kosrae State to establish a technically sound and financially sustainable solid waste management (SWM) system. To do so, this new SSWMS consists of not only strategic elements but also a mid-term action plan of the first five years with technically, institutionally and financially appropriate options, which will propel realization of the new SSWMS.

## **1.2 Structure of the new SSWMS**

The new National Solid Waste Management Strategy (SSWMS) is presented in two parts:

Part One provides the current SWM situation currently faced in the waste management sector in Kosrae State. In this part, the current issues are ascertained through a two-step process, through first understanding of the current SWM situation and then analysis of the current SWM situation. As a first step, current waste flow is formulated based on a series of baseline surveys, and the situation is technically as well as quantitatively understood. Then, the issues and challenges are identified based on the waste flow.

Part Two presents the main body of the new SSWMS. It consists of the following: (i) the strategy which sets out the policy directions for next 10 years along with numerical targets; (ii) a mid-term action plan of the first five years to steadily make strides to reach numerical targets of the new SSWMS; and (iii) annual implementation plans. Part Two will define the direction Kosrae State should take to address the key issues presented in Part One.

## **PART ONE: CURRENT SWM SITUATION**

### **2 Current Situation and Issues**

#### **2.1 State Information**

##### **2.1.1 Geography**

Kosrae State is a single, volcanic high island, shaped roughly triangular and surrounded by a fringing coral reef system. The island is roughly triangular, with an area of about 11,186 ha (27.64 acres). The island's climate is characterized by high temperatures, heavy rainfall and high humidity. The average annual rainfall measured at the weather station in coastal Lelu is 5000 mm (200 in.); in the mountainous interior, rainfall is estimated to be as high as 7,500 mm (300 in) annually. The average temperature is 27 °C (81 F) at sea level. Average monthly temperatures vary from the annual average by not more than 1 °C, and the difference between the average minimum and maximum temperatures is less than 8 °C (14 F) throughout the year.



Source: <https://en.wikipedia.org/wiki/Kosrae>

Figure 2-1 Topographic Map of Kosrae State

## 2.1.2 Administration

The Kosrae State Government is made up of three branches – Executive, Legislative and Judicial. Local governance is divided into four municipalities: Lelu, Malem, Utwe, and Tafunsak. Each municipality has its own governance structure headed by a mayor with legislative functions performed by a municipal council. Kosrae State also participates in the national governance through its two congressmen, one of which serves a four-year term and the other serves a two-year term with the FSM Congress.

## 2.1.3 Population

The last census of population and housing in Kosrae recorded a population of 6,616 in the year 2010. This population is spread over more than 30 kilometers of coastal land surrounding nearly two thirds of the island. Lelu Island has the most concentrated housing and centers are evident in other places with housing located fairly close to established townships. Housing locations become very sparse in areas located between these townships. A remote village, Walung, is located at the north western shores with very few residences and no connection to roads.

## 2.1.4 Economic and Financial situation

Economic and financial situation in FSM in 2016 are summarized as follows.

Table 2-1 Economic and Financial situation

FY2016			Population	GDP per
GDP current prices (\$ million):	329.9	capita		
Population:		Chuuk:	46,688	1,994
102,453		Kosrae:	6,227	3,376
GDP per capita (\$):	3,220	Pohnpei:	37,893	4,313
GNI per capita (\$):	3,715	Yap:	11,645	4,495
GNDI per capita (\$):	4,785			
FY2016 GDP estimates are "Interim" until administrative data on business gross revenues becomes available				
			2010	2016
GDP, % growth			2.0	-0.1
Prices (annual percent change)				
- Consumer price index			3.6	-1.0
- CPI Domestic items			5.7	-0.1
- CPI Imported items			3.0	-1.3
Employment and Wages				
- Number of employees			15,702	15,339
- Average annual wage			7,704	8,299
- Average annual real wage (less inflation)			5,728	5,067
Government Finance Statistics, \$ millions				
- Revenue			200.3	226.6
- Expense			135.8	163.3

Source: FSM FY2016 Economic Brief August 2017



## 2.2 Current Situation on Solid Waste Management

### 2.2.1 Overview of SWM from the point of view of Waste Flow

Creation of waste flow is the very first step to understand the current solid waste management (SWM) situation well. A series of baseline surveys such as the waste generation survey at the household level and survey on incoming waste to the public landfill site were carried out in July 2017 and based on these results and data, allowed for the creation of the current waste flow for Kosrae. In this section, the current SWM situation of Kosrae will be presented. As for the details of how the waste flow was created, please see Annex 1.

- **Waste generation by source:** Around seventy percent (69.6 %) of waste generated is from households while the remaining 30.4 % is from sources other than households such as shops, restaurants, businesses, and public institutions. Managing household waste is of great importance.
- **Recycling:** As much as 23.6 % of generated waste is recycled on site. Also, 1.9 % of the generated waste, which is 140 kg (309 lbs per day) per day, is recycled under the Container Deposit Legislation (CDL) Recycling Program. Although it is only 1.9 % by weight, the CDL program tremendously contributes to the State's beautification, as well as helps to save space at the public landfill site. Moreover, wooden pallet for transportation disposed at public landfill site is recycled an average of 0.1 ton/day at the site.
- **Waste collection:** In Kosrae, collection services are provided by each of the four municipalities. Collection of waste through collection service is only 16.6 % of the generated waste (25.3 % of the discharged waste).
- **Final disposal:** As much as 87 % of the discharged waste, which is equivalent to 55.4 % of generated waste, is properly discharged to the public landfill site. The remaining 13 %, which is equivalent to 8.9 % of generated waste, is discharged to nearby open spaces.
- **Final disposal:** Only 29.3 % of the incoming waste to the public landfill site is collected by municipal governments, while the remaining 70.7 % is brought directly by households and business entities.

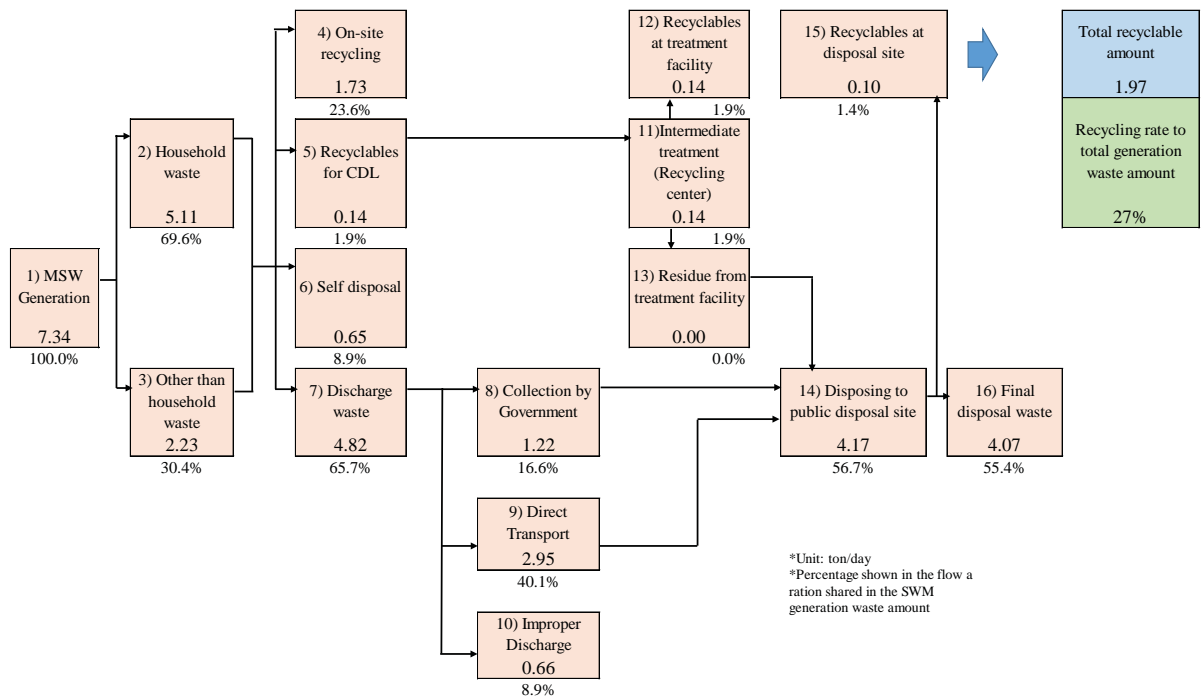


Figure 2-2 Waste flow in Kosrae State in 2017

## 2.2.2 Technical situation of SWM

### a. Waste Generation and Composition

In order to understand the complete picture of waste generation, generation rates are estimated<sup>1</sup>.

#### a.1 Generation rate of household waste

As shown in Table 2-2, waste generation rates of households are calculated by summing up (i) waste that is eventually recycled on-site, (ii) waste that goes to the CDL program, (iii) self-disposed waste and (iv) discharged waste. These figures were estimated based on the household survey on waste generation of 2017 and the waste amount and composition survey of 2015.

Table 2-2 Composition of generated household waste and data source

Composition of generated household waste		Data source
Recyclable	Waste that is recycled on-site	Household survey on waste generation (June 2017)
	Waste that goes to the CDL	

<sup>1</sup> (i) Generation rate of household waste = waste generated per person per day (g (lb)/person/day)

(ii) Generation rate of state solid waste (g (lb)/person/day) = Average generated waste amount of households per day + average generated waste amount of other than households per day) / population

	program	
Non-recyclable	Self- disposed waste	Waste amount and composition survey (WACS) (2015)
	Discharged waste	

As seen in Table 2-3, generation rate of household waste is 773 g (1.70l b)/person/day. The rate breaks down into (i) 262 g (0.58 lb)/person/day for on-site recycling, (ii) 25 g (0.05 lb)/person/day for the CDL program, (iii) 99 g (0.22 lb)/person/day for self-disposal, and (iv) 387 g (0.85 lb)/person/day of discharged waste. As much as 34 % of generated waste at the household level is recycled at source, and also partially disposed of at their premises, and the remaining 50 % is discharged as waste.

Table 2-3 Generation rate of household waste

Unit	Recyclable		Non-recyclable		Generation rate of household waste
	On-site recycling	Recyclable for the CDL program	Self-disposal	Discharged waste	
g/person/day	262	25	99	387	773
lb/person/day	0.58	0.05	0.22	0.85	1.70
%	33.9	3.2	12.8	50.1	100

(Source) Household survey on waste generation (2017) and Waste amount and composition survey (2015)

The following presents an outline and results of the waste amount and composition survey (WACS) carried out in 2015.

**【Outlines of WACS】**

- |                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>■ Survey period: four days in May of 2015</li> <li>■ Number of sample households: 20 households (5 households from each of the four municipalities)</li> <li>■ Survey items: Unit generation rates, waste composition, apparent specific gravity</li> <li>■ Categories of waste composition: 8 categories i.e. plastic, metal(aluminum), metal(steel), glass, paper, textile, biodegradable/kitchen waste and others</li> </ul> |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

**【Result of WACS】**

Generation waste amount of household waste per person per day is calculated as 387 g(0.85 lb)/person/day.

By weight ratio, that of plastic accounts for 30 % and biodegradable/kitchen waste accounts for 23 %. By volume ratio, that of plastic accounts for as much as 34 %, and Other (Styron-foam, rubber, etc.) accounts for 21 %.

Table 2-4 Waste composition of household waste

Composition	Percentage	
	Weight (%)	Volume (%)
Plastic	29.5 %	34.2 %
Metal (aluminum)	3.0 %	5.5 %
Metal (steel)	10.7 %	9.3 %
Glass	5.5 %	2.1 %
Paper	17.5 %	17.6 %
Textile	3.4 %	0.2 %
Biodegradable/ kitchen waste	23.2 %	10.3 %
Other (Styron-foam, rubber, etc.)	7.1 %	20.9 %
Total	100.0 %	100 %

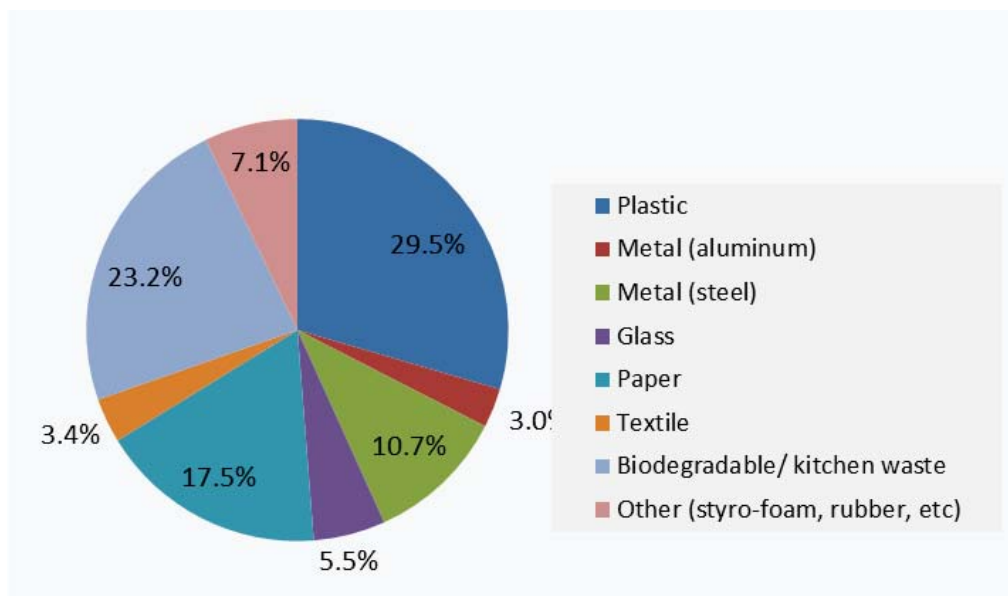


Figure 2-3 Waste composition (Weight %)

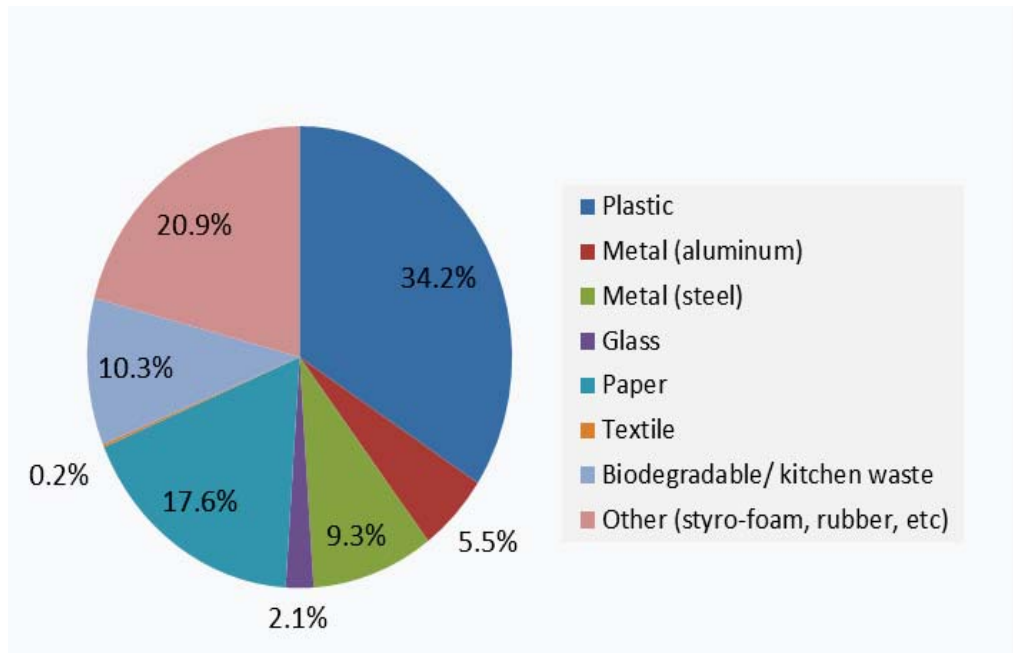


Figure 2-4 Waste composition (Volume%)

**a.2 Generation rate of SSW**

Waste is generated not only from households but also from business entities and public institutions. Generation rate of other than household waste, 355 g (0.78 lb)/person/day, is calculated through dividing waste generated from other than households by population. By summing up the generation rate of household waste and that of other than household waste, the generation rate of state solid waste, 1,128 g (2.48 lb)/person/day, is finally obtained.

Table 2-5 Generation rate of State Solid Waste

Unit	Household waste	Other than household waste	State solid waste
g/person/day	773	355	1,128
lb/person/day	1.70	0.78	2.48
%	68.5	31.5	100

(Source) Current waste flow of Kosrae State

**b. Waste Discharge**

General households who discharge waste through collection services usually use various containers such as plastic bags only or plastic bags in drums, trash bins (plastic, aluminum tin) and baskets made from metal net, cardboard, etc. Those containers are placed in front of houses or at curb side.

**c. Waste Collection**

Four municipalities in the Kosrae State Government are the responsible sector to collect waste.

Compactor trucks are used in Lelu Municipality and Tafunsak Municipality and dump trucks, which were purchased with USA Compact Fund, are used in Malem Municipality and Utwe Municipality.

Door to door or curb side collection system and once a week collection frequency are common systems in the four municipalities. The amount of collection fee is set individually by municipalities, and user provided service paid fee to treasury themselves.

Households for which waste collection services are not provided are discharging wastes into vacant land and this has caused a negative impact on the living environment.

Table 2-6 Waste collection system provided by municipalities

Municipality	Lelu	Tafunsak	Malem	Utwe
Collection coverage (%)	36 %	Not known	Not known	No regular service
Method	Door to door collection and curb side collection	Door to door collection and curb side collection	Door to door collection and curb side collection	-
Collection Frequency	Once a week	Once a week	Once a month	An occasional service (twice a year in 2017)
Fee	\$3/month	\$2/month	\$2/month	-
Payment venue	Treasury	Treasury	Treasury	-
Collection vehicle	Compactor (2 ton) 1 unit It has been used more than 18 years.	Compactor (2 ton) 1 unit It has been used more than 18 years. Also a dump truck is used for bulky waste	Cargo truck (rental)	-
Maintenance of vehicle	<ul style="list-style-type: none"> <li>Daily, periodical inspection: driver</li> <li>Minor repair: driver</li> <li>Major repair: DT&amp;I</li> </ul>	<ul style="list-style-type: none"> <li>Daily, periodical inspection: driver</li> <li>Minor repair: DT&amp;I</li> <li>Major repair: private</li> </ul>	-	-
Collection cost	<ul style="list-style-type: none"> <li>Salary: \$4,420/y</li> <li>Fuel: \$1,755/y (FY2016-2017)</li> </ul>	<ul style="list-style-type: none"> <li>Salary: \$7,964/y</li> <li>Fuel and maintenance: \$1,083/y (FY2017)</li> </ul>	<ul style="list-style-type: none"> <li>Salary: \$300/y</li> <li>Fuel: \$660/y (FY2017)</li> </ul>	-

Source: Municipalities as of January 2018

**d. Waste Disposal**

In Kosrae State, there is one public landfill site in Lelu Municipality which was constructed with

financial support from Embassy of Japan (EOJ). While 55.4 % of generated waste, which is equivalent to 87 % of discharge waste, is disposed at the public landfill site, 8.9 % of generated waste, which is equivalent to 13 % of discharged waste, is disposed (discharged) improperly to nearby open space.

**d.1 Public landfill site**

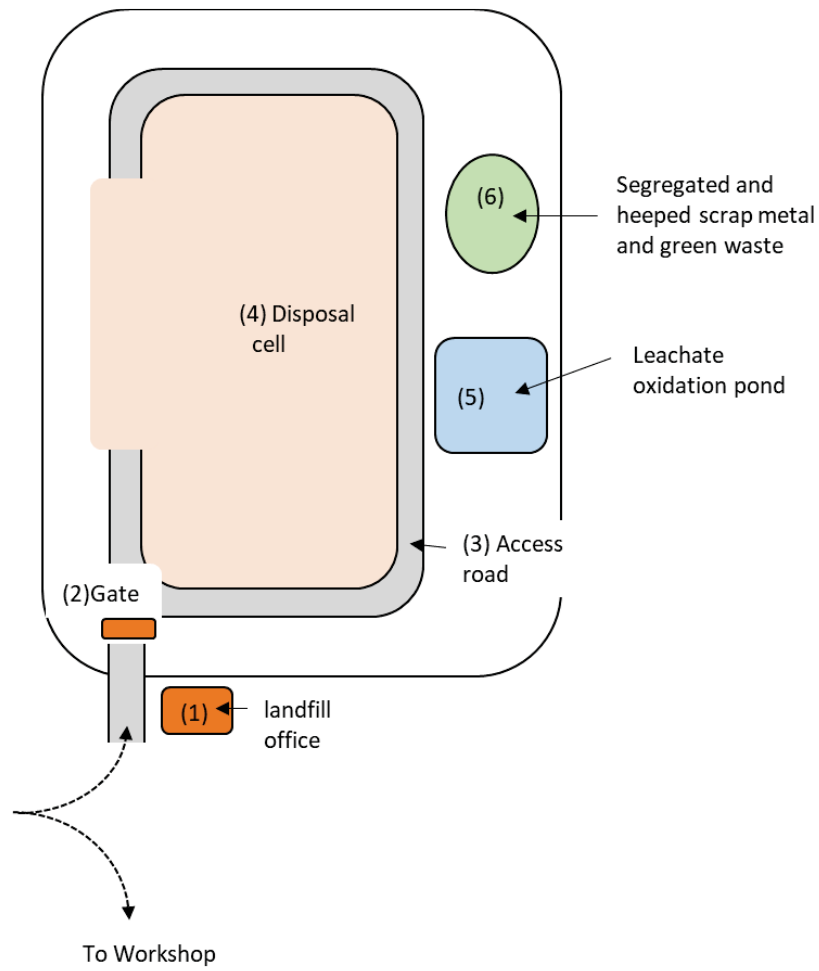
**A. Outline of the public landfill site and the status of O&M**

Outline of the public landfill site and the current status of O&M is shown in Table 2-7.

Table 2-7 Outline of the public landfill site and the O&M status

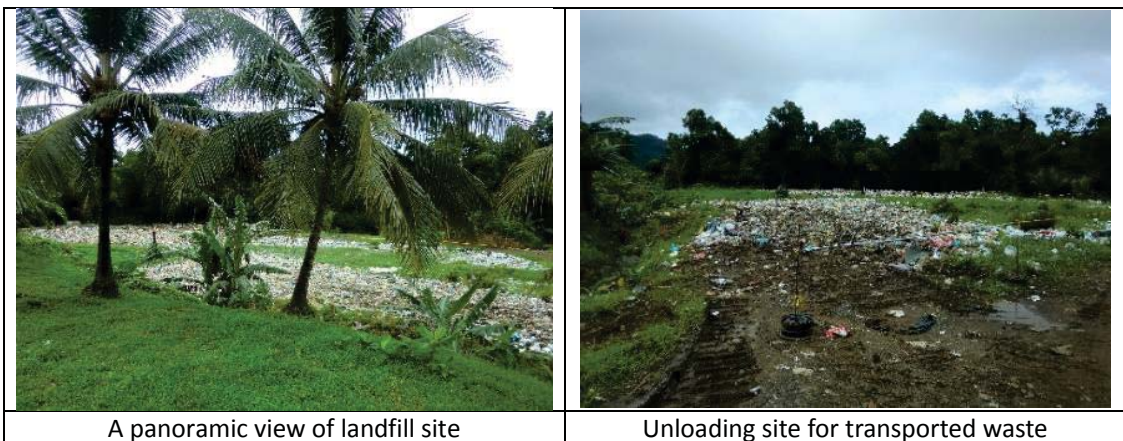
Item	Contents
Name of the site	Tofol Landfill site
Location	Tofol area in Lela Municipality
Land owner	State Government
Area	0.606 ha
Outline of the final landfill site	<p>Landfilling was commenced in 2009. This final landfill site was constructed by a Japanese fund called 'grassroots grant aid' and this is the first experience in Micronesia of applying the semi aerobic sanitary landfilling method called 'Fukuoka Method'.</p> <ul style="list-style-type: none"> <li>Ancillary facilities: gas ventilation pipes, leachate collection and circulation facilities, and leachate collection pond</li> </ul>
Operation	<p>Periodical soil cover was conducted a few times per month which contributes to maintaining the surrounding environment, preventing scattering of wastes, and pest control. Soil cover material was surplus soil obtained from public construction works.</p> <p>Furthermore, leachate is treated and monitoring of leachate quality is conducted as the sanitation and environment protection measures.</p> <ul style="list-style-type: none"> <li>Operation time: Mon.-Fri.: 8:00 am - 3:00 pm, Sat.: 8:00 am - 3:00 pm, Sun.: closed</li> <li>Management of incoming waste: installation of gate, designated areas for certain types of waste, records of incoming waste, no tipping fee</li> <li>Heavy equipment: excavator, bulldozer, dump truck (They are shared among divisions in DT&amp;I.)</li> </ul>
Management staffs members	<p>DT&amp;I operates directory.</p> <p>Three landfill attendants (gate keepers) operate and manage as permanent staff members.</p>

(Source) DT&I



JPRISM II

Figure 2-5 Layout of landfill site





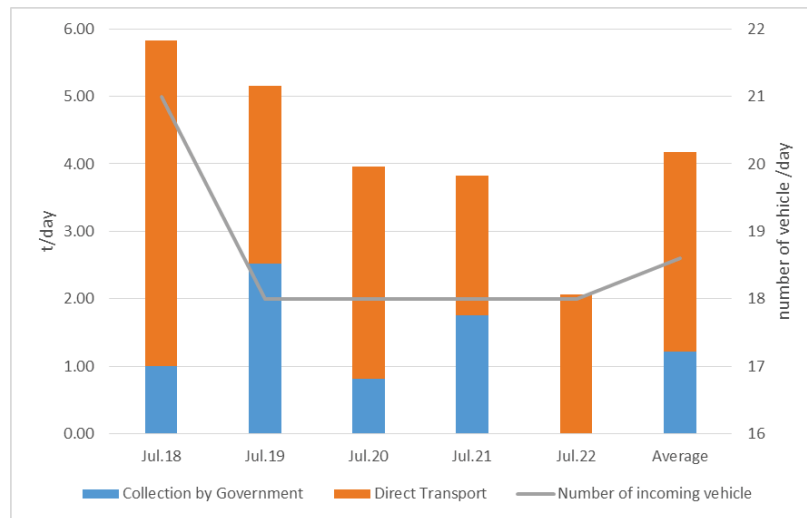
	
<p>Leachate oxidation pond</p>	<p>Segregated large electrical home appliances (refrigerators, washing machines, etc.)</p>
	
<p>Segregated waste tires</p>	<p>Bulldozer used for pushing and pressing disposed waste</p>
	
<p>(Additional) Funds are need for installation of Weigh bridge that was funded by the New-Zealand government .</p>	<p>Whole view of workshop to maintain bulldozers, excavators, trucks, etc.</p>

**B. Incoming waste**

In order to estimate the amount of waste as well as the number of vehicles coming to the public landfill site, the incoming waste survey was carried out in July 2017. The result of the survey is shown in Figure 2-6, while the current practice is summarized in Figure 2-7. As shown in Figure 2-6, the average amount of incoming waste per day is 4.17 ton, and the average number of incoming

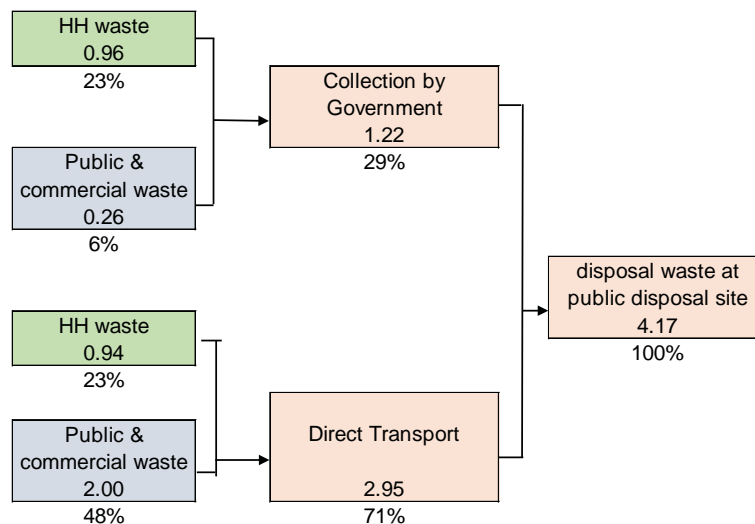
vehicles per day is 19, while the average amount of incoming waste per vehicle is calculated as 219 kg (483lbs).

Only 29 % of incoming waste are collected through collection services with the remaining 71 % of waste being brought directly from shops, households, etc. As much as 23 % of incoming waste is directly brought by households. In short, the limited collection services result in the current situation that many households frequently bring their small quantity of waste into the public landfill site by themselves.



(Source) The incoming waste survey in June 2017

Figure 2-6 Number of incoming vehicles & Disposal waste amount (ton/day)



(Source) The incoming waste survey in June 2017

Figure 2-7 Disposal waste amount by source and collection/direct transportation

**d.2 Improper disposal (discharge)**

As revealed in the current waste flow, 8.9 % of generated waste, which is equivalent to 13.7 % of discharged waste, is disposed improperly to nearby open space.

**e. Reduce, Reuse and Recycling (3Rs)**

**e.1 On-site recycling**

Through the waste generation survey at the household level, it became apparent that as much as 37.1 % of generated waste at households is recycled at source. In detail, 33.9 % is recycled within their premises, i.e. kitchen waste used as feed to livestock or dried coconut fiber/husks as firewood, while 3.2 % is containers set aside at each household of recycling system based on the CDL program.

	
<p>On-site Recycling: Kitchen waste for feed to livestock</p>	<p>On-site Recycling: Coconut shell dried for firewood</p>
	
<p>On-site Recycling: Compost of garden waste and fire wood</p>	<p>Beverage containers for the CDL program: These are brought to Recycling Center for a refund.</p>

**e.2 CDL Program**

The CDL program in Kosrae was commenced with UNDP assistance in 2007. The legal background of the CDL program is "Recycling Program Regulation in 2007".

Flow chart of recycling system based on the CDL program in Kosrae is shown in Figure 2-8. The detailed mechanism of the CDL program is as follows.

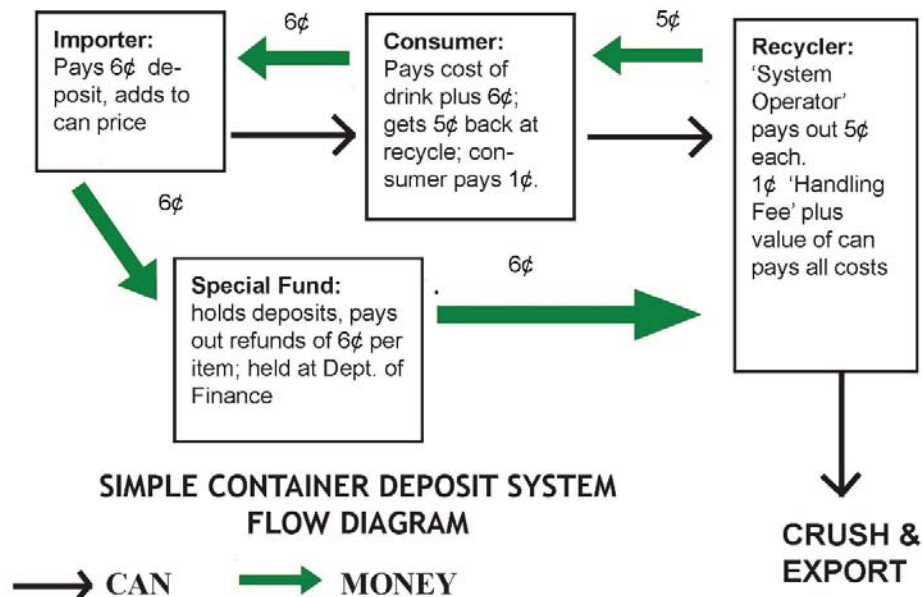


Figure 2-8 Flow chart of recycling system based on the CDL program in Kosrae State

#### A. Target Items

Target items for CDL program are;

- Aluminum cans,
- Glass bottles,
- PET beverage bottle and PET bottle for cooking oil, and
- Car batteries

#### B. Deposit amount

- Deposit : 6 cents/container (car battery : USD 4 /battery)
- Refund of collected deposit :
  - 5 cents/container (car battery : USD 3 /battery): returned to the consumers
  - 1 cent/container (car battery : USD 1 /battery): pay to the operator for recycling system based on the CDL program
- Redemption Center : Recycling center operated by private company

There are no collection activities by the operation company. Some consumers bring their containers to the recycling center by themselves. It is open for receiving containers every Wednesday.

#### C. Roles of related organizations

Roles and responsible organizations for recycling system based on the CDL program are shown as

follows.

Table 2-8 Outline of roles of responsible sectors on recycling system based on the CDL program

Organization		Role and responsibility
State organization	Kosrae Island Resource Management Authority (KIRMA)	KIRMA is the local equivalent of the Environmental Protection Authorities (EPA) found in other FSM states, and is the overall administrator of the recycling program under the relevant State Law. Their responsibilities are as follows: <ul style="list-style-type: none"> <li>✓ Administer the system and ensure it runs smoothly;</li> <li>✓ Contract a business to act as system operator;</li> <li>✓ Draft and promulgate Regulations; and</li> <li>✓ Report annually to the State Legislature on the recycling system operations.</li> </ul>
	Kosrae State Department of Administration (DOA)	DOA is responsible for managing the State finances. Importers pay their recycling deposits to DOA at the same time as filing state taxes due on imports into the State. DOA manages the Recycling Fund which holds deposits, and pays them out to the system operator for refunds.
	Kosrae State Legislature	The State Legislature is responsible to propose and pass any legislation. Legislation covering the CDL program is a state responsibility, and as such any legislative amendments that might be proposed would be required to be passed by the Legislature.
Micronesia Eco Corporation (MEC) (system operator)		MEC was set up to operate the recycling system after the owner of the Pacific Treelodge Resort won a bid to operate the recycling system. His wife is the manager of Micronesia Eco Corp, and it is largely her enthusiasm and persistence that has maintained the recycling operation.
Business entities	Importers	Business entities and importers are responsible to pay required deposits to the Department of Administration.
Consumer		Consumers are responsible to participate in the CDL Program through turning in recyclables to the Recycling Center following Program rules of condition of recyclables.

Source: JPRISM II

**D. Operation of recycling system based on the CDL program by MEC (Micronesia Eco Corporation)**

Micronesia Eco Corporation (MEC), the recycling operator for the CDL program in Kosrae, has carried out recycling activities since 2007. The outline of recycling operation by MEC is as follows.

In principle, recycling day (refund) is held once a week. Aluminum cans and PET bottles recycled are measured as a volume by gauge whose full capacity is equivalent to 500 pieces of cans and bottles

and the amount of refund is \$25 per full gage.

Recycling company, MEC, pays the refunded amount by cash. Signature for the payment from receivers are submitted to the state treasury and a refund of the same amount is requested.

Aluminum cans are pressed by a press machine donated by EOJ. Collected glass bottles are crushed by a crusher machine and crushed glass is stored on the metal containers. Preparations of export of car battery, however long it takes to clear requirements of the Basel Convention, is ongoing.

## E. Recycling data

### E.1 Recycling Fund

The amount of fund income and expenditures are shown in table 2-9 and figure 2-9. Fund expenditures have exceeded fund income between 2008 and 2014 due to the issue of deposit system. However, fund income has exceeded fund expenditures after 2015, and actual net funds have reached more than \$100,000.

Table 2-9 Amount of fund income and expenditure of recycling system based on the CDL program (US\$)

FY	Fund income	Fund expenditure	Net revenue	Net Funds
2008	111,218.00	115,560.00	-4,342.00	161,312.00
2009	78,785.00	97,920.00	-19,135.00	142,177.00
2010	80,578.00	97,766.00	-17,188.00	124,989.00
2011	61,651.00	91,447.00	-29,796.00	95,193.00
2012	61,968.00	70,175.00	-8,207.00	86,986.00
2013	69,984.00	72,437.00	-2,453.00	84,533.00
2014	64,393.29	79,592.30	-15,199.01	69,333.99
2015	80,858.09	57,312.90	23,545.19	92,879.18
2016	85,083.26	80,488.60	4,594.66	97,473.84
2017	83,796.03	78,230.10	5,565.93	103,039.77

Source: DOA and MEC

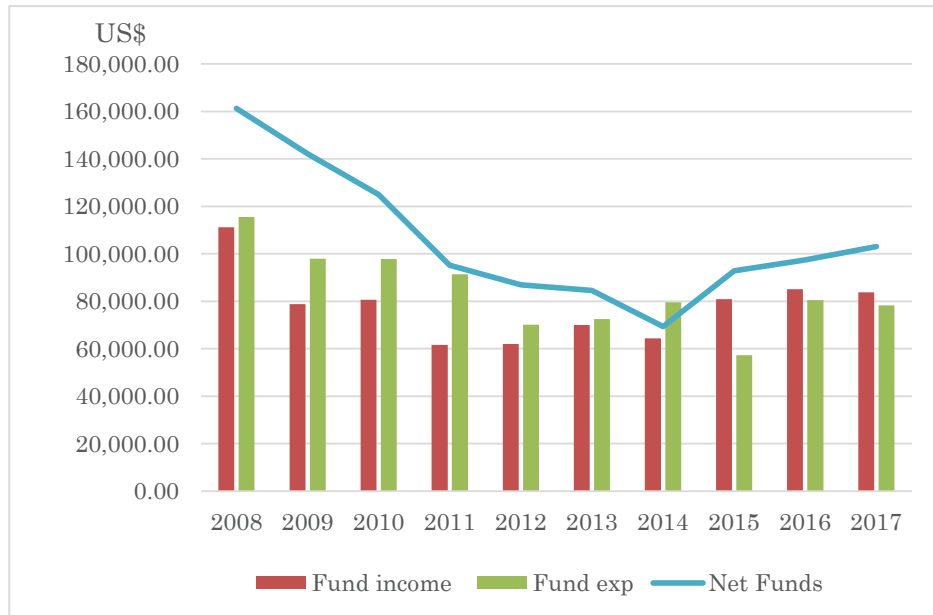


Figure 2-9 Amount of fund income and expenditures of recycling system based on the CDL program (US\$)

## E.2 Recycling amount and rate

Number and amount of containers deposited and refunded are shown in table 2-10. Number of containers deposited and refunded between 2015 and 2017 are converted to amount based on the following calculations;

- Aluminum can: 16 g / can
- PET bottle: 25 g / bottle
- Glass bottle: 300 g / bottle

Consequently, the average amount of containers deposited and refunded for three years are estimated at 0.14 ton / day.

And the recycling rate of recyclables for the CDL program is calculated based on the number between containers deposited and refunded. The recycling rate is shown in table 2-11. Presently, the recycling rate has reached nearly 90 %.

Table 2-10 Number and amount of containers deposited and refunded

Number of containers deposited and refunded (piece/year)

FISCAL YEAR:	Deposit				Refund			
	Alum. Cans	PET Bottles	Glass Bottles	Total	Alum. Cans	PET Bottles	Glass Bottles	Total
2015	897,425	151,428	251,038	1,299,891	895,920	134,990	108,965	1,139,875
2016	979,082	181,532	217,374	1,377,988	1,065,770	148,620	98,490	1,312,880

2017	911,856	289,263	175,479	1,376,598	951,615	182,740	51,265	1,185,620
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Amount of containers deposited and refunded (ton/year)

FISCAL YEAR:	Deposit				Refund			
	Alum. Cans	PET Bottles	Glass Bottles	Total	Alum. Cans	PET Bottles	Glass Bottles	Total
2015	14.36	3.79	75.31	93.46	14.33	3.37	32.69	50.39
2016	15.67	4.54	65.21	85.42	17.05	3.72	29.55	50.32
2017	14.59	7.23	52.64	74.46	15.23	4.57	15.38	35.18

Alum. can: 16 g/piece, PET bottle: 25 g/piece, Glass bottle: 300 g/piece

Amount of containers deposited and refunded (ton/day)

FISCAL YEAR:	Deposit				Refund			
	Alum. Cans	PET Bottles	Glass Bottles	Total	Alum. Cans	PET Bottles	Glass Bottles	Total
2015	0.04	0.01	0.21	0.26	0.04	0.01	0.09	0.14
2016	0.04	0.01	0.18	0.23	0.05	0.01	0.08	0.14
2017	0.04	0.02	0.14	0.20	0.04	0.01	0.04	0.09
Average	0.04	0.01	0.21	0.26	0.04	0.01	0.09	0.14

Source: DOA and MEC

Table 2-11 Recycling rate of containers targeted in recycling system based on the CDL program

FY	Total # of deposit (Piece)	Total # of refund (piece)	Recycling rate (%)	Collection days/year
2008		1.8 million pieces		N/A
2009	N/A	1,544,675	>100%	N/A
2010	N/A	1,663,495	>100%	N/A
2011	1,028,370	1,349,285	131%	N/A
2012	1,009,564	N/A	>100%	
2013	1,144,678	1,218,030	106%	28
2014	1,038,887	1,207,030	116%	23
2015	1,299,891	1,139,875	88%	18
2016	1,377,988	1,312,880	95%	17
2017	1,376,598	1,185,620	86%	14

Source: DOA and MEC





Residents who bring collected aluminum cans and PET bottles, etc., wait for measurement and refund of the recyclables.



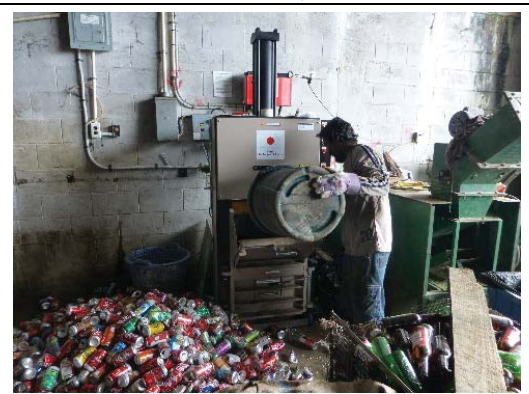
Full gage of aluminum cans is estimated at 500 pieces and the amount of refund is equivalent to \$25



Micronesia Eco pays refunded amount by cash. Signature for the payment from receivers are submitted to the state treasury and a refund for the same amount is requested.



Collected glass bottles are crushed by crusher machine and crushed glass is stored on the metal containers.



Aluminum cans are pressed by a press machine donated by the Japanese Embassy.



Preparations of export of car battery, however long it takes to clear requirements of Basel Convention, is ongoing.

### 2.2.3 Institutional Situation of SWM

#### a. Organization for SWM

The following are the main roles and responsibilities of the relevant SWM organizations.

##### a.1 Department of Transportation and Infrastructure : DT&I

DT&I is in charge of operation of the final landfill site and maintenance of equipment such as heavy equipment in the final landfill site and collection trucks which are operated by the municipality.

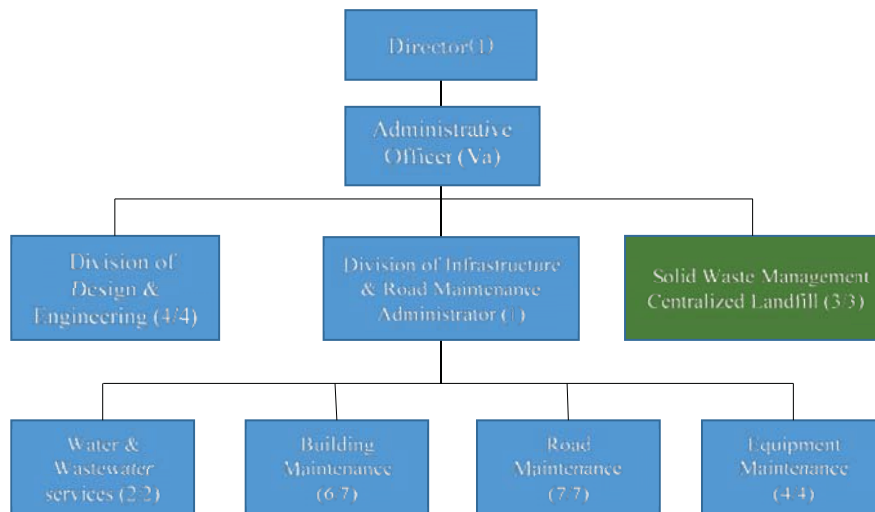


Figure 2-10 Organization chart of DT&I (Source: DT&I)

##### a.2 Kosrae Island Resource Management Agency : KIRMA

KIRMA is a regulatory agency. KIRMA controls, supervises, and guides DT&I on operation of final disposal for DT&I and waste collection for municipality. At this moment, there is no single staff member who is responsible full time for SWM.

The following are the main roles on SWM by KIRMA.

- Formulation of laws and regulations on environment, control activities based on relevant laws and regulations.
- Environmental education
- Environmental monitoring (leachate quality)
- Formulation of SWMP
- Promotion of Recycling
- Responsible Agency of recycling system based on the CDL program (Sub-contract out to private company)

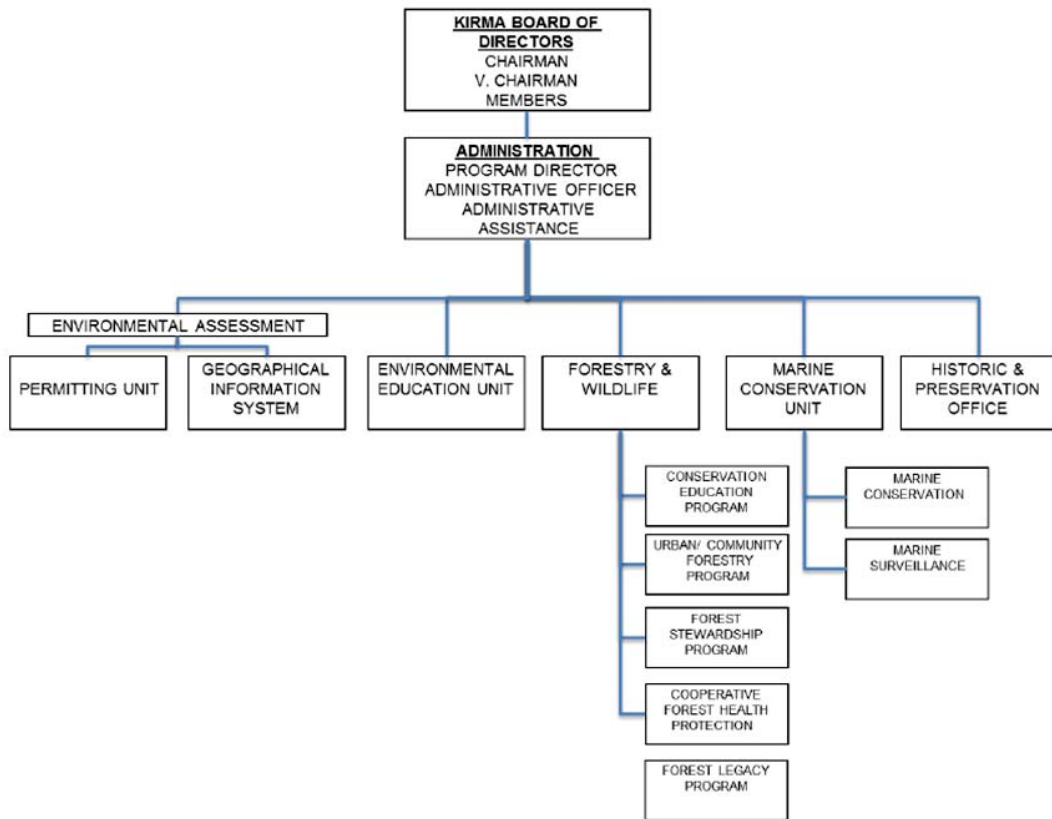


Figure 2-11 Organization chart of KIRMA

### a.3 Role of municipalities

There are four municipalities in Kosrae State. Mayors are selected by election and their term of office is three years. The majority of financial sources of municipalities is sales tax from business sectors which is split fifty-fifty between the municipality and state government and congress money. Municipalities collect waste collection fee from users and provide collection service. A situation of collection service provided by municipalities is shown in table 2-6.

### b. Policies and Laws on SWM

The following is the main law which is related to Solid Waste Management.

Kosrae State Code on Solid Waste Management

## 2.2.4 Financial Situation of SWM

### a. Waste collection fee

SWM-related income is collection fee only. Amount of collection fee has been set individually by

municipalities, and service users pay collection fee directly to municipal treasury.

**b. Expenditure for SWM and total state expenditure**

Based on the financial data for SWM submitted by DT&I, KIRMA and municipalities are summarized as follows. Total expenditures for SMW in Kosrae were around US\$40,600 in 2017. Total disposal waste amount was 1,522 ton/year (4.17 ton/day x 365 days). And unit cost for SWM was estimated at US\$26.7/ton (\$40,582 / 1,522 ton).

Table 2-12 SWM expenditure in Kosrae (US\$)

	FY2017					
	State	Municipalities				Total
		Lelu	Tafunsak	Malem	Sub-total	
A. Total State expenditure	13,000,000	-	-	-	-	
B. Total expenditure for SWM	40,582	-	-	-	-	
Ratio of SWM expenditure (B) / (A)	0.3%	-	-	-	-	
Breakdown of expenditure for SWM						
1. Waste Collection	-	6,175	9,047	960	16,182	16,182
1.1 Personnel cost	-	4,420	7,964	300	12,684	12,684
1.2 O&M (fuel, maintenance cost, etc.)	-	1,755	1,083	660	3,498	3,498
2. Landfill operational cost	24,400	-	-	-	-	24,400
2.1 Personnel cost	18,400	-	-	-	-	18,400
2.2 O&M cost (fuel maintenance cost, etc.)	6,000	-	-	-	-	6,000
Total	24,400	6,175	9,047	960	16,182	40,582

Source: State expenditure is by Assistance, Kosrae State Investment Trust, Gov. Fund, and breakdown of expenditure for SWM is by KIRMA, DT&I and municipalities.

**2.3 Major Characteristics of SWM in Kosrae**

**2.3.1 Waste generation**

While generation rate of household waste is calculated as 773 g (1.70 lb)/person/day, generation rate of other than household is 355 g (0.78 lb)/person/day. By summing up these figures, generation rate of state solid waste, 1,128 g (2.49 lb)/person/day, is finally obtained. This rate is almost the same as those of other states of FSM.

**2.3.2 Waste discharge**

While 49.9 % are prevented to become waste by either recycling at source or self-disposing within their premises, the remaining 50.1 % of the generated waste at household is discharged. The recycling rate, the amount of recycled waste as on-site recycling, under the recycling system based on the CDL program and recycling at landfill site as well divided by the generated amount from both

households and other than household, is proudly as high as 27.0 %.

While as much as 87 % of the discharged waste is appropriately disposed at the public landfill site, the remaining 13 % is disposed to nearby open spaces without much environmental consideration.

### **2.3.3 Waste collection system**

Municipalities have a responsibility to provide waste collection service. As a whole, the ratio of households who use collection services is 25.3 %.

### **2.3.4 Improper disposal**

8.9% of the generated waste is disposed somewhere in the municipality by an inappropriate manner.

### **2.3.5 Recycling system based on the CDL program and export of recyclable items collected under the program**

1.4 % of the generated waste is recycled under the CDL program. By weight, it accounts for only 1.4 % of the generated waste; however, the system tremendously contributes to the reduction of littering and beautification of the island. Currently, recyclables collected under the CDL program, excluding aluminum, haven't been exported since the transportation cost exceeds the sales price of such recyclables.

In summary, the key challenges faced by the system are as follows:

- Low commodity prices, especially for PET;
- Failing population numbers leading to lower overall consumption;
- Small baling equipment, leading to poor shipping density of bales for shipping and high cost per ton of materials shipped;
- Lack of community collections due to the loss of the truck resulting in high cost of gaining refunds for distant populations;
- Overall reduced recycling rates due to some of the above points; and
- Reduced handling fees due to reduced numbers of recyclable items entering the system.

### **2.3.6 Management of the public landfill site**

At the public landfill site, a gate to control incoming vehicles is installed. Operation time is only in the day time. Incoming vehicles are recorded but such records are not properly analyzed. Due to the limited collection coverage, many shops and households bring their waste directly into the public landfill site. This comprises 71% of the entire incoming waste to the public landfill site. No tipping fees are imposed.

### **2.3.7 Waste collection fee**

Waste collection fees are collecting by each municipality. However, the waste fee collection system does not function sufficiently. Waste fee and payment venue for each municipality are shown in Table 2-6.

### **2.3.8 Cost for SWM**

Total expenditure for SMW in Kosrae was around US\$40,600 in 2017. O&M cost for landfill site is borne by State and O&M cost for waste collection is borne by municipalities. Total disposal waste amount was 1,522 ton/year (4.17 ton/day x 365 days). And unit cost for SWM was estimated at US\$26.7/ton (US\$40,600 / 1,522 ton).

### **2.3.9 Institutional Settings**

Municipalities are responsible for waste collection service. However, waste collection could not be provided properly due to the following reasons: outdated equipment and without their own collection equipment, low fee collection rate and lack of O&M cost. It is necessary to examine state level collection system in collaboration with municipalities and state government considering collection efficiency.

## **PART TWO: STRATEGY**

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### **3 The State Solid Waste Management Strategy (SSWMS)**

#### **3.1 Background**

The SSWMS is being formulated based on the Solid Waste Management Plan (2010 to 2015) to understand the current state and different issues of waste management and to establish a roadmap to improve waste management practices in Kosrae for an increased timeframe of ten years; from 2018 to 2027.

With support extended through the JPRISM2, Kosrae State, along with other FSM states, is developing its strategy for the next ten years. This strategy supports the long-term goals developed within the FSM and Kosrae Strategic Development Plans as well as the Cleaner Pacific 2025 Plan developed by SPREP and JICA.

#### **3.2 Purpose**

The new SSWMS is developed as a means to understand the current state and different facets of waste management in the state and more importantly, to lay a practical road map to improve the key components of waste management and address the challenges faced in the aim of reaching a sustainable and truly integrated means of waste management in Kosrae State. It is also envisioned that this SSWMS be endorsed, adopted, and used as the guiding document for waste management activities for the state, and as such should be developed in collaboration and agreement with a wide range of stakeholders and as a formal means of adoption, and be endorsed by the Kosrae State Governor.

#### **3.3 Vision**

A sustainable Kosrae State where the culture and environment are preserved for future generations through better management of Solid Waste.

#### **3.4 Scope**

The new SSWMS covers the 10-year period from 2018 to 2027 with an action plan designed to be implemented for the first half of the period, 2018 to 2022. A general review of the strategy will be undertaken in 2022 to update its relevance to the current needs and plan for the next activities for the remaining period of the strategy.

The new SSWMS covers solid wastes generated in the household, institutional and commercial waste streams of the state, and those wastes are called State Solid Waste (SSW) in this strategy. The Strategy does not cover medical waste and hazardous waste except those that are included in the CDL program. Although, usually liquid and gaseous wastes are excluded by the definition of solid waste, this SSWMS of Kosrae includes treatment of waste oil.

### 3.5 Guiding Principles

#### **Principle 1: Establish financially sustainable SWM system with due consideration of “Post 2023”.**

Financially speaking, the current SWM system in Kosrae State heavily depends on the Compact Fund from the U.S. Government just like all other states of FSM. Since it is known that such financial support will end in 2023, it is rather appropriate to start considering establishing a self-financing SWM system with due consideration of “Post-2023”. **User-pays system**, (re)introduction of collection fee and/or tipping fee is one option, while **Public-Private Partnership (PPP)** such as contracting out further SWM-related activities to the private sector could also be an option.

#### **Principle 2: Waste reduction through maintaining current practice as well as by expanding CDL program**

Practices rooted in the lifestyle of the Kosrae people such as using kitchen waste as feed to livestock and dried coconut shell as firewood are widely observed in Kosrae State. Appreciating and maintaining such practices greatly contributes to **waste reduction**. Also, the ever-improving CDL program in Kosrae State that prevents recyclables from going into the garbage will further contribute to waste reduction by expanding target items.

#### **Principle 3: Commitment to the clean and beautiful pacific region**

Wastes are a grave threat to sustainable development in the Pacific Islands. Inadequate management of wastes can affect the health of Pacific Communities, degrade natural ecosystems and reduce their resilience to climate change impacts, and ultimately retard the social and economic development of Pacific Island Countries and territories. Many countries and territories of the Pacific face heightened risks from the impacts of poor waste and pollution management, since their economic bases (tourism, fishing and agriculture) are heavily reliant on an environment relatively free of waste. Furthermore, many waste issues are transboundary in nature, which means that poor control and management in one country (or region) can negatively affect neighboring countries. By considering all these issues, this SSWMS is basically well aligned with the aspirations elucidated in the Pacific Regional Waste and Pollution Management Strategy (Cleaner Pacific 2025<sup>2</sup>), which aims to support the Pacific Island Countries to develop practical and sustainable SWM systems.

### 3.6 SWM issues targeted under the strategy

#### **Issue 1: Expansion of collection services along with step-by-step approach**

As reiterated in previous sections, the collection services are provided by each of the four municipalities. The rate of households who receive collection service is as low as 37.5 %. The reasons of this low collection rate are: (i) it is difficult to provide collection service due to the weak financial basis; (ii) lack of infrastructure development (underdevelopment of road in Utwe Municipality); and (iii) extremely high rate of rate of direct haulage of waste to the public landfill site in Kosrae State. Expansion of the collection service will be achieved through community participation, mutual cooperation in municipalities and establishing a unified state collection system.

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<sup>2</sup> Cleaner Pacific 2025 is the regional SWM strategy which is formulated by SPREP and JICA. Refer to <http://www.sprep.org>



## **Issue 2: Further efforts to minimize waste**

The Container Deposit Legislation (CDL) program in Kosrae State, which contributes tremendously to reduction of littering and to increase of peoples' environmental awareness, is one of the best-functioning CDL programs among many Pacific Island Countries. Even such a well-functioning system can be improved further to contribute more to waste minimization through restart of recycling system based on the CDL program at communities.

## **Issue 3: Financial sustainability with sound institutional setting**

Last but not least, considering the financial sustainability of SWM is crucial at this juncture of the political economic situation faced by FSM. Both activities for expansion of collection services as well as minimization of waste shall be carried out with special attention to the financial sustainability. There are many ways to secure financial sustainability of SWM such as privatization of certain activities and introduction of fee collection. Furthermore, regardless of the ways to secure financial sustainability, the responsible organization has to be set and appointed to ensure financial sustainability.

### **3.7 Key Strategic Actions and Time Frame**

To steadily achieve strategic targets, firstly action plans targeting SWM issues were formulated, and secondly they will be implemented through a step by step approach.

#### **3.7.1 Key strategic actions**

The strategy consists of the following six strategic actions. These actions and their brief contents are shown as follows:

- **Improvement of waste collection system**

The waste collection rate in Kosrae State is only 25 % of generation waste amount, which is very low. One of the reasons that collection efficiency is very low is that waste collection is provided by each of the small scale municipalities individually. Another reason is that the number of households which pay waste collection fee is minimal so the total income for waste fee could not cover collection cost. Furthermore, Malem and Utwe municipalities do not have a collection vehicle.

For the reasons mentioned above it is necessary to improve the waste collection system of four municipalities in Kosrae State. Moreover, an effective, integrated collecting system and low financial burden for municipalities will be examined.

- **Improvement of the CDL program**

The current CDL program in Kosrae State needs some improvements through cutting costs, adding money or doing a mixture of both, to allow for the system to run commercially for another ten years. To do so, the stakeholders shall take the following three steps.

Step1: Amend the Regulations pursuant to the CDL Act

Step2: Recommence community collection

Step3: Update equipment to increase handling efficiency

- Proper management of public landfill site

Proper management of present Toful Landfill site and preparation of the next landfill site are conducted according to the following procedures;

Step 1: Establish incoming waste management system

Incoming waste management system shall be improved to collect useful information for management and to share information among relevant sectors. Tipping fee collection at disposal site system will be examined by establishing the collection system from the view point of user pay principle.

Step 2: Construction of dikes and disposal at second and third layers

The current landfill cell is full of wastes and extension work has to be carried out. Construction of dikes and concurrently raising up the access road will be required to develop a second cell for landfill

Step 3: Prepare for next landfill site construction

The Toful landfill site will be closed after the third phase of the landfilling is conducted. Quantitative monitoring shall be carried out in order to commence planning for the new landfill site. Selection of candidate site, Environmental Impact Assessment (EIA), and finding source of funds for construction will be required before actual construction works will commence.

- Proper treatment of waste oil

Proper treatment of waste oil shall conduct as follows;

Step1: Prior consultation and feasibility study to burn waste oil generated other than power plant

KIRMA shall take initiatives to discuss a possibility to burning treatment of waste oil generated other than power plant with KUA and other relevant organizations.

Step2: Enact regulation (Ordinance) for proper treatment of waste oil

KIRMA shall prepare enactment to the Regulation (Ordinance) for proper treatment of waste oil. And draft Regulation (Ordinance) shall be submitted to the Governor as well as other relevant state officials.

Step3: Proper treatment of waste oil

Treatment of waste oil shall be commenced based on the technical and institutional preparation.

### 3.7.2 Time Frame

This SSWMS covers the 10-year period from 2018 to 2027 with an action plan designed to be implemented for the first half of the period, 2018 to 2022. The time frame for strategic actions is shown in the table below. The first five years (2018-2022) will be a period mainly to establish technical and institutional system and the second half of the strategy (2023-2027) will be a period to expand and promote the established system.

Table 3-1 Time frame to conduct strategic actions

Activities	Mid-term plan					Long-term plan				
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
1. Improvement of waste collection system										
1.1 Improve present collection system in each municipality and introduce station collection										
1.2 Propose integrated collection system which will be effective and low financial burden for municipalities										
1.3 Acquire collection vehicle(s) and equipment for integrated collection system										
1.4 Commencement of integrated collection system										
2. Improvement of CDL program										
2.1 Amend the Regulations pursuant to the CDL Act										
2.2 Recommence community collection										
2.3 Update equipment to increase handling efficiency										
2.4 Commencement of appropriate recycling										
3. Proper management of public landfill site										
3.1 Establish incoming waste management system										
3.2 Construction of dikes and disposal at second and third layers										
3.3 Prepare for construction of new landfill site										
4. Proper treatment of waste oil										
4.1 Prior consultation and feasibility study to incinerate waste oil generated other than power plant										
4.2 Preparation of Regulation (Ordinance) for proper treatment of waste oil										
4.3 Incinerate waste oil properly										

### 3.8 Target

Numerical targets for strategic actions are established to evaluate progress of actions quantitatively.

Numerical targets for mid-term target year in 2022 and for final target year in 2027 have been established based on the future population projections and future waste amount (waste generation amount per person per day) projected for the main island in Kosrae State.

#### 3.8.1 Setting future targets

Future targets have been established based on the projected future population, waste amounts and strategic values.

Table 3-2 Target of strategy

Item	Unit	2017	2022	2027
Recycling rate (to generation waste amount)	%	27.0	27.0	27.0
Collection rate (to discharge waste amount)	%	25.3	50.0	84.0
Inappropriate discharge rate (to generation waste amount)	%	8.9	7.3	1.0
Rate of waste transported directly to landfill site	%	71.0	43.6	14.6

Table 3-3 Planning indices

Item	Unit	2017	2022	2027
Population	person	6,610	6,610	6,610
GDP Growth Rate	%	1.11	0.50	0.07
Waste generation rate	g/person/day	773	801	810
- Household waste	lb/person/day	1.70	1.77	1.79
Waste generation rate	g/person/day	1,128	1,169	1,184
- SSW	lb/person/day	2.48	2.58	2.61

### 3.8.2 Future waste flow

Waste flow created based on the numerical targets for mid-term target year in 2022 and for final target year in 2027 is shown below.

Table 3-4 Future waste amount

	Unit	2017	2022	2027
Generation amount	ton/day	7.34	7.55	7.70
Discharge amount	ton/day	4.82	4.91	5.41
Collection amount	ton/day	1.22	2.46	4.55
Recycle amount	ton/day	1.97	2.05	2.08
Final disposal amount	ton/day	4.07	4.26	5.23

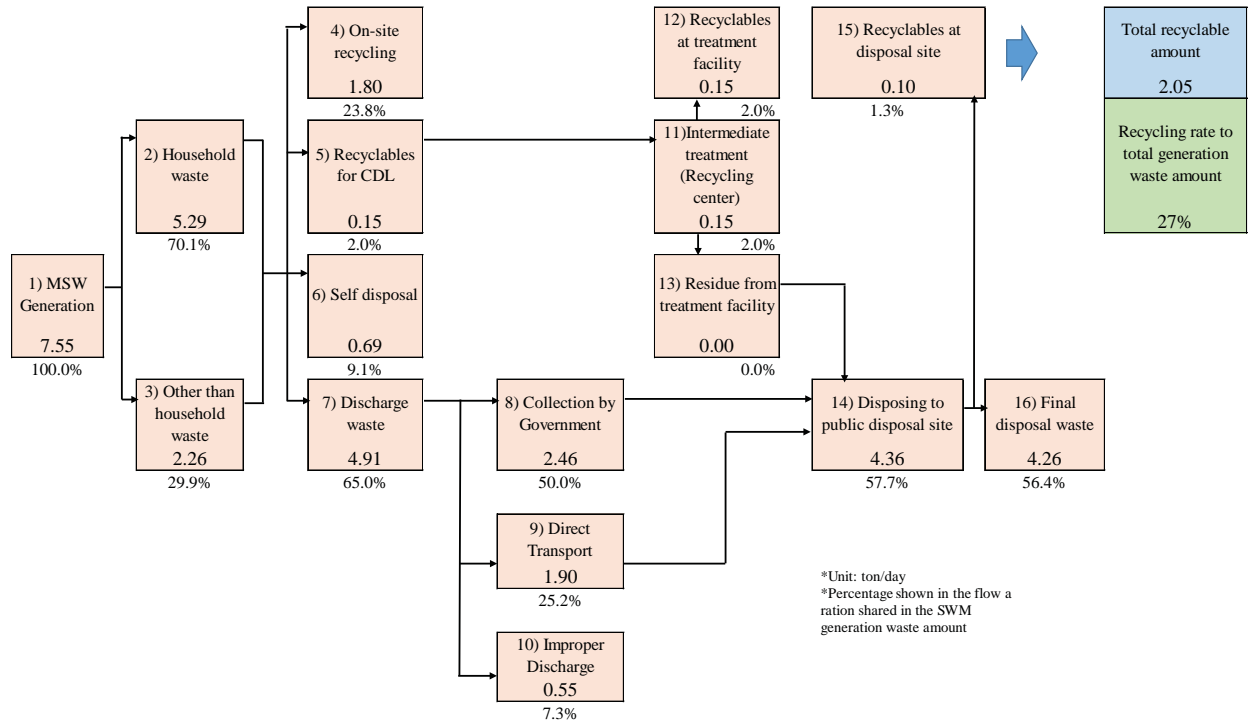


Figure 3 1 Future waste flow in 2022

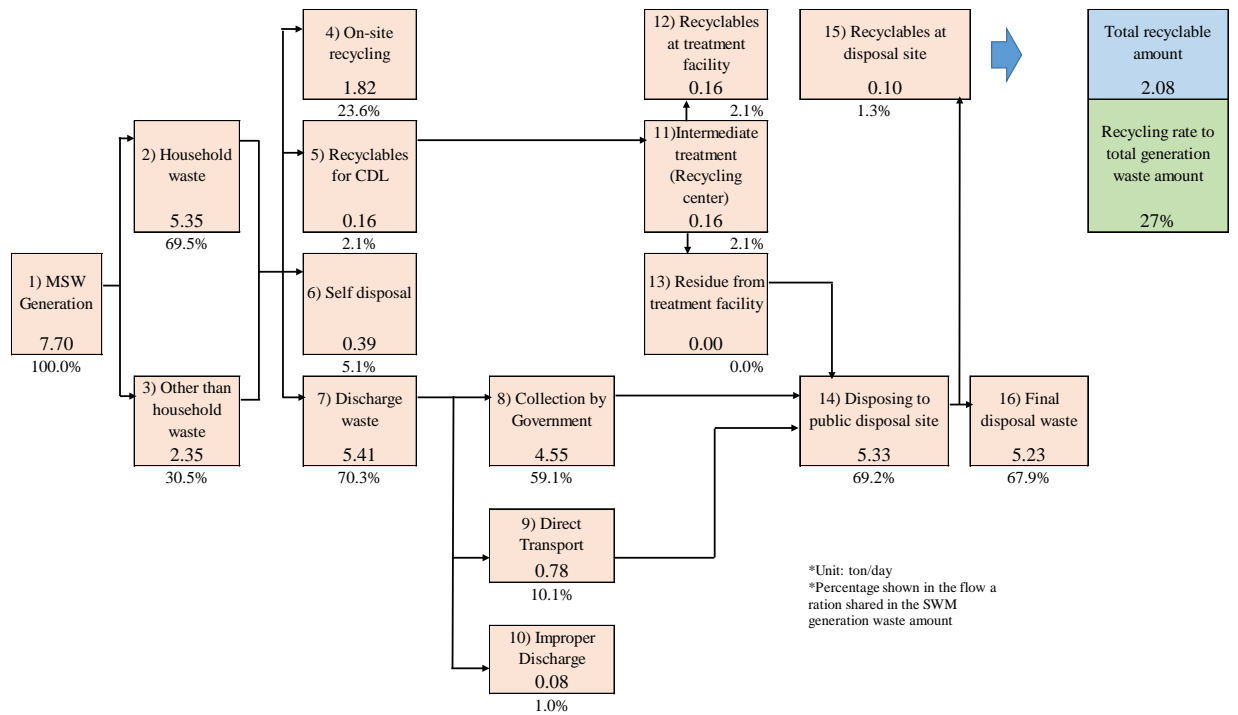


Figure 3-1 Future waste flow in 2027

### 3.8.3 Setting the planning indices

Planning indices established targets are shown below.

#### a. Future Population

The population in Kosrae State had decreased by approximately a thousand (1,000) people between 2000 to 2010 based on the census data. When the future population is predicted based on the negative growth rates between 2000 and 2010, the population decreases too much. Therefore, to be realistic, the population in 2010 was used in the formulation of the SWM strategy — with the assumption that the population remains the same until the end of the planning period in 2027.

Table 3-5 Future population

	Census		Growth rates 2000-2010	Present	Future estimation	
	2,000	2,010		2,017	2,022	2,027
Lelu	2,591	2,160	-1.66%	2,160	2,160	2,160
Malem	1,571	1,300	-1.73%	1,300	1,300	1,300
Utwe	1,067	983	-0.79%	980	980	980
Tafunsak	2,457	2,173	-1.16%	2,170	2,170	2,170
Total	7,686	6,616	-1.39%	6,610	6,610	6,610

#### b. Future waste generation amount

Future waste generation amount in Kosrae State was estimated using the following formula;

(Future waste generation rate per person per day) x (Future population) = Future waste generation amount in Kosrae State

Future waste generation rate per person per day is heavily influenced by the economic conditions. Actual GDP growth rate of FSM from 2008 to 2016 published by WB was used as economic indices to estimate future GDP growth rate. Future waste generation rate per person per day was estimated based on the future GDP growth rate.

##### b.1 Actual GDP Growth Rate

Actual GDP growth rate published by institutions, i.e. ADB, UN, CIA, WB are shown in the figure below. Actual GDP growth rate published by WB was used as economic indices to estimate future GDP growth rate.

Estimation Agency	2008	2009	2010	2012	2013	2014	2015	2016
ADB				-1.70%	-3.00%	-2.40%	3.70%	3.00%
UN	2.50%	6.40%	5.90%	4.70%	5.00%	-3.10%	0.60%	-1.00%
CIA						-2.40%	3.70%	2.00%
WB	0.00%	7.70%	3.60%	6.90%	3.20%	0.00%	0.00%	-1.33%

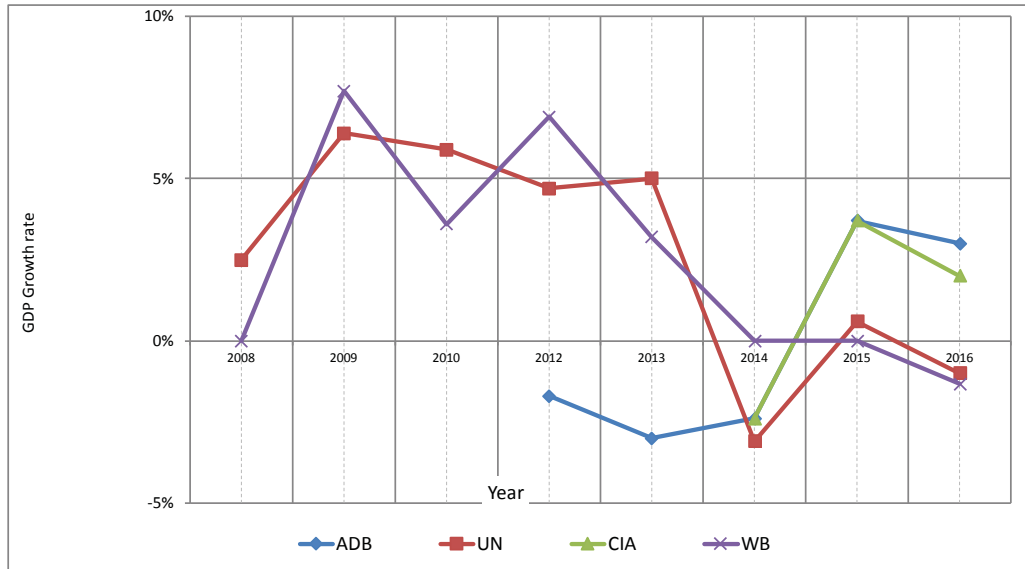


Figure 3-2 Actual GDP Growth Rate

## b.2 Estimated GDP Growth Rate

Result of estimation for future GDP growth rate in FMS is shown in the figure below. GDP growth rate was estimated to be decreasing; the rate will be 0.5 % and 0.07 % in mid-term target year in 2022 and long-term target year in 2027 respectively.

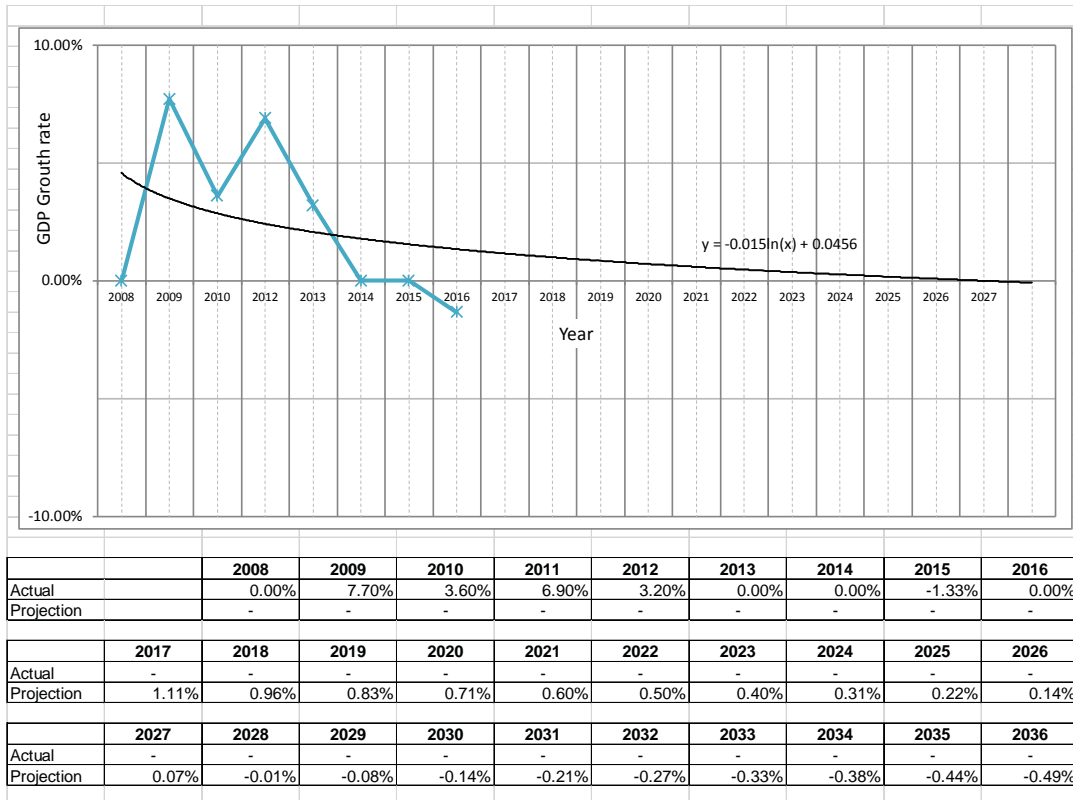


Figure 3-3 Estimated GDP Growth Rate

**b.3 Waste generation rate**

Current waste generation rates for household and other than household are shown in the table below.

Table 3-6 Waste generation rate

Year	Unit	Household waste	Other than household waste	State solid waste
2017	g / person / day	773	355	1,128
	lb /person / day	1.70	0.78	2.48

**b.4 Future waste generation rate**

Future waste generation rate is estimated using the following formula;

$$(\text{Waste generation rate}) \times (\text{Estimated GDP growth rate}) = \text{Future waste generation rate}$$

Future waste generation rates for mid-term target year in 2022 and long-term target year in 2027 are shown in the table below.



Table 3-7 Future waste generation rate

Year	Unit	Household waste	Other than household waste	State solid waste
2022	g / person / day	801	368	1,169
	lb /person / day	1.77	0.81	2.58
2027	g / person / day	810	374	1,184
	lb /person / day	1.79	0.82	2.61

## 4 Action plan

By reflecting upon the vision, the guiding principles and the identified SWM issues, the specific activities to pursue realization of the strategy are articulated and presented in this chapter. This action plan, which defined the priorities in the next five years, is formulated based on the following assumptions.

### Assumptions

- Looking firmly ahead to “post-2023”, SWM sector in Kosrae State has to wean itself off of dependency on the Compact Fund from the U.S. Government, and pursue the establishment of a self-financing system.
- By responding to an immediate financial challenge, which is that the Small Sector Grant of the U.S. Compact Fund will no longer finance recurring costs, this action plan is formulated just like a **stand-alone project**. KIRMA will be an apex responsible agency for every component.

### Title and components of the action plan

The tentative name for the five-year action plan is “**Action plan (Project) towards technically appropriate and financially sustainable SWM system in Kosrae State**”. (This name is just tentative, and stakeholders can rename it.)

The action plan consists of the following six components:

- Component 1: Improvement of waste collection system
- Component 2: Improvement of the CDL program
- Component 3: Proper management of public landfill site
- Component 4: Proper treatment of waste oil

For each component (i) necessary activities with personnel requirements; (ii) implementation schedule; and (iii) implementation costs, are detailed.

### 4.1 Component1: Improvement of waste collection system

#### 4.1.1 Necessary activities

The waste collection rate in Kosrae State is only 25 % of generation waste, which is extremely low. One of the reasons that collection efficiency is low is that waste collection is provided by each of the small scale municipalities individually. Another reason is that the number of households which pay waste collection fee is minimal so the total income for waste fee could not cover collection cost. Furthermore, Malem and Utwe municipalities do not have a collection vehicle as of now.

According to the results of Public Opinion Survey (POS) implemented to ten households for each of the four municipalities in 2018 January – February, the ratio of households which already receive collection service and households which hope to receive a service are 48 % respectively. The ratio of households which are willing to pay for waste collection fee is 88 % for the above mentioned households. The average amount of payment for waste collection fee is US\$5 per month.

For the reasons mentioned above, it is necessary to improve the waste collection system of four municipalities in Kosrae State.

- Step1: Improve present collection system in each municipality and introduce station collection

KIRMA shall support to establish a station collection system in Malem Municipality while solving problems in cooperation with the organization which supports the activity.

For the new collection system, firstly, platforms, steel stands for trash bins, were fabricated. Then they are installed along accessible road side. Two trash bins, each with a capacity of 32 gallons are set in platforms. Neighboring households could jointly use these waste stations (two trash bins in platforms). In Total, 75 platforms and 150 trash bins will be installed in Malem, 25 platforms to each of the three hamlets. And the possibility to introduce the same station collection system to Utwe Municipality shall be considered based on the result of the system in Malem Municipality.

The current collection efficiency and fee collection ratio in Lelu and Tafunsak municipalities will be improved. Collection frequency in Lelu Municipality is once a week in principal. However, as collection routes and collection days are not setup, collection truck runs the whole area in the municipality every collection day. Consequently, as collection efficiency is low, operation cost, namely fuel cost, increases. And as the waste fee collection ratio is low in both municipalities, it will be necessary to increase the waste fee income.

In parallel, Pilot Project (PP) to improve waste collection and fee collection will be implemented in one of the hamlets in Lelu and Tafunsak municipalities while referring to the method used in Malem. The PP using station collection system will expand to other hamlets in both municipalities based on the monitoring results.

- Step2: Propose integrated collection system which will be effective and low financial burden for municipalities

Propose integrated collecting system which will be effective and low financial burden for municipalities based on the results of collection improvement from the PP. In this case, it will be possible to outsource collection work to the private sector as well.

- Step3: Acquire collection vehicle(s) and equipment for integrated collection system

KIRMA shall take initiatives to find a donor or source of funds to acquire collection vehicle(s) and equipment for integrated collection system.

Table 4-1 Contents and organizations in charge

Activity	Contents of activity	Organization			
		KIRMA	DT&I	Municipalities	MEC
Step1. Improve present collection system in each municipality and introduce station collection					
1.1 Provide technical support for station collection introduced in Malem	<ul style="list-style-type: none"> <li>• KIRMA will support to establish a station collection system in Malem Municipality while solving problems in cooperation with the organization which supports</li> </ul>	○		◎	

Municipality	the activity.				
1.2 Improve collection efficiency and the fee collection system in Lelu and Tafunsak municipalities	<ul style="list-style-type: none"> <li>Assess current waste collection and the fee collection system in Lelu and Tafunsak municipalities</li> <li>Establish effective waste collection routes, days and the fee collection system</li> <li>Produce and distribute leaflets for improved system</li> <li>Evaluate waste collection improving effect</li> </ul>	○		◎	
1.3 Implement Pilot Project (PP) on improvement of the waste collection system in Lelu and Tafunsak municipalities	<ul style="list-style-type: none"> <li>Select a hamlet to be implemented in Pilot Project(PP)</li> <li>Make plan for waste collection, fee collection, etc.</li> <li>Meet with residents participating in the PP</li> <li>Install waste station</li> <li>Monitor the PP, evaluate and improve the system used in the PP</li> <li>Expand the station collection system to other hamlets in Lelu and Tafunsak municipalities</li> </ul>	○		◎	
<b>Step2. Propose integrated collection system which will be effective and low financial burden for municipalities</b>					
2.1 Set up Working Group (WG)	<ul style="list-style-type: none"> <li>Share monitoring results and issues for PP</li> <li>Inspect the PP</li> </ul>	◎	○	○	
2.2 Examine integrated collection system	<ul style="list-style-type: none"> <li>Examine technical system e.g. discharge rules, collection methods, structure of station, type of collection vehicles and equipment.</li> <li>Examine institutional system e.g. operation and management sectors, possibility of contracting out to private companies</li> <li>Examine financial system e.g. required costs, appropriate waste fees, method of fee collection and management</li> <li>Scheduling for integrated collection system introduction</li> </ul>	◎	○	○	
<b>Step3. Acquire collection vehicle(s) and equipment for integrated collection system</b>					
3.1 List quality and quantities of collection vehicle(s) and equipment required for integrated collection system	<ul style="list-style-type: none"> <li>Selection of type of collection vehicle(s) and equipment e.g. waste stations, discharge containers</li> <li>Required number of vehicles and equipment</li> </ul>	◎	○	○	
3.2 Find source of funds to purchase a collection vehicle(s) and equipment	KIRMA shall take initiatives to find a donor or source of funds.	◎			
3.3 Purchase a collection vehicle(s) and lease it to the operation organization	Once the source of funds is secured, KIRMA shall select and purchase an appropriate collection vehicle(s) and equipment. Then, KIRMA shall lease it out to the operation sector.	◎			

#### 4.1.2 Implementation schedule

Present collection system in each municipality will be improved in FY 2018 and 2019. The waste station collection system will be expanded after FY2020 based on the results of Pilot Project (PP). Integrated collection system will be examined in FY2019. Collection vehicle(s) and equipment for integrated collection system will be purchased when a donor or source of funds is found.

Table 4-2 Schedule for improvement of waste collection system

	FY2018				FY2019				FY2020				FY2021				FY2022			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
<b>1.1 Improve present collection system in each municipality and introduce station collection</b>																				
1.1.1 Provide technical support for station collection introduced in Malem Municipality																				
1.1.2 Improve collection efficiency and fee collection system in Lelu and Tafunsak municipalities																				
1.1.3 Implement Pilot Project (PP) on improvement of waste collection system in Lelu and Tafunsak municipalities																				
1.1.4 Expand collection area with waste station system																				
<b>1.2 Propose integrated collection system which will be effective and low financial burden for municipalities</b>																				
1.2.1 Set up Working Group (WG)																				
1.2.2 Examine integrated collection system																				
<b>1.3 Acquire collection vehicle(s) and equipment for integrated collection system</b>																				
1.3.1 List quality and quantities of collection vehicle(s) and equipment required for integrated collection system																				
1.3.2 Find source of funds to purchase a collection vehicle(s) and equipment																				
1.3.3 Purchase a collection vehicle(s) and lease it to the operation organization																				

\*FY: From 1st of October to next year 30th of September

\*\*Q1: Oct.-Dec., Q2: Jan.- Mar., Q3: Apr.-Jun., Q4: Jul.-Sep.

### 4.1.3 Implementation cost

Main cost items for improvement of waste collection system are as follows:

- Personnel cost: support of new collection system in Malem, improvement of collection system and implementation of the PP in Lelu and Tafunsak municipalities, and awareness raising
- Purchasing cost for machinery and equipment: waste stations, collection vehicles and equipment for integrated collection system
- Cost for product awareness material: leaflet on collection improvement
- OM cost: fuel, maintenance and labor cost, which will be covered by waste fee collected from users.

Cost required to implement this component t is shown in the table below. The Project cost was estimated at US\$0.14 million for five years.

Table 4-3 Cost for improvement of waste collection system (US\$)

	FY2018	FY2019	FY2020	FY2021	FY2022	Total
a. Personnel cost	6,600	11,940	8,880	7,920	7,320	42,660
b. Transportation expenses	66	117	90	81	75	429
c. Construction and treatment cost	0	0	0	0	0	0
d. Purchase of equipment/machinery	0	4,500	12,000	72,000	0	88,500
e. Operation cost	0	0	0	0	0	0
f. Design and printing cost for material	0	2,400	0	0	0	2,400
Total	6,666	18,957	20,970	80,001	7,395	133,989

## 4.2 Component 2: Improvement of the CDL program

### 4.2.1 Necessary activities

The current CDL program in Kosrae State needs some improvements through cutting costs, adding money or doing a mixture of both, to allow for the system to run commercially for another ten years. To do so, the stakeholders shall take the following three steps:

- Step 1: Amend the Regulations pursuant to the CDL Act  
All the deposit rates in Schedule A of the Regulations pursuant to the CDL Act need to be changed from 6 cents to 7 cents.

Table 4-4 Schedule A of the Regulations pursuant to the CDL Act

#	Recycling Material	Amount of Fee
1.	Any beverage container made from aluminum	\$0.07 per container
2.	Any glass beverage container	\$0.07 per container
3.	Any beverage container made from PET	\$0.07 per container
4.	Any cooking oil container made from PET	\$0.07 per container
5.	Any type of lead acid battery	\$4.00 per battery

- Step 2: Recommence community collection  
Suspended community collection due to the non-availability of a truck along with the decreasing population have contributed to a drop in the number of recycling items handled under the CDL program, refunds and handling fees. To recommence community collection is beneficial for the recyclers as well as for people living in the communities far from the redemption centre. Thus, KIRMA has to find a donor or source of funds to purchase a new truck suitable for community collection.
- Step 3: Update equipment to increase handling efficiency  
As the original equipment used to set up the system is either no longer functioning, or very worn out, some new equipment is needed to revitalize the system. Thus, KIRMA has to find

donors or sources of funds to purchase such equipment. In order of priority, these are as follows:

**Can Baling Press** - a bigger press that can put more cans into each container for shipping would improve aluminum shipping economics significantly by decreasing cost per ton shipped, thus cutting operation costs;

**PET Baling Press** - for better baling of PET bottles: this will improve shipping costs if/when shipped, but strong bales will make local use of PET possible for building into in-fill walls, or landfill-cell wall construction; and

**Glass Crusher** - the current unit is rather worn out and has several parts removed, resulting in poor containment of crushed glass, but it is still operational; glass quantities handled are not large, but have increased in the last few years due to more beer imported in glass.

Table 4-5 Contents and organizations in charge

Activity	Contents of activity	Organization			
		KIRMA	DT&I	Municipalities	MEC
Step1. Amend the Regulations pursuant to the CDL Act					
1.1 Assess the current CDL system in Kosrae State	The challenges shall be identified through the assessment of the current CDL program.	⊙			
1.2 Prepare the amendment to the Regulations pursuant to the CDL Act	Based on the assessment, the amendment to increase deposits shall be prepared by KIRMA.	⊙			
1.3 Submit the proposed amendment to the Governor and other relevant state officials	The amendment shall be submitted to the Governor as well as other relevant state officials.	⊙			
Step2. Recommence community collection					
2.1 Find source of funds to purchase a truck for community collection	KIRMA shall take initiatives to find a donor or source of funds.	⊙			
2.2 Purchase a truck and lease it to the recycling company	Once source of funds are secured, KIRMA shall select and purchase an appropriate truck for community collection. Then, KIRMA shall lease it out to the recycling company.	⊙			
2.3 Prepare a community collection plan	The recycling company shall prepare a community collection plan and notice each community				⊙
2.4 Recommence community collection	The recycling company shall restart community collection in line with the plan prepared under activity 2.3.				⊙
Step3. Update equipment to increase handling efficiency					
3.1 Find source of funds to purchase a can baling press	KIRMA shall take initiatives to find a donor or source of funds.	⊙			

3.2 Purchase a can bailing press and lease it to the recycling company	Once source of funds are secured, KIRMA shall select and purchase an appropriate can bailing press. Then, KIRMA shall lease it out to the recycling company.	◎			
3.3 Find source of funds to purchase a PET bailing press	KIRMA shall take initiatives to find a donor or source of funds.	◎			
3.4 Purchase a PET bailing press and lease it to the recycling company	Once source of funds are secured, KIRMA shall select and purchase an appropriate PET bailing press. Then, KIRMA shall lease it out to the recycling company.	◎			
3.5 Find source of funds to purchase a glass crusher	KIRMA shall take initiatives to find a donor or source of funds.	◎			
3.6 Purchase a glass crusher and lease it to the recycling company	Once source of funds are secured, KIRMA shall select and purchase an appropriate glass crusher. Then, KIRMA shall lease it out to the recycling company.	◎			

#### 4.2.2 Implementation schedule

Some of the activities have already been started. The current CDL program was assessed in the first quarter of FY2018, and KIRMA will submit the proposed amendment during the second quarter of FY2018. Although the schedule of the remaining activities which require purchase of new equipment highly depends on when KIRMA is able to obtain resources of funds, the following schedule shows the ideal time frame.



Table 4-6 Schedule for improvement of the CDL program

	FY2018				FY2019				FY2020				FY2021				FY2022			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
<b>2.1 Amend the Regulations pursuant to the CDL Act</b>																				
2.1.1 Assess the current CDL system in Kosrae																				
2.1.2 Prepare the amendment to the Regulations pursuant to the CDL Act																				
2.1.3 Submit the proposed amendment to the Governor and other relevant state officials																				
<b>2.2 Recommence community collection</b>																				
2.2.1 Find source of funds to purchase a truck for community collection																				
2.2.2 Purchase a truck and lease it to the recycling company																				
2.2.3 Prepare a community collection plan																				
2.2.4 Recommence community collection																				
<b>2.3 Update equipment to increase handling efficiency</b>																				
2.3.1 Find source of funds to purchase a can bailing press																				
2.3.2 Purchase a can bailing press and lease it to the recycling company																				
2.3.3 Find source of funds to purchase a PET bailing press																				
2.3.4 Purchase a PET bailing press and lease it to the recycling company																				
2.3.5 Find source of funds to purchase a glass crusher																				
2.3.6 Purchase a glass crusher and lease it to the recycling company																				

\*FY: From 1st of October to next year 30th of September

\*\*Q1: Oct-Dec., Q2: Jan.- Mar., Q3: Apr.-Jun., Q4: Jul.-Sep.

#### 4.2.3 Implementation cost

Main cost items for improvement of the CDL program are follows:

- Personnel cost: awareness raising for community collection of recyclables;
- Purchasing cost for machinery and equipment: collection truck (Community collection), can bailing press, ET bailing press, and glass crusher;
- Ongoing maintenance and running costs: electricity and labor, which will be covered by handling fees and income from crushed can sales overseas.

Cost required to implement this component is shown in the table below. The Project cost was estimated at US\$63,000 for five years.

Table 4-7 Cost for improvement of the CDL program (US\$)

	FY2018	FY2019	FY2020	FY2021	FY2022	Total
a. Personnel cost	3,940	3,240	1,680	1,680	1,200	11,740
b. Transportation expenses	39	30	18	18	12	117
c. Construction and treatment cost	0	0	0	0	0	0
d. Purchase of equipment/machinery	0	3,000	12,200	26,000	10,000	51,200
e. Operation cost	0	0	0	0	0	0
f. Design and printing cost for material	0	0	0	0	0	0
Total	3,979	6,270	13,898	27,698	11,212	63,057

### 4.3 Component 3: Proper management of public landfill site

#### 4.3.1 Necessary activities

Proper management of present Toful Landfill site and preparation of the next landfill site are conducted according to the following procedures;

- Step1: Establish incoming waste management system

Incoming waste management system will be improved to collect useful information for management and to share information among relevant sectors. Collection of tipping fees at disposal site will be examined from the view point of Polluter Pay Principle.

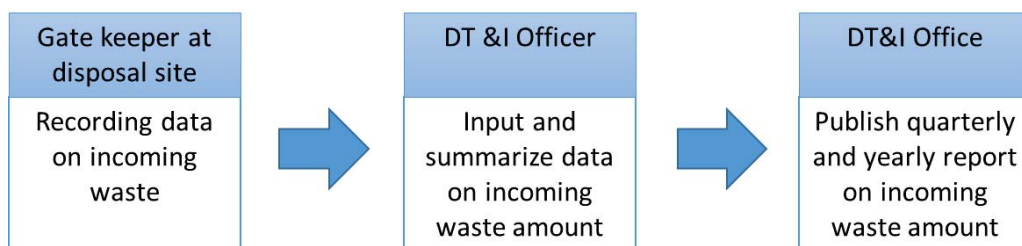


Figure 4-1 Procedure of data management system of incoming waste

Recording items are simplified as much as possible in consideration of the atmosphere of recording place and skill of recording staff members. Recording items are follows: (1) Incoming time; (2) Owner of vehicles; (3) Municipality where waste is generated; (4) Type of waste; (5) Type of vehicle and/or type of waste containers, bags loaded on the vehicle; (6) Loading ratio of waste to loading capacity of vehicle and/or loading ratio of waste to waste containers, bags (%); and (7) Number of waste containers and/or bags and (8) Special notes.

- Step2: Construction of dikes and disposal at second and third layers

As of the end of 2017, current landfill cell is full of wastes and extension work has to be carried out. Construction of dikes concurrently with raising up the access road will be required to develop the

second cell for landfill. KIRMA shall take initiatives to find a source of funds to construct it, and proper landfill operation using second phase cell will be required.



Figure 4-2 Drawings for construction of dike and access road and disposal plan for second and third phases in Toful Landfill site

- Step3: Prepare for construction of new landfill site

Toful Landfill site will be closed after the third phase of the landfilling is conducted. If proper compaction is carried out, it is estimated that the Toful Landfill site can be used for around 10 years. But careful monitoring shall be carried out in order to commence planning for the new landfill site. Selection of candidate site, EIA, and finding source of funds for construction will be required before actual construction works will commence.

Table 4-8 Contents and organizations in charge

Activity	Contents of activity	Organization		
		KIRMA	DT&I	Municipalities MEC
Step1. Establish incoming waste management system				
1.1 Assess the current situation of incoming waste	<ul style="list-style-type: none"> <li>• Assess the current situation of incoming waste</li> <li>• Evaluate present recording system</li> </ul>	○	◎	

1.2 Establish incoming waste management system and carry out trial using the system	<ul style="list-style-type: none"> <li>Establish incoming waste management system</li> <li>Train workers in charge of incoming waste management</li> <li>Make a trial using the system</li> </ul>	<input type="radio"/>	<input checked="" type="radio"/>		
1.3 Manage incoming waste and share the information	<ul style="list-style-type: none"> <li>Conduct and continue to conduct management for incoming waste</li> <li>Summarize incoming data quarterly and yearly and share with relevant sectors</li> </ul>	<input type="radio"/>	<input checked="" type="radio"/>		
1.4 Examine possibility to collect tipping fee	<ul style="list-style-type: none"> <li>Examine possibility to collect tipping fee with responsible sectors</li> </ul>	<input type="radio"/>	<input checked="" type="radio"/>		
<b>Step2. Construction of dikes and disposal at second and third layers</b>					
2.1 Forecast disposal waste amount/volume and plan for second and third phase landfill	<ul style="list-style-type: none"> <li>Future disposal waste amount shall be forecasted based on the waste flow (WF)</li> <li>Disposal volume, disposal period, construction schedule, etc., will be planned</li> </ul>		<input checked="" type="radio"/>		
2.2 Prepare drawings for extension of existing landfill site and calculate construction cost	<ul style="list-style-type: none"> <li>Drawings of dike and access road and calculation of construction cost for second phase landfill will be prepared</li> </ul>		<input checked="" type="radio"/>		
2.3 Find source of funds for extension works	<ul style="list-style-type: none"> <li>KIRMA shall take initiatives to find a donor or source of funds</li> </ul>	<input checked="" type="radio"/>	<input type="radio"/>		
2.4 Implement extension works	<ul style="list-style-type: none"> <li>Construct dike and access road for second phase landfill</li> </ul>		<input checked="" type="radio"/>		
2.5 Carry out proper landfill operation using extended platform	<ul style="list-style-type: none"> <li>Start proper landfill operation</li> </ul>		<input checked="" type="radio"/>		
<b>Step3. Prepare for construction of new landfill site</b>					
3.1 Estimate life time of current landfill site and prepare for new landfill site	<p>A period to be able to use existing landfill site shall be estimated with quantitative monitoring and construction for next landfill site shall be prepared e.g. selection of candidate site, EIA, finding a donor or source of funds</p>	<input type="radio"/>	<input checked="" type="radio"/>		

#### 4.3.2 Implementation schedule

Incoming waste management system will be established within FY2018. After 2019, incoming data shall be managed properly and shared with relevant sectors. The possibility to collect tipping fee shall be examined with responsible sectors from FY2021.

A second phase construction and disposal at second layer shall commence in FY 2019. The next landfill site construction will be prepared from FY 2020.

Table 4-9 Schedule for proper management of public landfill site

	FY2018				FY2019				FY2020				FY2021				FY2022			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
<b>3.1 Establish incoming waste management system</b>																				
3.1.1 Assess the current situation of incoming waste																				
3.1.2 Establish incoming waste management system and carry out trial using the system																				
3.1.3 Manage incoming waste and share the information																				
3.1.4 Examine possibility to collect tipping fee																				
<b>3.2 Construction of dikes and disposal at second and third layers</b>																				
3.2.1 Forecast disposal waste amount/volume and plan for second and third phase landfill																				
3.2.2 Prepare drawings for extension of existing landfill site and calculate construction cost																				
3.2.3 Find source of funds for extension works																				
3.2.4 Implement extension works																				
3.2.5 Carry out proper landfill operation																				
<b>3.3 Prepare for construction of new landfill site</b>																				
3.3.1 Estimate life time of current landfill site and prepare for new landfill site																				

\*FY: From 1st of October to next year 30th of September

\*\*Q1: Oct.-Dec., Q2: Jan.- Mar., Q3: Apr.-Jun., Q4: Jul.-Sep.

### 4.3.3 Implementation cost

Main cost items for proper management of public landfill site are follows:

- Personnel cost: operation of landfill site
  - OM cost: fuel for landfill operation
  - Construction and treatment cost: construction cost for dike and access road for second phase
- Cost required to implement this component is shown in the table below. The cost was estimated at US\$0.21 million for five years.

Table 4-10 Cost for proper management of public landfill site (US\$)

	FY2018	FY2019	FY2020	FY2021	FY2022	Total
a. Personnel cost	22,500	22,800	29,100	29,580	29,940	133,920
b. Transportation expenses	45	48	114	120	123	450
c. Construction and treatment cost	0	40,000	0	0	0	40,000
d. Purchase of equipment/machinery	0	0	0	0	0	0
e. Operation cost	6,000	6,000	6,000	6,000	6,000	30,000

f. Design and printing cost for material	0	0	0	0	0	0
Total	28,545	68,848	35,214	35,700	36,063	204,370

#### 4.4 Component 4: Proper treatment of waste oil

##### 4.4.1 Necessary activities

Proper treatment of waste oil shall be conducted as follows;

- Step 1: Prior consultation and feasibility study to incinerate waste oil generated other than power plant

KIRMA shall take initiatives to discuss the possibility of burning treatment of waste oil generated other than power plant with KUA and other relevant organizations and to find a donor or source of funds to treat existing waste oil generated and stored.

- Step 2: Preparation of Regulation (Ordinance) for proper treatment of waste oil

KIRMA shall prepare enactment to the Regulation (Ordinance) for proper treatment of waste oil. And draft Regulation (Ordinance) shall be submitted to the Governor as well as other relevant state officials.

- Step 3: Incinerate waste oil properly

A treatment of waste oil shall be commenced based on the following technical and institutional preparation:

- Establish procedure to apply and permit treatment of waste oil;
- Prepare treatment procedure for O&M of waste oil combustion facility; and
- Raise awareness for and business sectors to commence waste oil treatment



Figure 4-3 Waste oil treatment facility

Table 4-11 Contents and organizations in charge

Activity	Contents of activity	Organization				
		KIRMA	KUA	DT&I	Municipalities	MEC
Step1. Prior consultation and feasibility study to incinerate waste oil generated other than power plant						

1.1 Prior consultation among related organizations	KIRMA shall take initiatives to discuss the possibility of burning treatment of waste oil generated other than power plant with KUA and other relevant organizations.	⊙	⊙				
1.2 Feasibility study from technical and institutional points of view	Technical, institutional issues and issues for facility with waste oil generated other than power plant burning will have to be confirmed with contractor through KUA.	○	⊙				
1.3 Secure budget to incinerate existing waste oil in the state	KIRMA shall take initiatives to find a donor or source of funds to treat existing waste oil generated and stored.	⊙					
<b>Step2. Preparation of Regulation (Ordinance) for proper treatment of waste oil</b>							
2.1 Preparation of Regulation (Ordinance) for proper treatment of waste oil	Enactment to the Regulation (Ordinance) for proper treatment of waste oil shall be prepared. The Regulation (Ordinance) shall include treatment of waste oil, responsibility for discharger, treatment fee, permission for inappropriate treatment, etc.	⊙					
2.2 Submit the proposed Regulation(Ordinance) to the Governor and other relevant Organizations	The draft Regulation (Ordinance) shall be submitted to the Governor as well as other relevant state officials.	⊙					
<b>Step3. Incinerate waste oil properly</b>							
3.1 Establish procedure to apply and permit treatment of waste oil	<ul style="list-style-type: none"> <li>• Set up a system of waste oil treatment</li> <li>• Standardize reception desk system and procedure</li> <li>• Standardize method and place to carry-on waste oil</li> <li>• Establish charge payment system and method</li> </ul>	⊙	⊙				
3.2 Prepare treatment procedure for O&M of waste oil incineration facility	<ul style="list-style-type: none"> <li>• Establish OM system for waste oil treatment</li> <li>• Standardize method and procedure to check type of waste oil</li> <li>• Standardize method and procedure to transfer waste oil to storage tank</li> <li>• Set up combustion time and schedule</li> </ul>	○	⊙				
3.3 Raise awareness for resident and business sectors to commence waste oil treatment	<ul style="list-style-type: none"> <li>• Disseminate appropriate waste oil burning treatment to resident and business sectors</li> </ul>	⊙	⊙				
3.4 Commence incineration of waste oil	<ul style="list-style-type: none"> <li>• Acceptance processing will be started and burning treatment of waste oil will commence</li> </ul>	○	⊙				

#### 4.4.2 Implementation schedule

Prior consultation and feasibility study to incinerate waste oil generated other than power plant shall be carried out in FY2018. KIRMA shall take initiatives to find a donor or source of funds to treat every FY.

Preparation of Regulation (Ordinance) for proper treatment of waste oil shall be prepared in the last quarter FY2018 to 2019.

Proper incineration of waste oil shall be started when a donor or source of funds is found.

Table 4-12 Schedule for Proper treatment of waste oil

	FY2018				FY2019				FY2020				FY2021				FY2022			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
4.1 Prior consultation and feasibility study to incinerate waste oil generated other than power plant																				
4.1.1 Prior consultation among related organizations																				
4.1.2 Feasibility Study from technical and institutional point of view																				
4.1.3 Secure budget to incinerate existing waste oil in the state																				
4.2 Preparation of Regulation (Ordinance) for proper treatment of waste oil																				
4.2.1 Preparation of Regulation (Ordinance) for proper treatment of waste oil																				
4.2.2 Submit the proposed Regulation(Ordinance) to the Governor and other relevant Organizations																				
4.3 Incinerate waste oil properly																				
4.3.1 Establish procedure to apply and permit treatment of waste oil																				
4.3.2 Prepare treatment procedure for O&M of waste oil incineration facility																				
4.3.3 Disseminate to resident and business sectors to commence waste oil treatment																				
4.3.4 Commence incineration of waste oil																				

\*FY: From 1st of October to next year 30th of September

\*\*Q1: Oct.-Dec., Q2: Jan.- Mar., Q3: Apr.-Jun., Q4: Jul.-Sep.

#### 4.4.3 Implementation cost

Main cost items for proper treatment of waste oil are as follows:

- Personnel cost: pre-consultation with KUA, enactment of the Regulation, establishment of procedure and method to apply and permit
- Construction and treatment cost: burning treatment cost for existing waste oil in the Kosrae State

Cost required to implement this component is shown in the table below. The Project cost was estimated at US\$0.15 million for five years.

Table 4-13 Cost for proper treatment of waste oil (US\$)

	FY2018	FY2019	FY2020	FY2021	FY2022	Total
a. Personnel cost	6,560	8,820	7,140	7,620	8,340	38,480
b. Transportation expenses	66	87	75	81	87	396
c. Construction and treatment cost	0	20,000	30,000	30,000	30,000	110,000
d. Purchase of equipment/machinery	0	0	0	0	0	0
e. Operation cost	0	0	0	0	0	0



f. Design and printing cost for material	0	0	0	0	0	0
<b>Total</b>	<b>6,626</b>	<b>28,907</b>	<b>37,215</b>	<b>37,701</b>	<b>38,427</b>	<b>148,876</b>

#### 4.5 The Action Plan (The Project)

##### 4.5.1 Schedule of the Action Plan (The Project)

Entire schedule for the Project is shown in the table below.

Table 4-14 Entire Project Schedule

Activities	Mid-term plan				
	2018	2019	2020	2021	2022
1. Improvement of waste collection system					
1.1 Improve present collection system in each municipality and introduce station collection					
1.2 Propose integrated collection system which will be effective and low financial burden for municipalities					
1.3 Acquire collection vehicle(s) and equipment for integrated collection system					
1.4 Commencement of integrated collection system					
2. Improvement of CDL program					
2.1 Amend the Regulations pursuant to the CDL Act					
2.2 Recommence community collection					
2.3 Update equipment to increase handling efficiency					
2.4 Commencement of appropriate recycling					
3. Proper management of public landfill site					
3.1 Establish incoming waste management system					
3.2 Construction of dikes and disposal at second and third layers					
3.3 Prepare for construction of new landfill site					
4. Proper treatment of waste oil					
4.1 Prior consultation and feasibility study to incinerate waste oil generated other than power plant					
4.2 Preparation of Regulation (Ordinance) for proper treatment of waste oil					
4.3 Incinerate waste oil properly					

##### 4.5.2 Cost of the Action Plan (The Project)

Main costs for the Project are shown in the table below.

Table 4-15 List of main cost items by each components

Components	Personnel cost	OM cost	Parches cost for Machinery and equipment	Cost for product awareness material	Construction and treatment cost
Component1: Improvement of waste collection	<ul style="list-style-type: none"> <li>Malem: support new collection system</li> </ul>	-	<ul style="list-style-type: none"> <li>Waste stations</li> <li>Collection</li> </ul>	Leaflet on collection improvement	-

system	<ul style="list-style-type: none"> <li>Lelu and Tafunsak municipalities: improve collection system and implement PP</li> <li>Awareness raising</li> </ul>		vehicle and equipment for integrated collection system	in Lelu and Tafunsak municipalities	
Component2: Improvement of CDL program	<ul style="list-style-type: none"> <li>Awareness raising</li> </ul>	-	<ul style="list-style-type: none"> <li>Collection truck (Community collection)</li> <li>Can bailing press</li> <li>PET bailing press</li> <li>Glass crusher</li> </ul>	-	-
Component3: Proper management of public landfill site	<ul style="list-style-type: none"> <li>Operation of landfill site</li> </ul>	<ul style="list-style-type: none"> <li>Fuel for landfill operation</li> </ul>	—	—	<ul style="list-style-type: none"> <li>Construction cost for access road to raise level for second phase</li> </ul>
Component4: Proper treatment of waste oil	<ul style="list-style-type: none"> <li>Pre consultation with KUA</li> <li>Enactment of the Regulation</li> <li>Establishment of the procedure and method to apply and permit</li> </ul>	—	—	—	<ul style="list-style-type: none"> <li>Burning treatment cost for existing waste oil in the Kosrae State</li> </ul>

Cost required to implement the Project is shown in the table below. The entire project cost was estimated at US\$0.55 million for five years.

Table 4-16 Entire project cost by components (US\$)

Components	FY2018	FY2019	FY2020	FY2021	FY2022	Total
Component1: Improvement of waste collection system	6,666	18,957	20,970	80,001	7,395	133,989
Component2: Improvement of CDL program	3,979	6,270	13,898	27,698	11,212	63,057
Component3: Proper management of public landfill site	28,545	68,848	35,214	35,700	36,063	204,370
Component4: Proper treatment of waste oil	6,626	28,907	37,215	37,701	38,427	148,876
Total	45,816	122,982	107,297	181,100	93,097	550,292

Table 4-17 Entire project cost by expense items (US\$)

Expense items	FY2018	FY2019	FY2020	FY2021	FY2022	Total
a. Personnel cost	39,600	46,800	46,800	46,800	46,800	226,800
b. Transportation expenses	216	282	297	300	297	1,392

c. Construction and treatment costs	0	60,000	30,000	30,000	30,000	150,000
d. Purchase of equipment/machinery	0	7,500	24,200	98,000	10,000	139,700
e. Operation cost	6,000	6,000	6,000	6,000	6,000	30,000
f. Design and printing cost for material	0	2,400	0	0	0	2,400
Total	45,816	122,982	107,297	181,100	93,097	550,292

## 5 Annual Work Program

To implement the Action Plan (AP), an Annual Work Program (AWP) will be prepared. The primary purpose of preparing the AWP is to request the next fiscal year (FY) budget. KIRMA will produce the AWP and submit it to Kosrae State.

The contents of AWP will consist of (i) activities necessary to conduct the Project; (ii) Project implementation schedule; and (iii) Project cost estimated for next FY, from October to September. Forms of AWP are shown in this chapter.

Moreover, draft AWP for FY 2018 and 2019 are attached as Annex 2 and 3.

Form for Annual Work Program (FY )

<b>Title: Action plan towards technically appropriate and financially sustainable SWM system in Kosrae State</b>	
Implementation Activity	Cost(US\$)
<b>Component1: Improvement of waste collection system</b> Mainly the following activities/works will be implemented;	
<b>Component2: Improvement of CDL program</b> Mainly the following activities/works will be implemented;	
<b>Component3: Proper management of public landfill site</b> Mainly the following activities/works will be implemented;	
<b>Component4: Proper treatment of waste oil</b> Mainly the following activities/works will be implemented;	
<b>Total</b>	

**Form for Annual Work Program (FY ) Activities and the Schedule**

Component/Activity	Contents	Organization	FY2018												Remarks			
			Q1			Q2			Q3			Q4						
			Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.				
<b>Component1: Improvement of waste collection system</b>		Pacific Eco																
		Municipalities																
		DT&I																
		KUA																
		KIRMA																
<b>Component2: Improvement of CDL program</b>																		
<b>Component3: Proper treatment of waste oil</b>																		
<b>Component4: Proper management of public disposal site</b>																		

**Form for Annual Work Program (FY ) Cost of Component and activities**

Component/Activity	Cost						Total
	a. Personnel cost	b. Transportation expenses	c. Construction and treatment cost	d. Purchase of equipment/machinery	e. Operation cost	f. Design and printing cost for material	
<b>Component1: Improvement of waste collection system</b>							
<b>Component2: Improvement of CDL program</b>							
<b>Component3: Proper treatment of waste oil</b>							
<b>Component4: Proper treatment of waste oil</b>							
<b>Total</b>							

**Annex 1 : Current Waste flow in Kosrae State**

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# 1 Current Waste flow in Kosrae State

## 1.1 Purpose

Waste flow is mainly formulated for the following purposes:

- To figure out, from a quantitative perspective, the current situation of waste management and recycling in Kosrae State
- To set target figures for future waste management in Kosrae State
- To formulate a practicable strategy and action plan on waste management in Kosrae State

## 1.2 Outline of Waste Flow

Concept of waste flow is shown as follows.

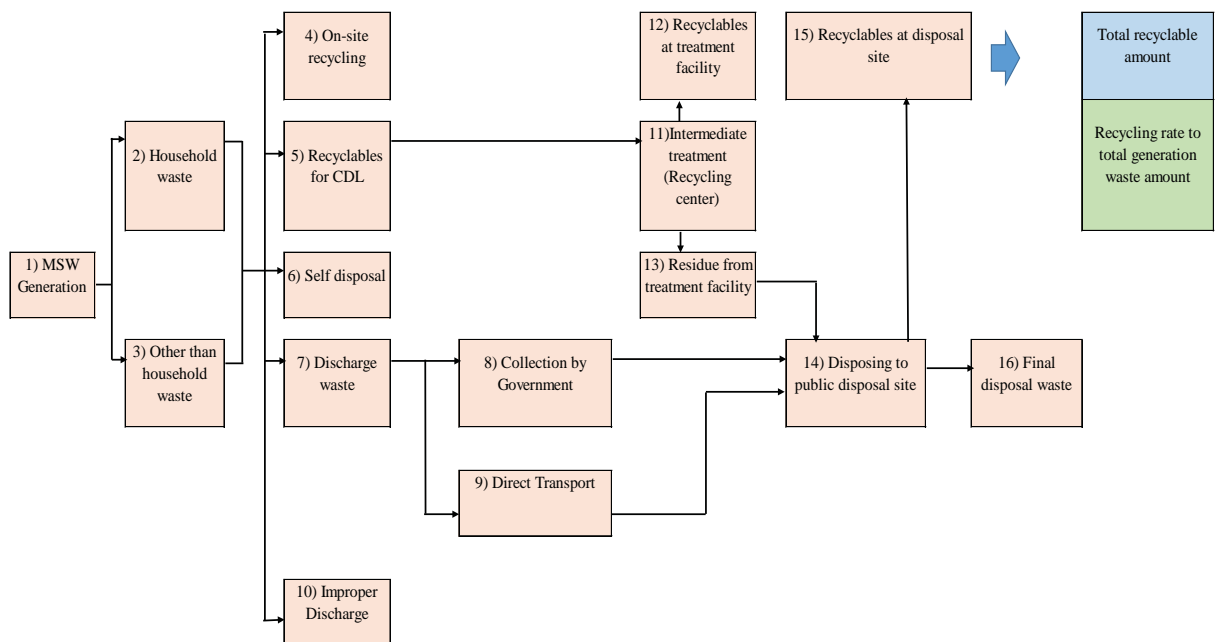


Figure 1-1 Concept of Waste Flow

Definition of each component in waste flow is as follows.

- [MSM Generation (1)] consists of [Household waste (2)] and [Other than household waste (3)].
- [On-site Recycling (4)] is recycling at generation sources such as composting of green waste and kitchen waste, using kitchen waste as feed for livestock and pets and using green waste as fire-wood.



- [Recyclables for the CDL program (5)] refers to beverage containers kept and refunded at recycling center.
- [Self-disposal (6)] refers to burying or open burning of waste in their own property.
- [Discharged waste (7)] refers to waste excluding [On-site Recycling (4)], [Recyclables for the CDL program (5)] and [Self-disposal (6)] from [MSM Generation (1)]
- [8] Collection waste] refers to waste collected by collection service.
- [9] Waste transported directly to public landfill site] refers to waste transported by households, shops, super markets, restaurants, hotels, public office, etc., to landfill site directly.
- When waste collection services are not provided, [Improper discharge at non-collection areas (10)] will take place. Households in non-collection areas discharge waste to their back yard. The amount can be estimated according to the discharge waste amount for household excluded collection waste and waste transported directly to public landfill site.
- [Intermediate Treatment (Recycling center) (11)] refers to the redemption center of recyclables for the CDL program.
- [Recyclables at a treatment facility (12)] refers to the recyclables separated and counted at the above-mentioned facility.
- [Intermediate residue (13)] refers to residue generated at [intermediate treatment facility (11)].
- [Disposing to public landfill site (14)] refers to collection waste and the transportation waste directly to public landfill site.
- [Recyclables at landfill site (15)] refers to the recyclables picked up at the public landfill site.
- [Final disposal waste (16)] refers to [Disposing waste to public landfill site (14)] excluding [(Recyclables at landfill site (15))].

### **1.3 Methodology**

#### **1.3.1 Baseline Survey**

The waste flow in Kosrae State was formulated based on the results of baseline survey as follows:

1. Waste amount and composition survey (from existing data)
2. Questionnaire survey on waste generation from household
3. Incoming waste survey at public landfill site (landfill site)

4. Analysis of the CDL program data in recycling center

**a. Waste amount of household waste**

Waste amount generated from household was calculated based on the following formula; unit waste amount (g(lb)/person/day) multiplied by population.

The Generated waste is composed of the following;

- Recyclable at generation source
  - ✓ On-site recyclables: compost, feed for livestock, fire-wood, etc.
  - ✓ Recyclables for CDL program: PET bottles, aluminum cans, and glass bottles
- Non-recyclables
  - ✓ Self-disposal waste: burning of garden waste, etc.
  - ✓ Discharge waste: discharging to collection service, transporting to landfill site individually, etc.

A questionnaire survey was conducted to each household as a part of baseline survey. The amount of on-site recyclables, recyclables for the CDL program and self-disposal waste was estimated based on the results of the household survey. The unit amount of discharged waste refers to the result of waste amount and composition survey conducted in 2015

**a.1 Generation waste amount (g (lb)/person/day)**

Generation waste amount, which was calculated based on the survey, is 773 g (1.70 lb)/person/day, 37.1 % of which such as on-site recyclables, recyclables for the CDL program and so on are recycled at generation source as shown in Table 1-1.

Table 1-1 Unit waste amount generated from household

Generation waste	Unit waste amount		%	Source
	(g/person/day)	(lb/person/day)		
1. Recyclable waste (a+b)	287	0.63	37.1	
a. On-site recycling waste	262	0.58	33.9	J-PRISM II ,2017
b. Recyclable waste for CDL program	25	0.05	3.2	J-PRISM II ,2017
2. No-recyclable waste	486	1.07	62.9	
c. Self- disposal waste	99	0.22	12.8	J-PRISM II ,2017
d. Discharge waste (2-c)	387	0.85	50.1	J PRISM I , 2015
Total (1+2)	773	1.70	100	

**a.2 Population**

The population in Kosrae State had decreased by approximately a thousand (1,000) people between 2000 to 2010 according to the census data. If the population in 2017 is predicted based on the growth rates between 2000 and 2010, it became 4,500 people, which was unrealistically small. Therefore, the population in 2017 is estimated as the same as the population in 2010 by assuming that the outflow of population slows down.

Table 1-2 Estimated population of Kosrae State in 2017

	Population in census		Growth rates	Population in 2017(estimate)
	2000	2010		
Lelu	2,591	2,160	-1.66%	2,160
Malem	1,571	1,300	-1.73%	1,300
Utwe	1,067	983	-0.79%	980
Tafunsak	2,457	2,173	-1.16%	2,170
Total	7,686	6,616	-1.39%	6,610

### a.3 Generation amount of household waste

Generation amount of household waste was calculated as 5.11 ton/day based on the formula below. Unit generation amount and population in the formula was referred to in the data mentioned above.

$$(\text{Generation amount of household waste}) = (\text{Unit waste amount}) \times (\text{Population})$$

Breakdown of the generation amount is shown in Table 1-3.

Table 1-3 Unit generation amount and waste amount generated from household

Item	Unit waste amount (g/capita/day)	Population	Waste amount (ton/day)
4) On-site recycling waste	262.00	6,610	1.73
5) Recycling waste for the CDL program	25.00	6,610	0.17
6) Self- disposal waste	99.00	6,610	0.65
7)+8) Discharge waste	387.00	6,610	2.56
2) Generation waste	773.00	6,610	5.11

\*The number attached beside each type of waste corresponds to the number in the chart of waste flow.

**b. Disposal waste amount**

Disposal waste amount in Kosrae State was calculated based on the amount of incoming waste and net specific weight of each type of waste.

Daily average amount of incoming waste is 4.17 ton/day, the breakdown of which is 1.22 ton/day of the collected waste and 2.95 ton/day of the waste transported directly by each household, small business, hotel and restaurant.



Incoming waste survey at landfill site

Table 1-4 Number of incoming vehicles and disposal waste amount

	Unit	Jul.18	Jul.19	Jul.20	Jul.21	Jul.22	Average
Number of incoming vehicles	Number of vehicles	21	18	18	18	18	19
Incoming waste amount	t/day	5.82	5.16	3.96	3.83	2.07	4.17
8) Collected waste amount	t/day	1.01	2.52	0.81	1.76	0	1.22
9) Waste amount transported directly	t/day	4.81	2.64	3.15	2.07	2.07	2.95

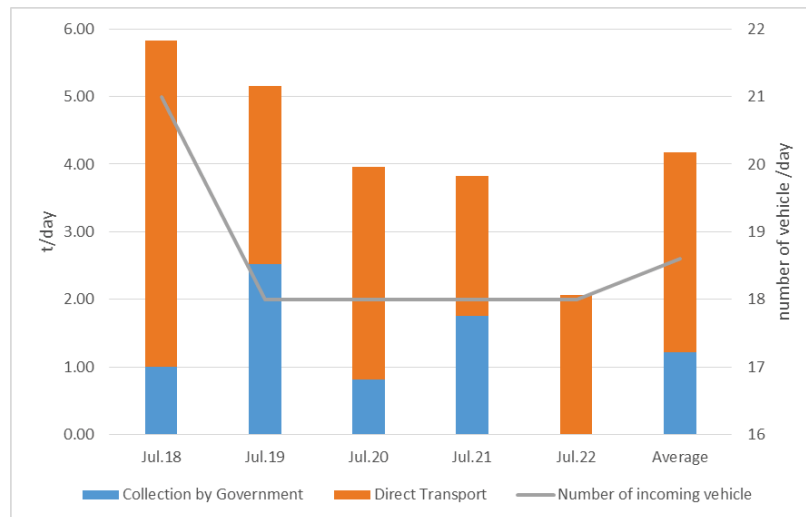


Figure 1-2 Number of Incoming vehicles and disposal waste amount

Breakdown of disposal waste at landfill site is shown as Figure 1-3.

Disposal amount of household waste accounts for 46 % (1.9 ton/day) of total disposal waste. The

other 54 % accounts for public waste and commercial waste such as from small businesses and restaurants.

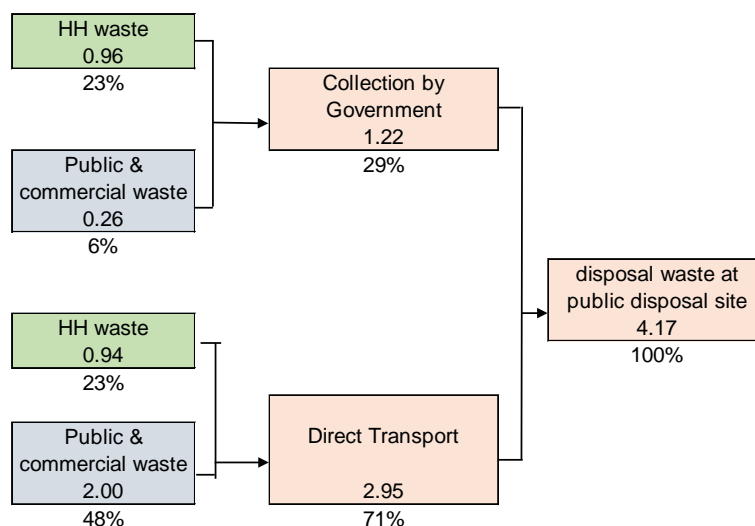


Figure 1-3 Breakdown of disposal waste at landfill site (ton/day)

**c. Recycling amount at landfill site**

Scrap metal and green waste are segregated and stored, and a wooden pallet for transportation is recycled at the landfill site. The recycling amount is estimated at 0.1 ton/day.

**d. Final disposal waste amount**

Final disposal waste amount was calculated using the following formula;

$$16) \text{ Final disposal waste amount} = 14) \text{ Disposal waste amount} - 15) \text{ Recycling amount at landfill site} \\ = 4.17 - 0.10 = 4.07$$

**e. Recycling amount of recyclables for the CDL program**

Micronesia Eco Corporation (MEC) is the only company which signed a contract on the CDL program with Kosrae State. Target containers for the CDL program such as aluminum cans, beverage plastic bottles and glass bottles are brought into the recycling center. A refund is paid with cash to the person who brings the containers after IPC counting. Then IPC reports and charges weekly amount of the refund they paid to the state government.

The recycling amount of beverage containers for the CDL program at the recycling center from 2015 to 2017 is shown in Table 1-5. The recycling amount for the CDL program was calculated at a daily average of 0.16 ton/day according to the table.

$$11) \text{ Intermediate treatment [Recycling at recycling center]} = 12) \text{ Recyclables at treatment facility} = \\ 5) \text{ Recyclables for the CDL program} = 0.14 \text{ ton/day}$$

Table 1-5 Recycling amount of recyclables for the CDL program

Number of containers deposited and refunded (piece/year)

FISCAL YEAR:	Deposit				Refund			
	Alum. Cans	PET Plastics	Glass Bottles	Total	Alum. Cans	Bev. Plastic Bottles	Glass Bottles	Total
2015	897,425	151,428	251,038	1,299,891	895,920	134,990	108,965	1,139,875
2016	979,082	181,532	217,374	1,377,988	1,065,770	148,620	98,490	1,312,880
2017	911,856	289,263	175,479	1,376,598	951,615	182,740	51,265	1,185,620

Amount of containers deposited & refunded (ton/year)

FISCAL YEAR:	Deposit				Refund			
	Alum. Cans	PET Plastics	Glass Bottles	Total	Alum. Cans	Bev. Plastic Bottles	Glass Bottles	Total
2015	14.36	3.79	75.31	93.46	14.33	3.37	32.69	50.39
2016	15.67	4.54	65.21	85.42	17.05	3.72	29.55	50.32
2017	14.59	7.23	52.64	74.46	15.23	4.57	15.38	35.18

Alum.can: 16g/piece, PET bottle: 25g/piece, Glass bottle: 300g/piece

Amount of containers deposited & refunded (ton/day)

FISCAL YEAR:	Deposit				Refund			
	Alum. Cans	PET Plastics	Glass Bottles	Total	Alum. Cans	Bev. Plastic Bottles	Glass Bottles	Total
2015	0.04	0.01	0.21	0.26	0.04	0.01	0.09	0.14
2016	0.04	0.01	0.18	0.23	0.05	0.01	0.08	0.14
2017	0.04	0.02	0.14	0.20	0.04	0.01	0.04	0.09
Average	0.04	0.01	0.21	0.26	0.04	0.01	0.09	0.14

\*(Source) DOE & MEC

**f. Waste amount from collection service**

Waste collection service is provided by four municipalities. The total waste amount collected by the municipalities is 1.22 ton/day.

**g. Improper discharge waste**

Residents which have no collection service discharge waste to nearby open spaces. The improper discharge waste amount was calculated as follows. The results show that 0.66 ton/day (8.9 % of generated amount, 13.7 % of discharged amount) of waste is disposed improperly.

10) Improper discharged waste amount = Discharged amount of household waste – Collected amount of household waste– Incoming amount of household waste transported directly to landfill site = 2.56 - 0.96 – 0.94 = 0.66 ton/day

**h. Discharged waste amount**

The total amount of discharged waste was calculated as 6.57 ton/day from the result mentioned above.

7) Amount of discharged waste = 8) Amount of collected waste + 9) Amount of disposal waste transported directly to landfill site + 10) Amount of improper discharge waste =  $1.22 + 2.95 + 0.66 = 4.82$  ton/day

**i. Waste generation from other than household**

Waste amount generated from other than household was calculated as 2.33 ton/day (31.3 % of generated waste) based on the following formula.

3) Amount of the waste generated from other than household = 4) Amount of On-site recycling + 5) Amount of recyclables for the CDL program + 6) Amount of self-disposal waste + 7) Amount of discharged waste – 2) Amount of household waste =  $(1.73+0.14+0.65+4.82-5.11) = 2.23$  ton/day

**j. Amount of State Solid Waste**

The total amount of generated waste in Kosrae State was calculated as 7.44 ton/day, which is the sum of generated amount of household waste and other than household waste.

1) Amount of state solid waste = 2) generated amount of household waste + 3) generated amount of other than household waste =  $5.11 + 2.23 = 7.34$  ton/day

**1.3.2 Waste flow in Kosrae State**

Waste flow in Kosrae State was formulated as follows, based on the result mentioned above.

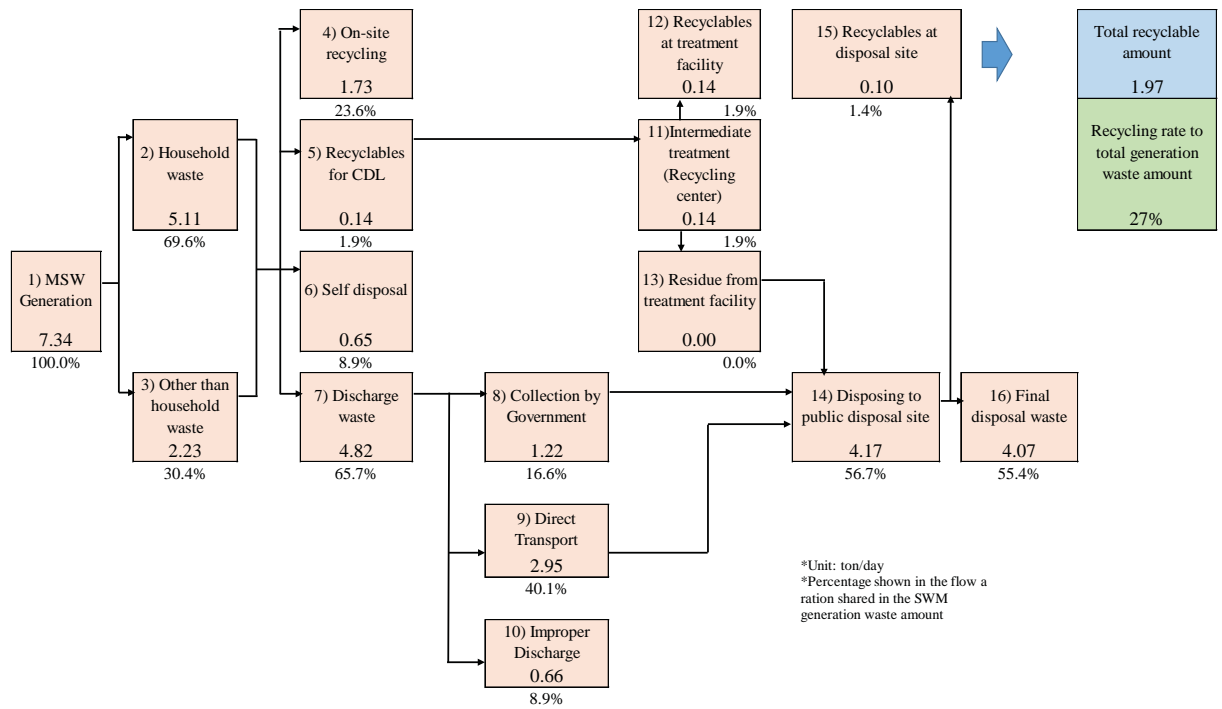


Figure 1-4 Waste flow in Kosrae State (2017)



**Annex 2 : Annual Work Program in FY 2018**

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Annual Work Program (FY 2018 )

<b>Title: Action plan towards technically appropriate and financially sustainable SWM system in Kosrae State</b>	
Implementation Activity	Cost(US\$)
<p><b>Component1: Improvement of waste collection system</b>            Mainly the following activities/works will be implemented;</p> <p>1.1.1 Provide technical support for station collection introduced in Malem Municipality            1.1.2 Improve collection efficiency and fee collection system in Lelu and Tafunsak municipalities            1.1.3 Implement Pilot Project (PP) on improvement of waste collection system in Lelu and Tafunsak municipalities</p>	6,666
<p><b>Component2: Improvement of CDL program</b>            Mainly the following activities/works will be implemented;</p> <p>2.1.1 Assess the current CDL system in Kosrae            2.1.2 Prepare the amendment to the Regulations pursuant to the CDL Act            2.1.3 Submit the proposed amendment to the Governor and other relevant state officials            2.2.1 Find source of funds to purchase a truck for community collection</p>	3,979
<p><b>Component3: Proper management of public landfill site</b>            Mainly the following activities/works will be implemented;</p> <p>3.1.1 Assess the current situation of incoming waste            3.1.2 Establish incoming waste management system and carry out trial using the system            3.1.3 Manage incoming waste and share the information            3.2.1 Forecast disposal waste amount/volume and plan for second and third phase landfill            3.2.2 Prepare drawings for extension of existing landfill site and calculate construction cost            3.2.3 Find source of funds for extension works            3.2.5 Carry out proper landfill operation</p>	28,545
<p><b>Component4: Proper treatment of waste oil</b>            Mainly the following activities/works will be implemented;</p> <p>4.1.1 Prior consultation among related organizations            4.1.2 Feasibility Study from technical and institutional point of view            4.1.3 Secure budget to incinerate existing waste oil in the state            4.2.1 Preparation of Regulation (Ordinance) for proper treatment of waste oil</p>	6,626
<b>Total</b>	45,816

**Annual Work Program (FY 2018) Activities and the Schedule**

Component/Activity	Contents	FY2018												Remarks						
		Organization				Q1			Q2			Q3			Q4					
		KIRMA	DT&I	KUA	MEC	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May		Jun.	Jul.	Aug.	Sep.		
<b>Component1: Improvement of waste collection system</b>																				
1.1.1 Provide technical support for station collection introduced in Matem Municipality	- KIRMA will support to establish a station collection system in Matem municipality while solving a problem in cooperation with the organization which support the activity.	⊙			○															
1.1.2 Improve collection efficiency and fee collection system in Lelu and Tafunsak municipalities	- Assess current waste collection and fee collection system in Lelu and Tafunsak municipalities - Establish effective waste collection routes, days and fee collection system - Produce and distribute a leaflets for improved system - Evaluate waste collection improving effect	○			⊙															
1.1.3 Implement Pilot Project (PP) on improvement of waste collection system in Lelu and Tafunsak municipalities	- Selection of Hamlet be implemented Pilot Project(PP) - Make plan for waste collection and fee collection etc. - Meeting with resident participate the PP - Install waste station - Monitor the PP, Evaluate and improve the system used in PP - Expand the station collection system to other hamlets in Lelu and Tafunsak municipalities	○			⊙															
<b>Component2: Improvement of CDL program</b>																				
2.1.1 Assess the current CDL system in Kosme	The challenges shall be identified through the assessment of the current CDL program.	⊙																		
2.1.2 Prepare the amendment to the Regulations pursuant to the CDL Act	Based on the assessment, the amendment to increase deposits shall be prepared by KIRMA.	⊙																		
2.1.3 Submit the proposed amendment to the Governor and other relevant state officials	The amendment shall be submitted to the Governor as well as other relevant state officials.	⊙																		
2.2.1 Find source of funds to purchase a truck for community collection	KIRMA shall take initiatives to find a donor or source of funds.	⊙																		

**Annual Work Program (FY 2018) Activities and the Schedule**

Component/Activity	Contents	FY2018												Remarks					
		Organization					Q1			Q2			Q3			Q4			
		KIRMA	DT&I	KUA	Municipalities	MEC	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.		May	Jun.	Jul.	Aug.	Sep.
<b>Component3: Proper treatment of waste oil</b>																			
3.1.1 Assess the current situation of incoming waste	- Assess the current situation of incoming waste - Evaluate present recording system	○	○																
3.1.2 Establish incoming waste management system and carry out trial using the system	- Establish incoming waste management system - Training workers in charge of incoming waste management - Make a trial using the system	○	○																
3.1.3 Manage incoming waste and share the information	- Management for incoming waste will be kept conducting. - An incoming date will be summarized quarterly and yearly and shared with relevant sectors.	○	○																
3.2.1 Forecast disposal waste amount/volume and plan for second and third phase landfill	- Future disposal waste amount shall be forecasted based on the waste flow (WF). - And disposal volume, disposal period and construction schedule etc. will be planned.	○	○																
3.2.2 Prepare drawings for extension of existing landfill site and calculate construction cost	- Drawings of dike and access road and calculation of construction cost for second phase landfill will be prepared	○	○																
3.2.3 Find source of funds for extension works	- KIRMA shall take initiatives to find a donor or source of funds.	○	○																
3.2.5 Carry out proper landfill operation	- Start Proper landfill operation	○	○																
<b>Component4: Proper management of public disposal site</b>																			
4.1.1 Prior consultation among related organizations	KIRMA shall take initiatives to discuss a possibility to burning treatment of waste oil generated other than power plant with KUA and other relevant organizations.	○	○																
4.1.2 Feasibility Study from technical and institutional point of view	Technical, institutional issues and issues for facility with waste oil generated other than power plant burning will be have to confirm to contractor through KUA.	○	○																
4.1.3Secure budget to incinerate existing waste oil in the state	KIRMA shall take initiatives to find a donor or source of funds to treat existing waste oil generated and stored.	○	○																
4.2.1 Preparation of Regulation (Ordinance) for proper treatment of waste oil	Enactment to the Regulation (Ordinance) for proper treatment of waste oil shall be prepared. The Regulation (Ordinance) shall be included subject treatment waste oil, responsibility for discharger, treatment fee, permission for inappropriate treatment etc.	○	○																

**Annual Work Program (FY 2018) Cost of Component and activities**

Component/Activity	Cost						Total
	a. Personnel cost	b. Transportation expenses	c. Construction and treatment cost	d. Purchase of equipment/machinery	e. Operation cost	f. Design and printing cost for material	
<b>Component1: Improvement of waste collection system</b>							
1.1.1 Provide technical support for station collection introduced in Malem Municipality	6,600	66	0	0	0	0	6,666
1.1.2 Improve collection efficiency and fee collection system in Lelu and Tafunsak municipalities	3,000	30	0	0	0	0	3,030
1.1.3 Implement Pilot Project (PP) on improvement of waste collection system in Lelu and Tafunsak municipalities	2,400	24	0	0	0	0	2,424
<b>Component2: Improvement of CDL program</b>							
2.1.1 Assess the current CDL system in Kostaie	1,200	12	0	0	0	0	1,212
2.1.2 Prepare the amendment to the Regulations pursuant to the CDL Act	3,940	39	0	0	0	0	3,979
2.1.3 Submit the proposed amendment to the Governor and other relevant state officials	0	0	0	0	0	0	0
2.2.1 Find source of funds to purchase a truck for community collection	940	9	0	0	0	0	949
<b>Component3: Proper treatment of waste oil</b>							
3.1.1 Assess the current situation of incoming waste	900	9	0	0	0	0	909
3.1.2 Establish incoming waste management system and carry out trial using the system	2,100	21	0	0	0	0	2,121
3.1.3 Manage incoming waste and share the information	22,500	45	0	0	6,000	0	28,545
3.2.1 Forecast disposal waste amount/volume and plan for second and third phase landfill	300	3	0	0	0	0	303
3.2.2 Prepare drawings for extension of existing landfill site and calculate construction cost	300	3	0	0	0	0	303
3.2.3 Find source of funds for extension works	1,500	15	0	0	0	0	1,515
3.2.5 Carry out proper landfill operation	600	6	0	0	0	0	606
<b>Component4: Proper treatment of waste oil</b>							
4.1.1 Prior consultation among related organizations	900	9	0	0	0	0	909
4.1.2 Feasibility Study from technical and institutional point of view	900	9	0	0	0	0	909
4.1.3 Secure budget to incinerate existing waste oil in the state	18,000	0	0	0	6,000	0	24,000
4.2.1 Preparation of Regulation (Ordinance) for proper treatment of waste oil	6,560	66	0	0	0	0	6,626
<b>Total</b>	2,080	21	0	0	0	0	2,101
	2,400	24	0	0	0	0	2,424
	880	9	0	0	0	0	889
	1,200	12	0	0	0	0	1,212
	39,600	216	0	0	6,000	0	45,816



**Annex 3 : Annual Work Program in FY 2019**

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Annual Work Program (FY 2019 )

<b>Title: Action plan towards technically appropriate and financially sustainable SWM system in Kosrae State</b>	
Implementation Activity	Cost(US\$)
<p><b>Component1: Improvement of waste collection system</b> Mainly the following activities/works will be implemented;</p> <p>1.1.2 Improve collection efficiency and fee collection system in Lelu and Tafunsak municipalities 1.1.3 Implement Pilot Project (PP) on improvement of waste collection system in Lelu and Tafunsak municipalities 1.2.1 Set up Working Group (WG) 1.2.2 Examine integrated collection system</p>	18,957
<p><b>Component2: Improvement of CDL program</b> Mainly the following activities/works will be implemented;</p> <p>2.2.2 Purchase a truck and lease it to the recycling company 2.2.3 Prepare a community collection plan 2.2.4 Recommence community collection 2.3.1 Find source of funds to purchase a can bailing press</p>	6,270
<p><b>Component3: Proper management of public landfill site</b> Mainly the following activities/works will be implemented;</p> <p>3.1.3 Manage incoming waste and share the information 3.2.4 Implement extension works 3.2.5 Carry out proper landfill operation</p>	68,848
<p><b>Component4: Proper treatment of waste oil</b> Mainly the following activities/works will be implemented;</p> <p>4.1.3 Secure budget to incinerate existing waste oil in the state 4.2.1 Preparation of Regulation (Ordinance) for proper treatment of waste oil 4.2.2 Submit the proposed Regulation(Ordinance) to the Governor and other relevant Organizations 4.3.1 Establish procedure to apply and permit treatment of waste oil 4.3.2 Prepare treatment procedure for O&amp;M of waste oil incineration facility 4.3.3 Raise awareness for resident and business sectors to commence waste oil treatment 4.3.4 Commence incineration of waste oil</p>	28,907
<b>Total</b>	122,982





**Annual Work Program (FY 2019) Activities and the Schedule**

Component/Activity	Contents	FY2019												Remarks								
		Organization				Q1				Q2					Q3				Q4			
		KIRMA	DT&I	KUA	Municipalities	MEC	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.		May	Jun.	Jul.	Aug.	Sep.			
<b>Component3: Proper treatment of waste oil</b>																						
3.1.3 Manage incoming waste and share the information	- Management for incoming waste will be kept conducting. - An incoming date will be summarized quarterly and yearly and shared with relevant sectors.																					
3.2.4 Implement extension works	Construct dike and access road for second phase landfill																					
3.2.5 Carry out proper landfill operation	Start Proper landfill operation																					
<b>Component4: Proper management of public disposal site</b>																						
4.1.3 Secure budget to incinerate existing waste oil in the state	KIRMA shall take initiatives to find a donor or source of funds to treat existing waste oil generated and stored.																					
4.2.1 Preparation of Regulation (Ordinance) for proper treatment of waste oil	Enactment to the Regulation (Ordinance) for proper treatment of waste oil shall be prepared. The Regulation (Ordinance) shall be included subject treatment waste oil, responsibility for discharge, treatment fee, permission for inappropriate treatment etc.																					
4.2.2 Submit the proposed Regulation(Ordinance) to the Governor and other relevant Organizations	The draft Regulation (Ordinance) shall be submitted to the Governor as well as other relevant state officials.																					
4.3.1 Establish procedure to apply and permit treatment of waste oil	- Set up subject treatment waste oil - Standardize reception desk system and procedure - Standardize method and place to carry-on waste oil - Establish charge payment system and method																					
4.3.2 Prepare treatment procedure for O&M of waste oil incineration facility	- Establish OM system for waste oil treatment - Standardize method and procedure to check type of waste oil - Standardize method and procedure to transfer waste oil to storage tank - Set up combustion time and schedule																					
4.3.3 Raise awareness for resident and business sectors to commence waste oil treatment	Disseminate appropriate waste oil burning treatment to resident and business sectors																					
4.3.4 Commence incineration of waste oil	Acceptance processing will be started and commencement burning treatment of waste oil																					

**Annual Work Program (FY 2019) Cost of Component and activities**

Component/Activity	Cost						Total
	a. Personnel cost	b. Transportation expenses	c. Construction and treatment cost	d. Purchase of equipment/machinery	e. Operation cost	f. Design and printing cost for material	
<b>Component1: Improvement of waste collection system</b>	11,340	111	0	4,500	0	0	18,957
1.1.2 Improve collection efficiency and fee collection system in Lelu and Tafunsak municipalities	600	6	0	0	0	2,400	3,006
1.1.3 Implement Pilot Project (PP) on improvement of waste collection system in Lelu and Tafunsak municipalities	4,620	45	0	4,500	0	0	9,165
1.2.1 Set up Working Group (WG)	1,500	15	0	0	0	0	1,515
1.2.2 Examine integrated collection system	5,220	51	0	0	0	0	5,271
<b>Component2: Improvement of CDL program</b>	3,240	30	0	3,000	0	0	6,270
2.2.2 Purchase a truck and lease it to the recycling company	1,020	9	0	3,000	0	0	4,029
2.2.3 Prepare a community collection plan	1,200	12	0	0	0	0	1,212
2.2.4 Reconnect community collection	0	0	0	0	0	0	0
2.3.1 Find source of funds to purchase a can bailing press	1,020	9	0	0	0	0	1,029
<b>Component3: Proper treatment of waste oil</b>	22,800	48	40,000	0	6,000	0	68,848
3.1.3 Manage incoming waste and share the information	4,200	42	0	0	0	0	4,242
3.2.4 Implement extension works	600	6	40,000	0	0	0	40,606
3.2.5 Carry out proper landfill operation	18,000	0	0	0	6,000	0	24,000
<b>Component4: Proper treatment of waste oil</b>	8,820	87	20,000	0	0	0	28,907
4.1.3 Secure budget to incinerate existing waste oil in the state	960	9	0	0	0	0	969
4.2.1 Preparation of Regulation (Ordinance) for proper treatment of waste oil	1,500	15	0	0	0	0	1,515
4.2.2 Submit the proposed Regulation(Ordinance) to the Governor and other relevant Organizations	960	9	0	0	0	0	969
4.3.1 Establish procedure to apply and permit treatment of waste oil	1,200	12	0	0	0	0	1,212
4.3.2 Prepare treatment procedure for O&M of waste oil incineration facility	1,200	12	0	0	0	0	1,212
4.3.3 Raise awareness for resident and business sectors to commence waste oil treatment	1,500	15	0	0	0	0	1,515
4.3.4 Commence incineration of waste oil	1,500	15	20,000	0	0	0	21,515
<b>Total</b>	46,200	276	60,000	7,500	6,000	0	122,982