4.2 Plan for Final Disposal by Landfill

4.2.1 Basic concept of Landfill Plan

Based on the results of the evaluation made in the major method of final disposal should still be landfill at the inland sites. KMS has an incineration plant, however, the capacity is quite insufficient comparing to the disposal demand growing year by year.

Therefore the plant will be kept its operation as a supplementary measure to the landfill disposal for the moment. It is not easy to acquire a land for landfilling, however, it is still recommendable to construct the landfill site within the territory of KMS during the planning period up to 2010. Fortunately KMS has already confirmed the policy to acquire the land for the landfill site in the western part of Surabaya that is expected to satisfy the most part of final disposal demand for the planning period. If KMS succeeds in acquiring an additional landfill site in the eastern part of Surabaya where an integrated development plan is now in progress, the sound and stable disposal will be secured. The development plan called "Pengambangan Kawasan Pantai Timur Surabaya (East Coast Development Area)" includes 2 to 3 hundred hectare of open air recreation zone such as sports field, golf course and marina. These type of land use can be constructed in general on the land converted from landfill site if only appropriate technical countermeasures are adopted. Therefore it is possible to expect that KMS would have a New East landfill site besides New West one in Benowo.

Based on this project, the final disposal plan by means of landfill is composed.

4.2.2 Projection of Disposal Amount

1) Total Amount

The volume of waste to be disposed in the disposal site is estimated for the period from 1992 to 2010 on the basis of the assumptions stated below:

1. The annual increase of the waste generation is five (5) %.

2. The operation efficiencies of the existing incinerator are assumed to be 75% and 50% (150 t/d and 100t/d) before and after the age of the plant reaches 15 years respectively.

3. The volume of the unauthorized disposal is assumed to be constant at 90 t/d up to 1999, after which there would be no unauthorized disposal.

4. Recycling of the waste will be made with the same rate as present 11.7% (190 t/d out of 1,626 t/d)

5. The waste disposed at unidentified sites will decrease. It would be zero in and after 1998 when the vehicle procurement will be completed.

6. The target coverage of cleansing service is set up at 95% in weight in 2010 against the present coverage of about 69%. The remaining 5% of the whole waste will remain uncollected.

The estimated amount of daily landfill is presented in Table 2.4-3 and Fig. 2.4-1.

Table 2.4-3 Volume of Waste to be Disposed in the Landfill Sites

(Unit: ton/day)

Description		Total Waste	Incinerated Waste	Unauthorized Disposal	Unidentified Disposal	Recycled Waste	Uncollected Waste	Disposed Volume
Wet Season	1992	1,748	194	90	186	190	263	825
Dry Season	1992	1,504	121	90	155	190	236	711
Through the year								
	1992	1,626	150	90	171	190	249	776
	1993	1,707	150	90	147	199	246	875
	1994	1,793	150	90	122	210	243	978
	1995	1,882	150	90	98	220	240	1,084
	1996	1,976	150	90	73	231	237	1,195
	1997	2,075	150	90	49	242	234	1,310
	1998	2,179	150	90	24	255	231	1,429
	1999	2,288	150	90	0	267	228	1,553
	2000	2,402	150	0	0	281	225	1,746
	2001	2,522	150	0	0	295	223	1,854
	2002	2,649	150	0	0	310	220	1,969
	2003	2,781	150	0	0	325	217	2,089
	2004	2,920	150	0	0	341	214	2,215
	2005	3,066	150	0	0	358	211	2,347
	2006	3,219	100	0	0	376	208	2,535
	2007	3,380	100	0	0	395	205	2,680
	2008	3,549	100	0	0	415	202	2,832
	2009	3,727	100	0	0	436	199	2,992
	2010	3,913	100	0	0	457	196	3,160

Note :
1. In 1998 both procurement of vehicle by the existing plan and repay of loan for existing incinerator will be completed.

2. Coverage of collection service will reach 95% in amount. (Refer to Part 2 Section 3.1 for explanation on the projection of recycled, uncollected, and illegally dumped waste.)

The annual amounts are also calculated based on the above daily amount as presented in Fig. 2.4-2. It is indicated that the annual disposal of waste in 1992 is only about 283,000 t, and it will increase gradually reaching the approximately 637,000 t and 1,153,000 t in 2000 and 2010, respectively. The cumulative volume of waste disposed from 1992 to 2010 is calculated as large as 13,000,000 t.

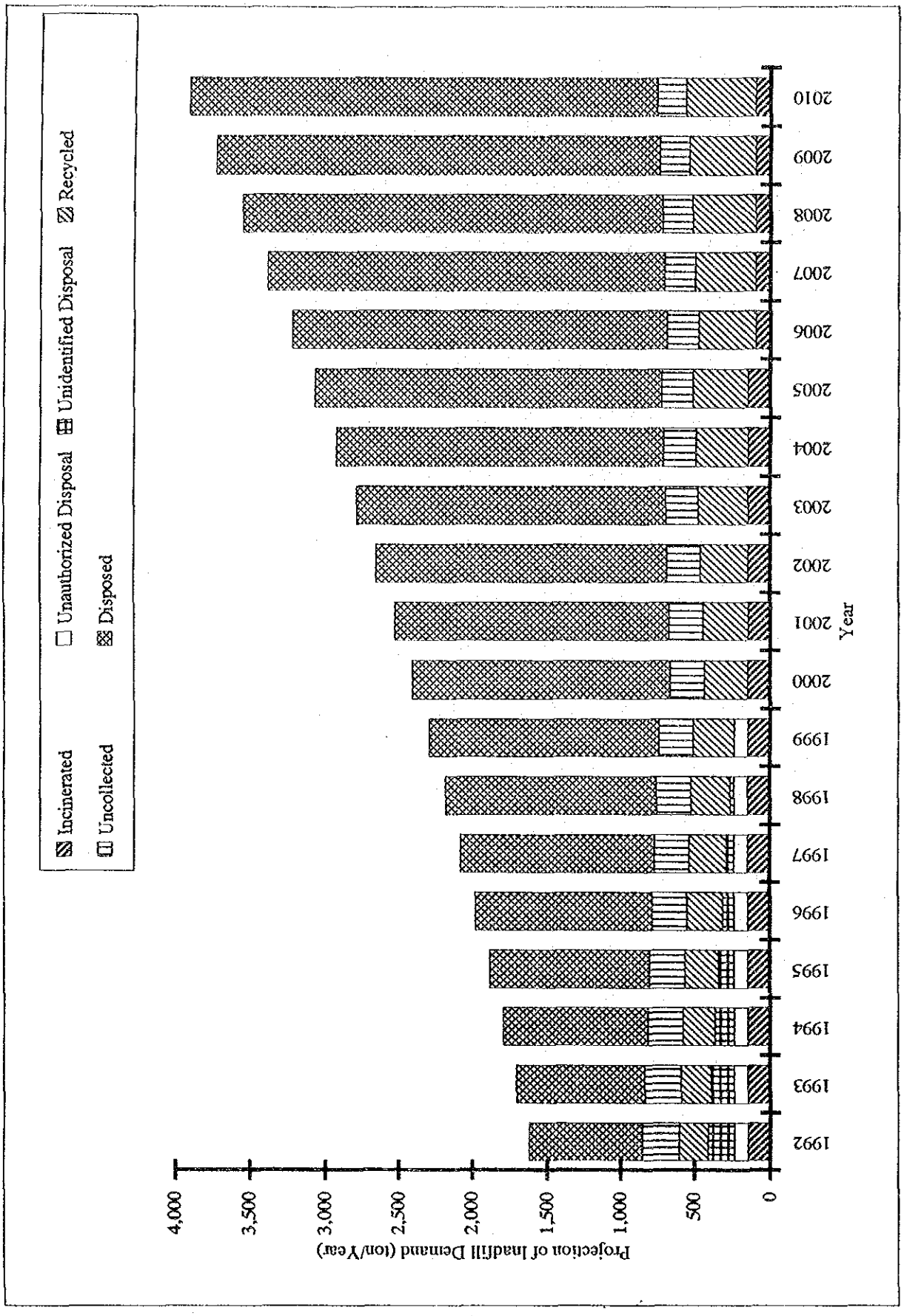
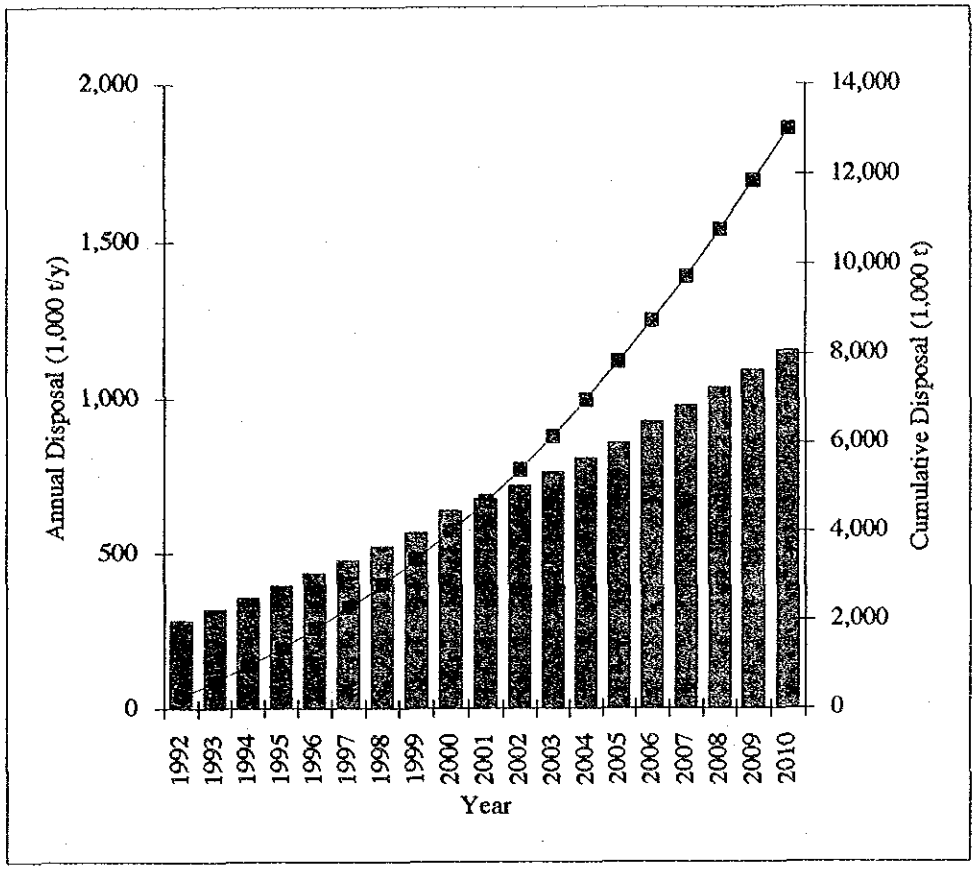


FIG. 2.4-1 PROJECTION OF WASTE DISPOSAL AMOUNT

THE STUDY ON THE SOLID WASTE MANAGEMENT IMPROVEMENT FOR SURABAYA CITY



Year	Daily Disposal (ton/day)	Annual Disposal (1,000 t/y)	Cumulative Disposal (1,000 t)
1992	776	283	283
1993	875	319	602
1994	978	357	959
1995	1,084	396	1,355
1996	1,195	436	1,791
1997	1,310	478	2,269
1998	1,429	522	2,791
1999	1,553	567	3,358
2000	1,746	637	3,995
2001	1,854	677	4,672
2002	1,969	719	5,391
2003	2,089	762	6,153
2004	2,215	808	6,961
2005	2,347	857	7,818
2006	2,535	925	8,743
2007	2,680	978	9,721
2008	2,832	1,034	10,755
2009	2,992	1,092	11,847
2010	3,160	1,153	13,000

FIG. 2.4-2 PROJECTED AMOUNT OF LANDFILL UPTO 2010

2) Landfill Demand by Rayon

The landfill demand of each Rayon is estimated to determine the waste amount disposed at each disposal site. The result of estimation is shown in Table 2.4-4 by using the assumptions shown in the note of the table.

Table 2.4-4 Projection of Landfill Demand by Rayon

Year	Projection Demand by Rayon (1,000 t/y)					
	Central	North	East	South	West	Total
1992	43	51	78	76	35	283
1993	48	57	89	85	40	319
1994	53	63	100	96	45	357
1995	58	70	112	106	50	396
1996	63	77	123	117	56	436
1997	68	84	136	128	62	478
1998	73	91	150	140	68	522
1999	79	98	163	152	75	567
2000	87	109	185	171	85	637
2001	91	115	198	182	91	677
2002	95	122	211	194	97	719
2003	99	128	225	206	104	762
2004	103	134	241	218	112	808
2005	108	142	256	232	119	857
2006	115	152	278	251	129	925
2007	119	160	296	265	128	978
2008	124	167	315	280	148	1,034
2009	129	175	334	297	157	1,092
2010	134	183	355	314	167	1,153

Note 1. : Present share of 5 Rayons is assumed to be the share observed by the Study Team at the final disposal sites and incineration plant.

2. : Future share is assumed to be in proportion to the share in projected population.

3. : Transition from the present share to the future is assumed linear.

4.2.3 Potential Capacity of Existing Landfill Sites

There were three (3) landfill sites under operation in Surabaya city in 1992: Keputih, Lakarsantri and Kenjeran Landfill Sites. The potential capacities of these landfill sites are examined as described below.

1) Keputih Landfill Site

The Keputih Landfill site consists of three (3) partitions with an area of about 30 ha except the areas for incineration plant and human waste treatment plant. Since the average elevation of the original ground surface is considered to be about EL.+2.50m, the potential capacity as of the end of 1992 is calculated to be about 943,000 t assuming that the maximum landfill height would be 5.0 m above the original ground surface.

The site is divided into three (3) isolated partitions, resulting in mal-function of the disposal site. In order to facilitate the function of this disposal site, it is recommended to include the narrow tracts of land between Partitions and the adjacent riverside area. The area of the said tracts is measured to be 11.5 ha, and it is possible to expect the additional capacity of 535,000 t for the Keputih Landfill Site.

The potential capacity of the Keputih Landfill Site is, therefore, calculated to be 1,478,000 t totaling the above original and additional capacities.

2) Lakarsantri Landfill Site

The site consists of two (2) isolated areas: A and B. The Area A is further divided into two (2) sub-areas by an improved river, a tributary of the River Kedurus. The area of the partition A is measured to be 7.6 ha. The capacity at the end of 1992 is estimated to be about 397,000 t setting the maximum height of landfill at 10.0 m from EL+16.00 m to EL+26.00 m.

The area B is not used for disposing waste at present due to the lack of access. In order to facilitate its disposal function, it is recommended to expand the area enough to connect two separated areas. The additional capacity of the extended area is calculated to be 441,000 t with the same range of elevation as the Partition A. Thus the overall potential capacity of the Lakarsantri Landfill Site is expected to be about 838,000 t.

3) Kenjeran Disposal Site

The waste receiving capacity of Kenjeran Disposal Site has been exhausted at the end of 1992. And it is reported that the site will be closed in 1993 due to the reasons of the land owner.

4) Summary of Existing Landfill Sites

The potential capacity of existing landfill sites is summarized in Table 2.4-6. After all the remaining capacity is the total of Keputih and Lakarsantri, 1,340,000 t.

Table 2.4-5 Remaining capacity of Existing Landfill Sites as of the End of 1992

(Unit : 1,000 t)

Condition	Keputih	Lakarsantri	Kenjeran	Total
Without Expansion	943	397	*	1,340
Proposed Expansion	535	441	-	976
With Expansion	1,478	838	-	2,316

* Kenjeran will be closed in 1992

4.2.4 Expecting Capacity of Future Landfill Sites

1) Benowo Landfill Site

The maximum capacity of the Benowo landfill site is set at 10,5000,000 t taking the following items into consideration:

- Landfill operation will start in the planned area of 40 ha (out of 150 ha) will start in 1995.
- About 70% of land would be utilized for landfilling out of the total assigned area of 150 ha.
- The height of landfill is set at 10.0 to 15.0 m above ground surface.

2) New East Landfill Site

A New East landfill site in the project area of "Pengembangan Kawasan Pantai Timur Surabaya" is expected to have a capacity as follows.

- The maximum capacity is set at 8,400,000 t. It corresponds to 120 ha assuming the same landfill conditions as applied to Benowo.

- It is desirable, that it will start its operation by the year when the capacity of Keputih LPA is exhausted.

4.2.5 Allocation of Landfill Demand

1) Simulation of Landfill Duration

Duration of landfill sites is limited by the supply of additional landfill capacity. Simulations on the duration of landfill sites are carried out for the following four (4) cases.

Case 1 : Existing Sites only
Case 2 : Existing Sites + Benowo I (40 ha)
Case 3 : Existing Sites + Benowo I, II (150 ha)
Case 4 : Existing Sites + Benowo I, II + New East (120 ha)

The results of simulations are presented in Table 2.4-7 and illustrated in Fig. 2.4-3 to Fig. 2.4-6. Major findings of the simulations are as follows:

Case 1. : The existing landfill sites which are at present under operation in Keputih and Lakarsantri will be overflowed in 1996, resulting in the necessity for constructing some new landfill sites.

Case 2. : Lakarsantri landfill site sill be exhausted in 1996. Keputih landfill site will be exhausted in 1997 even if it would accept waste only from East Rayon since the opening of Benowo I. Benowo I (40 ha) will be full in 2001.

Case 3. : Benowo landfill site will be full just before 2010, the target year of the long term plan, however, there will be no prospect to dispose waste thereafter.

Case 4. : Both west (Benowo) and East (New East) landfill sites will still have the capacity of receiving waste until 2016.

It is assumed that the landfill operation in New East landfill site will begin just after the closing of Keputih in 1997 in order not to transport the waste all the way from East Rayon to Benowo passing through the central part of the city.

As a conclusion the required area and capacity of two additional landfill sites are calculated as stated below assuming 10 m of landfill height.

- Benowo landfill site :
  10,500,000 t of capacity (150 ha of gross land area) is required.

- New East Landfill Site :
  8,400,000 t of capacity (120 ha of gross land area) is required.

If the required capacity of landfill site is procured respectively at one time, it is the best for stable operation of solid waste disposal. But it will bring KMS a harder financial burden than to purchase the project sites step by step. Then it is recommended to acquire the land according to a staged plan as shown below for KMS to reduce the investment cost in the early stage of project implementation.

Case 5. : Staged Land Acquisition Plan for New East Landfill Site

- in 1995 ..... to acquire 14 ha (corresponds to the capacity of 980,000 t)
- in 1999 ..... to acquire 31 ha (corresponds to the capacity of 2,143,000 t)
- in 2005 ..... to acquire 75 ha (corresponds to the capacity of 5,250,000 t)

Table 2.4-6 Duration of Landfill Sites

Case 1. Existing Sites and No New site

(Unit : 1,000 t/y)

Year	Total	Keputih		Lakarsantri	
	Disposal Demand	Disposal	Capacity	Disposal	Capacity
1992			943		397
1993	319	CNE 217	726	SW 102	295
1994	357	CNE 241	485	SW 116	179
1995	396	CNE 264	221	SW 132	47
1996	436	CNE 289	Δ 68	SW 147	Δ 100

Note : - CNE mean the waste brought from Center, North, and East Rayon.
- SW mean the waste brought from South and West Rayon.
- Δ means deficit of capacity.

Case 2. Existing Sites and Benowo (phase I : 40 ha only)

(Unit : 1,000 t/y)

Year	Total	Keputih		Lakarsantri		Benowo I	
	Disposal Demand	Disposal	Capacity	Disposal	Capacity	Disposal	Capacity
1992			943		397	0	0
1993	319	CNE 217	726	SW 102	295	0	0
1994	357	CNE 241	485	SW 116	179	0	0
1995	396	CNE 264	221	SW 132	47	0	2,800
1996	436	E 132	89	SW 47	0	CNS 253	2,543
1997	478	E 89	0	0	0	WNCSE 389	2,154
1998	522	0	0	0	0	WNCSE 522	1,632
1999	567	0	0	0	0	WNCSE 567	1,065
2000	637	0	0	0	0	WNCSE 637	428
2001	677	0	0	0	0	WNCSE 677	Δ 249

Note : - CNE mean the waste brought from Center, North, and East Rayon.
- SW mean the waste brought from South and West Rayon.
- Δ means deficit of capacity.

Case 3. Existing Sites and Benowo (phase I + II: 150 ha)

(Unit : 1,000 t/y)

Year	Total	Keputih		Lakarsantri		Benowo I		Benowo II	
	Disposal Demand	Disposal	Capacity	Disposal	Capacity	Disposal	Capacity	Disposal	Capacity
1992			943		397	0	0	0	0
1993	319	CNE 217	726	SW 102	295	0	0	0	0
1994	357	CNE 241	485	SW 116	179	0	0	0	0
1995	396	CNE 264	221	SW 132	47	0	2,800	0	0
1996	436	E 132	89	SW 47	0	NCS 257	2,543	0	0
1997	478	E 89	0	0	0	WNCSE 389	2,154	0	0
1998	522	0	0	0	0	WNCSE 522	1,632	0	0
1999	567	0	0	0	0	WNCSE 567	1,065	0	0
2000	637	0	0	0	0	WNCSE 637	428	0	7,700
2001	677	0	0	0	0	WNCSE 428	0	WNCSE 249	7,451
2002	719	0	0	0	0	0	0	WNCSE 719	6,732
2003	762	0	0	0	0	0	0	WNCSE 762	5,970
2004	808	0	0	0	0	0	0	WNCSE 808	5,162
2005	857	0	0	0	0	0	0	WNCSE 857	4,305
2006	925	0	0	0	0	0	0	WNCSE 925	3,380
2007	978	0	0	0	0	0	0	WNCSE 978	2,402
2008	1,034	0	0	0	0	0	0	WNCSE 1,034	1,368
2009	1,092	0	0	0	0	0	0	WNCSE 1,092	276
2010	1,153	0	0	0	0	0	0	WNCSE 1,153	Δ 877

Note : - CNE mean the waste brought from Center, North and East Rayon.
- SW mean the waste brought from South and West Rayon
- Δ means deficit of capacity

Case 4. Existing Sites and Benowo (phase I + II: 150 ha) and New East

(Unit : 1,000 t/y)

Year	Total	Keputih		Lakarsantri		Benowo I		Benowo II		New East	
	Disposal Demand	Disposal	Capacity	Disposal	Capacity	Disposal	Capacity	Disposal	Capacity	Disposal	Capacity
1992			943		397	0	0	0	0	0	0
1993	319	CNE 217	726	SW 102	295	0	0	0	0	0	0
1994	357	CNE 241	485	SW 116	179	0	0	0	0	0	0
1995	396	CNE 264	221	SW 132	47	0	2,800	0	0	0	0
1996	436	E 132	89	SW 47	0	NCS 257	2,543	0	0	0	8,400
1997	478	E 89	0	0	0	WNS 245	2,298	0	0	CE 144	8,256
1998	522	0	0	0	0	WNS 271	2,027	0	0	CE 251	8,005
1999	567	0	0	0	0	WNS 296	1,731	0	0	CE 271	7,734
2000	637	0	0	0	0	WNS 336	1,395	0	0	CE 301	7,433
2001	677	0	0	0	0	WNS 361	1,034	0	0	CE 316	7,117
2002	719	0	0	0	0	WNS 387	647	0	0	CE 332	6,785
2003	762	0	0	0	0	WNS 413	234	0	7,700	CE 349	6,436
2004	808	0	0	0	0	WNS 234	0	WNS 209	7,491	CE 365	6,071
2005	857	0	0	0	0	0	0	WNS 473	7,018	CE 384	5,687
2006	925	0	0	0	0	0	0	WNS 515	6,503	CE 410	5,277
2007	978	0	0	0	0	0	0	WNS 549	5,954	CE 429	4,848
2008	1,034	0	0	0	0	0	0	WNS 587	5,367	CE 447	4,401
2009	1,092	0	0	0	0	0	0	WNS 624	4,743	CE 468	3,933
2010	1,153	0	0	0	0	0	0	WNS 664	4,079	CE 489	3,444

Note : - CNE mean the waste brought from Center, North and East rayon.
- SW mean the waste brought from South and West Rayon
- Δ means deficit of capacity

Case 5. Existing Sites and Benowo (phase I + II: 150 ha) and New East (I + II + III : 120 ha)

(Unit : 1,000 t/y)

Year	Total	Keputih		Lakarsantri		Benowo I		Benowo II		New East I		New East II		New East III	
	Disposal Demand	Disp.	Capa.	Disp.	Capa.	Disp.	Capa.	Disp.	Capa.	Disp.	Capa.	Disp.	Capa.	Disp.	Capa.
1992			943		397	0	0	0	0	0	0	0	0	0	0
1993	319	217	726	102	295	0	0	0	0	0	0	0	0	0	0
1994	357	241	485	116	179	0	0	0	0	0	0	0	0	0	0
1995	396	264	221	132	47	0	2,800	0	0	0	0	0	0	0	0
1996	436	132	89	47	0	257	2,543	0	0	0	980	0	0	0	0
1997	478	89	0	0	0	245	2,298	0	0	144	836	0	0	0	0
1998	522	0	0	0	0	271	2,027	0	0	251	585	0	0	0	0
1999	567	0	0	0	0	296	1,731	0	0	271	314	0	0	0	0
2000	637	0	0	0	0	336	1,395	0	0	301	13	0	2,170	0	0
2001	677	0	0	0	0	361	1,034	0	0	13	0	303	1,867	0	0
2002	719	0	0	0	0	387	647	0	0	0	0	332	1,535	0	0
2003	762	0	0	0	0	413	234	0	7,700	0	0	349	1,186	0	0
2004	808	0	0	0	0	234	0	209	7,491	0	0	365	821	0	0
2005	857	0	0	0	0	0	0	473	7,018	0	0	384	437	0	0
2006	925	0	0	0	0	0	0	515	6,503	0	0	410	27	0	5,250
2007	978	0	0	0	0	0	0	549	5,954	0	0	27	0	402	4,848
2008	1,034	0	0	0	0	0	0	587	5,367	0	0	0	0	447	4,401
2009	1,092	0	0	0	0	0	0	624	4,743	0	0	0	0	468	3,933
2010	1,153	0	0	0	0	0	0	664	4,079	0	0	0	0	489	3,444

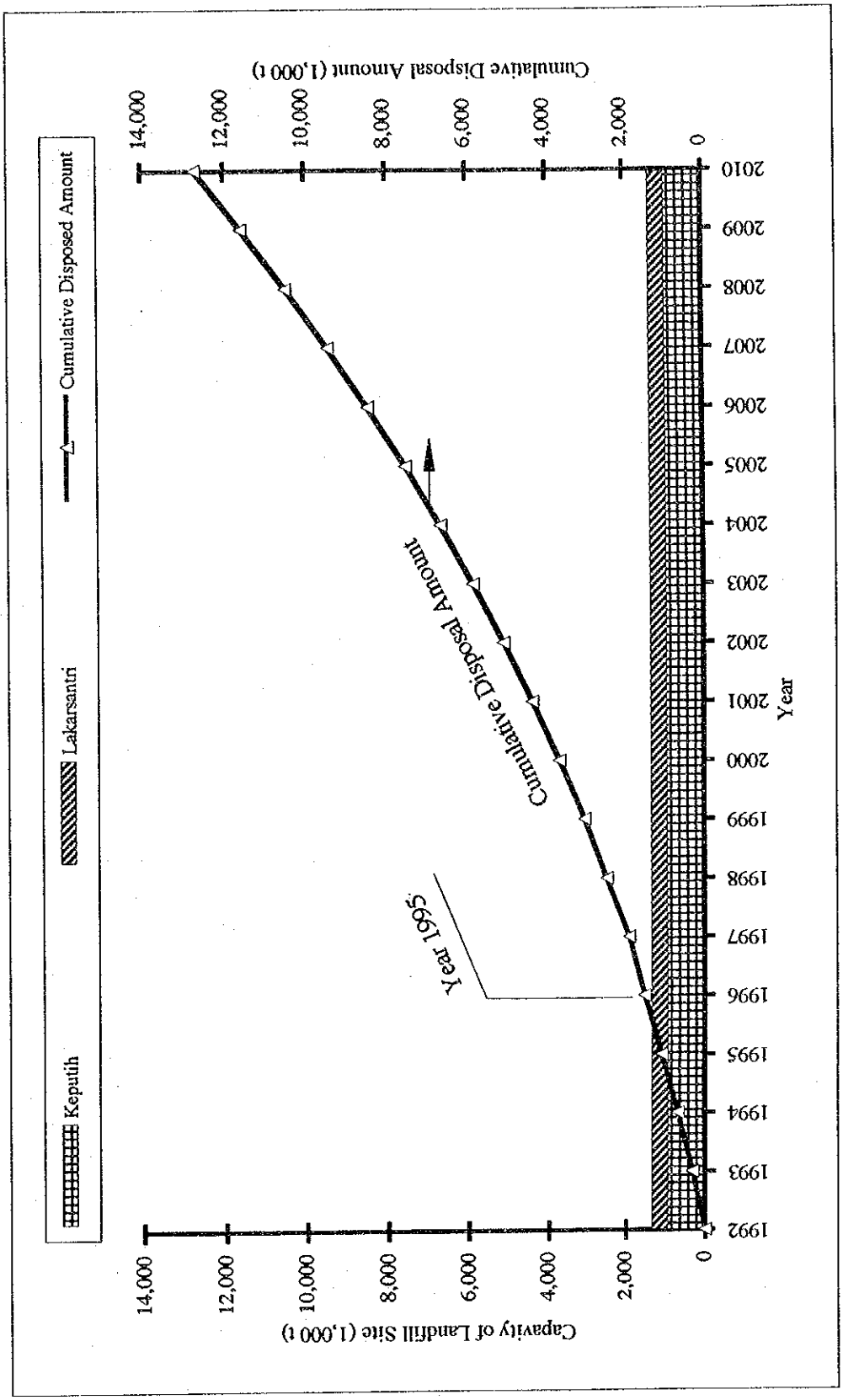


FIG. 2.4-3 LANDFILL DEMAND AND CAPACITY CASE 1

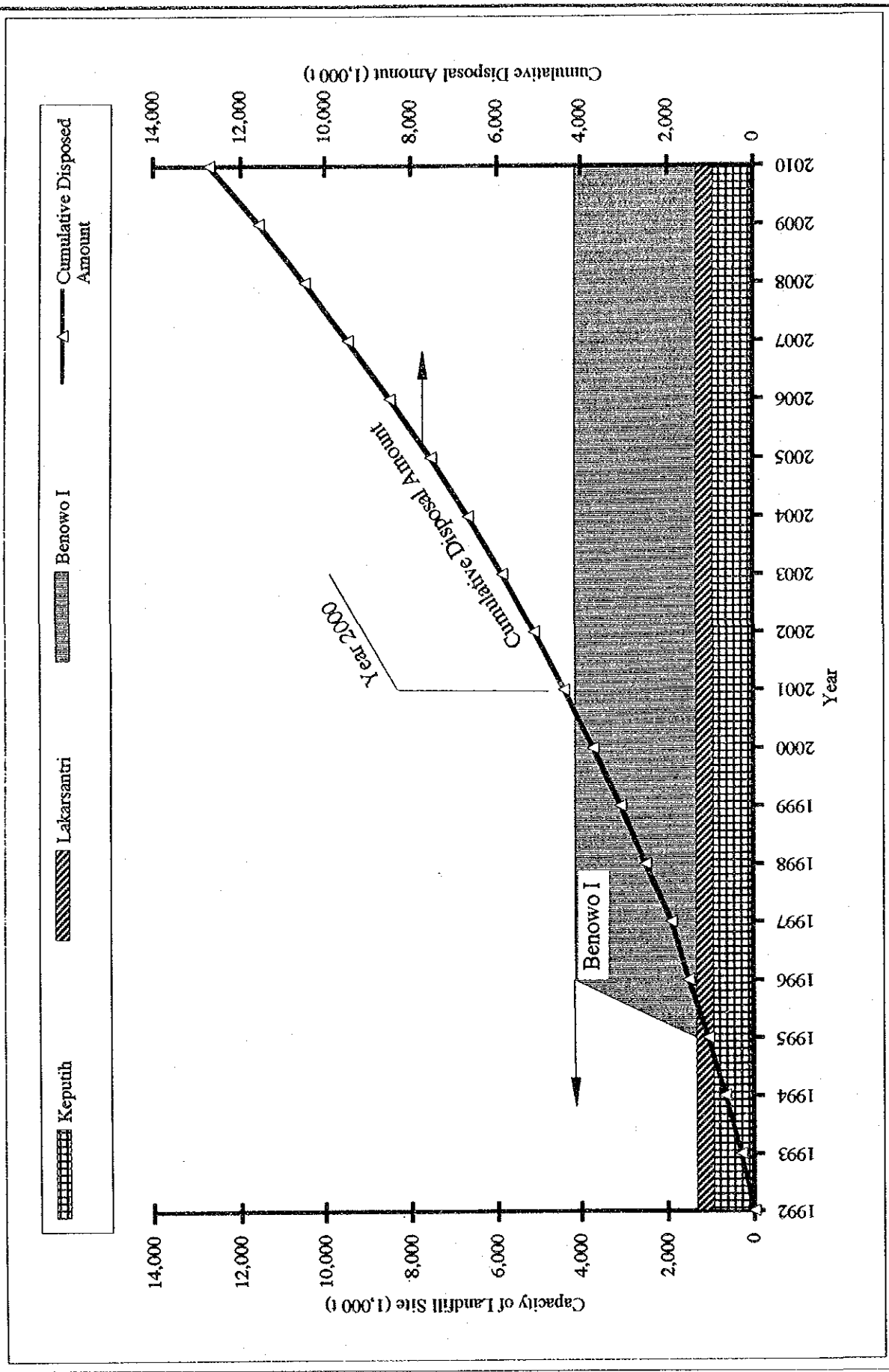


FIG. 2.4-4 LANDFILL DEMAND AND CAPACITY CASE 2

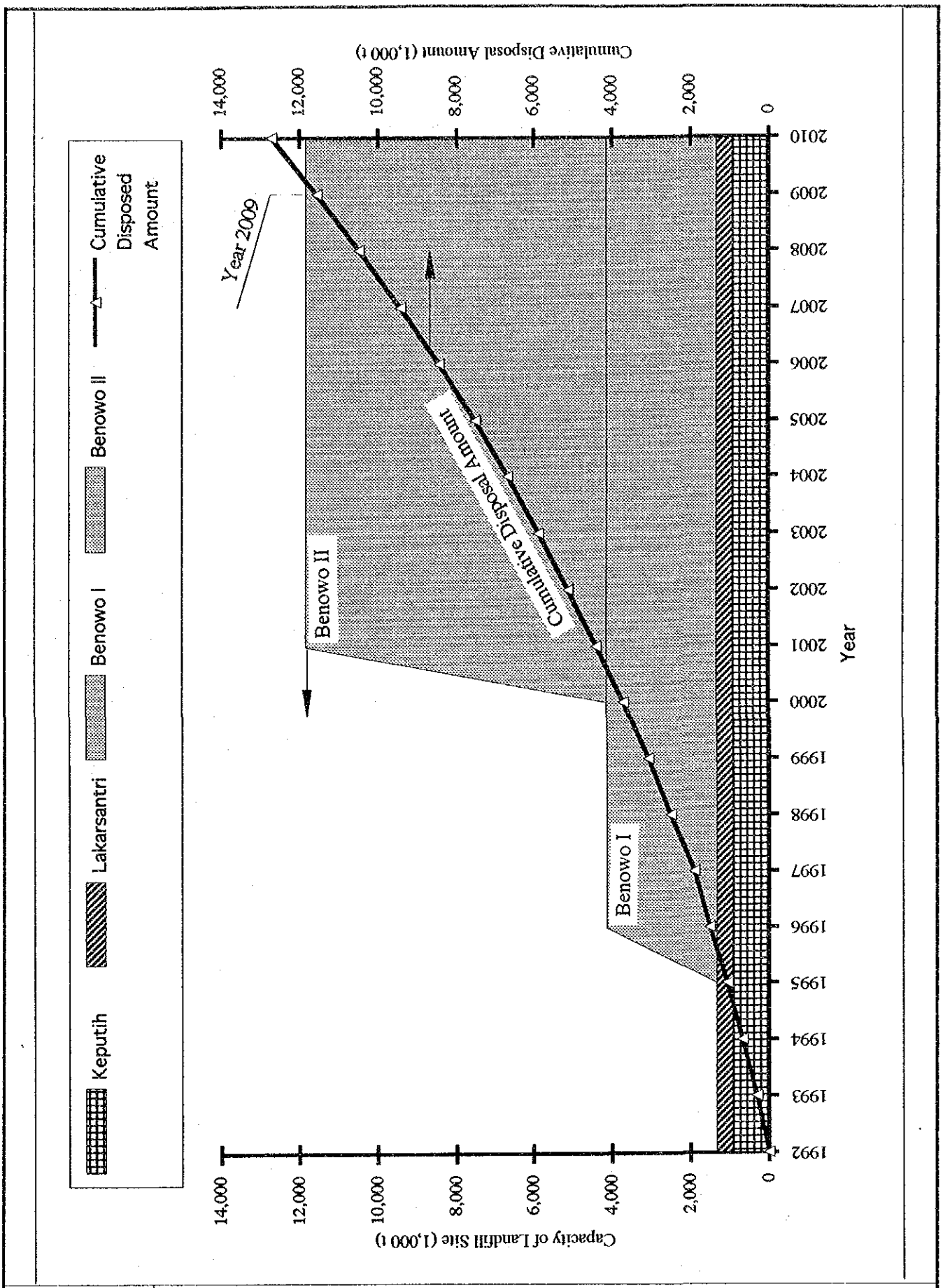


FIG. 2.4-5 LANDFILL DEMAND AND CAPACITY CASE 3

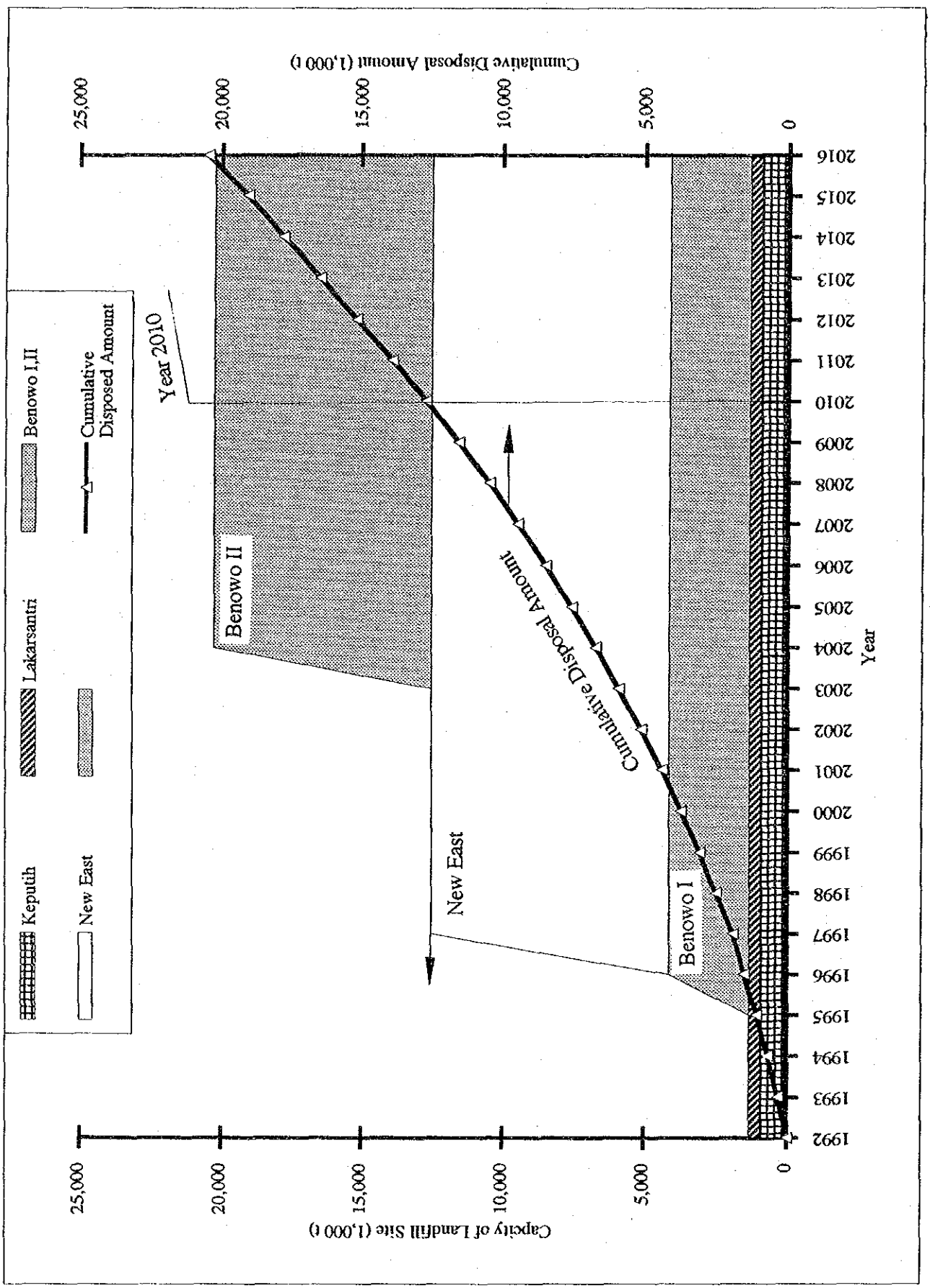


FIG. 2.4-6 LANDFILL DEMAND AND CAPACITY CASE 4

2) Allocation of Landfill Site to Rayon

To minimize the waste haulage distances, the following assignment of landfill sites for each Rayon is assumed. The assumed allocation for the planning period based on Case 4 is shown in Fig. 2.4-7.

a. Central Rayon : assigned to Eastern disposal site, however, before the opening of New East LPA, waste of Central Rayon will be hauled to Western disposal site.

b. North Rayon : assigned to Western disposal site, however, before Benowo is opened, assigned to Eastern disposal site.

c. East Rayon : assigned to Eastern disposal site.

d. South Rayon : assigned to Western disposal site.

e. West Rayon : assigned to Western disposal site.

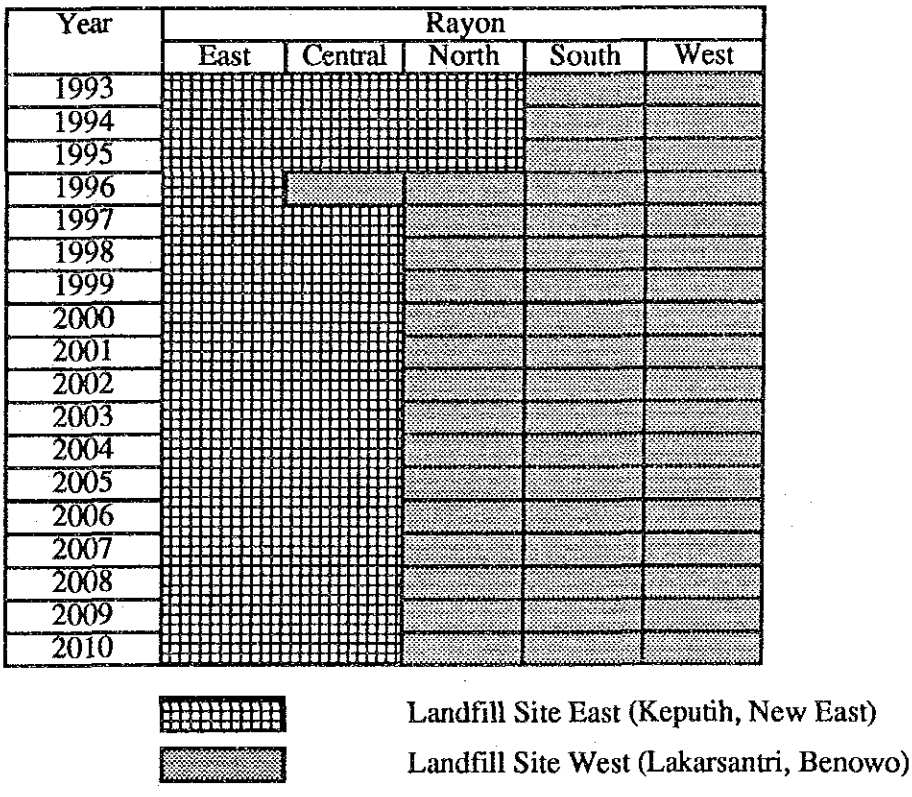


Fig. 2.4-7 Allocation of Landfill Site to Rayon

4.3 Improvement of Existing LPAs

The land once used as a final disposal site is liable to cause an unfavorable influence on surrounding area particularly on water body, for long time even after termination of landfill operation. To improve the sanitary condition is not only natural consequence of solid waste management but also necessary to make future disposal facilities acceptable to neighboring communities.

From this point of view, a sanitary improvement plan is prepared for each existing final disposal site. The key items of the improvement plan are identified, and the necessary countermeasures consisting of technical and administrative measures are proposed as stated below.

4.3.1 Lakarsantri LPA

Considering the present site condition and the situation of disposal operation in the Lakarsantri Landfill site, the objectives and the countermeasures are proposed as stated below.

Table 2.4-7 Improvement Plan of Lakarsantri LPA

Objective	Countermeasure	Remarks
1. Expansion of facility	Land acquisition	4.5ha
2. Leachate treatment	1) Diversionary ditch to prevent the run-off from upstream portion of the site 2) Leachate collection pipes and ditches with pump 3) Oxidation pond 4) Recirculation equipment	1) w=0.5m, l=1.9km 2) pipe ø = 0.3m, l = 1km ditch l = 2.9km pump 3 units 3) a = 1.2ha 4) Electric pump
3. Gas ventilation	Vertical gas vent	gravel pile ø = 1m
4. Prevention of offensive odor and insects	Soil cover	temporary and final
5. Stabilization of garbage Slope	Earthen retaining bund	berm width 5m, h = 5m
6. Upgrade the approach road	1) Improvement of pavement 2) Expansion in width	1) l = 0.3m 2) w = 6m

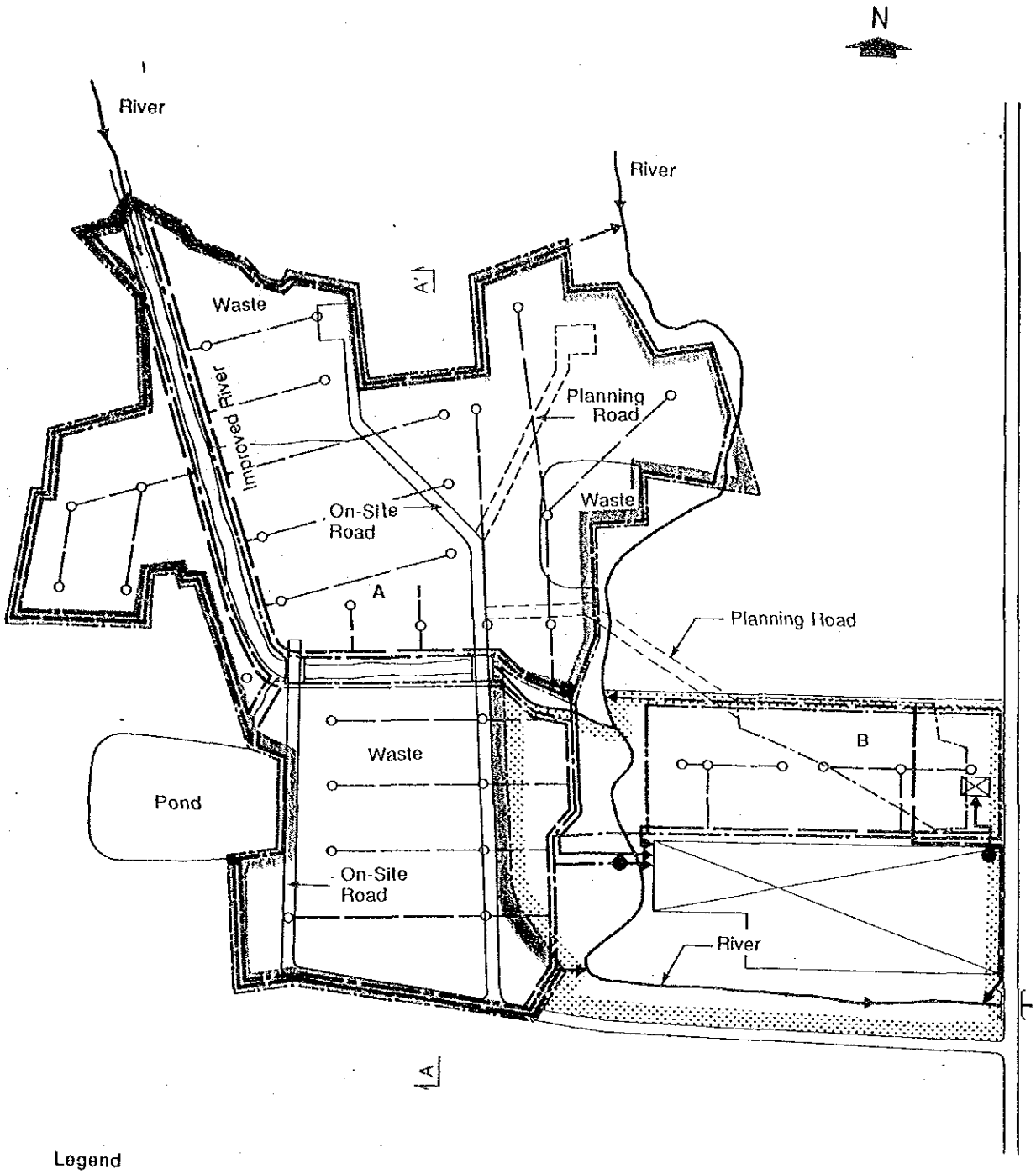


FIG. 2.4-8 GENERAL LAYOUT PLAN OF IMPROVEMENT LAKARSANTRI LANDFILL SITE

THE STUDY ON THE SOLID WASTE MANAGEMENT IMPROVEMENT FOR SURABAYA CITY

4.3.2 Keputih LPA

The objectives of necessary countermeasures for improvements are proposed below.

Table 2.4-8 Improvement Plan of Keputih LPA

Objective	Countermeasure	Remarks
1. Expansion of facility	Land acquisition	11.5ha
2. Leachate treatment	1) Enclosing ditch to prevent the run-off from outside 2) Leachate collection pipes and ditches with pump 3) Oxidation pond 4) Utilization of existing human waste plant for leachate treatment	1) w=0.5m, l=3.8km 2) pipe ø = 0.3, 0.6m l = 10km 3) a = 3.4ha
3. Gas ventilation	Vertical gas vent	gravel pile ø = 1m
4. Prevention of offensive odor and insects	Soil cover	temporary / final
5. Stabilization of garbage Slope	Earthen retaining bund	berm width = 5m, h = 5m
6. Upgrade the approach road	Expansion in width	w = 12m

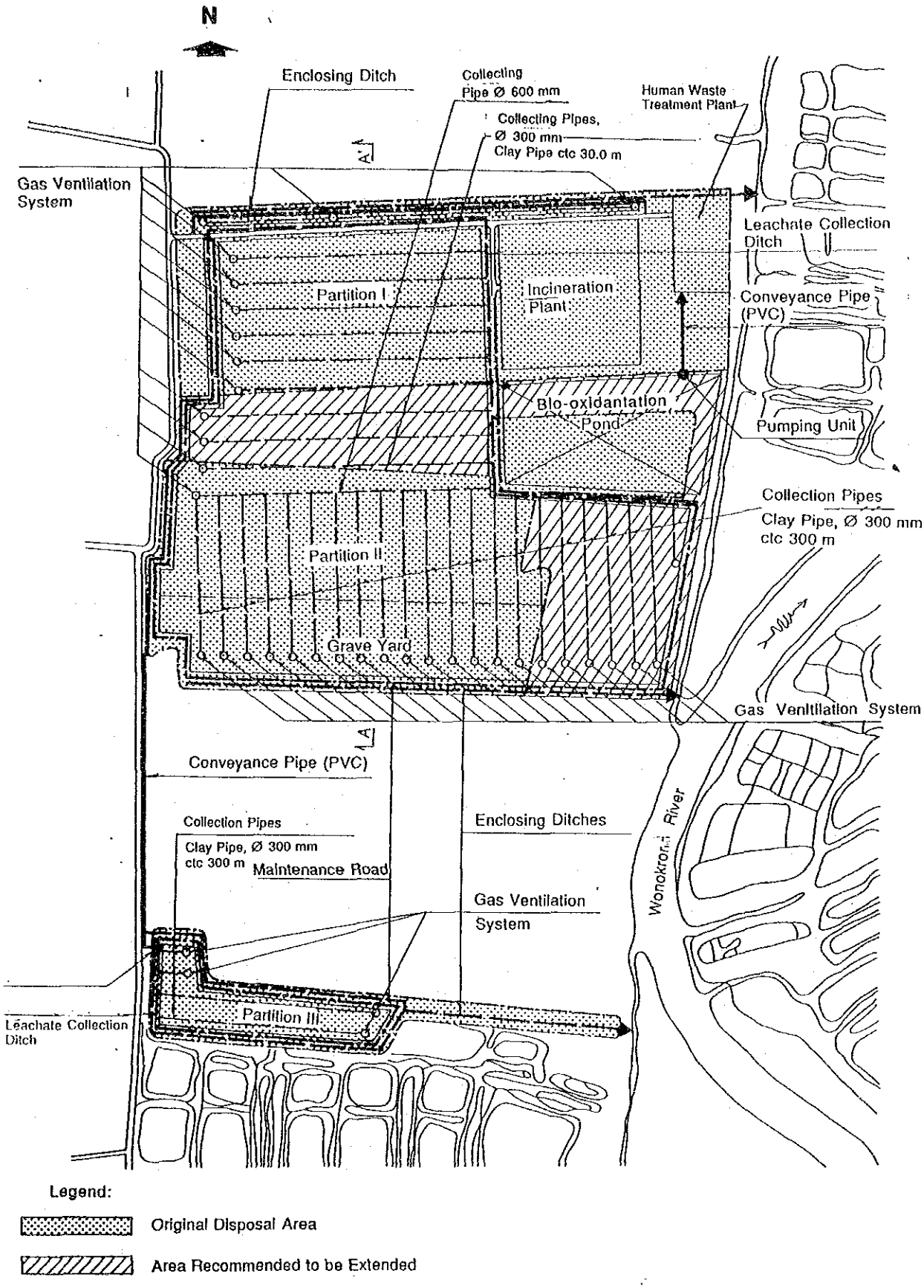


FIG. 2.4-9 GENERAL LAYOUT PLAN OF IMPROVEMENT OF KEPUTIH LANDFILL SITE

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4.3.3 Kenjeran LPA

Kenjeran final disposal site has been used by KMS since 1984. It accepted 5 million m^3 of waste by the closing time in 1992.

Though it was useful to Surabaya City, there remains a problem to be solved. There is a possible water pollution caused by leachate water coming out of the pile of solid waste already buried down. It seems that there is no problem in dry season, however, it is necessary to keep sound condition of neighboring water body even in rainy season.

The operating landfill site is enclosed by an onsite road which consists of rock-made breakwater and soil embankment with a width of about 10 m. The structure has a certain function to prevent seepage of leachate water coming out of site, however, it is uncertain if the pressure of seepage may exceed the impermeability of embankment in rainy season. That is the reason why an introduction of water treatment facility is proposed.

The most important objective is to prevent the intrusion of the pollutant into the adjacent sea area. It is recommended to provide enclosing drain along the road space.

The leachate water treatment plant is also recommended to be provided in the site to treat the leachate generated in the site. The treated leachate will be discharged into the sea area.

To prevent the offensive odor and insects it is recommended to provide the soil covers on the disposed wastes as early as possible.

As for the operation of the water treatment plant, it should be taken care of by the land owner who utilizes the site as a part of recreation facility because the operation is considered to be a component of the maintenance to keep the facility clean. Therefore it is better the operation of the water treatment plant would be entrusted to the owner by KMS Cleansing Department who is to be the constructor of the plant.

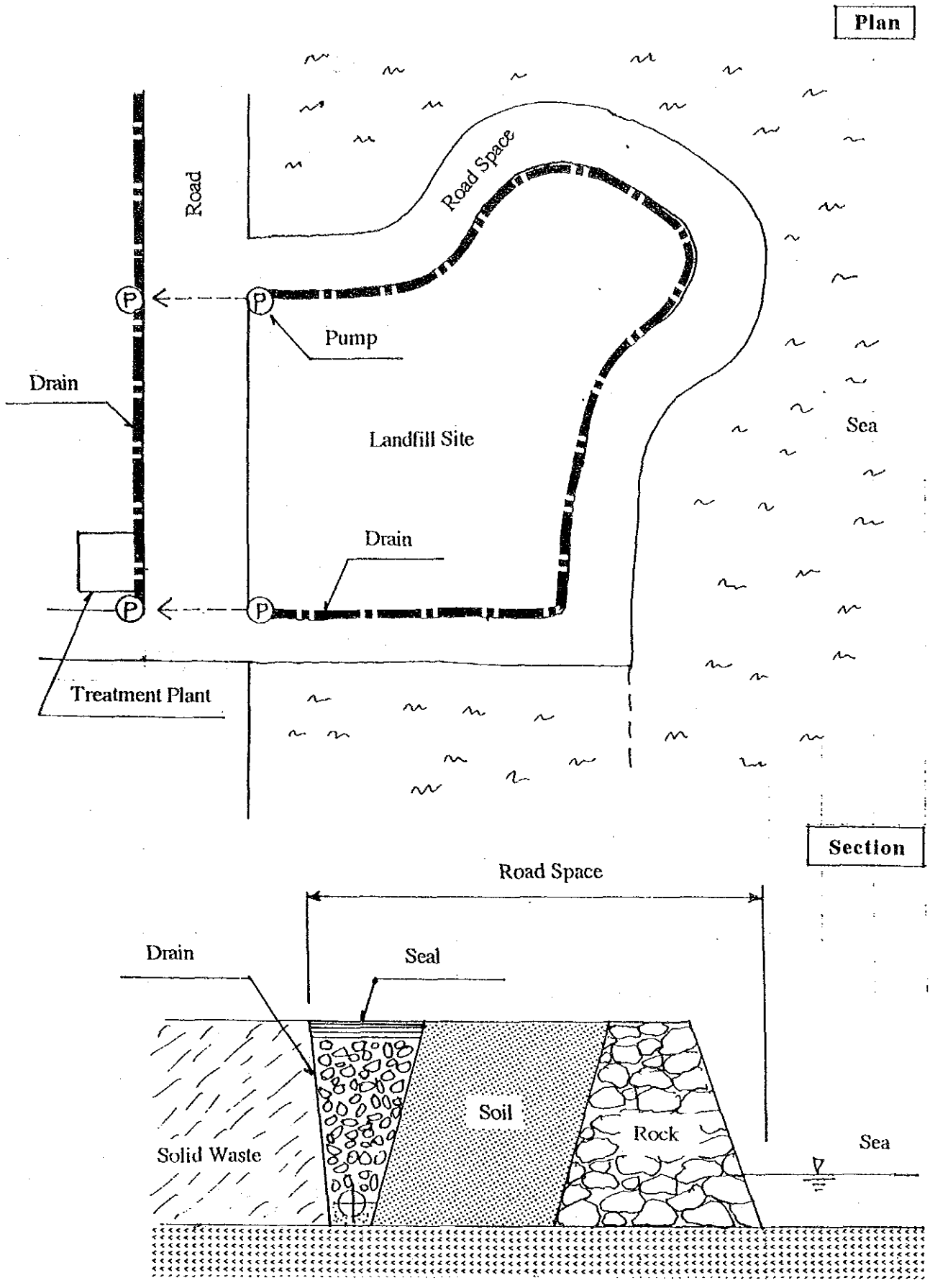


FIG. 2.4-10 CONCEPTUAL PLAN OF IMPROVEMENT OF KENJERAN LANDFILL SITE

4.4 Improvement of Existing Incineration Plant

4.4.1 Improvement Measures

Given the fact that KMS has the irreversible contractual obligation regarding the existing incinerator, it is advised that KMS should make an effective and efficient use of the incinerator. The following measures are suggested to improve the operation of the incinerator:

1) Select More Suitable Waste

It is advisable to select drier waste of higher calorific value for incineration. Such waste can be selected through the consideration on the results of the waste quality analysis.

Among the various kind of wastes, the market waste has a remarkably low calorific value that cannot sustain the spontaneous combustion by itself. Furthermore it contains a lot of coconut peels that obstruct the combustion due to its flameproof nature.

The other kind of wastes have enough calorific value to sustain somehow the spontaneous combustion except during the rainy season. To save the fuel, the waste from market should be excluded.

2) Keep Waste Dry

To improve the combustion efficiency, it is effective to keep the waste in dry condition in spite that the measures might not require so much cost.

For instance, during the storing time of three (3) days in the waste pit of the incinerator, moisture content might have reduced by five (5) % from the original state just after the collection. The reduction of moisture content is a match for the increment of calorific value by 200 kcal/kg at a rough estimate. Therefore it is advisable to secure as long drying time in the pit as possible, and at the same time, to mix them periodically in order to facilitate the drying process.

On the other hand, the wastes are treated outdoors throughout the process, so they are liable to get wet by rainfall. To prevent the wastes from getting wet is also effective to reduce the moisture content. From this point of view, it is advisable to provide with a cover/roof to containers and Depo/LPS to protect the wastes from rainfall.

3) Install Air Pre-heater to Incinerator

The flue gas of the incinerator is now exhausted at high temperature without any effective heat exchange. If an appropriate air pre-heater is installed, the heat recovered from the flue gas can be utilized to warm the intake air for combustion. The heated air may promote the drying process of waste in the furnace and consequently reduce the heat loss of incineration of the waste.

According to a rough estimate of heat balance under the condition of the air pre-heater installed, the annual saving cost of fuel proved to be about 10% as much as the installation cost of the air pre-heater. This suggests the investment cost will be recovered in ten (10) years. The incinerator is expected to continue its operation for longer than ten (10) years from now, therefore the earlier installation of the equipment is recommendable.

Note : Cost of Improvement

Among three proposed measures for improvement of the existing incinerator, the former three (3) are not so costly as to need a specific investment, however, the last one requires a certain amount of investment. The amount of investment is estimated at Rp 936 million for the whole plant consists of six (6) furnaces as explained in the Supporting Report I, Appendix 2.III.

4.4.2 Use of the Existing Incinerator for Incineration of Hazardous Industrial Waste

In May 1992, KMS started an independent waste collection service for major hospitals. Collected hospital waste is carried to and incinerated at the existing incinerator in Keputih. The combustion temperature has been recently increased to around 800 °C, which is high enough to make infectious waste harmless.

In order to make more effective use of the existing incinerator, it is proposed that KMS should use the existing incinerator for incineration of combustible and hazardous industrial waste which will be brought to the incinerator by generators of such waste. KMS should charge some incineration fees from whose who bring such waste.

According to the future hazardous waste treatment plan (proposal) shown in a report entitled "Feasibility Study on Centralized Hazardous and Toxic Waste Treatment Facility in GKS region" prepared by KLH, it is proposed that some facilities for storage and treatment of hazardous waste will be constructed in Gresik. In the first stage, storage facilities only

will be constructed, and treatment facilities in the second stage. According to the report, it is estimated that the sum of future unit costs of storage and treatment of hazardous waste will be about Rp 200,000 per ton on average.

This implies that KMS may charge a certain level of fees, Rp 20,000 - 50,000/ton for example. Assuming that KMS will use one furnace for this purpose and the fee rate is Rp 30,000/ton, KMS' expected revenues of incineration fees would amount to Rp 270 million per year corresponding to 13 % of the annual operation and maintenance cost of the existing incinerator of KMS.

Note :

1. The expected revenue Rp 270 million is estimated through the following calculation: Rp 30,000/ton x 30 tons/day x 300 days/year = Rp 270,000,000
2. The unit incineration cost of the existing incinerator is estimated at about Rp 85,600/ton including depreciation, interest, operation and maintenance costs.

It is advised that KMS had better study the possibility of the hazardous waste incineration from both technical and institutional view points through consultations and discussions with the central government and other relevant organization. The Study Team's preliminary study indicates that 1) combustion temperature of 800°C currently operated is high enough to make hazardous industrial waste harmless and stabilized chemically, and 2) it is not possible to increase the combustion temperature of the existing incinerator over 1,000°C judging from the following disadvantages caused by the combustion under the high temperature:

1. Fly ash is liable to melt and stick to inside the furnace that prevents normal combustion by checking the flue conduit.

2. Phermal Nox will be generated at an enormous rate at the temperature higher than 950°C.

4.5 Construction Schedule

The preliminary time schedule of the improvement of existing disposal sites and the construction of new disposal sites is proposed as shown in Table 2.4-9. In preparing the schedule, the following items are considered.

1. Since the operation of the existing Kenjeran Disposal Site is terminated in 1992, it is possible to commence the improvement works for preventing the intrusion of pollutant water into the sea immediately after such termination of disposal operation.

2. Considering that it is essential to extend the areas of the existing disposal sites, it is important to commence the necessary activities and formalities to acquire the land for such extension of the areas as soon as possible, and the improvement works should also be executed succeedingly after settlement of such land acquisition works.

3. Benowo Landfill Site is scheduled to open in 1996, the construction works of the necessary facilities should be completed by the year.

4. The existing Keputih landfill site is anticipated to be closed in 1997 because it would exhaust its capacity by that time. New East Landfill Site is expected to be opened after the closing of Keputih site for accepting waste from the central and eastern part of Surabaya. Therefore, it is necessary to complete the facilities including land acquisition and provision of approach road thereto by that year.

5. Since the original area (40 ha) of the Benowo Landfill Site will have been filled with wastes in 2004 according to the waste allocation plan, the Benowo Landfill Site should be expanded from the initial gross area of 40 ha to the expanded 150 ha by 2004.

6. It is recommended to complete the improvement of the existing Keputih Incinerator in the early stage of the master plan in order to have effects of the improvement as early as possible.

7. The workshops for repair and maintenance services of the vehicles should be constructed before the final delivery of such vehicles at site.

Table 2.4-9 Construction Time Schedule

Items	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
1. Improvement of Existing Disposal Sites																			
1.1 Keputih Landfill Site																			
1.2 Lakarsantri Landfill Site																			
1.3 Kenjeran Landfill Site																			
2. Construction of New Landfill Sites																			
2.1 Benowo Landfill Site (40 ha)																			
2.2 Benowo Landfill Site (110 ha)																			
2.3 New East Landfill Site (120 ha)																			
3. Improvement of Existing Keputih Incinerator																			
4. Construction of Workshop																			
4.1 Benowo Landfill Site																			
4.2 New East Landfill Site																			
5. Land Acquisition																			
5.1 Extension of Keputih Site																			
5.2 Extension of Lakarsantri Site																			
5.3 Benowo Site (40 ha)																			
5.4 Benowo Site (110 ha)																			
5.5 New East Site (120 ha)																			

4.6 Cost Estimate

The costs required for improving the existing landfill sites and constructing the proposed new landfill sites are estimated on preliminary basis. The estimated costs include i) direct costs required for constructing various facilities such as ditches, pipes, ponds, temporary access and approach roads, etc. including temporary works and material procurement, ii) direct costs for improving the existing incinerator, iii) construction costs for the garages to be provided in the proposed new landfill sites for the heavy equipment, and iv) land acquisition costs for the proposed new landfill sites and the extension of the existing landfill sites including those for the approach roads to be provided to facilitate access from the major roads to the respective sites.

The costs required for improving and constructing the landfill sites are estimated in Rp.213 billion as shown below.

Table 2-4-10 Summary of Preliminary Cost Estimate

(Rp million)

Work Item	Required Cost
1. Improvement of Existing Disposal Sites	12,429
1.1 Keputih Landfill Site	3,810
1.2 Lakarsantri Landfill Site	3,116
1.3 Kenjeran Landfill Site	5,503
2. Construction of New Landfill Sites	164,220
2.1 Benowo Landfill Site (40 ha)	25,611
2.2 Benowo Landfill Site (110 ha)	66,392
2.3 New East Landfill Site (120 ha)	72,217
3. Improvement of Existing Keputih Incinerator	1,030
4. Construction of Workshop	included in above construction cost
5. Land Acquisition	35,298
5.1 Extension of Keputih Landfill Site (11.5 ha)	2,909
5.2 Extension of Lakarsantri Landfill Site (4.5 ha)	2,029
5.3 Benowo Landfill Site (40 ha)	0
5.4 Benowo Landfill Site (110 ha)	0
5.5 New East Landfill Site (120 ha)	30,360
Total Costs	212,977

Note : including tax of 10%

Note: 1. The estimate is based on the prevailing prices collected in Surabaya in 1992.

2. Land acquisition costs for the landfill sites are assumed to be Rp41,000/m^2 (paddy field) and Rp23,000/m^2 (pond), respectively.

3. The costs for improving and constructing the facilities include only direct construction costs for them, but not include taxes.

4. Land acquisition costs for Benowo Landfill Site is assumed to be covered with the income of the sales of the existing landfill site, Keputih and Lakarsantri, after their completion of operation.

5. New East Landfill Site is supposed to have an administrative facilities including workshop for simple maintenance work and daily check. The construction is supposed to be carried out partly during the Feasibility Study period, fiscal year 1992 to 1998, up to 14 ha out of the whole size of 120 ha i.e. 12%. Therefore the estimated investment amount during this period is assumed as follows.

- Land acquisition = @ Rp 23,000/m^2 x 14 ha x 1.1 (tax)
  = Rp 3,542 million

- Construction = 12% x Rp 72,217 million
  = Rp 8,666 million

Chapter 5. Plan for Vehicle Maintenance and Repair

5.1 Introduction

5.1.1 General

Vehicle procurement costs are high in Indonesia and Surabaya relative to labor costs. (Price of a waste haulage vehicle is typically worth a driver's cumulative salary of 50 years or more.) Under this situation, it is very important for KMS to utilize such expensive equipment effectively for long period through good maintenance and repair. Poor vehicle maintenance will easily lower vehicle operation rates, and make the vehicle life shorter, and consequently cause vehicle costs to rise over a certain period. In general, good maintenance brings about the following benefits:

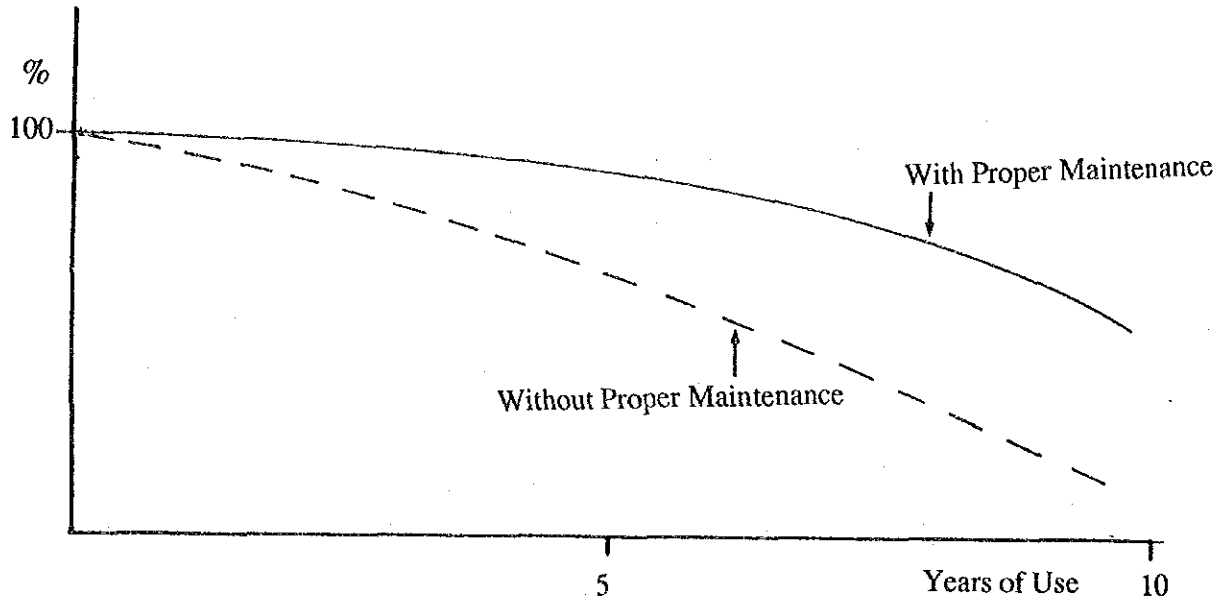
1. Improvement on vehicle conditions, which consequently lead to:
2. Increases in vehicle operation rates, which consequently lead to:
3. Provision of more regular, better and reliable waste haulage service.
4. To make the life of vehicles longer, which consequently leads to:
5. Reduction of vehicles procurement costs.
6. Reduction of repair costs.

The two figures on the next page show the benefits resulting from the improved maintenance: higher operation rates for a longer period, and reductions in repair costs.

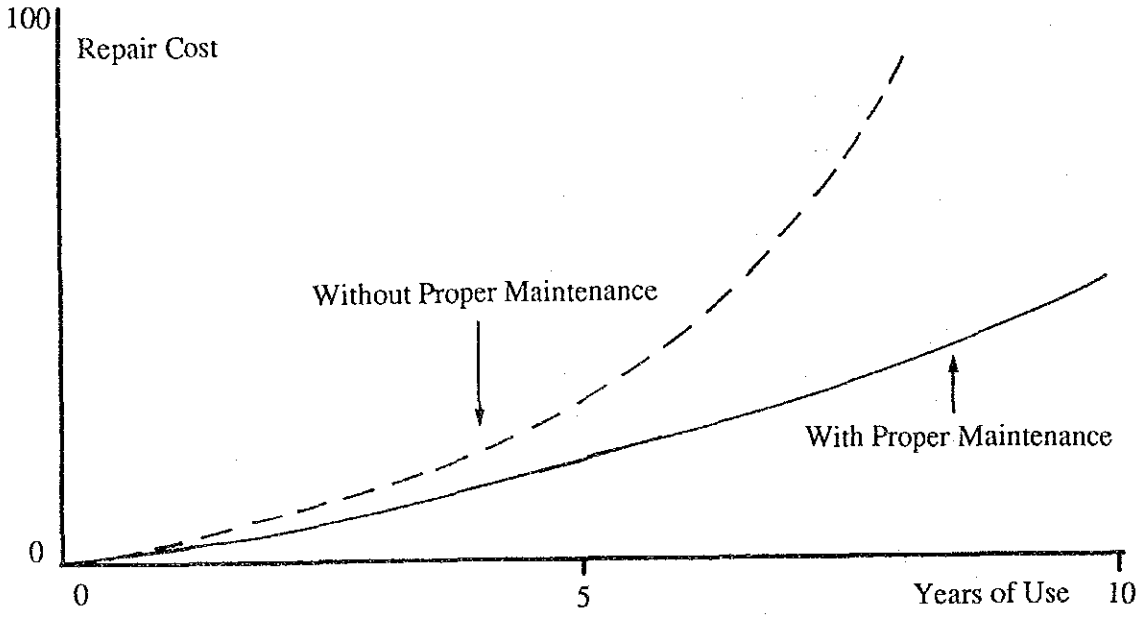
5.1.2 Recommendations

The following is a summary of recommendations discussed in subsequent sections:

1. Introduction of daily checking of vehicles (Refer to Section 5.2)
2. Introduction of regular maintenance services and repairs (Refer to Section 5.3)
3. Quick Procurements of Spare Parts and Increases in Spare Parts Stock (Refer to Section 5.4)
4. Improvements of Asemrowo Workshop (Refer to Section 5.5)
   1) Removal of abandoned vehicles
   2) Remodeling of the Workshop
   3) Procurement of tools and equipment for maintenance



Vehicle Operation Rates with/without Systematic Maintenance and Repairs



Repair Costs with/without Systematic Maintenance

FIG.	2.5-1	Vehicle Operation Rates with/without Systematic Maintenance and Repairs
	2.5-2	Repair Costs with/without Systematic Maintenance

5.2 Introduction of Daily Checking of Vehicles

Drivers should check their vehicles everyday before leaving the garage in the morning, and record results of the checking in a check sheet. Samples of the check sheet are shown on the next two pages. The purposes of the daily checking are as follows:

a. To know vehicle conditions and avoid vehicle troubles.
b. To utilize the information (recorded in the check sheet) so that a maintenance chief can plan and decide on the timing and items of repairs to be carried out.

FIG. 2.5-3 Daily Check Sheet for Haulage Vehicles (Sample Format)

Daily Check Sheet for Vehicle

Truck No. _____ Date ____ (D) ____ (M) ____ (Y)

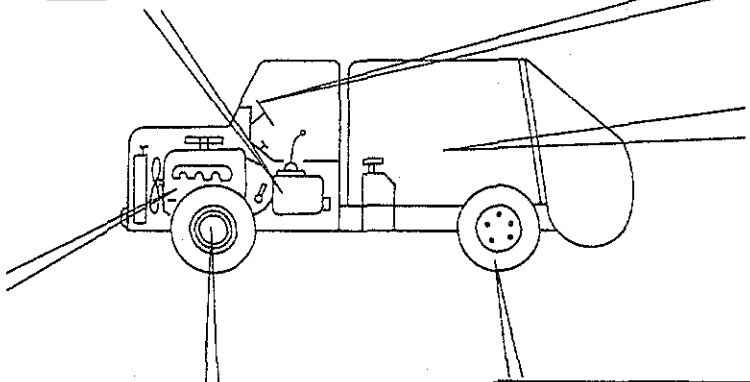
Odometer _____ (Km) Inspector Name _____

Inspection Mark	
✓	= Adjustment required
x	= Repairs required
o	= Good condition

Chassis & Body	Check
1. Visible damage exterior interior	
2. Lost•Loose bolts & nuts	
3. Leakage Oil & Water	
Remarks	

Engine System	Check
1. Cooling water level	
2. Flaw•Tension of the fan belt	
3. Engine oil level	
4. Engine will Start normally	
5. Color of exhaust smoke	
Remarks	

Main Clutch & Transmission	Check
1. Hydraulic clutch oil level	
2. Free travel dimension of clutch pedal	
3. Abnormal noise in the main clutch housing	
4. Shifter-control lever will work normally	
5. Abnormal noise in the transmission case	
Remarks	



Instrument Panel & Steering	Check
1. Condition of each gauges • Speed•Fuel•Water temperature • Engine oil Pressure•Ammeter	
2. Condition of each lamps	
3. Normally free play of steering wheel	
Remarks	

Work Equipment	Check
1. Hydraulic Oil (for work equipment)	
2. Condition of Work equipment	
Remarks	

Brake System	Check
1. Hydraulic brake oil level	
2. Condition of the hand brake	
3. Condition of the foot brake	
4. Normally travel dimension of break pedal	
Remarks	

Tires	Check
1. Air Pressure	
2. Wear•flaw	
3. Loosen bolts & nuts	
Remarks	

Electrical System	Check
1. Head lamps•Small lamps	
2. Stop lamps•tail lamps	
3. Winker lamps	
4. Horn	
5. Wipers	
Remarks	

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Daily Check Sheet for HE

Type HE ____________________

Date ________ (D) ________ (M) ________ (Y)

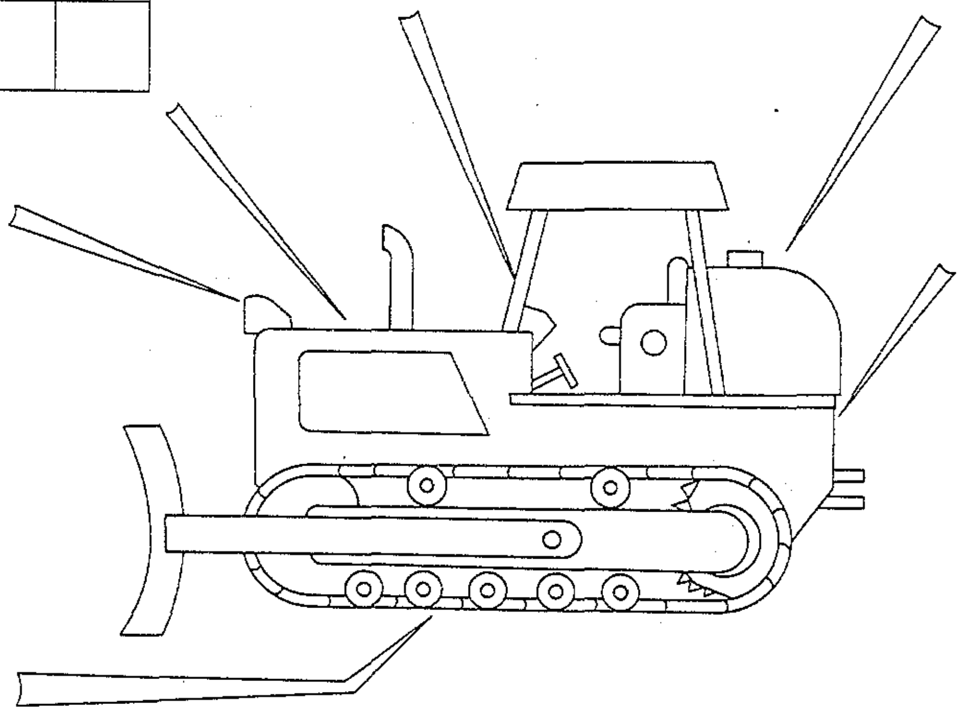
Inspector Name ____________________

Engine System	Check
1. Engine Oil Level	
2. Cooling Water Level	
3. Flaw Tension of the fan belt	
4. Engine will start Normally	
5. Color of Exhaust Smoke	
Remarks	

Brake & Steering System	Check
1. Condition of the Foot Brake	
2. Condition of the Steering	
3. Main Clutch & Transmission Oil Level	
4. Abnormal Noise in the Clutch & Transmission	
Remarks	

Chassis & Body	Check
1. Visible damage Exterior Interior	
2. Lost, Loose Bolts & Nuts	
3. Leakage Oil	
4. Hydraulic Oil Level	
Remarks	

Electrical System	Check
1. Head Lamp	
2. Starting System	
3. Horn	
Remarks	



Work Equipment	Check
1. Condition of Work Equipment	
2. Lost, Loose Bolts & Nuts	
Remarks	

Under Carrage System	Check
Track Roller	
Track Link	
Shoes	
Idler	
Sprocket	
Upper Roller	
Remarks	

Supplement Oil	
Engine	ℓ
Transmission	ℓ
Hydraulic	ℓ
Grease	kg
Remarks	

FIG. 2.5-4 **Daily Check Sheet for Heavy Equipment (Sample Format)**

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5.3 Introduction of Regular Maintenance Services and Repairs

5.3.1 Maintenance and Repairs of Waste Haulage Vehicles

The regular maintenance (changes of engine oil and filters, and application of oil and grease to necessary parts) and early repairs are very important to keep vehicles in good conditions, and to save the future repair costs.

1) Maintenance and Repairs of 18 Poor-Conditioned Vehicles

Of the 62 waste haulage vehicles owned by KMS, 18 vehicles (14 containers trucks with the capacity of 6 m^3 manufactured in 1981, 1982, and 1985, and 4 dump trucks) are old. They are in poor conditions. It is recommended that the Cleansing Department will execute systematic maintenance services and repairs for those vehicles. The following table shows the recommended schedule (activity cycle) for the maintenance and repair of the vehicles.

Table 2.5-1 Recommended Maintenance and Repair Activity Cycle for 18 Poor-Conditioned Trucks

		Vehicle OPERATION	MAINTENANCE & REPAIR ACTIVITIES REQUIRED
a.	1st day	Suspended (1 day)	Maintenance service (changes of engine oil and filter, and greasing)
b.	Next 10 days (12th - 10th days)	Operated (10 days)	Make a plan for repairs (Determine parts to be repaired, place orders for necessary spare parts)
c.	Next 5 days(12th - 10th days)	Suspended (5 days)	Repair troubled systems in such orders as brake system, electric system, springs, body, and keep the record of repairs executed.
d.	Next 30 days	Operated (30 days)	None

As shown above, a complete maintenance/repair/operation cycle takes 46 days, one and a half months. Therefore, there will be 8 cycles in a year. Commencement timing of the maintenance activity cycle should differ by trucks.

In one cycle, there is one (1) day for maintenance services, and five (5) days for repairs during which the vehicle cannot be operated. Annual total number of non-operating

days is 48 days (6 days/cycle/truck x 8 cycles), which is 13 % of 365 days/year. The 13%, however is lower than the current average non-operating rate of 18 %.

Annual maintenance costs (costs of changes of oil filters, fuel filters, and air filters) will range from Rp 60,000 to Rp 100,000 per truck. Annual repair cost is estimated at about Rp 3.5 million per truck at the current price. Parts to be repaired are shown in the table below.

Table 2.5-2 Parts of 18 Poor-Conditioned Vehicles to be Repaired

SYSTEM	PARTS TO BE REPAIRED
Engine	Nozzle, Water pump, Radiator
Steering	Steering box, Yoke
Electrical system	Lamp, Harness, Charge, Starting
Chassis & Spring	Chassis, Spring, Shock Absorber
Transmission & Clutch	Propeller shaft, and Overhaul of Transmission & Clutch
Brake	Wheel Cylinder, Overhaul of Brake lining
Attachment	Hydraulic pump, Valve, Pump, Overhaul of Cylinder
And Others	Cable, Bolts, Rubber, Battery
Body Reconditioning	Repair Cabin & Painting

2) Maintenance of Other Vehicles (44 units) (other than the 18 poor-conditioned trucks)

Other 44 vehicles are relatively new and in good conditions. However, some repairs will naturally be necessary. It is estimated that about Rp 800,000/truck/year would be needed to repair the future damages to be made to battery, lamps, brake, system, spring, etc.

3) Overhaul of Engines

It is proposed that engines of the following 4 vehicles should be overhauled at private workshops.

- Arm-roll truck serving for 6 m^3 Containers [(Toyota Dyna (81)] : 1 unit
- Arm-roll trucks serving for 6 m^3 Containers [(Isuzu TLD56 (85)] : 3 units

Engine parts such as nozzle, valve, piston, piston ring, bearing gasket set should be changed through the overhaul.

5.3.2 Repair of Containers (6, 10, & 12 m^3)

There are many containers which are damaged by corrosion. Damages occurs particularly on the sides of containers. It is recommended that the Workshop would repair such damages by replacing damaged parts with new steel plates. The cost of repair of a 6 m^3 container is estimated to be about Rp 410,000/container, which is less than 10% of the price of a new container. Therefore it is recommended that the Workshop will repair the damaged containers by using own men.

5.3.3 Maintenance and Repairs of Heavy Equipment

As shown in the following table, the Cleansing Department has 7 bulldozers, 2 soil compactors and 1 wheel loader, of which 5 bulldozers and 1 wheel loader are currently operated.

A major trouble with the heavy equipment is damages made to the undercarriage. Of the five (5) operating bulldozers, four (4) need repairs of the undercarriage. Damages to the undercarriage is mostly caused by corrosion, which probably is made by waste leach ate on the disposal sites.

Engines of most of heavy equipment are in good conditions. Even the two bulldozers which are not used can be operational upon the repair of the damaged undercarriage.

It is estimated that the repair cost of the damaged undercarriage is less than 10 percent of the purchase cost (about Rp 300 million) of a new bulldozer. Therefore, it is recommended that the Cleansing Department will repair the damages of the undercarriage, and use the bulldozers instead of buying new ones.

When repairing the undercarriage, it is important to change not only damaged parts but also parts which are worn away to some extent because the use of partly-worn-away-parts may cause other newly-changed-parts to be worn out quickly.

Table 2.5-3 Conditions of the Existing Heavy Equipment

PRODUCT	NO	OPERATIONAL OR NON-OPERATIONAL	SITE	CONDITIONS
Caterpillar D6C Bulldozer	01	Operational	Keputih	Manufactured in 1977. Very poor condition. The undercarriage needs a repair.
Komatsu D65E Bulldozer	01	Operational	Keputih	The undercarriage needs to be repaired. Early repair is advisable.
Komatsu D65E Bulldozer	02	Not Operational	Kenjeran	Not used due to the serious damages made to the undercarriage.
Komatsu D65E Bulldozer	03	Operational	Kenjeran	The undercarriage is seriously damaged, and needs repair.
Caterpillar D6D Bulldozer	01	Operational	Kenjeran	The undercarriage is seriously damaged, needs repair.
Caterpillar D6D Bulldozer	02	Not Operational	Keputih	Not used due to the serious damages made to the undercarriage.
Caterpillar D6D Bulldozer	03	Operational	Lakarsantri	The undercarriage was repaired this year.
Fiat Soil Compactor	01	Operational but Not Used	Keputih	Although this compactor is operational, it is not used as it is not useful.
Fiat Soil Compactor	02	Operational but Not Used	Keputih	Although this compactor is operational, it is not used as it is not useful.
Caterpillar Wheel-loader 920	-	Operational	Keputih	Good condition.

5.4 Quick Procurements of Spare Parts and Increases in Spare Parts Stock

Quick procurements of spare parts and adequate stock are vital for keeping high vehicle operation rates. However, it is often reported that some vehicles are not operated due to the shortage of necessary spare parts, and it sometimes takes a few months before the Workshop receives spare parts after placing an order.

It is highly recommended that the process of spare parts order would be simplified, and more authority and funds be given to the Cleansing Department for quicker and sufficient procurement of spare parts including spare tires.

It is surprising to note that there are as many as 40-50 punctures (flat tires) occurring everyday. Such frequent occurrence of the flat tires is due to the use of over-used tires. It is observed that the defacement rate of the existing tires is 35 on average (Defacement rate of a new tire is 100.) It is recommended that the Cleansing Department would change all tires which are less than 50.

In addition, it is advised that the Workshop will always keep sufficient stock of tires (50 % of the number of newly required tires).

5.5 Improvements of the Asemrowo Workshop

This section discusses the improvements of the Asemrowo Workshop through the following three matters:

1) Removal of abandoned vehicles
2) Remodeling of the Workshop
3) Procurement of tools and equipment for maintenance

5.5.1 Removal of Abandoned Vehicles and Containers

An apparent physical problem with the Asemrowo Workshop is that much of the area is occupied with abandoned trucks and containers. There are as many as 37 abandoned trucks waiting for a permission for official abandonment which are to be given by the municipal parliament. It seems that the Cleansing Department asked for such a permission three times since 1986, but did not receive the permission yet.

The existence of many abandoned vehicles and container has been causing not only obstacles to the traffic in the Workshop area, but also dangers as a passing vehicle may hit other vehicles while passing narrow areas on the premise.

The removal of the abandoned trucks and containers is a prerequisite for the remodeling of the Workshop.

5.5.2 Remodeling of the Asemrowo Workshop

It is proposed that the Workshop area should be remodeled in such a manner as to divide it into two major parts: one part for parking area, the other for maintenance and repair area. The purpose of the remodeling is to use the Workshop area more effectively and safely.

A fuel pump station should be provided in the Workshop. It is planned that the remodeling plan will be executed in the fiscal year 1994/95. A plan for the remodeling is shown in Part 5 of this main report.

5.5.3 Purchase of Tools and Equipment for Maintenance and Repairs

Asemrowo Workshop is not equipped with adequate tools and equipment for maintenance and repairs. For example, the Workshop does not have equipment such as gauges for measuring the accuracy and appropriateness of repairs and adjustments made.

Table 5.2-10 in Part 5 of this main report shows a list of tools and equipment to be purchased. The listed tools and equipment are recommended as basic ones necessary for carrying out proper and effective maintenance and repairs.

It is planned that the listed tools and equipment should be procured in the fiscal year 1994/95.

Although most of the listed tools and equipment are relatively simple and easy to use, the adequate training on the usage of those equipment should be provided.

Chapter 6. Waste Amount Reduction

6.1 Introduction

6.1.1 Benefits of Waste Amount Reduction

It is considered that the following benefits are brought about through the waste amount reduction.

1. Cost saving of waste management
2. Cleaner environment
3. Saving of natural and other resources through reuse and recycling

The figure below shows the relationship between the waste amount reduction and the recycling/reuse and their benefits.

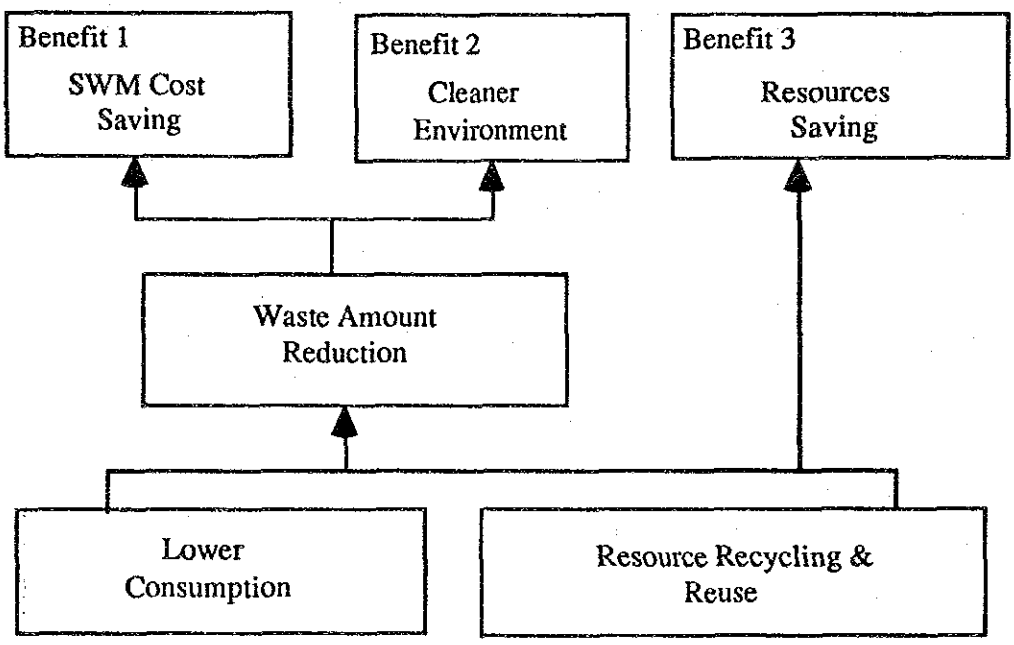


Fig. 2.6-1 Relationship between Waste Amount Reduction and Recycling/Reuse and Their Benefits

6.1.2 Governmental Options for Promotion of Waste Amount Reduction

Recycling and reuse market is one of the markets where the market failure occurs. In other words, people in general do not directly feel the benefits arising from the activities of this market and waste reduction. For example, it is the municipal government who directly can have the benefit of the SWM cost saving through waste reduction. And, it is rather the future generations who have the benefits of cleaner environment and resource saving

Means to Promote Waste Amount Reduction and Waste Recycling/Reuse

1. Provision of people with some economic incentives to do so, or with disincentives (economic or legal penalties) for activities leading to waste increases.

2. Education and campaign

3. Research, development, and diffusion of recycling technologies

Provision of economic incentives or disincentives would be the most powerful way for waste reduction and recycling/reuse. Examples of those incentives or disincentives are as follows:

a. To hold generators of large waste amount responsible for waste management
b. Volume-based rates of sanitary retribution (fees)
c. Support of recycling markets (Amount of financial subsidies could be equivalent to the amount of the benefits which are indirect to market participants.)
d. Support of waste pickers
e. Fines imposed on illegal waste dumping
f. Deposit-refund system (for bottles and cans)
g. Disposal tax on products

6.1.3 Ways for Reduction of Waste Amount

The following table shows activities contributing waste amount reduction at different levels.

Table 2.6-1 Activities Contributing to the Waste Amount Reduction

Actors	Activities
A. Reduction of Waste Generation	
1. At Manufacturers Level	1) Improvement of products design so as to make the products more recyclable. 2) Recycling within the manufacturing process. 3) Recycling and waste exchange among different industries. 4) To put labels to give users information on products so that users can dispose of the products properly for recycling. 5) Use of packageless or less packaged products.
2. At Distributors' Level	4) Less use of package materials. 5) Removal of nutshell of hard fruits
3. At Users and Household Level	6) Separation of reusable and recyclable materials for selling or for separate waste collection. 7) Selection of products of less waste generating or recyclable types 8) Use of house garbage compost facility
B. Recycling After Materials Turned into Waste	
4. Waste Pickers Level	9) Waste picking (scavenging)

6.2 Waste Amount Reduction in Surabaya

Reuse and recycling of resources are actively conducted in Surabaya as compared to most cities in Japan and other industrial countries. This is mainly because the relative value of reusable or recyclable materials to new materials is higher in Indonesia than in Japan and other countries.

It is a general tendency that recycling and reuse will be less as the economic standard rises. Therefore, it is important for KMS to take effective measures for the promotion of reuse and recycling.

It is considered that there are the following ways for KMS to promote waste amount reduction.

1. Shift of waste management responsibility from KMS to waste generators of large amount.

   This has been already agreed by KMS officials. This arrangement will provide waste generators with incentives to reduce waste generation for reduction of waste management costs that they have to pay.

2. Application of volume-based rates of the sanitary retribution to business establishments for which KMS provide waste haulage and disposal service.

   The more the waste, the higher the fee they have to pay under this arrangement. This arrangement will give waste generators strong incentives to reduce waste discharge amounts.

3. Encouragement of removal of nutshell of hard fruits before transporting into markets in Surabaya.

   Waste in Surabaya contains much garbage. According to the JICA Study Team' Survey, garbage shares 54 % of municipal waste on average. Fruit waste such as nutshell of coconut shares a large portion of garbage. Therefore, removal of the nutshell will much contribute to waste reduction.

4. Promotion of separation of recyclable materials at sources through campaign and dissemination of information to local communities.

   A way for the promotion of separation of recyclable materials is to organize "Most Active Recycling Community Competition", and give an award to the winning community.

5. Promotion of waste separation system by using small scale composting facility. Cleansing Department KMS has a conceptual plan on waste separation system as illustrated in Fig. 2.6-2. KMS has been planning to promote waste separation at

the point of discharge based on the utilization of separated use of dust bin identified by its color, yellow and blue. The new conceptual plan added the use of small scale composting facility distributed at various place in accordance with the waste handling flow. Though the effect of reduction derived from the execution of the plan is not clarified yet, it can be thought a progressive way even if it is introduced gradually within the limitation of KMS budget.

6. Continued support of waste pickers

Waste pickers contribute to the resource recycling. In this sense, waste pickers are part of waste management system in Surabaya. KMS has been actively supporting waste pickers in terms of education on waste picking, family supports, and training for changing job.

It is advisable that KMS will continue to support them. However, it is the tendency experienced in many counties that waste picking activities will decrease as the economic standards rise.

It is advisable for KMS to give higher priority to the promotion of reuse and recycling of materials before being thrown as waste rather than promotion of recycling after being thrown as waste.

KMS Policy Regarding Scavengers and Comments

Both KMS and the Central Government have a policy to support scavengers morally, socially and economically in the short and medium term, and encourage them to change their occupation to more-socially respected ones in the longer term.

KMS has the following policies regarding scavengers:

a. To acknowledge and recognize scavengers as a socially-useful group helping KMS in the solid waste management.

Remarks : It is expected such positive recognition will be helpful to the reduction of criminal activities that might otherwise occur.

b. To make scavengers form a Scavengers' Association in order to strengthen their status, and to facilitate the communication between the scavengers and the government.

Remarks : Such association has already been established. KMS financed the construction of the head office building of the Association.

c. To make the relationship between the scavengers and the yellow troop (sweepers and garbage collection workers) closer and friendlier to facilitate the cooperation between them for better and efficient job results.

Remarks : KMS hosted some gatherings and events for this and other purposes.

d. To guide the scavengers to change the job in the future, and guide also their children not to follow their parents' job.

Remarks : Bandung and Jakarta municipal governments in cooperation with GTZ conducted a project to find the best guidance to them.

JICA study Team considers that these policies are very good policies. It seems that KMS been implementing these policies successfully.

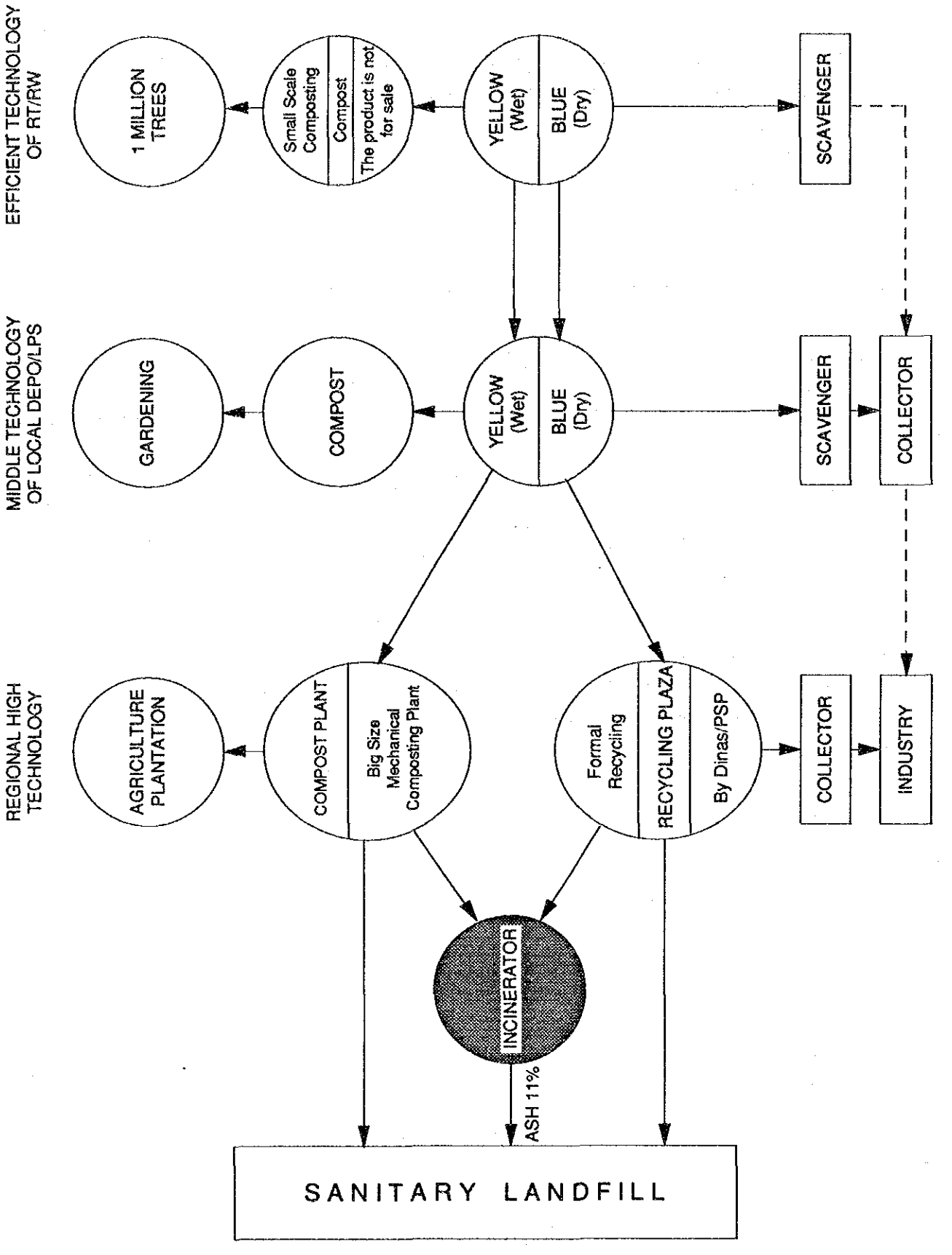


FIG. 2.6-2 CONCEPTUAL PLAN ON WASTE SEPARATION SYSTEM

THE STUDY ON THE SOLID WASTE MANAGEMENT IMPROVEMENT FOR SURABAYA CITY

JICA

Chapter 7. Institutional and Revenue Improvement Plan

7.1 Purpose of the Plan

Main purposes of the plans proposed in this chapter is to enable KMS 1) to save SWM costs, 2) to increase revenues, and to strengthen the organizational capacity. The table below shows the plans and their purposes.

Table 2.7-1 Institutional Plans and Their Purposes

Plans	Purpose of Proposals		
	Cost Saving	Increases of Fee Revenue	Streng-thening of Organiza-tional Capacity
1. Shift of waste haulage responsibility from KMS to generators of large waste amount	√		
2. Increases in the use of contractors (Contracting Out)	√		
3. Establishment of an independent cleansing authority (Perusahaan Daerah Kebersihan) in Surabaya.	√	√	√
4. Fee revenue improvement 1) Increases of fee rate 2) Application of volume-based fee rates to business establishments 3) Use of PLN tariff payment points		√	

7.2 Shift of Waste Haulage Responsibility from KMS to Generators of Large Waste Amount

7.2.1 Current Situation

It is estimated that the haulage and disposal of commercial and industrial waste cost KMS about Rp 3,000 million in 1992 assuming that the cost is proportional to the amount of waste managed, while KMS collected the sanitary retribution of Rp 1,300

million from the commercial and business establishments in 1992. The difference is financed by KMS' general budget. [Note: It is estimated that KMS managed 223 ton/day of business waste, 44 % of the total waste managed by KMS, while KMS' total cost of solid waste management is estimated to be Rp 12.5 billion in 1992. A 44 % of Rp 12.5 billion is about Rp 3 billion.]

The municipal regulation No. 6/1986 requires that those who generate solid waste of 2.5 m^3 or more each day to haul waste to the designated LPA by themselves unless they request the Cleansing Department to do so.

Taking the advantage of the last phrase " unless they request ...", many of those who have to haul waste by themselves request KMS to do so. In 1992, the total amount of waste hauled by waste generators themselves was only137 ton/day on average, of which 85 ton/day was hauled to the three (3) designated LPA, while the remaining 52 ton/day was hauled to unauthorized places.

As agreed by the KMS officials, it is planned that KMS will make it obligatory for those generating 2.5 m^3 or more each day to haul their waste by themselves due to the reasons stated in the following section.

7.2.2 Reasons for Shifting Waste Haulage Responsibility from KMS to Generators of Large Waste Amount

The reasons for the planned shift of responsibility include the following:

1. KMS can save costs.
2. The proposed shift of the responsibility is desirous from the Beneficiary Pay Principle (BPP).
3. The proposed shift of the responsibility is desirous also from environmental view point because this shift will give waste generators incentives for reducing waste generation.

The recommended shift of the responsibility is also desirous considering the following situation.

a. Business establishments that discharge large amount of waste have financial ability to have their waste hauled either by themselves or by using contractors.

b. Business waste will increase faster than household waste in Surabaya - like many other cities in the world.

7.2.3 Enforcement and Target

1) As a first step, KMS should apply this new regulation to Market Authority (PD Pasar). PD Pasar is the biggest waste generator in Surabaya. Total market waste generation amounted to as much as 258 ton/day of on average in 1992. It however takes time for the PD Pasar to make arrangements to have their waste hauled by themselves or by contractors. During the time of the arrangement which should be less than a few years, KMS may haul market waste at prices close to the full costs.

2) It is proposed that KMS will apply the new regulation to more number of waste generators, and strengthen the enforcement year by year. The following table show the target application in terms of amount of waste to be hauled by generators themselves. It is proposed that the ratio of self-hauled-waste to total waste generation amount will reach to 25 % by the year 2000.

Table 2.7-2 Target Waste Amount to be Hauled by Waste Generators Themselves

Year	Total Waste Generation in Surabaya (1)	Waste to be Hauled by Generators (2)	Percentage (1) + (2) = (3)
1992	1,626 ton/day	137 ton/day	8 %
1995	1,882 ton/day	332 ton/day	18 %
2000	2,402 ton/day	601 ton/day	25 %
2005	3,066 ton/day	767 ton/day	25 %
2010	3,913 ton/day	978 ton/day	25 %

7.3 Increases in the Use of Contractors (Contracting Out)

7.3.1 Advantages of Increases of Contracting Out

("Contracting Out" means to use contractors to let them do a part of the services that have to be originally provided by the public agency.)

Increases in the contracting out bring about the following benefits:

1. KMS can save substantial costs.

   Note: An estimated cumulative costs to be saved by the contracting out of the waste haulage service is Rp 22.8 billion (Rp 1.2 billion/year) during the period 1992 - 2010 assuming that 1) average haulage cost of contractors is 66 % of KMS' cost, and 2) KMS will increase the contracting out from the current 30 % to 73 % by the year 2010.

2. Technological development can possibly be promoted by the intensive use of contractors.

   Note: For example, if the waste collection and haulage from mini containers is contracted out, contractors would attempt to select the most cost-effective haulage system (either FEL or REL trucks), and modify and develop the technologies tto make them more cost-effective.

3. Coverage of waste collection and haulage can be expanded if an appropriate contract method is applied.

   Note: If the contract price is based on the amount of waste hauled, and provision of containers is the responsibility of contractors, contractors will attempt to increase waste haulage amounts as much as possible even by placing containers in places wherever placement is possible.

7.3.2 Target Degree of Contracting Out

It is proposed that KMS will increase its degree of the contracting out to 73 % in the year 2010 from the current rate of 30 % as shown below.

Table 2.7-3 Target Waste Haulage Amount and Degree of Contracting Out

Unit: Ton/Day

Year	Total Waste to be Hauled (1)	Waste to be Hauled by KMS' Trucks (2)	Waste to be Hauled by Contractors (1) - (2) = (3)	Degree of Contracting Out (3) ÷ (1) = (4)
1992	889	621	268	30 %
1995	1,007	621	386	38 %
2000	1,312	621	691	53 %
2005	1,752	621	1,131	65 %
2010	2,310	621	1,689	73 %

7.3.3 Type of Haulage Systems to be Contracted Out

Type of haulage systems to be contracted out should be determined on the basis on degree of benefits expected through the contracting out.

KMS uses two major haulage systems:

1) Haulage with small containers
2) Haulage with large containers

It is considered that the contracting out of the 1st system (haulage with small containers) would bring about more benefits than the contracting out of the second system (haulage with large containers) would.

KMS will be able to save Rp 6,266/ton, 38 % of the unit cost of KMS' haulage with small containers if such service is contracted out, while the corresponding saving to be made in case of contracting out the haulage service with large containers is Rp 3,125/ton, 31 % of the KMS' unit cost. See the table below:

Table 2.7-4 Comparison of Expected Cost Savings through the Contracting Out of Two Haulage Systems

	Estimated Unit Cost of KMS' Own Operation (1)	Estimated Unit Contract Price including KMS' Supervision Cost (2)	Expected Saving for KMS (1) - (2) = (3)
1. Haulage with small containers	Rp 16,353/ton (100 %)	Rp 10,087/ton (62 %)	Rp 6,266/ton (38 %)
2. Haulage with large containers	Rp 10,172/ton (100 %)	Rp 7,047/ton (69 %)	Rp 3,125/ton (31 %)

See Appendix to Chapter 7 for details of the above-estimated costs.

With respect to the future responsibility to be shared by KMS and its contractors, it is advised that:

1. KMS will be responsible for:
   1) Waste haulage service (621 ton/day on average) with large containers,
   2) Waste haulage of special waste (collected through community voluntary work and bulky waste on request base)

2. Contractors will be responsible for:
   1) All the remaining haulage service with large containers,
   2) All the haulage service with small containers

7.3.4 Inclusion of Provision and Maintenance of Containers in the Contract

It is advised that the future contract with waste haulage contractors will include the provision and maintenance of containers due to the following reasons:

1. A complete responsibility for a haulage system (consisting of containers and trucks) will make contractors to choose or develop a better haulage system.
2. The contract price may decrease as a result of choosing most cost-effective system comprising of containers and trucks of appropriate type and capacity..
3. A complete responsibility for a haulage system will reduce the risk of contractors' failure.
4. Coverage of waste collection and haulage service would increase.

7.3.5 Conditions for Increasing the Contracting Out

KMS should satisfy the following conditions in order to increase the contracting out of the waste haulage service:

Conditions to be Met in order to Increase the Contracting Out of Haulage Service

1. Increases of the contract price
2. Longer contract period - at least one year
3. To lease or sell KMS' used trucks if contractors accept it.
4. The unit contract price should be decided on tonnage base (Rp/ton), not volume base (Rp/m^3). For this purpose, KMS needs to purchase truck scales to be placed in LPA.

7.4 Establishment of an Independent Cleansing Authority (Perusahaan Daerah Kebersihan Surabaya)

7.4.1 Advantages and Disadvantages of Establishing PDK

Major advantages are:

1) Increases in the service efficiency and cost effectiveness
2) Increases in cost recovery - more realization of Beneficiary Pay Principle (BPP) through a clearer and stronger linkage between revenues and expenditures

Possible disadvantages are:

1) Less availability of public cooperation

   This has not been proved yet. However, even if it is so, this disadvantage can be overcome through the mother municipal government' supports in the fields of the law enforcement, and public education and instruction.

2) Loss of the central government funds for basic salary of employees of PDK

This disadvantage to a local government is a money saving advantage to the central government. There is no net disadvantage to the Indonesian society as a whole. From BPP view point, it is more fair and sound that local SWM service costs be paid by its citizens who directly receive the service.

The advantages are absolute, permanent and much greater than the disadvantages, which are transitional and can be overcome through the mother municipal government' supports.

7.4.2 Conditions for Establishing PDK

To establish PDK in Surabaya is feasible and recommendable with the following conditions:

Condition 1. A mother municipal government should provide its PDK with supports in the following areas:

1) Law enforcement, and public education and instruction
2) Guidance and supports of waste pickers
3) Financial supports

Condition 2. A new concept for evaluation of the benefits of establishment of PDK should be developed.

1) The maximization of financial profits should not be considered as a prime target of PDK.

2) Benefits of establishment of PDK should be evaluated in terms of degree of improvements achieved after the establishment in the following areas:

a. Increases in cost effectiveness of the SWM services
b. Increases in cost recovery ratio
c. Improvements of cleanliness of the city
d. Expansion of service coverage

7.4.3 Financial Supports

1) Necessity

The reasons that PDK needs financial supports from its mother municipal government are as follows:

a. There always exist free riders who receive SWM service without paying fees because the elimination of free riders is difficult because there is no effective way to punish the free riders. (The stoppage of SWM services for free riders are not only difficult from operational view point, but also undesirable from sanitary view point because the stoppage of the service may cause them to throw away their waste into public spaces.)

b. In the unavoidable presence of free riders, any attempts for full cost recovery from the honest fee payers alone would impose unfairly high financial burden on the honest fee payers, which is not desirable from the Beneficiary Pay Principle.

2) Appropriate Amounts of Subsidies

Appropriate amounts to be provided by the mother municipal government for PDK are the ones which are close to the gap between the actual costs of SWM services and the target fee revenue.

3) Target Amounts of PDK' Fee Revenue

A target amount of fee revenue is equal to the cost of SWM services provided for the fee payers.

4) Necessity for Selecting Appropriate Base on Which Amounts of Subsidies are Determined

Item 2) does not means that the municipal government should automatically finance the above gap. Such automatic way of financing the gap will deprive PDK of incentives to increase its fee revenues, and save costs.

Table 2.7-5 Evaluation of the Alternative Methods for Deciding Amounts of the Subsidies

Alternatives	Long Term Impacts (More important than short term impact.)	Short Term Impacts
Alternative 1 Amounts of subsidies are determined based upon the costs of provision of capital equipment and facilities	[A] No negative impacts. Expected percentage of subsidy under this Alternative will be about 30 - 35 % of the total SWM costs.	[A] No negative impacts.
Alternative 2 Amounts are determined based upon a fixed percentage of PDK' expenditures	[B-] Amounts of subsidy could substantially change depending on amounts of PDK's capital investments. This situation would reduce the financial autonomy of PDK in the medium and long term.	[B-] More the expenditure, more the subsidy PDK can receive. This situation is not sound, and may affect PDK's incentive for improving the service efficiency in short term.
Alternative 3 Amounts are determined based upon fixed a percentage of PDK' fee revenue	[C] There is not much logical justification for this Alternative. This Alternative does not match with the characteristics of SWM services either.	[A] More the revenue, more the subsidy PDK can receive. This situation will encourage PDK to increase its fee revenue in the short term.
Alternative 4 Amounts are quivalent to the gap between the accounting costs and the target fee revenue.	[C] This method will significantly reduce PDK's incentive for increasing fee revenues or for saving expenditures once PDK's fee revenue reached a target level.	[A] The amounts determined under this Alternative is very appropriate based upon an application of Beneficiary Pay Principle.
Alternative 5 Any amounts are provided necessary to fill gap between actual SWM expenditure and actual fee revenue	[C-] This alternative gives PDK no incentive for improving its efficiency in the long run. This Alternative will completely spoil the financial autonomy of PDK, therefore, it will not serve for the purpose of establishing PDK.	[B+] The subsidy provided under this Alternative will completely satisfy PDK's need for cash.

5) Appropriate Base on Which Amounts of Subsidies are Determined

Alternative methods for deciding the amounts of subsidy are presented and evaluated in Table 2.7-5. The most appropriate alternative is Alternative 1 [use of procurement costs of major equipment (trucks, etc.) and construction costs of facilities (LPA & Depo) as the base for determining amounts of the subsidy] because (1) this alternative would not spoil PDK's incentives for increasing its service efficiency and for strengthening cost recovery efforts, and (2) amounts of subsidies to be determined under this alternative would be close to the ideal subsidy amounts; the gap between the SWM service cost and the target fee revenue.

6) Sub-Alternatives for Deciding Amounts of Subsidies

The recommended Alternative 1 can be developed into the following sub-alternatives:

1.1 PDK's all investment expenditures for major equipment and facilities will be paid by its mother municipal government.

1.2 Annual amounts of subsidies will be equivalent to accounting costs (depreciation and interests) of major equipment and facilities.

1.3 Annual amounts of subsidies will be equivalent to depreciation costs of major equipment and facilities.

1.4 A mother municipal government will lease capital equipment and facilities to PDK at very low rates - 10 % of equipment prices at maximum.

An appropriate sub-alternative is the one that will generate subsidies close to the gap between the actual SWM expenditures and the target fee revenue. The target fee revenues differ depending on cities and time. Therefore, an appropriate sub-alternative will differ as well depending on cities and time.

7) Special Financial Supports during Early Period of PDK

During early period of PDK (for the first 10 years), special subsidies for covering salary of transferred employees, and maintenance and repair costs of equipment may be necessary.

7.5 Fee Revenue Improvement

This Section proposes the following three methods for increases of the fees.

1. Increases of Rates of the Sanitary Retribution
2. Application of Volume-Based Fee Rates to Business Establishments
3. Use of PLN Fee Collection Points as Collection Points of the Sanitary Retribution

7.5.1 Increases in the Fee Rates

1) Current Fee Revenue

KMS' SWM cost and net revenue (sanitary retribution) in 1991 is estimated as follows:

1.	Total SWM Cost:	Rp 12,500,000,000	(100 %)
2.	Net Revenue to KMS:	Rp 3,340,000,000	(27 %)
3.	Gap between the Cost and Revenue:	Rp 9,160,000,000	(73 %)

Notes:
1) The above-shown total SWM cost include estimated depreciation cost of trucks and incinerators.

2) The net revenue is calculated as follows:
Rp 3,975,000,000 (Gross revenue) - Rp 635,000,000 (handling charges paid to those involved in the fee collection) = Rp 3,340,000,000

The cost recovery is 27 %, which much lower than the corresponding percentage (70 %) of the Cleansing Authority of Bandung (PDKB).

Fee Payers

It is estimated that 399,000 payers paid the sanitary retribution in 1991, which is 94 % of an estimated number of recipients of SWM service provided by KMS.

1.	Number of Registered Households & Business Establishments	530,000	(100 %)	
2.	Estimated Number of Recipients of SWM Service Provided by KMS:	424,000	(80 %)	(100 %)
3.	Number of Fee Payers	399,000	(75 %)	(94 %)
4.	Number of Non-Fee Payers (Free Riders)	25,000	(5 %)	(6 %)

Note: Of the registered number of households and business establishments, the number of business establishments are about 20,000.

The above two facts that 1) cost recovery ratio is as low as 27 %, and 2) ratio of fee payers to an estimated number of SWM service recipients is as high as 94 % mean that the rates of the fee (retribution) is low.

2) Proposed Target and Policy for Increases of Fee Revenue

a. Planned Increases in Fee Rates

KMS has a plan to substantially increase rates of the sanitary retribution from 1993 as shown below.

Table 2.7-6 Rates of the Sanitary Retribution

Types of Households	The Existing Rates (Household/month)	New Rates (Household/month)
1. Household Type B*1	Rp 500	Rp 1,000
2. Household Type A*2	Rp 1,000	Rp 2,000*3 Rp 3,000*3

Notes:
*1: Household Type B is those facing roads of which width is 6 m or less
*2: Household Type A is those facing roads of which width is more than 6 m.
*3: The fee rates (Rp 2,000 or Rp 3,000) for household type A will depend on the width of roads to which houses face.

Expected fee revenues after application of the new fee rates are shown in the following table.

Table 2.7-7 Expected Fee Revenue after Application of the New Rates

Types of Households	New Rate (Household/ month) (Rp) (1)	Number of Fee Payers (2)	Expected Revenue per year (Rp Million) (1) x (2) = (3)	Net Revenue After Deduction of Handling Charges (Rp Million)
1. Household Type B*1	Rp 1,000	68,225*1 246,000*2 314,225	Rp 819 m. Rp 2,952 m. Rp 3,771m.	Rp 737 m. Rp 2,184 m Rp 2,921 m.
2. Household Type A*2	Rp 2,000 Rp 3,000	43,592 21,796 65,388	Rp 1,046 m. Rp 785 m. Rp 1,831 m.	Rp 942 m. Rp 706 m. Rp 1,648 m.
3. Business Establishment	Rp 5,750	18,918	Rp 1,305 m.	Rp 1,175 m.
4. Total		398,531	Rp 6,907 m.	Rp 5,744 m.

Notes:
1. Fee payers marked with *1 are those who pay through PDAM (Water Authority.)
2. Fee payers marked with *2 are those who pay through RT/RW.
3. Net revenues (the most right column) are calculated assuming that handling charges will 10 % of the fee revenue collected through PDAM, and 26 % of the fee revenue collected through RT/RW.
4. It is assumed two thirds (2/3) of the household type A will pay Rp 2,000/month, and the remaining one third (1/3) will pay Rp 3,000/month.

The expected net revenue, Rp 5,744 million is 1.7 times of the current net fee revenue, Rp 3,340.

b. Policy and Targets for Fee Revenue Increases

Targets and policy for the future fee revenue are proposed as follows:

1. KMS will increase its fee rates every three years.

2. KMS should increase its fee (retribution) revenue so that the cost recovery ratio will increase every three years by 3 % over the previous cost recovery ratio as shown in the table below. (With the planned increases of fee rates, the cost recovery ratio will be 50 % in 2006.)

The following table is prepared based upon the above proposed targets and policy.

Table 2.7-8 The Future SWM Costs and Proposed Cost Recovery Ratio

Unit: Million Rupiah in 1992 price

Year	Projected SWM Cost (1)	Expected Cost Recovery Ratio (2)	Target Net Fee Revenue (1) x (2) = (3)	Fee Rates Index (1991 Fee Rate = 100)
1991	Rp 12,500	27 %	Rp 3,340	100
1994	Rp15,000	38 %	Rp 5,744	172
1997	Rp 18,000	41 %	Rp 7,380	221
2000	Rp 21,600	44 %	Rp 9,504	285
2003	Rp 25,900	47 %	Rp 12,173	364
2006	Rp 31,100	50 %	Rp 15,500	464
2009	Rp 37,300	53 %	Rp 19,769	592

Note: It is projected that the cost of SWM service will increase by 20 % in each 3 years in real term due to 1) increases in waste amount, and 2) application of higher standard of disposal systems.

7.5.2 Application of Volume-Based Fee Rates to Business Establishments

Application of the volume-based fee rates to business establishments (generating waste of less than 2.5 m^3/day) is proposed in view of the expected benefits as shown below. (Business establishments generating 2. 5 m^3 or more each should haul their waste by themselves as proposed in Section 7.2.)

Advantages to be Brought by the Application of Volume Based-Fee Rates

1. This method is more fair than a fixed rate method.
2. Fee revenues can substantially increase.
3. This method gives waste generators incentives to reduce waste generation.

The Cleansing Authority of Bandung (PDKB) introduced the volume based fee rates in 1987. As a result, the fee revenue from business establishments dramatically increased from Rp 409 million in 1986 to Rp 988 million in 1987 (241 % of the 1986 revenue). PDKB's current fee rate is Rp 4,650/m^3.

7.5.3 Use of PLN Tariff Collection Offices as SWM Fee Collection Points

It is proposed that KMS will request PLN (State Electric Company) that KMS can use PLN' tariff collection offices as points of collection of the sanitary retribution. This method is practiced by the Cleansing Company of Bandung (PDKB). PDKB substantially increased its fee revenue through the application of this method.

Like PDKB, it is expected that KMS would be able to increase its fee revenue through the following two factors.

1. Increases of fee payers

Number of households with PLN connection is estimated to be about 400,000, while the number of households with PDAM (Water Company) is only 153,000.

2. Reductions of handling charges to be paid to those involved in the fee collection

The handling charge to be paid to PLN is expected to be about a few percent. In addition, this method would require administrative costs; salary for fee collectors staying in PLN' tariff collection points. The total cost including the handling charge and administrative costs would be about 5 % of the gross fee revenue.

On the other hand, the current handling charges paid to PDAM and RT/RW are much higher than 5 % as shown below:

- Handling charges paid to PDAM: 10 %
- Handling charges paid in case of Non-PDAM collection (RT/RW, Offices of Kelurahan, Kecamatan, etc.): 26 %

Appendix to Chapter 7. Major Assumptions and Cost Details Used for Estimation of the Unit Contract Prices and KMS' Costs Used in Table 2.7-4

1. 10 m3 Compactor Truck and Small Containers

a. Major Assumptions

	KMS	CONTRACTORS
1. Truck Purchase Price	Rp 109,300,000	Rp 109,300,000
2. Duration of Truck	7 years	10 years
3. Duration containers	5 years	5 years
4. Number of containers served per trip	12 units	12 units
5. Number of trips to LPA per day	3 trips/day	4 trips/day
6. Loan period	20 years	5 years
7. Loan interest	10.5 %/year	25 %/year
8. Number of Crew (per Person)		
8.1. Driver	1	1
8.2 Assistant	2	1
9. Rate of Salary of Crew		
9.1 Driver	Rp 2,760,000/year*1	Rp 3,300,000/year
9.2 Assistant	Rp 1,500,000/year	Rp 1,800,000/year
10. Density of waste		
10.1 Base of contract volume	0.2 ton/m^3	0.2 ton/m^3
10.2 At container	0.33 ton/m^3	0.33 ton/m^3
10.3 After compaction	0.396 ton/m^3	0.396 ton/m^3

*1: Note on Salary rate of driver of KMS:

- Basic Salary:	Rp 150,000
- Incentive:	Rp 60,000
- Premee:	Rp 20,000
Total:	Rp 230,000

b. Assumptions on Waste Amount Hauled

	KMS	CONTRACTORS
1. Average waste collected per container (1 m3)	0.33 ton/container	0.33 t/container
2. Average waste hauled per trip (12 containers)	3.96 ton/trip	3.96/trip
3. Average umber of trips per operating day	3 trips/day	4 trips/day
4. Waste amount hauled per truck per operating day	11.88 t/truck/d	15.84 t/truck/d
5. Average number of operating days per year	310 days/y	310 days/y
6. Average amount hauled per truck per year	3,683 t/truck/y	4,910 t/truck/y

c. Cost per Truck per Year (10 m^3 Compactor Truck and Small Containers)

		KMS	CONTRACTORS
1.	Depreciation	Rp 15,614,000	Rp 10,930,000
2.	Loan interest	Rp 11,476,000	Rp 6,832,000
3.	Operation & Maintenance		
	3.1 Fuel	Rp 5,000,000	Rp 6,667,000
	3.2 Salary of Drivers and Assistants	Rp 5,760,000	Rp 5,100,000
	3.3 Tax and insurance	Rp 2,590,000	Rp 2,590,000
4.	Maintenance	Rp 1,366,000	Rp 1,530,000
	(% of Truck purchase cost: 12.5 % for KMS, 14 % for Contractors)		
5.	Cost of containers (36 for KMS, 48 for Contractors)		
	5.1 Depreciation of containers per truck	Rp 4,320,000	Rp 5,760,000
	5.2 Maintenance of containers per truck	Rp 540,000	Rp 720,000
6.	Total cost (1+2+3+4+5)	Rp 46,666,000	Rp 40,129,000
7.	Indirect Management Cost (10 % of Item 6)	Rp 4,667,000	Rp 4,013,000
8.	Grand total (6+7)	Rp 51,333,000	Rp 44,142,000

Note on Calculation of Annual Interest:

KMS: Cumulative interest for 20 years (10.5 % x Rp 109,300,000 x 20 years ÷ 2 = Rp 114,765,000)
Annual average interest = Rp 114,765,000 ÷ 7 years = Rp 16,395,000
Annual average interest after discount = Rp 11,476,000

Contractors: Cumulative interest for 5 years (25 % x Rp 109,300,000 x 5 years ÷ 2 = Rp 68,312,000)
Annual average interest = Rp 68,312,000 ÷ 10 years = Rp 6,832,000

d. Unit Haulage Cost Per Ton

		KMS	CONTRACTORS
1.	Total Annual Cost per Truck	Rp 51,333,000/year	Rp 44,142,000/year
2.	Total Annual Waste Hauled per Truck		
	2.1 Theoretical Amount	3,683 t/year	4,910 t/year
	2.2 Actual Amount	3,139 t/year	
3.	Unit Haulage Cost per Ton		
	3.1 Theoretical Unit Cost (1 ÷ 2.1)	Rp 13,938/ton	Rp 8,990/ton
	3.2 Actual Unit cost of KMS (1 ÷ 2.2)	Rp 16,353/ton	-
	3.3 Contract Price with 10 % Profit	-	Rp 9,889/ton
	3.4 Cost of supervision and administration of contractors (2 % of Item 3.3)		Rp 198/ton
4.	Final Unit Costs for Comparison	Rp 16,353/ton	Rp 10,087/ton
5	Cost Index (Contractor = 100)	162	100
6.	Cost Saving for KMS	Rp 6,266/ton	-

2. Arm-Roll Truck and 10 m3 Containers

a. Major Assumptions

		KMS	CONTRACTORS
1.	Truck Purchase Price	Rp 81,300,000	Rp 81,300,000
2.	Duration of Truck	7 years	10 years
3.	Duration containers	5 years	5 years
4.	Number of trips to LPA per day	5 trips/day	7 trips/day
5.	Loan period	20 years	5 years
6.	Loan interest	10.5 %/year	25 %/year
7.	Number of Crew		
7.1.	Driver	1	1
7.2	Assistant	1	0
8.	Rate of Salary of Crew		
8.1	Driver	Rp 2,760,000/year	Rp 3,300,000/year
8.2	Assistant	Rp 1,500,000/year	-
9.	Density of waste		
9.1	Base of contract volume	0.2 ton/m3	0.2 ton/m3
9.2	At container	0.33 ton/m3	0.33 ton/m3

b. Assumptions on Waste Amount Hauled

		KMS	CONTRACTORS
1.	Average waste collected per Container (10 m3)	3.2 ton/container	3.2 t/container
2.	Average number of trips per operating day	6 trips/day	8 trips/day
3.	Average waste amount hauled per truck per operating day	19.2 t/truck/d	25.6 t/truck/d
4.	Average number of operating days per year	330 days/y	330 days/y
5.	Average amount hauled per truck per year	6,336 t/truck/y	8,448 t/truck/y

c. Cost per Truck per Year (Arm-Roll Truck and 10 m3 Containers)

		KMS	CONTRACTORS
1.	Depreciation	Rp 11,614,000	Rp 8,130,000
2.	Loan interest	Rp 8,536,000	Rp 5,100,000
3.	Operation & Maintenance		
	3.1 Fuel	Rp 6,081,000	Rp 8,400,000
	3.2 Salary of drivers and assistants	Rp 4,260,000	Rp 3,300,000
	3.3 Tax and insurance	Rp 2,030,000	Rp 2,030,000
4.	Maintenance	Rp 10,163,000	Rp 11,382,000
	(% of Truck purchase cost: 12.5 % for KMS, 14 % for Contractors)		
5.	Cost of containers (6 for KMS, 8 for Contractors)		
	5.1 Depreciation of containers per truck	Rp 6,600,000	Rp 8,800,000
	5.2 Maintenance of containers per truck	Rp 825,000	Rp 1,100,000
6.	Total cost (1+2+3+4+5)	Rp 50,109,000	Rp 48,242,000
7.	Indirect Management Cost (10 % of Item 6)	Rp 5,011,000	Rp ,4,824000
8.	Grand total (6+7)	Rp 55,120,000	Rp 53,066,000

Note on Calculation of Annual Interest:

KMS: Cumulative interest for 20 years (10.5 % x Rp 81,300,000 x 20 years ÷ 2 = Rp 85,365,000)
Annual average interest = Rp 85,365,000 ÷ 7 years = Rp 12,195,000
Annual average interest after discount = Rp 8,536,000

Contractors: Cumulative interest for 5 years (25 % x Rp 81,300,000 x 5 years ÷ 2 = Rp 51,000,000)
Annual average interest = Rp 51,000,000 ÷ 10 years = Rp 5,100,000

d. Unit Haulage Cost Per Ton

		KMS	CONTRACTORS
1.	Total Annual Cost per Truck	Rp 55,120,000/year	Rp 53,066,000/year
2.	Total Annual Waste Hauled per Truck		
	2.1 Theoretical Amount	6,336 t/year	8,448 t/year
	2.2 Actual Amount	5,419 t/year	-
3.	Unit Haulage Cost per Ton		
	3.1 Theoretical Unit Cost (1 ÷ 2.1)	Rp 8,699/ton	Rp 6,281/ton
	3.2 Actual Unit Cost (1 ÷ 2.2)	Rp 10,172/ton	-
	3.3 Possible Contract Price with 10 % Profit	-	Rp 6,909/ton
	3.4 Cost of supervision and administration of contractors (2 % of Item 3.3)		Rp 138/ton
4.	Final Unit Cost for Comparison	Rp 10,172/ton	Rp 7,047/ton
5.	Cost Index (Contract Price = 100)	144	100
6.	Cost Saving for KMS	Rp 3,125/ton	

PART 3.

FEASIBILITY STUDY

PART 3. FEASIBILITY STUDY

Chapter 1. Feasibility Study Project Components

1.1 Project Components

The JICA Study Team has carried out a feasibility study for the SWM improvement project which comprises of the following four (4) components that are recognized important and urgent by both KMS officials and the Study Team.

Component 1. Procurement of haulage vehicles, containers and handcarts
Component 2. Construction of sanitary landfill site in Benowo
Component 3. Construction and rehabilitation of Depo/LPS and Improvement of Asemrowo Workshop
Component 4. Procurement of heavy equipment (bulldozers, etc.) to be used at LPA

Of the above-shown components, components 1, 3 (construction and rehabilitation of Depo/LPS only), 4 were already studied by a local consulting firm and its associate foreign consultants.

The JICA Study Team has reviewed the previous study, utilized the study and planning outputs that do not need revisions, but modified some of the outputs that were found necessary after discussions with KMS officials. In addition, the Study Team carried out a feasibility study for some new components, i.e., Construction of sanitary landfill site in Benowo, and Improvement of Asemrowo workshop. The reasons for inclusion of those additional components in the feasibility study are as follows:

Construction of sanitary landfill in Benowo: This component was not included in the previous study just because KMS had not decided on a location of site for the sanitary landfill during the previous study period. However, KMS, during the current JICA Study, decided that an area in Benowo should be the site location. Therefore, it was made possible to include this component in the current study.

Improvement of Asemrowo Workshop: This component was newly added to the current study through the discussion with the KMS officials because of the strong needs for the improvement of the maintenance of waste haulage vehicles that directly affects the efficiency of waste haulage.

1.2 Imporatance and Urgency of the Project

The importance and urgency of implementing the project comprising of the above four (4) components could be understood by knowing that conditions that 1) most of KMS' waste haulage trucks need replacement now or within a few years. (KMS' newest waste haulage vehicles are those purchased in 1988.), 2) the existing landfill sites (LPA) will be exhausted within two (2) years, 3) waste haulage coverage and efficiency cannot be improved without improvement of Depo/LPS and maintenance facility (Asemrowo workshop), and 4) heavy equipment is an essential equipment needed for operation of sanitary landfill.

Chapter 2. F/S Component 1: Waste Haulage Vehicles, Containers, and Handcarts

2.1 Background, Purpose and Outline of the Project

2.1.1 Background and Purposes

At present, KMS has 67 units of trucks for waste haulage and road sweeping, of which details are shown below:

1)	Arm-roll container trucks:	43 units
2)	Rear end loader (REL) compactor trucks:	15 units
3)	Dump trucks:	4 units
4)	Flat body trucks:	2 units
5)	Mechanical road sweepers:	3 units
Total:		67 units

As can be seen from the above, arm-roll trucks and REL compactor trucks are two major types of trucks used by KMS. The arm-roll trucks are hauled-in-container-trucks which haul containers filled with waste, from Depo*1 or LPS*2. There are three sizes of containers used by KMS: i.e., 6 m^3, 10 m^3, 12 m^3. REL compactor trucks collect waste from 1 m^3 small containers placed on roadsides.

*1: Depo is a small transfer station equipped with a small control office.

*2: LPS is a small transfer station without an office.

Of the existing 67 trucks, about 50 % were purchased in or before 1985. It is considered that most of KMS' waste haulage trucks require or will require replacement in a few years time.

The purpose of this study is to prepare a complete procurement plan of waste haulage vehicles, containers and handcarts for KMS to be procured during the SUDP (Surabaya Urban Development Projects) period of 6 years from 1992/93 through 1997/98.

2.1.2 Outline (Equipment to be Procured)

The proposed types and quantity of equipment to be procured are summarized in the table below. Total procurement cost is estimated to be Rp 6,644.4 million including the value added tax (PPN) in 1992 price.

Table 3.2-1 Summary of Procurement Plan of Waste Haulage Vehicles, Containers and Handcarts during 1992/93 - 1997/98

Equipment	Quantity (1)	Unit Price (1992 Price in Million Rupiah) (2)	Total Price (1992 Price in Million Rupiah) (3) = (1) x (2)
A. Waste Haulage Trucks (1 -3)			
1. Arm-roll trucks (7 GVW) for 8 m^3 containers	26	Rp 50.6 m.	Rp 1,315.6 m.
2. Arm-roll trucks (14 GVW) for 14 m^3 container	39	Rp 85.3 m.	Rp 3,326.7 m.
3. Open dump trucks	5	Rp 50.7 m.	Rp 253.5 m.
Sub-Total of Vehicles (1+2+3)	68	-	Rp 4,895.8 m
B. Containers (4 & 5)			
4. 8 m^3 containers	89	Rp 6.0 m.	Rp 534.0 m.
5. 14 m^3 containers	130	Rp 8.0 m.	Rp 1,040.0 m.
Sub-Total of Containers (4+5)	229	-	Rp 1,574.0 m.
C. Handcarts (6 & 7)			
6. 1.0 m^3 handcarts	256	Rp 0.48 m.	Rp 122.9 m.
7. 1.5 m^3 handcarts	94	Rp 0.55 m.	Rp 51.7 m
8. Sub-Total of Handcars	350	-	Rp 174.6 m.
Total			Rp 6,644.4 m

Note: The above prices include the value added tax (PPN).

It is planned that all the handcarts shown in the above table will be given to local communities (RT/RW) that are relatively low income, in order to support their waste collection activities.

The remaining sections of this chapter provide reasons for selecting certain types, and capacity and quantity of the equipment as shown in the above table.

2.2 Types and Capacity of Equipment

2.2.1 Arm-Roll Trucks and Compactor Trucks

Arm-roll trucks and compactor trucks are two major types of trucks currently used by KMS. The former type of truck hauls waste-filled-containers from Depo or LPS, while the latter type of truck collects waste from small containers placed on the roadsides. These two system are considered effective, and should continue in the future.

However, it is proposed that KMS will purchase only arm-roll trucks, and none of compactor trucks on the base of agreed policy that KMS will use contractors for haulage of waste from small containers in view of the expected cost advantage of using contractors for this purpose.

2.2.2 Types and Capacity of Containers and Arm-Roll Trucks

The recommended types and capacity of containers and arm-roll trucks are as follows:

1) Containers

a. 8 m^3 containers (closed type)
b. 14 m^3 containers (closed type)

Note: Open type containers are suitable for markets in view of ease of waste loading work. Fig. 3.2-3 shows examples of open type containers.

2) Trucks (Chassis)

a. 7 GVW chassis with single rear axle for 8 m^3 containers
b. 14 GVW chassis with single rear axle for 14 m^3 containers

Examples of the recommended types of trucks and containers are shown in Figs. 3.2-1 and 3.2-2.

Source :WIRA GULFINDO SARANA

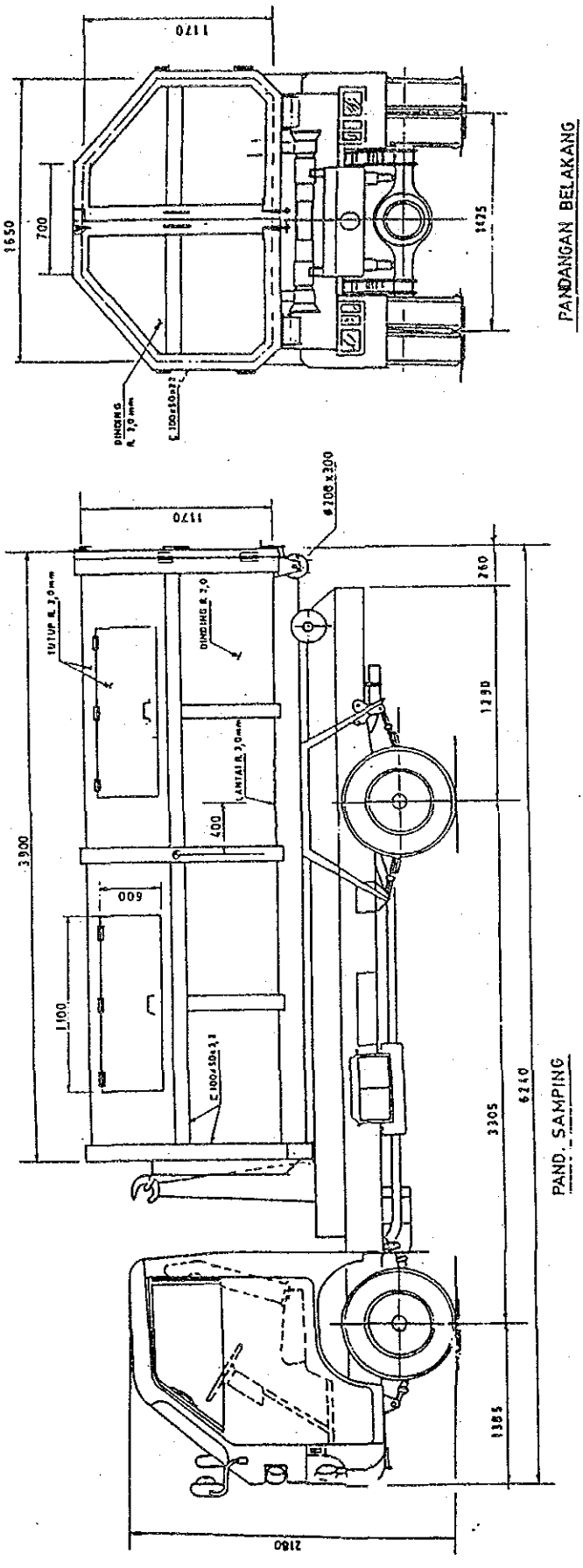
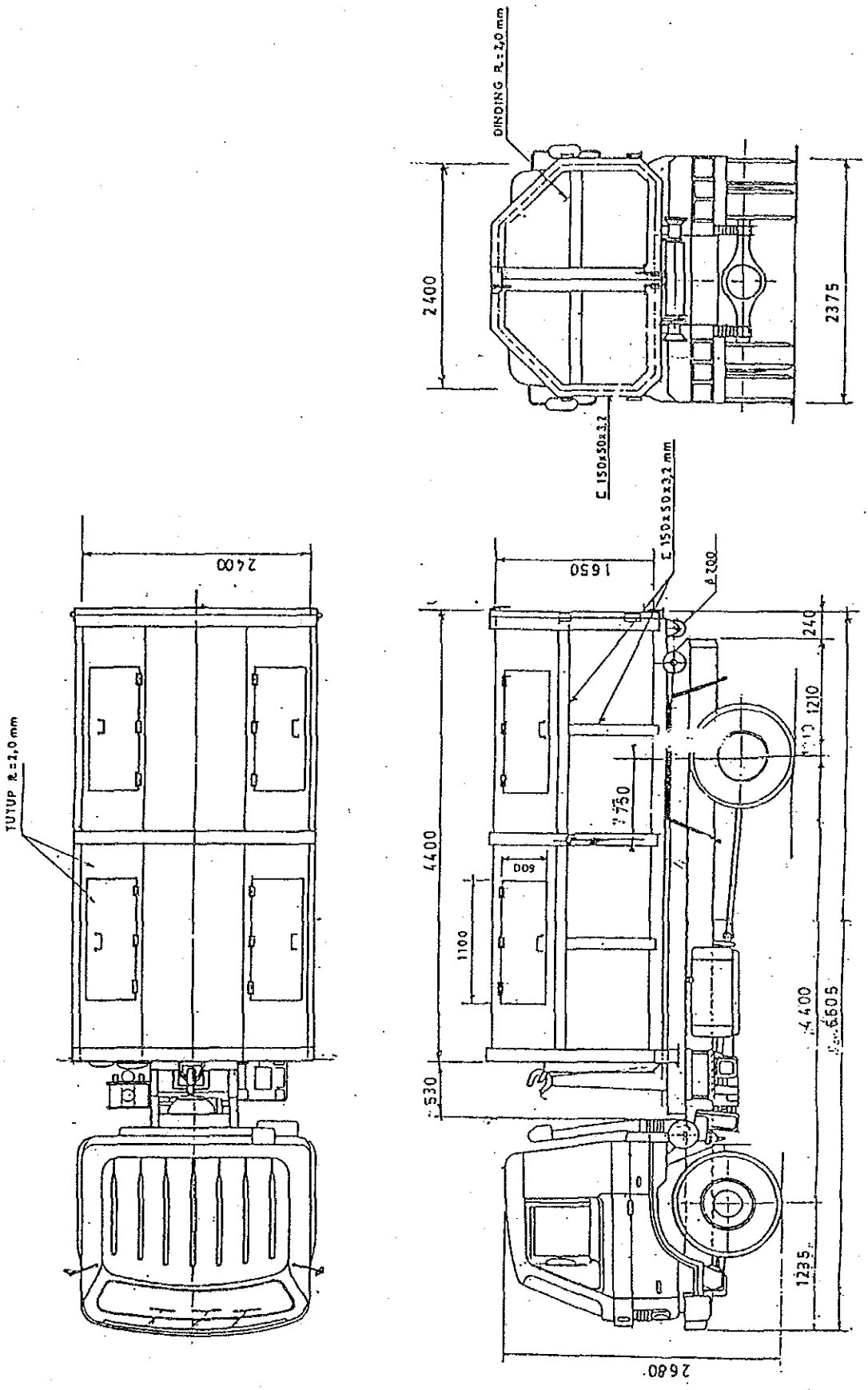
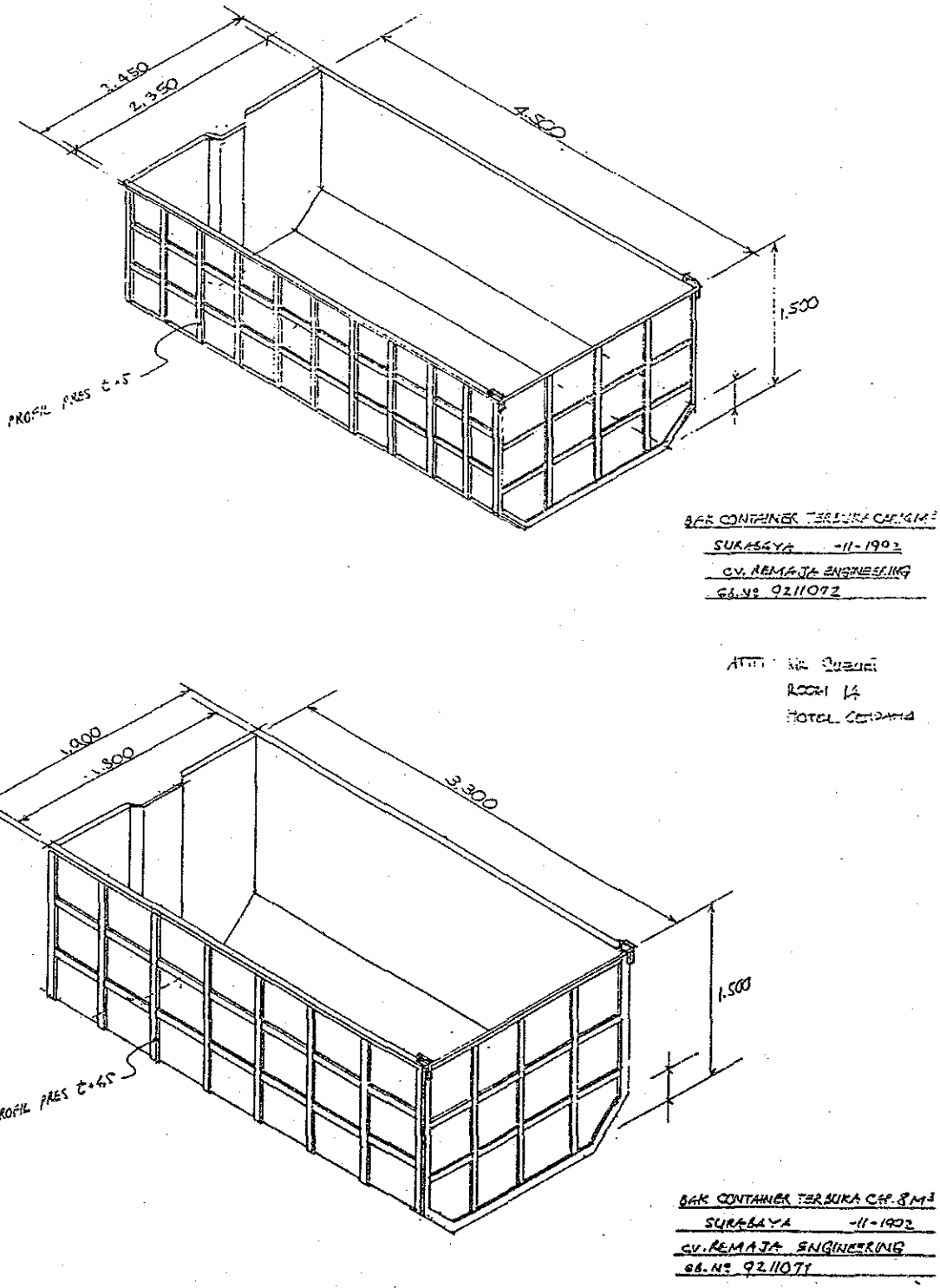


FIG. 3.2-1 **Example of 7 GVW Arm-Roll Truck with 8 M^3 Container**



Source : WIRA GULFINDO SARANA

FIG. 3.2-2 **Example of 14 GVW Arm-Roll Truck with 14 M^3 Container**



Source : CV. REMAJA ENGINEERING

FIG. 3.2-3	Example of Open Type Containers Suitable for Markets

2.2.3 Reasons for Recommendations

1) Reasons for Recommending 2 Sizes of Containers (8 m^3 and 14 m^3)

The particular capacity of the containers (8 m^3 and 14 m^3) are selected based on the following conditions and factors:

1. Capacity of the recommended chassis (7 GVW and 14 GVW) that have been chosen based upon operational reliability)

2. Road regulation that restricts dimensions of trucks and freight (Maximum dimensions of trucks including freight are as follows:

   Height: 3.5 m
   Width: 2.5 m
   Length: 9.0 m

3. Cost-effectiveness
4. Sizes of and access to the existing Depo and LPS

In general, the larger the container, the greater the cost-effectiveness of waste haulage. The following table shows unit procurement costs of truck/containers per ton of waste to be hauled.

Table 3.2-2 Unit Procurement Cost of Truck and Container Per Ton of Waste

Container and Truck System	Unit Procurement Cost
1. Recommended 14 m^3 Container & Truck System	Rp 2,313/ton (100)
2. Current 12 m^3 Container & Truck System	Rp 2,557/ton (111)
3. Recommended 8 m^3 Container & Truck System	Rp 2,630/ton (114)
4. Current 10 m^3 Container & Truck System	Rp 2,995/ton (129)
5. Current 6 m^3 Container & Truck System	Rp 3,385/ton (146)

Note: Refer to Supporting Report (Volume 4) Table 1.1-7 for assumptions used for calculation of the above-shown unit procurement costs.

14 m^3 containers are recommended in principle for Depo and LPS that have no constraints on the space and access, while 8 m^3 containers are recommended for Depo and LPS that have the constraints or daily waste amounts of Depo or LPS are not large enough to necessitate 14 m^3 containers.

Comment on 16 m3 Containers Proposed in the IUIDP Solid Waste Sector Report

The IUIDP Solid Waste Sector Report recommended 16 m^3 containers. However, it is considered that they would be too large, and would not simultaneously satisfy both the road regulation that restricts on the dimensions of trucks and freight, and the structural requirement (If the height of containers is higher than a certain height, the truck with the waste container would not be stable as the gravity center becomes higher than it should be.)

2) Reasons for Recommending 14 GVW Chassis for 14 m^3 Containers

In Indonesia, two kinds of chassis, i.e., 7 GVW chassis and 14 GVW chassis are available. The IUIDP Solid Waste Sector Report recommended 10 GVW chassis uprated from 7 GVW by providing 1 additional rear axle in view of its low cost. However, the current study cannot recommend the 10 GVW chassis uprated from 7 GVW chassis due to the reasons shown below unless KMS produces a prototype, and verifies its operational reliability through the test operation.

a. There is no guarantee that the uprated 10 GVW chassis satisfactorily performs its function. The local manufacturers in Surabaya have never modified a 7 GVW chassis to a 10 GVW chassis.

b. Troubles may occur to brake system and driving system such as engine, transmission, clutch due to the augmented payload because they remain unchanged.

c. There is uncertainty as to durability. Durability may become shorter than regular chassis. In addition, it may require higher maintenance costs than regular chassis.

2.2.4 Compactor Trucks Serving for Small Containers

I t is planned that the future waste haulage service with compactor trucks and small containers will be contracted out to contractors. Therefore, KMS will not purchase compactor tracks serving for small containers.

It is advised that KMS will either sell or lease the existing REL compactor trucks to contractors by 1995 if they are still usable.

It is expected that contractors will choose the most cost-effective type of trucks. The JICA Study Team recommend 14 m^3 REL trucks so far due to the reason shown in Appendix 4 of the report.

2.3 Policy, Target, Conditions, and Assumptions for Planning

2.3.1 Factors Involved in the Determination of the Future Demand for Waste Haulage Service

Number and types of equipment (trucks an containers) to be procured depend on the future demand for haulage service, which in turn depend on amounts of waste to be hauled by KMS. Amounts of waste to be hauled by KMS then depend on various factors as explained below. In the current study, the waste amount to be hauled by KMS and its contractors (expressed as X below) is estimated through the following formula:

$$X = a - b - c - d - e$$

where,

X: Waste amount to be hauled by KMS and its contractors
a: Waste amount to be generated
b: Waste amount that may not be collected
c: Waste amount to be recycled before being hauled to LPA
d: Waste amount to be collected by RT/RW but disposed at unidentified places (not disposed properly)
e: Waste amount to be collected and hauled by waste generators

Some of the factors such as the future waste generation amounts (a) are estimated based on some technical assumptions including projection of the future population and economic growth, while some other factors such as waste amounts to be collected and hauled by waste generators are estimated based upon the future KMS policy agreed upon between KMS and the Study Team. The following sections explain the above factors respectively.

2.3.2 Waste to be Generated

As explained in the Master Plan (Part 2), it is assumed that the waste generation amount will increase by 5 % each year considering the past economic growth and population increases.

2.3.3 Waste That May Not Be Collected

At present, waste amount not collected (average throughout year) is 249 ton/day, 15% of the total waste generation amount.

As expressed by KMS officials, it is planned that KMS will reduce non-collected waste in terms of not only percentage but also absolute amount. Target non-collected waste amount will be 240 ton/day (12.8 %) in 1995, 225 ton/day (9.4 %) in 2000, 195 ton/day (5 %) in 2010.

The target percentage of non-collected waste (5 %) is considered very ambitious. KMS needs to make much efforts to achieve the target.

Non-collected waste does not necessary means bad. Some of non-collected waste are used to feed domestic animals. Some are burned.

2.3.4 Waste to be Recycled

At present, 190 ton/day, 12 % of the total waste generation amount is recycled. Of the 190 ton/day of waste recycled, 180 ton/day is recycled before being hauled to LPA, and the remaining 10 ton/day is recycled in LPA.

As expressed by KMS officials, it is planned that the recycling amount will remain constant in terms of ratio to the waste generation amount throughout the Master Plan period till 2010, which means that the recycling amount will increase in terms of amount. Target waste amount to be recycled before being hauled to LPA is 207 ton/day in 1995, 264 ton/day in 200, and 430 ton/day in 2010.

2.3.5 Waste to be Collected by RT/RW but Disposed at Unidentified Places

It is estimated that this kind of waste amounted to 171 ton/day, 10.5 % of the total waste generation amount in 1992.

As agreed by KMS officials, it is planned that this kind of waste will be completely eliminated by 1999 by providing new Depo and LPS as well as small containers.

2.3.6 Waste to be Collected and Hauled by Waste Generators

At present, only 137 ton/day of waste, 8.4 % of the total waste generation amount is collected and hauled by generators themselves.

KMS agreed that it would make necessary arrangements to make it compulsory for waste generators generating 2.5 m^3 or more each day to haul waste by themselves. Through this arrangement, great cost saving can be expected.

Target amount of waste to be collected and hauled by generators will increase to 25 % of the total waste generation amount in 1999, and the same percentage will be maintained thereafter. Target amount is 332 ton/day (18 %) in 1995, 601 ton/day (25 %) in 2000, and 978 ton/day (25 %) in 2010.

2.3.7 Waste to be Hauled by KMS and Its Contractors

At present, KMS and its contractors hauls 889 ton/day, 55 % of the total waste generation amount in 1992, of which 621 ton/day, 70 % of the said 889 ton/day is hauled by using KMS' own trucks, the remaining 30 % is hauled by KMS' contractors.

KMS agreed to keep the waste amount to be hauled by KMS' own trucks at a constant level of 621 ton/day on average same as the 1992 level throughout the Master Plan period till 2010, and all the remaining waste to be hauled under KMS' responsibility should be hauled by KMS' contractors.

As a result of implementing the above policy, waste amount to be hauled by contractors will increase. Increasing use of contractors is rational and advisable as it will bring about great cost saving for KMS.

Target waste amount to be hauled by KMS' contractors is 386 ton/day (38 %) in 1995, 691 ton/day (53 %) in 2000, and 1,689 ton/day (73 %) in 2010.

2.3.8 Waste Amounts to be Generated, Recycled, and Hauled

Table 3.2-3 and Fig. 3.2-4 show the future waste amounts to be generated, recycled, hauled by generators, KMS's own trucks and KMS' contractors, which derive based on the policy and planning conditions as explained in the previous sections.

Table 3.2-3 Waste Amount to be Generated, Recycled and Hauled (Average Throughout Year)

(ton/day)

Year	Waste to be Gene-rated	Waste That May not be Colle-cted	To be Recycled before being hauled to LPA	To be Collected by RT/RW but Disposed at Unidenti-fied Places	To be Collected and Hauled by Waste Generators	To be Hauled under KMS' Respon-sibility	To be Hauled by KMS' Trucks	To be Hauled by KMS' Cont-ractors
	(1)	(2)	(3)	(4)	(5)	(6)=(1)-(2)-(3)-(4)-(5)	(7)	(8)=(6)-(7)
1992	1,626	249	180	171	137	889	621	268
1993	1,707	246	188	146	202	925	621	304
1994	1,793	243	197	121	267	965	621	344
1995	1,882	240	207	96	332	1,007	621	386
1996	1,976	237	217	71	397	1,054	621	433
1997	2,075	234	228	46	462	1,105	621	484
1998	2,179	231	240	21	527	1,160	621	539
1999	2,288	228	252	0	572	1,236	621	615
2000	2,402	225	264	0	601	1,312	621	691
2001	2,522	222	277	0	631	1,392	621	771
2002	2,649	219	291	0	662	1,477	621	856
2003	2,781	216	306	0	695	1,564	621	943
2004	2,920	213	321	0	730	1,656	621	1,035
2005	3,066	210	337	0	767	1,752	621	1,131
2006	3,219	207	354	0	805	1,853	621	1,232
2007	3,380	204	372	0	845	1,959	621	1,338
2008	3,549	201	390	0	887	2,071	621	1,450
2009	3,727	198	410	0	932	2,187	621	1,566
2010	3,913	195	430	0	978	2,310	621	1,689

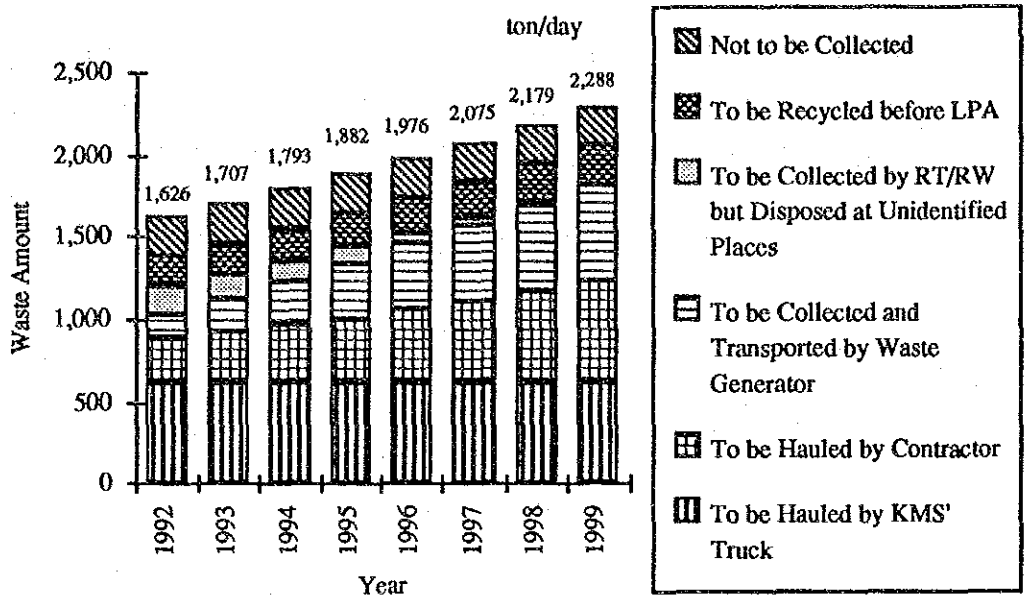


Fig. 3.2-4 Future Amount of Waste to be Generated, Recycled, and Hauled

Use of Rainy Season Waste Amounts for Preparation of Procurement Plan

Waste generation and haulage amounts vary by season. Waste amounts are larger during rainy seasons than in dry seasons as shown below. The variation in waste generation is ± 8 % in 1992 with an average amount throughout year as a base.

1) Average waste generation amount throughout year: 1,626 ton/day (100)
2) Average waste generation amount during rainy season: 1,748 ton/day (108)
3) Average waste generation amount during dry season: 1,503 ton/day (92)

Note: Figures in parenthesis ( ) are indices with the waste amount throughout the year being 100.

Table 3.2-4 Waste Amount to be Generated, Recycled and Hauled (Average During Rainy Season)

(ton/day)

Year	Waste to be Gene-rated	Waste That May not be Colle-cted	To be Recycled before being hauled to LPA	To be Collected by RT/RW but Disposed at Unidenti-fied Places	To be Collected and Hauled by Waste Generators	To be Hauled under KMS' Respon-sibility	To be Hauled by KMS' Trucks	To be Hauled by KMS' Cont-ractors
	(1)	(2)	(3)	(4)	(5)	(6)=(1)-(2)-(3)-(4)-(5)	(7)	(8)=(6)-(7)
1992	1,748	263	180	186	130	989	691	298
1993	1,835	260	189	159	200	1,027	691	336
1994	1,927	257	198	132	270	1,070	691	379
1995	2,024	254	208	105	340	1,117	691	426
1996	2,125	251	219	78	410	1,167	691	476
1997	2,231	248	230	51	480	1,222	691	531
1998	2,342	245	241	24	550	1,282	691	591
1999	2,460	242	253	0	615	1,350	691	659
2000	2,583	239	266	0	646	1,432	691	741
2001	2,712	236	279	0	678	1,519	691	828
2002	2,847	233	293	0	712	1,609	691	918
2003	2,990	230	308	0	748	1,704	691	1,013
2004	3,139	227	323	0	785	1,804	691	1,113
2005	3,296	224	339	0	824	1,909	691	1,218
2006	3,461	221	356	0	865	2,019	691	1,328
2007	3,634	218	374	0	909	2,133	691	1,442
2008	3,816	215	393	0	954	2,254	691	1,563
2009	4,006	212	413	0	1,002	2,379	691	1,688
2010	4,207	209	433	0	1,052	2,513	691	1,822

In addition to the seasonal variations in waste amounts, there are daily variations, which are found as small as $\pm$ 1 % or less. Therefore, daily variations are not considered in the preparation of procurement plan of equipment.

2.3.9 Proposed Arrangements to be Made for Successful Use of Contractors

During the Master Plan period including SUDP period, it is planned that KMS will substantially increase the use of waste haulage contractors. A carefully prepared contract, and adequate and strong supervision of contractors are keys to the successful use of contractors. In particular, KMS should make the following arrangements:

Arrangements to be Made by KMS for Successful and Increasing Use of Contractors

1. Longer contract - at least one year
2. Increases of the contract prices to a level enough to attract more contractors
3. Use of actual tonnage base (Rp/ton), instead of volume base (Rp/m^3) in order to give incentives to contractors to haul more waste. (For this purpose, KMS needs to purchase truck scales to be placed at entrances of LPA.)
4. Sales or lease of KMS' used trucks (arm-roll trucks and compactor trucks) and containers to contractors if they accept.

Explanation of the above arrangements are shown in Part 2 Master Plan Section 7.2 of this report.

2.3.10 Working Shift

The trucks and containers procurement plan is prepared based upon 1 shift working system due to the following reasons:

1) Although the cost of haulage with two working shift is lower than that with one shift, the difference is not so large (about 10 %).

2) Night shift work may cause the following problems:

   a. Safety problem
   b. Operational problem
   c. Noise and other environmental problems to the residents

3) Responsibility problem may occur if some damages occurred to a truck that are operated by two drivers on two working shifts (one responsible for operation during day time, the other during night time)