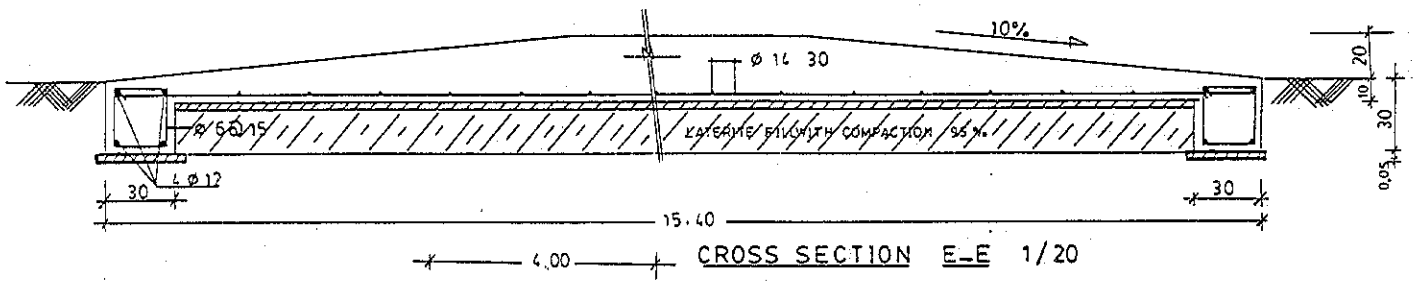
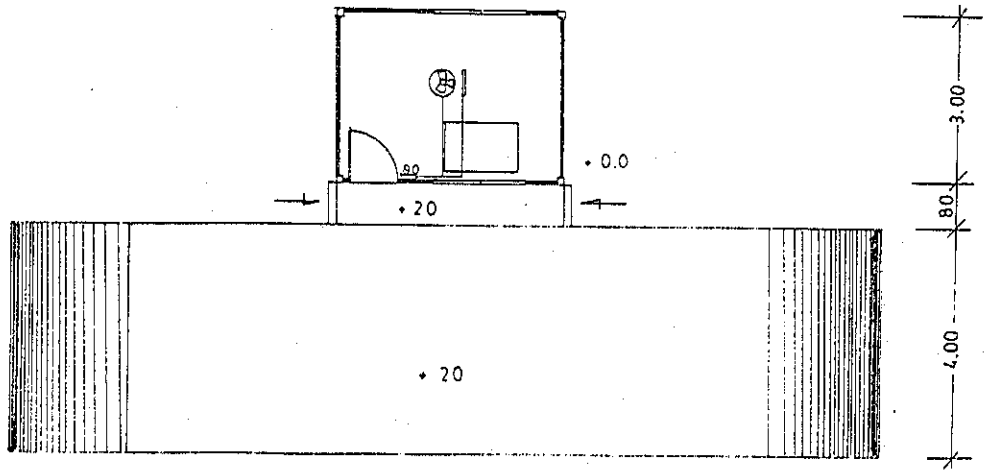


CROSS SECTION E-E 1/20



ELECTRIC PLAN 1/100

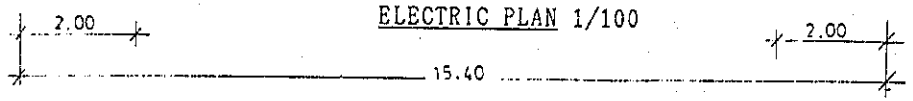


Fig. E.4-4 Details of Weighbridge Foundation

THE STUDY ON THE SOLID WASTE MANAGEMENT SYSTEM IMPROVEMENT PROJECT IN VIENTIANE, LAO P.D.R.

JAPAN INTERNATIONAL COOPERATION AGENCY

E.5 Time and Motion Study

1) Objectives of the Study

The objectives of the study are ;

- to observe the present collection and haulage system ; and
- to clear the problems and appreciable practices of the present collection and haulage system.

2) Contents of the Study

The contents of the study are ;

- relation to time, distance and weight on collection and transportation ;
- type of dustbins ;
- working efficiency of collection workers ;
- collection route ;
- level of users cooperation with collection work ;
- service level ; and
- maintenance condition of collection vehicles.

3) Method of the Study

The vehicles belonging to DCTC and Private-SWM were traced for time and motion study.

Study team consisted of 4 members including a driver. The duties and responsibilities of each member were assigned in the preparation stage. The following were the assignment of each study team member.

i. group leader --- dustbin study (size, condition, number), road condition, crew behavior, collection vehicle (condition, loading capability, coverage area);

ii. member A --- mapping of the route and dustbin set-out

points;

iii. member B --- time, distance and weight measurement; and

iv. driver --- tracing solid waste collection vehicles.

a. Time recording

The following times were recorded in the field with a watch.

i. time of departure from vehicle depot ;
ii. time of arrival and departure from each collection route ;
iii. time of arrival and departure from disposal site ; and
iv. time of arrival at vehicle depot.

The time consumption in each step was calculated later in the office.

b. Distance

The following distance in kilometer was recorded in the field with an odometer of a passenger car.

i. distance in kilometer at the time of departure from vehicle depot ;
ii. distance in kilometer at the time of arrival at each station;
iii. distance in kilometer at the time of arrival at disposal site ; and
iv. distance in kilometer at the time of arrival at vehicle depot.

The distance between each destination was calculated later in the office based on the distance recorded in kilometer at each point.

c. Dustbin

Dustbins were counted and classified according to their size and types.

d. Mapping

The following information was marked in the map.

i. collection route ;
ii. collection points ;
iii. direction of vehicle depot ;
iv. direction of disposal site ; and
v. serial numbers of the collection points.

4) Results

a. Relation to time, distance and weight on collection and transportation

Table E.5-1 Collection Time, Distance and Weight Observed

	Private-SWM	DCTC
Basic Information		
Date	12 November	13 November
Collection area	Phone Xai	Namphou
Crew	1 driver 4 collectors	1 driver 3 collectors
Departure time from garage	8:58	8:10
Arrival time at garage	15:25	10:15
Number of trips	1	1
Type of collection vehicle	Dump Truck ($12m^3$)	Dump Truck ($8m^3$)
Time		
Collection time	3 hr.35 min.	45 min.
Transportation time (between stations)	46 min.	18 min.
Transportation time (from garage to 1st station from last station to dump site and from dump site to garage)	50 min.	55 min.
Unloading time	5 min.	5 min.
Others(lunch, repair, etc.)	1 hr.11 min.	2 min.
Total	6 hr.27 min.	2 hr.05 min.

Distance

From garage to 1st station	12 km	4 km
From 1st station to last station	73 km	19 km
From last station to dump site	12 km	15 km
From dump site to garage	13 km	15 km
Total distance	110 km	53 km
Weight of Loaded Waste	1.9 ton	1.5 ton

b. Type of dustbins

A bamboo basket is mainly used as a dustbin for waste storage and discharge.

c. Working efficiency

Working efficiency per worker, including the driver, is shown in Table E.5-2. Working efficiency of DCTC crew is calculated at 188 kg/hour/worker. On the other hand, working efficiency of Private-SWM is calculated at 58 kg/hour/worker.

Table E.5-2 Working Efficiency of Collection Workers

	Amount of Collected Waste (ton/day/worker)	(kg/hour/worker)
Private - SWM	0.38	58
DCTC	0.38	188

Working efficiency of the DCTC crew is three times better than Private-SWM due to the following ;

i. The collection area of the DCTC crew was a densely populated commercial area, while that of the Private-SWM was a residential area ;

ii. In a part of the collection area of the DCTC crew the bell collection system was applied; and

iii. The Private-SWM crew had a punctured tire which took one hour of repairing ; and

iv. The Private-SWM moved up to a total of 110 km, while DCTC ran for only 53 km. For a better comparison, the mileage required for one ton of waste collection and transport is 58 km/ton for Private-SWM and only 35 km/ton for DCTC.

d. Collection route

Collection routes traced are shown in Fig. E.5-1 for the Private-SWM and Fig. E.5-2 for the DCTC.

e. Level of user's cooperation with collection work

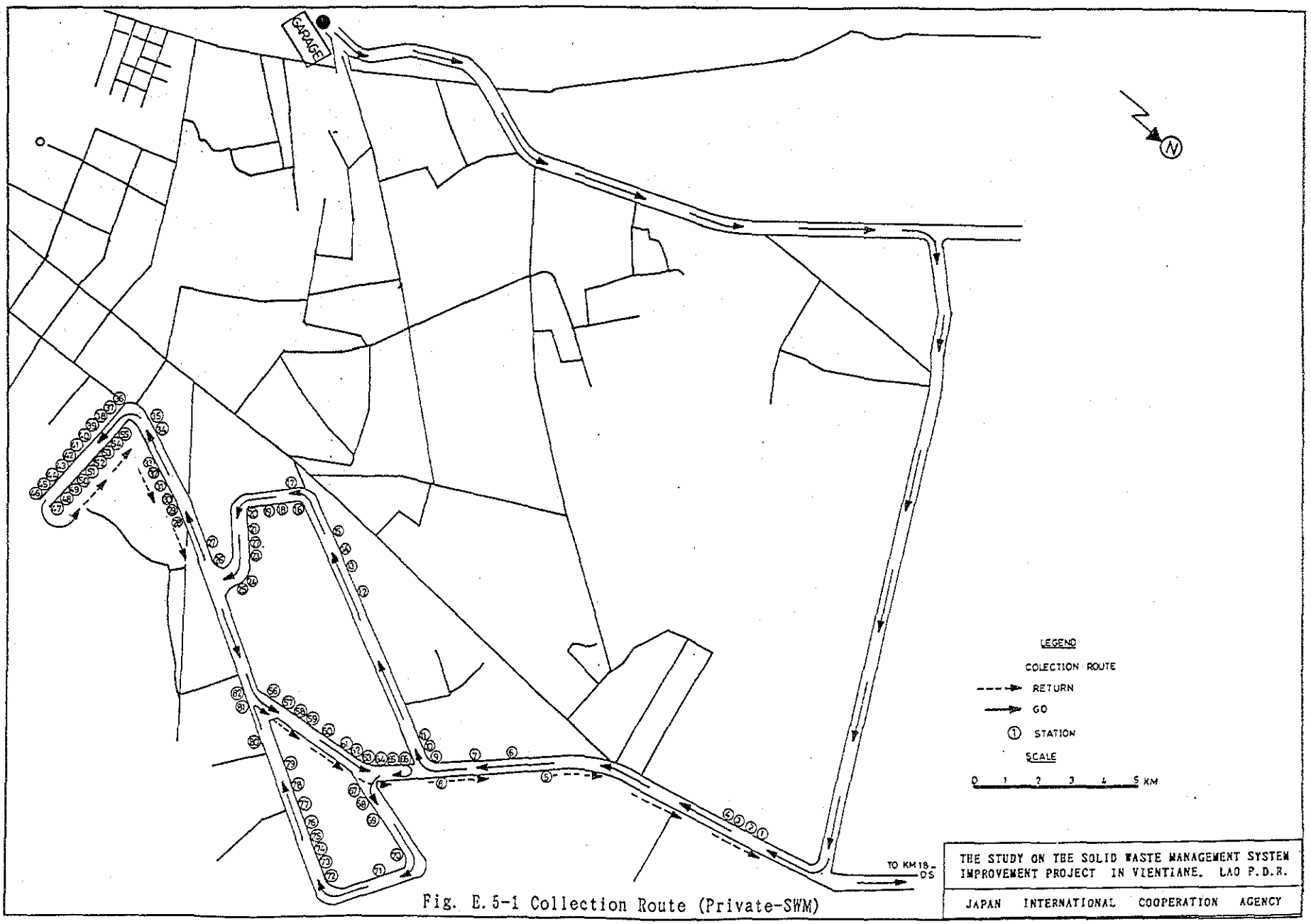


Fig. E.5-1 Collection Route (Private-SWM)

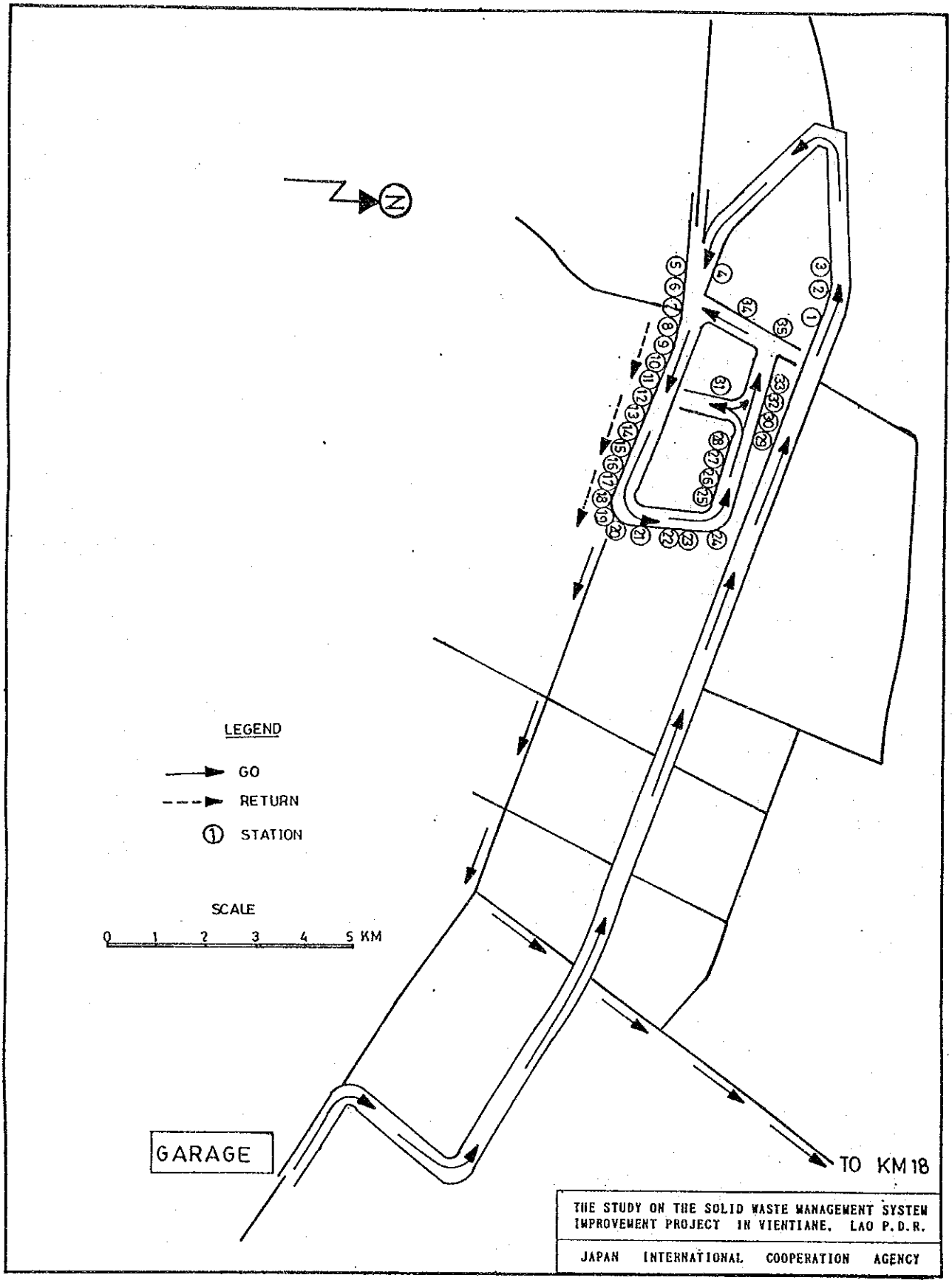


Fig. E.5-2 Collection Route (DCTC)

The residents were cooperative in the collection service. Especially, in the area where a bell collection service is adopted, residents brought the waste to the collection vehicle upon hearing sound of truck tapping.

f. Maintenance of collection vehicles

As the Private-SWM had a punctured tyre and it took one hour for repairing due to the lack of a spare tyre, the maintenance of collection vehicles was very poor, making collection efficiency worse.

APPENDIX F

PRESENT SOLID WASTE MANAGEMENT

APPENDIX F PRESENT SOLID WASTE MANAGEMENT

F.1 Waste Stream

F.1.1 Concept of Waste Stream

The waste stream in the Study area is drawn up based on the following two surveys. WACS was conducted both in the rainy season and in the dry season in Vientiane Lao P.D.R.;

- WACS (Waste Amount and Composition Survey): and
- CCS (Community Consciousness Survey)

A weighbridge was installed in the middle of November 1991 in order to collect the data of the actual waste amount hauled to the KM 18-DS. As a result, the actual waste amount hauled to the KM 18-DS was observed from November 15, 1991 to end of January 1992 and analyzed. Based on the analysis of it, the waste stream is reviewed in this report.

A concept of the waste stream is illustrated and shown in Fig. F.1-1. Solid waste generated in each generation source is classified into three categories ; i.e. recycled, discharged and self-disposed waste. Discharged waste is divided into waste collected by each collection service and waste dumped in clandestine methods; i.e. illegal dumping or littering.

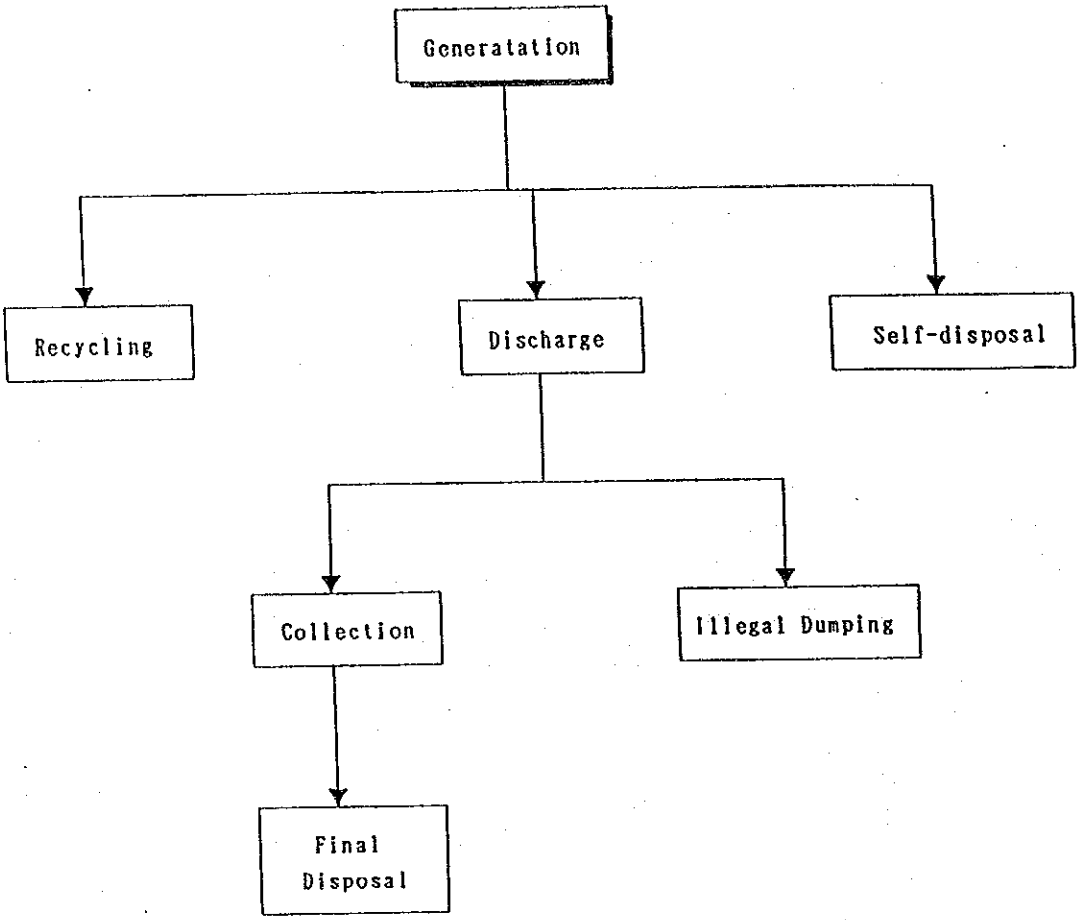


Fig. F.1-1 Concept of Waste Stream

F.1.2 Waste Generation and Discharge

The generation sources in the Study area are classified in the Study as follows ;

- Residence (Domestic Wastes)
- Shop (Commercial Wastes)
- Market (Market Wastes ..... Institutional Wastes)
- Office (Office Wastes ..... Institutional Wastes)
- Hospital (Hospital Wastes ..... Institutional Wastes)
- Road, drain and parks (Road Sweeping, Drain Cleansing and Grass-Cutting Wastes ..... Road Sweeping Wastes)

1) Domestic Wastes

The generation and discharge of the domestic wastes in the collection area is estimated by the WACS and CCS, and is shown in Fig. F.1-2. The bases of the estimation are explained as follows;

a. The domestic wastes are classified into food recycled wastes (#2), garden waste (#3) and rubbish (#4) in the Study. Total generation ratio of the domestic wastes per capita is estimated at 753g/day/person.

b. 75% of households surveyed use their food waste (#2) as animal feed. The use of food waste as animal food is considered as a kind of recycling. The amount of food waste recycled is calculated below based on the result of the CCS ;

1.0 lit./d/res. x 0.75 / 7.5 per./hou. = 0.1 lit./d/per.

Say 100 g/d/per.

Note :

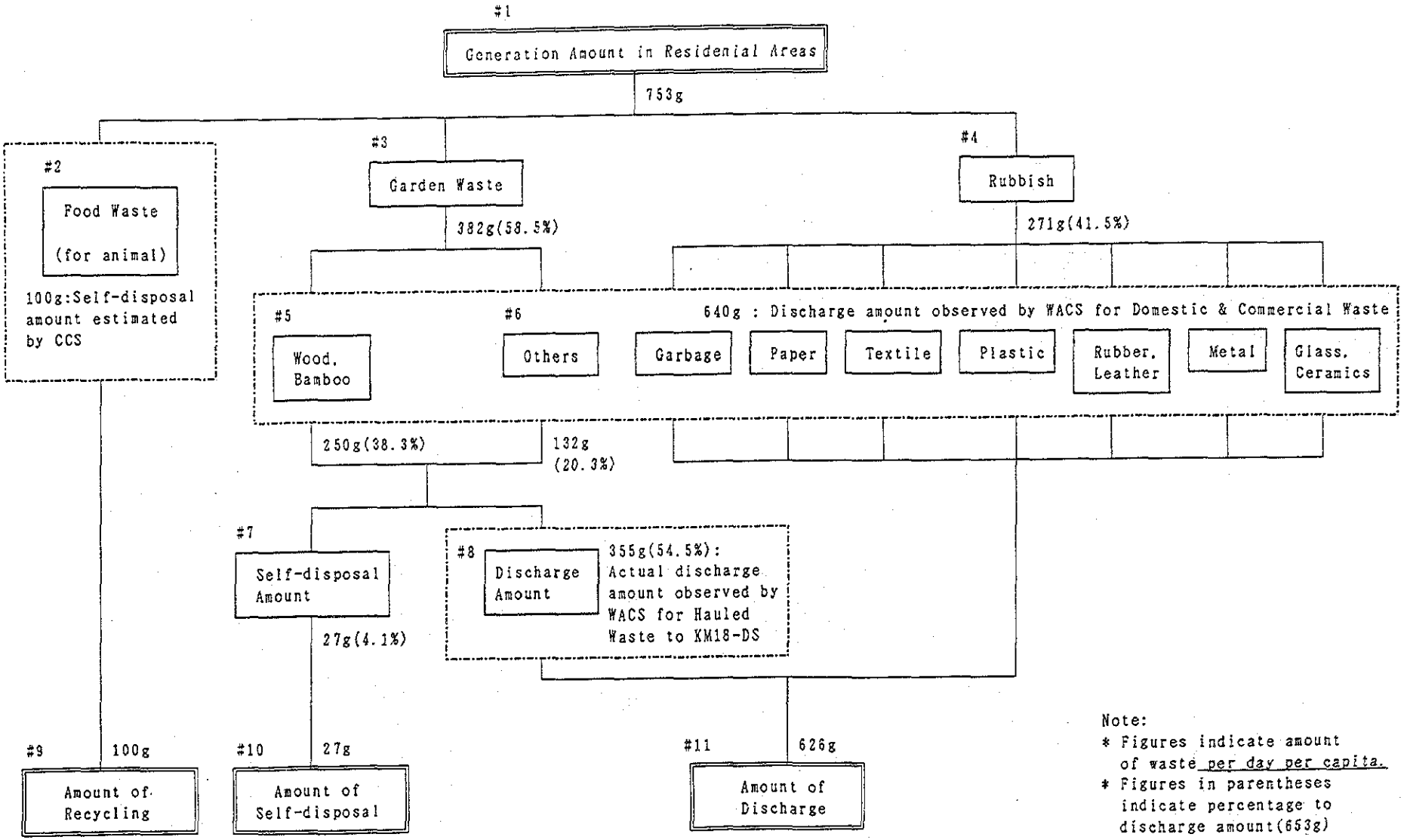


Fig.F.1-2 Generation and Discharge of Dommestic Waste in the Collection Area

- 1.0 lit./d/res. : Average amount of the food waste fed per day per household which bred animals.

- 75% : Ratio of the household which bred animals.

- 7.5 per./hou. : Average number of family members in the CCS.

c. Average discharge amount per day per capita (#3,#4) is calculated at 653g/d/per. and is tabulated in Table F.1-1.

Table F.1-1 Average Discharge Amount (g/d/per.)

Unit : g

Zone	Residential Area			Commercial Area		
Items	Rainy Season	Dry Season	Average	Rainy Season	Dry Season	Average
1. Number of Residence	26	29	27.5	5	5	5
2. Total Number of Family Member	214	235	225	41	38	40
3. Average Number of Family Member	8.2	8.1	8.2	8.2	7.6	7.9
4. Average Discharge Amount (g/d/hou.)	5,241	5,406	5,324	8,769	9,149	8,959
5. Average Discharge Amount (g/d/per.)	639	667	653			

The result of the waste composition obtained by the WACS for the domestic and commercial wastes are tabulated in Table F.1-2.

Table F.1-2 Waste Composition of Domestic and Commercial Wastes

Zone		Residential Area			Commercial Area		
Category		Rainy Season	Dry Season	Average	Rainy Season	Dry Season	Average
A.S.Gravity	kg/lit.	0.187	0.150	0.168	0.153	0.187	0.170
Garbage	%	11.1	22.7	16.9	29.2	57.4	43.3
Paper	%	2.6	2.9	2.8	24.7	15.2	20.0
Textile	%	2.0	1.2	1.6	0.3	0.2	0.3
Plastic	%	6.3	5.8	6.1	8.3	7.4	7.9
Wood/Bamboo	%	42.2	34.3	38.2	14.3	3.2	8.8
Rubber/Leather	%	1.1	1.1	1.1	0.0	0.5	0.3
Metal	%	4.0	3.4	3.7	7.8	3.9	5.9
Glass/Ceramic	%	7.0	11.7	9.3	6.5	6.8	6.7
Others	%	23.6	16.9	20.3	8.9	5.4	7.2

Note : A.S. Gravity means Apparent Specific Gravity.

As for garden waste (#3), the discharge amount of it is calculated at 382 g/d/per. which is equivalent to 58.5% of

total discharge. The garden waste is divided into wood/bamboo (#5) and others (#6). The major contents of the others (#6) were soil and sand accumulated from gardening work. The discharge amount of rubbish (#4), which is defined in the Study as discharged waste other than garden waste, is calculated at 271 g/d/per. equivalent to 41.5% of the total discharge.

d. In order to get the actual amount of garden waste collected and disposed at KM18-DS, the WACS for hauled waste to the KM 18-DS was conducted. The results of the survey are tabulated in Table F.1-3.

Table F.1-3 Composition of Hauled Waste to KM 18-DS

Waste Category	WACS	WACS for Domestic Waste	WACS for Hauled Waste
A.S. Gravity kg/m^3		0.168	0.141
Garbage	%	16.9	15.2
Paper	%	2.8	3.8
Textile	%	1.6	2.5
Plastic	%	6.1	8.9
Wood/Bamboo	%	38.3	34.2
Rubber/Leather	%	1.1	2.5
Metal	%	3.7	5.1
Glass/Ceramic	%	9.3	7.6
Others	%	20.3	20.3

As shown in Table F.1-3, the ratio of the garden waste was reduced 4.1% from 58.6% to 54.5%. Consequently, the reduced amount of 27 g/d/per. (4.1%) is considered as self-disposed waste in each residence. (#7) The remaining 355 g/d/per. is the actual discharge amount of garden waste.

e. The amount of self-disposed waste is calculated at 27 g/d/per.. (#10)

f. The discharge amount of domestic waste is calculated at 626 g/d/per..(#11) by the formula below ;

Discharge Amount = Garden Waste Amount (#3)
+ Rubbish Amount (#4) - Self-disposed Amount of Garden Waste (#7)

g. The amount of reusable materials recycled at each household is few and is, therefore, considered as negligible. ; i.e. 0.14 g/d/per. according to the estimation made from the CCS result. Consequently, the amount of recycling is estimated at 100 g/d/per..

2) Commercial Wastes

Based on the result of the WACS and CCS, the generation and discharge of commercial wastes (shop waste) is estimated and shown in Fig.F.1-3. The bases of the estimation are described as follows ;

a. The wastes generated in the commercial area (#1) are classified into the following in the Study.

i. Commercial Waste (#2)
- food waste recycled (#4)
- reusable materials (#5)
- commercial waste discharged (#6)

ii. Domestic waste (#3)

Total generation ratio of the commercial area is estimated at 12,165 g/d/shop.

b. According to the results of the CCS, food waste (#4) generated in shops is collected by food waste collectors or farmers and recycled as feed for livestock. The amount food

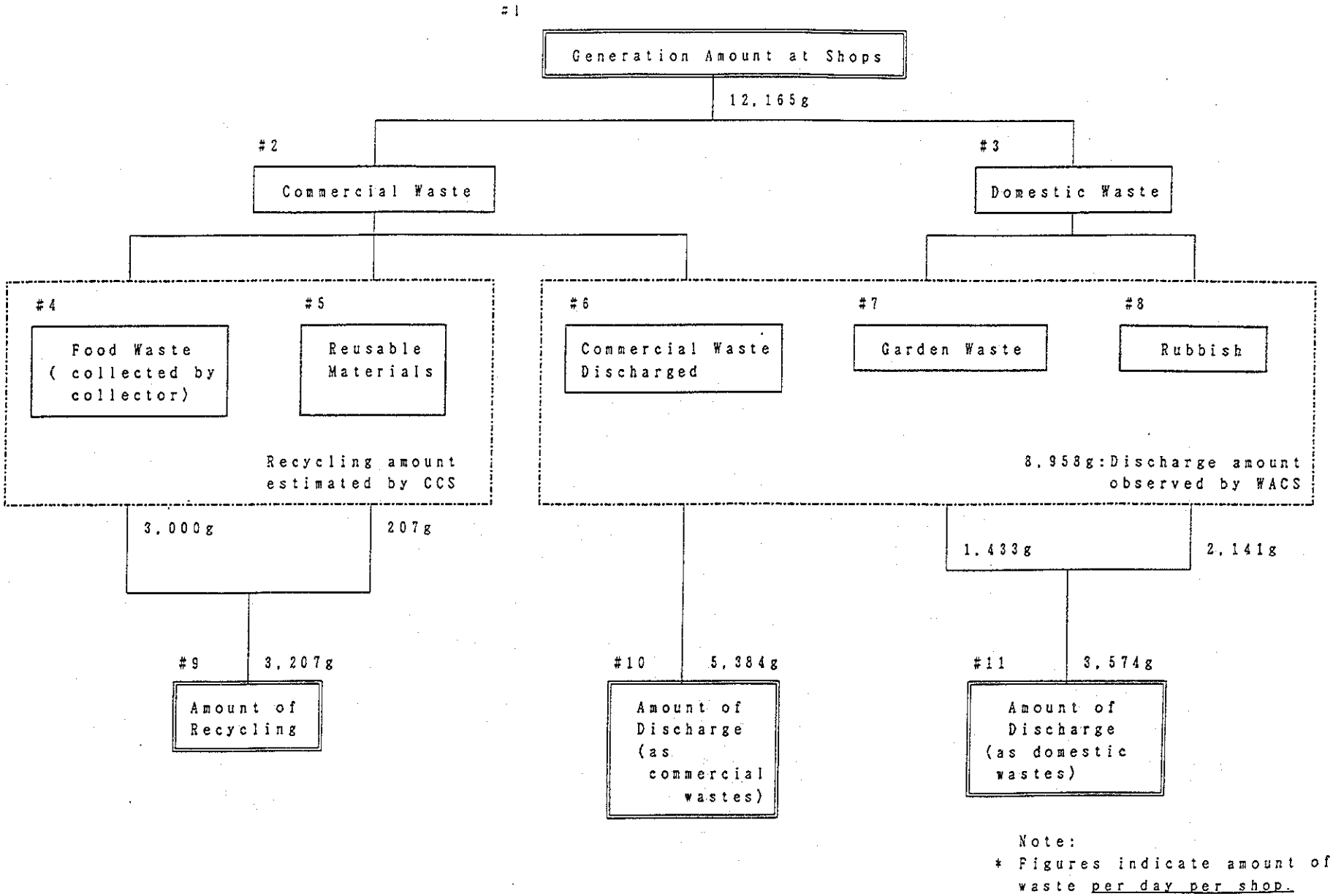


Fig.F.1-3 Generation and Discharge of Commercial Waste in the Collection Area

waste collected is estimated at 3,000 g/d/shop as follows ;

15 lit. x 0.47 x 3/7 = 3.0 lit/d/shop

Say 3,000 g/d/shop

Note :

- 15 lit. : Average amount of food waste collected from a shop at one time.
- 47% : Ratio of the shop which has food waste collection service.
- 3/7 : Frequency of the collection service : i.e. 3 times per week.

c. As shown in Table F.1-1, the average daily discharge amount from shops is 8,958 g/d/shop as observed in the WACS. Among the discharged wastes, garden waste (#7) shares 16.0% of the composition as shown in Table F.1-2. Then, the discharge amount of it is calculated at 1,433 g/d/shop (0.16 x 8,958). On the other hand, the discharge amount of rubbish (#8), which composes the domestic waste together with garden wastes, is calculated at 2,141 g/d/shop by the following formula ;

271 g/d/per. x 7.9 persons = 2,141 g/d/shop

Note :

- 271 g/d/per. : The figure estimated in 1) and shown in Fig. F.1-2 (#4).
- 7.9 persons : Average number of persons who live in a shop.

Consequently, the discharge amount of commercial wastes (#10) is calculated at 5,384 g/d/shop as the balance of 8,958 g - 1,433 g - 2,141 g.

d. The discharge amount of domestic wastes (#10) is calculated at 3,574 g/d/shop by the addition of the garden waste (#7) and rubbish (#8).

e. The amount of reusable materials sold to the recyclers is estimated at 207 g/d/shop by the following formula according to the results of the CCS ;

2,069 g/d/shop x 1/10 = 207 g/d/shop

Note :

- 2069 g : Average amount of reusable materials sold to the recyclers at one time.

- 1/10 : Frequency of the visit of the recyclers; i.e. once a ten days.

As a result, the amount of waste recycled is estimated at 3,207 g/d/shop.

3) Other Generation Sources

The discharge amount of other generation sources was observed in the WACS conducted in November and tabulated in Table F.1-4. Based on the results of the WACS, the discharge ratios of the following generation sources are estimated as follows ;

a. Market ; 1,300 g/d/shop (The figure includes daily shops which do not have permanent space in the market)

b. Office ; 30 g/d/employee

c. Hospital ; 960 g/d/bed

d. Road Sweeping; 58,000 g/d/km

Table F.1-4 Discharge Ratios of Other Generation Sources

Generation Source	Number of Generation Sources Survey	Total Discharge Amount per day	Discharge Ratios
Market Rainy	1,830 shops	1,770 kg	970 g/d/shop
Dry		2,990 kg	1,630 g/d/shop
Average		2,380 kg	1,300 g/d/shop
Office Rainy	550 employees	16.5 kg	30 g/d/emp.
Dry		17.1 kg	30 g/d/emp.
Average		16.8 kg	30 g/d/emp.
Hospital Rainy	450 beds	652.2 kg	1,450 g/d/bed
Dry		209.4 kg	470 g/d/bed
Average		430.8 kg	960 g/d/bed
Road Sweeping			
Rainy	2 km	53 kg	27,000 g/d/km
Dry		179 kg	89,000 g/d/km
Average		116 kg	58,000 g/d/km

According to the interview conducted with the persons concerned in the above-mentioned generation sources, only very limited recycling is observed. Therefore, the recycling amount of these sources is neglected. Consequently, the generation ratios of the above-mentioned sources is considered to be the same as the discharge ratios.

F.1.3 Service Coverage

1) Review of the Hauled Waste Amount

The amount of waste hauled to the KM 18-DS was estimated based on the WACS and CCS in the Progress Report. The actual amount of waste hauled has been observed from November 15th 1991 to end of January 1992 by using the weighbridge installed at the KM 18-DS by the Study Team. The result of the observation is tabulated in Table F.1-5 and illustrated in Fig. F.1-4. According to these, a great difference was found between the maximum and minimum amount of hauled waste, as the former indicated 39.36 tons and the latter 3.04 tons sharing an average of 17.40 tons. The average number of incoming vehicles was about 8.5 units/day.

Consequently, the estimated amount of waste collected in accordance with the classification is corrected, as shown in Table F.1-6, based on the following;

a. The estimated amount of waste hauled to the KM 18-DS could not be changed regarding the institutional, road sweeping and direct hauled wastes.

b. Then, the modification of the collection amount is done regarding domestic and commercial wastes in accordance with each ratio of hauled amount.

c. The collection amount of domestic and commercial wastes is the same as their hauled amount.

Table F.1-5 Actual Amount of Waste Hauled to KM18-DS and Number of Incoming Vehicles (1)

DATE	Amount of Waste Hauled to KM18-DS (ton)						Number of Incoming Vehicles					
	DCTC	Private-CRC	Private-ISC	Private-SWM	Direct	Total	DCTC	Private-CRC	Private-ISC	Private-SWM	Direct	Total
Nov. 1 Fri	-	-	-	-	-	0	-	-	-	-	-	0
2 Sat	-	-	-	-	-	0	-	-	-	-	-	0
3 Sun	-	-	-	-	-	0	-	-	-	-	-	0
4 Mon	-	-	-	-	-	0	-	-	-	-	-	0
5 Tue	-	-	-	-	-	0	-	-	-	-	-	0
6 Wed	-	-	-	-	-	0	-	-	-	-	-	0
7 Thu	-	-	-	-	-	0	-	-	-	-	-	0
8 Fri	-	-	-	-	-	0	-	-	-	-	-	0
9 Sat	-	-	-	-	-	0	-	-	-	-	-	0
10 Sun	-	-	-	-	-	0	-	-	-	-	-	0
11 Mon	-	-	-	-	-	0	-	-	-	-	-	0
12 Tue	-	-	-	-	-	0	-	-	-	-	-	0
13 Wed	-	-	-	-	-	0	-	-	-	-	-	0
14 Thu	-	-	-	-	-	0	-	-	-	-	-	0
15 Fri	8.82	4.14	2.26	3.12	0.07	18.41	4	2	1	1	1	9
16 Sat	6.18	3.43	6.21	0	4.01	19.83	5	2	2	0	3	12
17 Sun	0	1.29	2.62	0	0.93	4.84	0	1	1	0	1	3
18 Mon	7.51	6.42	3.21	2.8	2.71	22.65	5	2	1	1	2	11
19 Tue	5.36	5.83	0	0	5.8	16.99	4	2	0	0	3	9
20 Wed	9.78	6.48	3.08	3.34	3.39	26.07	5	2	1	1	4	13
21 Thu	9.21	8.61	3.11	3.32	15.11	39.36	6	3	1	1	8	19
22 Fri	7.05	2.97	2.72	3	3.77	19.51	6	1	1	1	2	11
23 Sat	6.06	5.82	2.79	0	0	14.67	6	2	1	0	0	9
24 Sun	0.02	0.84	0	0	2.18	3.04	1	0	0	0	1	2
25 Mon	10.71	6.47	2.82	3.16	1.96	25.12	6	2	1	0	4	13
26 Tue	1.83	4.58	4.75	0	0	11.16	1	2	2	0	0	5
27 Wed	8.13	2.63	4.75	0	1.95	17.46	5	2	1	1	1	10
28 Thu	8.5	4.78	3.13	3.18	3.34	22.93	5	2	1	1	5	14
29 Fri	12.68	2.75	5.98	0	6.22	27.63	6	1	2	0	3	12
30 Sat	7.06	3.91	2.82	3.49	3.36	20.64	3	2	1	1	3	10
						0						0
Total	108.9	70.95	50.25	25.41	54.8	310.31	68	28	17	8	41	162
Average(per day)	6.81	4.43	3.14	1.59	3.43	19.39	4.25	1.75	1.06	0.50	2.56	10.13
Average (per working day)	7.26	4.43	3.59	3.18	3.91		4.53	1.87	1.21	1.00	2.93	

Table F.1-5 Actual Amount of Waste Hauled to KM18-DS and Number of Incoming Vehicles (2)

DATE		Amount of Waste Hauled to KM18-DS (ton)						Number of Incoming Vehicles					
		DCTC	Private-CRC	Private-ISC	Private-SWM	Direct	Total	DCTC	Private-CRC	Private-ISC	Private-SWM	Direct	Total
Dec. 1	Sun	0	0	6.39	2.15	5.85	14.39	0	0	2	1	3	6
2	Mon	0	0	2.64	0	2.39	5.03	0	0	1	0	2	3
3	Tue	1.38	4.4	3.52	3.63	3.03	15.96	2	2	1	1	5	11
4	Wed	10.83	4.17	3.16	3.28	2.33	23.77	6	2	1	1	4	14
5	Thu	5.63	5.93	5.31	2.9	0.67	20.44	3	2	2	1	3	11
6	Fri	5.63	4.77	2.74	0	1.88	15.02	3	2	1	0	1	7
7	Sat	2.16	5.01	2.89	3.15	3.71	16.92	2	2	1	1	3	9
8	Sun	2.92	2.31	5.31	0	2.19	12.73	2	1	2	0	2	7
9	Mon	12.59	4.75	2.36	3.16	1.91	24.77	6	2	1	1	3	13
10	Tue	4.61	4.53	3.37	0	0.03	12.54	3	2	1	0	1	7
11	Wed	9.97	4.04	3.28	0	0.17	17.46	7	2	1	0	2	12
12	Thu	5.34	2.54	2.54	2.99	3.5	16.91	3	1	1	1	3	9
13	Fri	-	-	-	-	-	0	-	-	-	-	-	0
14	Sat	3.24	3.72	5.4	0	0.47	12.83	3	2	2	0	1	8
15	Sun	0	0	0	0	0	0	0	0	0	0	0	0
16	Mon	6.21	2.4	3.3	3.7	2.6	18.21	3	1	1	1	3	9
17	Tue	10.48	3.91	2.74	0	0.08	17.21	5	2	1	0	2	10
18	Wed	2.44	4.4	3.06	0.78	0	10.68	2	2	1	1	0	6
19	Thu	4.23	4.13	3.62	2.96	0.6	15.54	2	2	1	1	2	8
20	Fri	11.88	2	2.57	0	0	16.45	6	1	1	0	0	8
21	Sat	1.99	4.07	3.32	0	1.61	10.99	2	2	1	0	3	8
22	Sun	0	0	2.46	3.08	0	5.54	0	0	1	1	0	2
23	Mon	9.26	0	4.27	0	0.51	14.04	5	0	1	0	2	8
24	Tue	7.21	4.93	3.63	0	0.97	16.74	2	2	1	0	1	6
25	Wed	7.33	1.96	3.54	0	0.17	13	3	1	1	0	1	6
26	Thu	-	-	-	-	-	0	-	-	-	-	-	0
27	Fri	-	-	-	-	-	0	-	-	-	-	-	0
28	Sat	-	-	-	-	-	0	-	-	-	-	-	0
29	Sun	-	-	-	-	-	0	-	-	-	-	-	0
30	Mon	8.71	3.43	4.66	2.85	1.18	20.83	4	1	1	1	2	9
31	Tue	6.61	2.34	2.55	0	0	11.5	3	1	1	0	0	5
Total		140.65	79.74	88.63	34.63	35.85	379.5	77	35	29	12	49	202
Average(per day)		5.63	3.19	3.55	1.39	1.43	15.18	2.48	1.13	0.94	0.39	1.58	6.52
Average (per working day)		6.39	3.80	3.55	2.66	1.71		3.50	1.67	1.16	0.52	1.88	

Table F.1-5 Actual Amount of Waste Hauled to KM18-DS and Number of Incoming Vehicles (3)

DATE		Amount of Waste Hauled to KM18-DS (ton)						Number of Incoming Vehicles					
		DCTC	Private-CRC	Private-ISC	Private-SWM	Directly	Total	DCTC	Private-CRC	Private-ISC	Private-SWM	Directly	Total
Jan. 1	Wed	-	-	-	-	-	0	-	-	-	-	-	0
2	Thu	9.12	2.25	3.9	0	1.29	16.56	4	1	1	0	1	7
3	Fri	8.25	0	2.34	0	10.14	20.73	3	0	1	0	3	7
4	Sat	16.66	3.83	2.38	0	1.23	24.1	5	2	1	0	2	10
5	Sun	-	-	-	-	-	0	-	-	-	-	-	0
6	Mon	4.34	1.71	6.55	0	1.02	13.62	2	1	1	0	1	5
7	Tue	5.21	2.44	3.8	0	3.41	14.86	4	1	1	0	3	9
8	Wed	5.58	2.82	3.46	0	8.87	20.73	2	1	1	0	4	8
9	Thu	1.38	3.52	3.18	0	5.45	13.53	1	1	1	0	5	8
10	Fri	8.02	2.6	3.52	0	5.72	19.86	3	1	1	0	4	9
11	Sat	3.25	2.6	0	0	5.64	11.49	1	1	0	0	4	6
12	Sun	3.14	0	3.98	0	0	7.12	1	0	1	0	0	2
13	Mon	5.21	5.58	2.09	0	5.45	18.33	2	2	1	0	4	9
14	Tue	6.46	2.48	3.91	4.11	10.68	27.64	3	2	1	1	4	11
15	Wed	5.87	2.52	2.87	0	0	11.26	3	1	1	0	0	5
16	Thu	10.81	5.03	4.72	3.19	2.63	26.38	4	2	1	1	2	10
17	Fri	9.4	2.7	2.32	0	9.09	23.51	4	1	1	0	2	8
18	Sat	4.48	4.1	3.54	0	4.32	16.44	3	2	1	0	2	8
19	Sun	-	-	-	-	-	0	-	-	-	-	-	0
20	Mon	6.21	1.14	2.38	0	2.7	12.43	2	1	1	0	2	6
21	Tue	5.23	2.38	4.03	0.05	2.5	14.19	3	2	1	1	3	10
22	Wed	8.35	5.89	0	0	10.78	25.02	4	2	0	0	5	11
23	Thu	5.52	5.33	4.09	3.49	6.8	25.23	3	2	1	1	3	10
24	Fri	6	4.26	2.99	0	17.6	30.85	3	2	1	0	6	12
25	Sat	7.93	4.32	0	0	4.5	16.75	3	2	0	0	4	9
26	Sun	0	3.35	0	0	6.43	9.78	0	1	0	0	2	3
27	Mon	4.16	5.46	4.69	0	10.28	24.59	2	2	1	0	7	12
28	Tue	1.47	4.81	3.41	3.88	5.38	18.95	1	2	1	1	2	7
29	Wed	10.69	5.8	4.39	3.87	5.71	30.46	4	2	1	1	6	14
30	Thu	11.07	5.61	3.1	0	3.37	23.15	4	2	1	0	4	11
31	Fri	6.82	3.45	0	0	2.33	12.6	3	1	0	0	2	6
Total		180.63	95.98	81.64	18.59	153.32	530.16	77	40	23	6	87	233
Average(per day)		6.45	3.43	2.92	0.66	5.48	18.93	2.75	1.43	0.82	0.21	3.11	8.32
Average (per working day)		6.69	3.69	3.55	3.10	5.90		2.85	1.54	1.00	1.00	3.35	

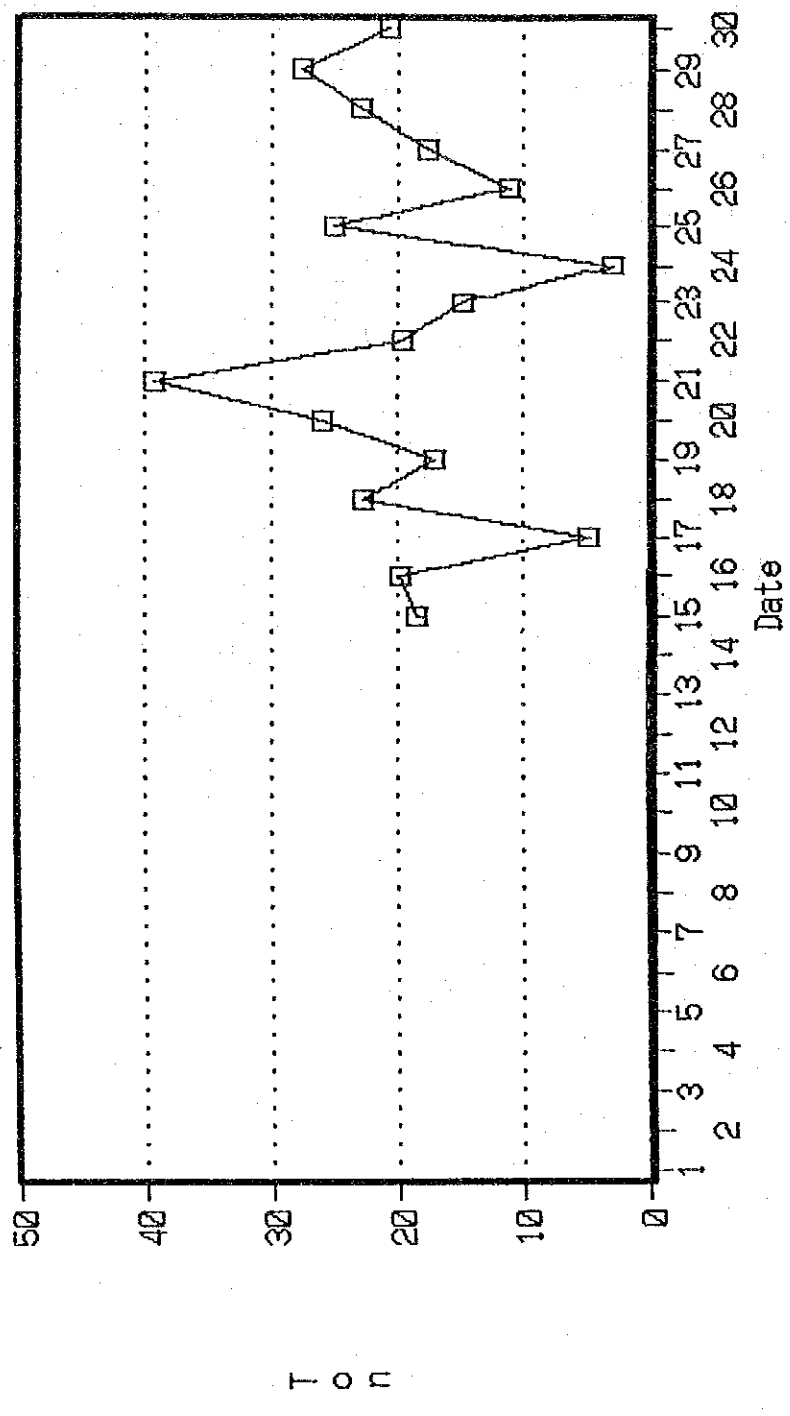


Fig.F.1-4 Amount of Waste Hauled to KM18-DS November, 1991 (1)

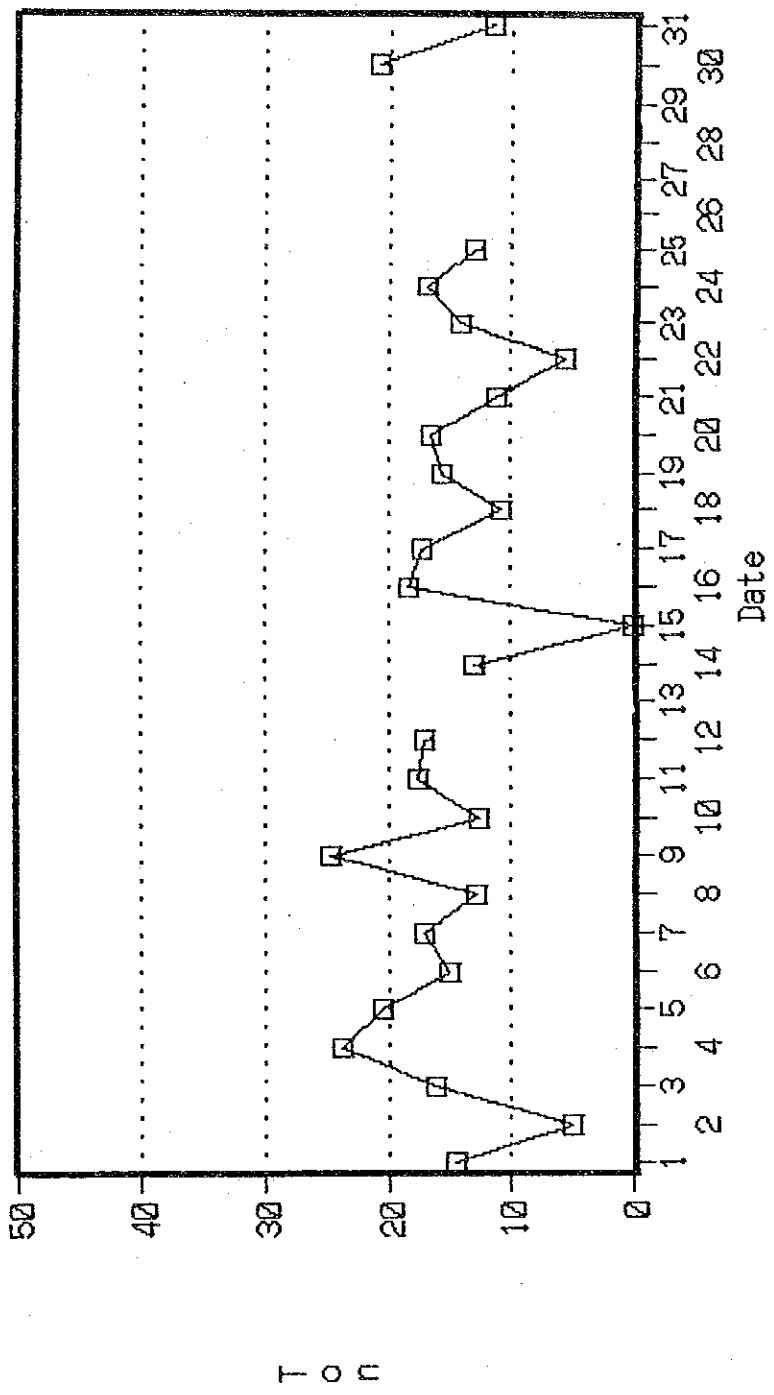


Fig.F.1-4 Amount of Waste Hauled to KM18-DS December, 1991 (2)

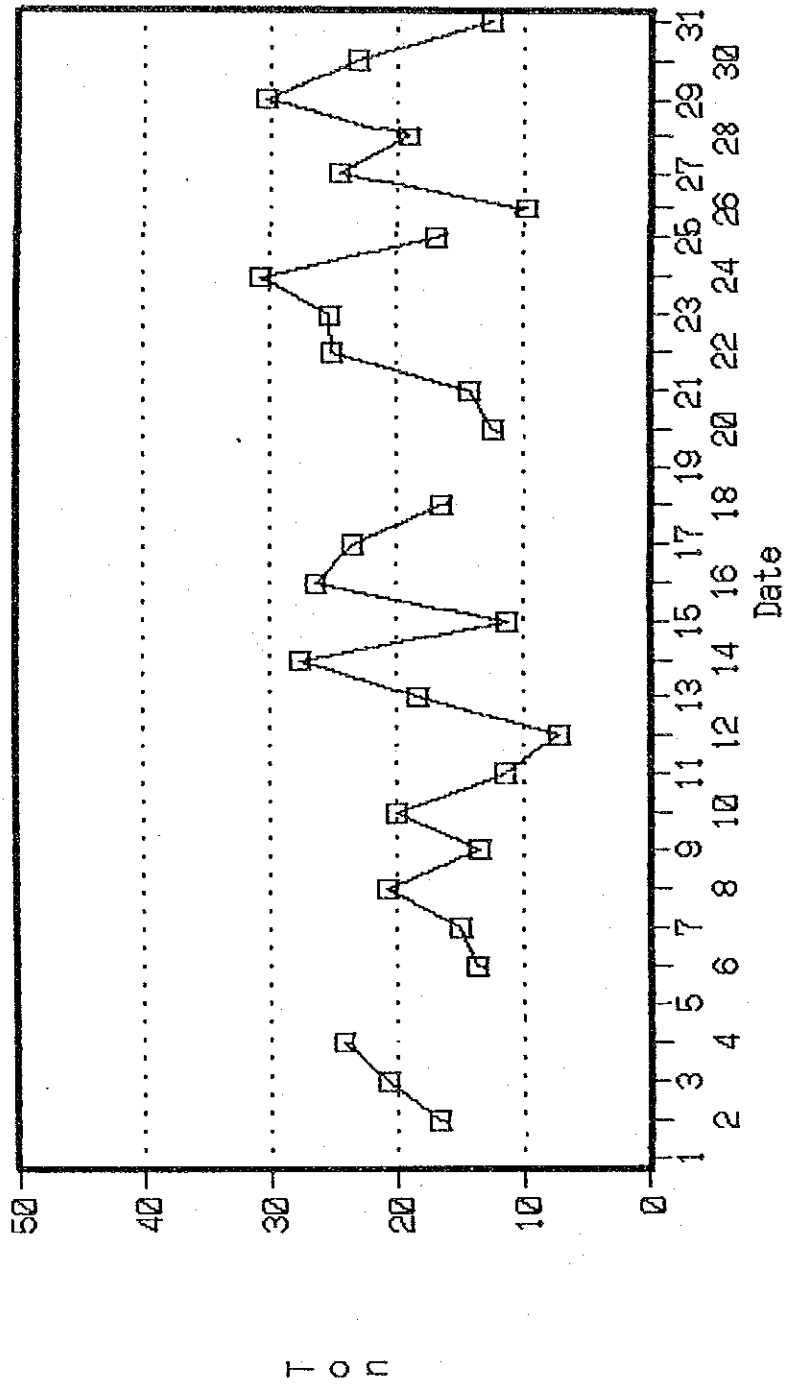


Fig.F.1-4 Amount of Waste Hauled to KM18-DS January, 1992 (3)

Table F.1-6 Modification of Hauled Waste Amount

(Unit: ton/day)

Classification of Waste Hauled to KM 18-DS	Hauled Waste Amount Estimated from WACS and CCS	Actual Amount of Hauled Wastes
Domestic wastes	17.0	4.3
Commercial wastes	11.7	3.0
Market wastes	4.1	4.1
Office wastes	0.8	0.8
Hospital wastes	0.8	0.8
Road sweeping wastes	0.9	0.9
Directly hauled wastes	3.5	3.5
Total	38.8	17.4

2) Service Coverage; Population

Based on the CCS, about 19% of the residents interviewed was covered by collection services.

On the other hand, the actual waste amount hauled to the KM 18-DS observed for about two and half months from 15th November 1991 to end of January, 1992 indicates that the coverage ratio should be less than 19%. Because the actual hauled waste amount is 13.9 ton/day, while the estimated collected amount based on the CCS is 35.3 ton/day. It is deemed that the difference between the actual and estimated collected amount is due to the error of the CCS regarding the collection service coverage both in the residential and commercial areas.

Consequently, the population covered by the collection services is about 6,850 an amount equivalent to about 4.8% of the whole population (142,723) in the Study area.

3) Service Coverage; Shops

According to the CCS, 87% of the shops in the Study area receive collection services. As described in the former paragraphs, the ratio of 87% should be revised as 22.3% in order to coincide with the actual collected amount. Since there are no available data on the number of the shops in the Study area, the number of shops in all commercial areas in Vientiane urban area was surveyed and counted by the Study Team. The results of the survey indicate a total of 2,500 shops in the Study area, and are tabulated in Table F.1-7 and illustrated in Fig. F.1-5. The number of shops covered by the collection service is estimated at 560.

Table F.1-7 Number of Shops and their Location

Code	Name of Area	Name of Road	Numbers of Shop
1	Namphou	Samsentai Road	130
2	Namphou	Khounbourom Road	85
3	Namphou	Heng Boun Road	65
4	Namphou	Anou Road	45
5	Namphou	Pang Kham Road	35
6	Wattay	Luang Prabang Road	130
7	Sisangvone	Sisangvone Road	74
8	Nongbone	Nongbone Road	150
9	Ban Dong Palane	Dongpalane Road	260
10	Ban Hatsady	Hatsady Road	37
11	Ban Hatsady	Lane Xang Road	24
12	That Luang	That Luang Road	170
13	Ban Sihom	Samsenthai Road	89
14	Ban Khounta-Wattay	Luang Prabang Road	310
15	Ban Wat Chanh Tha	Setthathirat Road	71
16	Ban Wat Chanh Tha	Kham Khong Road	36
17	Ban Wat Chanh Tha	Samsenthai Road	290
18	Ban Wat Chanh Thong	Khounbourom Road	29
19	Ban Thong Khan kham	Thong Khan kham Road	55
20	Ban Hongkha	Hongkha Road	85
21	Ban Nong Duang	Nong Bouathong Road	138
22	Ban Nong Duang	Nong Duang Road	84
23	Ban Khoua Luang	Soi Khoua Luang	50
24	Ban Khoua Luang	Soi Khoua Luang	58
	Total		2,500

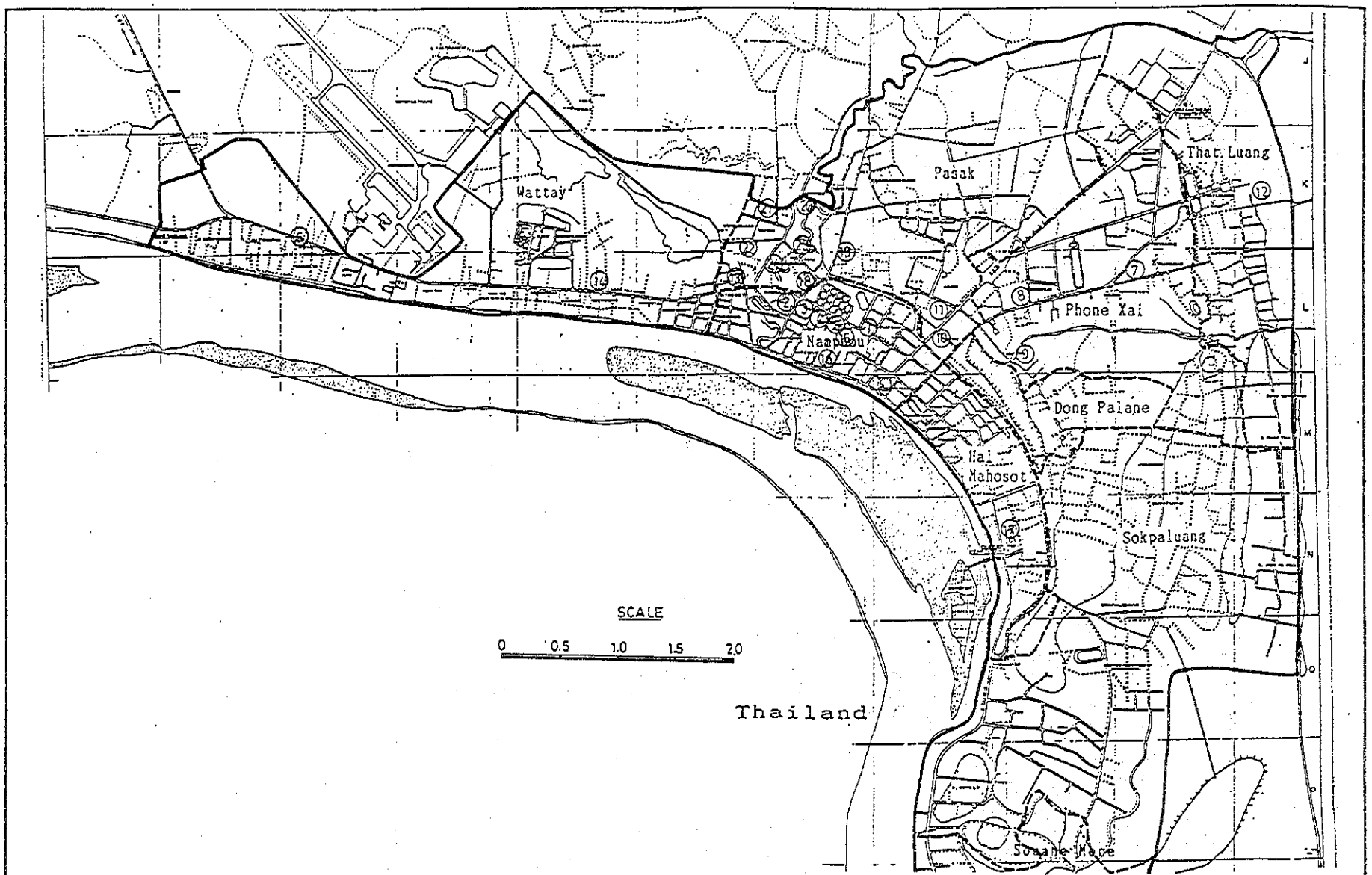


Fig. F.1-5 Location Map of Existing Shop

THE STUDY ON THE SOLID WASTE MANAGEMENT SYSTEM IMPROVEMENT PROJECT IN VIENTIANE, LAO P. D. R.

JAPAN INTERNATIONAL COOPERATION AGENCY

4) Service Coverage; Markets

Most of the markets in the Study area excluding temporary and negligible small markets receive collection services and the total number of the shops, including daily shops which do not have permanent space in the market, is 4,000 and the number of shops covered by the collection service is 3,160, because Thong Khan Kham market collects and transports their own waste.

Table F.1-8 Market Covered by Collection Services and Number of Shops

Name of Market	Number of Shops	
Nong Chanh	780	shops
That Luang	1,050	"
*Thong Khan Kham	840	"
Sikhai	230	"
Souane Mone	330	"
Nong Douang	400	"
Dong Palane	180	"
Simouang	40	"
Kok Pho	120	"
Sisawat	30	"
Total	4,000	"

Note ;

* Thong Khan Kham market collects and transports their own waste.

5) Service Coverage; Government Offices

Almost all of the government offices in the Study area are covered by collection services. Total number of the government employees is about 26,700.

Table F.1-9 Number of Government Employees

	Number of Employees
National Level	15,733
Municipality Level (in urban area)	11,000
Total	26,733

Source : Vientiane Municipality

6) Service Coverage; Hospitals

The hospitals and number of beds in the Study area are tabulated in Table F.1-10 based on the answers in the questionnaires distributed in the hospitals surveyed by the Study Team. Among these, the Military Hospital 103 does not receive collection services and disposes this waste by themselves by means of landfill and burning within the compound. Consequently, 66% of the beds in the hospitals are covered by collection service.

Table F.1-10 Hospitals and Number of Beds in the Study Area

Name of Hospital	Number of Beds
Mahosot Hospital	450
Police Hospital	60
Military Hospital 103	450
Setthathirat Hospital	200
Lao-Soviet Hospital	150
Total	1,310

7) Service Coverage; Road

Total length of the road which receives road sweeping services is 15 km. This is equivalent to 24.3 % of the total length of the permanently paved road in the Study area.

F.1.4 Waste Stream

The present waste stream in the Study area is estimated by the Study Team and illustrated in Fig. F.1-6.

1) Amount of Generation (#1)

According to the calculation shown below, the total generation of waste in the Study area is calculated at 140.8 t/d.

a. Domestic wastes (#1-1)	142,723 per.	x	753 g/d	=	107.5 t/d.
b. Commercial wastes (#1-2)	2,500 shops	x	8,591 g/d	=	21.5 t/d.
c. Market wastes (#1-3)	4,000 shops	x	1,300 g/d	=	5.2 t/d.
d. Office wastes (#1-4)	26,700 emp.	x	30 g/d	=	0.8 t/d.
e. Hospital wastes (#1-5)	1,310 beds	x	960 g/d	=	1.3 t/d.
f. Road sweeping wastes (#1-6)	15 km	x	58,000 g/d	=	0.9 t/d.
g. Unclassifiable reusable materials					1.2 t/d.
h. Direct hauled wastes (# 1-7)					2.4 t/d.
Total					140.8 t/d.

2) Amount of Recycled of Food Waste at Generation Sources (#2)

As shown in the following calculation, the amount of recycled of food waste at the generation sources is estimated at 21.8 t/d.

a. Food waste recycled at residences (#2-1)

142,723 per. x 100 g/d = 14.3 t/d.

b. Food waste recycled from shops (#2-2)

2,500 shops x 3,000 g = 7.5 t/d.

Total	21.8 t/d.

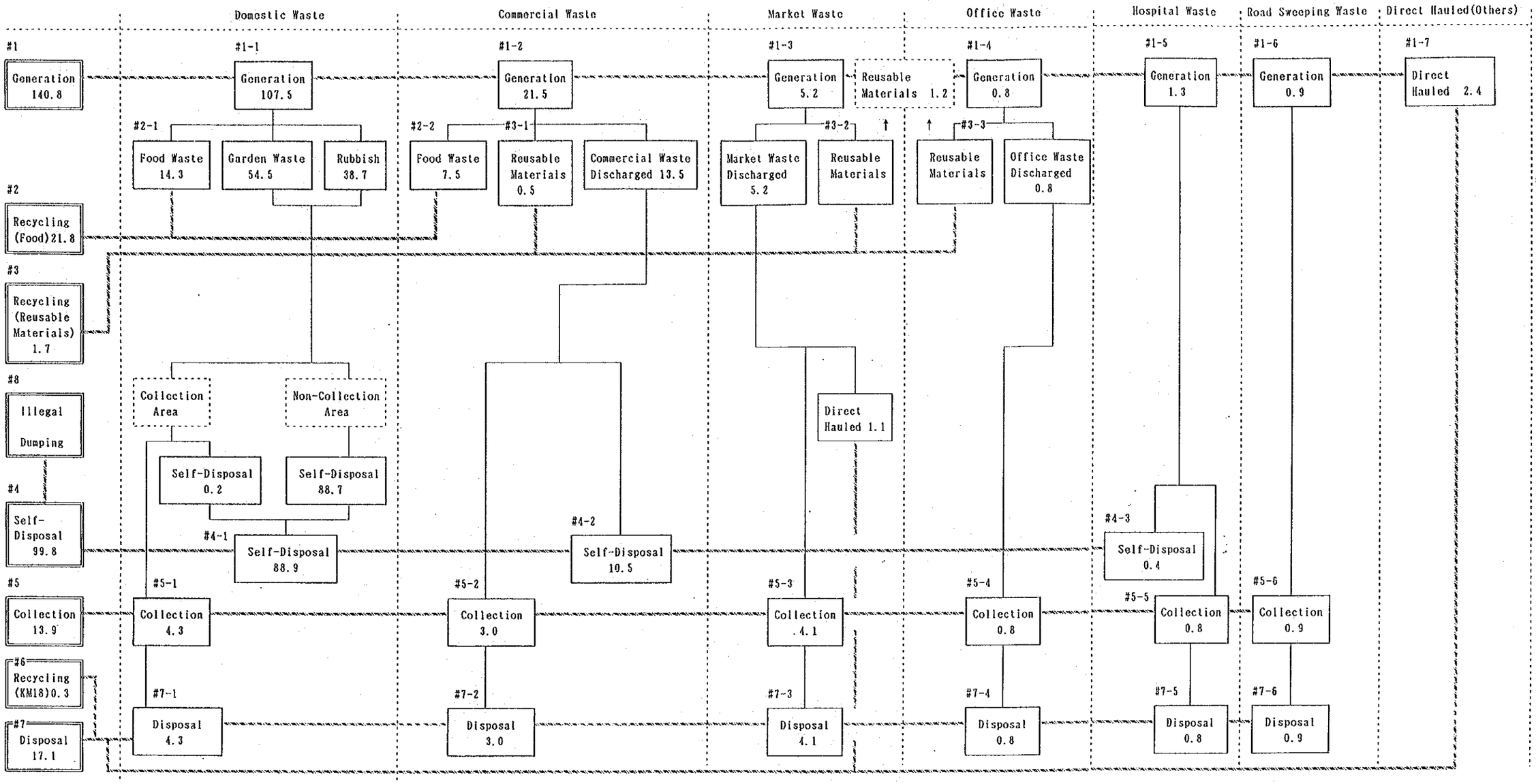


Fig. F.1-6 Present Waste Stream in The Study Area (Unit: Ton/Day)

3) Amount of Recycled Reusable Materials

Based on the surveys of private recyclers and the CCS, the total amount of recycled reusable materials at generation sources is estimated at 1.7 t/d as follows ;

a. Reusable materials recycled from shops (#3-1)
2,500 shops x 207 g = 0.5 t/d

b. Unclassifiable reusable materials (#3-2, #3-3)
= 1.2 t/d

Total	1.7 t/d

4) Amount of Self-disposed Wastes (#4)

The total amount of self-disposed waste is calculated at 99.8 t/d as follows ;

a. Self-disposed waste at residences (#4-1) 88.9 t/d

- self-disposed waste at residences covered by collection services (142,723 per.x 0.048 x 27 g/d = 0.2 t/d)

- self-disposed waste at residences uncovered by collection services (142,723 per.x 0.952 x 653 g/d = 88.7 t/d)

b. Self-disposed waste at shops (#4-2)
2500 shops x 0.777 x 5,384 g/d = 10.5 t/d

c. Self-disposed waste at hospitals (#4-3)
450 beds x 960 g/d = 0.4 t/d

Total	99.8 t/d

5) Amount of Collected Wastes (#5)

As shown in the following calculation, the total amount of collected wastes is calculated at 13.9 t/d.

a. Collected waste from residential area (#5-1)

142,723 per.x 0.048 x 626 g/d = 4.3 t/d

b. Collected waste from commercial area (#5-2)

2500 shops x 0.223 x 5,384 g/d = 3.0 t/d

c. Collected waste from markets (#5-3)

3,160 shops x 1,300 g/d = 4.1 t/d

d. Collected waste at offices (#5-4)

26,700 emp. x 30 g/d = 0.8 t/d

e. Collected waste from hospitals (#5-5)

860 beds x 960 g/d = 0.9 t/d

f. Collected waste from road sweeping (#5-6)

15 km x 58,000 g/d = 0.9 t/d

Total	13.9 t/d

6) Amount of Recycling at KM 18-DS

Total amount of recycling at the KM 18-DS is estimated at 0.3 t/d according to the survey on scavengers.

7) Amount of Disposed Waste at KM 18-DS

The actual disposed amount of waste at the KM 18-DS is studied by using the weighbridge installed by the Study Team in the middle of November 1991. The data obtained during November 15th to December 8th are analyzed in this report.

According to the results, the total amount of wastes disposed at the KM 18-DS is calculated at 17.1 t/d as follows ;

a. Amount of collected wastes (#5)	13.9 t/d
b. Amount of directly hauled wastes	3.5 t/d
c. Amount of recycling at Km 18-DS	- 0.3 t/d
Total	17.1 t/d

8) Amount of Illegally Dumped Waste (#8)

To get the amount of illegally dumped wastesi is difficult. As far as the survey done by the Study Team is concerned, the amount could not be estimated. It shall be, therefore, included in the amount of self-disposed waste.

F.2 Collection and Haulage

F.2.1 Discharge and Storage

Present discharge and storage system in the Study area is summarized in Table F.2.1.

1) Source Separation

The source separation at the resident and commercial area is well established and organized. The waste generated in the area is segregated into the following ;

i. waste to be discharged;
ii. food wastes for domestic animals' feed;
iii. reusable materials for recycling; and
iv. waste for self-disposal.

In contradiction to the above, source separation at the markets, offices and hospitals is not established. There are no segregation at all. In addition, although infectious waste which is very dangerous is segregated at the generation sources, it is discharged together with other wastes without being placed in any special container.

2) Type of Refuse Bins

A banboo basket without a lid having 30 to 50 liters capacity is commonly used in residential and commercial areas for storage and discharge container. Although it seems to be unsanitary as pointed out in the UNDP report, it atracts few flies and scavenging animals because the waste composition includes less garbage, as described in F.1.2. On the other hand, the scattering of waste around the bamboo basket and road-sides is a common occurance. This is, however, mainly due to littering and partly due to the uncovered bamboo baskets.

Table F.2-1 Present Discharge and Storage System

Generation Sources		Source Separation	Type of Refuse Bins	Storage & Discharge Points
Residential Area	Collection Area	Separate discharge (Food waste is separated as food for animals.)	Bamboo basket	Premise or its surroundings
	Non-Collection Area	Separate discharge (Food waste is separated as food for animals.)	-	Self disposal at premise or its surroundings
Commercial Area	Collection Area	Separate discharge (Food waste is separated as food for animals.)	Bamboo basket	Premise or its surroundings
	Non-Collection Area	Separate discharge (Food waste is separated as food for animals.)	-	Self disposal at premise or its surroundings
Market		Mixed discharge	Open heap (That Luang market has concreat wall for stock yard.)	Premise
Office		Mixed discharge	Open heap	Premise
Hospital		Mixed discharge (Infectious waste is discharge with other wastes.)	Mahosot : Trailer Sethathirat:Iron container Others : Open heap	Premise (A container is installed outside of the Sethathirat hospital.)
Road Sweeping		Mixed discharge	Open heap	Roadside

As opposed to the above, generally, institutional wastes have no refuse bins or containers, and they are usually discharged into open heaps. However, wastes of institutions like that Luang Market, Mahosot and Setthathirat Hospitals are discharged into a concrete wall, a trailer, and an iron container, respectively. Due to the open heaps, wastes scatter in the surroundings and loading work becomes difficult, particularly the loading of hospital waste due to the mixture of infections waste.

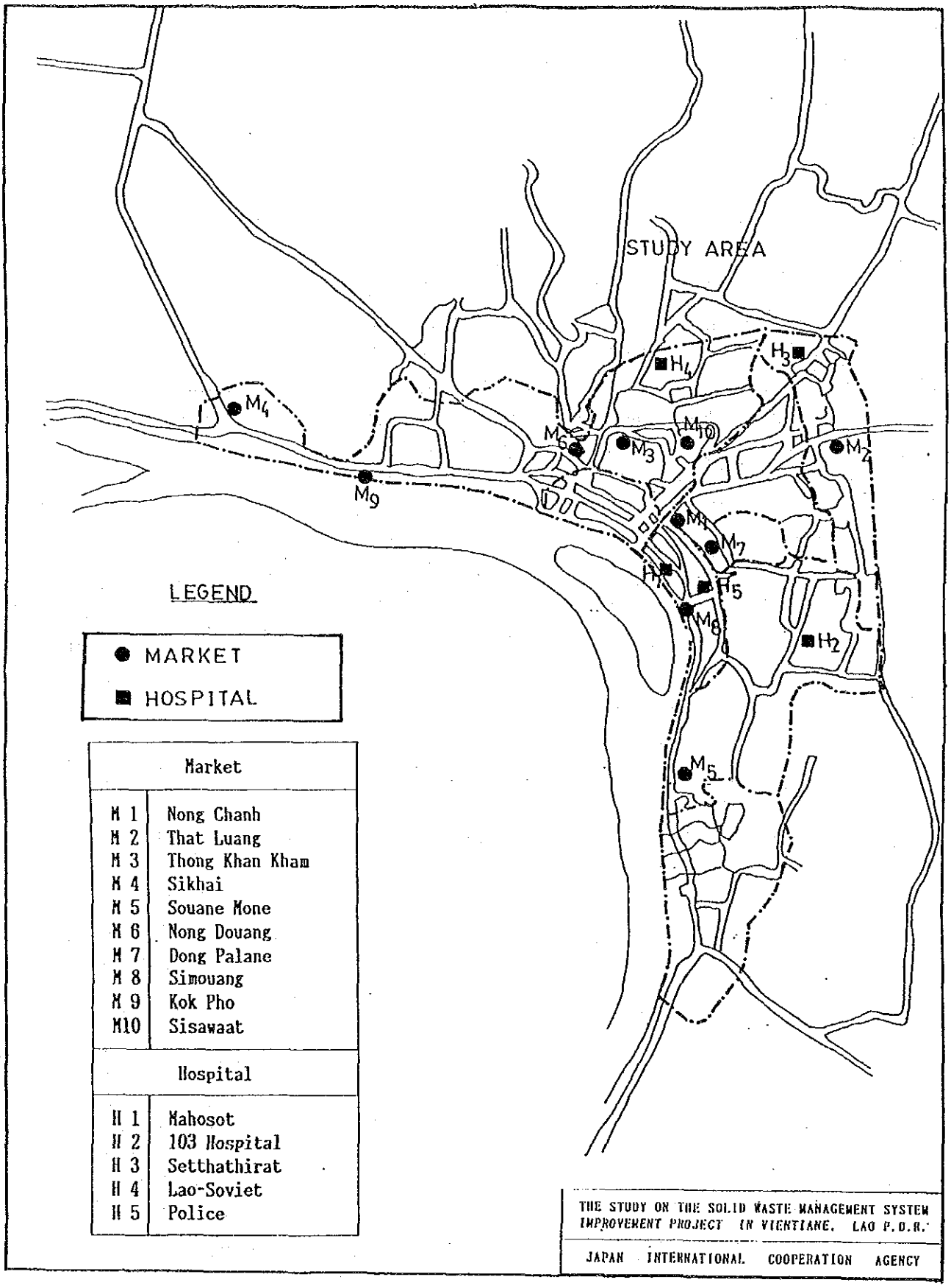
3) Storage and Discharge Points

The wastes in the residential and commercial areas covered by collection services are discharged at the premises or its surroundings and then collected. On the other hand, in the non-collection area, waste is self-disposed at the premises or its surroundings such as road-sides mainly through open burning and land-filling.

Institutional wastes, are also discharged at the premises. Some are self-disposed mainly through open burning and partly by landfilling.

4) Location of Market and Hospital

Main markets and hospitals are surveyed and tabulated in Table F.2-2 and F.2-3, respectively, and their locations are shown in Fig. F-2-1.



Market	
M 1	Nong Chanh
M 2	That Luang
M 3	Thong Khan Kham
M 4	Sikhai
M 5	Souane Mone
M 6	Nong Douang
M 7	Dong Palane
M 8	Simouang
M 9	Kok Pho
M10	Sisawaat
Hospital	
H 1	Mahosot
H 2	103 Hospital
H 3	Setthathirat
H 4	Lao-Soviet
H 5	Police

Fig. F.2-1 Location of Markets and Hospitals

Table F.2-2 List of Markets in the Study Area

Code	Name of Market	Collection Service	Number of Shops *
M1	Nong Chanh	Private (2 times/day)	786
M2	That Luang	Private (6 times/week)	1,045
M3	Thong Khan Kham	by themselves (1 time/day)	838
M4	Sikhai	DCTC (3 times/week)	229
M5	Souane Mone	Private	330
M6	Nong Douang	DCTC	400
M7	Dong Palane	Private	180
M8	Simouang	Private	40
M9	Kok Pho	DCTC (3 times/week)	120
M10	Sisawaat	DCTC (1 time/week)	30

* The figure includes daily shops which do not have permanent space in the market.

Table F.2-3 List of Hospitals in the Study Area

Code	Name of Hospital	Collection Service	Number of bed
H1	Mahosot Hospital	DCTC	450
H2	Military Hospital 103	Self-disposal (burning)	450
H3	Setthathirat Hospital	DCTC (2 times/week)	200
H4	Lao-Soviet Hospital	DCTC	150
H5	Police Hospital	DCTC	60

F.2.2 Collection and Haulage

Present collection and haulage system in the Study area is summarized in Table F.2-4.

1) Collection Area

At present, waste collection services in the Study area is being carried out by DCTC and three private companies. Based on the results of F.1, collection ratio in the residential area is only 4.8% including the households who receive irregular services and the ratio in the commercial area is 22.3%.

Table F.2-4 Present Collection and Haulage System

Generation Sources	Survice Coverage(%)	Collection Frequency	Collection System	Collection Time	Collection Tools	Haulage Method	Transfer System
Residential Area	4.8%	Once a week	Curb and Door-to-door (A part of area is adopted bell collection system.)	Day Time	Bamboo basket and hoe	Dump truck Flat truck Trailer	Without transfer
Commercial Area	22.3%	Once a week (A part of commercial area receives collection service more than twice a week.)	Curb and Door-to-door (In a part of area bell collection system is adopted	Day time	Bamboo basket and hoe	Ditto	Without transfer
Market	* 100%	Every day for Nong Chan, That Luang and Khan Kham Others:1～3/week	Station	Day time or Evening	Bamboo basket and hoe	Ditto	Transfer from open heap
Office	100%	More than twice a week	Station	Day time	Bamboo basket	Ditto	Ditto
Hospital	66%	More than twice a week	Station	Day time	Bamboo basket and Hoe	Ditto	**** Ditto
Road Sweeping	**100%	Twice a week	Station	Day time	***	Ditto	Ditto

* In Thong Khan Kham market, collection and haulage of waste is managed by the market.
** The length of road sweeping is 15 Km.
*** Collection tools for road sweeping are bamboo basket, handcart, brooms, shovels, hatchets, rakes.
**** In Mahosot Hospital, a transfer system by trailer is adopted.
In Sethathirat Hospital, a transfer system from container is adopted.

Since there were no data regarding the collection area covered by both DCTC andprivate companies, the Study Team traced collection routes of all vehicles in order to know the present collection area. As a result, a map showing the present routes was prepared and is shown in Fig. F.2-2. As shown in the figure, present collection service is conducted in accordance with the collection routes and residences, shops, offices, etc. along the route instead of collection area. The collection routes are almost same as the main roads in the commercial area of the Study area, as shown in Fig. F.2-3.

Consequently, it is concluded that the present collection service is mainly carried out in the commercial area. The collection area covered by DCTC and three private companies is described below ;

a. DCTC... Commercial area in Namphou Zone
Commercial area in Wattay Zone
Phone Xai Zone
Hal Mahosot Zone

b. Private-CRC... Commercial area in Namphou Zone
Pasak Zone

c. Private-ISC... Sokpaluang Zone
Hal Mahosot Zone

d. Private-SWM... Phone Xai Zone
That Luang Zone

2) Collection Amount of Waste

The actual amount of waste collected has been observed from Novemer 15th, 1991 to end of January 1992 using the weighbridge installed at the KM18-DS by the Study Team.

According to the observation, the present collection capability of each sector is as follows;

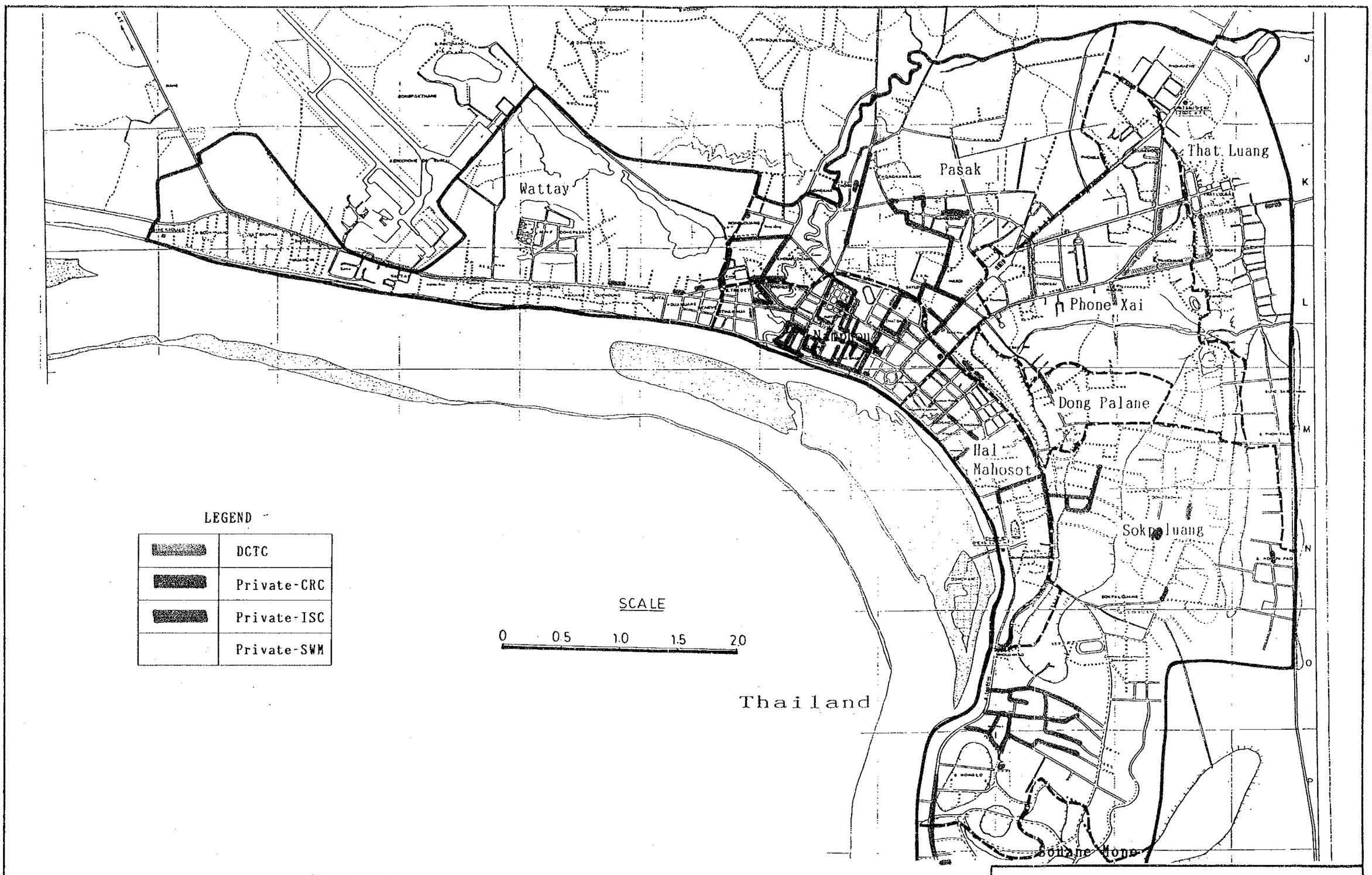


Fig. F.2-2 Collection Routes of DCTC and Private Contractors

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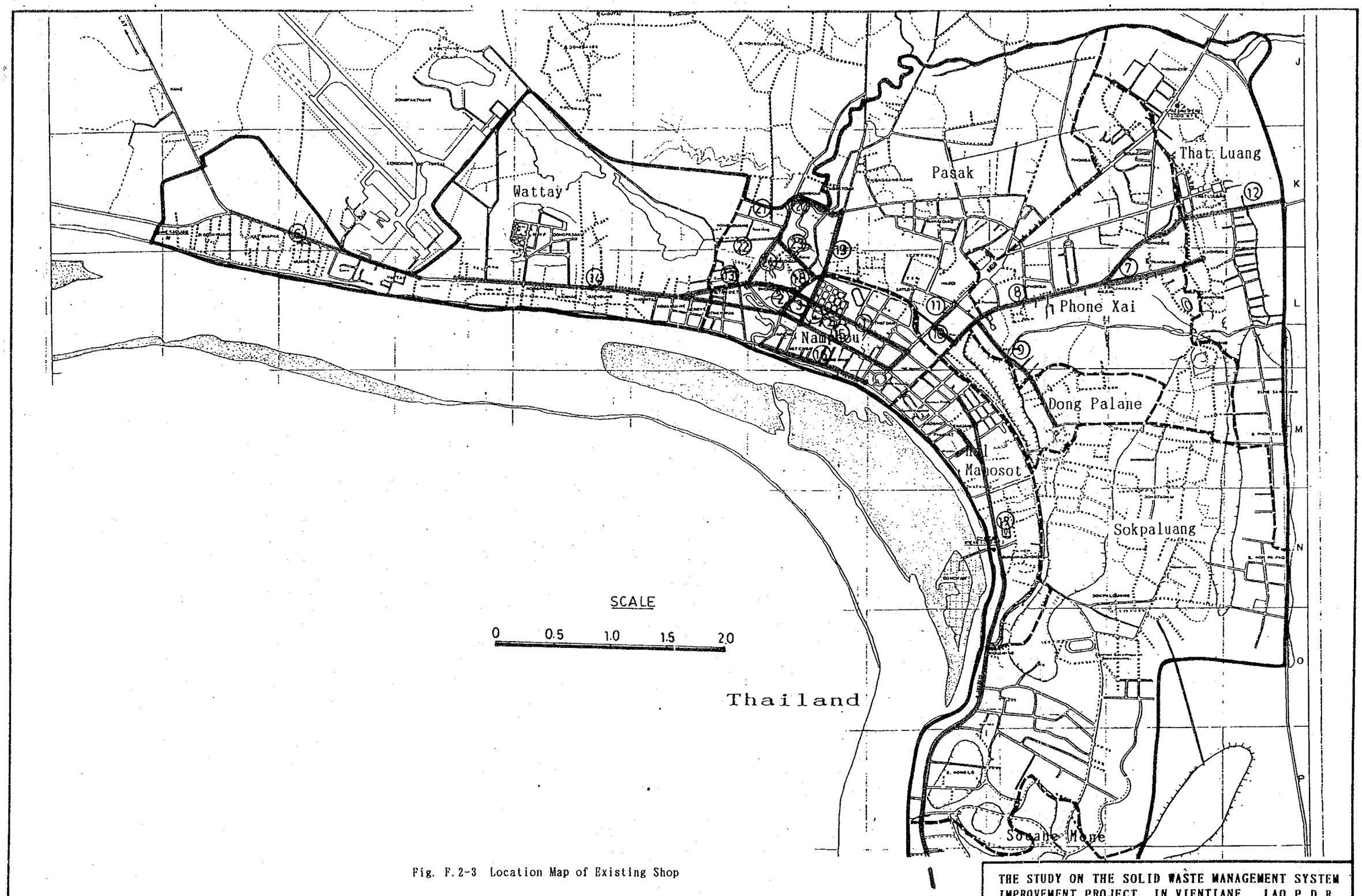

Fig. F.2-3 Location Map of Existing Shop

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- DCTC : 6.1 tons/day (44%)
- Private Contractors : 7.8 tons/day (56%)
  - .Private CRC : 3.5 tons/day
  - .Private ISC : 3.2 tons/day
  - .Private SWM : 1.1 tons/day

- Total 13.9 tons/day (100%)

3) Service Level

a. Collection system

The major collection system applied in the Vientiane urban area is curb and door to door collection system. In curb collection system, waste baskets are set at roadside for collection. In the door to door collection system, the collector visits each residence or shop directly and collects their waste in front of their houses and shops.

In addition to these systems, the bell collection system is used in the commercial and residential areas where collection vehicles could not get access to due to road conditions. In the system, the collector calls the residents for discharge of their waste when the collection vehicle arrives at a certain collection point.

b. Collection frequency

Collection is conducted once a week in most of the collection areas except for the part of the commercial area shown in Fig. F.2.-4 and institutions, such as markets, offices and hospitals. The areas, receiving more than twice a week collection services is, however, very limited. Twice a week collection service are conducted in the following collection routes;

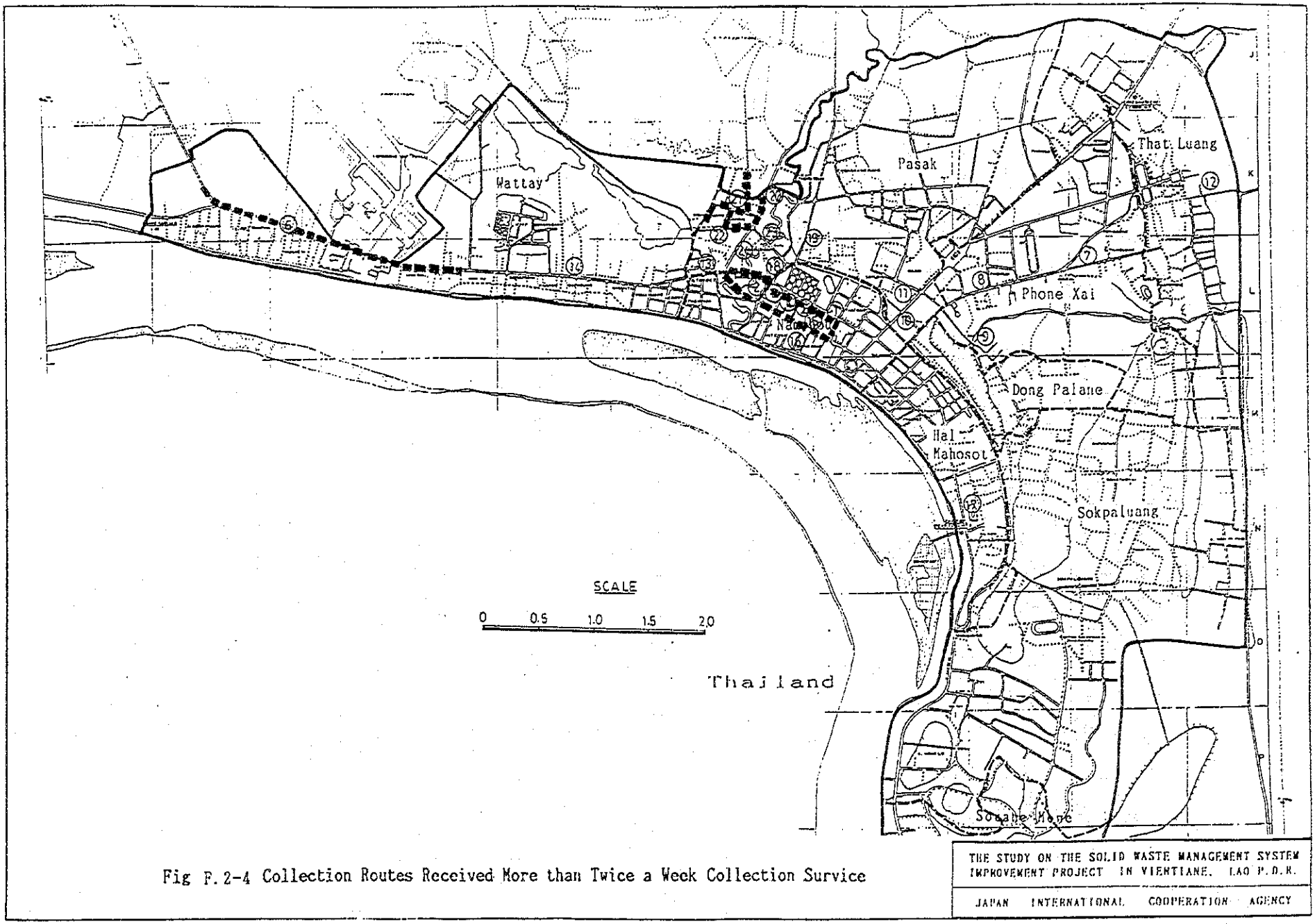


Fig F.2-4 Collection Routes Received More than Twice a Week Collection Survice

i. Namphou
- Khounbourom Road
- Heng Boun Road
- Anou Road
- Pang Kham Road

ii. Wattay
- Luang Prabang Road

iii. Pasak
- Nong Boriathong Road
- Nong Duang Road

c. Collection fee

There is no clear tariff on the collection fee of DCTC and the private companies. The collection fee is decided basically by negotiation in consideration of the amount of discharge and collection frequency.

Although the results of the CCS indicated that an average residence paid about 500 kips/month for collection service, the results of the interview to DCTC and three private contractors gave the information on collection fee about 1000 kips/month for once a week collection service. The Study Team, therefore, concluded that the average collection fee for the average family in terms of family members would be about 1,000 kips/month for once a week collection. Further, the collection fee of waste for irregular collection services is 200 kips for a bamboo basket.

Most of residents and shop owners except for some Bans pay directly to DCTC and private companies. According to DCTC, about 60% of the fee is collected by bill collectors and the remaining 40% is transferred to the bank account of DCTC. Generally, direct collection is done for residences and shops and the other is for the institutions such as embassies, banks, etc.

4) Equipment

Present collection vehicles of both DCTC and private companies are described in F.6.

As for collection and loading tools, bamboo baskets and hoes are commonly used except for road sweeping.

5) Collection Work

a. Crew

A collection team with a collection vehicle is formed by 5 crew members, namely a driver and 4 collectors. One or two labourer(S) work on the truck for loading, while two or three labourers collect the waste.

b. Loading work

The wastes in the residential and commercial areas are directly collected and loaded into the vehicle. On the other hand, the institutional wastes which are normally heaped make the loading work difficult.

For example, according to the one week observation done by the study Team at Nong Chang and That Luang markets, the loading time for one ton of waste was about one hour as shown in Table F.2-5.

Table F.2-5 Loading Time at Markets

Name of Market	Number of Collector (Person)	Average Amount of Waste (ton/day)	Average Loading Time (min./day)	Average Loading Time (min./ton)
Nong Chanh	4	0.81	43	53
That Luang	4	0.94	54	57

In addition, primary collection is done by the heapers to the open heaps at the market.

The same procedure is applied to the other open heaps of institutional wastes.

c. Unloading work

Although there are no problems on the trucks with damping devices, problems on passage due to bad access conditions and the arrangement of wastes dumped can be found, according to the observation of the Study Team on the unloading work at the KM18-DS.

However, the truck without a dumping device and two trailers, both of which belong to DCTC, required more than one hour for unloading.

6) Haulage

a. Haulage method

Open dump trucks are commonly used for the collection and transportation of waste, except for a flat truck without a dumping device and two trailers. A trailer is installed at Mahosot Hospital and the other is connected to a truck.

b. Transfer system

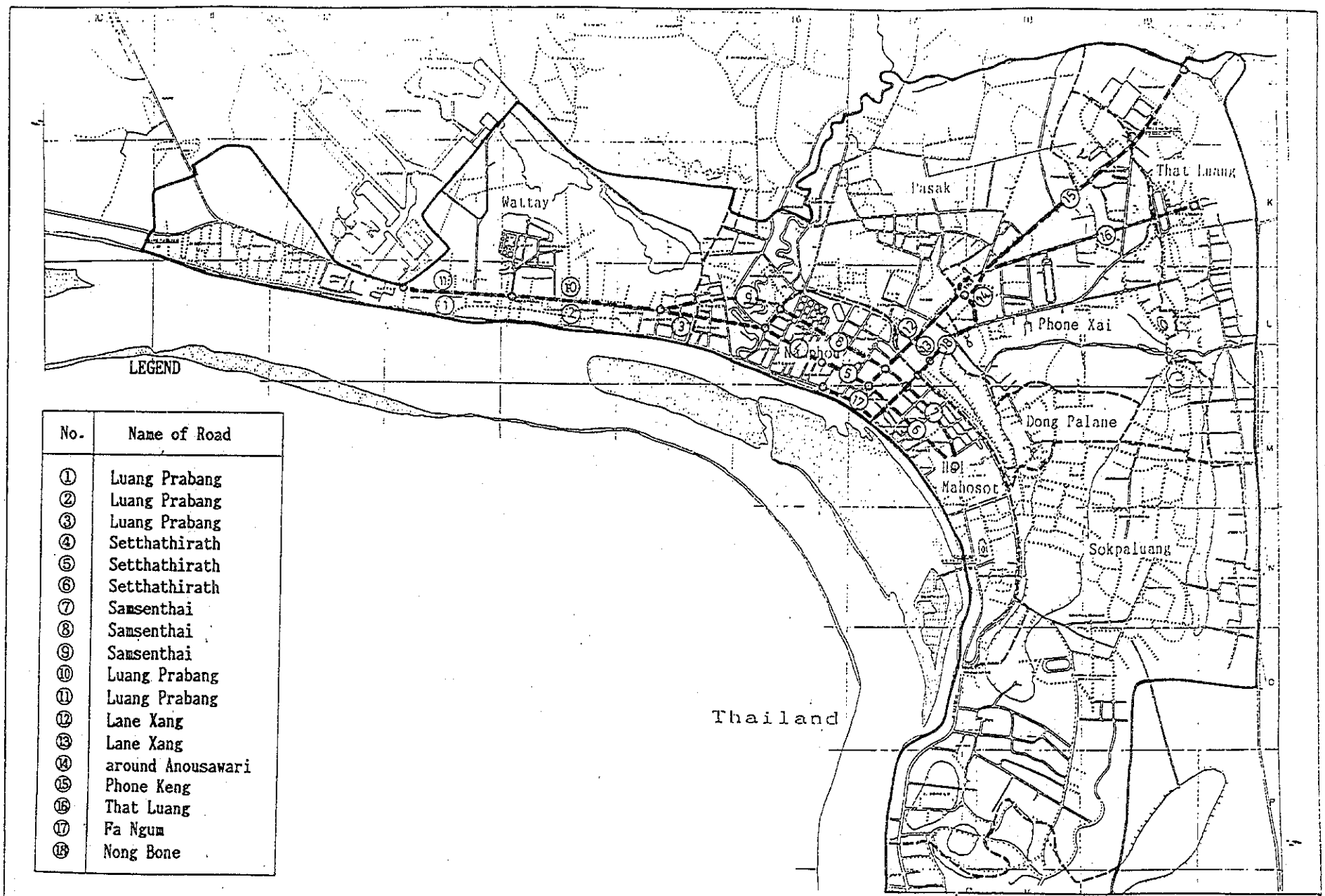
There is no transfer system observed in the waste collection services in residential and commercial areas. As for institutional wastes, most of the wastes generated are primarily collected and heaped at the open station. Then, the collection team shall make considerable effort for loading the heaped waste, except for the trailer used for Mahosot Hospital.

F.3 Road Sweeping, Drain Cleansing and Grass Cutting

F.3.1 Road Sweeping

1) Road Sweeping Length

Road sweeping service is carried out by the Cleansing Section of DCTC. The roads covered by the sweeping service are limited to the main street of Vientiane urban area, and the total length of the road covered is 15 km. The names of roads covered and the responsible labourers are listed in Table F.3-1. the roads covered by the sweeping service is shown in Fig. F.3-1.



No.	Name of Road
①	Luang Prabang
②	Luang Prabang
③	Luang Prabang
④	Setthathirath
⑤	Setthathirath
⑥	Setthathirath
⑦	Samsenthai
⑧	Samsenthai
⑨	Samsenthai
⑩	Luang Prabang
⑪	Luang Prabang
⑫	Lane Xang
⑬	Lane Xang
⑭	around Anousawari
⑮	Phone Keng
⑯	That Luang
⑰	Fa Ngum
⑱	Nong Bone

Fig. F.3-1 Road Covered by Sweeping Service

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Table F.3-1 Road Covered by Sweeping Service and Responsible Labourer

No.	Name of Road	Worker		
		Age	Sex	Working Year
1	Luang Prabang	56	Female	3
2	Luang Prabang	28	Female	3
3	Luang Prabang	69	Male	25
4	Setthathirat	37	Female	7
5	Setthathirat	61	Male	3
6	Setthathirat	61	Male	2
7	Samsenthai	51	Female	4
8	Samsenthai	41	Female	4
9	Samsenthai	50	Female	4
10	Luang Prabang	51	Male	3
11	Luang Prabang	38	Female	2
12	Lane Xang	60	Male	4
13	Lane Xang	57	Female	4
14	around Anousawari	57	Female	27
15	Phone Keng	45	Female	22
16	That Luang	50	Female	4
17	Fa Ngum	48	Female	14
18	Nong bone	23	Male	1

As shown in Table F.3-2, the total road length in the Study area is 228.1 km and the length of the pavement roads is 61.8 km. It is indicated that 24% of the paved roads in the Study area is covered by sweeping services.

Table F.3-2 Road Length in Study Area

No.	Homogeneous Zones by UNDP	Length (km)	Pavement (Km)
1	Wattay	38.7	8.3
2	Namphou	19.2	8.7
3	Pasak	38.6	8.2
4	Hal Mahosot	17.3	7.9
5	Phone Xai	23.3	8.3
6	That Luang	15.0	6.4
7	Dong Palane	7.5	2.5
8	Sokpaluang	42.2	7.7
9	Souane Mone	26.3	3.8
	Total	228.1	61.8

Source : ITSTP, MCTPC

2) Road Sweeping System

As shown in Table F.3-1, a total of 18 labourers are in charge of the road sweeping work. Among them, there are 11 female labourers and 12 labourers over 50 years old.

In addition to the 18 labourers, there is a chief road sweeper responsible for the implementation the following tasks ;

- inspection of the road for sweeping service ;
- control of cleansing equipment ; and
- arrangement of a collection vehicle in case a lot of waste is generated by the road sweeping work.

A sweeper is responsible for about 1 km of roads and works 4 to 5 hours every day except on Sundays. The tool used in sweeping works are handcarts, bamboo baskets, brooms, shovels, hatchets, rakes, etc. These tools are kept by the labourer themselves.

Waste swept is heaped at several points at the road-side without any container. The waste swept is collected and loaded into the collection vehicle about once every three days by DCTC.

3) Wage

The average wage of a labourer is about 18,000 kips per month.

F.3.2 Drain Cleansing

Drain cleansing service is not established in the Study area. However, when a request is made to the DCTC for cleansing a drain, the DCTC provides drain cleansing service, including the collection of waste from drain in the condition of a certain amount of fee-charging.

F.3.3 Grass Cutting

Grass cutting is carried out on the same roads where road sweeping is done by DCTC, as shown in Fig. 4.4-1. Two labourers are assigned to do the work everyday, except on Sundays, on a rotation basis.

As for cleansing equipment, there are two hand-push type grass cutters (4 HP). Due to the hand-push type, cutting place is limited. Cut grass is heaped up by the road sweeper and collected by the collection vehicle like the wastes swept from the road.

F.4 Processing and Final Disposal

F.4.1 Processing

There is no processing facility other than an old, dilapidated and small chamber for incineration in the Military Hospital 103. It seems, however, to be unused for several years.

The construction of an incinerator in Ban That Luang Kang for all hospital waste was recommended in the "Report on disposal of Solid Wastes in Urban Vientiane" by UNDP. However, no action has been taken after the submission of the report in April 1989.

In addition, the site recommended by the report is a private paddy field which seems to be unsuitable for the incineration plant in terms of the accessibility, high construction cost of embankment and compensation to the land owner, environmental considerations on the surrounding residents, etc..

In case an incinerator for hospital waste be necessary, its construction in a hospital such as the Mahosot Hospital is recommended because of sufficient space available. (refer to Fig. F.4-1)

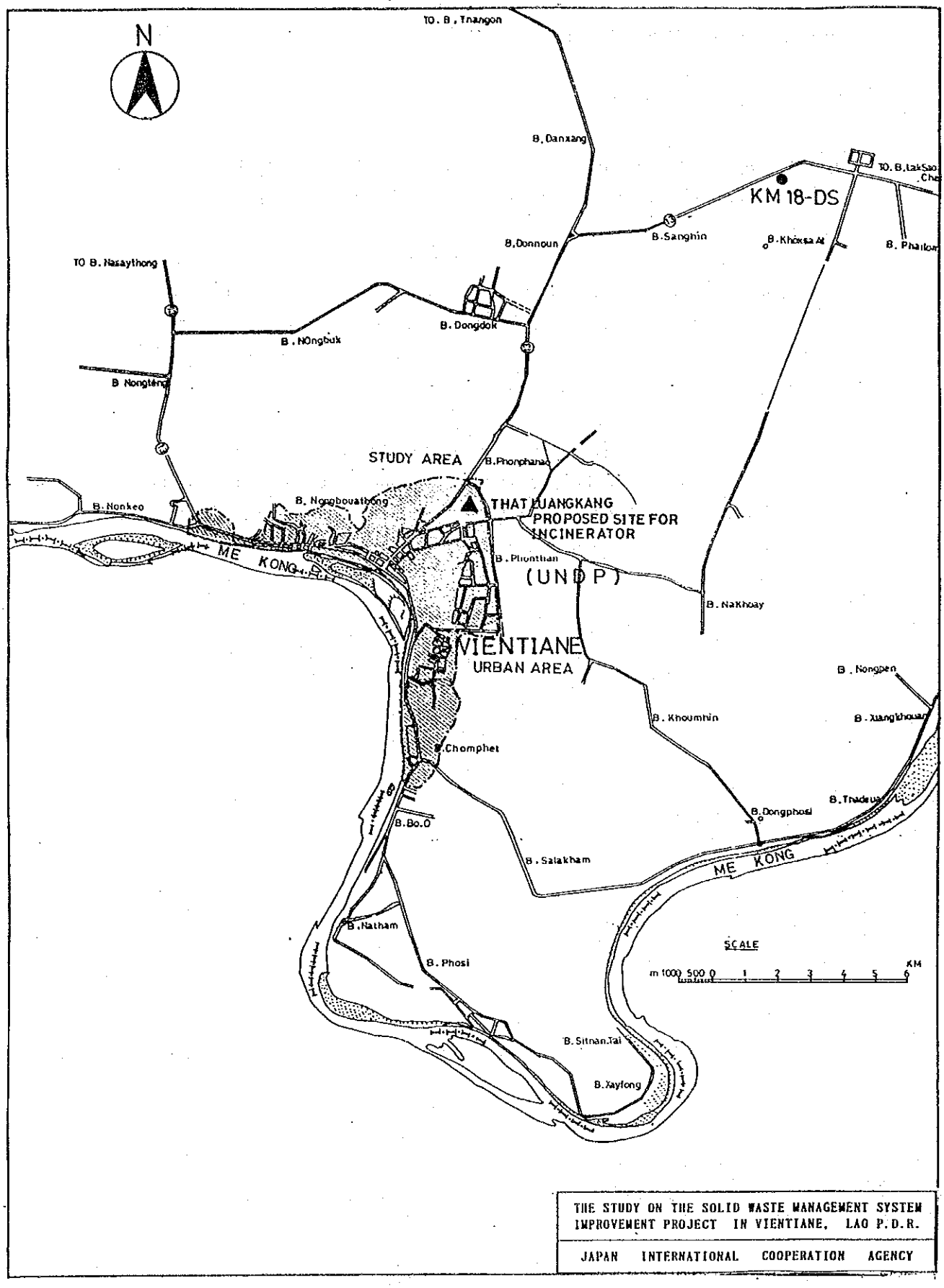


Fig. F.4-1 Location Map of Proposed Site for Incinerator and KM 18-DS

F.4.2 Final Disposal

1) General condition

Solid waste in the Study area is finally disposed at the landfill disposal site of Vientiane Municipality (KM 18-DS). Crude open dumping is adopted at the site, causing such environmental problems as air pollution due to on-site fires, water pollution due to the seepage of leachate, and littering in the surrounding area. No sanitary landfill is conducted.

In order to improve the solid waste management in Lao P.D.R., a national level workshop was held in vientiane in August 1990 under the auspices of the WHO. In the workshop, it was recommended that the Municipality of Vientiane, with the support of the national government, should upgrade current landfill practices to more hygienic method; i.e. a sanitary landfill. However, no action has been taken since then.

2) KM 18 Disposal Site

The present KM 18-DS (KM 18 disposal site) is located 18 km from the urban center. The KM 18-DS is outlined below ;

a.	Service area	: entire Study area
b.	Disposal amount	: 17.1 ton/day
c.	Subject solid waste	: mostly municipal solid waste plus some types of industrial waste
d.	Site area	: more than 60 ha
e.	Landfill area	: approximately 2.0 ha
f.	Year of commencement	: 20 years ago
g.	Life expectancy	: more than 30 years from 1991
h.	Former land use	: bush and forest
i.	Future land use	: undecided
j.	Land owner	: Vientiane Municipality

3) Management of KM 18-DS

a. Organization

The KM 18-DS is under the management of the DCTC of Vientiane Municipality. No management, however, has been done other than the employment of a temporary overseer by verbal contract. His assignment is mainly to collect dumping fees from incoming vehicles. His remuneration per month is 15,000 kips. In the middle of November 1991, a weighbridge was installed by the Study Team and two operators were assigned by the DCTC for the inspection of the incoming vehicles.

b. Disposal site staff

- overseer : 1 person
- weighbridge operators : 2 persons

c. Working hours

6:00 am - 6:00 pm

d. Budget

A special budget for the final disposal in 1991 was not prepared except for the wage of the overseer ; i.e. 180,000 kips per annum.

F.4.3 Illegal Dumping

1) Survey of Illegal Dumping

According to the "Report on Disposal of Solid Waste in Urban Vientiane" by the UNDP, there were so many clandestine disposal sites in the Study area. However, the actual conditions of these sites were not mentioned except for their locations.

The Study Team carried out a field survey including interviews with the areal residents, to know the actual conditions of the sites.

The illegal dumping sites are illustrated in Fig. F.4-2 and are classified into the following 4 categories;

- dumps along the Mekong river;
- dumps along the Khoua Khao canal;
- dumps along the Nam Pasak canal; and
- others.

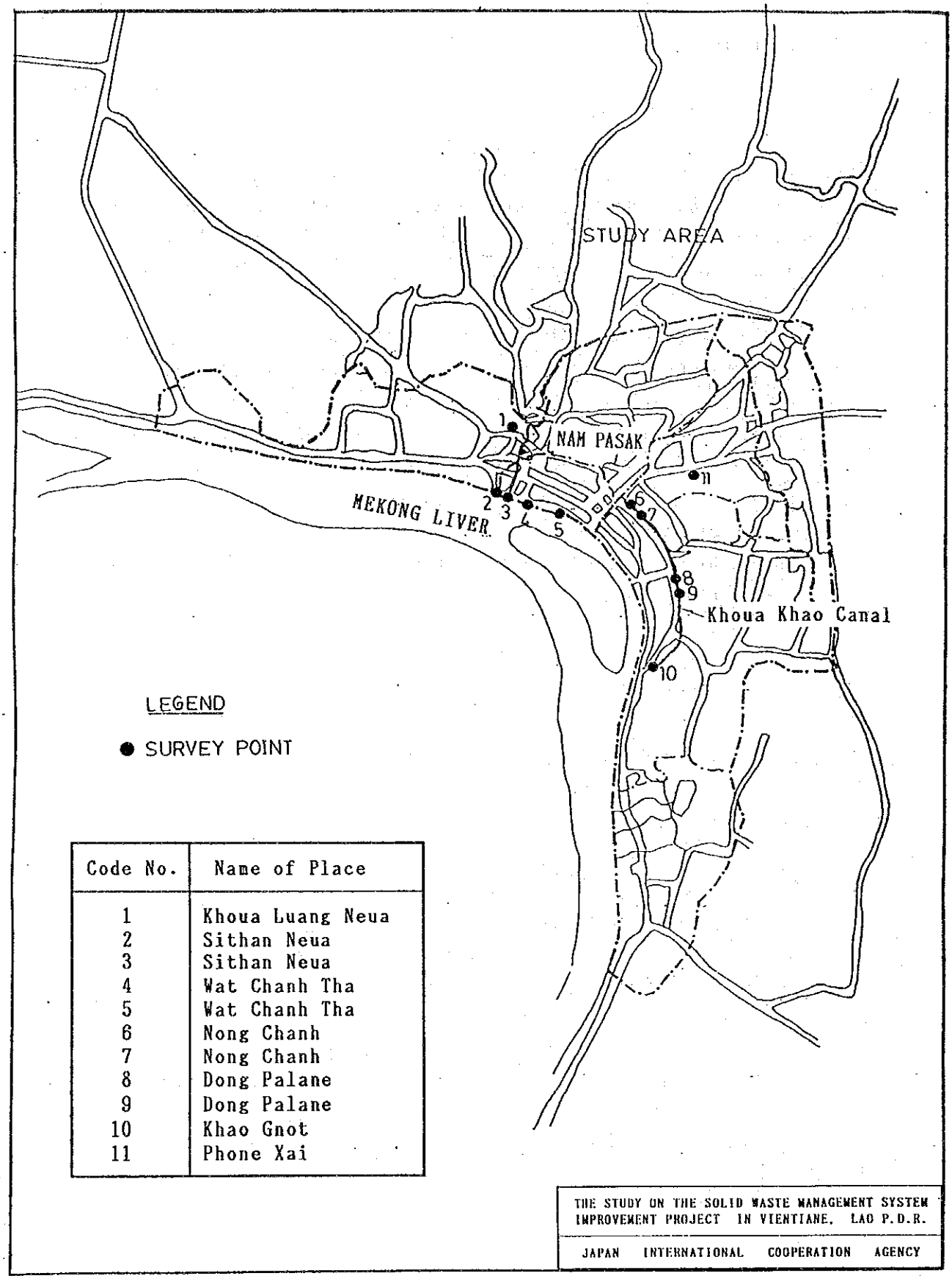
2) Results of the Survey

The results of the survey are tabulated in Table F.4-1.

a. Dumps along the Mekong river

Many small scale illegal dumps (3 and 5 in Fig. F.4-2) are spotted along the Mekong river. These dumps are mainly used by the areal residents. These residents sometimes burn the dumps, too.

However, at Ban Wat Chanh Tha (4) and Ban Sithan Neua (2), there are a few middle scale (20 ~50 m^3) illegal dumps, specially at the Ban Wat Chanh Tha, many street stalls along the Mekong can be founded, and wastes from the stalls seem to be discharged illegally. According to the areal residents, some private



Code No.	Name of Place
1	Khoua Luang Neua
2	Sithan Neua
3	Sithan Neua
4	Wat Chanh Tha
5	Wat Chanh Tha
6	Nong Chanh
7	Nong Chanh
8	Dong Palane
9	Dong Palane
10	Khao Gnot
11	Phone Xai

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Fig. F.4-2 Location of the Survey Points for Illegal Dumps

Table F.4-1 Results of Illegal Dumps Survey

Survey Point	Dumping Area (m^2)	Amount of Waste (m^3)	Period of Illegal Dumping (Year)	Reason of Illegal Dumping	Clean-up of the Waste Dumped		Who dumps the waste illegally?	Problems
					Who	Measure		
1	10	1.5	1	suitable place to dump	Nobody	Burning	Resident around the area	sanitation
2	40	20	3	suitable place to dump	Nobody	Nothing	Resident and some collector	sanitation
3	30	2.0	4	N.A.	Nobody	Nothing	Resident around the area	sanitation
4	60	30	10	suitable place to dump	Nobody	Nothing	Resident around the area	N.A.
5	12	0.5	10	N.A.	Nobody	Nothing	Resident around the area	N.A.
6	10	0.5	3	N.A.	N.A.	N.A.	N.A.	N.A.
7	15	0.8	3	suitable place to dump	DCTC	Collection	Shop around the area	N.A.
8	8	0.2	5	suitable place to dump	Nobody	Nothing	Resident around the area	N.A.
9	4	0.8	3	N.A.	Nobody	Nothing	N.A.	N.A.
10	4	0.1	3	N.A.	Nobody	Nothing	Resident around the area	N.A.
11	4	0.4	10	Free of charge	Nobody	Nothing	N.A.	N.A.

collectors come for the illegal dumps. The actual fact, however, is not clear and the amount of waste illegally dumped seems to be small.

b. Dumps along the Khao canal

The illegal dumps in this area stretches from the Nong Chanh Market(6 and 7) to the floating houses in Dong Palane (8,9 and 10). Wastes dumped illegally near the Nong Chanh Market seem to have originated from the street stalls in the area, while those near the floating houses are discharged or littered by areal residents. However, the scale of both wastes is small.

c. Dumps along the Nam Pasak canal

Small illegal dumps can be spotted along the Nam Pasak canal (1). Waste is these dumps seems to be discharged by the areal residents.

d. Others

Along the trunk road (11), small scale illegal dumps are scattered in the Study area.

3) Findings

The current conditions of illegal dumping in Vientiane are summarized as follows;

- The main items illegally dumped are domestic waste and commercial waste in the order of volume.

- As a whole, a large volume of waste is illegally dumped in the Mekong, canals and drains, causing frequent blockage and contamination of water quality.

- Illegal dumping occurs throughout the area, most especially in the Mekong river, canals, and vacant spaces along roads.

- The illegally dumped waste is mostly discharged by the areal residents and street stalls. Except for the small amount burned by the residents or collected by the DCTC, no other waste management measure is implemented.

- Illegal dumping is caused by lack of morals on the part of dumpers, loose enforcement of the regulation of 633/VMAC and defective collection services, etc.

- Suggested remedial measures include the provision of education for residents, strict enforcement of the regulation, and the extension of the appropriate collection services to the areas uncovered by collection services.

F.5 Recycling

F.5.1 Recycling

1) Surveys on Recycling

There are no facilities that will enable the mechanical or manual selection of reusable materials from solid waste for recycling purposes in the Study area. The recovery of valuable items is mainly conducted by hand by both private recyclers and scavengers at the sources of waste generation or at disposal sites.

There has been no reliable and comprehensive study or report on recycling in the Municipality of Vientiane. In order to study the present situation of recycling in the Study area, the following various surveys were carried out by the Study Team;

a. Survey on Scavengers

The study consists of the following aspects,

- scavenging at municipal disposal site;
- mode of operation and activities of scavengers;
- distribution channel for scavenged goods;
- social and public health hazard aspects of the scavengers;

The details of the results are available in E.2

b. Survey on private recyclers

The private recyclers consist of individual collectors, dealers and end users of reusable materials. The survey was conducted both in Lao P.D.R. and Thailand.

The study includes the following,

- present situation
- mode of operation and activities
- distribution channel

The details of the results are described in E.3

c. Interview survey to residents and shop owners on recycling

The survey (the CCS) is intended to identify the recycling activities in each household and shop considered as generation sources of both domestic and commercial wastes. The details of the survey results could be found in C.5

2) Recycling System

Based on the above-mentioned studies and surveys, the present recycling system in the Study area became clear and is summarized in Table F.5-1. As clearly described in the table, the dominant recycled materials is food waste. Although food waste recycled in each household can be considered as a mode of self-disposal, it is defined as recycled waste in the Study.

The total amount of waste recycled is estimated at 23.8 tons/day. As a whole, a self-sustaining system in the society or community is still existing and well organized so that the existing recycling system is much more efficient than that of other countries.

F.5.2 Market for Reusable Materials

1) Reusable Materials

The above-mentioned surveys reveal the following findings ;

a. The recovery of reusable materials from waste in Vientiane is mostly conducted by individuals or small groups on a door-to-door basis at the sources waste generation sources, like houses, shops, markets and factories. Scavengers operate at the disposal site to recover valuable items on a small scale.

b. Valuable items recovered by private recyclers and scavengers are sold to local and foreign end-users via primary and secondary dealers. The market for recycled materials is well established by the private sector. The distribution channel of reusable materials in the Study area is illustrated in Fig. E.2-1.

c. The main items for recycling are metals, paper, glass, bottles and plastics etc.. Metals, rubber shoes and animal's bone are exported in bulk to Thailand, the biggest market for reusable materials recovered in Vientiane through a Thai dealer living in Nongkhai. Plastic and papers are exported to Vietnam, but some

Table F.5-1 Present Recycling System in the Study Area

Items / Contents: Recycled Materials	Place of Salvaging or Collection	Kinds of Recyclers	Purpose or End User	Recycled Amount (ton/day)	Information Source
Food Waste					
	1. Household	Family member	Feed for animal	14.3	CCS
	2. Shop	Food waste collector or farmer	Feed for live-stock	7.5	CCS
Reusable Materials					
	1. Household	-	-	negligible	CCS
	2. Shop	Individual collector	Factory	0.5	CCS
	3. KM 18-DS	Scavenger	Factory	0.3	Survey of scavengers
	4. Unclassifiable	Individual collector	Factory	1.2	Survey of dealers
Total				23.8	

of the recovered paper are sold and reprocessed in a paper mill in Vientiane for tissue-paper production. The type and prices of reusable materials are tabulated in Table E.2-1.

d. Based on the answers of the private recyclers, it is estimated that over 2 tons/day of reusable materials are recovered in the Study area.

2) Food Waste Recycled

The major waste recycled in Vientiane is food waste and the total amount of food waste recycled is estimated at 21.8 tons/day, based on the results of the CCS.

a. Food waste recycled in households

According to the CCS, 75% of the households use their food waste as feed mainly for livestock. The average amount of food waste recycled per person is calculated at 100 g/d/per. Consequently, the total amount of food waste recycled in the Study area is calculated at 14.3 tons/day by multiplying 0.1 kg by the whole population (142.723).

b. Food waste collected from shops

According to the CCS, food waste generated by shops is collected by food waste collectors or farmers and recycled as feed for livestock. The amount of food waste generated by shops and recycled in the Study area is estimated at 7.5 tons/days.

F.5.3 Scavenging

The survey on scavengers conducted by the Study Team reveals the following findings;

a. Almost all of the scavengers live in Phokham village which is located only 300 m from the KM 18-DS. All of the adult scavengers are farmers in the village.

b. Average number of scavengers at the KM 18-DS is 30 persons per day, including children of the farmers. The number, however, fluctuates seasonally.

c. All the scavengers have their own means of transportation to transport their goods to local dealers in town.

d. Amount of waste recovered by the scavengers at KM 18-DS is estimated at 0.3 ton/day.

e. Average income of the scavengers is estimated at 20,000 kip/month (28 US $). Although it is less than a manual workers earnings, they are satisfied with the income they get from scavenging.

f. Despite the unfavorable condition of the KM 18-DS, all of the scavengers working at the dump site were healthy. There has never been any report on scavengers suffering from communicable diseases, minor diseases or body pains.

F.6 Equipment

F.6.1 Equipment

The equipment of the DCTC are presently in very poor condition and 57 percent are out of order as shown in Table F.6-1.

DCTC has 14 units of equipment for cleansing work as follows;

a. Flat Trucks	5 units
b. Dump Truck	1 unit
c. Water Tank Truck	1 unit
d. Pick-up	1 unit
e. Trailers and Water Tanks with Wheel	6 units
Total	14 units

The present conditions of them, however, are as follows;

- 1 unit is in smooth operation;
- 1 unit is able to operate with the light maintenance works such as greasing;
- 4 units are required to receive the heavy repairs such as overhaul;
- 5 units are being repaired; and
- 3 units are considered as scraps.

In addition, it is very difficult to get spare parts for U.S.S.R. vehicles.

Three private companies, namely the Construction and Renovation Company, the Solid Waste Management Company and the Inter-construction and Sanitation Company, have a total of 6 units of dump trucks as shown in Table F.6-2. However, one unit is stationed outside Vientiane.

Table F.6-1 List of Equipment of Cleansing Section of DCTC

No.	Name of Vehicle	Regis. No.	Engine No.	Chassis No.	Location	KM	Manufac-ture Tear	* Condition
1	Flat Truck	0161	N.A.	N.A.	KM 7	N.A.	USSR 1984	Grade 5
2	Flat Truck	0238	N.A.	N.A.	Vientiane	N.A.	USSR 1984	Grade 4
3	Flat Truck	0160	N.A.	N.A.	Vientiane	N.A.	USSR 1984	Grade 3
4	Dump Truck	0248	N.A.	N.A.	Vientiane	N.A.	Japan 1972	Grade 3
5	Flat Truck	0246	N.A.	N.A.	Vientiane	N.A.	USSR 1983	Grade 4
6	Flat Truck	0192	N.A.	N.A.	Vientiane	N.A.	USSR 1984	Grade 4
7	Water Tank Truck	0163	N.A.	N.A.	Vientiane	N.A.	USSR 1984	Grade 2
8	Pick-up	0638	N.A.	N.A.	Vientiane	N.A.	AUSTRALIA 1988	Grade 1
9	Trailer	N.A.	N.A.	N.A.	KM 7	N.A.	USSR N.A.	Grade 4
10	Trailer	N.A.	N.A.	N.A.	KM 7	N.A.	USSR N.A.	Grade 4
11	Trailer	N.A.	N.A.	N.A.	Nong Duang Market	N.A.	USSR N.A.	Grade 3
12	Trailer	N.A.	N.A.	N.A.	Sikhai Market	N.A.	USSR N.A.	Grade 3
13	with wheel	N.A.	N.A.	N.A.	KM 7	N.A.	USSR N.A.	Grade 5
14	with wheel	N.A.	N.A.	N.A.	KM 7	N.A.	USSR N.A.	Grade 5

Note ;

Grade 1; in smooth operation

Grade 2; in operation with the light maintenance works such as greasing

Grade 3; in the condition required for the heavy repairs such as overhaul

Grade 4; in repairing

Grade 5; in scraps

Table F.6-2 List of Equipment of Three Private Companies

No.	Name of Vehicle	Regis. No.	Engine	Chassis	Location	KM	Year Munufac-tured	Condition
Construction and Renovation Company								
1	Dump Truck	0508	N.A.	N.A.	Thakhek	N.A.	Japan N.A.	No Inspection
2	Flats Truck	0443	N.A.	N.A.	Vientiane	N.A.	U.S.A. N.A.	Grade 1
3	Flats Truck	3913	N.A.	N.A.	Vientiane	N.A.	USSR 1989	Grade 4
Solid Waste nagement Company								
4	Dump Truck	0312	N.A.	N.A.	Vientiane	N.A.	Japan 1970	Grade 3
Inter-Construction Management Company								
5	Dump Truck	0554	N.A.	N.A.	Vientiane	N.A.	U.S.A. 1960	Grade 4
6	Dump Truck	1208	N.A.	N.A.	Vientiane	N.A.	India 1979	Grade 1

* Note ; Grade mentioned here is the same meaning as table F.6-1

There are only 20 units of cleansing work equipment, 10 of which are out of order.

Neither DCTC nor private companies have heavy equipment for the dump site at KM 18.

Neither DCTC nor private companies have a workshop and workshop tools and facilities.

About 55 percent of the equipment are more than 10 years old.

F.6.2 Operation and Maintenance

1) Operation

The present operational ratio is very poor at only 20%.

Operational capability is very limited, because the Maintenance Section of DCTC does not have any maintenance workshop, data on daily, weekly, monthly inspection sheets, and one year operational records for all equipment.

Three private companies have neither data nor manual for the operation of the equipment.

2) Maintenance

The establishment of the repair, maintenance and back-up services will help the effective use of the equipment and vehicles.

At present, however, the following is not established;

a. Before and after inspection of equipment;
b. Weekly, monthly and yearly inspection sheets;
c. Numbering system; and
d. Records on repair specification.

The situation is the same in the private companies and maintenance system. However, basic minor service has been done by drivers in the field and heavy duty repair has been done at private workshops.

F.7 Organization

The informations about the organization were obtained from the interview survey with the concerned personnel of the related organizations.

F.7.1 National Level

At the national level, no agency is directly designated as responsible for solid waste management. No responsible organization on solid waste management existes in the Ministry of Communication, Post, Transportation and Construction. The MCTPC works closely with the DCTC mainly on the construction, maintenance, operation and management of road-bridges, transportation systems and construction work. The MCTPC is also responsible for the legislation and regulation on houses and building construction in Vientiane Municipality, the construction and maintenance of the national road-bridge, post and transportation system at national and international levels.

However, there are two related organizations involved in the solid waste management in the Ministry of Health. The Ministry of Health is concerned with solid waste management in terms of the control of communicable diseases and the protection of environmental health. Furthermore, much effort for solid waste management improvement has been made in the past two years by the 2 related agencies in the Ministry of Health; namely the Department of Hygiene and Curative Medicine and the National Institute of Hygiene and Epidemiology. These agencies organized and participated in an international workshop held in Vientiane in 1990. After the workshop and in response to the recommendation made during the workshop, they prepared and submitted a draft on the laws and regulations regarding solid waste management to the Office of the Prime Minister for approval, in the middle of 1991.

The organization chart of the Ministry of Health is shown in Fig. F.7-1. As shown in the organization chart, the Ministry of Health consists of the following (1 cabinet, 4 departments and 2 committees);

- Cabinet of Ministry
- Scientific and Technical Committee
- National Coordinating Committee
- Department of Hygiene, Curative and Rehabilitation
- Department of Training
- Department of Organization and Human Resources for Health
- Department of Pharmaceuticals and Medical Equipment

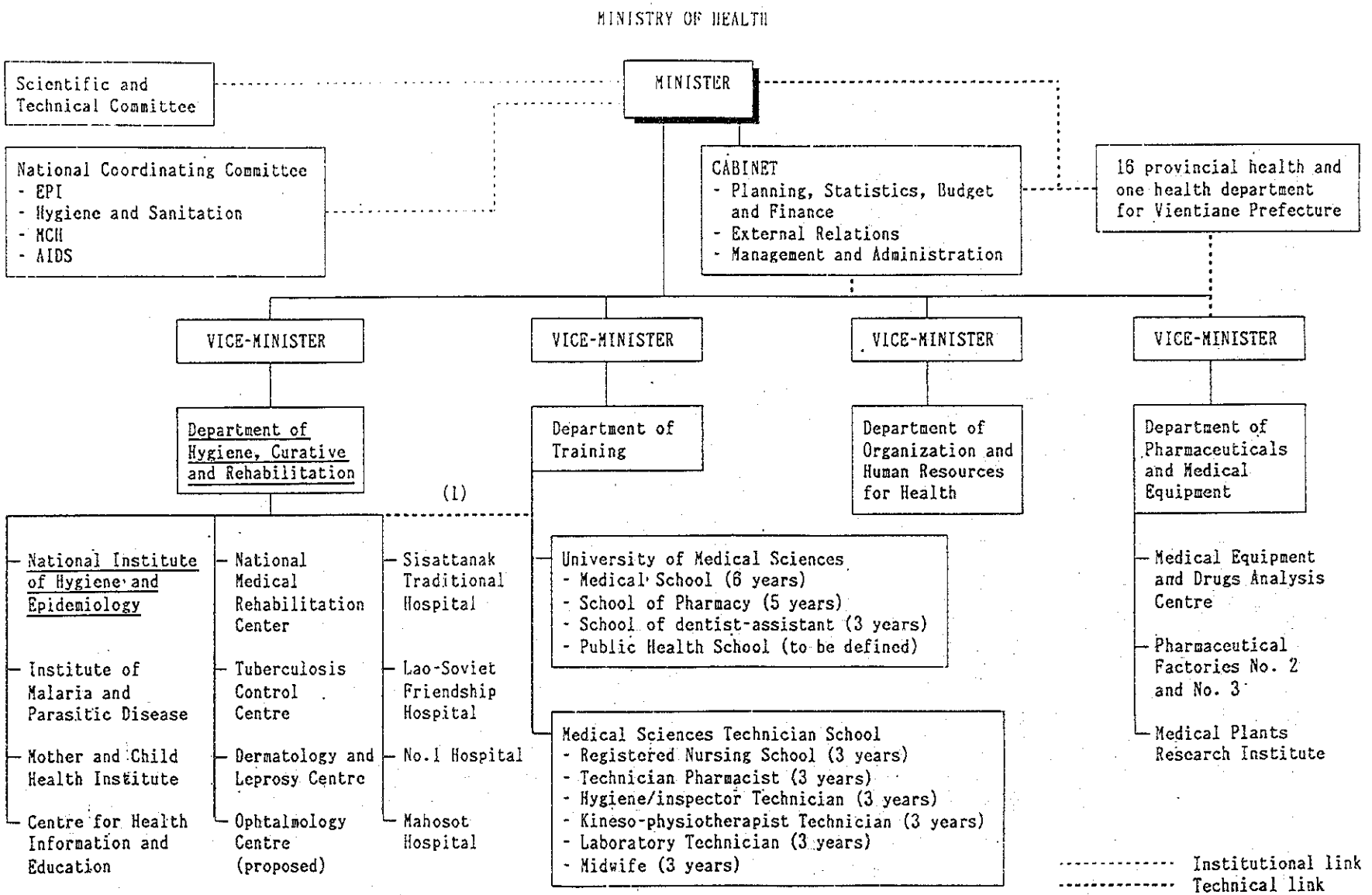
As mentioned, there are 2 related organizations in the Ministry of Health involved in the solid waste management and they are as follows;

a. Department of Hygiene, Curative and Rehabilitation (DHCR)

The DHCR (Department of Hygiene, Curative and Rehabilitation) is composed of the following 7 divisions:

- Environmental Health Division
- Epidemiology Division
- Administration Division
- Curative Division
- Rehabilitation Division
- Health Infrastructure Division
- Health Education Division

The organization chart of the Department of Hygiene, Curative and Rehabilitation is shown in Fig. F.7-2.



(1) Hospitals are also used for training purposes
Source: Department of Organisation and Human Resources Development (Ministry of Health), as of November 1990
Secondary Source: UNICEF: The Situation analysis of the Children and Women in the Lao P.D.R., 1990

F.7-1 Organization Chart of Ministry of Health

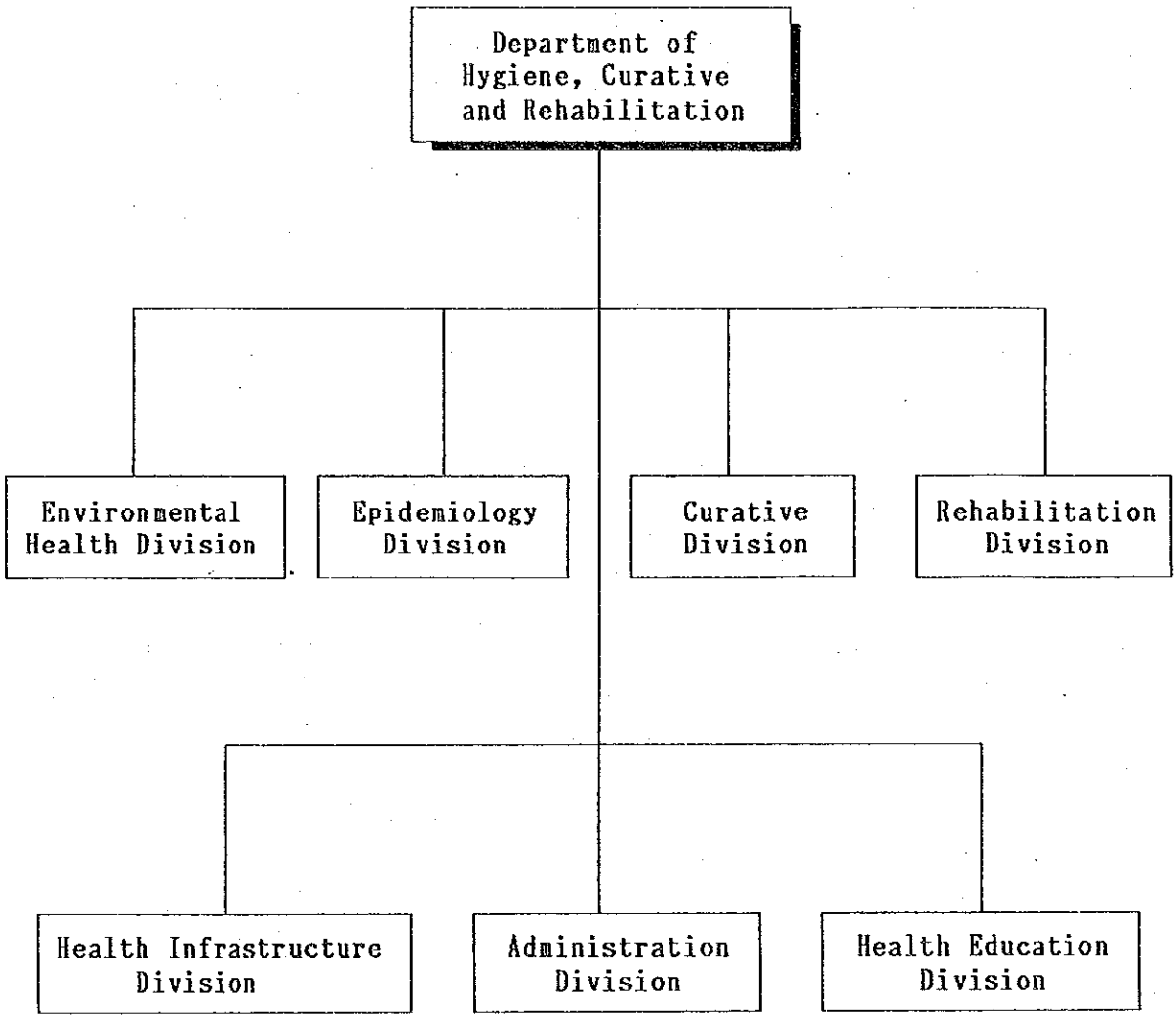


Fig. F.7-2 Organization Chart of Department of Hygiene, Curative and Rehabilitation

The DHCR has a total number of 11 personnel, as of November 1991. However, only 3 medical doctors who are working for Environmental Health Division in the Department are considered to be involved in the environmental health of the country. Their involvement also includes solid waste management, not only in Vientiane Municipality but also nation wide.

3 doctors working in the Environmental Health Division, are described as follows;

Chief of Division	1
Deputy Chief	1
Medical Doctor	1

The main work items of the Environmental Health Division are summarized as follows;

- planning
- collaboration with international organization
- preparation of guidelines, laws and regulations

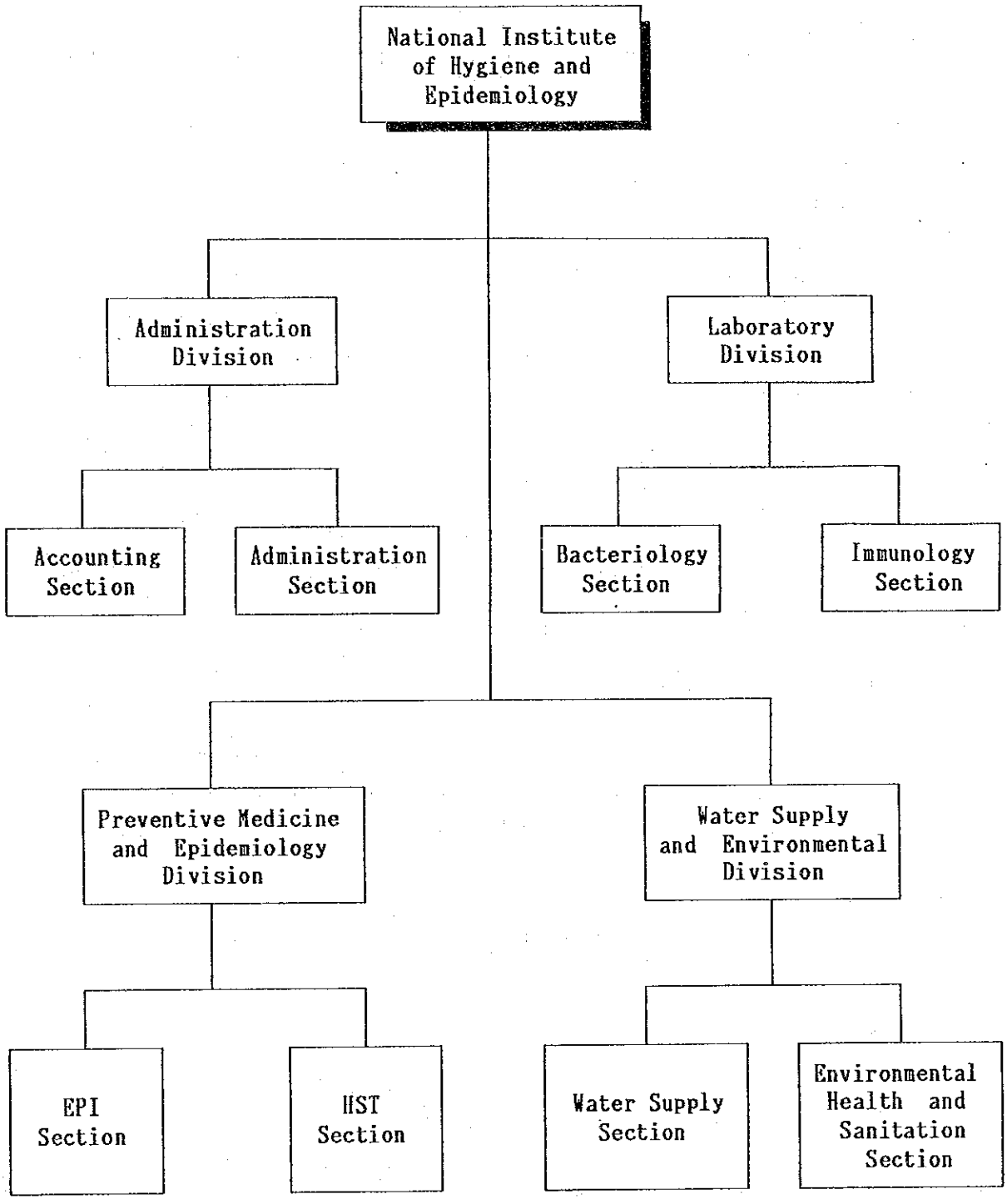
b. The National Institute of Hygiene and Epidemiology (NIHE)

The NIHE (National Institute of Hygiene and Epidemiology) consists of the following 4 divisions:

- Administration Division
- Laboratory Division
- Preventive Medicine and Epidemiology Division
- Water Supply and Environmental Health Division

The organization chart of NIHE is shown in Fig. F.7-3

Generally, the NIHE, which has a total number of 65 personnel, is responsible for the training of the public health personnel.



EPI Section = Enlarged Program of Immunization Section
HST Section = Health Statistic Training Section

Fig. F.7-3 Organization Chart of National Institute of Hygiene and Epidemiology

The Water Supply and Environmental Health Division within the NIHE is in charge of the environmental health including solid waste management, while the Division pays more attention to water supply. Most of its staff is involved with the water supply works in the rural area.

The Water Supply and Environmental Health Division is divided into 2 Sections, namely the Section of Water Supply and Section of Environmental Health and Sanitation. Only 5 of the total number of 18 staffs of the Water Supply and Environmental Health Division work in the Environmental Health and Sanitation Section which is concerned with solid waste management.

The Section of Environmental Health and Sanitation has 7 main duties. Fig. F.7-4 shows the duties of the Section of Environmental Health and Sanitation.

F.7.2 Vientiane Municipality

The organizations responsible for the solid waste management in the Study area are the DCTC (Department of Communication, Transportation and Construction) and DPH (the Department of Public Health of the Municipality) of Vientiane.

1) Department of Communication, Transportation and Construction (DCTC)

a. Organization

DCTC (Department of Communication, Transportation and Construction) is responsible for mainly the construction, maintenance, operation and management of roads, bridges, transportation systems, drainage, waste disposal and sanitation in Vientiane Municipality .

DCTC is also responsible for the solid waste management and night soil management in Vientiane Municipality.

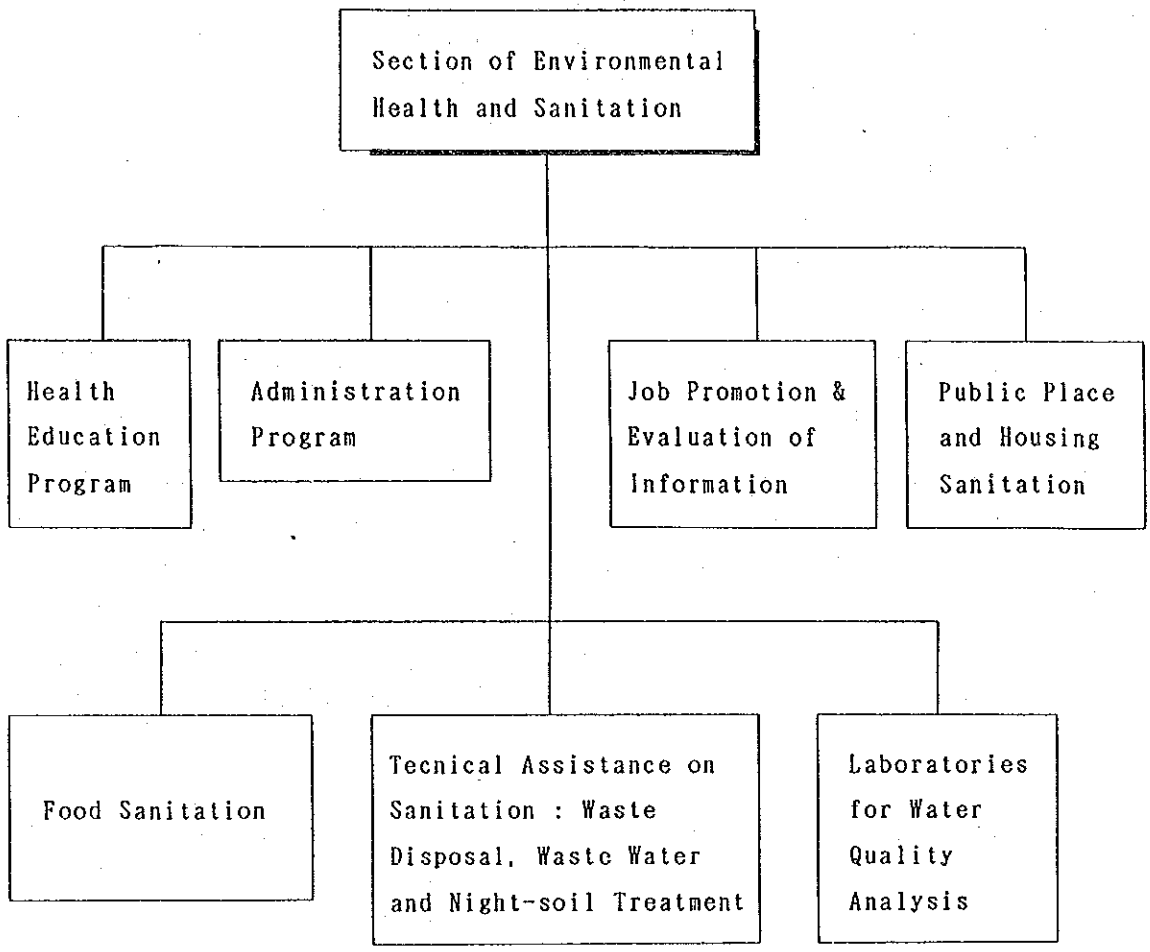


Fig. F.7-4 Duties of Environmental Health and Sanitation Section, NIHE, MOH

DCTC had a total of 24 bureaus and other organizations in 1990 but at present, it has only 14 bureaus and other organizations. The reduction of the local state enterprises and companies was done under the policy of the State Government to reduce the number of civil servants. The following sentence shows the number of bureaus and organizations of DCTC as of November 1991 in comparison with the 1990 figures in the parentheses. The DCTC is composed of 7 bureaus(7), 4 state enterprises/companies (12), 1 factory (2) and 1 cleansing section (0), as shown in Fig. F.7-5. In addition, it also operated a technical school in 1990.

The head of the department is called a director and under him are two deputy directors. The chief of the bureaus of the Transportation, Bridge and Road, Housing and Urban and Economic and External Relation are engineers as a qualification. The chief of the Bureaus of the Administration and Establishment, Statistic and Finance, and Vehicle Registration are the administrators.

A senior technician (as a cleansing superintendant) is responsible for the cleansing section, while chiefs of state enterprises, company, workshop and factory are engineers.

b. Number of personnel

The DCTC has a total of 442 employees as of November 1991. Number of staff the of bureaus and a state company of DCTC is tabulated in Table F.7-1. Among the 442 employees, 67 are involved in solid waste management. Breakdown is shown below;

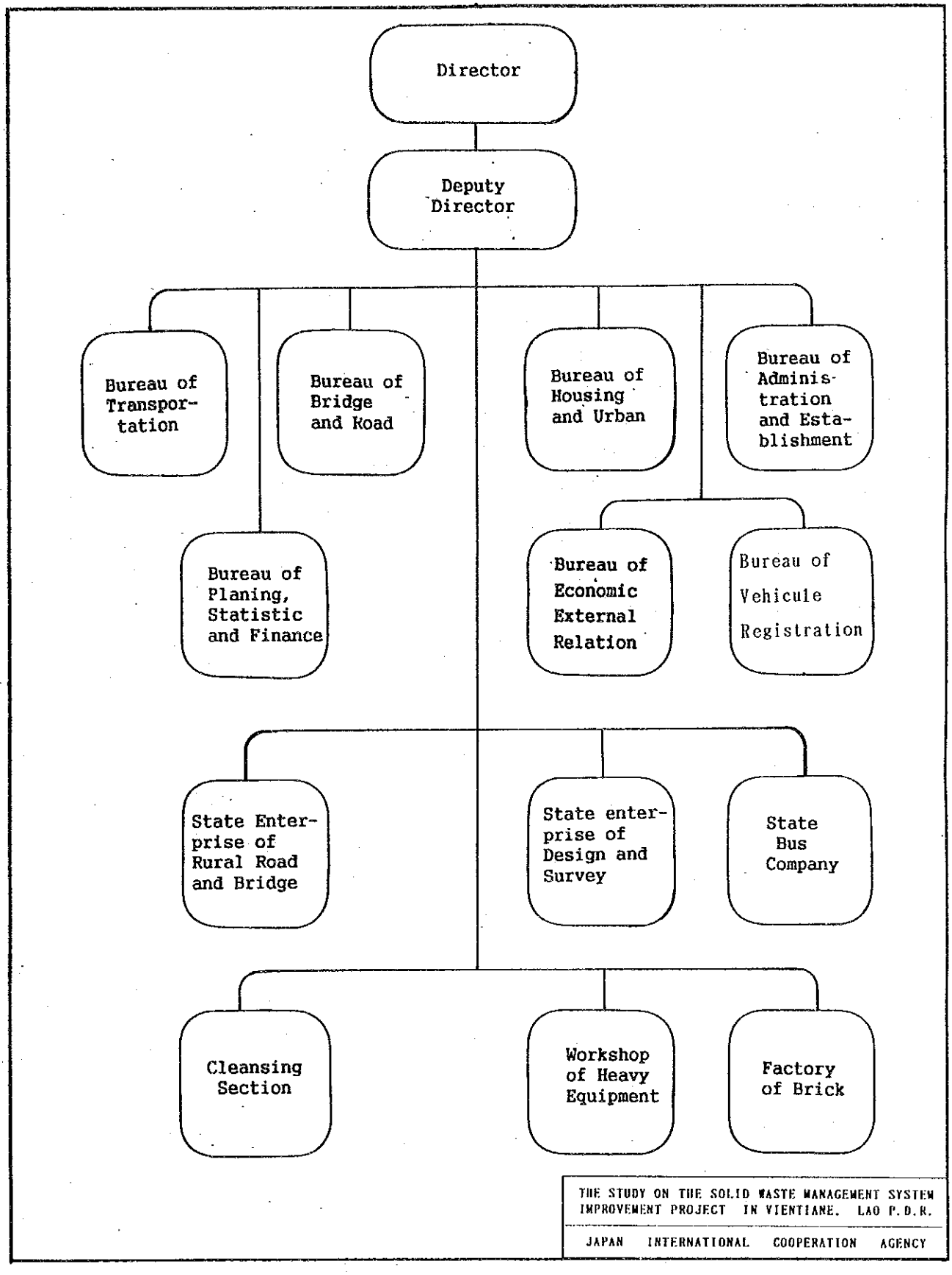


Fig. F.7-5 Organization Chart of DCTC in November 1991

Table F.7-1 Number of Staff of Bureau and State Company of DCTC in November 1991

List of Bureau and State Company	Staff
1. Bureau of Planning, Statistic and Finance	7
2. Bureau of Administration and Establishment	11
3. Bureau of Bridge and Road	5
4. Bureau of Housing and Urban	8
5. Bureau of Transportation	5
6. Bureau of Economic External Relation	3
7. Bureau of Vehicle Registration	25
8. State Enterprise of Rural Road and Bridge	52
9. State Enterprise of Design and Survey	21
10. State Bus Company	141
11. Cleansing Section	67
12. Workshop of Heavy Equipment	15
13. Factory of Brick	82
Total	442

Source : Department of Communcation, Transportation and Construction, Vientiane Municipality

i. high ranking officer

. Director	1
. Deputy Director	2
Sub-total	3

ii. Number of personnel in the Cleansing Section

- Officer

. Cleansing Superintendent	1
. Assistant Cleansing Superintendent	2
Sub-total	3

- Solid Waste Management Sub-unit

. Labourer	12
. Driver	3
Sub-total	15

- Market Sweeping Sub-unit

. Overseer	1
. Labourer	11
Sub-total	12

- Road Sweeping and Grass-cutting Sub-unit

. Overseer	1
. Labourer	18
Sub-total	19

- Night Soil Management Sub-unit

. Driver	2
. Labourer	2
Sub-total	4

- Treatment of Dead Body Sub-unit

. Driver	1
. Labourer	3
Sub-total	4

- Watering Flowers Sub-unit

. Driver	1
. Labourer	1
Sub-total	2

- Administration and Accounting Sub-unit

. Clerk	1
. Junior clerk	2
. Accountant	2
. Typist	1
Sub-total	6

- Vehicle Maintenance

. Mechanic	2
Sub-total	2
Total	67

In addition to the above-mentioned employees, the DCTC hires an overseer for the inspection and control of the KM 18-DS by verbal contract.

c. Cleansing Section

The Cleansing Section consists of 3 units, namely the Solid Waste Management Unit, Night Soil Management Unit and Administration Unit.

The head of Cleansing Section must be a senior technician and is called as the Cleansing Superintendent. He is supported by two Assistant Cleansing Superintendents. One of the two Assistant Cleansing Superintendents is the head of both the Solid Waste Management Unit and the Night Soil Management Unit. The other is the head of the Administration Unit. Each unit has three sub-units as shown in Fig. F.7-6.

The Solid Waste Management Unit has three sub-units. The Solid Waste Management Sub-unit is directly controlled by the Assistant Cleansing Superintendant, while the other two are under the responsibility of the two overseers. There are 15, 12 and 19 staffs all distributed in the Solid Waste Management Sub-unit, Market Sweeping Sub-unit and Road Sweeping and Grass-cutting Sub-unit, respectively. The contents of the works of the labourers are as follows;

i. collection and transport of waste to collection points;
ii. drain cleansing;
iii. road sweeping;
iv. loading waste into trucks; and
v. grass-cutting.

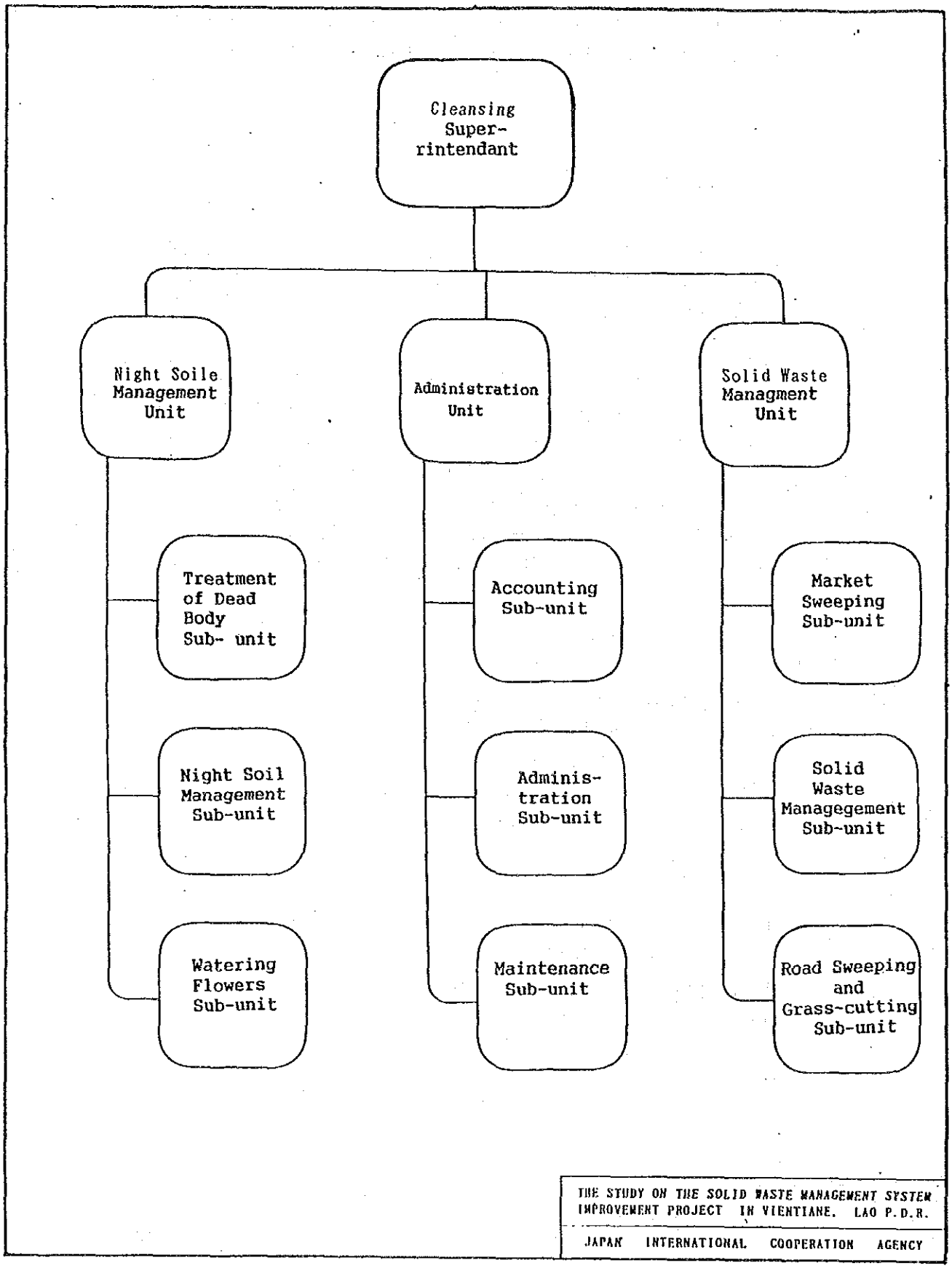
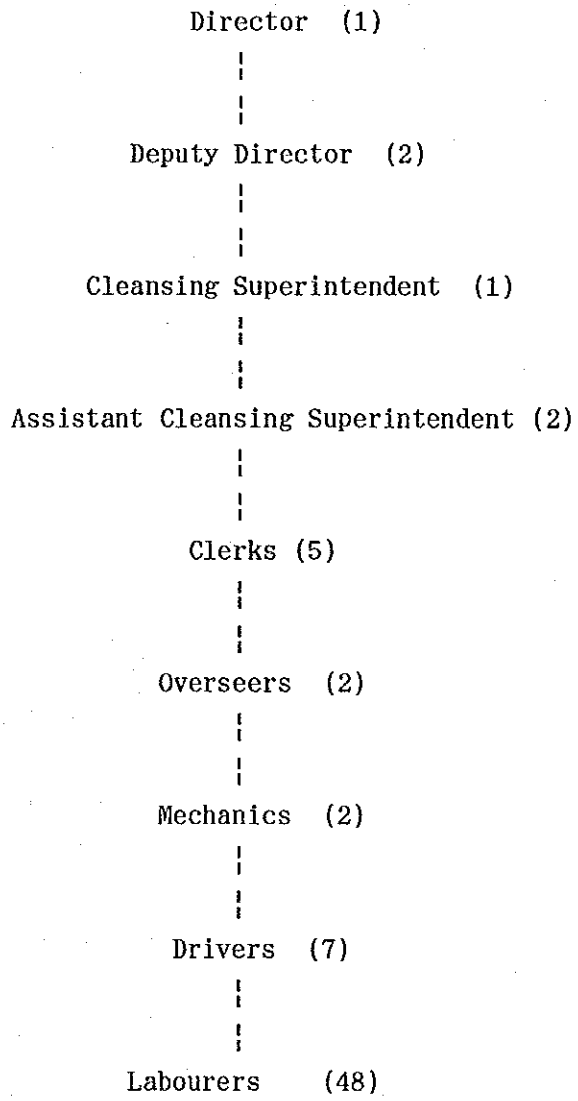


Fig. F.7-6 Organization Chart of Cleansing Section

d. Personnel hierarchy in the solid waste management

The personnel hierarchy in the solid waste management is summarized as follows (Number in the parentheses shows the number of personnel.);



e. Labour Condition

i. Overview

In general, the wage by a government sector employee is lower than it of a private sector employee with similar qualification and experience.

Minimum legal wage in government sector is 8,000 kips/month while the lowest wage paid to private laborers is 20,000 kips/month.

ii. Salary system in government sector

Salary of the government employee in Lao P.D.R. is described as follows,

Position	Minimum Monthly Salary
1. Director	23,000 kips/month
2. Deputy Director	20,000 kips/month
3. Engineer	18,000 kips/month
4. Supervisor	18,000 kips/month
5. Technician, Operator, Mechanic	16,000 kips/month
6. Clerk (Fee Collector)	15,000 kips/month
7. Driver, Overseer	13,000 kips/month
8. Worker	12,000 kips/month

The above-mentioned monthly salary does not include dependency allowance and transportation allowances for director level. It, however, excludes social charge and over time payment in every position level. The salary is also in accordance with the educational qualification of the employee.

iii.Working day and time

All the municipal employee work 6 days a week. Basic working hours are 7 hours per days (AM 8:00 to 12:00, PM 2:00 to 5:00) with about 306 working days/year.

iv. Labor wage and overtime

The overtime is paid for the employee under the position 5 mentioned in the ii; i.e. lower level than 4 supervisor. The overtime payment is double of basic wage per hour. Payment for work on Sunday and national holidays are also double of regular rates as below,

1. Overseer, Clerk, Driver 1,000 kips/day

2. Labor or Worker 800 kips/day

v. Education qualification

The position shown in the cleansing section can be classified into a few categories according to educational qualification required ;

	Education Qualification Required
Group 1	
Laborer, Driver Overseer	Primary School (6 years)
Group 2	
Clerk (Fee Collelctor) Technician, Operator, or Mechanic	Secondary School (6 years)
Group 3	
Engineer, Supervisor	University (4~5 years)
Group 4	
Director, Deputy Director	Upper University

vi. Vacation leave

Any public sector employee is entitle to take 15 days paid leave per year at maximum set by the government.

vii. Sick leave

Normally, the employee can take 7 days paid leave in case of sick with doctor's certificate. In case of long sick leave, the employee has to get a Medical Council's certificate and the approval from Minister of Health, then he may be given a maximum 1 year paid sick leave. After 1 year, if the Medical Council consider he is still not recovered, the employee is requested to retire with all the ordinary retirement benefit even if his age is less than the official retirement age at 60 years for male and 55 years for female.

In case of the delivery of a baby, a female employee may take 3 months paid leave at maximum.

f. Reason for the establishment of the Cleansing Section

The Cleansing Section was established in the DCTC in September 1991 as a replacement for the SSC (State Sanitary Company). The following is the reasons for the change;

i. The collection services provided by the State Sanitary Company was not efficient and did not satisfy for the future needs of Vientiane Municipality.

ii. The waste collection vehicles were almost out of order, and their maintenance and replacement them required a considerable amount of money.

iii. The lack of budget was identified as the major constraint in the improvement of the present SWM . The lack of capable and numerous the staff in the SSC was also identified. In addition, the waste collection vehicles available for the SWM were not enough and their capability them was less than 40% of their original capability according to the Cleansing Section.

2) Department of Public Health (DPH)

a. Organization

The DPH (Department of Public Health) is one of the 12 departments in Vientiane Municipality. The DPH consists of 3 Groups, namely the Technical, Administration, and Business Group. The organization chart of DPH is shown in Fig. F.7-7.

The Technical Group is the main group and responsible for the execution of medical and public health services except for the sale and production of pharmaceutical products which are provided by 2 local state enterprises. The head of Technical Group is a Deputy Director. The Technical Group consists of 6 offices as shown in Fig. F.7-7. The head of each office is a Medical Doctor as qualification. Among the 6 offices, the Station of Hygiene and Epidemiology has the responsibility on the public health and solid waste management.

b. Station of Hygiene and Epidemiology

The Station of Hygiene and Epidemiology is responsible for the inspection of, not only solid waste management, but also night soil management and other public health control matters; i.e. sanitation inspection of premises, and inspection of infectious diseases, etc.

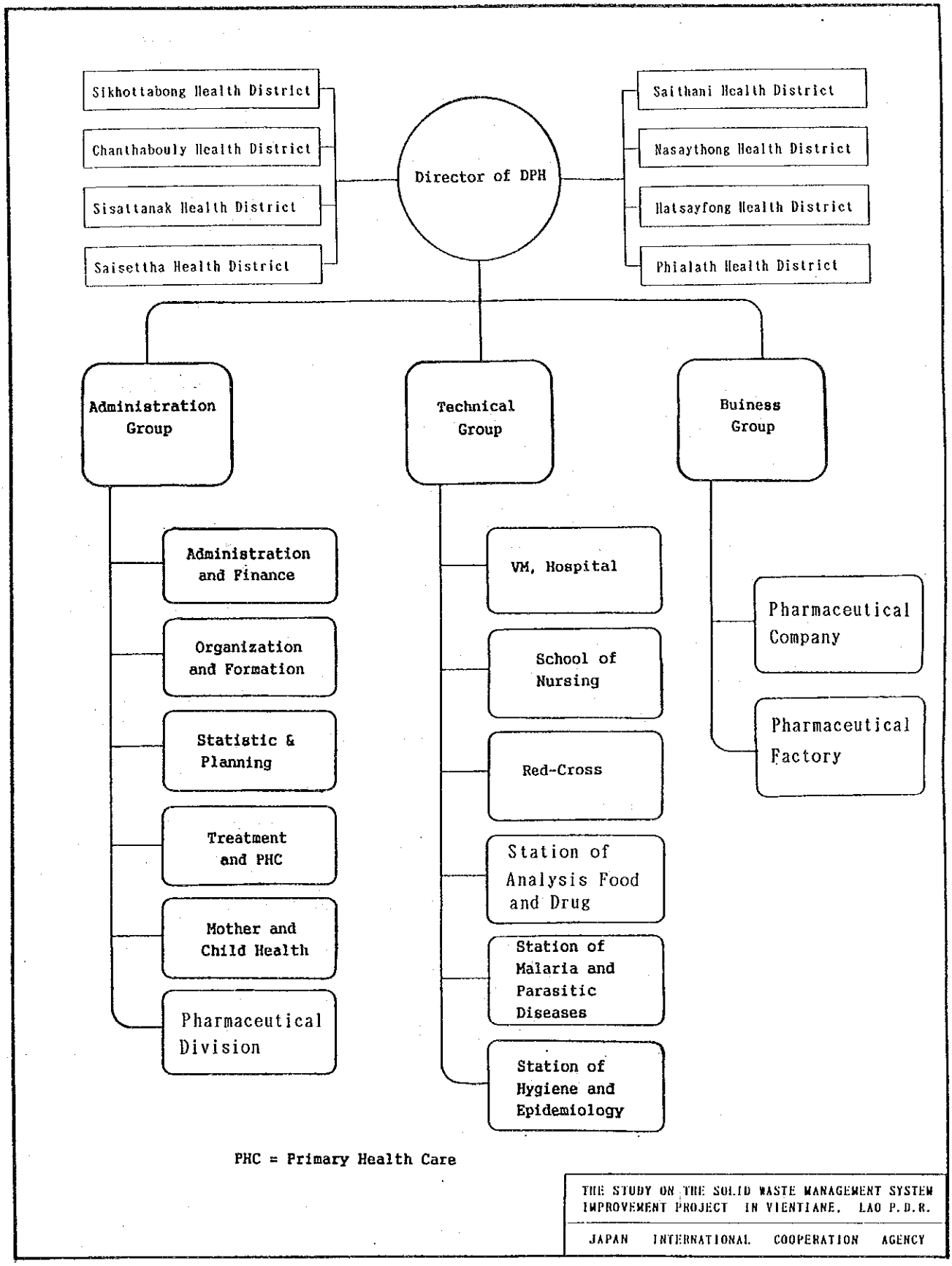


Fig. F.7-7 Organization Chart of DPH, VM

The Station of Hygiene and Epidemiology consists of the following 7 sectors;

- Administration sector,
- Enlarged Programme Immunization sector,
- Epidemiology sector,
- Rural Water Supply and Environmental Health sector,
- Cleansing Inspection sector,
- Leprosy sector,
- Licensing sector,

Among the seven sectors, the Cleansing Sector inspection is responsible for solid waste management.

c. Cleansing Inspection Sector

The head of the sector is a senior overseer, and under him, is an overseer. Overseers are responsible for the inspection and supervision of all daily cleansing operations. In each district, there is at least area office with an overseer. The number of senior overseers and overseers totals 8; i.e. 2 in the sector, 2 in Sisattanak District, 1 in Sikhottabong District, 1 in Saisettha District and 2 in Chanthabouly District.

d. Number of personnel

Number of personnel involved in the cleansing inspection in Vientiane Municipality are 11, as shown below;

i.	Director of DPH	1
ii.	Deputy Director (Health of Technical Group)	1
iii.	Chief of the Station of Hygiene and Epidemiology (Medical Doctor)	1
iv.	Senior Overseer	1
v.	Overseer	7
	Total	11

e. Cleansing Inspection Activities

The cleansing inspection activities in Vientiane Municipality are as follows:

i. inspection and control measures of daily cleansing services;

ii. issue of violation tickets;

iii. preparation of a weekly report on Monday to be submitted to station and monthly report to the Vientiane Municipality; and

iv. planning of the following week's schedule.

F.8 Financial Situation

F.8.1 National Level

The budget of Ministry of Health is shown in Table F.8-1. There is none for solid waste management.

Table F.8-1 Budget Expenditure 1982-1990 Ministry of Health

Unit;thousand kips

Year	Ministry of Health (only national level excluding provincial and lower level)	National Institute of Hygiene and Epidemiology	Department of Hygiene Curative and Rehabilitation
1982	347,000	17,000	-Salary of
1983	430,000	19,000	Personnel
1984	494,000	21,000	-Travel allo-
1985	1,489,000	27,000	wance
1986	2,104,000	31,000	-Administrative
1987	2,462,000	31,000	(none for the
1988	903,000	25,000	solid waste
1989	1,241,000	28,500	management)
1990	1,764,000	30,000	

Note : I. The 1990 budget of the Ministry of Health.

i.e. Budget Expenditure : 1,764,000,000
Salaries : 832,000,000
Administration : 632,000,000
Investment : 300,000,000

Travel Allowance Minimum : 8,000 kips/day/person
maximum : 10,000 kips/day/person

Administration recurrent cost (excluding salaries)

salary (only basic salaries; others excluded)

Position	Monthly Salary (k = kips)
1. Director	22,200 k
2. Deputy Director	21,400 k
3. Chief of Division	19,000 k
4. Assistant Chief	18,600 k
5. Medical Doctor	16,000 k
6. Public Health Officers	14,200 k
7. New graduate (Doctor)	13,400 k
8. Nurse of Overseer	12,200 k
9. Labor	8,000 k

II. Foreign Aids (Years 1990)

a. Bilateral Aids

Socialist Countries : US $ 104,000

Capitalist Countries: US $ 110,000

b. International Organization and Non-governmental Organizations : US $ 4,594,000

Total = US $ 4,808,000

F.8.2 Vientiane Municipality

Solid waste management of Vientiane Municipality is executed by the Cleansing Section under DCTC as mentioned in chapter F.7. The section was once privatized but now returned to one of public service sections.

The trend of its budget is shown in Table F.8-2.

On revenue, the weight of fee collection has increased relatively.

On expenditure, personnel cost and fuel cost has increased as shown in Fig. F.8-1.

The budget of DPH (Department of Public Health) for inspection is shown in Table F.8-3.

Table F.8-2 Balance Sheet of State Sanitary Company

Unit: Thousand Kips

Year	1985	1986	1987	1988	1989	1990	1991
A. Revenue							
1. Waste collection	4,442	9,221	9,439	7,708	6,195	7,780	16,575
2. Night soil management	1,283	2,233	2,245	2,452	3,913	3,750	8,721
3. Dumping fee	-	-	-	-	-	-	372
4. Others	1,770	1,984	1,247	3,522	2,750	3,158	981
Sub-total	7,495	13,438	12,931	13,682	12,858	14,688	26,649
B. Budget from Vientiane Municipality							
1. Street and market sweeping, treatment of dead body	4,111	9,468	11,166	7,912	7,594	7,890	10,512
2. Grass cutting	1,190	2,205	2,510	1,883	2,850	1,800	-
Sub-total (* A)	5,301	11,673	13,676	9,795	10,444	9,690	10,512
Total Revenue	12,796	25,111	26,607	23,476	23,302	24,378	37,161
C. Expenditure							
1. Personnel expenditure	2,570	4,985	5,950	5,504	7,310	7,316	11,486
2. Office work	2,264	2,083	2,510	4,107	3,922	3,588	2,590
3. Vehicle maintenance cost	2,212	5,706	4,844	5,134	2,150	2,745	5,400
4. Fuel and lubricant	2,827	5,371	5,572	4,950	7,116	7,784	14,100
5. Fire wood	273	410	370	265	345	384	766
6. Development expenditure	1,113	2,209	2,189	1,156	670	622	904
7. Tax	621	3,462	3,887	1,174	1,165	1,463	727
Total Expenditure	11,880	24,226	25,321	22,291	22,678	23,902	35,973
C. Balance	916	885	1,286	1,185	624	476	1,188
Reference	1,198,563	1.421,700	1,859,700	2,169,700	2,599,200	3,553,200	4,254,500
Budget of VM;*B	0.4	0.8	0.7	0.4	0.4	0.3	0.2
*A/*B x 100 (X)	70,000	110,000	140,000	160,000	200,000	210,000	345,000
Budgelt of DCTC;*C.	7.6	10.6	9.8	6.1	5.2	4.6	3.0
*A/*C x 100 (%)							

Remarks: 1. Other revenues/mean extra jobs; i.e. cleaning of drain canal, transportation of sand, gravel and construction materials
2. Tax was paid to Vientiane Municipality
3. Balance was returned to Vientiane Municipality
4. SSC was diverted and became a section of the DCTC in November 1991

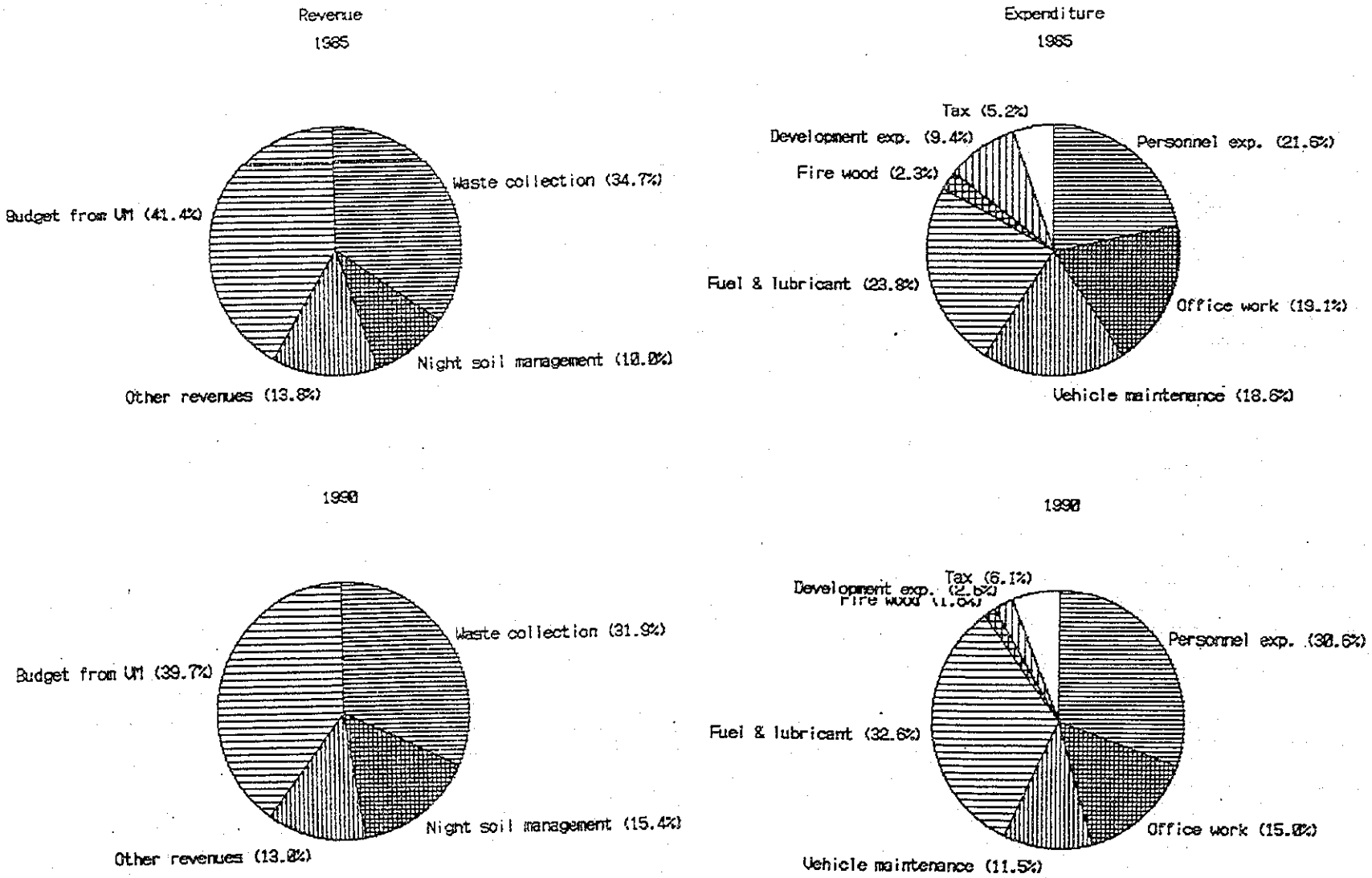


Fig. F.8-1 Revenue and Expenditure of State Sanitary Company

Table F.8-3 Budget Expenditure 1986-1991 of Department of Public Health, Vientiane Municipality

Unit; thousand kips

Year	Budget of Department of Public Health,VM	Cleansing Inspection Section, Station of Hygiene and Epidemiology, VM
1986	53,347	-
1987	65,810	-
1988	217,453	-
1989	184,175	1,000
1990	220,307	1,000
1991	249,841	1,000

Source ; Department of Public Health, Vientiane Municipality

It is difficult to find out the cost of solid waste management according to the category of cleansing work. Rough calculation is done using the present proportion of person and vehicle, and is shown in Table F.8-4.

Table F.8-4 Solid Waste Management Cost by Work Items

Thousand kips

	Collection	Disposal	Night Soil	Treatment Dead Body	Road Sweeping and Others	Total
Personnel	3,109	122	762	503	2,820	7,316
Expenditure	*(2,561)	(122)	(488)	(360)	(2,683)	(6,219)
	(548)		(274)	(137)	(137)	(1,097)
Vehicle Maintenance	1,373		686	343	343	2,745
Fuel and Lubricant	3,892		1,946	973	973	7,784
Fire Wood	-	-	-	384	-	384
sub total	8,374	122	3,394	2,203	4,136	18,229
Development Expenditure	** 286	4	116	75	141	622
Office Work	**1,648	24	668	434	814	3,588
Tax**	672	10	272	177	332	1,463
Total	10,980	160	4,450	2,889	5,423	23,902
	(45.9)	(6.7)	(18.6)	(21.1)	(22.7)	(100.0)
Reference Person	21	1	4	3	22	51
Vehicles	4		2	1	1	8

* 85% of the personnel cost is divided by the proportion of number of person, and 15% is divided by the proportion of number of vehicles.

** The cost with the mark ** is divided by the proportion of value of sub-total.

F.8.3 Private Sector

Three private companies are in charge of waste collection in the Study area at present.

Thc balance of these companies is in the black.

A company, which collects markets, big offices and foreign organizations is more profitable.

A comparison on the cost of collection services done by DCTC and three private companies is done and tabulated in Table 4.8-4.

Table F.8-5 Cost of Collection Services

kips/month

	PRIVATE -C R C	PRIVATE -I S C	PRIVATE -S W M	D C T C
1. Expenditure				
Personnel Expenditures (A)	360,395 (42.2)	141,000 (26.7)	59,000 (23.9)	1,300,000 (65.0)
Fuel and Others	237,879 (27.8)	200,000 (37.9)		
Maintenance	150,000 (17.6)	70,000 (13.3)		500,000 (25.0)
Rent of Vehicle			176,000 (71.3)	
Depreciation	37,768 (4.4)			
Material and Tools	18,753 (2.0)	48,300 (9.1)		50,000 (2.5)
Tax		23,700 (4.5)	12,000 4.9)	150,000 (7.5)
Total (B)	854,518 (100.0)	528,000 (100.0)	247,000 (100.0)	2,000,000 (100.0)
2. Reference				
Number of Employees (C)	25	11	4	66
Personnel Cost Per employee (A/C)	14,416	12,818	14,750	19,697
Revenue (D)	987,260	1,360.000	250,000	2,000,000
Balance (D-B)	132,742	832,000	3,000	0
Project Ratio (%)	15.5	157.6	1.2	0

Note ; The figure in the parentheses is the percentage.

F.9 Public Cooperation, Legislation and Enforcement

F.9.1 Public Cooperation

The Ministry of Health has laid out the primary concern of mass education in the practice of elementary hygiene and sanitation as a preventive measure since 1975. Team of public health officers were sent out all over the country to explain simple hygienic measures necessary to reduce the occurrence of communicable diseases. The basic health education involves the three clean concept campaign ; i.e. clean food, clean water and clean houses. This campaign was carried out seriously and implemented in order to achieve a substantial level of environmental health awareness among the population. The people realised the necessity for the collection and disposal of waste in terms of safety and hygiene for better environmental health and aesthetic condition.

As for public cooperation with respect to solid waste disposal, a cleansing day or the "Red Saturday" was established in communitiess, schools, hospitals, ministries, etc.. From 1975-1985 increase in public cooperation has been considerably felt all over the country because of a government program based on the dedication of the new regime and the influence of the high ranking members of the Lao People's Revolutionary Party. The organizers of the three clean concept compaign, the Ministry of Health together with Provincial Administration Committees, have given a certificate to the villages or individuals for the promotion of the activity. From 1986 upto the present, public cooperation has decreasing gradually due to the failure of the government programs, i.e. poor coordination among involved agencies and low economic performance, weakness of the organization structure and lack of continuous policy.

However, cleansing day is still being carried out especially in schools and in the community before any important day, i.e., Lao New Year "Pimi" and national day. This, however, highly depends on the enthusiasm, or inertia of the village committee or the leader of the community.

F.9.2 Law and Regulation

a. National level

A basic law regarding solid waste management and cleansing activities has not been issued in Lao P.D.R.

However, the Ministry of Health has prepared a draft guideline related to solid waste management and protection of environmental health in accordance with the results of the international workshop which was organized by the National Institute of Hygiene and Epidemiology, Ministry of Health, with the collaboration of WHO (Pepas) in August 1990.

The draft guideline has been submitted to the Office of the Prime Minister for get approval since the middle of 1991. The guideline is composed of 17 chapters and 58 articles, and only one chapter deals with solid waste management.

Content of the guideline is summarized as follows;

Chapter I	-	Objectives of the Guideline
Chapter II	-	Contents of the Guideline
Chapter III	-	Organization and Job Description of Environmental Health
Chapter IV	-	Water Supply and Sewage
Chapter V	-	Air Pollution Protection
Chapter VI	-	Protection of Ground Water
Chapter VII	-	Sanitary Housing Conditions
Chapter VIII	-	Hygiene of Restaurant, Barber Shop and Beauty Salons
Chapter IX	-	Food Sanitation
Chapter X	-	Hygiene of Kitchen Utensils
Chapter XI	-	Hygiene of Working Conditions in Factory
Chapter XII	-	School Hygiene
Chapter XIII	-	Vibration and Noise Protection
Chapter XIV	-	Protection from Toxic Substances

Chapter XV - Solid Waste Management
Chapter XVI - X-ray
Chapter XVII - Implementation of a Guideline

The details of Chapter XV is described below.

Chapter XV : Solid Waste Management

Article 47

i. Rubbish and garbage (solid or liquid) are important sources of raw material and energy. Therefore, they should be economically utilized. Otherwise, they should be properly disposed to protect the environment.

ii. Solid waste disposal is necessary to protect the health of the public and the environment.

Article 48

Any place which produces waste must eliminate its waste or reuse it.

Article 49

Rubbish and garbage should be collected daily and should be distinctly classified under paper, metal, bone, cotton, etc..

Article 50

i. At the public disposal site, the waste (solid or liquid) for recycling and disposal must be distinctly classified to avoid biological, and chemical contamination which might adversely affect the environment.

ii. Rubbish and garbage that may contaminate the surface water must be eliminated properly.

b. Vientiane Municipality

The Vientiane Municipality has issued a regulation serial No.633/VMAC, on the 13 th of October 1988 concerning the environmental health and cleansing services of the Vientiane Municipality.

Although Vientiane Municipality has a few rules regarding solid waste management, they are virtually insufficient. The regulation consists of the following four articles;

Article 1 : Organization and job description of the cleansing inspection committee.

Article 2 : Supervision and inspection of the cleansing services in the city, main roads, drain canals, markets, restaurant, beauty salons.

act 1 : A regulation prohibiting the construction of houses and other structures on foot-paths and drain canals.

act 2 : A regulation prohibiting the passage of heavy and light trucks without proper rear covers during the transport of construction materials, sand, gravel, waste, etc.

act 3 : A regulation prohibiting any light workshop and petty trade which utilizes foot-paths and drain canals for repair ang as waste disposal areas.

act 4 : A regulation prohibiting the construction of cottages, orchards, erecting of fences, digging of fishing ponds on public foot-paths and drain canal.

Article 3 : Cattle raising on the roads such as the main road. Regulation prohibiting raising of any poultry and four legged animals (sheeps, goats, cows and buffalos) in unproper places.

Article 4 : Cleansing services and protection of environmental health in the main road.

act 1 : A regulation prohibiting the dumping of waste and garbage into the drainage canal.

act 2 : A regulation prohibiting any offices, enterprises, hotels, restaurants, schools, theatres from dumping their wastes in to the open sites without putting them in containers.

act 3 : A regulation prohibiting the public and private owner of restaurants, barber shops, beauty salons from utilizing dirty water for their business. Persons who have skin diseases must wear white shirts for protection.

act 4 : A regulation prohibiting the leaving of waste for more than 4 hours in public areas after the end of a ceremony such as concerts or festivals.

act 5 : A regulation prohibiting the keeping of domestic animals underneath houses with poor sanitary conditions.

act 6 : A regulation prohibiting illegal dumping.

F.9.3 Enforcement

Although draft of the guideling prepared by the Ministry of Health does not have any legal power, the SWM regulation No.633/VMAC issued by the Vientiane Municipality on the 13th of October 1988 is legally valid. Based on the regulation, the Cleansing Inspection Committee was organized to control the cleansing services of the Vientiane Municipality. The Cleansing Inspection Committee was headed by the DCTC and consisted of other related agencies, i.e., Department of Public Health, Department of National Defence and Public Security (Police), District Administrative Committee in the urban area and mass organizations.

The activities of the Cleansing Inspection Committee were carried out smoothly in the first year of establishment and was strongly supported by the community. But in the following year, due to the poor coordination of the related agencies and lack of decision-making participation, the activities of the committee decreased gradually and the task was performed only for important national holidays. Consequently, the Cleansing Inspection Committee was dissolved, 2 years after it was organized.

At present, the existing organization controling the cleansing services in the Vientiane Municipality is the Cleansing Inspection Sector in the Station of Hygiene and Epidemiology, Department of Public Health, Vientiane Municipality.

The Cleansing Inspection Sector consists of 7 overseers, of which 3 come from the sector and the rest from 4 urban districts i.e. Chanthabouly, Sisattanak, Saisettha and Sikhottabong.

The Cleansing Inspection Sector is vested with legal power. According to the regulation of Vientiane Municipality, they can also fine violators aside from just issuing warnings. Fining, however, is not really effective, as nobody pays and no action is taken against it.

Due to serious problems on littering and illegally dumping waste, some village committees have made an agreement with their villages to apply the regulation of Vientiane Municipality. They organized the overseers to issue a ticket to the violator who litters or disposes waste i n their surrounding. The kind of punishment agreed upon entails the following:

- First, they shall be warned and fined with the amount of stipulated in the act and article; and

- Second, the fine for the next offence or for every successive violation of the rules shall be doubled.

The punishment of Vientiane Municipality's Regulation No.633/VMAC regarding environmental health and solid waste management is described as follows;

Article	Act	Contents	Fine for 1st violation	Fine for any or next violation
2	1	Regulation prohibiting the construction of houses and other structures on the foot-paths blocked drain canals	500 kips	double
	2	Regulation prohibiting the passage of heavy and light trucks without proper rear covers during the transport of contruction materials, sand, gravel, waste, etc.	500 kips	double
	3	Regulation prohibiting any light workshop and petty trade which utilizes foot-paths and drain canals for repair and as waste disposal areas.	500 kips	double
	4	Regulation prohibiting the construction of cottages, orchards, erecting of fences, digging of fishing ponds in public foot-paths and drain canals	200 kips	double

Article 3		Regulation prohibiting the raising of poultry and four legged animals (sheeps, goats, cows and buffaloes) in unproper places, i.e., main roads, public places	poultries 100 k/each 150 k/day/feeding 7 days big animals 1,000 k/each 200 k/day/feeding 7 days	
Article 4	1	Regulation prohibiting the dumping of waste and garbage in drain canals	500 kips	double
	2	Regulation prohobiting any offices, enterprises, hotels, restaurants, schools, theatres from dumping their wastes in open sites without putting them in containers	500 kips	double
	3	Regulation prohibiting public and private owners of restaurants barber shops, and beauty salons from utilizing dirty water for their business. Persons who have skin diseases must wear white shirts for protection	500 kips	double
Article	4	Regulation prohibiting the leaving of waste for more than 4 hours in public places after the end of ceremonies such as concerts or festivals	1,000 kips	

5	Regulation prohibiting the keeping of domestic animals underneath houses with poor sanitary conditions	500 kips	double
6	Regulation prohibiting illegal dumping depending on the quantity of waste		
	- bamboo baskets	200 kips	double
	- push carts	500 kips	double
	- transport trucks	2,000 kips	double
	- illegal dumping sites (organized by village excluding KM 18)	5,000 kips	double

F.9.4 Existing Standards, Codes of Practice and Guidelines

There are no existing standards, codes of practice and guidelines regarding solid waste management both in the country and in Vientiane Municipality.

L. 5 Continuation by DCTC

The collection experiment was taken over by DCTC from the end of March 1992. The following aspects are found out through the collection eperiment taken over by DCTC.

1) Number of Families and Shops Contracted

Number of families and shops contracted with DCTC is kept almost the same number as when experiment was commenced, as shown in Table L.5-1. Although fee collectors made an effort not to reduce the number of collection service recipients, some of collection fee was not able to collected from the recipients due to the absence of masters and owner. Therefore, it is necessary to examine the time and schedule of fee collection. Moreover, DCTC shall delete the contract marks on the baskets of the household who canceled waste collection service contract in order to keep the Beneficiary-Pay-Principle and avoid the delivery of a collection service without collection fee.

Table L.5-1 Number of Families and Shops Contracted

	March	April	May	June
Ban Dong Mieng	133	134	135	133
Ban Sisavath Tay	101	107	95	99
Ban Sisavath Kang	87	90	83	77
Total	326	331	313	309

APPENDIX G

EVALUATION OF PRESENT SOLID WASTE MANAGEMENT

APPENDIX G EVALUATION OF PRESENT SOLID WASTE MANAGEMENT

G.1 Review of Existing Plans and Studies

With regard to the existing plans and studies regarding the solid waste management in Vientiane, the following plans and studies were identified by the Study Team;

a. Report on Solid Waste in Urban Vientiane, S. Sandanam, April 1989, Project UNDP-UNCHS LAO/85/003;

b. Report on a Pilot Project on the Collection and Disposal of Solid Waste, S. Sandanam, October 1989;

c. Report on the Field Visit to Vientiane Lao People's Democratic Republic 14-21 March 1989, Dr. Hisashi Ogawa;

d. Mission Report on Workshop and Field Visit on Solid Waste Management, Dr. H.Ogawa, WHO staff, Mr. D.J.V. Campbell, WHO Consultant, Environmental Safety Center, Harwell Laboratory, United Kingdom; and

e. The Study of Compost in Vientiane, Ministry of Agriculture and Forestry, Lao P.D.R..

The plans and studies shall be reviewed in order to adjust the Basic Plan to the above. The review has been carried out and described below.

G.1.1 Report on Solid Waste in Urban Vientiane

1) Contents of the Report

The "Report on Solid Waste in Urban Vientiane" was prepared by Mr. Sangarappillai Sandanam, a country officer of Lao P.D.R., Water Supply and Sanitation Sector Development Team, World Bank/UNDP Project in April 1989 as a working paper of the Urban Development Programme in the Prefecture of Vientiane (Project UNDP-UNCHS LAO/85/003).

It is probably the first report in Lao P.D.R. on Solid Waste Management which includes basic information such as the quantity of solid waste generated in the area, the population covered by the collection service, etc..

The report recommended the following;

a. An "Environmental Health" division should be established in the Municipality of Vientiane. Along with other activities, this organization should be responsible for the disposal of solid wastes in Urban Vientiane. The proposed Environmental Health Division should:

i. Co-ordinate with the heads of all the urban villages to organize a viable collection, transport and disposal system for the domestic solid wastes within the urban area of Vientiane. The collection should be done at least 2 times a week;

ii. Establish an expedient route of collection for the solid wastes in urban Vientiane;

iii. Procure at least 4 trucks each with a capacity of about 4 cubic meters for the transport of solid wastes and also the equipment needed for the landfill operation; and

iv. Co-ordinate with the various industries functioning in Vientiane and arrange the safe disposal of all industrial solid wastes, some of which may be hazardous to the environmental health in the region.

b. All clinical solid wastes should be transported to a central place in Ban That Luang Kang. A common incinerator should be installed there and all clinical solid wastes should be incinerated.

c. All domestic solid wastes should be transported to the proposed landfill site along That Luang - Thadeua road at about 7.5 km from the central city. A sanitary landfill should be established there in an area of 7 hectares. The earth necessary for covering could be burrowed from the adjoining high ground.

The landfill could be utilized for a period of 5 years from 1990-1995, with provision for an extension up to 1996.

During 1995-1996, the alternate site suitable for landfill which is situated at about 12 km from the central city along the Thadeua Road should be put into operation.

d. The Municipality should employ a supervisor who should be responsible for the collection and transport of solid wastes and an attendant to supervise the activities at the sites for sanitary landfill and common incineration.

e. The existing open dump situated at a distance of 18 km from the central city along route No. 13 (which is very far) should be abandoned.

When an effective collection and disposal system for solid wastes becomes operational in urban Vientiane, investigations should be carried out for the establishment of a composting plant with facilities for pre-separation, resource recovery and possibly recycling.

f. The results of the Pilot Project in Sihom village should be used as a feedback to amend the strategy for the disposal of solid wastes with due emphasis on "COST RECOVERY" as a salient feature of the envisaged scheme.

2) Discussions

First of all, as the first solid waste management study, the report should be appreciated. It presents a lot of valuable information and studies regarding SWM in urban Vientiane. However, unfortunately, the following main aspects of SWM in urban Vientiane were not included in the report;

a. Organization involved in SWM;
b. Financial situation;
c. Legislation and enforcement;
d. Recycling system; and
e. Cost of the recommended projects.

According to the DCTC and DPH of the Vientiane Municipality and the Ministry of Health, those agencies were not involved in the study and they received the report in August 1990 when the workshop had been held in Vientiane under the auspices of the PEPAS, WHO; i.e. One year and 4 months after the submission of the report. The report seemed be prepared only by the UNDP expert and the ITSTP, MCTPC. This seems to be the reason why no action had been taken for two and half years after the submission of the report.

In addition to the above, the following matters should be noted when the basic information of the report is referred to;

a. Generation of domestic waste in urban Vientiane was surveyed only for one day (normally, 8 days of survey are required and the first day should be excluded for the study);

b. Generation of other modes of wastes such as commercial, market, hospital, and office was not studied; and

c. The composition of wastes was not studied.

G.1.2 Report on a Pilot Project on the Collection and Disposal of Solid Waste

1) Contents of the Report

A pilot project was conducted under the auspices of the UNDP at Ban Sihom from the 5th of September to the 4th of October 1989 in order to use the result of the project as a feedback to formulate an appropriate strategy for the collection and disposal of solid waste in urban Vientiane.

The following findings and conclusions were drawn according to the results of the one month pilot project.

a. The Pilot Project planned and implemented at Ban Sihom was fully compatible with the social customs and habits of the people.

b. The environmental health awareness of the people of Ban Sihom - with respect to the collection and disposal of solid wastes - was enriched to a relatively higher level at the conclusion of the Pilot Project.

c. Motivation for community participation in the collection and disposal of solid wastes was found to be at a substantial level in Ban Sihom.

d. The people of Ban Sihom were found adaptable to the Pilot Project and they provided an effective and efficient cooperation by willingly participating in the Pilot Project.

A notable feature in this regard was their reversal from some of their earlier (unhealthy) practices into the safe, hygienic and nuisance free method of collection and disposal of solid wastes adopted in the Pilot Project.

e. Clandestine methods of disposal of solid wastes could be eliminated almost completely by the successful implementation of a well planned Pilot Project.

In the aftermath of such a Project, the cleanliness and the reduction of vector nuisances achieved would be quite high.

f. The capacities and the respective serviceability limits of the expendable equipment(the yard containers, the common containers and the litter bins) were quite satisfactory.

From the point of view of cost effectiveness and the quality of the equipments;

i. The common containers made of steel were completely satisfactory and were liked by the people.

ii. The Litter Bins made of steel were completely satisfactory from the point of view of quality and were liked by the people very much, but those were more expensive; and

iii. The yard containers made of bamboo were highly cost-effective and of satisfactory quality, but the people of Ban Sihom seemed to prefer yard containers made of plastics to those made of bamboo.

g. The cost of implementing the Pilot Project was US$ 1,718.28 (i.e. a per capita cost of about US$ 1.00) which was a little lesser than the estimated cost of US$ 2,200/=.

The overall Cost/ Benefit Ratio involved in the Pilot Project could be considered to be highly satisfactory.

Based on these favourable conclusions, the report recommended the following;

a. The same as the recommended item (a.) of the "Report on Solid Waste in Urban Vientiane", except for the exclusion of iv. of (a.).

b. The chiefs of villages in each of the 81 urban villages should be responsible for soliciting the co-operation of the people in their respective villages and for organizing the collection and disposal of solid wastes.

   Each chiefs of village should supply the equipment necessary for the collection and temporary storage of solid wastes which had been recommended in the report after the implementation of a Pilot Project in Ban Sihom for the collection and disposal of domestic solid wastes. The supply of these equipment should involve cost recovery (from the householders) as a salient feature.

   The recommended equipment are:

   i. bamboo yard containers;
   ii. steel common containers; and
   iii. plastic litter bins.

c. The village chief should co-ordinate with the Municipality in order to employ the necessary number of cyclists with rear carts- to assist the interior houses in the transport and deposition of their containers - and the road sweepers necessary for sweeping all the roads. A supervisor would be needed for the effective supervision of all collection and disposal of solid wastes in each village. The salary for the 3 personnel needed in each village should be paid from the money recovered from the householders in that village.

The recommendations of the items d, e, f and g are the same as the recommended item c,d,e and f of the above-mentioned report respectively. (refer to 1 of G.1.1)

2) Discussions

According to the report, the pilot project was successfully implemented and it was fully compatible with the social customs and habits of the people in the Ban Sihom where the project was executed.

The Study Team has made field reconnaissances in Ban Sihom in November 1991, in order to examine the result of the pilot project. However, the method of the collection and disposal in the village was the same manner as it was done before the execution of the pilot project. Only bamboo baskets without lids installed in front of each house were used instead of steel common containers and plastic litter bins. Absolutely no changes resulted from the implementation of the pilot project. The following is considered as the reasons why the system planned by the pilot project was not applied in the village;

a. For the execution of the pilot project, both the Vientiane Municipality and Ministry of Health were not involved.

b. The cost of the O&M (operation and maintenance) of the pilot project, such as the salary of the supervisor, cyclist and road sweeper and lease of the trucks were bore by the UNDP.

However, when the project ended successfully, the provision of the O&M cost became difficult due to lack of financial sources.

c Due to the problems on the containers provided by the project (i.e. in terms of loading, it was very difficult to take the wastes from the container), the collection fee in the area was increased from 6,000 kips/trip to 7,000 kips/trip.

d. The system was planned without the participation of the residents of the village, and educational campaigns and other related programmes were not included in the project.

G.1.3 Report on the Field Visit in Vientiane, Lao P.D.R.

1) Contents of the Report

The report was prepared by Dr. Hisashi Ogawa, WHO (PEPAS) staff.

The purpose of the visit in general was to review the management of solid waste in the Municipality of Vientiane. The specific terms of reference of the assignment were as follows:

a. to discuss with relevant authorities problems associated with solid waste management in Vientiane and possible solutions to overcome these problems;

b. to make field trips to relevant sites and facilities;

c. to discuss future collaborative activities between the World Health Organization (WHO) and the Government in the field of solid waste management; and

d. to make recommendations on the future course of action of the Government.

The conclusions and recommendations of the report were as follows.

a. Virtually all aspects of solid waste management in Vientiane need to be improved, including strengthening the institutional setting; developing human resources; enhancing refuse collection services; upgrading final disposal to sanitary landfill; securing funds for capital and recurrent expenditure; and encouraging public participation through development of public education programmes.