

8.2 Description Master of the Master Plan

8.2.1 Projection until 2010

8.2.1.1 Population

Table 8-13 presents the population data and forecast from 2000 to 2010.

Table 8-13: Population forecast in AMSS (1999 – 2010)

Muni.		2000	2003	2006	2010
SS	T	479,605	497,844	510,367	512,873
	U	479,605	497,844	510,367	512,873
	R	0	0	0	0
MJ	T	189,392	200,917	209,708	217,248
	U	189,392	200,917	209,708	217,248
	R	0	0	0	0
CD	T	153,350	164,069	172,570	180,727
	U	153,350	164,069	172,570	180,727
	R	0	0	0	0
CT	T	94,062	104,640	114,077	125,618
	U	94,062	104,640	114,077	125,618
	R	0	0	0	0
AY	T	39,953	44,720	49,034	54,427
	U	29,663	34,056	38,014	43,005
	R	10,290	10,664	11,020	11,422
SM	T	70,610	73,452	75,326	76,106
	U	70,610	73,452	75,326	76,106
	R	0	0	0	0
ST	T	158,207	175,286	192,131	213,431
	U	144,025	160,588	176,944	197,690
	R	14,182	14,698	15,187	15,741
AC	T	45,123	52,790	61,090	72,950
	U	45,123	52,790	61,090	72,950
	R	0	0	0	0
SY	T	285,286	290,412	297,183	309,772
	U	285,286	290,412	297,183	309,772
	R	0	0	0	0
IL	T	132,231	144,985	155,957	168,554
	U	132,231	144,985	155,957	168,554
	R	0	0	0	0
SMT	T	107,212	123,663	139,463	160,949
	U	78,761	94,175	108,991	129,365
	R	28,451	29,488	30,472	31,584
AP	T	171,833	192,728	211,715	235,614
	U	171,833	192,728	211,715	235,614
	R	0	0	0	0
NJ	T	32,172	34,119	35,601	36,866
	U	15,492	16,831	17,737	18,350
	R	16,680	17,288	17,864	18,516
TN	T	41,277	45,020	48,193	51,733
	U	30,265	33,607	36,399	39,509
	R	11,012	11,413	11,794	12,224
Total	T	2,000,313	2,144,645	2,272,415	2,416,868
	U	1,919,698	2,061,094	2,186,078	2,327,381
	R	80,615	83,551	86,337	89,487

Note: T: total, U: urban, and R: rural

Source: arranged by the Study Team on the basis of information from the municipalities and Dirección General de Estadística y Censos, Ministerio de Economía, 1995, "Proyección de la Población de El Salvador," El Salvador

8.2.1.2 Waste Amount

a. Municipal Solid Waste

Table 8-14 summarizes waste generation amount in 2010.

Table 8-14: Waste Generation Amount in 2010

Unit : ton/day

	Household	Restaurant	Other than restaurant	Institutional	Market	Road sweeping	Total
San Salvador	257.6	9.4	24.7	18.3	39.2	64.4	413.6
Mejicanos	101.0	4.8	10.9	8.5	2.8	5.8	133.8
Delgado	79.8	4.2	10.6	4.6	0.9	3.0	103.1
Cuscatancingo	54.6	4.1	6.0	3.0	0.0	1.8	69.5
Ayutuxtepeque	21.2	0.6	1.8	2.1	0.5	0.5	26.7
San Marcos	34.5	1.8	2.7	1.3	0.9	1.4	42.6
Nueva San Salvador	106.8	3.3	8.2	8.1	5.5	8.5	140.4
Antiguo Cuscatlan	41.2	1.1	3.6	4.6	1.2	10.2	61.9
Soyapango	136.4	11.2	13.4	8.9	6.2	2.5	178.6
Ilopango	75.4	3.9	5.9	3.4	0.9	0.3	89.8
San Martin	57.5	6.0	6.7	2.9	7.8	0.3	81.2
Apopa	100.4	9.3	8.9	3.2	11.3	1.1	134.2
Nejapa	8.9	0.7	1.3	0.4	0.2	0.1	11.6
Tonacatepeque	19.0	0.8	2.7	3.4	0.3	0.6	26.8
Total	1,094.3	61.2	107.4	72.7	77.7	100.5	1,513.8

b. Medical Waste

Table 8-15 summarizes medical waste generation amount in 1999 to 2010.

Table 8-15: Forecast of Future Medical Waste Generation Amount

Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Increase Rate*	1.000	1.027	1.053	1.078	1.103	1.126	1.148	1.170	1.189	1.208	1.227	1.245
Amount (ton/day)	3.20	3.29	3.37	3.45	3.53	3.60	3.67	3.74	3.80	3.87	3.93	3.98

Note: * Increase rate having the amount in year 1999 as the base.

8.2.2 Technical System

8.2.2.1 Municipal Solid Waste Management

SWM activities in 14 municipalities of AMSS mainly consist of collection, street sweeping, transport and final disposal activities. Separate discharge and collection is not practiced in reality. As for intermediate treatment activities in SWM, only small-scale composting activities using market wastes are carried out.

“Special Regulation on Integral Solid Waste Management” was published on June 1st 2000. Accordingly, in future planning of municipal SWM, it is necessary to follow and comply with this national environmental regulation. The regulation specifies final disposal requirements of: sanitary landfill; impermeable structure; and leachate drainage and treatment.

In its consequence, among all the final disposal sites in El Salvador, the MIDES Nejapa S/L seems to be the only final disposal site that complied with the recently published national regulation on SWM. Therefore, all municipalities other than the MIDES Nejapa users turn out to be violators of the said national regulation.

As a matter of course, the above national regulation should be observed by all municipalities with respect to the environmental viewpoint. However, if an immediate compliance with this regulation is demanded, it will require a substantial increase of financial burdens by municipalities and which may consequently affect the whole municipal finance to a great length.

The principal SWM mission for COAMSS/OPAMSS and 14 municipalities is to implement sustainable municipal SWM services for all citizens reminding the environmental conservation and targeting the service coverage expansion and service quality improvement. Whereas the grade of collection services, organizational integrity of the cleansing offices, its budget and resources in hand are diversely different among those municipalities. In view of that, the M/P categorizes the SWM issues in AMSS into what requires regional focus and solutions by OPAMSS/COAMSS and what requires individual focus and solutions by respective municipalities. The M/P outlines the action plans respectively for the metropolitan focuses and individual municipal focuses.

a. Discharge and Storage System

Waste is generated on a somewhat continuous basis. However, collection occurs intermittently, a few times a week or perhaps daily, depending on the quantity generated at a specific location and climatic conditions. Therefore, it is necessary to provide proper storage of waste at home until it is collected.

As the POS shows that the use of the plastic sack is widely accepted in the Study Area, this is favorable in view of sanitation and handling. The problem is that it is vulnerable to animal infestation. Therefore, the best recommendable storage method is combination use of the plastic bag and the plastic dustbin.

b. Collection and Transport System

b.1 Collection System

In order to achieve the essential objective of waste collection, i.e., to eliminate waste from living environment before the waste becomes hindrance to keep the sanitary environment, twice or three times a week of collection frequency should be applied. On the other hand, every day waste collection is not recommendable as it results in considerably high collection cost.

Almost of the municipalities in the Study Area still need to raise collection coverage. Therefore, mixed collection is recommendable over the Study Area in principal. There are, however, some municipalities that have achieved high collection coverage such as Nueva San Salvador and Antiguo Cuscatlan. In high-income areas of such municipalities, introduction of separate collection in the near future is recommendable.

In the Study Area many communities that is inaccessible for the collection vehicle exist. For such communities, point collection (container collection or station collection) or house to house collection by community-based collection or micro-enterprises depending on conditions of a target community would be applicable. For the accessible area to collection vehicle, continuation of the present collection method, i.e., curbside collection with ringing bell, is recommendable.

b.2 Transport System

Whether the transfer transport should be employed or not is depending on the size of T/Ss that are used. Small T/Ss' unit costs tend to be expensive, contrarily large T/Ss' ones are likely to be inexpensive due to economy of scale. In the examination of breakeven distance and travel time to Nejapa Disposal Site, 100ton/day transfer transport system never became beneficial to the Study Area, 300ton/day or over transfer transport system were advantageous compared with the direct transport.

In consequence of the examination of T/S case studies, installing two numbers of T/S (a 350ton/day T/S in the western part, and a 900ton/day T/S in the eastern part) used by 8 municipalities becomes an optimum proposal of the transfer stations and transport (T/S&T) system in the M/P. The respective users for the two T/Ss are listed below.

Table 8-16: Major Users of Transfer Stations

Name of T/S	Major User (name of municipality)
West T/S (350 ton/day)	San Salvador, Nueva San Salvador, Antigo Cuscatlan
East T/S (900 ton/day)	San Salvador, Mejicanos, Cuscatancingo, San Marcos, Soyapango, Ilopango

On the other hand, the examination verified that maintaining the current transport system (i.e., direct transport by collection vehicles) stands as the optimum choice for the remaining 6 municipalities.

As for type of T/S, direct-load type is recommendable due to its fewer cost and smaller environmental impacts on and around the site.

20 ton or over tractor-trailers are recommendable as transport vehicles. Smaller capacity vehicles than those are not recommendable because use of a small vehicle for transfer transport raises transport cost.

c. Intermediate Processing System

Under the circumstances, it is judged that the necessity for introducing intermediate processing system in AMSS for municipal SWM is fairly small. Team's observation is summarized as follows.

- As for compost, its market size is currently small and a market demand for compost products only exists in relatively short periods. Therefore, it is anticipated that if compost is produced substantially more than what is produced today, its limited marketability may result in price drop and surplus of compost product and further financial burdens for municipalities.

- There might be a justifiable reason to introduce a MIDES S/P for creating job opportunities for waste pickers. However, material recovery from mixed discharged waste has large limitation for resource conservation purposes. It is also doubtful whether S/P that recovers materials from mixed discharged waste has financial feasibility in maintaining the operation. Whereas if a S/P is fed with source separated recyclable materials, its efficiency will be much higher. Therefore, S/P that recovers materials from mixed discharged waste is not recommended.
- Incineration facilities are very expensive and also require technical capability for their operation and maintenance. It is judged that introduction of such intermediate processing system for present AMSS should be too early, in view of economical dimensions that municipalities has.

Hence, it is proposed in this M/P that a S/P should start its operation when 14 municipalities deploy the separate collection of recyclable materials. As for incineration, the M/P recommends that an examination whether incineration system is necessary or not should take place around year 2009 to 2010.

d. Final Disposal System

d.1 Appropriate Number of Final Disposal Sites

Currently, 10 out of 14 municipalities in AMSS dispose their municipal waste at MIDES Nejapa landfill. As for remaining 4 municipalities, 2 municipalities use ESPIGA controlled dumping site and the other 2 municipalities dispose of at open dumping site within their jurisdiction.

It should be a matter of course that the selection of a final disposal alternative lies on discretion of respective autonomous municipalities. Meanwhile, "Special Regulation on Integral Solid Waste Management (Reglamento Especial sobre el Manejo Integral de los Desechos Sólidos)" was published on 1st June 2000. Out of present final disposal sites that 14 municipalities use, a final disposal site that complies with this requirement is only MIDES Nejapa sanitary landfill that 10 municipalities use. Therefore, other 4 municipalities will be required to implement satisfactory final disposal of their municipal waste in order to comply with such environmental legislative requirements.

However, viewing financial capabilities of respective municipalities, the US\$18/ton tipping fee of MIDES should be very expensive. Which consequently would impose a significant financial burden on municipal finances that may possibly lead to municipal financial crisis. This implies serious questions that whether or not a "sustainable SWM" that being the goal of the Master Plan could be realized by respective 14 municipalities, from municipal financial aspects.

Meanwhile, municipalities that currently use ESPIGA site consider to participate in the New ESPIGA S/L that is supposed to be managed by a private sector and of course is supposed to comply with the regulation mentioned above. Therefore, measures to comply with the regulation are needed for the two (2) municipalities that currently have open dumping practices, i.e., Tonacatepeque and San Martin municipalities. Consequently, this M/P recommends constructing another regional sanitary landfill that said two municipalities are going to use.

Currently there is only one regional S/L (MIDES Nejapa) that complies with the national regulation of SWM. When the New ESPIGA S/L and another S/L for the Tonacatepeque and San Martin municipalities are constructed, AMSS in total will have 3 regional S/Ls. It consequently will raise the safety factor of final disposal management in AMSS that can fully cope with the emergency and accident occasions.

d.2 Tipping Fee

d.2.1 Tipping Fee of MIDES Nejapa S/L

10 municipalities currently make payment of US\$18.0/ton to MIDES for its waste treatment/disposal services. The services in consideration for the price consist of what listed in the table below, and it is informed that MIDES recently presented the price breakdown as shown in the table.

However to date, the service provided by MIDES is only the waste disposal in the sanitary landfill and the whole price of the US\$18/ton is being paid. Under such circumstances, a set of incertitude e.g., interpretation of the contractual context remains unsolved.

Table 8-17: Breakdown of MIDES Project

Item	Cost (U\$/ton)
Sanitary Landfill (Nejapa landfill site)	12.80
Composting Plant	0.25
Transfer Station and Selection Plant	3.90
Environmental Education	0.40
Waste Picker Welfare	0.15
Closure of Ex-dumping sites	0.50
Total	18.00

Source: verbal information from a C/P

d.2.2 Tipping Fee of Tonacatepeque S/L

On the other hand, in the case that a new S/L (total site area 20ha and total disposal capacity 433,000ton assumed) is constructed in Tonacatepeque municipality in compliance with the regulation, the total cost is estimated to be about U\$5,900,000. That entails land acquisition costs assumed to be 12,000colones/ha, construction costs, O&M costs till the end of its service life, etc.

Table 8-18: Outline of Tonacatepeque Landfill Site

Type of landfill	Sanitary landfill with leachate treatment
Site area	approximate 20 ha
Landfill capacity	approximate 433,000 ton (exc. cover soil)
Type of liner	HDPE liner
Leachate treatment method	Aerated lagoon and oxidation pond
Equipment	Bulldozer, Dump truck, Waste truck, etc.
Initial investment cost	approximate US\$ 3,000,000

The table below summarizes the cases of the Tonacatepeque S/L tipping fee (US\$/ton disposed) depending upon the alternatives of project execution modality (e.g., public direct management, private administration) with respective financial conditions as presented in the table.

Table 8-19: Tipping Fee of Tonacatepeque S/L

		Base (net cost)	OPAMSS/COAMSS		Private company
			Direct management	Public company	
Tipping fee	inc. VAT	-	-	18.8 (US\$/ton)	31.0 (US\$/ton)
	exc. VAT	13.7 (US\$/ton)	20.4 (US\$/ton)	16.6 (US\$/ton)	27.4 (US\$/ton)
Conditions					
Security	(%)	-	0	25	15.5
Interest ratio	(%)	-	8.1 (libor+1%)	1.7*	10.75
Corporation tax	(%)	-	0	25	25
VAT	(%)	13	13	13	13
Capital	(%)	-	0	20 % of initial investment	20 % of initial investment
Evaluation period		-	2001 to 2022	2001 to 2022	2001 to 2022
Evaluation index		-	FIRR>8%	Profit rate>5%	Return on own capital >13.75%

Note: * loan rate for environmental improvement project, (repayment period 25 years, deferment 7 years) Japan Bank of International Cooperation

On the other hand, as distances from Tonacatepeque and San Martin municipalities to Tonacatepeque S/L or MIDES Nejapa S/L are different, respective costs are different. The table below summarizes collection and transport costs for both municipalities with respective cases.

Table 8-20: Collection and Transport Cost

Municipality Destination	San Martin	Tonacatepeque
Tonacatepeque S/L	16.2 (US\$/ton)	12.8 (US\$/ton)
MIDES Nejapa S/L	22.3 (US\$/ton)	17.7 (US\$/ton)

Summary of outcome listed in Table 8-19 and Table 8-20 is presented below.

Table 8-21: Comparison of Collection/Haulage and Landfill Cost

		Tonacatepeque S/L			MIDES Nejapa S/L	
		Direct	Public company	Private company		
SMT	Tipping fee	20.4	16.6	27.4	18.0	12.8
	Collection & haulage	16.2	16.2	16.2	22.3	22.3
	Total	36.6	32.8	43.6	40.3	35.1
TN	Tipping fee	20.4	16.6	27.4	18.0	12.8
	Collection & haulage	12.8	12.8	12.8	17.7	17.7
	Total	33.2	29.4	40.2	35.7	30.5

The above table compares alternative choices of final disposal for municipalities of Tonacatepeque and San Martin.

If the tipping fee of the MIDES Nejapa S/L remains US\$18.0/ton, it will be cheaper for both municipalities of Tonacatepeque and San Martin to use the Tonacatepeque S/L when it is operated by the following modalities:

- direct operation by OPAMSS/COAMSS; or
- operation by a public company using an international loan of low interest rate (e.g., JBIC loan for environment projects)

If the tipping fee of the MIDES Nejapa S/L is resolved as US\$12.8/ton, it will be cheaper for both municipalities of Tonacatepeque and San Martin to use the Tonacatepeque S/L when it is operated by the following modality:

- operation by a public company using an international loan of low interest rate (e.g., JBIC loan for environment projects).

In any cases, total cost burden of SWM will be substantially increased in order to comply with the newly published environmental legislation for all municipalities other than the municipalities currently utilizing MIDES Nejapa S/L that have already been bearing such environmental costs since May 1999.

d.2.3 Tipping Fee of New Espiga Landfill Site

The new ESPIGA S/L is planned to be constructed and operated to receive municipal waste from municipalities of Cuscatancingo, Antigo Cuscatlan etc. As a matter of course, it should be structured and operated to satisfy the environmental requirements of the newly published legislation. Its engineering specifications and project execution modality should be devised to reduce the additional burden of final disposal cost as small as possible. On the other hand, in view of economy of scale that the new ESPIGA S/L is expected to have, compared with the case of Tonacatepeque S/L, it will have to be devised that the tipping fee should become in the order of less than US\$12.8/ton. This is essential in order to have competitiveness against MIDES tipping fee, since the transport distance from municipalities of Cuscatancingo and Antigo Cuscatlan are in the same order either to the New ESPIGA S/L or to the MIDES Nejapa S/L.

e. Waste Stream

Waste streams in years of 2003, 2006, 2010, which are respective phase ends, are shown below.

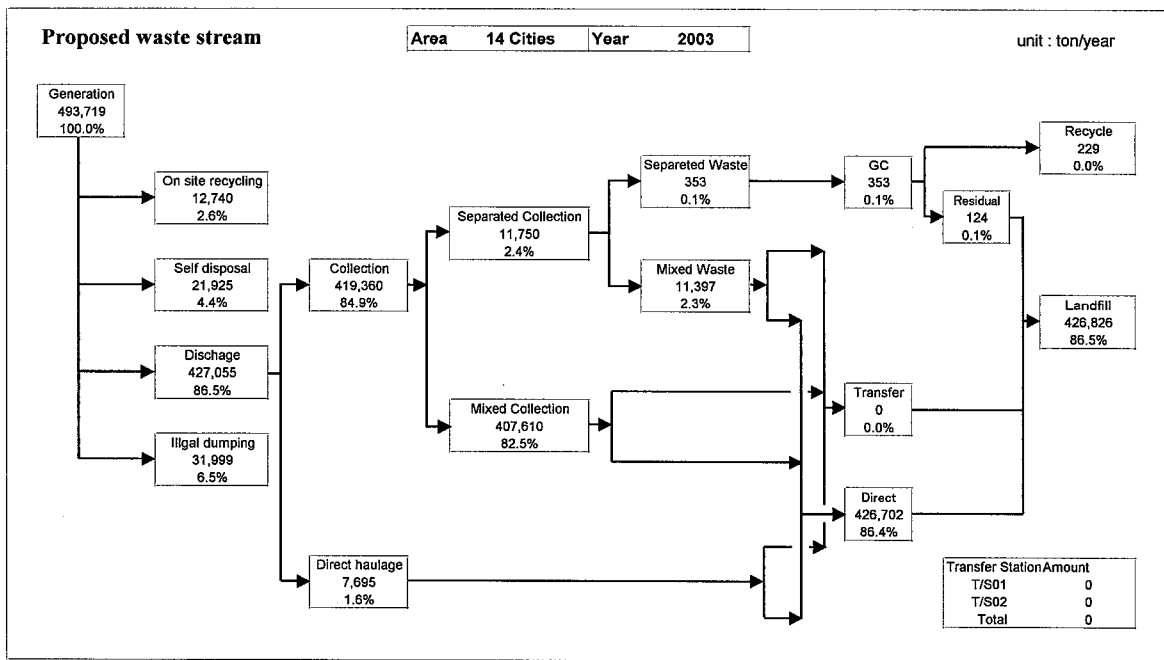


Figure 8-6: Waste Stream in 2003

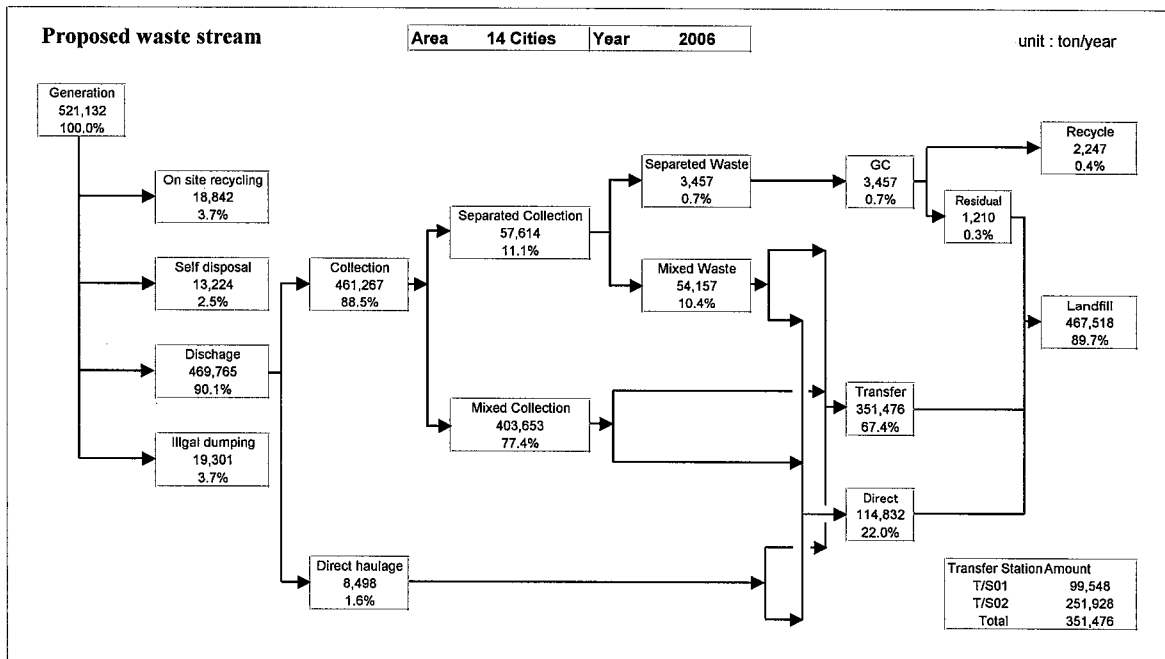


Figure 8-7: Waste Stream in 2006

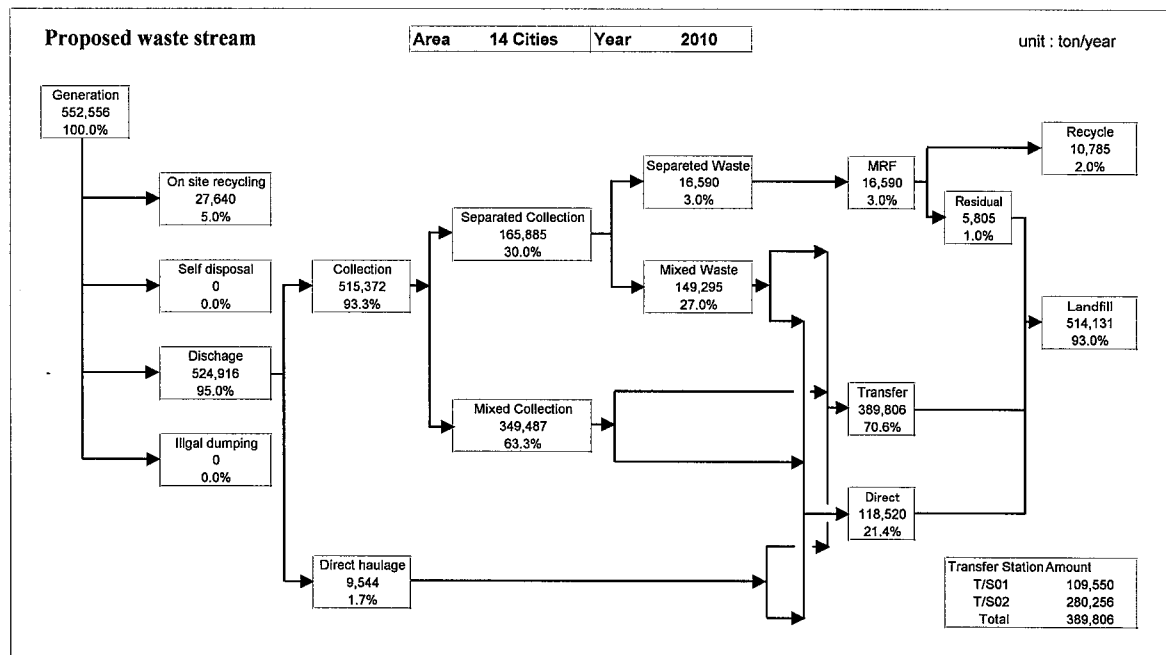


Figure 8-8: Waste Stream in 2010

8.2.2.2 Medical Waste Management

a. Intra-hospital Management

a.1 Instruction and Training on Separate Discharge

Instruction for separate discharge should be strictly given to such small medical institutions that have not practiced intra-hospital separate discharge yet. Furthermore, training should be offered by authorities for them to promote their cooperation and participation.

a.2 Medical Waste Classification for Separate Discharge

Medical institutions that have already been practicing separate discharge should maintain the same. Medical institutions that have not started separate discharge practices should start it with the following waste classification.

Medical wastes and common wastes should be separately managed. Medical wastes should be classified into the following 4 categories and managed respectively:

- Sharps;
- Infectious and Pathological waste;
- Radioactive waste; and
- Other medical waste (than the above categories).

b. Appropriate Collection System

b.1 Collection Agents

It is expected that all medical institutions practice the separate discharge in the near future. Therefore, the medical waste collection system should also be improved to cope with all medical institutions.

As for the Japanese experiences as outlined below, a collection agent normally has more than 100 clients (i.e., medical institutions) in order to have appropriate business efficiency in medical waste collection works. Therefore it might suggest that one or two agents to serve for all medical institutions in AMSS would have a better efficiency in view of economy of scale.

Therefore, it will be necessary to have a contract mechanism in AMSS that, even only one or two contractors are working, a competitive price is offered and accepted through an open tender prepared by the competent authority.

b.2 Collection Frequency

Since there are few medical institutions in AMSS that have cool storage facilities, it is not appropriate to store medical wastes at hospitals for a longer time. The collection should be frequent enough for example at least once a week. It would be preferable to have the collection plan of twice a week.

b.3 Collection Vehicle

It is a minimum requirement to maintain the current system of collection vehicles that vehicles are exclusively assigned for the medical waste collection. In case that a new vehicle is to be procured for this, the vehicle should satisfy the following requirements:

- It should be a cool storage vehicle of a box type or a wagon type;
- It should be equipped with provisions that can cope with its traffic accident and a vehicle breakdown; and
- The warning sign of "biohazard" should be clearly indicated on the vehicle.

b.4 Containers

Although recipients and/or containers for medical waste collection should preferably be disposable types with respect to workers health risk and environmental consideration, it is anticipated that costs burden of container purchase impinges prevalence of such practices in AMSS. Hence, it is foreseen that waste cardboard boxes and/or waste plastic recipients are utilized for intra-hospital separate collection and are stored in the designated red-color plastic containers. It is observed that those designated red-color plastic containers are reused. In case of such reuses of containers, they should be carefully and thoroughly disinfected each time.

b.5 Transfer Stations for Medical Waste

Transport using transfer stations is currently practiced in AMSS in order to make gain the efficiency of collection and transport works. It is foreseen that future increase of medical institutions that practice the separate discharge will require some new transfer stations of medical wastes.

Transfer station should satisfy the following requirements:

- Medical waste storage periods therein should be as short as possible;
- Fencing all around the site should be made in order to prohibit unauthorized access; and
- Storage works should take places only for the transfer purpose.

Large and clear sign of “infectious waste” should be indicated that all people concerned with the site could notice it. Handling procedures and precautions should also be indicated.

Storage places in the transfer station should have such structure that medical wastes stored do not scatter or spill, the floor should be waterproof to prevent infiltration to ground.

c. Appropriate Treatment System

c.1 Principles

The M/P recommends establish the medical waste incineration system as the action plan for the medical waste management. Its objective is to ensure the reliable treatment for all medical waste generated in AMSS at all time. The medical waste incinerator will enable the reliable treatment that is continuously given to the all amount of the future increased medical waste. Meanwhile, on occasions of the MIDES autoclave breakdown, appropriate treatment of medical waste can be maintained.

The plan proposes 24 hours continuous operation for the medical incinerator to be capable of treating all generated amount of medical waste. When the incinerator is halted for such as periodical inspections and maintenance, the autoclave facility should substitute the medical waste treatment.

In future, it is expected that the present autoclave facility and the proposed incinerator should complement each other for the regional medical waste treatment.

c.2 Medical Waste Incineration Facilities

Incineration systems are diverse such as: stoker firing system (fixed grate or travelling grate); rotary kiln system; destructive gasifying system; fluidized bed system; etc. Meanwhile, incinerator operation systems are basically classified into the batch feed system and the continuous feed system.

Rotary kiln system is proposed herewith for the medical waste incineration in AMSS, in view of its advantages of easier operation and combustible wastes purview being wider. 24 hours continuous operation is proposed in order to avoid pollution problems of such as dioxins.

Technical specifications that the incinerator should comply with are as follows:

- The facility should be a fire resisting structure for maintaining more than 800°C temperature at the main combustion chamber exit;
- The facility should have an auxiliary combustion equipment in order to rapidly raise the temperature at the main combustion chamber exit at more than 800°C, and to be capable to maintain that temperature; and

- The facility should have the control of air supply to combustion chamber.

d. Management of Hazardous Medical Solid Wastes

Intra-hospital management of hazardous solid wastes must be managed, operated and financed by each generation health establishment, be it from MSPAS, ISSS or the private sector.

As for collection, initial investment and operation can be conducted either by MSPAS or by a private specialized collection enterprise contracted. For both alternatives, financing of collection will be in charge of each health establishment from MSPAS, ISSS or the private sector.

For the incineration method proposed, initial investment and operation can be carried out by MSPAS or a private company contracted through a previous bid: For both alternatives, functioning of the incineration process will be in charge of each health establishment from MSPAS, ISSS or the private sector.

For each one of the above stages, supervision and control is in charge of MSPAS, as shown below.

Table 8-22: Proposal of Hazardous Medical SWM

Component	Management
Intra-hospital management	Management, operation and financing: by each health establishment generator of such hazardous SW (health establishments of MSPAS, ISSS or private ones) Investment: by each health establishment generator Supervision and control: MSPAS
Collection	Management and operation: a) Directly by MSPAS b) Contract-out to specialized private company Financing of investment: a) By MSPAS b) By private collection company Financing of operation: by each health establishment generator Control and supervision: MSPAS
Incineration	Management and operation: a) Directly by MSPAS b) By private contracted-out enterprise Financing of investment: a) By MSPAS b) By private enterprise Financing of operation: by each health establishment generator, be it from MSPAS, ISSS or private Control and supervision: MSPAS