2.3.11 Future Destinations (LPA) of Waste Haulage Trucks by Origin (Rayon)

It is planned that a new LPA in Benowo will open in 1996. Commencement of waste receiving will differ by origin (Rayon) of waste, and by closure schedule of the existing LPA in Keputih and Lakarsantri.

It is assumed that all waste generated in Center, North and South Rayons will be hauled to the new LPA in Benowo in 1996 and thereafter. Waste of West Rayon will be hauled to the new LPA in Benowo in 1997. In 1998 and thereafter, all waste in Surabaya including East Rayon will be hauled to the new LPA in Benowo. Table 3.2–5 shows the destinations (LPA) to be used by origin and by year.

Table 3.2-5 Future Destinations (LPA) of Waste Haulage by Waste Origin (Rayon)

Year	Waste Hauled from Center	Waste Hauled from North	Waste Hauled from East	Waste Hauled from South	Waste Hauled from West
1993	Keputih	Keputih	Keputih	Lakarsantri	Lakarsantri
1994	Keputih	Keputih	Keputih	Lakarsantri	Lakarsantri
1995	Keputih	Keputih	Keputih	Lakarsantri	Lakarsantri
1996	Benowo	Benowo	Keputih	Benowo	Lakarsantri
1997	Benowo	Benowo	Keputih	Benowo	Benowo
1998	Benowo	Benowo	Benowo	Benowo	Benowo
1999	Benowo	Benowo	Benowo	Benowo	Benowo

2.3.12 Target Average Waste Amount to be Hauled per Truck per Day

1) Method of Estimation

Target average waste amount to be hauled per truck per day (expressed as A below) is estimated through the following calculation:

$$A = b \times c$$

where, b: Target average waste amount to be hauled per trip per truck

c: Target average number of trip to be made per truck per day

2) Target Average Waste Amount per Trip per Truck

Target average waste amounts per trip per trucks are estimated as follows:

a. Arm-roll truck with 8 m^3 container: 2.376 ton/trip/truck

Calculation: 8 m^3 x 90 % x 0.33 ton/m^3 = 2.376 ton/trip/truck
Assumptions used:
- Average utilization of container capacity: 90 % of the container
- Average waste density in the container: 0.33 ton/m^3

(The average waste density 0.33 ton/m^3 is used based on the JICA Study Team' waste survey conducted in both rainy and dry seasons.)

b. Arm-roll truck with 14 m^3 container: 4.158 ton/trip/truck

Calculation: 14 m^3 x 90 % x 0.33 ton/m^3 = 4.158 ton/trip/truck
Assumptions used:
- Average utilization of container capacity: 90 % of the container
- Average waste density in the container: 0.33 ton/m^3

3) Haulage Distance between LPA and Waste Origins (Rayon) and Travel Time

a. Haulage Distance

The haulage distance between waste origins and LPA (Keputih, Lakarsantri and Benowo) are estimated as shown in the table below based upon the truck trip survey conducted by JICA Study Team.

Table 3.2-6 Haulage Distance to LPA from Waste Origin (Rayon)

Destination LPA	Waste Hauled from Center	Waste Hauled from North	Waste Hauled from East	Waste Hauled from South	Waste Hauled from West
Keputih	11 km	16 km	3 km	Not Hauled	Not Hauled
Lakarsantri	17 km	Not Hauled	Not Hauled	12 km	2 km
Benowo	23 km	21 km	28 km	24 km	17 km

b. Haulage Time

Time taken for one way waste haulage trip from waste origins to LPA (Keputih, Lakarsantri and Benowo) is estimated as shown in the table below based upon the truck trip survey conducted by JICA Study Team.

Table 3.2-7 One Way Haulage Trip Time from Waste Origins to LPA

Unit: Minutes per one way trip

Destination LPA	Waste Hauled from Center	Waste Hauled from North	Waste Hauled from East	Waste Hauled from South	Waste Hauled from West
Keputih	18 min.	33 min.	10 min.	Not Hauled	Not Hauled
Lakarsantri	35 min.	Not Hauled	Not Hauled	30 min.	10 min.
Benowo	45 min.	45 min.	65 min.	50 min.	35 min.

4) Target Trip Number

Trip number per truck per day differ by origin and destination of trip. Target average trip numbers as shown in the table below are used as basis for estimation of average waste amounts to be hauled per arm-roll truck per day, which in turn are used for estimation of number of arm-roll trucks needed for waste haulage.

Table 3.2-8 Target Average Round Trip Numbers per Truck per Day

Unit: Round trips/truck/day

Origin of Trips	Destination LPA		
	Keputih LPA	Lakarsantri LPA	Planned Benowo LPA
1. Center	7.8	N.A.	3.8
2. North	4.9	N.A.	3.8
3. East	11.4	N.A.	2.8
4. South	N.A.	5.3	3.5
5. West	N.A.	11.4	4.7

Note: N.A. stands for not applicable; waste generated in the areas marked with N.A. are note hauled to the destination indicated.

The above-shown average round trip numbers are estimated based on 1) the trip study conducted by the Study Team, 2) assumption that net working time is 400 minutes per worker per day, and 3) assumption that loading of containers and waste dumping take 15 minutes on average per trip.

Consideration on the Future Traffic Congestion

Some people may be worried that number of trips may decrease in the future because the future traffic congestion would get worse due to increasing number of cars in Surabaya. However, it is considered possible to maintain the target trip numbers at the target level in view of the following:

a. It is possible for waste haulage trucks to avoid traffic congestion by leaving the garage early in the morning. At present, KMS' trucks leave between 7:30 and 8:30 am. It is advised that KMS trucks should leave the garage before 7:30 am.

b. KMS has a plan to construct new roads during the SUDP period, which could alleviate traffic congestion.

5) Target Average Waste Amount to be Hauled per Truck per Day

Based on the two kinds of information shown in the previous two sections (waste amount per trip, and trip number), target average waste amounts to be hauled per truck per day are estimated as shown in the table below:

Table 3.2-9 Target Daily Average Waste Amount to be Hauled per Truck (Arm-Roll Truck with 8 m^3 Container)

Unit: ton per truck per day

Origin of Trips	Destination LPA		
	Keputih LPA	Lakarsantri LPA	Planned Benowo LPA
1. Center	18.5	N.A.	9.0
2. North	11.6	N.A.	9.0
3. East	27.1	N.A.	6.7
4. South	N.A.	12.6	8.3
5. West	N.A.	27.1	11.2

Table 3.2-10 Target Daily Average Waste Amount to be Hauled per Truck (Arm-Roll Truck with 14 m^3 Container)

Unit: ton per truck per day

Origin of Trips	Destination LPA		
	Keputih LPA	Lakarsantri LPA	Planned Benowo LPA
1. Center	32.4	N.A.	15.8
2. North	20.4	N.A.	15.8
3. East	47.4	N.A.	11.6
4. South	N.A.	22.0	14.6
5. West	N.A.	47.4	19.5

2.3.13 Waste to be Hauled by Type of Trucks

1) Use of Contractors for Haulage with Small Containers and Compactor Trucks

At present, KMS applies two major waste haulage systems, i.e., 1) haulage system with large containers and arm-roll trucks, and 2) haulage system with small containers and REL compactor trucks. It is planned that KMS will continue to apply these two major systems in the future.

However, KMS will concentrate on the haulage system with large containers and arm-roll trucks in the future, and will not purchase compactor trucks and small containers.

KMS will use contractors for the waste haulage with compactors and small containers because it is expected that contractors will be very cost-effective in the application of this haulage system.

In addition, it can be expected that the use of contractors for this haulage system will cause the haulage service coverage to increase as the contractors would wish to purchase more equipment (small containers and trucks) to increase waste haulage amounts if the remuneration to the contractors is based on the amount of waste hauled.

2) Open Dump Trucks

KMS will use 5 trucks; one for each Rayon for haulage of the following special waste irregularly collected:

1) Bulky waste
2) Construction debris such as stones, sand and concrete
3) Trees cut
4) Waste collected from rivers and drainage by citizens

Future waste amounts to be hauled by KMS and its contractors, and by type of trucks are shown in the table below:

Table 3.2-11 Future Amount of Waste to be Hauled by Type of Trucks

Unit : ton/day on rainy season base

Year	Waste Amount	To be Hauled by K M S' Own Trucks				To be Hauled by Contractors			
	to be Hauled under KMS' Responsi-bility	Arm-Roll Trucks	Com-pactor Trucks	Open Dump Trucks	KMS Total	Arm-Roll Trucks	Com-pactor Trucks	Open Dump Trucks	Con-tractors' Total
	(1)	[2]	(3)	(4)	(5)=(2)+(3)+(4)	[6]	[7]	[8]	(9)=[6]+[7]+[8]=(1) - [5]
1992	989	539	121	31	691	0	0	298	298
1993	1,027	617	60	14	691	217	69	50	336
1994	1,070	658	30	5	691	246	108	25	379
1995	1,117	691	0	5	691	266	148	12	426
1996	1,167	691	0	5	691	312	158	6	476
1997	1,222	691	0	5	691	362	169	0	531
1998	1,282	691	0	5	691	410	181	0	591
1999	1,350	691	0	5	691	464	195	0	659

Note: Waste to be hauled by contractors' compactor trucks (column 7) will increase by a 20 % of annual incremental waste (column 1) in 1996 and thereafter.

2.3.14 Waste Haulage Amount by Rayon (Districts)

1) Differential Waste Increases by Rayon

Surabaya has 5 Rayon, i.e., Center, North, East, South and West. Table 3.2-12 shows projection of the future waste amounts to be hauled under KMS' responsibility. The future waste amounts are projected based upon the projection of future population. It is projected that waste amount in the Center will be rather constant, while the waste amounts in the East, South and West will increase rapidly.

Table 3.2-12 Projection of Future Waste Haulage Amount by Rayon

Unit: ton/day on rainy season base

Year	Center	North	East	South	West	Total
1992	207 (20.9%)	174 (17.6%)	298 (30.1%)	235 (23.8%)	75 (7.6%)	989 (100%)
1993	208 (20.2%)	180 (17.5%)	310 (30.2%)	245 (23.9%)	84 (8.2%)	1,027 (100%)
1994	209 (19.5%)	186 (17.4%)	324 (30.3%)	257 (24.0%)	94 (8.8%)	1,070 (100%)
1995	210 (18.8%)	193 (17.3%)	340 (30.4%)	269 (24.1%)	105 (9.4%)	1,117 (100%)
1996	212 (18.2%)	201 (17.2%)	356 (30.5%)	282 (24.2%)	116 (9.9%)	1,167 (100%)
1997	215 (17.6%)	209 (17.1%)	374 (30.6%)	298 (24.4%)	126 (10.3%)	1,222 (100%)
1998	215 (16.8%)	218 (17.0%)	394 (30.7%)	315 (24.6%)	140 (10.9%)	1,282 (100%)
1999	219 (16.2%)	228 (16.9%)	415 (30.8%)	335 (24.8%)	153 (11.3%)	1,350 (100%)

2) Waste Haulage by KMS and Contractors

It is planned that KMS' trucks will concentrate on the waste haulage in the Center, North and East Rayon, while KMS will use contractors for hauling waste from West Rayon at first, and then gradually increase waste haulage activity in South and East Rayon.

Respective amounts to be hauled by KMS' trucks and contractors are shown in the following two tables that were produced as a result of decomposition of the above table.

Table 3.2-13 Projection of Future Waste by Rayon to be Hauled by KMS' Trucks

Unit: ton/day on rainy season base

Year	Center	North	East	South	West	Total
1992	133	99	286	110	63	691
1993	177	149	263	101	1	691
1994	178	158	275	79	1	691
1995	178	164	289	59	1	691
1996	180	171	302	37	1	691
1997	183	178	318	11	1	691
1998	183	185	321	1	1	691
1999	186	194	309	1	1	691

Table 3.2-14 Projection of Future Waste by Kecamatan to be Hauled by KMS' Contractors

Unit: ton/day on rainy season base

Year	Center	North	East	South	West	Total
1992	74	75	12	125	12	298
1993	31	27	47	144	83	336
1994	31	28	49	178	93	379
1995	32	29	51	210	104	426
1996	32	30	54	245	115	476
1997	32	31	56	287	125	531
1998	32	33	73	314	139	591
1999	33	34	106	334	152	659

2.3.15 Planned Waste Amount to be Hauled by KMS' New Trucks by Waste Origin and by Type of Trucks

The following tables show planned waste haulage waste amounts to be hauled by KMS' new trucks by area by types of trucks.

Table 3.2-15 Planned Waste Amount to be Hauled by KMS' Existing Trucks and New Trucks

Unit: ton/day on rainy season base

Year	Total (1)	Waste to be Hauled by Existing Trucks (2)	Waste to be Hauled by New Trucks (3)= (1) - (2)
1992	691	691	0
1993	691	316	375
1994	691	122	569
1995	691	21	670
1996	691	0	691
1997	691	0	691
1998	691	0	691
1999	691	0	691

Table 3.2-16 Planned Waste Amount to be Hauled by KMS' New Arm-Roll Trucks (for 8 m^3 Containers) by Waste Origin

Unit: ton/day on rainy season base

Year	Total (1)= (2)+(3)+(4) +(5)+(6)	Center (2)	North (3)	East (4)	South (5)	West (6)
1992	0	0	0	0	0	0
1993	72	19	16	27	10	0
1994	86	22	19	35	10	0
1995	186	48	44	78	16	0
1996	199	52	49	88	10	0
1997	192	51	50	88	3	0
1998	185	49	49	87	0	0
1999	178	48	50	80	0	0

Table 3.2-17 Planned Waste Amount to be Hauled by KMS' New Arm-Roll Trucks (for 14 m^3 Containers) by Waste Origin

Unit: ton/day on rainy season base

Year	Total (1)= (2)+(3)+(4) +(5)+(6)	Center (2)	North (3)	East (4)	South (5)	West (6)
1992	0	0	0	0	0	0
1993	303	78	65	116	44	0
1994	480	124	110	191	55	0
1995	480	124	114	202	40	0
1996	488	127	121	214	26	0
1997	494	131	127	229	7	0
1998	501	133	134	234	0	0
1999	508	137	143	228	0	0

Table 3.2-18 Planned Waste Amount to be Hauled by KMS' New Dump Trucks by Waste Origin

Unit: ton/day on rainy season base

Year	Total (1)= (2)+(3)+(4) +(5)+(6)	Center (2)	North (3)	East (4)	South (5)	West (6)
1992	0	0	0	0	0	0
1993	0	0	0	0	0	0
1994	3	1	1	1	0	0
1995	4	1	1	1	1	0
1996	4	1	1	1	1	0
1997	5	1	1	1	1	1
1998	5	1	1	1	1	1
1999	5	1	1	1	1	1

2.3.16 Truck Requirement by Rayon and by Type

Number (not the number of additional purchase units) of trucks to be used for waste haulage by origin (Rayon) are estimated as shown in the tables below based on the planned waste haulage amounts by waste origin and type of trucks, and the target waste haulage amounts per truck per day.

If the number of trucks calculated have decimals, the decimals are rounded up. (Example: 1.23 units of truck is rounded up to 2 units of truck.)

Table 3.2-19 Number of New Arm-Roll Trucks Serving for 8 m^3 Containers to be Used

Unit: Number of trucks

Year	Total (1)= (2)+(3)+(4) +(5)+(6)	Center (2)	North (3)	East (4)	South (5)	West (6)
1992	0	0	0	0	0	0
1993	6	2	2	1	1	0
1994	7	2	2	2	1	0
1995	11	3	4	3	1	0
1996	17	6	6	4	1	0
1997	17	6	6	4	1	0
1998	26	6	6	14	0	0
1999	25	6	6	13	0	0

Table 3.2-20 Number of New Arm-Roll Trucks Serving for 14 m^3 Container to be Used

Unit: Number of trucks

Year	Total (1)= (2)+(3)+(4) +(5)+(6)	Center (2)	North (3)	East (4)	South (5)	West (6)
1992	0	0	0	0	0	0
1993	12	3	4	3	2	0
1994	18	4	6	5	3	0
1995	17	4	6	5	2	0
1996	24	9	8	5	2	0
1997	24	9	9	5	1	0
1998	39	9	9	21	0	0
1999	39	9	10	20	0	0

Table 3.2-21 Number of New Dump Trucks to be Used

Unit: Number of trucks

Year	Total (1)= (2)+(3)+(4) +(5)+(6)	Center (2)	North (3)	East (4)	South (5)	West (6)
1992	0	0	0	0	0	0
1993	0	0	0	0	0	0
1994	3	1	1	1	0	0
1995	4	1	1	1	1	0
1996	4	1	1	1	1	0
1997	5	1	1	1	1	1
1998	5	1	1	1	1	1
1999	5	1	1	1	1	1

Table 3.2-22 Number of New Trucks to be Used by Type

(This table is prepared based on the previous 3 tables.)

Year	Arm-Roll Trucks for 8 m^3 Containers (1)	Arm-Roll Trucks for 14 m^3 Containers (2)	Dump Trucks (3)	Total (1)+(2)+(3)= (4)
1992	0	0	0	0
1993	6	12	0	18
1994	7	18	3	28
1995	11	17	4	32
1996	17	24	4	45
1997	17	24	5	46
1998	26	39	5	70
1999	25	39	5	69

Table 3.2-23 Remaining Number of the Existing Trucks

Year	Arm-Roll Trucks				REL Compactor Trucks			Open Trucks	Total
	for 6 m^3 Container (1)	for 10 m^3 Containers (2)	for 12 m^3 Containers (3)	Sub-Total (1)+(2)+(3)= (4)	7 GVW (6 m^3) (5)	14 GVW (10 m^3) (6)	Sub-Total (5)+(6)= (7)	(8)	(4)+(7)+(8)= (9)
1992	26	13	4	43	5	10	15	6	64
1993	12	5	4	21	5	10	15	6	42
1994	12	0	0	12	3	5	8	2	22
1995	0	0	0	0	0	0	0	1	1
1996	0	0	0	0	0	0	0	1	1
1997	0	0	0	0	0	0	0	0	0
1998	0	0	0	0	0	0	0	0	0
1999	0	0	0	0	0	0	0	0	0

Fig. 3.2-5 compares the number of the existing trucks and new trucks. Number of new trucks will exceeds the number of the existing trucks in 1994. Most of the existing trucks will abandoned by 1995.

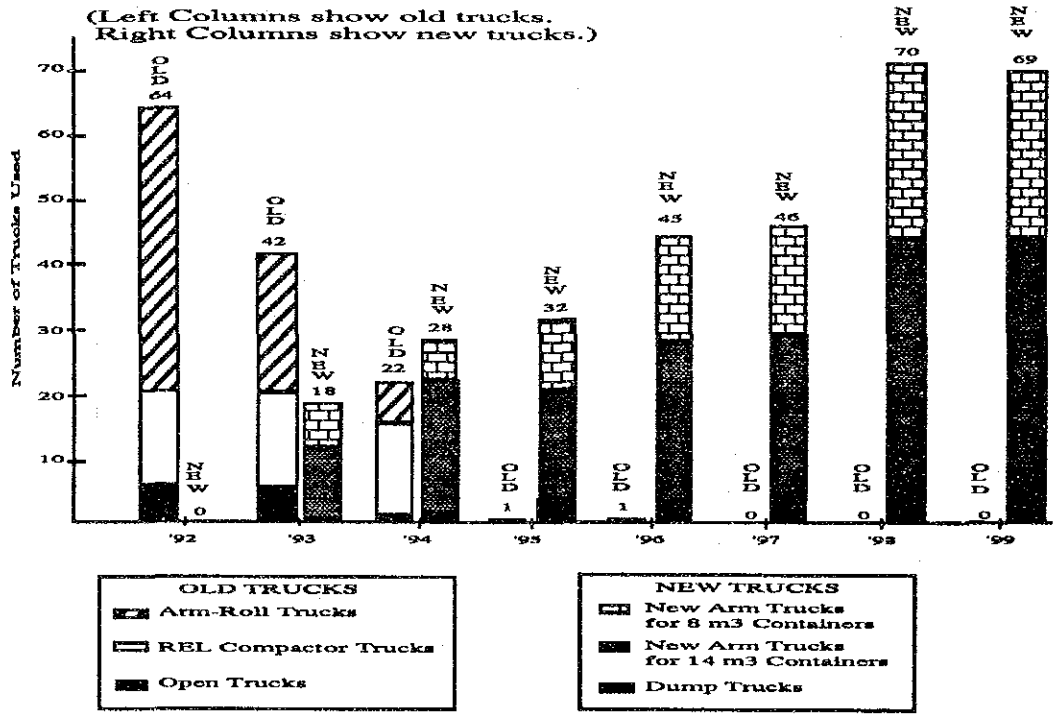

Fig. 3.2-5 Number of the Existing and New Trucks in Comparison

2.3.17 Container Requirement by Rayon and Type

Numbers (not the numbers of purchase units) of containers to be used by each Rayon are estimated as shown in the tables below based on the planned waste haulage amounts by waste origin and type of trucks.

If the calculated number of containers have decimals, the decimals are rounded up. (Example: 14.34 units of containers is rounded up to 15 units of containers.)

Table 3.2-24 Number of New Containers to be Used

Year	8 m^3 Containers	14 m^3 Containers
1993	33 (2)	77 (4)
1994	39 (2)	122 (6)
1995	83 (4)	122 (6)
1996	89 (5)	124 (6)
1997	86 (5)	125 (7)
1998	82 (4)	128 (7)
1999	79 (4)	130 (7)

Note: Figures in parenthesis ( ) indicate number of spare containers, which are included in the numbers without parenthesis.

2.3.18 Feasibility Study of a Large Transfer Station for Waste Haulage to the Planned Disposal Site (LPA) in Benowo

1) Background

The planned future LPA in Benowo is located further than the existing LPA in Keputih or Lakarsantri. The JICA Study Team has made a comparative study of the haulage costs with or without a large transfer station in order to know whether or not a transfer station is necessary.

2) Conclusions

As a result of the comparative study it is concluded that :

a. Under the existing haulage system of Surabaya where there are many Depo and LPS, a large transfer station is not necessary if a final disposal site (LPA) is located within 40 km from collection areas.

b. The above conclusion means that construction of any large transfer stations is not feasible, and therefore not advisable if a LPA is located in Surabaya.

c. A transfer station might be necessary if a LPA is constructed outside Surabaya such as Sidoarjo.

d. The KMS's existing haulage system with Depo and LPS is efficient as Depo and LPS serve as mini-transfer stations.

3) Cost Comparison

The haulage distances between the collection areas and Benowo LPA ranges 17 km - 30 km. As shown in the table and figure below, cost ratio between with and without a transfer station differ by the haulage distance.

If the haulage distance is 20 km, the haulage cost with a transfer station is 37 % higher than the haulage cost without a transfer station. If the haulage distance is 30 km, the haulage cost with a transfer station is still 11 % higher than the haulage cost without a transfer station. The haulage costs become identical if the haulage distance is 40 km.

Table 3.2-25 Comparison of Haulage Cost With and Without a Transfer Station

Unit: Rupiah per ton

Distance between LPA and Collection Areas	Haulage Cost Without a Transfer Station (1)	Haulage Cost With a Transfer Station (2)
10 km	8,285 [100]	16,462 [199]
20 km	12,759 [100]	17,430 [137]
30 km	16,313 [100]	18,148 [111]
40 km	18,641 [100]	18,639 [100]

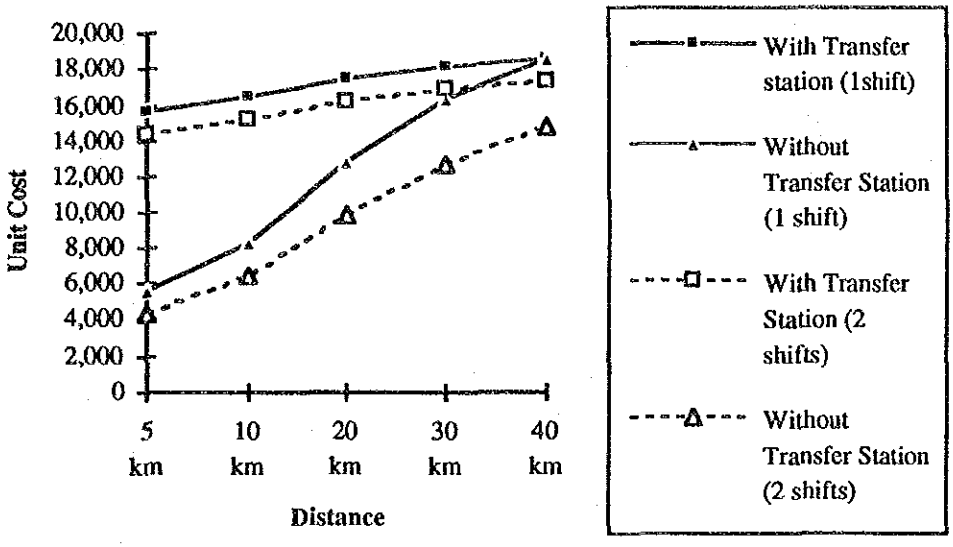

Fig. 3.2-6 Comparison of Haulage Cost With and Without a Transfer Station

4) Major Assumption Used

The above conclusions were drawn based upon the assumptions and cost estimation as shown below :

a. Transfer Station Assumed

a) Type: Compaction type (same as designed for Jakarta)
b) Capacity: 1,000 ton/day
c) Location: 5 km from central part of Surabaya
d) Operation: 2 working shifts
e) Investment: Rp 14,704 million

1. Main Facility:	Rp 9,293 million
2. Waste Water Treatment:	Rp 1093 million
3. Building:	Rp 2,457 million
4. Building Facility:	Rp 682 million
5. Civil work:	Rp 1,179 million
Total:	Rp 14,704 million

b. Waste Haulage from Collection Areas to a Transfer Station

a) Type and Capacity of Trucks: Arm-roll trucks with 10 m^3 containers

c. Haulage Cost from a Transfer Station to LPA

a) Type and capacity of Trucks: 40 m^3 trailer
b) Waste haulage amount: 20 ton per trailer per trip
c) Working shifts: 2 working shifts
d) Purchase cost of trailer: Rp 300 million per unit

d. Details of Unit Costs of Haulage with a Transfer Station

The following table shows details of haulage costs with a transfer station.

Table 3.2-26 Details of Unit Haulage Cost with a Transfer Station

Unit cost: Rupiah per Ton of waste

Distance between LPA and Collection Areas	Unit Cost of Haulage from Collection Areas to Transfer Station (1)	Unit Cost of Transfer Station (Depreciation, Operation & maintenance (2)	Unit Cost of Haulage from Transfer Station to LPA (3)	Total Unit Cost (1)+(2)+(3)= (4)
10 km	5,674	9,731	1,057	16,462
20 km	5,674	9,731	2,025	17,430
30 km	5,674	9,731	2,743	18,148
40 km	5,674	9,731	3,234	18,639

More details on the assumptions and costs are shown in Volume 4 Supporting Report Part 1 Section 1.3.

2.4 Placement of Containers in Depo and LPS

2.4.1 Container Placement Plan

Table 3.2-29 shows a container placement plan with number and size (either 14 m^3 or 8 m^3) of containers to be placed in each of the existing Depo and LPS. This plan was prepared based on the field survey of all the existing Depo and LPS conducted with respect to the following conditions:

1. Present amount of waste hauled from each Depo and LPS
2. Space of and access to Depo and LPS to determine physical possibility to place either 14 m^3 or 8 m^3 containers
3. Existing status (Some Depo and LPS are not used at present.)

Space and access requirement are shown in the table below:

Table 3.2-27 Space Requirement for Placement of Containers

	Conditions for Placement of 14 m^3 Containers	Conditions for Placement of 8 m^3 Containers
1. Length of Depo/LPS	13 m minimum	11 m minimum
2. Width of Depo/LPS	3 m minimum	2.5 m minimum
3. Width of Entrance	4 m minimum	4 m minimum
4. Turning Space for Trucks	10 m radius minimum for turning	9 m radius minimum for turning

Number of Depo and LPS to be placed with either 14 m^3 or 8 m^3 containers are as shown below:

Table 3.2-28 Number of the Existing Depo and LPS to be Placed with Containers

	Depo & LPS to be Placed with 14 m^3 Containers	Depo & LPS to be Placed with 8 m^3 Containers	Number of Depo & LPS that Need either Expansion or Relocation
1. Depo	42	11	0
2. LPS	40	61	6
3. Total (1+2)	82	72	6

In principle, 14 m^3 containers will be placed in Depo/LPS that have adequate space. As can be seen from the table above, it is possible to place 14 m^3 containers in 82 Depo/LPS, while 72 Depo/LPS have to be provided with 8 m^3 containers.

It should be noted that it is necessary to construct new Depo and LPS in the near future (as planned in Part 3 of this report), and also more number of containers will have to be provided as amounts of waste increase in the future.

2.4.2 Expansion of Depo and LPS

As can be seen in Table 3.2-28, there are 8 Depo/LPS as listed below where it is not possible to place either 14 m^3 or 8 m^3 containers. Those Depo/LPS need expansion or relocation.

1) Depo/LPS that Require either Expansion or Relocation

1. LPS Pasar Kapasan (Kel. Sidodadi, Kec. Simokerto)
2. LPS Pasar Turi (Kel. Bubutan, Kec. Bubutan)
3. LPS Pasar Tambak Rejo (Kel. Rangkah, Kec. Tambaksari)
4. LPS Pasar Bangun Rejo (Kel. Dupak, Kec. Krembangan)
5. LPS Krembangan (Kel. Krembangan Selatan, Kec. Krembangan)
6. LPS Bak Larangan (Kel. Sukolilo, Kec. Kenjeran)

2) Depo/LPS of Which Entrance Needs to be Enlarged

7. LPS Pasar Kembang (2.7 m) (Kel. Wonorejo, Kec. Tegalsari)
8. LPS Pasar Kapasan (Kel. Sukolilo, Kec. Kenjeran)

Abbreviations:

Kel.: Kelurahan

Kec.: Kecamatan

Table 3.2-29 Container Placement Plan (1)

No	Sub District	Kecamatan	Kelurahan	Name of Depo/LPS	Status	Hauled by	Type of Truck Currently Used	No. of the existing Containers	Estimated Waste Amount	14 m3 Containers to be placed	8 m3 Containers to be placed
1	Central Surabaya	Bubutan	Alun Alun Contong	Sulung	Used	KMS	10 m3 container	1	3.0 t	1	[2]
2	Central Surabaya	Bubutan	Bubutan	Penghela	Used	KMS	10 m3 container	4	11.9 t	3	N.P.
3	Central Surabaya	Bubutan	Bubutan	Depo Pringadi	Used	KMS	10 m3 container	4	10.8 t	3	N.P.
4	Central Surabaya	Bubutan	Bubutan	Pasar Turi	Used	KMS	Dump truck	-	15.5 t	N.P.	N.P.
5	Central Surabaya	Bubutan	Jepara	Babadan/Dupak	Used	KMS	10 m3 container	2	5.9 t	2	[3]
6	Central Surabaya	Bubutan	Tembok Dukuh	Pasar Tembok	Used	KMS	10 m3 container	2	6.0 t	2	N.P.
7	Central Surabaya	Bubutan	Tembok Dukuh	Depo Demak	Used	KMS	12 m3 container	4	14.3 t	4	N.P.
8	Central Surabaya	Genteng	Embong Kaliasin	Depo Kayoon	Used	KMS	12 m3 container	5	17.8 t	5	N.P.
9	Central Surabaya	Genteng	Genteng	Depo Simpang Dukuh	Used	KMS	6 m3 container	5	8.9 t	N.P.	4
10	Central Surabaya	Genteng	Kapasari	Pecindilan	Used	KMS	10 m3 container	6	14.9 t	4	N.P.
11	Central Surabaya	Genteng	Peneleh	Makam Peneleh	Used	KMS	6 m3 container	4	7.1 t	2	[3]
12	Central Surabaya	Simokerto	Kapasan	Gembong Gas	Used	KMS	6 m3 container	4	7.1 t	2	[3]
13	Central Surabaya	Simokerto	Sidodadi	Pasar Kapasan	Used	Contractor	Dump truck	-	8.9 t	N.P.	N.P.
14	Central Surabaya	Simokerto	Simokerto	Simolawang	Used	Contractor	Dump truck	-	11.0 t	N.P.	[5]
15	Central Surabaya	Simokerto	Simolawang	Pegirian	Used	KMS	6 m3 container	4	7.9 t	N.P.	4
16	Central Surabaya	Simokerto	Tambakrejo	Depo Tambakrejo	Used	KMS	10 m3 container	4	14.9 t	4	N.P.
17	Central Surabaya	Tegalsari	Dr. Sutomo	Pandegiling	Used	KMS	10 m3 container	4	15.0 t	4	N.P.
18	Central Surabaya	Tegalsari	Dr. Sutomo	Pasar Kupang	Used	KMS	6 m3 container	1	1.8 t	N.P.	1
19	Central Surabaya	Tegalsari	Dr. Sutomo	Taman Ketampon	Used	KMS	6 m3 container	3	5.4 t	2	[3]
20	Central Surabaya	Tegalsari	Kedungdoro	Kedung Anyar Wetan	Used	Contractor	Dump truck	-	11.0 t	3	[5]
21	Central Surabaya	Tegalsari	Keputran	Depo Keputran	Used	KMS	Dump truck	-	18.0 t	4	N.P.
22	Central Surabaya	Tegalsari	Keputran	Depo Dinoyo	Used	Contractor	Dump truck	-	12.8 t	3	N.P.
23	Central Surabaya	Tegalsari	Tegalsari	Kedungsari	Used	KMS	6 m3 container	4	9.4 t	3	[4]
24	Central Surabaya	Tegalsari	Wonorejo	Pasar Kembang	Used	Contractor	Dump truck	-	3.6 t	N.P.	2
25	North Surabaya	Kenjeran	Bulak	Depo Tambak Deres	Used	KMS	6 m3 container	1	1.8 t	[1]	1
26	North Surabaya	Kenjeran	Bulak Banteng	Depo Bulak Banteng	Will be used	-	-	-	-	P	P
27	North Surabaya	Kenjeran	Kenjeran	Kenjeran	Used	KMS	6 m3 container	1	1.8 t	[1]	1
28	North Surabaya	Kenjeran	Kenjeran	Depo Wiratno	Used	KMS	6 m3 container	1	0.9 t	[1]	1
29	North Surabaya	Kenjeran	Sidotopo Wetan	Depo Sidotopo Wetan	Used	KMS	6 m3 container	3	2.8 t	1	[2]
30	North Surabaya	Kenjeran	Sukolilo	Bak Larangan	Used	Contractor	Dump truck	-	2.0 t	N.P.	N.P.
31	North Surabaya	Kenjeran	Tanah Kali Kedinding	Depo Kali Kedinding	Used	KMS	6 m3 container	2	3.0 t	1	[2]
32	North Surabaya	Krembangan	Dupak	Pasar Bangun Rejo	Used	Contractor	Dump truck	-	3.0 t	N.P.	N.P.
33	North Surabaya	Krembangan	Dupak	Depo Dupak Bandarejo	Used	KMS	6 m3 container	4	7.2 t	N.P.	4
34	North Surabaya	Krembangan	Krembangan Selatan	Krembangan Barat	Used	KMS	10 m3 container	4	11.0 t	3	[5]
35	North Surabaya	Krembangan	Krembangan Selatan	Krembangan	Used	KMS	6 m3 container	1	0.6 t	N.P.	1
36	North Surabaya	Krembangan	Moro Krembangan	Depo Gresik	Used	KMS	12 m3 container	4	14.0 t	4	N.P.

Table 3.2-29 Container Placement Plan (2)

No	Sub District	Kecamatan	Kelurahan	Name of Depo/LPS	Status	Responsible Body	Type of Truck	No. of the existing Containers	Estimated Waste Amount	14 m3 Containers to be placed	8 m3 Containers to be placed
37	North Surabaya	Krembangan	Perak Barat	Depo Tanjung Sadari	Used	Counterpart	Dump truck	-	9.7 t	3	[5]
38	North Surabaya	Pabean Cantikan	Bongkaran	Depo Bunguran	Used	KMS	6 m3 container	5	8.9 t	3	[4]
39	North Surabaya	Pabean Cantikan	Bongkaran	Pengampon	Used	KMS	6 m3 container	4	7.1 t	2	[3]
40	North Surabaya	Pabean Cantikan	Krembangan Utara	Babaan	Used	Contractor	Dump truck	-	9.2 t	3	N.P.
41	North Surabaya	Pabean Cantikan	Krembangan Utara	Pesapen Pompa	Used	Counterpart	Dump truck	-	4.8 t	[2]	2
42	North Surabaya	Pabean Cantikan	Nyamplungan	Gambir	Used	Contractor	Dump truck	-	7.5 t	N.P.	4
43	North Surabaya	Pabean Cantikan	Nyamplungan	Dukuh Gili	Used	KMS	10 m3 container	2	3.0 t	1	[2]
44	North Surabaya	Pabean Cantikan	Perak Timur	Indrapura PLN	Used	Contractor	Dump truck	-	1.0 t	[1]	1
45	North Surabaya	Pabean Cantikan	Perak Timur	Kalimas Barat	Used	KMS	10 m3 container	3	5.9 t	2	[3]
46	North Surabaya	Pabean Cantikan	Perak Utara	Depo Kalimas Baru	Used	Sea Port Authority	Dump truck	-	2.6 t	1	[2]
47	North Surabaya	Pabean Cantikan	Perak Utara	Teluk Kumai	Used	Sea Port Authority	6m3 container	3	5.4 t	2	[3]
48	North Surabaya	Pabean Cantikan	Perak Utara	Kalianget	Used	Sea Port Authority	Dump truck	-	1.0 t	N.P.	1
49	North Surabaya	Pabean Cantikan	Perak Utara	Depo Tanjung Priok	Used	Sea Port Authority	Dump truck	-	7.0 t	2	[3]
50	North Surabaya	Pabean Cantikan	Perak Utara	Teluk Nibung	Used	KMS	6 m3 container	1	1.8 t	[1]	1
51	North Surabaya	Pabean Cantikan	Perak Utara	Jamrut Selatan	Used	KMS	6 m3 container	2	3.6 t	1	[2]
52	North Surabaya	Pabean Cantikan	Perak Utara	Nilam	Used	KMS	6 m3 container	1	1.8 t	[1]	1
53	North Surabaya	Pabean Cantikan	Perak Utara	Mirah	Used	KMS	6 m3 container	1	1.8 t	[1]	1
54	North Surabaya	Pabean Cantikan	Perak Utara	Jakarta Lloyd	Used	KMS	6 m3 container	1	1.8 t	[1]	1
55	North Surabaya	Semampir	Ampel	Pasar Pegirian	Used	KMS	10 m3 container	4	9.6 t	3	[4]
56	North Surabaya	Semampir	Ampel	Nyamplungan	Used	KMS	10 m3 container	2	5.0 t	2	[3]
57	North Surabaya	Semampir	Sidotopo	Kunti	Used	Contractor	Dump truck	-	10.0 t	[3]	N.P.
58	North Surabaya	Semampir	Wonokusumo	Depo Wonosari Tegal	Used	Contractor	Dump truck	-	13.8 t	4	N.P.
59	West Surabaya	Benowo	Benowo	Benowo	Will be used					P	P
60	West Surabaya	Lakarsantri	Lidah Kulon	Wisma Lidah Kulon	Used	KMS	6 m3 container	1	0.8 t	[1]	1
61	West Surabaya	Lakarsantri	Lontar	Depo Candi Lontar	Used	KMS	6 m3 container	1	1.8 t	[1]	1
62	West Surabaya	Tandes	Asemrowo	Pasar Asemrowo	Used	Contractor	Dump truck	-	0.6 t	[1]	1
63	West Surabaya	Tandes	Balongsari	Depo Balongsari	Used	KMS	6 m3 container	2	4.8 t	2	[3]
64	West Surabaya	Tandes	Buntaran	Buntaran	Will be used					P	P
65	West Surabaya	Tandes	Karang Poh	Depo Karang Poh	Used	KMS	6 m3 container	2	2.8 t	1	[2]
66	West Surabaya	Tandes	Manukan Kulon	Depo Manukan Kulon	Used	KMS	6 m3 container	4	8.8 t	3	[4]
67	West Surabaya	Tandes	Manukan Kulon	Manukan Telaga	Used	KMS	6 m3 container	1	3.4 t	N.P.	2
68	West Surabaya	Tandes	Manukan Wetan	Manukan Wetan	Used	KMS	6 m3 container	1	2.4 t	[1]	1
69	West Surabaya	Tandes	Putat Gede	Depo Kupang Indah	Used	KMS	6 m3 container	3	5.8 t	2	[3]
70	West Surabaya	Tandes	Simomulyo	Depo Simomulyo	Used	Contractor	Dump truck	-	11.0 t	3	[5]
71	West Surabaya	Tandes	Simomulyo	Depo Simohilir	Used	KMS	6 m3 container	2	3.4 t	1	[2]
72	West Surabaya	Tandes	Sonokwijenan	Depo Sonokwijenan	Used	KMS	6 m3 container	2	3.0 t	1	[2]

Table 3.2-29 Container Placement Plan (3)

No	Sub District	Kecamatan	Kelurahan	Name of Depo/LPS	Status	Responsible Body	Type of Truck	No. of the existing Containers	Estimated Waste Amount	14 m3 Containers to be placed	8 m3 Containers to be placed
73	West Surabaya	Tandes	Sukomanunggal	Sukomanunggal	Used	KMS	6 m3 container	1	0.6 t	[1]	1
74	West Surabaya	Tandes	Tandes Kidul	Darmo Indah	Stop			-	-	P	P
75	West Surabaya	Tandes	Tandes Lor	Sentong	Stop			-	-	P	P
76	West Surabaya	Tandes	Tubanan	Depo Tubanan	Used	KMS	10 m3 container	1	3.2 t	1	[2]
77	South Surabaya	Karang Pilang	Babatan	Depo Babatan	Used	KMS	6 m3 compactor	[3]	0.5 t	[1]	1
78	South Surabaya	Karang Pilang	Balas Klumprik	Balas Klumprik	Stopped	-	-	-	-	-	-
79	South Surabaya	Karang Pilang	Dukuh Kupang	Dukuh Kupang Barat (Sel)	Used	KMS	6 m3 container	1	1.8 t	[1]	1
80	South Surabaya	Karang Pilang	Dukuh Kupang	Dukuh Kupang Barat (Utara)	Used	KMS	10 m3 compactor	1	1.8 t	[1]	1
81	South Surabaya	Karang Pilang	Gunungsari	Yani Golf	Used	KMS	6 m3 container	1	1.0 t	[1]	1
82	South Surabaya	Karang Pilang	Jajar Tunggal	Jajar Tunggal	Used	KMS	6 m3 container	1	1.8 t	[1]	1
83	South Surabaya	Karang Pilang	Karang Pilang	Karang Pilang	Used	KMS	6 m3 container	1	1.7 t	[1]	1
84	South Surabaya	Karang Pilang	Kebraon	Kemlaten	Used	KMS	6 m3 container	1	1.7 t	[1]	1
85	South Surabaya	Karang Pilang	Kebraon	Kebraon	Used	KMS	6 m3 container	2	4.0 t	1	[2]
86	South Surabaya	Karang Pilang	Kedurus	Kedurus	Used	KMS	6 m3 container	2	3.6 t	1	[2]
87	South Surabaya	Karang Pilang	Waru Gunung	Waru Gunung	Used	KMS	6 m3 container	1	1.5 t	[1]	1
88	South Surabaya	Karang Pilang	Wiyung	Wiyung	Used	KMS	6 m3 container	1	1.6 t	[1]	1
89	South Surabaya	Karang Pilang	Wiyung	Depo Gunung Sari Indah	Used	KMS	6 m3 container	1	1.7 t	[1]	1
90	South Surabaya	Sawahan	Banyu Urip	Pasar Simo	Used	Contractor	Dump truck	-	5.4 t	2	[3]
91	South Surabaya	Sawahan	Banyu Urip	Simo Katrungan	Used	KMS	6 m3 container	2	1.8 t	[1]	1
92	South Surabaya	Sawahan	Pakis	Bintang Diponggo	Used	KMS	12 m3 container	2	5.0 t	2	[3]
93	South Surabaya	Sawahan	Pakis	Depo Dukuh Kupang Timur	Used	KMS	12 m3 container	3	7.5 t	2	[4]
94	South Surabaya	Sawahan	Pakis	Depo Kembang Kuning	Used	Contractor	Dump truck	-	33.0 t	8	N.P.
95	South Surabaya	Sawahan	Peterman	Depo Bukit Barisan	Used	Contractor	Dump truck	-	16.7 t	4	N.P.
96	South Surabaya	Sawahan	Putat Jaya	Pasar Kupang Gunung	Used	Contractor	Dump truck	-	1.2 t	[1]	1
97	South Surabaya	Sawahan	Sawahan	Widodaren	Used	KMS	6 m3 container	2	2.4 t	[1]	1
98	South Surabaya	Sawahan	Sawahan	Merapi	Used	KMS	6 m3 container	2	1.6 t	N.P.	1
99	South Surabaya	Wonocolo	Bendul Merisi	Depo Bendul Merisi	Used	KMS	6 m3 container	3	4.1 t	1	[2]
100	South Surabaya	Wonocolo	Gayungan	Gayungan Pring	Used	KMS	6 m3 container	1	1.5 t	N.P.	1
101	South Surabaya	Wonocolo	Gayungan	Depo Gayungsari	Used	KMS	6 m3 container	2	3.6 t	1	[2]
102	South Surabaya	Wonocolo	Gayungan	Gayungsari Pasar	Will be used			-	-	N.P.	P
103	South Surabaya	Wonocolo	Jambangan	Kebon Agung	Used	Contractor	Dump truck	-	2.2 t	[1]	1
104	South Surabaya	Wonocolo	Jemur Wonosari	Jemur Woonosari	Used	KMS	6 m3 container	3	5.4 t	2	[3]
105	South Surabaya	Wonocolo	Jemur Wonosari	Jemur Ngawinan	Used	KMS	6 m3 container	1	1.8 t	[1]	1
106	South Surabaya	Wonocolo	Karah	Depo Karah	Will be used				-	P	P
107	South Surabaya	Wonocolo	Ketintang	Ketintang LPN	Used	Contractor	Dump truck	-	1.8 t	N.P.	1
108	South Surabaya	Wonocolo	Ketintang	Ketintang Sekolahan	Will be used			-	-	N.P.	P

Table 3.2-29 Container Placement Plan (4)

No	Sub District	Kecamatan	Kelurahan	Name of Depo/LPS	Status	Responsible Body	Type of Truck	No. of the existing Containers	Estimated Waste Amount	14 m3 Containers to be placed	8 m3 Containers to be placed
109	South Surabaya	Wonocolo	Ketintang	Ketintang Baru	Used	Contractor	Dump truck	-	1.4 t	N.P.	1
110	South Surabaya	Wonocolo	Menanggal	Perum. BBD Ahmad Yani	Used	KMS	6 m3 compactor	1	0.3 t	[1]	1
111	South Surabaya	Wonocolo	Menanggal	Depo Menanggal	Used	KMS	6 m3 container	2	2.5 t	1	[2]
112	South Surabaya	Wonocolo	Pagesangan	Depo Pagesangan	Used	Contractor	Dump truck	-	2.7 t	1	[2]
113	South Surabaya	Wonocolo	Pagesangan	Kebonsari	Used	Contractor	Dump truck	-	1.8 t	N.P.	1
114	South Surabaya	Wonocolo	Siwalan Kerto	Siwalan Kerto	Used	KMS	6 m3 container	1	1.6 t	[1]	1
115	South Surabaya	Wonokromo	Darmo	Opak	Used	KMS	6 m3 container	1	0.4 t	N.P.	N.P.
116	South Surabaya	Wonokromo	Jagir	Bendul Merisi	Used	Contractor	Dump truck	-	12.1 t	3	[5]
117	South Surabaya	Wonokromo	Jagir	Pasar Wonokromo	Used	Contractor	Dump truck	-	16.2 t	4	N.P.
118	South Surabaya	Wonokromo	Ngagel	Ngagel	Used	Contractor	Dump truck	-	3.6 t	1	[2]
119	South Surabaya	Wonokromo	Ngagel Rejo	Depo Bratang Lapangan	Used	KMS	6 m3 container	4	5.4 t	2	[3]
120	South Surabaya	Wonokromo	Ngagel Rejo	Depo Ngagel Dadi III	Used	KMS	6 m3 container	4	4.3 t	[2]	2
121	South Surabaya	Wonokromo	Ngagel Rejo	Pasar Krukah	Used	KMS	6 m3 container	1	1.5 t	[1]	1
122	South Surabaya	Wonokromo	Sawunggaling	Wonoboyo	Used	KMS	6 m3 container	2	1.8 t	[1]	1
123	South Surabaya	Wonokromo	Sawunggaling	Pasar Wonokitri	Used	Contractor	Dump truck	-	0.4 t	[1]	1
124	South Surabaya	Wonokromo	Sawunggaling	Pasar Wonokitri	Used	KMS	6 m3 container	3	6.0 t	2	[3]
125	South Surabaya	Wonokromo	Sawungggaling	Joyoboyo	Used	KMS	6 m3 container	1	1.5 t	[1]	1
126	South Surabaya	Wonokromo	Wonokromo	Depo Kintamani	Used	KMS	6 m3 container	5	11.2 t	3	[5]
127	South Surabaya	Wonokromo	Wonokromo	Jetis	Used	KMS	6 m3 container	1	2.2 t	[1]	1
128	East Surabaya	Gubeng	Airlangga	Srikana	Used	KMS	12 m3 container	3	14.0 t	4	[6]
129	East Surabaya	Gubeng	Barata Jaya	Bratang Binangun	Used	KMS	10 m3 container	3	9.0 t	3	[4]
130	East Surabaya	Gubeng	Baratajaya	Baratajaya	Used	KMS	10 m3 container	1	4.5 t	[2]	2
131	East Surabaya	Gubeng	Gubeng	Depo Kangean	Used	KMS	10 m3 container	3	12.6 t	3	N.P.
132	East Surabaya	Gubeng	Kertajaya	Pasar Pucang Anom	Used	Contractor	Dump truck	-	2.0 t	[1]	1
133	East Surabaya	Gubeng	Mojo	Mojoarum	Used	KMS	10 m3 container	1	9.0 t	3	[4]
134	East Surabaya	Gubeng	Mojo	Depo Kaliwaron	Used	KMS	6 m3 container	2	3.8 t	1	[2]
135	East Surabaya	Gubeng	Mojo	Mojo	Used	KMS	6 m3 container	2	3.5 t	1	[2]
136	East Surabaya	Gubeng	Pucang Sewu	Depo Kalibokor	Used	KMS	6 m3 container	4	8.1 t	2	[4]
137	East Surabaya	Rungkut	Kali Rungkut	Raya Rungkut	Used	KMS	6 m3 container	2	3.0 t	1	[2]
138	East Surabaya	Rungkut	Kali Rungkut	Rungkut Harapan	Used	KMS	6 m3 container	1	1.2 t	[1]	1
139	East Surabaya	Rungkut	Kali Rungkut	Depo Rungkut Alang Alang	Used	Contractor	Dump truck	1	8.1 t	2	[4]
140	East Surabaya	Rungkut	Kali Rungkut	Raya Kali Rungkut	Stopped	-	-	-	-	P	P
141	East Surabaya	Rungkut	Kedung Baruk	Kedung Asem	Stopped			-	-	P	P
142	East Surabaya	Rungkut	Kendang Sari	Raya Kendang Sari Industry	Used	KMS	6 m3 container	2	2.8 t	[1]	1
143	East Surabaya	Rungkut	Kendangsari	Depo Kendangsari Block C	Used	KMS	6 m3 container	1	1.7 t	[1]	1
144	East Surabaya	Rungkut	Kendangsari	Prapen	Used	KMS	6 m3 container	1	0.8 t	[1]	1

Table 3.2-29 Container Placement Plan (5)

No	Sub District	Kecamatan	Kelurahan	Name of Depo/LPS	Status	Responsible Body	Type of Truck	No. of the existing Containers	Estimated Waste Amount	14 m3 Containers to be placed	8 m3 Containers to be placed
145	East Surabaya	Rungkut	Kendangsari	Kendangsari Telkom	Used	KMS	6 m3 container	2	2.2 t	[1]	1
146	East Surabaya	Rungkut	Kutisari	Kutisari Indah	Used	KMS	6 m3 container	3	4.6 t	[2]	2
147	East Surabaya	Rungkut	Panjaringan Sari	Panjaringan Sari	Used	KMS	6 m3 container	1	1.2 t	[1]	1
148	East Surabaya	Rungkut	Rungkut Kidul	Depo Rungkut Kidul	Used	KMS	6 m3 container	5	9.6 t	3	[4]
149	East Surabaya	Rungkut	Rungkut Menanggal	Depo Rungkut Menanggal	Used	KMS	6 m3 container	2	3.6 t	1	[2]
150	East Surabaya	Rungkut	Rungkut Menanggal	Rungkut Barata	Stopped	-	-	-	-	P	P
151	East Surabaya	Rungkut	Tenggilis Mejoyo	Tenggilis Tengah	Will be used	-	-	-	-	P	P
152	East Surabaya	Rungkut	Tenggilis Mejoyo	Depo Tenggilis Mejoyo	Used	KMS	6 m3 container	2	3.2 t	1	[2]
153	East Surabaya	Tambak Sari	Ploso	Depo Karang Gayam	Used	KMS	6 m3 container	3	6.0 t	2	[3]
154	East Surabaya	Tambak Sari	Rangkah	Pasar Tambak Rejo	Used	Contractor	Dump Truck	-	3.6 t	N.P.	N.P.
155	East Surabaya	Tambak Sari	Rangkah	Sarangan Tuwowo	Used	KMS	6 m3 container	[3]	0.8 t	N.P.	1
156	East Surabaya	Tambak Sari	Tambak Sari	Depo Bogen	Used	KMS	6 m3 container	4	6.6 t	2	[3]
157	East Surabaya	Sukolilo	Dukuh Sutorejo	Sutorejo I	Used	Contractor	Dump truck	-	0.6 t	[1]	1
158	East Surabaya	Sukolilo	Dukuh Sutorejo	Sutorejo II	Used	Contractor	Dump truck	-	0.6 t	[1]	1
159	East Surabaya	Sukolilo	Kalisari	Mulyosari	Used	KMS	12 m3 Container	1	4.3 t	[2]	2
160	East Surabaya	Sukolilo	Manyar Sabrangan	Manyar Kertoadi	Used	KMS	10 m3 container	2	5.9 t	2	[3]
161	East Surabaya	Sukolilo	Manyar Sabrangan	Depo Manyar	Used	KMS	10 m3 containers	4	16.o t	4	N.P.
162	East Surabaya	Sukolilo	Menur Pumpungan	Sarangan Arif Rahman Hakim	Stopped				-	P	P
163	East Surabaya	Sukolilo	Menur Pumpungan	Arif Rahman Hakim	Used	KMS	10 m3 container	2	7.0 t	2	[3]
164	East Surabaya	Sukolilo	Mulyorejo	Depo Wisma Permai	Used	KMS	6 m3 container	1	1.5 t	[1]	1
165	East Surabaya	Sukolilo	Semolowaru	Semolowaru Elok	Used	KMS	6 m3 container	2	1.7 t	[1]	1
166	East Surabaya	Sukolilo	Semolowaru	Depo Semolowaru	Used	KMS	6 m3 container	2	3.6 t	1	[2]
167	East Surabaya	Tambak Sari	Gading	Putro Agung Wetan	Used	KMS	10 m3 container	3	10.0 t	3	[4]
168	East Surabaya	Tambak Sari	Pacar Keling	Tambangboyo	Used	KMS	6 m3 container	2	3.7 t	1	[2]
169	East Surabaya	Tambak Sari	Pacar Keling	Depo Pacar Keling	Used	KMS	6 m3 container	3	4.4 t	[2]	2
170	East Surabaya	Tambak Sari	Pacar Keling	Pasar Gubeng Masjid	Used	KMS	6 m3 container	1	1.4 t	[1]	1
171	East Surabaya	Tambak Sari	Pacar Keling	Pacar keling	Used	KMS	10 m3 container	1	4.0 t	1	[2]
172	East Surabaya	Tambak Sari	Pacar Keling	Petojo	Used	KMS	6 m3 container	1	1.9 t	[1]	1
173	East Surabaya	Tambak Sari	Pacar Keling	Gubeng Masjid	Used	KMS	6 m3 container	1	1.9 t	[1]	1
174	East Surabaya	Tambak Sari	Pacar Kembang	Sarangan Pacar kembang	Used	KMS	Dump truck	-	0.3 t	[1]	1
175	East Surabaya	Tambak Sari	Ploso	Ploso Baru	Stopped			-	-	P	P

Note : 1. Figures in parenthesis [ ] indicate numbers of optional containers that can be possibly be placed, but not advisable mainly because waste amount is not large enough, or not cost-effective.
2. "N.P." means not possible or difficult to place containers because the spaced or access to Depo/LPS is inadequate.
3. "P" means possible to place containers. But the marked Depo/LPS are not used currently.

2.5 Procurement Plan and Manpower Requirement

2.5.1 Annual Procurement Plan

Annual procurement schedule during the period 1992/93 - 1998/99 are shown in the following three (3) tables.

It is planned that all equipment needed will be procured in the preceding years. (Eg. Trucks to be used in 1995/96 will be procured in 1994/95.)

The life time (duration) of trucks and equipment is assumed as follows:

1) Trucks: 7 years
2) Containers: 5 years

Table 3.2-30 Trucks Procurement Schedule During SUDP Period 1992/3-1998/99

Year	8 m^3 Container Truck (1)	14 m^3 Container Truck (2)	Open Dump Truck (3)	Compactor Trucks (4)	Total (5)
1992/93	0	0	0	0	0
1993/94	7	18	3	0	28
1994/95	4	0	1	0	5
1995/96	6	6	0	0	12
1996/97	0	0	1	0	1
1997/98	9	15	0	0	24
1998/99	0	0	0	0	0
Total	26	39	5	0	70

Table 3.2-31 Containers Procurement Schedule During SUDP Period 1992/3-1998/99

Year	8 m^3 Container (1)	14 m^3 Container (2)	Total (1) + (2) = (3)
1992/93	0	0	0
1993/94	39	122	161
1994/95	44	0	44
1995/96	6	2	8
1996/97	0	1	1
1997/98	0	3	3
1998/99	0	2	2
Total	89	130	219

Table 3.2-32 Handcarts Procurement Schedule During SUDP Period 1992/3-1998/99

Year	1.0 m^3 Handcart (1)	1.5 m^3 Handcart (2)	Total (1) + (2) = (3)
1992/93	0	0	0
1993/94	85	31	116
1994/95	85	31	116
1995/96	86	32	118
1996/97	0	0	0
1997/98	0	0	0
1998/99	0	0	0
Total	256	94	350

2.5.2 Manpower Requirement

At present, there are 146 truck crew (drivers and assistant) in 1992. It is expected that the number of crew will decrease gradually in the future as the existing containers and trucks are replaced with larger containers and trucks.

It is planned that the future size of crew will be constant at 92 in 1995 and thereafter as shown in the table below.

Some of the personnel to be made redundant will retire after reaching the retirement age or will be transferred to other sections in the Cleansing Department.

Like the present system, a truck (serving for either 8 m^3 or 14 m^3 containers) will be operated by:

- one (1) driver, and
- one (1) assistant

However, it is considered possible for a driver to operate arm-roll trucks without any assistants. As a matter of fact, arm-roll trucks are operated by one man in Japan and other countries. Therefore, it is advised that KMS will use a driver only for a truck towards the end of the SUDP period.

All dump trucks will be operated by one driver per unit. Assistants will be provided from Rayon offices depending on need of each occasion.

Table 3.2-33 Number of Drivers and Assistants Needed (Summary)

Year	New Trucks		Existing Trucks		Spare Crew		Total		
	Driver (1)	Assis-tant (2)	Driver (3)	Assis-tant (4)	Driver (5)	Assis-tant (6)	Driver (1)+(3) + (5) = (7)	Assis-tant (2)+(4) +(6) = (8)	Total (7)+(8) = (9)
1992/93	0	0	64	68	5	9	69	77	148
1993/94	21	18	38	46	4	5	63	69	132
1994/95	29	25	21	25	8	8	58	58	116
1995/96	33	28	3	2	14	13	50	43	93
1996/97	46	41	0	0	3	2	49	43	92
1997/98	46	41	0	0	3	2	49	43	92
1998/99	70	18	0	0	4	0	74	18	92

Table 3.2-34 Number of Drivers and Assistants Needed for New Trucks

Year	Arm-Roll Trucks Serving for 8 m^3 Containers		Arm-Roll Trucks Serving for 8 m^3 Containers		Open Dump Trucks		Total		
	Driver (1)	Assis-tant (2)	Driver (3)	Assis-tant (4)	Driver (5)	Assis-tant (6)	Driver (1)+(3) + (5) = (7)	Assis-tant (2)+(4) +(6) = (8)	Total (7)+(8) = (9)
1992/93	0	0	0	0	0	0	0	0	0
1993/94	6	6	12	12	3	0	21	18	39
1994/95	7	7	18	18	4	0	29	25	54
1995/96	11	11	17	17	5	0	33	28	61
1996/97	17	17	24	24	5	0	46	41	87
1997/98	17	17	24	24	5	0	46	41	87
1998/99	26	0	39	18	5	0	70	18	88

Table 3.2-35 Number of Drivers and Assistants Needed for the Existing Trucks

Year	Trucks for 6 m^3 Container		Trucks for 10 m^3 Container		Trucks for 12 m^3 Container		REL Trucks for 0.6m^3 Container		REL Trucks for 1.0m^3 Container		Open Dump Trucks		Total		
	D	A	D	A	D	A	D	A	D	A	D	A	D	A	To-tal
1992/93	26	26	13	13	4	4	5	5	10	20	6	0	64	68	112
1993/94	12	12	5	5	4	4	5	5	10	20	2	0	38	46	84
1994/95	12	12	0	0	0	0	3	3	5	10	1	0	21	25	46
1995/96	2	2	0	0	0	0	0	0	0	0	1	0	3	2	5
1996/97	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1997/98	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1998/99	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

D: Driver

A: Assistant

2.6 Investment, Operation and Maintenance Costs

2.6.1 Investment

Yearly investment schedules of trucks, containers, and handcarts are shown in the table below. Total investment amount is estimated to be Rp 6,644.4 million in 1992 price including the 10 % government tax (PPN).

Table 3.2-36 Yearly Investment Schedule

Unit: Million Rupiah in 1992 price

Year	Trucks				Containers			Handcarts			Grand Total (4)+(7)+(10)= (11)
	8 m3 Container Truck (1)	14 m3 Container Truck (2)	Open Dump Truck (3)	Total Truck (1)+(2)+(3) = (4)	8 m^3 Container (5)	14 m^3 Container (6)	Total container (5)+(6) =(7)	1 m^3 Hand-cart (8)	1.5 m^3 Hand-cart (9)	Total Hand-cart (8)+(9) =(10)	
1992/93	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
1993/94	354.2 (7)	1,535.4 (18)	152.1 (3)	2,041.7 (28)	234.0 (39)	976.0 (122)	1,210.0 (161)	40.8 (85)	17.1 (31)	57.9 (116)	3,309.6
1994/95	202.4 (4)	0.0 (0)	50.7 (1)	253.1 (5)	264.0 (44)	0.0 (0)	264.0 (44)	40.8 (85)	17.0 (31)	57.8 (116)	3574.9
1995/96	303.6 (6)	511.8 (6)	0.0 (0)	1,068.5 (12)	36.0 (6)	16.0 (2)	52 (8)	41.3 (86)	17.6 (32)	58.9 (118)	1,179.4
1996/97	0.0 (0)	0.0 (0)	50.7 (1)	50.7 (1)	0.0 (0)	8.0 (1)	8.0 (1)	0	0	0	58.7
1997/98	455.4 (9)	1,279.5 (15)	0.0 (0)	1,734.9 (24)	0.0 (0)	24.0 (3)	24.0 (3)	0	0	0	1,758.9
1998/99	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)	16 (2)	16 (2)	0	0	0	16
Total	1,315.6 (26)	3,326.7 (39)	253.5 (5)	4,895.8 (70)	534.0 (89)	1,040.0 (130)	1,574.0 (219)	122.9 256	51.7 (94)	174.6 (350)	6,644.4

Note:

1) Figures in parenthesis show number of units to be procured.
2) The above costs include the government tax (PPN - 10 %).

2.6.2 Operation and Maintenance Costs

Operation and maintenance costs of new trucks and containers to be procured are estimated to be Rp 5,276 million in total during the period 1992/93 - 1998/99 in 1992 price. The details of the costs are shown in the tables below. There will be no costs incurred for operation and maintenance of handcarts because they will be given to local communities.

Table 3.2-37 Operation and Maintenance Costs of Trucks and Containers

Unit: Rupiah in 1992 price

Year	7 GVW Arm-Roll Trucks & 8 m^3 Containers (1)	14 GVW Arm-Roll Trucks & 14 m^3 Containers (2)	Dump Trucks (3)	Total (1)+ (2)+ (3) = (4)
1992/93	0	0	0	0
1993/94	116,490,000	295,836,000	39,384,000	451,710,000
1994/95	135,905,000	443,754,000	52,512,000	632,171,000
1995/96	213,565,000	419,101,000	52,512,000	685,178,000
1996/97	330,055,000	591,672,000	65,640,000	987,367,000
1997/98	330,055,000	591,672,000	65,640,000	987,367,000
1998/99	504,790,000	961,467,000	65,640,000	1,531,897,000
Total	1,630,860,000	3,303,502,000	341,328,000	5,275,690,000

Note: The above costs are calculated based upon the unit operation/maintenance costs per truck system as shown in the table below, and number of units used as shown in Table 3.2-22.

Unit operation and maintenance costs are estimated below. A unit cost covers one arm-roll truck and 6 containers (either 8 m^3 or 14 m^3) served by an arm-roll truck.

Table 3.2-38 Unit Annual Operation and Maintenance Costs

Unit: Rupiah in 1992 price

	A 7 GVW Arm-Roll Truck & 6 units of 8 m^3 Containers	A 14 GVW Arm-Roll Truck & 6 units of 14 m^3 Containers	A Dump Truck
1. Fuel	5,900,000	6,500,000	2,000,000
2. Salary for Driver & Assistant	4,260,000	4,260,000	2,760,000
3. Tax and Insurance	2,030,000	2,030,000	2,030,000
4. Maintenance (12.5 % of truck purchase Cost)	6,325,000	10,663,000	6,338,000
5. Sub-total (1+2+3+4)	18,515,000	23,453,000	13,128,000
6. Maintenance cost of 6 containers (2.5 % of purchase cost)	900,000	1,200,000	0
7. Total (5 + 6)	19,415,000	24,653,000	13,128,000

Chapter 3 F/S Component 2: Construction of Sanitary Landfill Site in Benowo

3.1 Key Factors of Design

3.1.1 Site Locations and Conditions

KMS decided that KMS's future landfill should be sited Kelurahan Benowo, the western part of Surabaya City. This decision was made by the competent officials of KMS including Mayor of the city on November 28, 1992. The whole site designated has an area of about 150 ha, of which the westernmost part was designated to be the first phase construction site of the sanitary landfill for which the Study Team has carried out the Feasibility Study. The site is found to be possible to convert to a solid waste landfill site based on the consideration of its characteristics if some appropriate countermeasures are applied.

1) Location and Access

The planned landfill in Kecamatan Benowo is about 10 to 15 km to the west of the central part of the city as shown in Fig. 3.3-1. The following five (5) subdistricts locate partly or wholly in the planned site (150 ha).

- Kelurahan Sumberejo
- Kelurahan Pakal
- Kelurahan Benowo
- Kelurahan Romo Kalisari
- Kelurahan Tambak Osowilangon

The planned site is situated in a catchment area of River Lamong, five (5) km away from the estuary of the river. The site extends along the river channel.

Access road to the planned site is AMD road and through Jl. Benowo it leads to all the other city area as shown in Fig. 3.3-2. AMD road does not have any connection to the neighboring Kabupaten Gresik, therefore the access from the other parts of the city is limited only through Jl. Benowo to AMD road. AMD road has a railway crossing which is not installed any protetion device, then all the vehicles go over the rail directly at present.

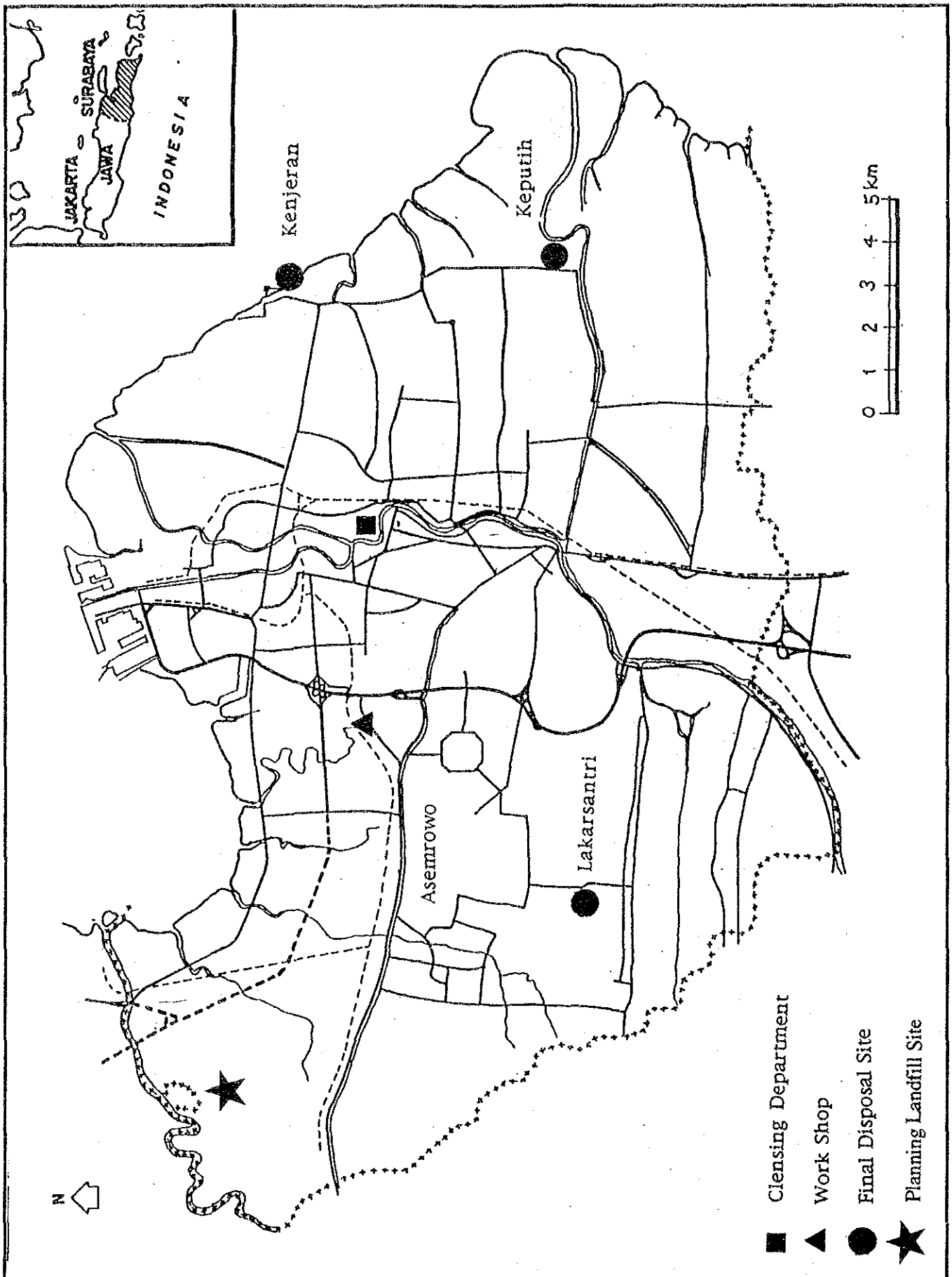

FIG. 3.3-1 LOCATION OF PLANNED LANDFILL SITE

THE STUDY ON THE SOLID WASTE MANAGEMENT IMPROVEMENT FOR SURABAYA CITY

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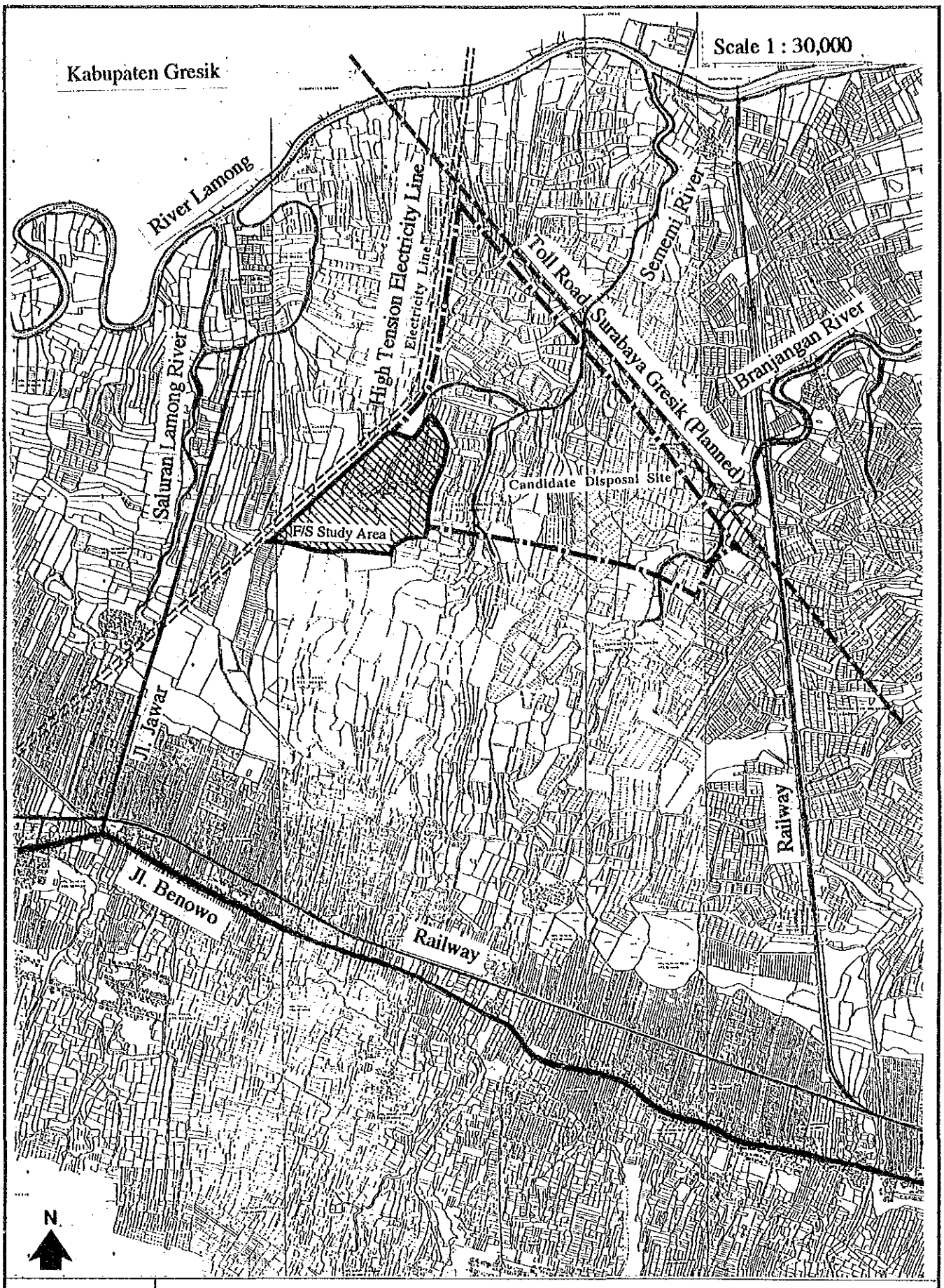

FIG. 3.3-2 ACCESS OF PLANNED LANDFILL SITE

THE STUDY ON THE SOLID WASTE MANAGEMENT IMPROVEMENT FOR SURABAYA CITY

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2) Topography

The planning site is located on an alluvium plane belongs to River Lamong's catchment area. The altitude ranges from 2 to 3 meter above sea level in the area about 5 km away from seashore. This means the site is originally flat and furthermore most area here is used as the salt farm so the ground surface is kept precisely horizontal to facilitate the salt production by using solar heating.

Reflecting the dominant land use, the surface of the site is classified simply into 3 major types, namely Salty water drying bed, River, channel and pond, and Footpath and bank.

The altitude is so low that the coastal plane belongs to tidal compartment. River Lamong and its many tributaries distributed around the site show consequently alternate flow direction corresponding to the tidal wave, and this nature enables the utilization of salty water for salt production here.

3) Geology

Surface soil consists of soft silty clay which classified as alluvium deposit. The depth of this soft clay was confirmed by the boring test at around 10 m at the site. Below this soft clay, there distribute stiff clay and silt layer with the thickness of about 15 m which has already been consolidated and dense fine sand/silt.

The clay is generally used for water proof linig material for the footpath and the partition of salt farms here. Then it is considered that the surface soil has enough impermeability under the small head not more than 1 meter. According to the result of laboratory test, the coefficient of permeability distributes in the range from 0.8 to 5×10^{-5} cm/s. The surface soil causes many cracks when dried up, however, it is considered to beimpermeable if it is kept in wet condition.

The whole layer of alluvium deposit with a depth of about 10 m still has a possibility of consolidation. According to the result of laboratory test, the pre-compression stress is measured to be from 3 to 4 t/m^2.This means the subsoil stays in normal consolidation status.

4) Existing Land Use

Most part of coastal plane is occupied by salt farm around the planning landfill site, and remaining part such as canal, dredged pond are used for fishery or fish breeding. Bigger sized canal or tributary of River Lamong are used for water transportation of salt or salt production materials.

Small villages are located in the marginal area of coastal plane or along the river in isolated position each other. The nearest residences with about 20 houses are located on AMD road, 300 m away from the proposed connection point between AMD road and the access road of the landfill site. There are four villages that are located on the downstream of tribultaries that flow through the planning landfill site. The nearest village from the whole candidate landfill site for future expansion is located about 1 km below along the stream. In these villages no piped waster is available, so people use river water for laundry and bathing. Drinking water is supplied by PDAM tank lorry and stored in a communal reservoir installed in each village.

Amid the salt farm, there is no permanent residence, however, some temporary huts for seasonal laborers of salt farm are scattered with a distribution one in several hectare. These huts are only used during the dry season when the salt production is executed, therefore there are no inhabitants during the rainy season in the planning landfill site.

3.1.2 Design Concept

To design a landfill site, the technical guideline issued by Directorate of Environmental Sanitation, CIPTA KARYA, was referred to. The guideline explains several negative impacts that may be caused by landfill operation, and at the same time suggests mitigation measures against each impact. First of all, the design of planned landfill site in Benowo followed the recommendations of this guideline as long as the guideline shows circumstances similar to the planned site. Besides this guideline, the following factors were taken into consideration:.

a. Environmental protection
b. Construction cost and operation
c. Future land use

These items are investigated respectively below.

1) Environmental Protection

Surrounding water body is mostly used for salt production or fishery. On the contrary, ground water is not utilized in the neighboring villages located along the lower reaches of the tribularies flowing through the planned site due to salinity of the groundwater. Then the fundamental subject in environmental protection is water quality of the surface water.

Considering the circumstances of the site, the water in the site should be controlled to prevent the pollution of the surrounding water body in the manner shown below :

a. Enclose the leachate within the site
b. Reduce the leachate by recirculation and evaporation
c. Lower the porewater pressure by underdrain
d. Collect the rainwater that has not touched the garbage separately from the leachate and discharge

Garbage pile generates inflammable gases during decomposition process, which is caused by microorganism and ensures the volume reduction. The gases sometimes cause spontaneous fire on the surface of the garbage layer. It is not only dangerous but a choking and in some cases harmful smoke would intrude into the adjacent area. Therefore the ventilation facility is planned to be introduced to the landfill site. The facility consists of vertical gas vents and horizontal underdrain network. Both of them have the two functions, namely leachate drain by the infiltrated part and ventilation by the other vacant part. The facility is expected to obtain the following effects of ventilation.

a. Facilitate the aerobic decomposition by supplying air into the garbage layer
b. Shorten the necessary time for stabilizing the layer that results in the subsidence of the surface.
c. Disperse the inflammable gases safely

Another major protection subject is prevention of overflow of garbage out of site as is commonly observed in the existing landfill sites. For this purpose, the landfill operation is planned to be conducted within enclosure dike higher than the waste pile. Garbage surface is also covered with some stable material periodically and finally covered with soil with sufficient thickness.

2) Construction Cost and Operation

Major part of construction cost usually consists of soil works such as enclosure dyke and drainage, and leachate treatment facility. As for soil works, there are few choices in the selection of construction method because the site has a very soft ground surface that is not suitable to sustain any complicated or heavy structures on it. Therefore the major interest in the selection of an economic method would be how to treat leachate water.

a. Application of the Least Cost Systems

The sanitary landfill facilities consist of various sub-systems. The Study Team has given a priority to the selection of the most cost-effective systems of the least cost that fulfill required functions as explained below.

(1) Use of Steel Sheet Pile for Reinforcement of Foundation of Dike

The total construction cost turned out to be costlier than initially thought because that the site is covered with soft clay, and it is necessary to reinforce the foundation of dike by driving either steel sheet pile or steel pipes into the clay soil to the depth of 10 m. As a matter of fact, the cost of the reinforcement of the soft clay foundation shares 40 % of the total construction cost of the planned LPA.

As a result of the cost comparison, the use of steel sheet pile is recommended and adopted for the plan because the other method (use of steel pipes) is more than 60 % costlier than the former as shown below:

		Unit Price	Cost Index
(1)	Steel sheet pile:	Rp 1,600/ton	(100)
(2)	Steel pipe:	Rp 2,600/ton	(163)

(2) Leachate Treatment

There are the following two methods for leachate treatment: 1) leachate recirculation system, and 2) mechanical treatment. The JICA Study recommend the former because the latter is more than 12 times costlier than the former as shown below:

	Cost	Index
1) Leachate Recirculation System:	Rp 754 million*	(100)
2) Mechanical Treatment:	Rp 9,600 million	(1,273)

* Details of the costs of the leachate recirculation system are as follows:

- Construction of retention pond: Rp 186 million
- Recirculation pump: Rp 108 million
- Land acquisition Rp 460 million (Rp 23,000m^2 x 20,000 m2)
- Total: Rp 754 million

b. Unit Cost Comparison between the Planned Sanitary Landfill and the Existing Incinerator

The unit waste incineration cost of the existing incinerator, Rp 85,600/ton is more than 7 times higher than the unit disposal cost (about Rp 12,000/ton max.) of the planned sanitary landfill in Benowo.

In view of operation, the leachate confining method requires less intensive maintenance than the mechanical treatment plant. The main point of operation is only to control the water level of the retention pond by using the pump and recirculation facilities during rainy season when the monthly precipitation exceeds the monthly evaporation. Therefore this treatment method can be thought a better way to save an operation cost and manpower.

3) Future Land Use

The planned site is involved in a comprehensive development plan called "Rencana Detail Tata Ruang Kota Tambak Osowilangon". The land around the site will be green area according to the development plan. The site and the neighboring area for future expansion is bounded by two high tension electricity line in the west side and also bounded by planned toll road Surabaya Gresik in the north side. The south side is connected with planned residential area or golf course.

The future land use of the planned landfill site is not definitely decided yet. If the land would be used is decided as green area, it is possible to change the site with less care after completion of landfill operation. According to the experience of Japan, in about 15 years after the end of landfill operation, it can be converted into various types of land use with some mitigation measures for the site and the building. If the type of land use has less requirements like park, green belt and golf course, it can be converted

sooner than 15 years. Some examples of land use conversion from final disposal site are presented in Appendix 6 of this report.

4) Stage Plan

The most desirable plan for acquiring the landfill site is to get both Benowo (150 ha) and the New East (120 ha). The critical time when the existing landfill site is exhausted is forecast to be the year 1996. It is necessary to prepare the new landfill site before the critical time at the latest. This means KMS should have the additional capacity of landfill by the end of 1995 with the minimum capacity that meets the demand expected in the next year.

This requirement of time correspondence seems to be difficult, but it is not necessary to construct all the facilities before the beginning of landfill operation. The construction should be continued even after the commencement of the landfill operation according to the annual landfill amount expected in the successive years. Time schedule for the execution of the project is outlined in Table 3.3-1.

Table 3.3-1 Project Stage of Benowo Landfill Site

Activity	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Land Acquisition													
Construction (Including Detail Design)													
Landfill													
Closing													

Note : Broken lines mean the work for installation of underdrain and gas vent. The installation is supposed to be done during dry seasons.

The planned landfill site for the Feasibility Study is expected to expand to northeastern direction along the high tension lines up to Surabaya-Gresik Toll Road. In the course of expansion, it is assumed that the land for another landfill site will be acquired in an area adjacent to area (45 ha) of the Feasibility Study, and the site will be expanded in a step by step manner. Based on this assumption, a lay-out of facility is prepared so as to avoid duplicated construction of common facilities such as on-site access road, retention pond and enclosure dike those which are required for each stage of construction.

Another point to be considered is that the northern boundary contacts the high tension line and Surabaya-Gresik Toll Road both of which should be protected against the displacement of ground surface. To satisfy this requirement, it is desirable to keep the landfill point away from the said high tension lines and the toll road as far as possible. As for the high tension line, it is not allowed to build facilites such as dike within 50 m from the center of high tension lines. Considering these requirements, the retention ponds for each step of landfill sites will be constructed along the northern boundary next to high tension line and Surabaya-Gresik Toll Road.

Thus the final lay-out of the whole area of 150 ha is placed as shown in Fig. 3.3-3. Consequently the first step of the first landfill site (45 ha) has been designed according to the lay-out plan.

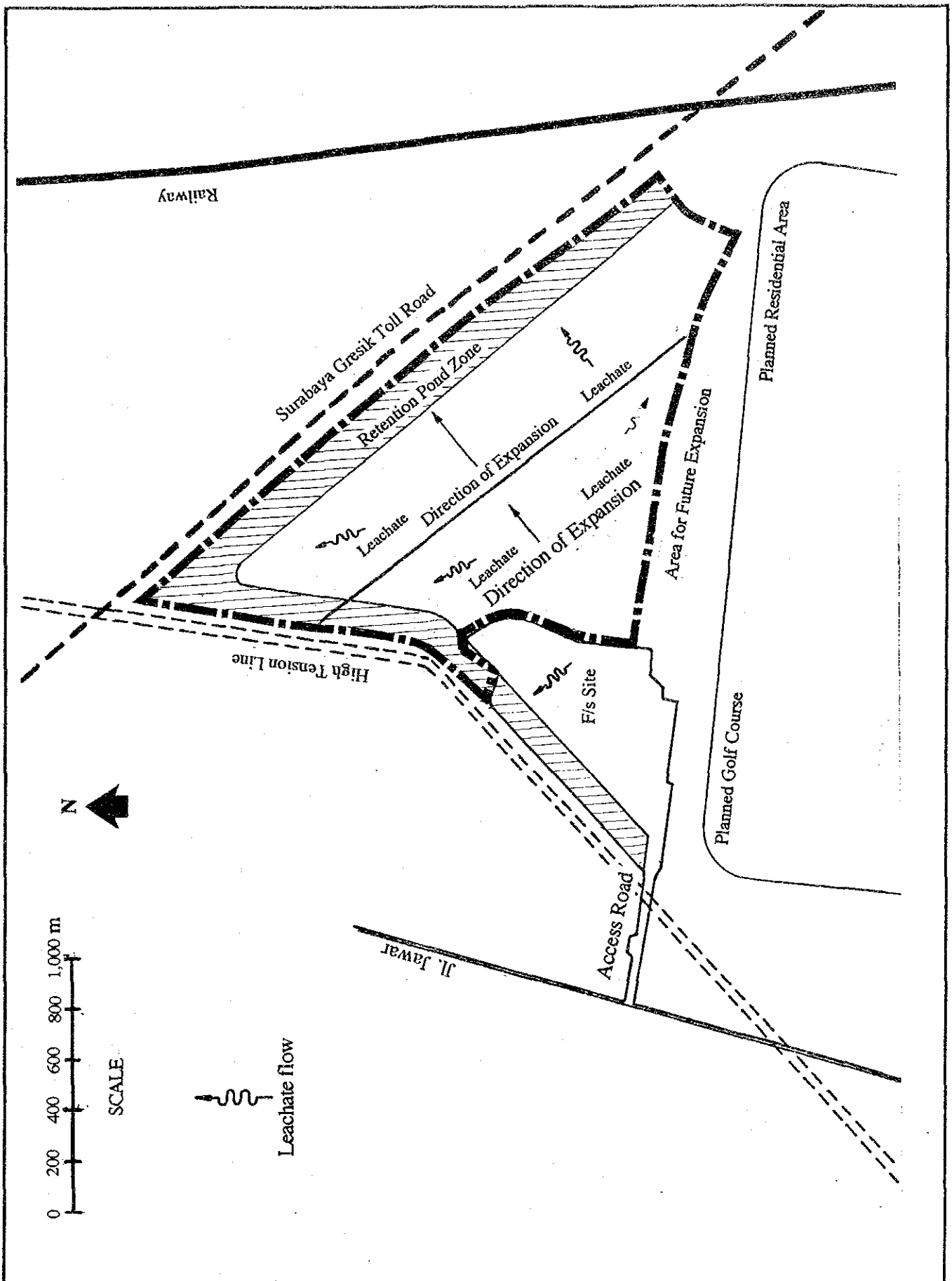

FIG. 3.3-3	PLAN FOR FUTURE EXPANSION

THE STUDY ON THE SOLID WASTE MANAGEMENT IMPROVEMENT FOR SURABAYA CITY

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3.2 Structure and Function of Facility

3.2.1 Composition of Facility

Facilities for the planned new landfill site consist of the following components. A lay-out plan for the facilities is shown in Fig. 3.3-4.

Table 3.3-2 Major Component of Landfill Site

Type	Definition
1. Access Road	a. Connect the planned site with AMD road b. Constructed as an essential component of the landfill site
2. Leachate Control Facility	a. Consists of collection facility, reservoir and recirculation facility b. Collection facility has the function to collect the rain water through the garbage pile.
3. Rainwater Drainage	a. Consists of collection facility, retention pond and discharge facility b. Collection facility has the function to collect the rain water in principle c. Discharge facility has the function to overflow the excessive rainwater during heavy rain that ensure enough dilution effect on leachate concentration
4. Enclosure Dike	a. Made of soil in principle b. Limit the range of dumping area c. Placed along the boundary of the site
5. Divider Dike	a. Made of aged garbage in principle b. Limit the range of dumping area c. Placed on the boundary of the partition for the demarcation of annual operation
6. Landfill Area	a. The place where waste is placed b. Installed with on-site road, under drain for leachate and gas vent according to the progress of the landfill operation c. Divide the total area of 37 ha into 3 zones Zone 1 12 ha (south) Zone 2 13 ha (center) Zone 3 12 ha (north)
7. Gas Vent	a. Made of porous material to facilitate the penetration of gaseous substances and recirculation water b. Installed vertically through the garbage layer and cover soil c. Connected with the under drain at each level
8. Administrative Facility	a. Consists of building and other miscellaneous facilities b. Contain the function for occupation of the necessary operation staff c. Limit the landfill activity within the site

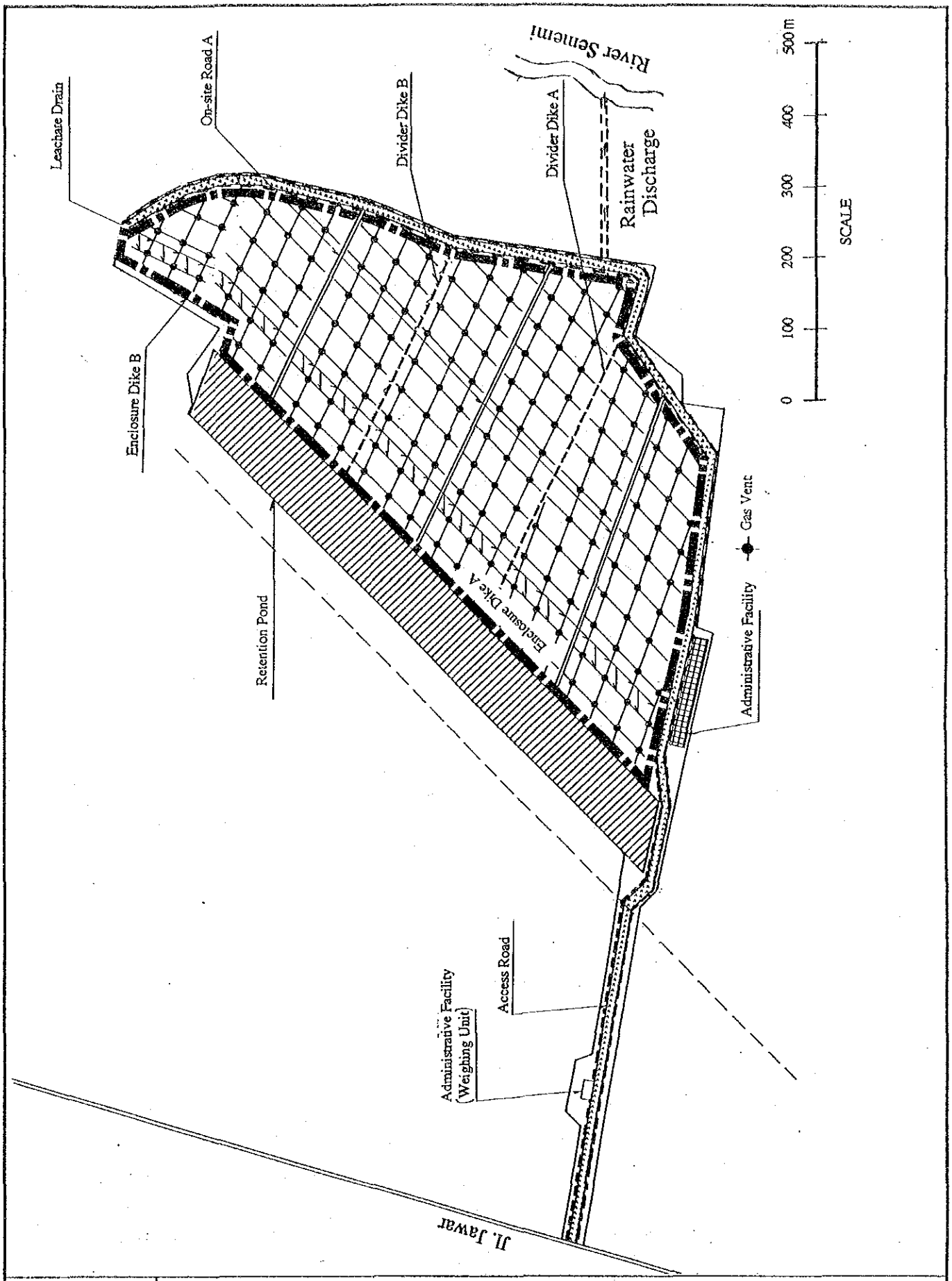


FIG 3.3-4 **LAYOUT PLAN OF FACILITY**

THE STUDY ON THE SOLID WASTE MANAGEMENT IMPROVEMENT FOR SURABAYA CITY

3.2.2 Access Road

It is planned that an access road will be provided along the existing main footpath that is now used for bicycle transportation of salt product and production materials. The planned access road will provide the shortest access to the existing public road..

The bearing capacity of the access road is planned to be 10 ton of axle load according to the regulation of DPU (Ministry of Public Works) : Decree of Minister No. 378, 1987. The pavement specification will be decided so as to satisfy the above regulation and referring to the standard enacted by DPU : Decree of Minister No.378, 1987. The design width of the access road is 30 m considering the mitigation of influence caused by garbage haulage vehicles to the neighboring area. The road side space of 8 m in width will serve as a buffer zone.

On-site road which is constructed along the boundary of the site in direct connection with the access road will be subject to the similar standard as applied to the access road.

As for the crossing point with the high tension line of PLN, it is necessary to adapt a special protection measures in accordance with the regulation on the electricity supply. The requirement of protection work is specified by PLN. A protection work for the access road as planned accordingly is included in this plan.

The similar item related to AMD road can be pointed out, namely the railway crossing improvement. It will be also necessary to be solved by Dinas PU before the construction of landfill site starts.

3.2.3 Leachate Control Facility

Leachate water should be taken out from waste layers as soon as possible and reserved in a retention pond. Then it is aerated and returned to waste layers again. The function of the leachate control system is classified into two parts; one is collection and the other is aeration and recirculation.

Leachate is collected by the network of under drain placed on the bottom of the dumping area first. The network is also installed in an appropriate level according to the progress of landfill operation, considering the subsidence of the site that would be caused by the load of filled garbage and soil. The bottom network leads to the retention

pond and the upper networks are connected with the lower networks through vertical conduit of gas vent. The structure of the collection system is shown in Fig. 3.3-5.

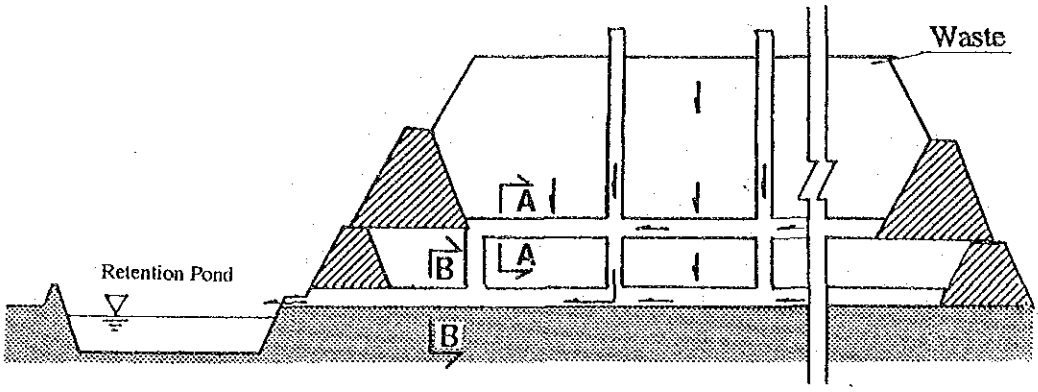
Leachate will be recirculated with an electric pump from the retention pond to the top of the enclosure dike. Pumped up water is delivered to the recharging point by the combination of small reservoir tank and connection hose. Recharge point is selected out of gas vent distributed on the surface of dumping area according to the stage of landfill operation. Therefore the delivery facility should have a convenient structure so as to make it easy to move the facility from one recharge point to another. The concept of recirculation system is illustrated in Fig. 3.3-6. The recirculation enables to keep the retention pond empty for 8 months, and to keep the water level lower than the bottom of under drain outlet during the remaining 4 months from January to April. Therefore outflow of leachate scarcely happens even in rainy season. Most organic matters contained in leachate will be returned to the garbage pile and finally fixed there through the process of recirculation. Then the amount of pollutant in the retention pond can be reduced steadily, however, there remains a risk that the leachate or its sediment exposed in the air may emit an offensive odor created through anaerobic decomposition of organic matters. But it is not certain if the influence of the odor reaches a critical level that affects the neighboring area. In general, it is difficult to design a mitigation measure without identifying the magnitude and frequency of the risk in advance. So countermeasures against offensive odor are not included in the current plan. It is however advisable that some measures be taken when details of the offensive odor are known.

The surface soil is so soft and contractible, the elevation of the under drain faces the risk to lose its function because of subsidence of the surface soil layer. In order to prevent the leachate discharge function being affected by the subsidence, the structure of the under drain network is designed as follows:

a. Place several rows of bamboo piles vertically just below the bottom under drain in order to support the drain against the surface soil subsidence.
b. Construct an upheaved under drain as the bottom network with a height of 1.5 m in order to secure the horizontal conduit for both leachate and air even if the subsidence occurs.

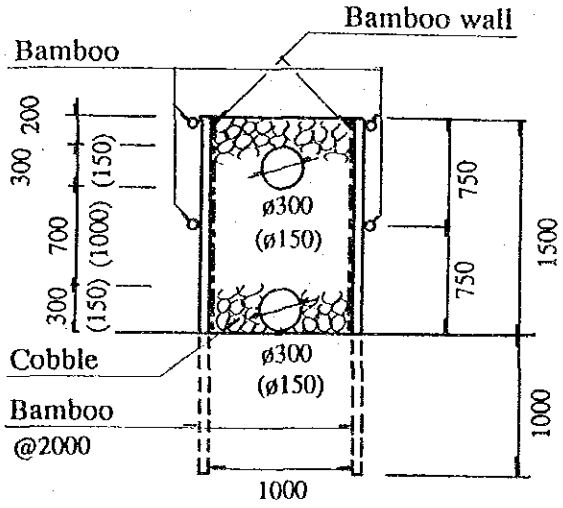
Cross Section

Leachate S = Non



Cross Section of Leachate Drain

1st Stage Main Drain
(Branch Drain)
B - B



2nd Stage Main Drain
(Branch Drain)
A - A

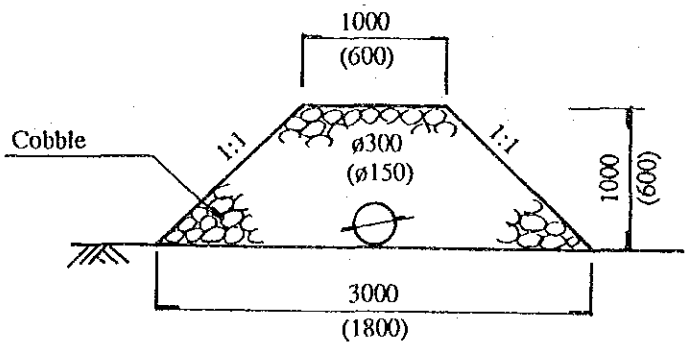


FIG 3.3-5	LEACHATE COLLECTION SYSTEM

THE STUDY ON THE SOLID WASTE MANAGEMENT IMPROVEMENT FOR SURABAYA CITY

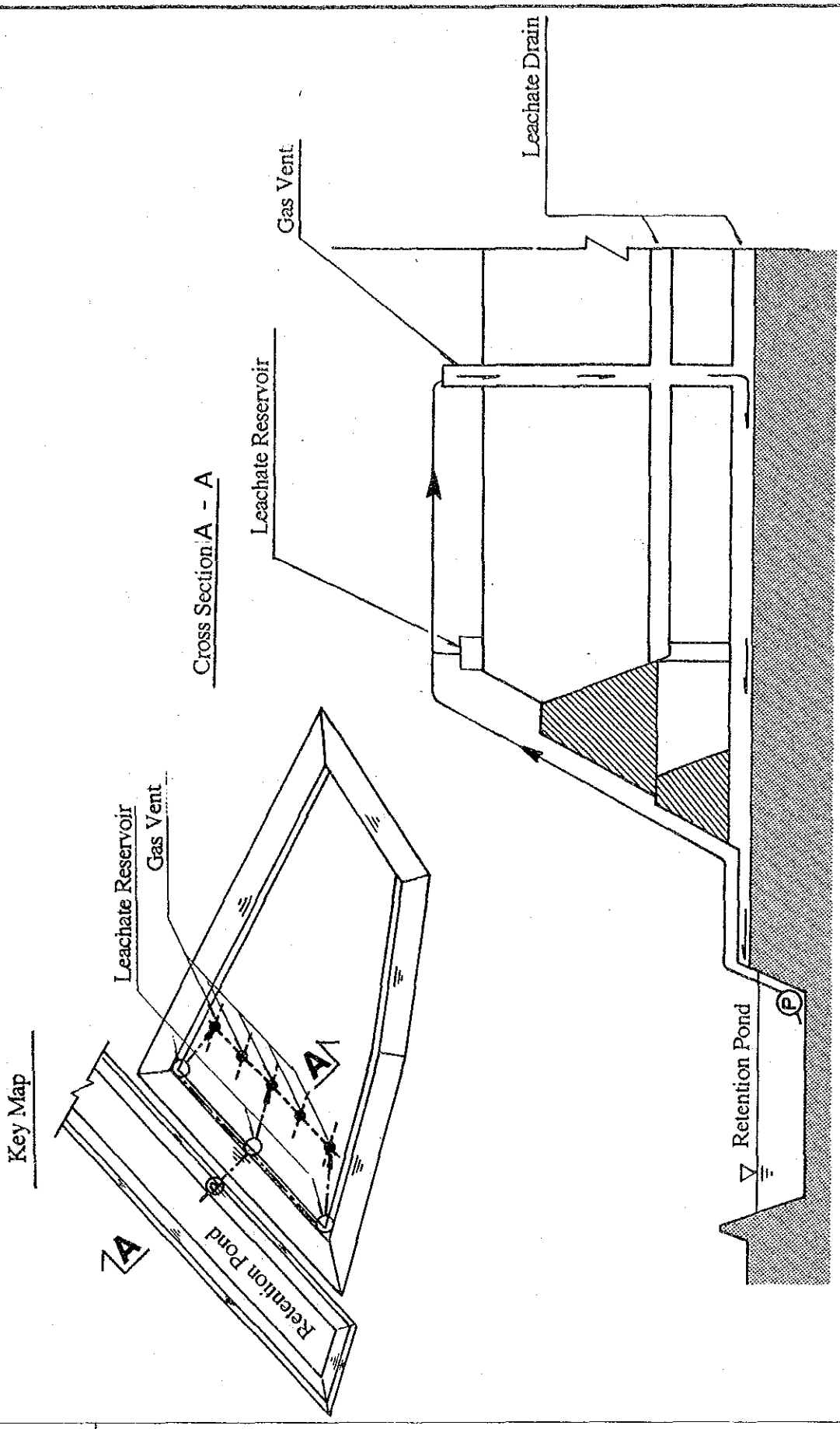


FIG. 3.3-6 LEACHATE RECIRCULATION SYSTEM

THE STUDY ON THE SOLID WASTE MANAGEMENT IMPROVEMENT FOR SURABAYA CITY

3.2.4 Rainwater Discharge

Rainwater should be discharged to the neighboring water body directly as far as it can be separated from leachate in principle. It is also permissible to discharge rainwater including leachate during heavy rain if only the water does not flow directly into the neighboring salt farm or fish pond.

The critical intensity of rainfall is set at 80 mm/h that may happen once in ten years based on the statistics of rainfall in Surabaya. The critical rainfall will generate about 5 m^3/s of water flow from the site assuming the run-off rate would be 40%. Compared with the average of leachate volume in peak month of 0.03 m^3/s, the rainwater flow is forecast to be more than 100 times bigger. This means that even if the leachate is mixed into the storm water effluent, the negative influence of leachate will be mitigated enough to be neglected. Furthermore, the rainwater during flood forms a constant and rapid flow toward the sea dilluting the effluent coming from the landfill site with a huge amount of water coming out of the other part of catchment area of the River Lamong.

To achieve the above mentioned requirements, an appropriate discharge point of rainwater should be selected. Based on the survey result of land use and topography, the River Sememi seems to be the best because it flows directly to the River Lamong without passing through any salt farm or fish pond. To discharge rainwater through the River Sememi, it is necessary to install a conduit across some neighboring salt farms. The length and the size of the conduit is estimated at about 300 m and 5 m^2 respectively. The rainwater discharge system is illustrated in Fig. 3.3-7.

In addition to this system, some supplementary diversion work will be required to keep the existing flow of the surrounding water body. It will be done just outside the landfill site. Costs of the supplementary diversion works are included in the current estimate of the site construction.

It is planned that rainwater will be utilized for the administrative facilities. The utilization system consists of collection ditch, underground reservoir, delivery equipment and consumer equipment.

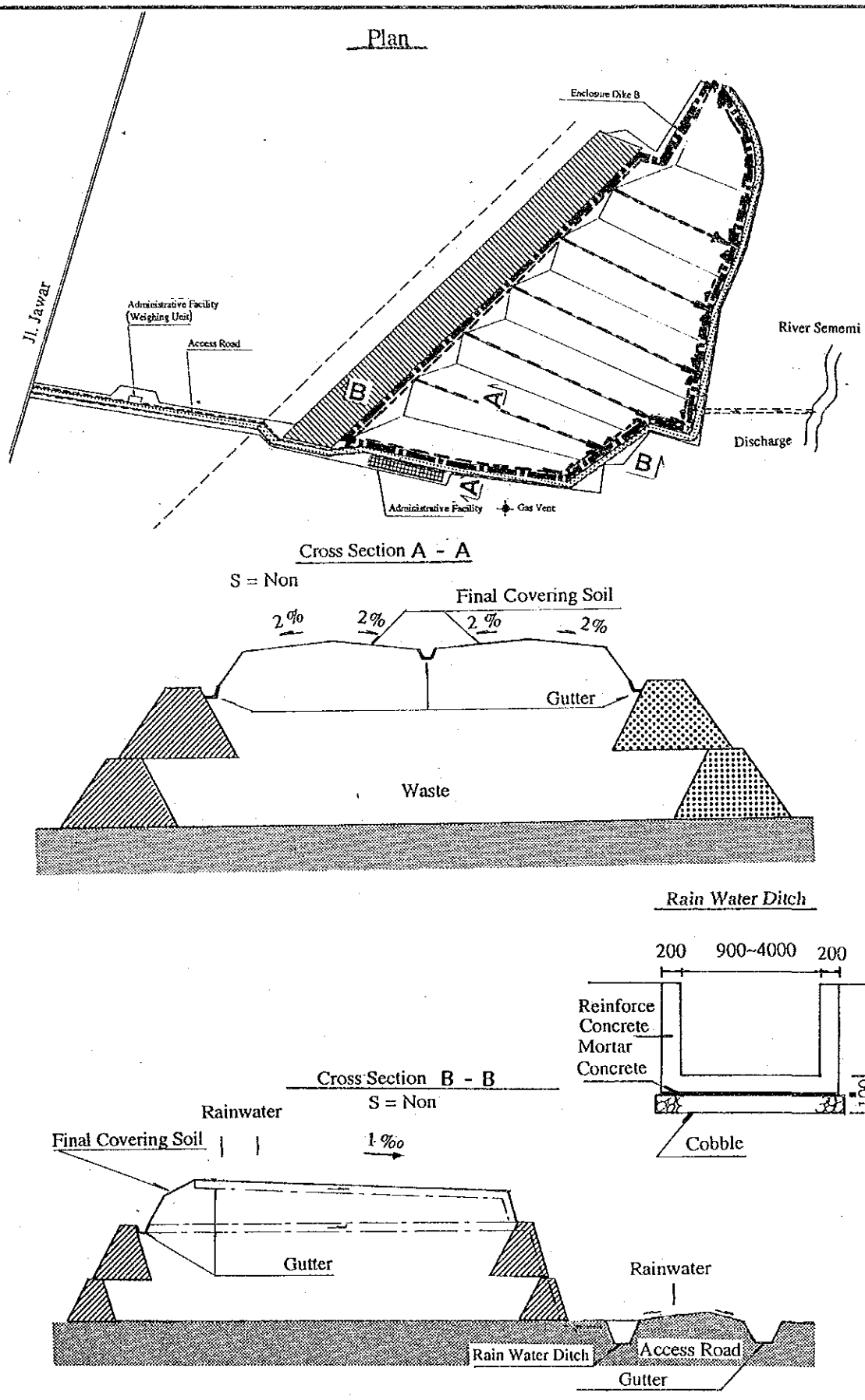


FIG. 3.3-7 **RAINWATER DRAINAGE**

3.2.5 Dike

Landfill area is planned to place within an enclosed area by dikes which are classified into two types by their location, namely :

a. Enclosure dike
b. Divider dike

Dikes should be constructed before the landfill operation starts in order to prepare the landfill area for the first year operation. Then the construction is carried out three times according to the stage plan, and finally the whole layer reaches 10 m in height.

The section of dike is planned to be a trapezoid with the following basic dimensions :

a. Width of the top : minimum 3 m
b. Gradient of exterior slope : 1:2.0
c. Gradient of interior slope : 1:1.2

Material of dike is selected so as to secure its stability at low costs. From this view point, a possibility to acquire the aged garbage buried in Lakarsantri landfill site or Keputih is worth studyng.

According to the result of geological survey, the surface soil is used as the basis of the dike does not have enough capacity to bear the load, therefore, some reinforcement should be adopted prior to the the construction. Based on the analysis of stability against slide corruption, it is planned to install a row of metal pile with a length of 15 m below the enclosure dike in order to reinforce the soil foundation. The structure of dike is illustrated in Fig. 3.3.8.

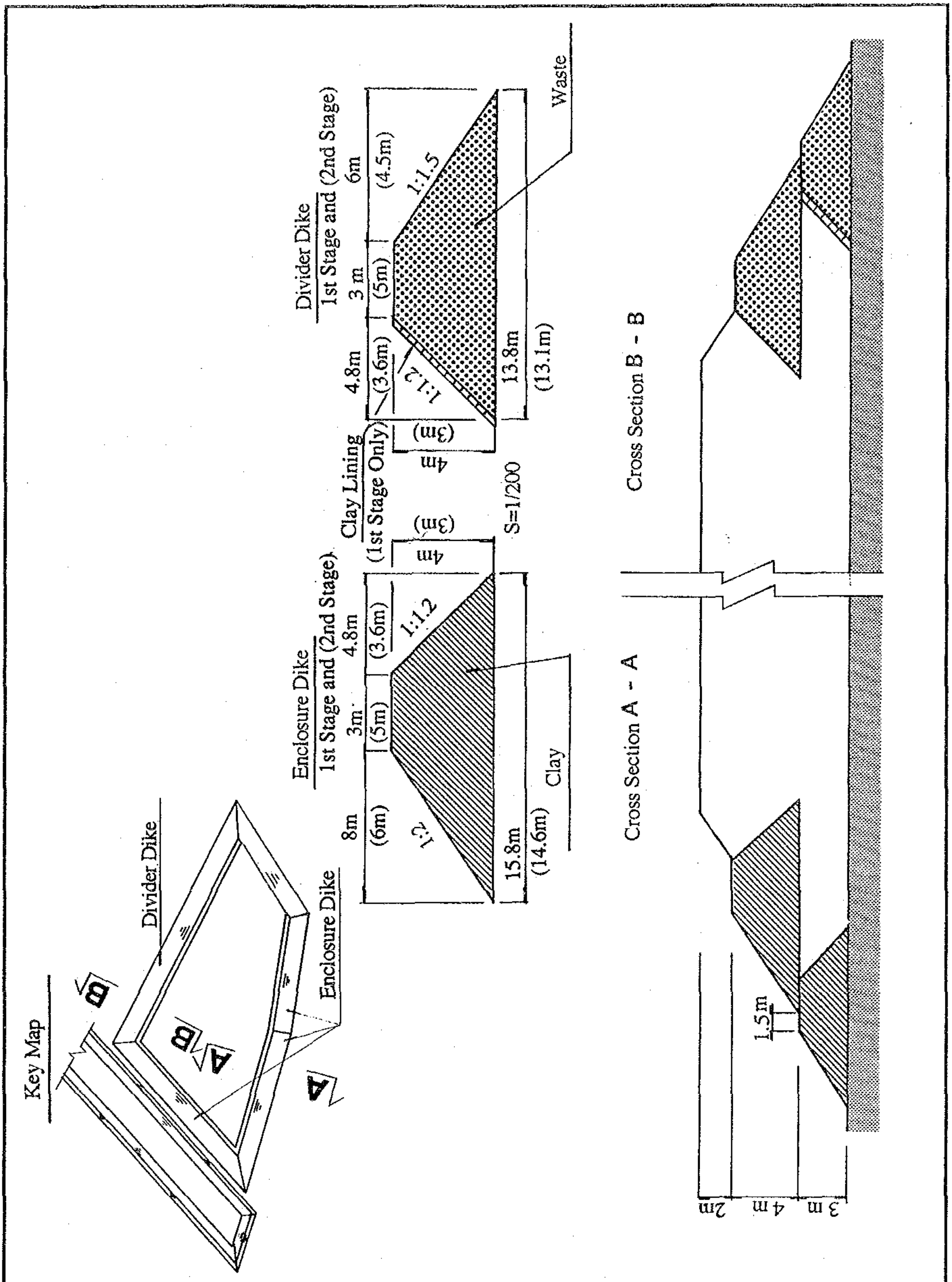


FIG. 3.3-8	STRUCTURE OF DIKE

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3.2.6 Gas Ventilation

Gas ventilation facility has three function :

a. Supply air into the garbage layer to facilitate aerobic decomposition
b. Discharge gaseous substance generated in the garbage layer
c. Discharge rainwater collected by a horizontal underdrain network through the bottom drain network

To perform these functions, the vertical gas vent will be installed besides horizontal underdrain network. The gas vent is mainly composed of the porous material such as crushed stone, however, PVC tube is also applied to the bottom layer of underdrain network in order to increase the air supply amid the garbage layer.

Considering the convenience of installation, it should be placed just before the start of the landfill operation. Consequently the structure of gas vent requires the stability to keep its form during landfill operation by heavy equipment around it. Then the crushed stone is contained in a conical bamboo basket without top and bottom, and placed at an intersection of the horizontal underdrain network. The top diameter of the taper shape of bamboo basket is smaller than the bottom, and the shape of bamboo basket facilitates the penetration of recirculated leachate into the garbage layer. The outline of the structure is shown in Fig. 3.3-9.

As for gas utilization it is not taken into consideration because 1) the planned site is rather far from the nearest residents that could be the consumer of methane gas, and 2) the waste layer is as deep as 9 m at final level. Normally, recovery of methane gas is feasible in case the depth of waste layer is more than 10 m. Then an example of applied usage of recovered methane gas is presented in case it was found feasible in Appendix 7.

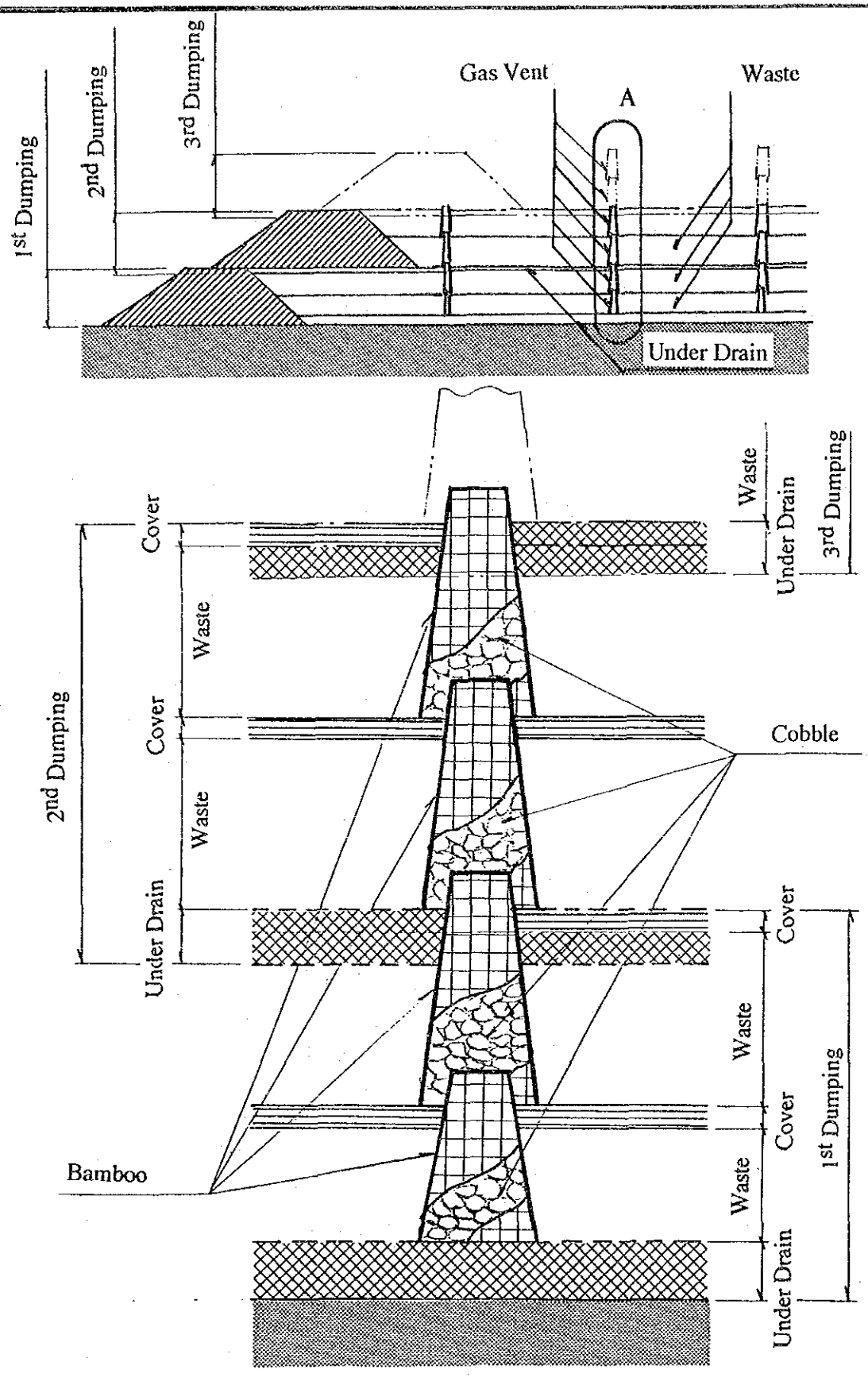


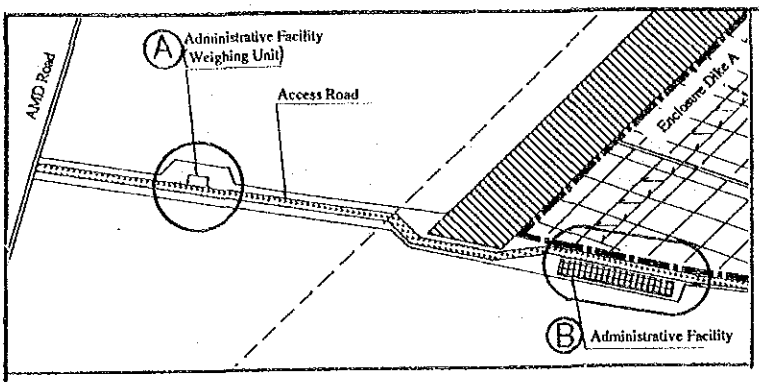
FIG. 3.3-9 STUCTURE OF GAS VENT

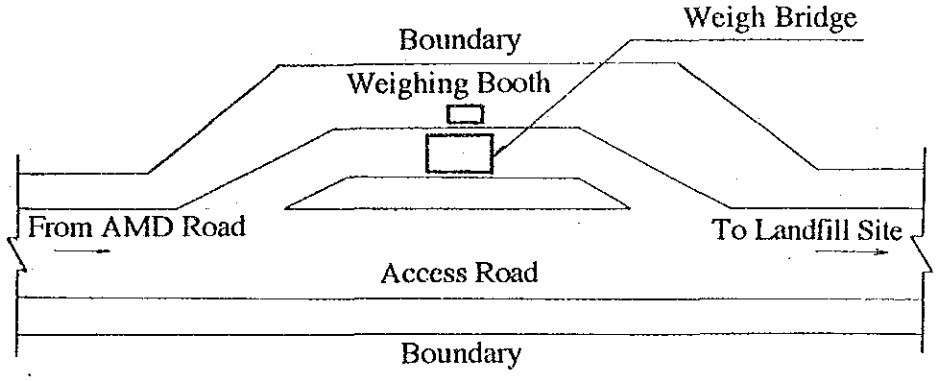
3.2.7 Administrative Facility

The proposed components of administrative facilities are summarized in Table 3.3-3, and its layout is shown in Fig. 3.3-10. To keep an orderly landfill operation, it is necessary to assign a resident administrative staff at the site.

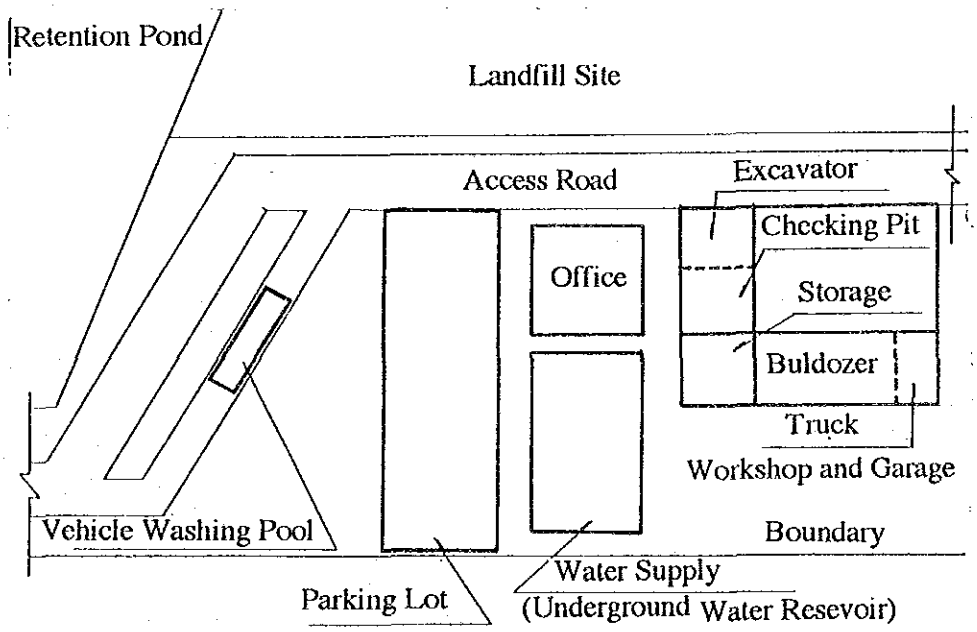
Table 3.3-3 List of Administrative Facility

Function	Remarks
Office	a. Include the space for the chief and his seven staffs wiht an area of about 80 m^2 b. Locker and rest room for 11 heavy equipment operators and office staffs with an area of about 40 m^2 c. Kitchen 20 m^2 d. Storage 20 m^2 e. Toilet and bath 60 m^2
Workshop and Garage	a. Include the following vehicles - 4 Bulldozers - 1 Excavator - 2 Dump trucks b. Install a set of equipment for daily maintenance of heavy equipment which consists of : - Hot water spray washer - Tuning tools - Checking pit - Storage
Weighing Booth	a. Install a unit of weigh bridge with a maximum capacity of 30 ton b. Automatic recording system installed in a booth located on the access road
Water Supply	a. Utilization of rainwater by using collection ditch, underground reservoir and delivery equipment b. Access road is planned to be the rainwater collection surface and the attached ditches on both sides are connected with underground reservoir c. Water will be used for office, workshop and truck washing pond. d. Delivery is done by electric pump. For workshop's use, the water is supplied through a solar heating apparatus.
Vehicle Washing Pool	a. Wash the lower part of vehicle and tyre in a shallow pool b. Fresh rainwater will be used. c. Placed on the way out before the weighing booth
Parking Lot	a. Space for vehicles of employers and visitors b. Placed at the entrance of the site
Miscellaneous	a. Gate and fence b. Lighting c. Signboard





Detail A



Detail B

FIG. 3.3-10 **LAYOUT OF ADMINISTRATIVE FACILITY**

3.3 Proposed Operation and Maintenance

3.3.1 Design of Landfill Operation

1) Stage Plan

It is planned that the landfill operation period will be 9 years based on the simulation for the allocation of landfill demand. The whole operation period is divided into three stages in accordance with the height of garbage layer as shown below :

- Stage 1 : 1996 - 1998 (height up to 3 m)
- Stage 2 : 1999 - 2001 (height up to 7 m)
- Stage 3 : 2002 - 2004 (height up to 9 m)

The landfill area is also divided into 3 zones which correspond to the annual operation in each stage. Therefore, the operation is executed in each zone for a year and transferred to the next zone year by year as shown below.

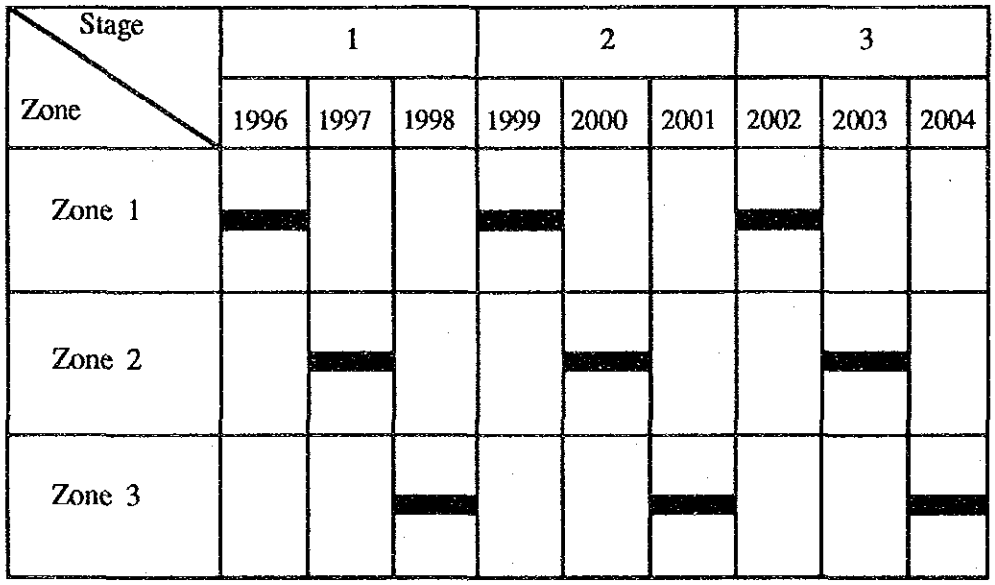


Fig. 3.3-11 Stage Plan for Landfill Operation by Partition

2) Design of Working Face

To maintain a sanitary condition, it is necessary to minimize area of working face where the garbage is unloaded every day. The average specification of working face is calculated for one week operation as follows :

- Duration of unloading : 7 days
- size of working face : 50 to 70 m
- Daily amount of garbage : 900 t/d
- Height of layer : 1.8 to 2.0 m (x 2 layers)
- Size of cell (1 lot of a series of operation for 7 days) : 4,200 m^2

Each cell is covered with aged garbage or soil in order to prevent the generation of offensive odor and waste scattering. Covering is planned to be carried out once a week just after finishing the shaping of a layer for a cell. The thickens of cover layer is planned to be 10 to 20 cm for every intermediate cover.

3) Operation Cycle

Landfill operation in a cycle is executed according to the repeated cycle which is composed of the process to complete a cell of garbage. The standard process is explained sequentially as follows:

1st Layer

- Unloading garbage/shaping the cell ----- 7 days
- Surface covering ----- 1 or 2 days
- Gas vent installation ----- within 1 week or less

2nd Layer

- Unloading garbage/shaping the cell ----- 7 days
- Surface Covering ----- 1 or 2 days
- Gas vent installation ----- within 1 week or less
- Underdrain installation ----- within 1 week or less

The cycle will be applied to each zone of landfill. The operation in a zone will be completed when the operation crew has covered the whole zone. Then the crew moves to the next zone.

4) Additional Construction and Material Demand

Gas vent and underdrain should be constructed for each cell in stage by stage manner because these facilities are placed among the waste layer. This part of construction cost is estimated separately from the initial construction cost. Table 3.3-4 presents a tentative bill of quantity for the operation stage.

Table 3.3-4 Bill of Quantity for Operation Stage

Items		Unit	Quantity				
			1996	1997	1998	1999	2000
Leachate Drain	Cobble filling	m3			7,700	7,910	6,630
	PVC pipe	m			5,680	5,720	5,360
Gas Vent	Bamboo cage	piece	55	63	105	118	113
Covering	Soil Transport	m3	66,000	66,000	66,000	66,000	66,000
	Thickness	(m)	(0.4)	(0.4)	(0.4)	(0.4)	(0.4)

Items		Unit	Quantity				
			2001	2002	2003	2004	Total
Leachate Drain	Cobble filling	m3					22,240
	PVC pipe	m					16,760
Gas Vent	Bamboo cage	piece	105	118	113	50	840
Covering	Soil Transport	m3	66,000	120,000	120,000	120,000	756,000
	Thickness	(m)	(0.4)	(1.0)	(1.0)	(1.0)	

3.3.2 Organization

It is recommended that the landfill site is operated by the full-time staff. The proposed organization for landfill site is shown in Fig. 3.3-12.

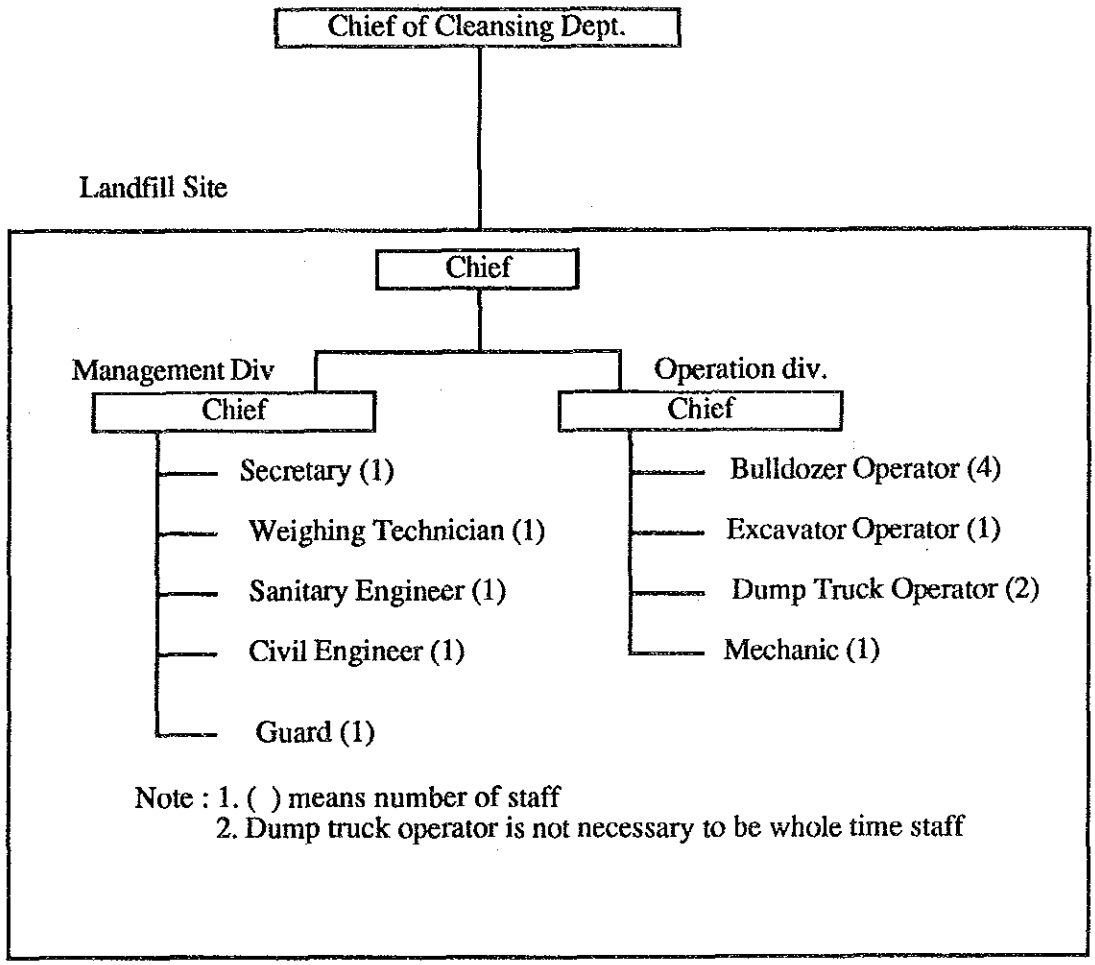


Fig. 3.3-12 Proposed Administrative Organization

Among this organization, the operation division is thought to be a branch of the existing haulage section (Seksi Angkutan), however, it is desirable to execute the landfill operation under the instruction of technical staff in order to satisfy technical requirements of sanitary landfill.

However, it may be suitable for KMS to entrust the landfill operation to a private contractor because the landfill operation requires frequent installation of drain and gas vent for each landfill stage. Installation work has usually been entrusted to private

contractors in many cities in Japan and other countries. And the place of installation work is located very closely to that of landfill operation.

Therefore, the whole landfill operation as well as construction may be done by one contractor efficiently. The use of a private contractor for landfill operation is worth investigation when KMS has acquired a certain experience in sanitary landfill operation.

3.3.3 Heavy Equipment

Landfill operation is planned to be executed with heavy equipment listed in Table 3.3-5.

Table 3.3-5 List of Heavy Equipment

Type	Quantity	Duty
Bulldozer	4	Construct on-site road Place and compact garbage Form the cell Soil cover
Excavator	1	Finish the cell Maintain ditch, road and pond
Dump truck	2	Transport cover soil from the internal deposit to the working cell.

Note : Dump trucks are expected to work for 2 days a week.

3.4 Construction Schedule

Construction schedule is shown in relation to the operation stage in Fig. 3.3-13 and 3.3-14. Initial stage of construction will take about 2 years excluding design work since 1995 to 1996. The whole construction will last for 9 years up to 2003 according to the progress of the landfill operation.

Work Design		1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Design		▬											
Construction	Access Road		0,1 2	3									
	Retention Pond		A	B									
	Enclosure Dike		1	2	3	4	5	6	7	8	9		
	Divider Dike		1	2	3	4	5		6	7			
	Rainwater Drain		1	2	3								
	Leachate Ditch			1	2	3							
	Leachate Drain		1	2	3	4	5	6	7	8	9		
	Gas Ventilation		1	2	3								
	Recirculation facility		1	2	3	4	5	6	7	8	9		
	Adm. Building		▬										
	Onsite Road		1	2	3	4	5	6	7	8	9		
Operation	Zone-1			▬			▬			▬			
	Zone-2				▬			▬			▬		
	Zone-3					▬			▬			▬	
	Covering			▬	▬	▬	▬	▬	▬	▬	▬	▬	
Closing Work													▬

FIG. 3.3-13 TIME SCHEDULE OF CONSTRUCTION

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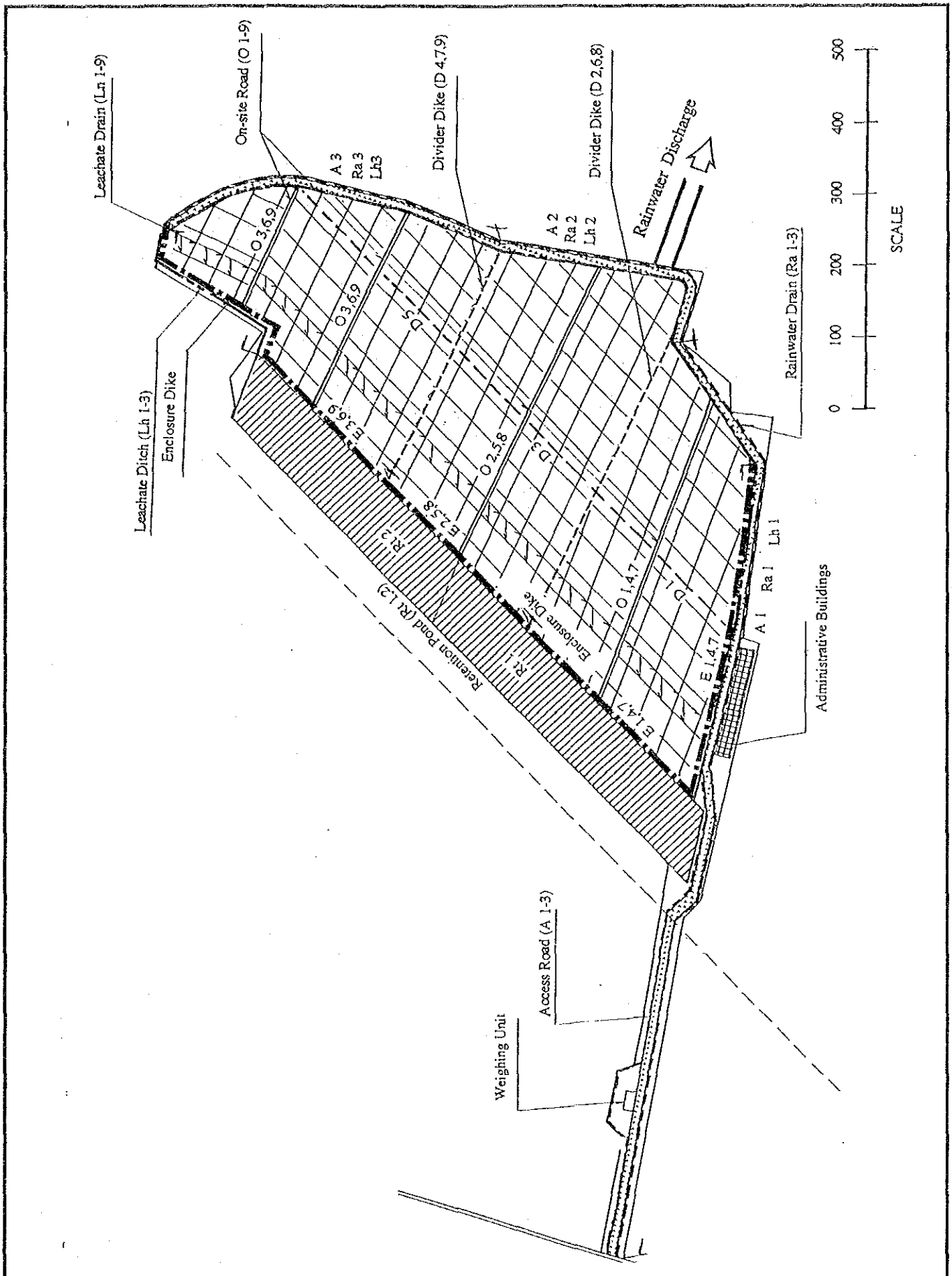

FIG. 3.3-14 PLAN FOR CONSTRUCTION STAGE

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3.5 Project Cost and Finance

3.5.1 Investment Cost

Investment costs except vehicle or heavy equipment procurement are summarized in Table 3.3-6. The total amount of direct cost is estimated at about Rp 23,283,000 and adding tax of 10%, the total investment cost is estimated at Rp 25,610,000.

3.5.2 Operational and Maintenance Cost

The operation and maintenance costs are classified into two (2) types; 1) costs of operation and maintenance of heavy equipment including salary of employees, and 2) costs for application of cover material.

Table 3.3-6 Investment Cost for Construction
(Total Cost)

Works	Type	Subitem	Unit	Quantity	Unit Price	Amount (10^3Rp)	Remarks
Ground work	Flattening		m2	445,000	670	298,150	
Foundation	Steel Sheet Pile		t	4,785	1,650,000	7,895,250	
	Installation		m	99,680	10,000	996,800	
Subtotal						8,892,050	
Main Structure	Banking	Clay	m3	364,740	14,000	5,106,360	with material
	Banking	Aged Waste	m3	47,420	12,780	606,028	with transport cost
	Slope Forming		m2	88,520	13,550	1,199,446	
	Lining	t=200mm	m2	4,180	15,680	65,542	
Subtotal						6,977,376	
Retention Pond	Excavation		m3	15,650	5,600	87,640	
	Soil Haulage		m3	15,650	470	7,356	
	Banking		m3	2,040	14,000	28,560	
	Slope Forming		m2	4,580	13,550	62,059	
Subtotal						185,615	
Leachate Recirculatio	Pump	22kw	Unit	2	54,000,000	108,000	
Underdrain	PVC Tube	ø300	m	24,540	38,500	944,790	
		ø150	m	24,300	15,000	364,500	
	Crushed Stone		m3	44,860	16,520	741,087	
	Bamboo		m	103,920	605	62,872	
	Bamboo Panel		m2	47,949	1,500	71,924	
Subtotal						2,185,172	
Gas Vent		ø500 x ø1000	Piece	1,008	17,000	17,136	
Rainwater Drain	a block	900 x 1,350	m	690	326,000	224,940	
	b block	1,600 x 1,800	m	160	466,000	74,560	
	c block	2,700 x 2,000	m	180	818,000	147,240	
	d block	2,300 x 1,500	m	970	458,000	444,260	
	e block	4,000 x 1,150	m	220	579,000	127,380	
	Box Culvert		L.S.	1		63,569	
	Side Ditch	R=25(semicircle)	m	2,360	4,205	9,923	
	Weir	H=300	L.S.	1		10	
Subtotal						1,091,882	
Access Road	A Type		m	510	1,084,000	552,840	
	B Type		m	1,340	510,000	683,400	
Subtotal						1,236,240	
Maintenance Road	C Type	W=2m	m	1,950	15,000	29,250	
	D Type	W=5m	m	885	97,000	85,845	
Subtotal						115,095	
On-site Road		W=7m	m	1,355	57,000	77,235	
Adm. Building	Building		L.S.	1		379,450	
	Power Receiving		L.S.	1		207,100	
Subtotal						586,550	
Workshop			L.S.	1		283,175	
Weighing Facility	Truck Scale		L.S.	1		168,663	
	Weigh Booth		L.S.	1		8,560	
Subtotal						177,223	
Small Water Supply	Tank, Pump Small Purifyer	10m x 6m x 3.5m	L.S.	1		64,199	
Vehicle Washing Pool		5m x 10m x 0.5m	L.S.	1		12,351	
Parking Lot			L.S.	1		22,750	
Total						22,330,198	
Auxiliary Works			L.S.	1		953,628	x5%
Direct Cost Total			L.S.			23,283,826	

The first type of cost is shown in Table 3.3-7.

Table 3.3-7 Cost of Operation & Maintenance of Heavy Equipment

Item	Calculation (Rp. 1,000/y)	Cost (Rp. million/y)
a. Insurance	Rp. 1,430,000 (purchase cost of equipment) x 2%	29
b. Equipment Maintenance	Rp. 1,430,000 (purchase cost of equipment) x 12.5%	179
c. Fuel	Bulldozer 20l/h x 8h/d x 365d x Rp. 450 x 4 units	105
	Excavador 20l/h x 5h/d x 365d x Rp. 450	16
	Dump Truck 4l/h x 5h/d x 2 d/w x 52w x Rp. 450 x 2 units	2
d. Salary	14 person x Rp. 100,000 x 12 m	17
e. Electricity	90 kwh/d x 365 x 0.153 + 6.9 x 12	5
Total		353

Note: Purchasing cost of heavy equipment

Bulldozer	@	Rp. 300 million x 4 = Rp. 1,200 million
Excavator	@	Rp. 230 million x 1 = Rp. 230 million
	Total	Rp. 1,430 million

The second type of cost is shown in the following table.

Table 3.3-8 Cost of Application of Cover Material (1996-2004)

Items	Calculation (Rp./y)	Cost (Rp million/y)
Cover Material	@ 5,000 Rp/m^3 x 66,000 m^3 (1996-2001)	330
	@ 5,000 Rp/m^3 x 120,000 m^3 (2002-2004)	600

Overall operation and maintenance costs are shown in the following table.

Table 3.3-9 Overall Maintenance and Operational Cost

Maintenance & Operational Cost for		Cost (Rp million/y)	Planning Disposal Amount (1,000 t/y)	Unit Cost (Rp/t)
O & M Cost related to Heavy Equipment		353	329	1,073
Cost of Application of Cover Material	1996-2001	330	329	1,000
	2002-2004	600	329	1,820
Total (cash expense)	1996-2001	683	329	2,073
	2002-2004	953	329	2,893

Operation and Maintenance Cost is estimated at about Rp 683 million/year for the first six (6) years and Rp 953 million/year for the last three (3) years. This cost corresponds to a unit cost of about Rp 2,100/t and Rp 2,900/t according to the respective operation stage. These unit costs are higher than present unit cost by 25% and 75% respectively.

3.5.3 Investment Schedule

Investment will concentrate in the initial stage of the project to construct the landfill site and procure heavy equipment for landfill operation.

Total investment amount is estimated at about Rp 25.6 billion including value added tax as shown in Table 3.3-10.

Table 3.3-10 Investment Schedule

Without value added tax (unit : Rp million)

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Total
Initial	16,668	3,356	0	0	0	0	0	0	0	0	20,024
Additional Construction Cost	0	1	1	1,278	909	1,012	2	2	2	52	3,259
Total	16,668	3,357	1	1,278	909	1,012	2	2	2	52	23,283

Including value added tax (unit : Rp million)

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Total
Initial	18,335	3,692	0	0	0	0	0	0	0	0	22,027
Additional Construction Cost	0	1	1	1,405	1,000	1,113	2	2	2	57	3,583
Total	18,335	3,693	1	1,405	1,000	1,113	2	2	2	57	25,610

Note : Value Added Tax (VAT) is 10% of the original price without the tax.

Unit investment cost per ton of waste disposed is estimated to be approximately Rp 9,000/ton assuming that total disposal amount would be about 3 million ton during the period from 1995 to 2004.

3.6 Environmental Impact Assessment (EIA)

3.6.1 Procedure of EIA

An environmental impact assessment (EIA) has been carried out according to the Indonesian laws and regulations listed below. The EIA also followed the Indonesian standards with respect to water and air quality and by-laws concerning river management and solid waste management.

a. Laws No.4/1982 concerning the Principle Determination of Environmental Management.

b. Governmental Regulations No.29/1986 concerning Environmental Assessment

c. Decree of Minister of Population and Environment No.KEP-49/MENKLH/6/1987 and Decree of East Java Governor No.183/1988 concerning Important Impact Determination Guidelines and its attachments.

d. Decree of Minister of Population and Environment No.JEP-50/MENKLH/6/1987, Decree of East Java Governor No.184/1988 concerning Environmental Assessment Preparation Guidelines, and Attachment to the Decision of East Java Governor No.185/1988

e. Decree of Public Works Minister No.531/KPTS/1989 concerning AMDAL Selection Guidelines of Public Works Projects.

f. Decree of Public Works Minister No.506/KPTS/1991 Replace Decree No.557/KPTS/1989 concerning AMDAL Management Guidelines of Public Works Projects.

g. Decree of Public Works Minister No.779/KPTS/1989 concerning AMDAL Technical Guidelines of Public Works Projects - Solid Waste Project

It is understood that an EIA with respect to the construction of a new disposal site is required by the Decree e. listed above. An EIA was then conducted according to the procedure stipulated in the Decree c. above.

Cipta Karya and East Java Provincial Government agreed that an EIA and its appraisal should be conducted in the following manner:

1. AMDAL Commission on this project should consist of the Central AMDAL Commission of Cipta Karya and Local AMDAL Commission of East Java Provincial Government.

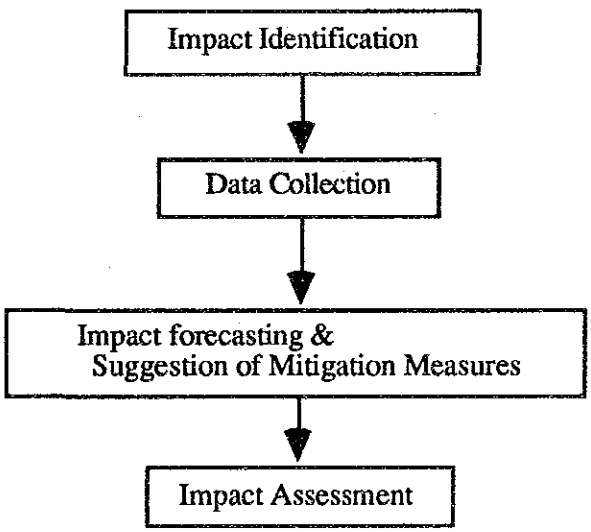
2. The Decree g. is used as a technical guideline for the EIA.

3. The procedure of EIA follows the Decree d.

To begin with EIA, the Study Team prepared a terms of reference (KA ANDAL), and submitted it under the name of the mayor of Surabaya City, project proponent, to the Local AMDAL Commission of East Java Province. The KA ANDAL was accepted by the Governor of the East Java Provincial Government in January 1993.

3.6.2 Environmental Impact Analysis (ANDAL) Conducted

ANDAL was conducted with a process shown below:



1) Impact Identification

Impacts of the project were identified by the following four (4) project phases:

1. Acquisition of site
2. Construction
3. Landfill operation
4. Post operation phase

2) Data Collection

Primary data on the following aspects were collected through a field survey conducted for two (2) months from October 1992.

1. Topography of the areas in and around the project site (General topography, River catchment area, Elevation)
2. Geology (Strata, Soil mechanics and physical characteristics)
3. Land utilization (area and distribution by land use)
4. Quality of air (NH_3, H_2S)
5. Quality of surface and ground water (Temperature, pH, Cl^-, DO, SS, COD, BOD, T-N, SO_4^{2-}, CN^-, Heavy metals, Coliform and other toxic substances)
6. Wild lives (Flora and Fauna)
7. Health Conditions
9. Socio-economic conditions

3) Impact Forecasting and Suggestion of Mitigation Measures

Impacts of the project were forecasted qualitatively in terms of comparison of the conditions that would arise with and without implementation of the project. Mitigation measures were suggested against any significant impacts forecasted.

4) Impact Assessment

Impacts of the project were assessed in terms of the following aspects according to the Decrees b) and c) listed in Section 3.6.1.

1. Number of people affected,
2. Affected Area,
3. Duration of impact,
4. Intensity of impact,
5. Other components affected,
6. Cumulative characteristics of the impacts, and
7. Possible re-occurrence of the impact

3.6.3 Impact Identification

The project can be divided into three phases: land acquisition phase, construction phase, operation phase and post operation phase. Environmental impacts are described for both positive and negative aspects in four phases as follows:

a. Land Acquisition Phase

Negative environmental impacts by this phase are:

- Decreases of land value
- Loss of job in fishery and salt arming

b. Construction Phase

A positive environmental impact by the construction works is :

- Increasing employment opportunities of labor

Negative environmental impacts by the construction works are as follows :

- Increases in traffic volume caused by transportation of construction materials and equipment
- Generation of noise, vibration and air pollution caused by heavy equipment and vehicles
- Generation of turbid water

c. Operation Phase

The main objective of the sanitary landfill is to upgrade the sanitary standard of solid waste disposal. This is positive environmental impact.

It is expected that the landfill operation would cause some negative environmental impacts as follows:

- Generation of leachate from garbage
- Generation of odor from the disposal site and vehicle
- Garbage scattering by wind, birds and mammal

- Generation of noise and air pollution by heavy equipment and vehicle
- Increases in traffic volume by haulage vehicles

d. Post Operation Phase

A positive environmental impact after operation is expected by converting the disposal area to other purposes. For example, it is possible to create some open - air facilities such as park, garden, sport facilities and so on. But, some mitigation measures will be necessary for a certain period even after the completion of closing works.

3.6.4 Forecasted Significant Environmental Impact and Possible Mitigation Measures

1) Air Quality and Noise

a. Dust and Noise

The site preparation and waste haulage to the site will cause an impact in the form of: 1) dust raising by construction and haulage vehicles, 2) Noise of the above vehicles. To mitigate the negative impacts, the following measures can be applied:

1. Spray water on the access road close to the neighboring community
2. Cover the freight of vehicles with canvas or plastic sheet
3. No activities at night

b. Offensive Odor and Gasses

Gasses will be generated at landfill site through waste decomposition process. As a result, offensive odor will be generated through landfill operation and also waste haulage and landfill operation. Offensive odor may directly affect neighbors. Gasses, mainly composed of methane may cause spontaneous fire or lead to generation of other harmful gasses such as formaldehyde. To mitigate the negative impacts, the following measures can be applied:

1. Cover the freight of haulage vehicles with canvas or plastic sheet.
2. Provide a green belt as a buffer zone around the landfill site.
3. Cover the waste layer with soil as soon as possible.
4. Diffuse gasses safely through ventilation network.

2) Surface Water and Ground Water Quality

The significant negative impact to surface water and ground water quality is pollution due to leachate. The major components of leachate is COD, N and P which are about 30,000 mg/ℓ, 20 mg/ℓ and 60 mg/ℓ respectively.

To mitigate the negative impact, leachate recirculation will accelerate waste decomposition process: COD of leachate supplies the energy source and N&P as nutrient for microorganism. The other alternative is the natural treatment of leachate using soil process, ARIFANI & SARWOKO (1992) found out the reduction of COD, N and P by about 90% can be made possible by flowing the leachate to the land with soil texture of sand:silt:clay = 45%:35%:20%. Irrespective of whatever technology used, the leachate treatment gives the positive impact.

3) Flora and Fauna

The flora and fauna that may be affected by LPA operation are:

1. The impact will be interlocked with pollution of water surface by leachate, especially in the wet season because the leachate control is very difficult.

2. Disease carrying vector such as insects and rats will increase because of the solid waste disposal.

   Measures for mitigation of impact on the aquatic flora and fauna are same as those for mitigation of leachate.

   To reduce insects and rats population, it is effective to cover solid waste with soil as soon as possible after the waste dumping.

4) Socio-Economic Condition

Land acquisition activity may raise restless opinion in local community. Especially if the cost of compensation is too low or if the land acquisition negotiation is not smooth, the project will make the community restless because the perception of the people on LPA is "the environmentally poor land".

The general method to solve that problem is to give the reasonable compensation to the loss of their land and other property.

The procedure of land acquisition and compensation, by government is stipulated in Kep. Men. Dagri No.2/1985: If the area of land is less than 5 ha, camat and lurah take the responsibility, if the area is more than 5 ha, the Nine - Persons - Committee (Panitia Sembilan) takes responsibility. The stipulated steps of land acquisition are :

a. Coordination meeting among responsible agencies.

b. After the meeting, announcement of the land acquisition is released by Walikota (Mayor).

c. Preconditioning meeting with affected community should be held. The agencies are responsible to arrange meetings with affected community. The agencies should explain community about the project, and people can ask some questions.

d. "9 - Persons - Committee" calculate some items of land acquisition. There are a specification of costs according to land status, building type, land use, etc. After estimation of costs, they will arrange meetings with the community again.

The other related stipulations are as follows:

a. The community may propose the compensation costs.

b. The Government will not give the compensation to the people who live in the government land.

c. If negotiations with the land owners are not agreeable, then the problem of compensation can be brought to the court.

d. The compensation costs are paid by the Government.

e. That procedure may last for one year.

Based on the experience in the Surabaya city, the compensation by means of "money" is the successful factor of the land acquisition.

In construction phase, use of external man power will frustrate the local people who have no chance to get job from the project. To prevent that, the project must use the local man power. Use of external man power should be allowed in specific conditions only.

5) Amenity

In operation phase, the negative impact that need specific mitigation are the aesthetic disturbance that may be caused through

1. used old trucks to bring the solid waste and
2. dispersion of paper and other waste by wind to the settlements nearby the site.

The mitigation of these problem is described in section 1) Air Quality and Noise.

The community may full in a restless condition because people have perception that impact of landfill activities will create security problems. Therefore the sanitary landfill authority must manage the activities, and give guarantee to community that the landfill activities is not disturbing aesthetic environment

3.6.5 Evaluation

A detailed assessment of the project impacts was carried out. As a result, an ANDAL report was prepared. It was then submitted to the Local Commission of AMDAL, Jawa Timur. The approval letter of ANDAL report was already issued by the Local Commission as shown in Appendix 5.

Based on the Approval Letter, this project was identified environmentally sound in terms of both natural and social conditions, if only the executing agency of the project pays attention to the following issues:

1. The negative impact on Social-Culture to be caused by the operation of new disposal site.

2. Pay attention on the aesthetic environment after development of new disposal site.

3. Handle leachate and construct the leachate retention ponds and to control its limited state.

4. Handle air pollution problems such as dust, smell, etc.

5. Establish green linkage area by planting trees around the disposal site area.

6. The traffic disturbing or congestion that may be caused by the waste trucks.

Chapter 4. F/S Component 3: Construction and Rehabilitation of Depo/LPS & Improvement of Asemrowo Workshop

4.1 Background, Purpose and Outline of the Project

4.1.1 Construction of New Depo and LPS

At present, KMS has 58 Depo and 102 LPS in Surabaya which serve as small transfer stations. (A Depo has a small administrative office stationed with an officer, while LPS does not have such office.)

The existing Depo and LPS is not sufficient in number at present. In principle, a Kelurahan should be provided with either a Depo or LPS. In view of the future increases in population and waste amount, it is considered necessary to construct new Depo and LPS.

It is planned 24 Depo and 12 LPS will be constructed during the 4 years period 1994/95 - 1997/98. Total construction cost is estimated to be Rp 1,157 million approximately in 1992 price.

The priority is given to Kelurahan with higher population density in the selection of the Kelurahan where new Depo or LPS are constructed, as well as in the determination of order of construction.

4.1.2 Rehabilitation of the Existing Depo and LPS

Some of the existing Depo and LPS need rehabilitation with respect to the following facilities:

1. Wall
2. Office building
3. Drainage
4. Gate
5. Floor
6. Water pipes and Electricity equipment
7. Enlargement of entrance
8. Expansion of area

In addition, tree planting around Depo and LPS is advisable as it is effective to make them look nicer. KMS should identify suitable kinds of trees.

It is planned that 30 Depo and 34 LPS will be rehabilitated during the planned 4 years period 1994/95 - 1997/98.. In addition, it is planned that tree will be planned for 90 % of Depo and LPS during the period. Total cost of the rehabilitation is estimated to be Rp 184 million.

4.1.3 Improvements of Asemrowo Workshop

In order to improve the vehicle maintenance capacity of Asemrowo Workshop, the following construction and procurement is planned.

1. Remodeling of the Workshop
2. Procurement of tool and equipment for maintenance and repair

Total cost needed for the above improvements is estimated to be Rp 267 million approximately in 1992 price. These improvements will be implemented in 1994/95.

4.2 Project Description

4.2.1 Construction of New Depo and LPS

1) Construction Program

It is planned that 24 new Depo and 12 LPS will be constructed during the 4 years period from 1994/95 - 1997/98. In each year, 6 Depo and 3 LPS will be constructed. Table 3.4-2 shows names of Kelurahan where Depo or LPS should be constructed. Locations of new Depo and LPS are shown in Fig. 3.4-1.

Land Acquisition

The land ownership status is shown also in Table 3.4-2. Of the 24 Depo and 12 LPS, it is identified that KMS should purchase land for construction of nine (9) Depo as shown in the table below. Land for other Depo and LPS is either owned by KMS or can possibly be made available for KMS free of charge.

Table 3.4-1 Land Acquisition for Construction of New Depo and LPS

Land Status	Depo	LPS
1. Number of Depo & LPS to be constructed	24	12
2. Number of Depo & LPS of which land is owned by KMS	10	1
3. Number of Depo & LPS of which land belongs to other persons or organizations, but can possibly be made available for KMS' use free of charge	5	11
4. Number of Depo & LPS of which land must be purchased (1 - 2 - 3)	9	0

Table 3.4-2 Depo and LPS Construction Program

No	Construction Year	Kecamatan	Kelurahan	Area (ha)	Population #########	Population Density (per ha)	Depo	LPS	Land Status	Necessity of Land Purchase
1	1994/1995	Bubutan	Jepara	45	28,400	632	1		TNI AD	-
2		Bubutan	Gundih	50	28,900	577		1	PJKA	-
3		Semampir	Sidotopo	65	31,700	488		1	KMS	-
4		Simokerto	Sidodadi	35	16,000	427		1	Market/KMS	-
5		Krembangan	Kemayoran	48	19,000	396	1		Private	√
6		Sawahan	Kupang Krajan	69	25,400	368	1		Private	√
7		Semampir	Pegirian	78	26,700	342	1		Cemetery	-
8		Sawahan	Petemon	174	42,000	241	1		Private	√
9		Sawahan	Putat Jaya	207	42,400	205	1		Cemetery	-
10	1995/1996	Krembangan	Dupak	66	27,000	412		1	Market/KMS	-
11		Genteng	Peneleh	53	19,000	302		1	Brantas Hilir	-
12		Tambaksari	Rangkah	67	19,600	292		1	Market/KMS	-
13		Sukolilo	Nginden Jangkungan	104	12,700	122	1		KMS	-
14		Lakarsantri	Jeruk	37	4,400	119	1		KMS	-
15		Suko	Tanjung Sari	108	12,400	115	1		Real Estate	-
16		Gunung Anyar	Rungkut Tengah	119	13,700	115	1		Real Estate	-
17		Sukolilo	Klampis Ngasem	150	16,400	109	1		KMS	-
18		Wonocolo	Sidosermo	114	8,900	78	1		KMS	-
19	1996/1997	Krembangan	Krembangan Selatan	86	18,400	214		1	Market/KMS	-
20		Bubutan	Bubutan	81	15,300	189		1	Market/KMS	-
21		Krembangan	Moro Krembangan	277	36,900	133		1	Binamarga	-
22		Benowo	Tambakdono	29	1,879	65	1		Private	√
23		Tandes	Gedang Asin	11	1,716	65	1		Private	√
24		Dukuh Pakis	Dukuh Pakis	143	8,696	61	1		TVRI	√
25		Tandes	Banjar Sugihan	130	7,935	61	1		KMS	-
26		Tandes	Karang Poh	51	2,866	56	1		Private	√
27		Tambaksari	Gading	1,115	59,243	53	1		Private	√
28	1997/1998	Genteng	Ketabang	121	11,000	91		1	KMS	-
29		Kenjeran	Sukolilo	53	3,900	74		1	Market/KMS	-
30		Mulyorejo	Kalijudan	135	6,842	51		1	Uncertain	-
31		Sukolilo	Gebang Putih	118	5,582	47	1		Private	√
32		Kenjeran	Kenjeran	53	2,163	41	1		KMS	-
33		Sukolilo	Medokan Semampir	180	6,800	38	1		KMS	-
34		Kenjeran	Kedung Cowek	89	3,339	38	1		KMS	-
35		Rungkut	Penjaringan Sari	189	6,900	37	1		KMS	-
36		Lakarsantri	Sambi Kerep	348	9,600	28	1		KMS	-

Note : "√" shown in the most right column means that KMS should purchase land.