Table 2.2-1 Precipitation and Reserved Amount of Leachate

NO	MONTH	Precipitation (mm/mon)	Evaporation (mm/mon)	Depth of Leachate without Pump (m)	Depth of Leachate with Pump (m)	Days in month	Fall of Leachate Level (m)	Pumped Volume (m^3/min)
1	DEC.	228	135	1.162	0.000	31	1.162	2.603
2	JAN.	336	133	3.697	0.897	31	1.638	3.669
3	FEB.	266	117	5.558	1.279	28	1.479	3.669
4	MAR.	265	136	7.169	1.252	31	1.638	3.669
5	APR.	156	129	7.506	0.005	30	1.585	3.669
6	MAY	86	136	7.456	0.000	31	0.000	0.000
7	JUN.	56	131	7.381	0.000	30	0.000	0.000
8	JUL.	15	152	7.244	0.000	31	0.000	0.000
9	AUG.	5	176	7.073	0.000	31	0.000	0.000
10	SEP.	18	194	6.897	0.000	30	0.000	0.000
11	OCT.	35	205	6.727	0.000	31	0.000	0.000
12	NOV.	101	170	6.658	0.000	30	0.000	0.000
	TOTAL	1567	1814					

Data : Meteorology office of Surabaya, survey period since 1979 to 1988 (10 years)

Under this circumstances, the leachate volume reserved in the pond is connected to the beforementioned meteorological data and the size of retention pond.
The size of retention pond is given by the due consideration on the share of each component facility as 2 ha. With this size of retention pond, the peak water level appears to be 7.5 m in depth according to the monthly fluctuation of precipitation and evaporation as shown in Table 2.2-1.

This level cannot be accepted of course, because the depth of retention pond is limited at 1.3 m below the bottom of underdrain outlet due to the level of water table there.
Then the excessive amount of leachate should be removed by pump units to keep the water level within the said limited level of 1.3 m. Provided that the pumped and recirculated leachate can be held in the garbage layer by 30%, the reserved leachate can be reduced and consequently, the water level of retention pond can be fallen. The required amount of leachate to be pumped is shown in Table 2.2-1. As a result of pumping every day 24 hours, the water level is controlled within 1.3 m even in the peak month of February.

2) Pump Unit

Requirement of pump unit is concluded as :

a. Total Head : 10 to 15 m
b. Discharge Capacity : 3.7 m^3/min

Referring to the manufacturer's catalogue as shown in Table 2.2-2, the rated output is determined to be 22 Kw. The number of unit to be installed is set at 2 units in order to cope with the extraordinary heavy rain and to secure the maintenance break.

Table 2.2-2 Specification of Submerged Pump

Type	Diameter of Outlet (mm)	Motor (Kw)	Voltage (V)	Discharge Capacity (m^3/min)	Total Head (m)	Weight (kg)
8-BE_2	50	0.75	200	0.21 0.3	8 5.8	23
15-BE_2	80	1.5	200	0.55 0.7	8 5	36
37-BE_2	80	3.7	200	1.0 1.5	11 7	84
150-BH	150	15	200	2.5 4.0	20 12	330
220-BH_2	150	22	200	2.5 4.0	25 17	520

3) Delivery Equipment

Outlet of pump unit should be connected to a flexible hose with the diameter of 15 cm and the hose is also connected to the temporary reservoir placed on the top of the enclosure dyke. Temporary reservoirs are distributed on the surface of garbage pile with an appropriate distance. The capacity of the reservoir tank is limited by the convenience of replacement that is necessary when the working layer is altered. Therefore the type of tank should be designed with a structure suitable for replacement by an arm-roll truck. Each tank is connected by pipe network in order to transfer the leachate from the initially receiving reservoir tank to the end one. At the end of network, the outlet is installed some flexible hoses to pour leachate to recharge points by manpower.

2.4.3 Concept of Wind-driven Aerator

This section is aiming at illustrating a possibility to apply the basic technology of water treatment even in an simplified manner. To achieve this target a conceptual design is presented for a low-cost and less maintenance aerator that would be applicable to the planning retention pond. The object equipment is composed of wind turbine for the power source and trickling filter bed. Both of its components are planned to be fabricated with such material as is easy to prepare by locally.

1) Characteristics of Wind in Surabaya

A statistic record on wind observation for ten years in available as shown in Table 2.2-3 and Fig. 2.2-3 to Fig. 2.2-4. As for the wind direction, there are two dominant wind directions, namely the east wind prevails since April to November and the west wind during the rest of the year. These two dominant wind direction appear about 60% in frequency whereas the share of the windy hours in 80% of the entire observation hours. As for the wind speed, the frequency of the calm state when the wind speed is not faster than 1 knot is 19%. The average wind speed is calculated at 4.1 knots (2.1 m/s).

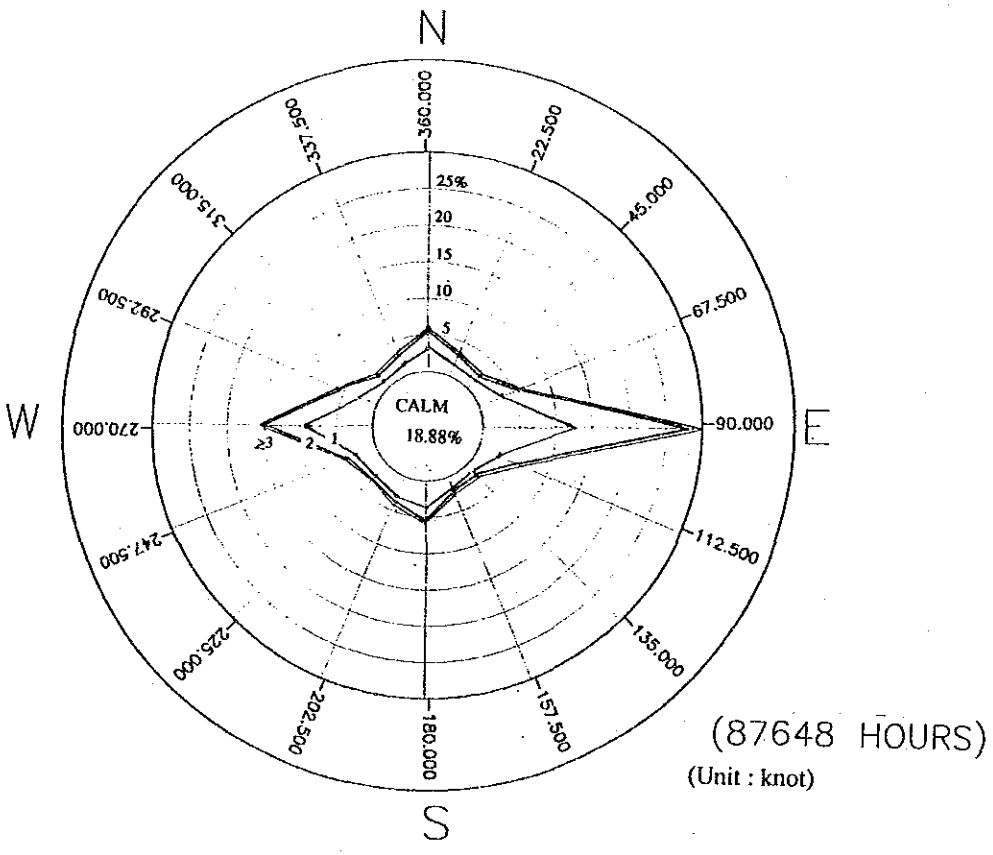
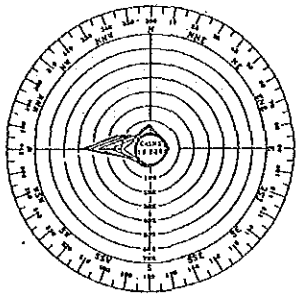
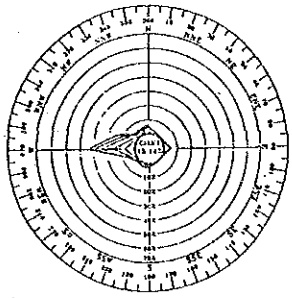


FIG. 2.2-3 WIND ROSE THROUGHOUT YEAR IN SURABAYA (1982 - 1991)

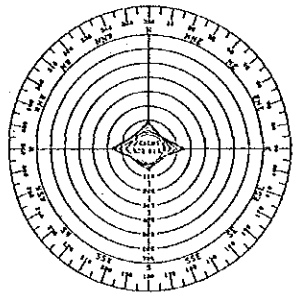
SURABAYA WINDROSE
JANUARY
1982 - 1991



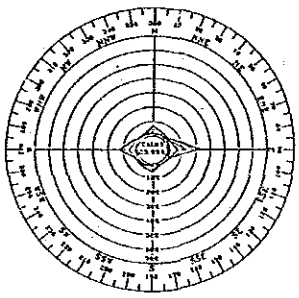
SURABAYA WINDROSE
FEBRUARY
1982 - 1991



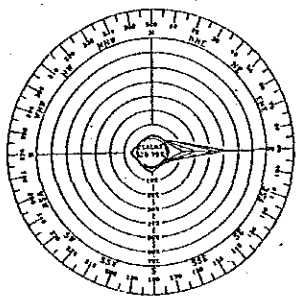
SURABAYA WINDROSE
MARCH
1982 - 1991



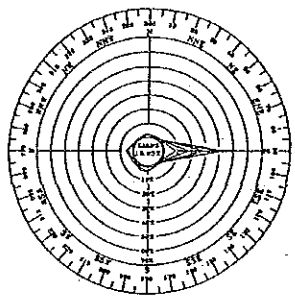
SURABAYA WINDROSE
APRIL
1982 - 1991



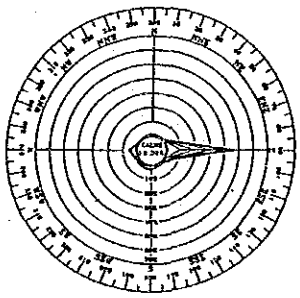
SURABAYA WINDROSE
MAY
1982 - 1991



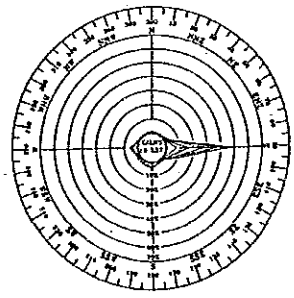
SURABAYA WINDROSE
JUNE
1982 - 1991



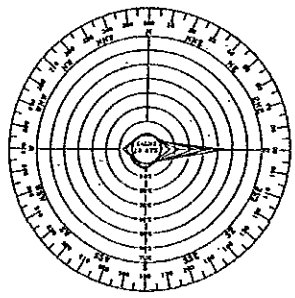
SURABAYA WINDROSE
JULY
1982 - 1991



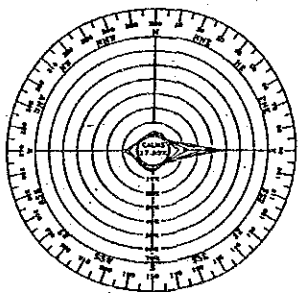
SURABAYA WINDROSE
AGUSTUS
1982 - 1991



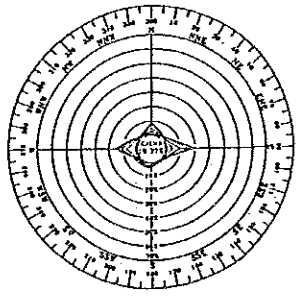
SURABAYA WINDROSE
SEPTEMBER
1982 - 1991



SURABAYA WINDROSE
OCTOBER
1982 - 1991



SURABAYA WINDROSE
NOVEMBER
1982 - 1991



SURABAYA WINDROSE
DESEMBER
1982 - 1991

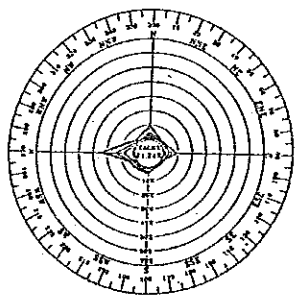


FIG. 2.2-4 **WIND ROSE BY MONTH**

Table 2.2-3 FREQUENCY OF WIND SPEED AND DIRECTION IN SURABAYA (1982 - 1991)

Wind Direction	Frequency by Wind Speed (Knot)																	
	Calm	2	3	4	5	6	7	8	9	10	11	12	13	14	15	≥16	Subtotal of Windy Hours	Share (%)
N		28	857	959	958	548	113	400	14	136	3	63	5	6	12	7	4111	4.69
NNE		9	327	478	452	222	50	110	1	35	0	9	0	0	4	4	1702	1.94
NE		13	233	246	279	133	34	50	2	20	0	4	1	0	2	0	1017	1.16
ENE		75	975	834	1111	439	74	356	8	93	1	21	0	0	11	2	4001	4.56
E		150	4437	5350	6161	3962	974	2656	157	996	11	367	23	19	75	18	25359	28.93
ESE		30	689	943	891	550	170	350	27	127	2	52	3	4	6	2	3847	4.39
ES		19	162	198	143	81	39	41	5	11	0	4	2	3	0	0	708	0.81
SSE		31	307	227	130	60	7	29	4	7	0	4	0	0	0	0	806	0.92
S		109	1414	807	350	116	33	33	5	18	0	6	3	2	7	5	2908	3.32
SSW		66	975	736	302	64	23	27	4	15	0	4	0	0	1	5	2222	2.53
SW		62	635	694	282	47	14	30	2	12	0	7	0	0	0	1	1786	2.04
WSW		68	892	844	477	126	32	73	1	21	1	12	1	0	3	1	2552	2.91
W		157	4078	3280	2385	1243	253	721	43	306	0	99	5	12	38	13	12635	14.41
WNW		54	966	875	1074	529	135	447	32	188	1	71	2	5	36	6	4422	5.04
NW		21	255	234	286	192	38	142	15	63	0	23	4	2	9	5	1289	1.47
NNW		11	241	337	409	261	52	225	12	91	1	42	3	1	21	5	1714	1.96
Total	16582	903	17443	17042	15690	8573	2041	5690	332	2139	20	788	52	54	225	74	71079	81.08
																Total Hour	87661	
Share (%)	18.9	1.0	19.9	19.4	17.9	9.8	2.3	6.5	0.4	2.4	0.0	0.9	0.1	0.1	0.3	0.1	81.1	100

Date: Local Meteorology Office of Surabaya

2) Specifications of Wind-driven Pump

a. Type and Size of Rotary Wings

The diameter of rotary wing is set at 3.5 m as is commonly used in Surabaya for salt falm. The number of wings is set at 4 as is also common in conventional type in Surabaya. Actually speaking, there are two rotary wing type and four rotary wing type now in operation, however, the four wing type is more stable against the turbulence caused by the supporting member behind the rotor. The section of wing is planned to be in a Clark-Y type with the constant shape along the radius direction. Width, thickness and length are set at 0.2 m, 0.025 m and 1.4 m respectively. The maximum attack angle is limited by the assumed traveling speed rate as follow.

$$\alpha = \tan^{-1}\frac{1}{\lambda}$$

where : α : Maximum attack angle at a certain position of radius
λ : Traveling speed rate of wing to the wind speed and is determined at "4" at the tip of the wing

The value of attack angle by the location of radius is calculated a shown below.

Location	λ	α
100% radius	4	14°
80%	3.2	17°
60%	2.4	23°
40%	1.6	32°
20%	0.8	51°

b. Expected Wind Power

The output of the rotary wing is introduced by the following formula.

$$P = Cp \cdot \frac{1}{2}\rho V^3 \pi R^2$$

where : P : Output (kgf•m/s)
Cp : Output Coefficient = 0.3
ρ : Density of atmosphere = 0.123 (kgs s^2/m^4)

V : Wind speed (m/s)

R : Rotating radius = 1.75 (m)

Considering the wind characteristics, the rated wind speed is set at 3 m/s and the output is consequently calculated at 4.8 kgf•m/s (47w)

Revolutions of rotary wing is calculated by the following equation for the various wind speed as shown below.

$$n = \frac{\lambda V}{\pi d}$$

Where n : Revolutions per second

λ : Traveling speed rate = 4

π : Wind speed (m/s)

d : Rotating diameter = 3.5 m

Wind speed (m/s)	n (r.p.s)	n (r.p.m)
2	0.7	44
2	1.1	65
4	1.5	87
5	1.8	109
6	2.2	131
7	2.5	153
8	2.9	175

c. Discharge Capacity

The dimensions of pump are set referring to the conventional model as follows:

a. Stroke : 20 cm

b. Diameter : 10 cm

This gives a discharge volume of 1.7 l/s in a reciprocal movement of piston under the rated wind speed of 3 m/s as calculated below.

$$Q = n \cdot \frac{\pi}{4} \phi^2 \cdot S$$

Where Q : discharge volume (l/s)

n : Revolution per second = 1.1 (r.p.s)
ϕ : Diameter of cylinder = 10 (cm)
S : stroke = 20 (cm)

This corresponds to 100 l/min. On the other hand, the required head is set at 2 m to create the down flow through the trickling filter. This requirement of pressure indicates the force of emission should be higher than 16 kg as is calculated below.

$$f = \frac{\pi}{4}\phi^2 \cdot p$$

where f : Minimum force of emission (kgf)
ϕ : Diameter of sylinder = 10 (cm)
p : Discharge pressure = 0.2 (kgf/cm^2)

This amount of emission force exerts a work of 3.5 kgf•m every second under the rated wind speed (3 m/s) as calculated below.

$$W = n \cdot f \cdot s = 1.1 \times 16 \times 0.2 = 3.5 \text{ (kgf•m/s)}$$

where W : Amount of work
n : Revolution per second = 1.1 r.p.s
f : Force of emission = 16 (kgf)
s : Stroke = 20 (cm)

Since the wind turbine generates excessive power of 4.8 kgf•m/s to the above described work W, the pumping can be executed by a pump with an efficiency of about 70%.

3) Function and Structure of Aerator

a. Method of Aeration

The type of aeration system is classified into five (5) basic methods by their principal mechanism.

a. Activated sludge method
b. Forced air diffusion method
c. Mechanical churning method
d. Revolving disk method

e. Trickling filter bed system

Out of these methods, the trickling filter bed method is thought to be recommendable to this project because it has such advantages as 1) wide range of adaptability to the fluctuation of water quality and volume, 2) simple structure and easy maintenance and 3) less demand for power source. Since the leachate volume and quality in the retention pond is oblige dot change greatly by the influence of seasonal change of rainfall, the proposed aerator is requested to have the enough adaptability. And the initial investment cost so huge that the operation cost should be reduced as far as possible.

b. Structure and Capacity

Proposed structure of the trickling filter is illustrated in Fig. 2.2-5 as the prototype that can operate under the limitation of power supply by wind turbine.

According to the capacity of the pump, flow volume with a head of 2 m is expected at 1.7 l/s (6 m^3/h) under the rated wind speed of 3 m/s that is available during the duration of 23% to the whole year. This duration of time when the rated flow volume is available corresponds to 5.5 hours in a day. Consequently the pump can be evaluated to have a capacity of 33 m^3 per day in average.

$$v = 5.5 \text{ hour/day} \times 6 \text{ m}^3/\text{h} = 33 \text{ m}^3/\text{day}$$

Japanese Guide Line for Sewerage Design gives the critical value of BOD (Biochemical Oxygen Demand) load as 1.2 $kg/m^3 \cdot day$ or less. To satisfy this criterion, the trickling load is necessary to meet the following equation.

$$TL = 1000 \times B \cdot D / (BOD)$$

where TL : Trickling load ($m^3/m^2 \cdot day$)
B : Critical BOD load = 1.2 ($kg/m^3 \cdot day$)
D : Depth of trickling bed (m)
(BOD) : BOD concentration of raw leachate (mg/l)

Provided the depth of trickling bed is 1 m and the BOD of raw leachate is 1,000 mg/l, the Trickling load is determined at about 1.2 $m^3/m^2 \cdot day$. By using a trickling bed with the area of 28 m^2 (2 m wide and 7 m long), daily treatment capacity is estimated at about 33 m^3 that can be supplied by the pump.

$28\ m^2 \times 1.2\ m^3/m^2 \cdot day = 33.6\ m^3/day$

The efficiency of BOD removal by this system is expected at about 2/3 as explained in the above mentioned Japanese Guide Line. According to the Guide Line, the proposed aerator is expected to remove BOD load of 22 kg/day. The removed organic matters are changed into sludge and are necessary to be taken away out of sludge bed below the filter be. The removal of sludge is planned to be done by manpower or pump, and disposed at the landfill site every day during rainy season.

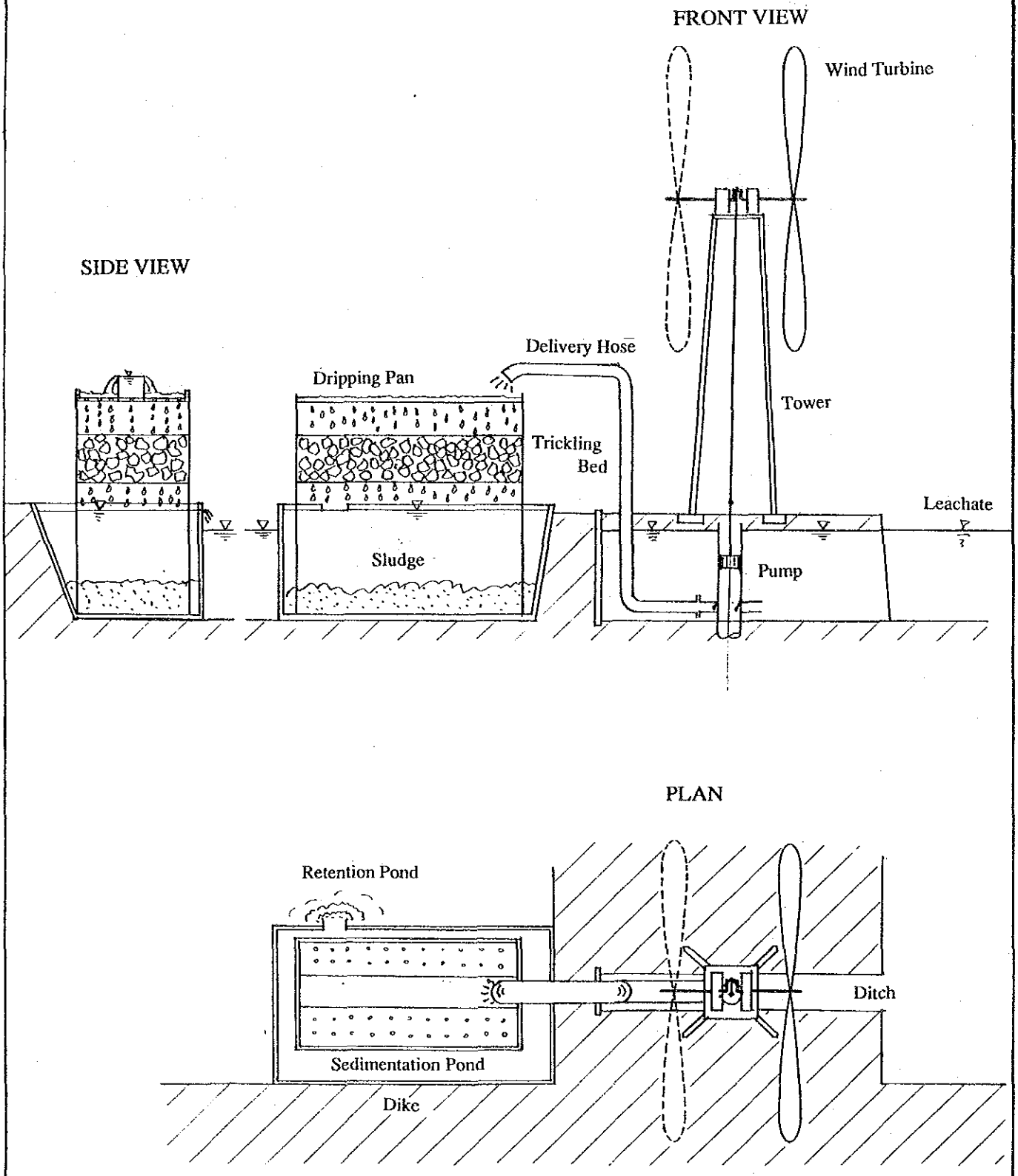


FIG. 2.2-5 SUPPOSED STRUCTURE OF TRICKLING BED

2.5 Cross Section of Stormwater Discharge Channel

1) Rainfall Intensity Formula

The rainfall intensity formula for 10-year probability used in the urban drainage plan in Jakarta is used.

$$I_{10} = \frac{8,571}{t^{1/1.02} + 50.1} \qquad (1)$$

For reference, 60-minute rainfall intensity (I_{10}^{60}) and 10-minute rainfall (I_{10}^{10}) intensity in Equation (1) are as follows:

$$I_{10}^{60} = \frac{8,571}{60^{1/1.02} + 50.1} = 81.3 \ mm/hr \qquad (2)$$

$I_{10}^{10} = B_{10}^{10} \times I_{10}^{60}$

B_{10}^{10} : characteristic coefficient

$$\frac{60 - 10B_{10}^{10}}{B_{10}^{10} - 1} = 50.1 \qquad (3)$$

$I_{10}^{10} = 1.83 \times 81.3 = 148.8$ mm/hr

The maximum 24-hour rainfall in Surabaya City in the past 10 years (1979 - 1988) was 105 mm with the rainfall duration being 1 - 2 hours. Therefore, it is considered reasonable to use Equation (1) which has given the value of 81.3 mm/hr for 10-year probability.

2) Conditions

a. Stormwater Run-off (Q)

Rational formula

$Q = \frac{1}{360} C \cdot I \cdot A \ (m^3/sec)$

where, C : run-off coefficient = 0.4

(Corresponds to 0.6 for seepage coefficient)

I : Rainfall intensity (mm/hr) = Equation (1) with

t = rainfall duration (min) = $t_1 + \frac{L}{v} \times \frac{1}{60}$

t_1 = inlet time (from rainfall point to the channel) = 7 min.

L = channel length; refer to sub-section (3)

v = average flow velocity (m/sec); refer to sub-section (2)

A : drainage area (ha); refer to sub-section (3)

b. Flow Capacity (Q')

$$Q' = \frac{1}{n} R^{2/3} T^{1/2} A' = vA'$$

where, n : roughness coefficient
= 0.013 for mortal open channel

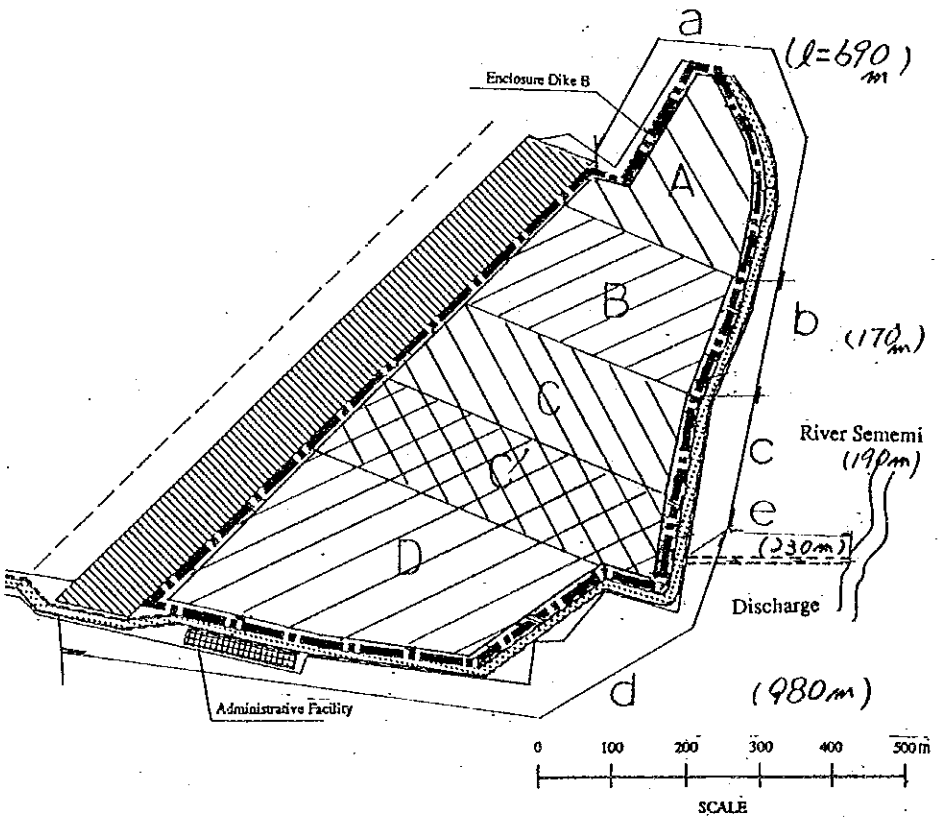
R : hydraulic radius (m)

T : Channel slope

A' : cross sectional area of the channel (m^2)

v : channel flow velocity (m/sec)

c. Drainage Area and Channel Length



Channel Section	Section length (L)	Cumulative channel length	Drainage area
a	690m	690m (La)	5.21ha (A)
b	170m	860m (La+Lb)	11.14ha (A+B)
c	190m	1,050m (La+Lb+Lc)	23.04ha (A+B+C+C')
d	980m	980m (Ld)	18.33ha (D+C')
e	230m	1,280m (La+Lb+Lc+Le)	43.58ha (A+B+C+D)

d. Computation Cases

	Flow depth	Surface gradient
Case 1	0.5m	0.001
Case 2	0.8m	0.001
Case 3	0.8m	0.0005

3) Computation Result

Refer to Table 4-1

4) Conclusion

Case 2 is adopted by considering channel width, channel bottom elevation and flow surface elevation.

Another point of rainwater drainage is the utilization of it : it is planned to utilize the rainwater for the demand of administrative facilities. Utilization system consists of collection ditch, underground reservoir, delivery equipment and consumer equipment which are shown in Fig. 2.2-6.

Computation for Channel Cross Section

1) Outlet to River Sememi (end of section e)

Case	Channel width (m)	Flow depth (m)	n	Hydraulic radius (m)	Surface slope	Average velocity (m/sec)	Channel length (m)	Inlet time (min)	Rainfall duration (min)	Flow capacity (m3/sec)	Rainfall intensity (mm/hr)	Rainfall area (m2)	Stormwater run-off (m3/sec)	Channel bottom elevation (m)	Flow surface elevation (m)
(1)	6.5	0.5	0.013	0.433	0.001	1.39	1,280	15.35	22.35	4.518	120	435,800	4.4	1.52	2.02
(2)	3.5	0.8	0.013	0.549	0.001	1.63	1,280	13.09	20.09	4.564	124	435,800	4.547	1.22	2.02
(3)	4.5	0.8	0.013	0.59	0.0005	1.21	1,280	17.63	24.63	4.356	117	435,800	4.29	1.86	2.66

2) 1st-Phase Partition (end of section d)

Case	Channel width (m)	Flow depth (m)	n	Hydraulic radius (m)	Surface slope	Average velocity (m/sec)	Channel length (m)	Inlet time (min)	Rainfall duration (min)	Flow capacity (m3/sec)	Rainfall intensity (mm/hr)	Rainfall area (m2)	Stormwater run-off (m3/sec)	Channel bottom elevation (m)	Flow surface elevation (m)
(1)	3.9	0.5	0.013	0.398	0.001	1.32	980	12.37	19.37	2.574	125	183,300	2.546	1.82	2.32
(2)	2.3	0.8	0.013	0.472	0.001	1.47	980	11.11	18.11	2.705	128	183,300	2.607	1.52	2.32
(3)	2.8	0.8	0.013	0.509	0.0005	1.1	980	14.85	21.85	2.464	121	183,300	2.464	2.01	2.81

3) 2nd-Phase Partition (end of section c)

Case	Channel width (m)	Flow depth (m)	n	Hydraulic radius (m)	Surface slope	Average velocity (m/sec)	Channel length (m)	Inlet time (min)	Rainfall duration (min)	Flow capacity (m3/sec)	Rainfall intensity (mm/hr)	Rainfall area (m2)	Stormwater run-off (m3/sec)	Channel bottom elevation (m)	Flow surface elevation (m)
(1)	4.8	0.5	0.013	0.414	0.001	1.35	1,050	12.96	19.96	3.24	124	230,400	3.174	1.75	2.25
(2)	2.7	0.8	0.013	0.502	0.001	1.54	1,050	11.36	18.36	3.326	127	230,400	3.251	1.45	2.25
(3)	3.4	0.8	0.013	0.544	0.0005	1.15	1,050	15.22	22.22	3.128	121	230,400	3.098	1.975	2.775

4) 3rd-Phase Partition (end of section b)

Case	Channel width (m)	Flow depth (m)	n	Hydraulic radius (m)	Surface slope	Average velocity (m/sec)	Channel length (m)	Inlet time (min)	Rainfall duration (min)	Flow capacity (m3/sec)	Rainfall intensity (mm/hr)	Rainfall area (m2)	Stormwater run-off (m3/sec)	Channel bottom elevation (m)	Flow surface elevation (m)
(1)	2.6	0.5	0.013	0.361	0.001	1.23	860	11.65	18.65	1.599	127	111,400	1.572	1.94	2.44
(2)	1.6	0.8	0.013	0.4	0.001	1.32	860	10.86	17.86	1.69	128	111,400	1.584	1.64	2.44
(3)	2	0.8	0.013	0.444	0.0005	1	860	14.33	21.33	1.6	122	111,400	1.51	2.07	2.87

5) Dike Slope of 3rd-Phase Partition (end of section a)

Case	Channel width (m)	Flow depth (m)	n	Hydraulic radius (m)	Surface slope	Average velocity (m/sec)	Channel length (m)	Inlet time (min)	Rainfall duration (min)	Flow capacity (m3/sec)	Rainfall intensity (mm/hr)	Rainfall area (m2)	Stormwater run-off (m3/sec)	Channel bottom elevation (m)	Flow surface elevation (m)
(1)	1.5	0.5	0.013	0.3	0.001	1.09	690	10.55	17.55	0.818	129	52,100	0.747	2.11	2.61
(2)	0.9	0.8	0.013	0.288	0.001	1.06	690	10.85	17.85	0.763	128	52,100	0.741	1.81	2.61
(3)	1.2	0.8	0.013	0.343	0.0005	0.84	690	13.69	20.69	0.806	123	52,100	0.712	2.155	2.955

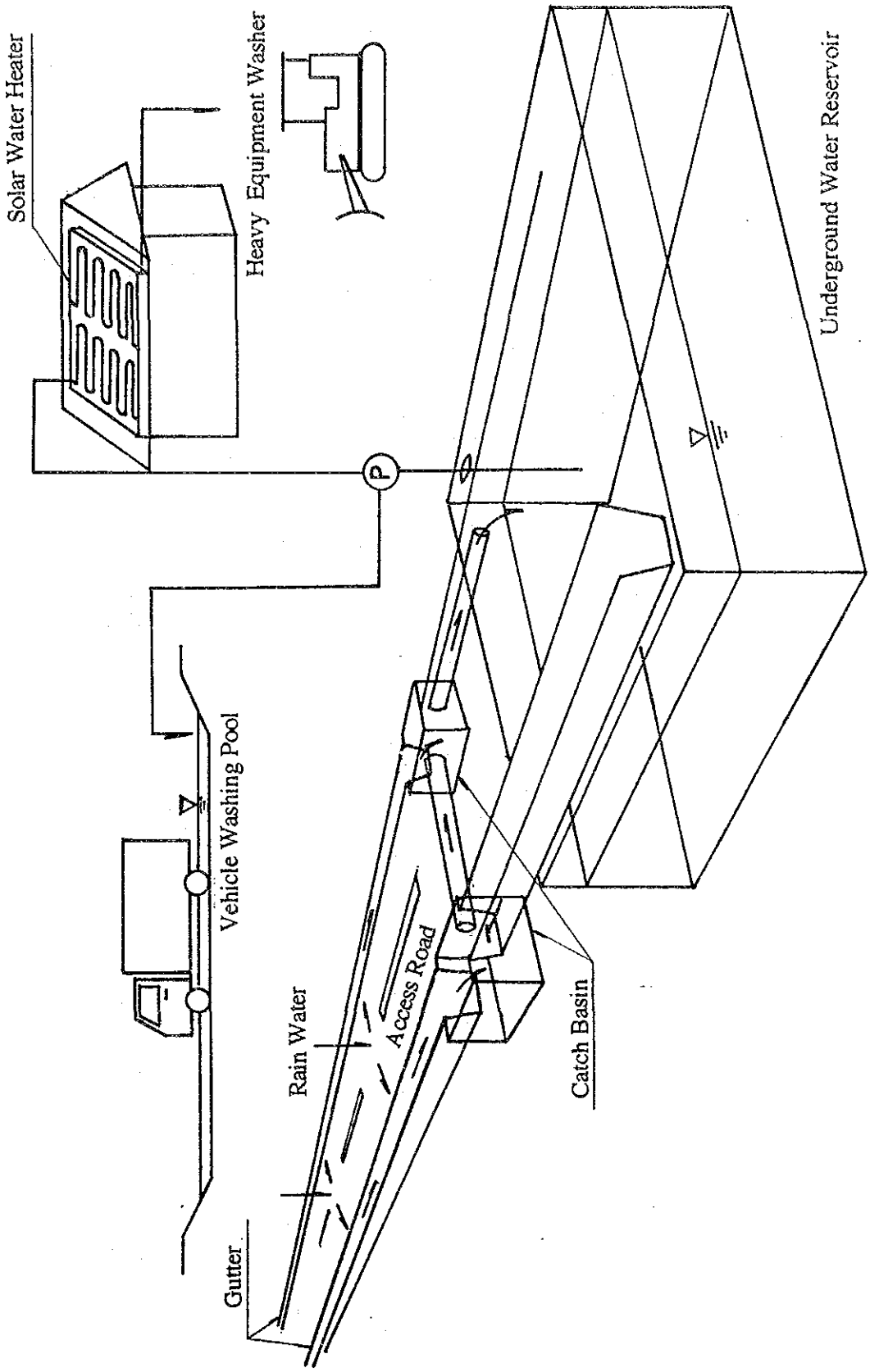


FIG. 2.2-6 **RAINWATER UTILIZATION SYSTEM**

Chapter 3. Operation

3.1 Layout of Working Face

To maintain a sound condition, it is necessary to control the range of working face where the garbage is unloaded every day. The layout plan and operation order of cell are shown in Fig. 2.3-1 for example.

Operation Cycle

Landfill operation is executed according to the repeated cycle which consists of :

1st Layer

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

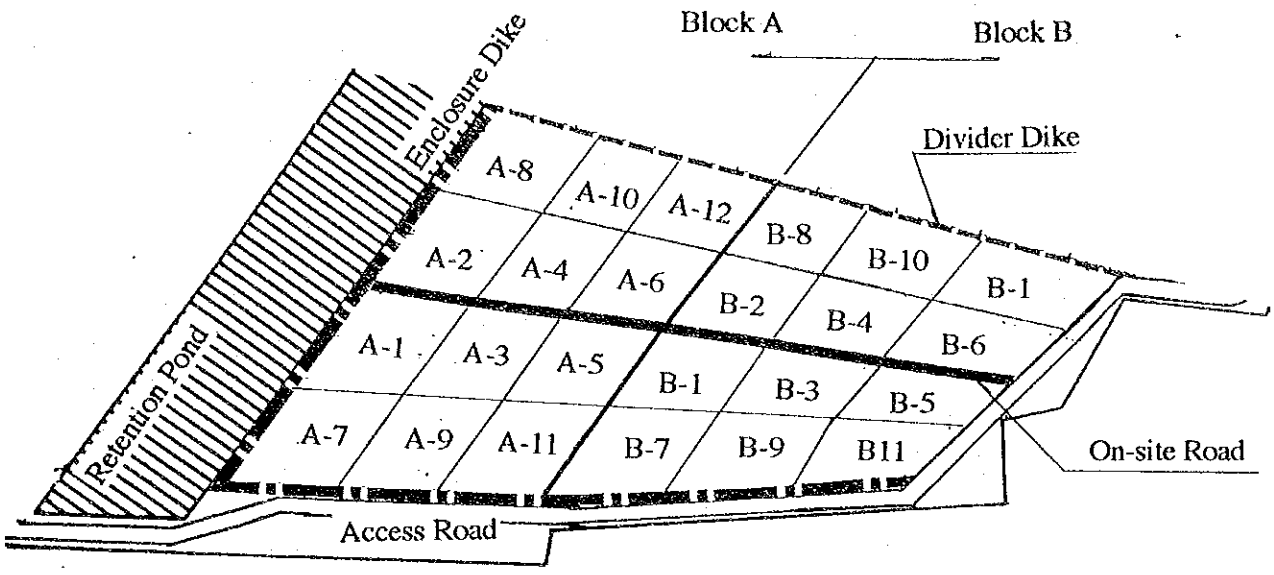
------- repeated at all cells in turn -------

2nd Layer

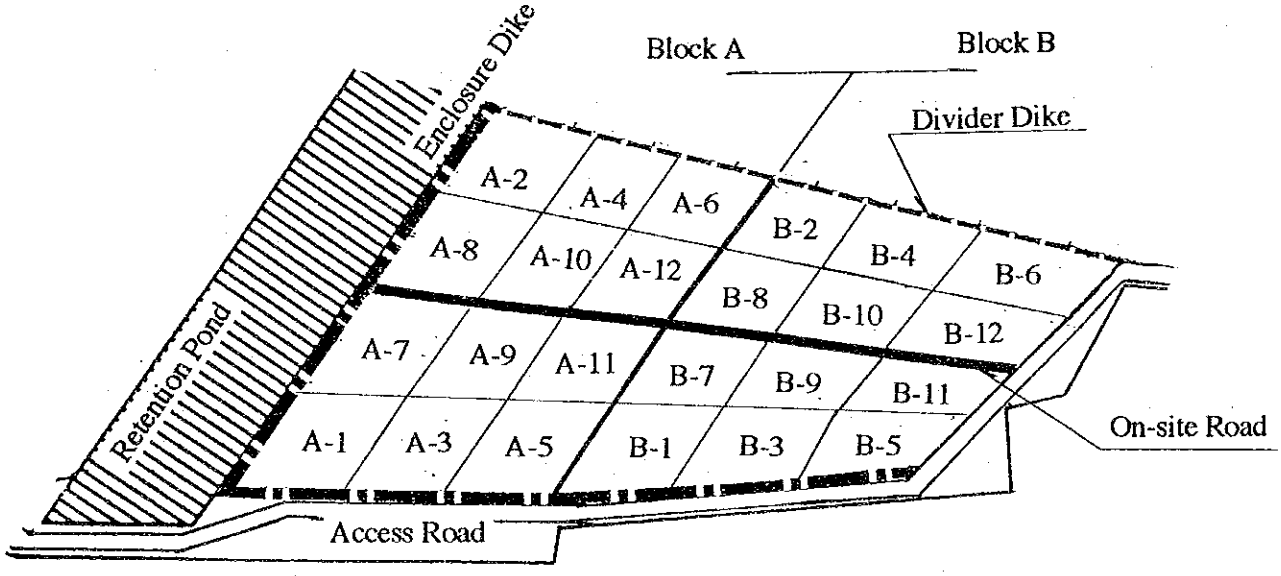
- Unloading/shaping ..... 7 days
- Covering ..... 1 or 2 days
- Gas vent ..... within 1 week or less
- Underdrain ..... within 1 week or less

------- repeated at all cells in turn -------

The sample of the application is shown for zone 1 in Fig. 2.3-2.



1st Layer (Zone I)



2nd Layer (Zone I)

FIG. 2.3-1 **LAYOUT PLAN OF CELL**

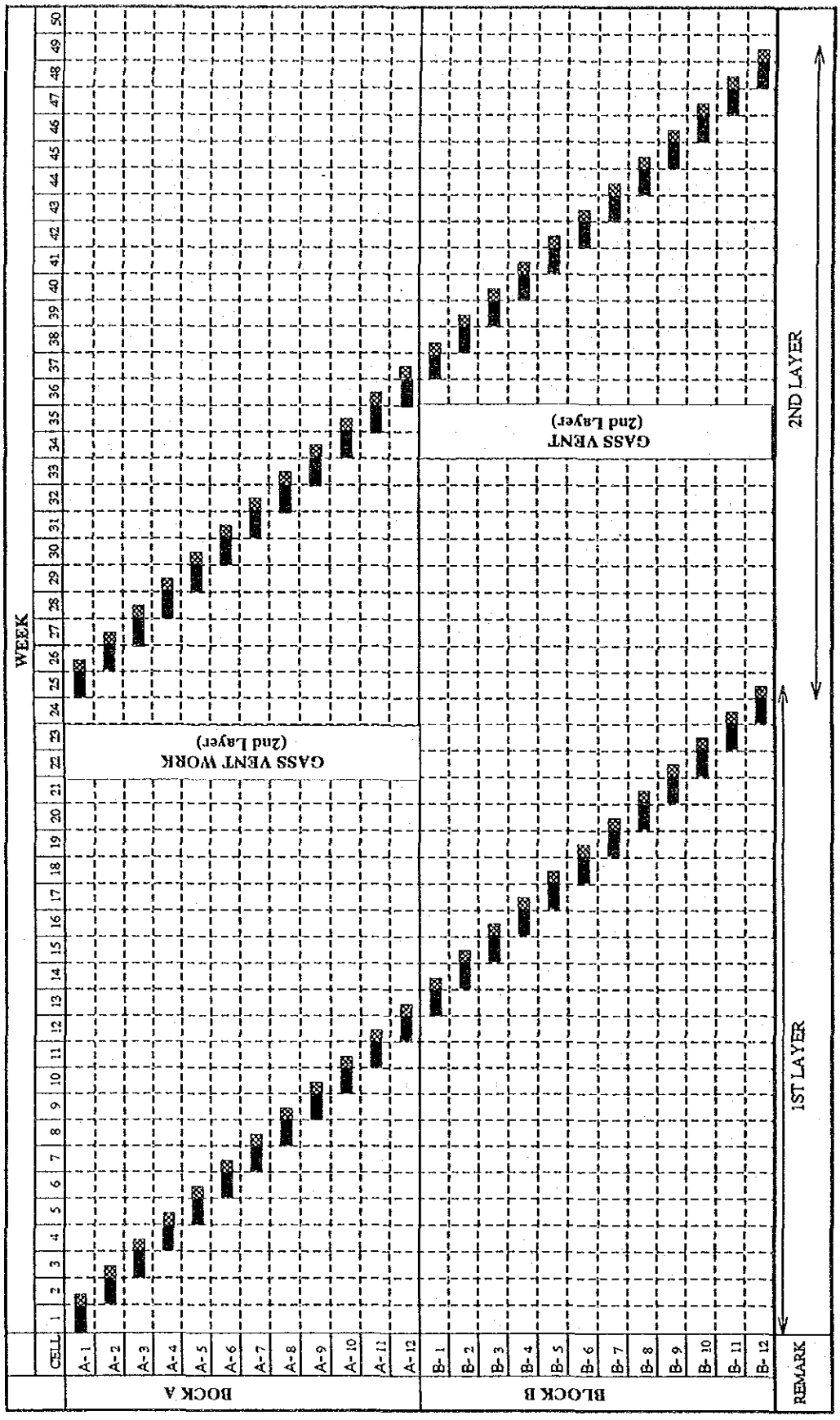
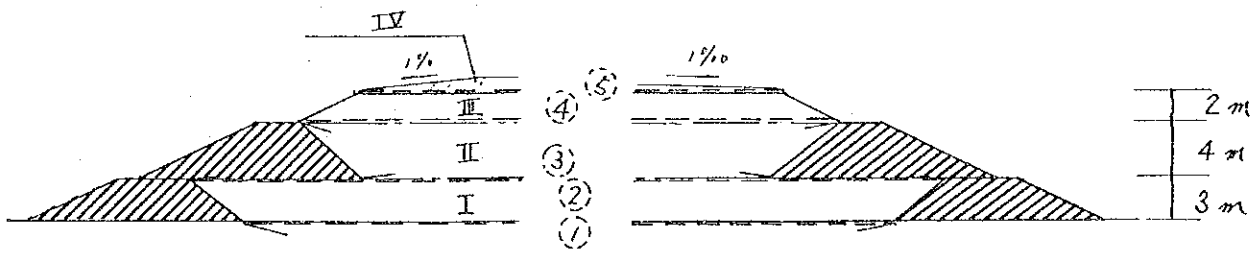


FIG. 2.3-2 PLANNING OPERATION CYCLE FOR ZONE 1

THE STUDY ON THE SOLID WASTE MANAGEMENT IMPROVEMENT FOR SURABAYA CITY

3.2 Landfill Capacity

The estimated capacity of each zone are summarized below.



Computation of Landfill capacity

Block	Area (ha)	Average area (ha)	Height	Capacity (10^3 m^3)	Pipe volume (10^3 m^3)	Volume of Partition dikes (10^3 m^3)	Landfill capacity (10^3 m^3)
I	(1) 33 (2) 34.0	33.5	3	1,005	23	19	963
II	(3) 30.6 (4) 32.2	31.4	4	1,256	44	29	1,183
III	(4) 32.2 (5) 30.6	31.4	2	628	0	0	628
IV	(5) 30.6 - 0	15.3	0.5	77	0	0	77
Total				2,966	67	48	2,851

Chapter 4 Bill of Quantity

Bill of quantity for the construction of sanitary landfill site and related estimated costs are shown in accordance with the time schedule in Table 2.4-1 and 2.4-2.

Table 2.4-1

Bill of Quantity

Works	Type	Subitem	Unit	Total	Initial Sub-Total	Initial 1995	Initial 1996	Running 1996	Running 1997	Running 1998	Running 1999	Running 2000	Running 2201	Running 2002	Running 2003	Running 2004
Ground work	Flattening		m2	445,000	445,000	445,000	-	-	-	-	-	-	-	-	-	-
Foundation	Steel Sheet Pile		t	4,785	4,785	4,785	-	-	-	-	-	-	-	-	-	-
	Installation		m	99,680	99,680	99,680	-	-	-	-	-	-	-	-	-	-
Main Structure	Banking	Clay	m3	364,740	263,950	154,277	109,673	-	-	38,160	21,130	39,070	-	-	-	2,430
	Banking	Aged Waste	m3	47,420	18,870	10,388	8,482	-	-	15,790	12,760		-	-	-	-
	Slope Forming		m2	88,520	40,720	17,073	23,647	-	-	18,930	11,610	16,060	-	-	-	1,200
	Lining	t=200mm	m2	4,180	4,180	2,303	1,877	-	-	-	-	-	-	-	-	-
Retention Pond	Excavation		m3	15,650	15,650	15,650	-	-	-	-	-	-	-	-	-	-
	Soil Haulage		m3	15,650	15,650	15,650	-	-	-	-	-	-	-	-	-	-
	Banking		m3	2,040	2,040	2,040	-	-	-	-	-	-	-	-	-	-
	Slope Forming		m2	4,580	4,580	4,580	-	-	-	-	-	-	-	-	-	-
Leachate Recirculation	Pump	22kw	Unit	2	2	2	-	-	-	-	-	-	-	-	-	-
Underdrain	PVC Tube	ø300	m	24,540	15,990	5,638	10,352	-	-	3,020	3,180	2,350	-	-	-	-
		ø150	m	24,300	16,090	5,182	10,908	-	-	2,660	2,540	3,010	-	-	-	-
	Crushed Stone		m3	44,860	22,620	7,617	15,003	-	-	7,700	7,910	6,630	-	-	-	-
	Bamboo		m	103,920	103,920	35,039	68,881	-	-	-	-	-	-	-	-	-
	Bamboo Panel		m2	47,949	47,949	16,167	31,782	-	-	-	-	-	-	-	-	-
Gas Vent		ø500 x ø1000	Piece	1,008	168	55	113	55	63	105	118	113	105	118	113	50
Stormwater Drain	a block	900 x 1,350	m	690	690	690	-	-	-	-	-	-	-	-	-	-
	b block	1,600 x 1,800	m	160	160	160	-	-	-	-	-	-	-	-	-	-
	c block	2,700 x 2,000	m	180	180	180	-	-	-	-	-	-	-	-	-	-
	d block	2,300 x 1,500	m	970	970	970	-	-	-	-	-	-	-	-	-	-
	e block	4,000 x 1,150	m	220	220	220	-	-	-	-	-	-	-	-	-	-
	Box Culvert		L.S.	1	1	1	-	-	-	-	-	-	-	-	-	-
	Side Ditch	R=25(semicircle)	m	2,360	2,360	2,360	-	-	-	-	-	-	-	-	-	-
	Weir	H=300	L.S.	1	1	1	-	-	-	-	-	-	-	-	-	-
Access Road	A Type	Entrance	m	510	510	510	-	-	-	-	-	-	-	-	-	-
	B Type	Peripheral	m	1,340	1,340	1,340	-	-	-	-	-	-	-	-	-	-
Maintenance Road	C Type	W=2m	m	1,950	1,950	1,950	-	-	-	-	-	-	-	-	-	-
	D Type	W=5m	m	885	885	885	-	-	-	-	-	-	-	-	-	-
On-site Road		W=7m	m	1,355	1,355	1,355	-	-	-	-	-	-	-	-	-	-
Adm. Building	Building		L.S.	1	1	1	-	-	-	-	-	-	-	-	-	-
	Power Receiving		L.S.	1	1	1	-	-	-	-	-	-	-	-	-	-
Workshop			L.S.	1	1	1	-	-	-	-	-	-	-	-	-	-
Weighing Facility	Truck Scale		L.S.	1	1	1	-	-	-	-	-	-	-	-	-	-
	Weigh Booth		L.S.	1	1	1	-	-	-	-	-	-	-	-	-	-
Small Water Supply	Tank, Pump Small Purifyer	10m x 6m x 3.5m	L.S.	1	1	1	-	-	-	-	-	-	-	-	-	-
Vehicle Washing Pool		5m x 10m x 0.5m	L.S.	1	1	1	-	-	-	-	-	-	-	-	-	-
Parking Lot			L.S.	1	1	1	-	-	-	-	-	-	-	-	-	-
Auxiliary Works			L.S.	1	1	1	1	-	-	-	-	-	-	-	-	-

Table 2.4-2

Investment Schedule for Landfill Site

(UNIT : Rp1,000)

Works	Type	Subitem	Total	Initial			Running								
				Sub-Total	1995	1996	1996	1997	1998	1999	2000	2201	2002	2003	2004
Ground work	Flattening		298,150	298,150	298,150	-	-	-	-	-	-	-	-	-	-
Foundation	Steel Sheet Pile		7,895,250	7,895,250	7,895,250	-	-	-	-	-	-	-	-	-	-
	Installation		996,800	996,800	996,800	-	-	-	-	-	-	-	-	-	-
Main Structure	Banking	Clay	5,106,360	3,695,300	2,160,000	1,535,300	-	-	534,240	295,820	546,980	-	-	-	34,020
	Banking	Aged Waste	606,028	241,159	133,000	108,159	-	-	201,796	163,073	-	-	-	-	-
	Slope Forming		1,199,446	551,756	231,000	320,756	-	-	256,502	157,316	217,613	-	-	-	16,259
	Lining	t=200mm	65,542	65,542	36,000	29,542	-	-	-	-	-	-	-	-	-
Retention Pond	Excavation		87,640	87,640	87,640	-	-	-	-	-	-	-	-	-	-
	Soil Haulage		7,355	7,355	7,355	-	-	-	-	-	-	-	-	-	-
	Banking		28,560	28,560	28,560	-	-	-	-	-	-	-	-	-	-
	Slope Forming		62,059	62,059	62,059	-	-	-	-	-	-	-	-	-	-
Leachate Recirculation	Pump	22kw	108,000	108,000	108,000	-	-	-	-	-	-	-	-	-	-
Underdrain	PVC Tube	ø300	944,790	615,615	217,000	398,615	-	-	116,270	122,430	90,475	-	-	-	-
		ø150	364,500	241,350	78,000	163,350	-	-	39,900	38,100	45,150	-	-	-	-
	Crushed Stone		741,087	373,682	126,000	247,682	-	-	127,204	130,673	109,528	-	-	-	-
	Bamboo		62,871	62,871	21,000	41,871	-	-	-	-	-	-	-	-	-
	Bamboo Panel		71,924	71,924	24,000	47,924	-	-	-	-	-	-	-	-	-
Gas Vent		ø500 x ø1000	17,136	935	0	935	935	1,071	1,785	2,006	1,921	1,785	2,006	1,921	1,836
Stormwater Drain	a block	900 x 1,350	224,940	224,940	224,940	-	-	-	-	-	-	-	-	-	-
	b block	1,600 x 1,800	74,560	74,560	74,560	-	-	-	-	-	-	-	-	-	-
	c block	2,700 x 2,000	147,240	147,240	147,240	-	-	-	-	-	-	-	-	-	-
	d block	2,300 x 1,500	444,260	444,260	444,260	-	-	-	-	-	-	-	-	-	-
	e block	4,000 x 1,150	127,380	127,380	127,380	-	-	-	-	-	-	-	-	-	-
	Box Culvert		63,569	63,569	63,569	-	-	-	-	-	-	-	-	-	-
	Side Ditch	R=25(semicircle)	9,923	9,923	9,923	-	-	-	-	-	-	-	-	-	-
	Weir	H=300	10	10	10	-	-	-	-	-	-	-	-	-	-
Access Road	A Type	Entrance	552,840	552,840	552,840	-	-	-	-	-	-	-	-	-	-
	B Type	Peripheral	683,400	683,400	500,000	183,400	-	-	-	-	-	-	-	-	-
Maintenance Road	C Type	W=2m	29,250	29,250	15,000	14,250	-	-	-	-	-	-	-	-	-
	D Type	W=5m	85,845	85,845	29,000	56,845	-	-	-	-	-	-	-	-	-
On-site Road		W=7m	77,235	77,235	29,000	48,235	-	-	-	-	-	-	-	-	-
Adm. Building	Building		379,450	379,450	379,450	-	-	-	-	-	-	-	-	-	-
	Power Receiving		207,100	207,100	207,100	-	-	-	-	-	-	-	-	-	-
Workshop			283,175	283,175	283,175	-	-	-	-	-	-	-	-	-	-
Weighing Facility	Truck Scale		168,663	168,663	168,663	-	-	-	-	-	-	-	-	-	-
	Weigh Booth		8,560	8,560	8,560	-	-	-	-	-	-	-	-	-	-
Small Water Supply	Tank, Pump Small Purifyer	10m x 6m x 3.5m	64,199	64,199	64,199	-	-	-	-	-	-	-	-	-	-
Vehicle Washing Pool		5m x 10m x 0.5m	12,351	12,351	12,351	-	-	-	-	-	-	-	-	-	-
Parking Lot			22,750	22,750	22,750	-	-	-	-	-	-	-	-	-	-
Auxiliary Works			953,628	953,628	794,000	159,628	-	-	-	-	-	-	-	-	-
Directo Cost Total			23,283,803	20,024,276	16,667,784	3,356,492	935	1,071	1,277,697	904,418	1,011,667	1,785	2,006	1,921	52,115

PART 3

CONSTRUCTION AND REHABILITATION OF DEPO/LPS

PART 3. CONSTRUCTION AND REHABILITATION OF DEPO/LPS

Chapter 1 Plan for Construction of New Depo/LPS

1.1 New Construction Sites and Schedule

1) Construction Period and Finance

It is proposed that the KMS will construct Depo/LPS during from 1994/95 to 1997/98. It is proposed that the KMS will acquire necessary land by wing its own budget, and the construction would be financed by an OECF loan.

2) Number of New Depo/LPS to be Constructed

Based upon the KMS' past experience in the new Depo/LPS construction, the maximum number of Depo/LPS to be constructed is 4 - 6 Depo and 2 - 3 LPA per year. It is difficult for KMS to construct more number of Depo and LPS for each year because of the necessity for negotiation with relevant organizations and persons such as the City Planning Division of KMS, land owners. Therefore, it is propsed that KMS will construct 6 new Depo and 3 new LPS per year. In total 24 new Depo and 12 new LPS will be constructed during 4 years 1994/95-1997/98.

3) Location of the new Depo/LPS

The above-mentioned 24 Depo and 12 LPS are selected from more number of candidate palces. the selection was made on the criteria that 1) all Kelurahan should be provided by at least one Depo or LPS in principle, and 2) the area with higher population density should be provided by Depo or LPS as early as possible.

The proposed 24 Depo and 12 LPS are primarily selected from a list of 43 Depo and 6 LPS identified by KMS and the SUDP consultants as shown below :

	DEPO	LPS
a. Identified by KMS & SUDP consultants	43	6
b. Selected from Item a.	21	4
c. Newly identified JICA Study Team	3	8*
d. Proposed construction (b+c)	24	12

* of the 8 LPS newly identified by JICA Study Team, 6 LPS is proposed to replace the existing LPS where open dumping is practical.

The location of the 24 proposed new Depo and 12 new LPS is shown in Fig. 3.1-1.

4) Schedule of the new Depo/LPS construction

The construction schedule of the new Depo/LPS is shown in Table 3.1-1

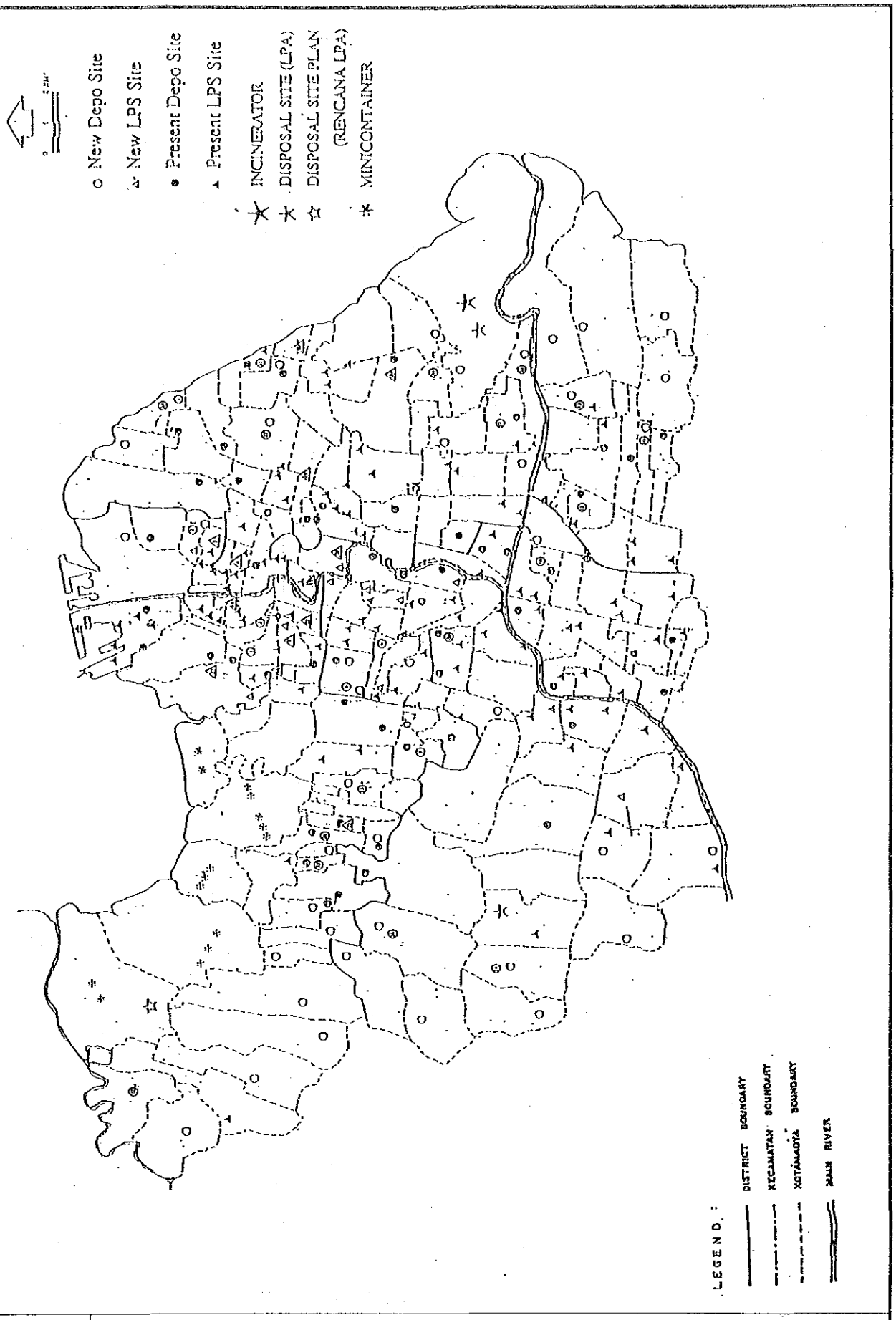


FIG. 3.1-1 **Planned Location of New Depo and LPS**

THE STUDY ON THE SOLID WASTE MANAGEMENT IMPROVEMENT FOR SURABAYA CITY

JICA

Table 3.1-1 Depo and LPS Construction Program

No	Construction Year	Kecamatan	Kelurahan	Area (ha)	Population \\\(1990\\\)	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.

1.2 Manpower Requirement

For each Depo, one person is needed to supervise both waste collection and haulage activities. No person is needed for LPS. therefore, 24 persons will be needed for the proposed new 24 Depo.

1.3 Construction Cost of Depo/LPS

1) Depo Construction

Construction caost of one depo is estimated to be Rp. 33.6 million. IfKMS has no purchase land, it will cost additional rp. 27 million, totally Rp. 60.6 million. All Depo have standard specifications as shown below. Each Depo has an area of 300 m^2.

Table 3.1-2 Construction Cost of a Depo

	Price	Remarks
(1) Wall	Rp. 6,300,000	70 m length
(2) Office	Rp. 12,500,000	5x5 m^2 (Building)/15 m^2 open terace
(3) Drainage	Rp. 2,150,000	20 m
(4) Plant	Rp. 250,000	20 plant
(5) Gate	Rp. 1,400,000	1 gate - 6 m
(6) Concrete floor	Rp. 5,500,000	150 m^2
(7) Electricity and water pipe	Rp. 1,200,000	450 watt-220V-9 points plug 1 water pump - 2 points faucet
(8) Furniture	Rp. 1,250,000	2 desks, 4 chairs, and 1 cabinet
Sub-Total	Rp. 30,550,000	
Tax/PPN 10%	Rp. 3,055,000	
Depo Construction	Rp. 33,605,000	
Land Purchase	Rp. 27,000,000	Rp. 90,000/m^2 x 300 m^2
Total	Rp. 60,605,000	

2) LPS contruction

The price for one LPS construction is estimated at in Table 3.1-3. The existing LPS are not equiped with appropriate drainage. Construction of drainage is desirable to prevent leachate from flowing to roadside.

Table 3.1-3 Construction Cost of a LPS

	Price	Remarks
(1) Wall	Rp. 2,550,000	25 m Length
(2) Plant	Rp. 250,000	20 Plants
(3) Concrete Floor	Rp. 3,200,000	100 m^2
(4) Drainage	Rp. 2,150,000	20 m
Sub-total	Rp. 8,150,000	
Tax/PPN 10%	Rp. 815,000	
LPS Construction	Rp. 8,965,000	

3) Annual Cost for New Depo/LPS

Annual cost for new Depo/LPS is estimated to be Rp. 5,014,000 for one Depo, and Rp. 1,011,000 for one LPS as shown below :

	DEPO	LPS
1) Depreciation	Rp. 1,222,000	Rp. 359,000
2) Loan Interest	Rp. 1,528,000	Rp. 448,000
3) Operation & Maintenance	Rp. 2,264,000	Rp. 204,000
(1) Salary of workers	Rp. 1,500,000	--
(2) Maintenance	Rp. 764,000	Rp. 204,000
4) Total cost	Rp. 5,014,000	Rp. 1,011,000

The capital investment program is shown in Table 3.1-4. The total capital investment is estimated to be Rp. 1,074.6 million, of which Rp. 831 million is for the construction, the remaining rp. 243 million is for land purchase.

Table 3.1-4 Capital investment Program for the Cost of New Depo/LPS

(Unit : Rp. Million)

Year	Building Construction Cost	Land Purchase Cost	Total Cost
1994/95	207.75	81.0	288.75
1995/96	207.75	0	207.75
1996/97	207.75	135.0	342.75
1997/98	207.75	27.0	234.75
Total	831.00	243.0	1,074,000

Chapter 2 Plan for Rehabilitation of Existing Depo/LPS

2.1 Required Number for Rehabilitation of Depo/LPS and Its Contents

1) Rehabilitation Period

It is proposed that the KMS will rehabilitate Depo/LPS during the period from 1994/95 to 1997/98.

2) Necessary Rehabilitation for Depo/LPS

Based upon the Depo/LPS survey conducted by the JICA Study Team in May 1992, it was identified that 45 Depo and 41 LPS need rehabilitation.

The following Depo and LPS need rehabilitation :

(1) Depo/LPS with damaged walls.
(2) Depo with damaged office building : (wall damage, leak in the roof, lack of furnitures, etc)
(3) Depo with damaged drainage
(4) Depo with damaged gate
(5) Depo/LPS with damaged floor
(6) Depo/LPS with damaged water pipe and electricity equipment.
(7) Depo/LPS that need enlargement of entrance for trucks
(8) LPS that need expansion
(9) Depo/LPS with no or insufficient plants

As for Item (9) tree planting, it is estimated that about 90% of the existing Depo and LPS need tree planting. It is advised that KMS should identify exact Depo and LPS that ned tree planting, and select suitable types of trees.

Depo/LPS that need rehabilitations are shown in Table 3.2-1 and Table 3.2-2.

Table 3.2-1 Depo Which Need Rehabilitation

Things to be rehabilitated	No	Name of Depo/LPS	Kelurahan	Kecamatan	Population density
1) Wall	1	Depo Keputran	Keputran	Tegalsari	174
	2	Depo Gersik	Moro Krembar	Krembangan	133
	3	Depo Kaliwaron	Mojo	Gubeng	184
2) Office	1	Depo Raya Dukuh Kupa	Dukuh Kupang	Karang Pilang	232
	2	Depo Kembang Kuning	Pakis	Sawahan	65
	3	Depo Candi Lontar	Candi Lontar	Lakarsantri	18
	4	Depo Gayung Sari	Gayung Sari	Wonocolo	74
	5	Depo Menanggal	Menanggal	Wonocolo	66
3) Drainage	1	Depo Demak*5	Tembok Duku	Bubutan	637
	2	Depo Rungkut Menangg	Rungkut Mena	Rungkut	121
	3	Depo Tenggilis Mejoyo	Tenggilis Mejo	Rungkut	93
	4	Depo Wonosari Tegal	Wonokusumo	Semampir	357
	5	Bendul Merisi	Bendut Merisi	Wonocolo	169
4) Gate	1	Depo Kalibokor	Pucang Sewu	Gubeng	637
	2	Depo Gersik	Moro Krembar	Krembangan	133
	3	Depo Manyar	Manyar Sabran	Sukolilo	119
	4	Depo Rungkut Manangg	Rungkut Mana	Rungkut	121
	5	Depo Ngagel Dadi III	Ngagel Rejo	Wonokromo	1091
	6	Depo Candi Lontar	Candi Lontar	Lakarsantri	18
	7	Depo Pagesangan	Pagesangan	Wonocolo	103
5) Concrete Floor	1	Depo Demak	Tembok Duku	Bubutan	637
	2	Depo Bunguran	Bongkaran	Pabean Cantikan	221
	3	Depo Manukan Kulon	Manukan Kulo	Tandes	131
	4	Depo Tambak Rejo	Tambak Rejo	Simokerto	363
	5	Depo Semolowaru	Semolowaru	Sukolilo	80
	6	Depo Gayung Sari	Gayungan	Wonocolo	74
	7	Depo Karah	Karah	Wonocolo	87
	8	Depo Dinoyo*10	Keputran	Tegalsari	174
6) Electricity and Water Pipe	1	Depo Manukan Kulon	Manukan Kulo	Tandes	131
	2	Depo SimoMulyo	Simo Mulyo	Tandes	171
	3	Depo Keputran	Keputran	Tegalsari	174
	4	Depo Kayon	Embong Kalia	Genteng	196
	5	Depo Balong Sari	Balong Sari	Tandes	65
	6	Depo Manyar Wetan	Manyar Wetan	Tandes	78
	7	Depo Dinoyo	Keputran	Tegalsari	174
	8	Depo Pirngadi	Bubutan	Bubutan	189
	9	Depo Gersik	Moro Krembar	Krembangan	133
	10	Depo Pacar Keling	Pacar Keling	Tambaksari	235
	11	Depo Kintamani	Wonokromo	Wonokromo	378
	12	Depo Simo Hilir	Simo Mulyo	Tandes	171
	13	Depo Karang Poh	Karang Poh	Tandes	56
	14	Depo Rungkut Kidul	Rungkut Kidul	Rungkut	116
	15	Depo Candi Lontar	Candi Lontar	Lakarsantri	18
	16	Depo Pagesangan	Pagesangan	Wonocolo	103
7) Entrance	1	Depo Numgiram*8	Bongkaran	Pabean Cantikan	221

Table 3.2-2 Rehabilitation of LPS By Work Items

Things to be rehabilated		Name of Depo/LPS	Kelurahan	Kecamatan	Population density
1) Wall	1	Asem Rowo	Asem Rowo	Tandes	47
	2	Manukan Wetan	Manukan Wetan	Tandes	78
	3	Gunung Sari	Sawung Galing	Wonokromo	163
	4	Babadan/Dupak	Jepara	Bubutan	632
	5	Pasar Kapasan	Sidodadi	Simokerto	472
	6	Jemur Ngawinan	Jemur Wonosari	Wonocolo	109
2) Concrete floor	1	Pegirikan	Ampel	Semampir	438
	2	Pucang Anom	Kertajaya	Gubeng	332
	3	Bratang Binangun	Baratajaya	Gubeng	172
	4	Penghela	Bubutan	Bubutan	189
	5	Pasar Tembok	Tembok Dukuh	Bubutan	637
	6	Rungkut Harapan	Kali Rungkut	Rungkut	214
	7	Pacar Keling	Pacar Keling	Tambaksari	235
	8	Tambak Boyo *1	Pacar Keling	Tambaksari	235
	9	Pasar Gubeng Masjid *2	Pacar Keling	Tambaksari	235
	10	Joyoboyo	Sawung Galing	Wonokromo	163
	11	Simo Hilir	Simo Mulyo	Tandes	171
	12	Pasar Harapan	Sidodadi	Simokerto	472
	13	Mulyosari	Kalisari	Sukolilo	31
	14	Jemur Wonosari *3	Jemur Wonosari	Wonocolo	109
	15	Siwalankerto	Siwalankerto	Wonocolo	76
	16	Menanggal	Menanggal	Wonocolo	153
	17	Ketintang Baru	Ketintang	Wonocolo	143
	18	Tenggilis Tengah	Tenggilis Mejoyo	Rungkut	93
	19	Jetis *4	Wonokromo	Wonocolo	378
3) Drainage	1	Pasar Gubeng Masjid *2	Pacar Keling	Tambaksari	235
	2	Kali Rungkut	Kali Rungkut	Rungkut	214
	3	Rungkut Harapan	Kali Rungkut	Rungkut	214
	4	Ketintang Baru	Ketintang	Gayungan	143
	5	Siwalankerto	Siwalankerto	Wonocolo	176
	6	Kedurus	Kedurus	Karang Pilang	123
	7	Kemlaten	Kebraon	Karang Pilang	96
4)Entrance	1	Pasar Kembang	Wonorejo	Tegalsari	398
5) Expansion	1	Baratajaya	Baratajaya	Gubeng	194
	2	Pecindilan	Kapasari	Genteng	255
	3	Kebraon	Kebraon	Karang Pilang	98
	4	Karang Pilang	Karang Pilang	Karang Pilang	101
	5	Tambak Boyo *1	Pacar Keling	Tambaksari	235
	6	Bendul Merisi	Jagir	Wonokromo	350
	7	Jemur Wonosari*3	Jemur Wonosari	Wonocolo	109
	8	Jetis *4	Wonokromo	Wonokromo	378

Note : *n shows the same LPA.

3) Priority of Depo/LPS Rehabilitation and Rehabilitation Schedule

The priority is given based upon the population density : Depo/LPS of the areas with higher population density should be rehabilitated earlier. Concerning the replant of depo/LPS trees, replant schedule should be decided by the KMS' decision because most of trees of Depo/LPS are deteriorated. thus, the number of replant is too many (the JICA Study Team estimate 90% of Depo/LPS need replant).

Depo/LPS rehabilitation schedule is shown in Table 3.2-3.

Table 3.2-3 Depo and LPS Rehabilitation Program

No	Rehabilitation year	Name of Depo/LPS	Required Rehabilitation	Estimated Rehabilitation Cost	Kecamatan	Kelurahan	Population Density
1	1994/1995	Depo Nagel Dadi III	Gate	Rp. 1,400,000	Wonokromo	Ngagel Rejo	1091
2		Depo Demak	Gate	Rp. 1,400,000	Bubutan	Tembok Dukuh	637
			Concrete floor	Rp. 2,200,000			
3		Babadan/Dupak	Wall	Rp. 765,000	Bubutan	Jepara	632
4		Pasar Kapasan	Wall	Rp. 765,000	Simokerto	Sidodadi	472
5		Pasar Harapan	Concrete floor	Rp. 1,480,000	Simokerto	Sidodadi	472
6		Pegirikan	Concrete floor	Rp. 1,480,000	Semampir	Ampel	438
7		Pasar Kembang	Entrance	Rp. 225,000	Tegalsari	Wonorejo	398
8		Jetis	Concrete floor	Rp. 1,480,000	Wonocolo	Wonokromo	378
			Expansion	Rp. 5,705,000			
9		Pasar Kembang	Entrance	Rp. 225,000	Tegalsari	Wonorejo	378
10		Depo Kintamani	Electricity & water pipe	Rp. 360,000	Wonokromo	Wonokromo	378
11		Depo Tambak Rejo	Concrete floor	Rp. 2,200,000	Simokerto	Tambak rejo	363
12		Depo Wonosari Tegal	Drainage	Rp. 430,000	Semampir	Wonokromo	357
13		Bendul Merisi	Expansion	Rp. 5,705,000	Wonokromo	Jagir	350
14		Pucang Anom	Concrete floor	Rp. 1,480,000	Gubeng	Kertajaya	332
15		Depo Kalibokor	Gate	Rp. 1,400,000	Gubeng	Pucang Sewu	256
16		Depo Pacar Keling	Electricity & water pipe	Rp. 360,000	Tambaksari	Pacar Keling	235
			Concrete floor	Rp. 2,200,000			
17		Tambak Boyo	Concrete floor	Rp. 1,480,000	Tambaksari	Pacar Keling	235
			Expansion	Rp. 5,507,000			
18		Gubeng Masjid	Concrete floor	Rp. 1,480,000	Tambaksari	Pacar Keling	235
19		Depo Raya Dukuh Kupang	Office	Rp. 2,500,000	Karang Pilang	Dukuh Kupang	232
20		Depo Bunguran	Concrete floor	Rp. 2,200,000	Pabean Cantikan	Bongkaran	221
			Electricity & water pipe	Rp. 360,000			
21		Pecindilan	Expansion	Rp. 5,507,000	Genteng	Kapasari	255
22		Depo Kayoon	Electricity & water pipe	Rp. 360,000	Genteng	Embong Kaliasin	196
23		Baratajaya	Expansion	Rp. 5,507,000	Gubeng	Baratajaya	194
24		Depo Pirngadi	Electricity & water pipe	Rp. 360,000	Bubutan	Bubutan	189
25		Penghela	Concrete floor	Rp. 1,480,000	Bubutan	Bubutan	189
26		Depo Kaliwaron	Wall	Rp. 1,890,000	Gubeng	Mojo	184
27		Depo Keputran	Wall	Rp. 1,890,000	Tegalsari	Keputran	174
			Electricity & water pipe	Rp. 360,000			
28		Depo Dinoyo	Electricity & water pipe	Rp. 360,000	Tegalsari	Keputran	174
29		Bratang Binangun	Concrete floor	Rp. 1,480,000	Gubeng	Barata Jaya	172

No	Rehabilitation year	Name of Depo/LPS	Required Rehabilitation	Estimated Rehabilitation Cost	Kecamatan	Kelurahan	Population Density
30		Depo Simomulyo	Electricity & water pipe	Rp. 360,000	Tandes	Simomulyo	171
31		Depo Simo Hilir	Electricity and water pipe	Rp. 360,000	Tandes	Simo Mulyo	171
			Concrete floor	Rp. 2,200,000			
32		Bendul Merisi	Drainage	Rp. 430,000	Wonocolo	Bendul Merisi	169
33		Gunung Sari	Wall	Rp. 765,000	Wonokromo	Sawunggaling	163
34		Joyoboyo	Concrete floor	Rp. 1,480,000	Wonokromo	Sawunggaling	163
35		Menanggal	Concrete floor	Rp. 1,480,000	Wonocolo	Menanggal	153
36		Ketintang Baru	Concrete floor	Rp. 1,480,000	Wonocolo	Ketintang	143
37		Depo Gersik	Wall	Rp. 1, 890,000	Krembangan	Moro Krembangan	133
			Gate	Rp. 1,400,000			
			Electricitiy & water pipe	Rp. 360,000			
38		Depo Manukan Kulon	Concrete floor	Rp. 2,200,000	Tandes	Manukan Kulon	131
			Electricity & water pipe	Rp. 360,000			
39		Depo Rungkut Menanggal	Gate	Rp. 1,400,000	Rungkut	Rungkut Menanggal	121
			Drainage	Rp. 430,000			
40		Depo Manyar	Gate	Rp. 1,400,000	Sukolilo	Manyar Sabrangan	119
41		Depo Rungkut Kidul	Electricity & water pipe	Rp. 360,000	Rungkut	Rungkut Kidul	116
42		Jemur Ngawinan	Wall	Rp. 765,000	Wonocolo	Jemur Wonosari	109
43		Jemur Wonosari	Expansion	Rp. 5,507,000	Wonocolo	Jemur Wonosari	109
			Concrete floor	Rp. 1,480,000			
44		Depo Pagesangan	Electricity & water pipe	Rp. 360,000	Wonocolo	Pagesangan	103
			Gate	Rp. 1,400,000			
45		Karang Pilang	Expansion	Rp. 5,507,000	Karang Pilang	Karang Pilang	101
46		Kebraon	Expansion	Rp. 5,507,000	Karang Pilang	Kebraon	98
47		Tenggilis Tengah	Concrete floor	Rp. 1,480,000	Rungkut	Tenggilis Mejoyo	93
48		Depo Karah	Concrete floor	Rp. 2,200,000	Wonocolo	Karah	87
49		Depo Semolowaru	Concrete floor	Rp. 2,200,000	Sukolilo	Semolowaru	80
50		Depo Manukan Wetan	Electricity & water pipe	Rp. 360,000	Tandes	Manukan Wetan	78
51		Siwalankerto	Concrete floor	Rp. 1,480,000	Wonocolo	Siwalankerto	76
52		Depo Gayungsari	Office	Rp. 2,500,000	Wonocolo	Gayungan	74
			Concrete floor	Rp. 2,200,000			
53		Depo Menanggal	Office	Rp. 2,500,000	Wonocolo	Menanggal	66
54		Depo Kembang Kuning	Office	Rp. 2,500,000	Sawahan	Pakis	65
55		Depo Karang Poh	Electricity & water pipe	Rp. 360,000	Tandes	Karang Poh	56
56		Mulyosari	Concrete floor	Rp. 1,480,000	Sukolilo	Kalisari	31
57		Depo Candi Lontar	Electricity & water pipe	Rp. 360,000	Lakarsantri	Candi Lontar	18
			Gate	Rp. 1,890,000	Wonocolo	Siwarankerto	76
58		Depo Gayungsari	Office	Rp. 2,500,000	Wonocolo	Gayungan	74
			Concrete Floor	Rp. 2,200,000			

No	Rehabilitation year	Name of Depo/LPS	Required Rehabilitation	Estimated Rehabilitation Cost	Kecamatan	Kelurahan	Population Density
59		Depo Menanggal	Office	Rp. 2,500,000	Wonocolo	Menanggal	66
60		Depo Kembang Kuning	Office	Rp. 2,500,000	Sawahan	Pakis	65
61		Depo Karang Poh	Electricity & water pipe	Rp. 360,000	Tandes	Karang Poh	56
62		Asemrowo	Wall	Rp. 765,000	Wonokromo	Sawung Galing	47
63		Mulyosari	Concrete floor	Rp. 1,480,000	Sukolilo	Kalisari	31
64		Depo Candi Lontar	Electricity & water pipe	Rp. 360,000	Lakarsantri	Candi Lontar	18
			Office	Rp. 2,500,000			
			Gate				

2.2 Cost Estimation for Rehabilitation and Expansion of Depo/LPS

The total cost of rehabilitation and expansion of Depo and LPS is estimated as follows:

a. Total Cost of Rehabilitation of Depo :	Rp 66,110,000
b. Total Cost of Rehabilitation and Expansion of LPS :	Rp 117,625,000
Total (a + b) :	Rp 183,735,000

Cost details are shown in the following tables.

Table 3.2-4 Cost of Rehabilitation and Expansion of Depo

Items	Unit Cost (1)	No. of Depo to be Rehabilitated (2)	Total Cost (1) x (2) = (3)
1. Wall	(30 %) Rp 1,890,000	3	Rp 5,670,000
2. Office	(20 %) Rp 2,500,000	5	Rp 12,500,000
3. Drainage	(20 %) Rp 430,000	5	Rp 2,150,000
4. Gate	(100%)Rp 1,400,000	7	Rp 9,800,000
5. Concrete floor	(40 %) Rp 2,200,000	8	Rp 17,600,000
6. Electricity & Water pipe	(30 %) Rp 360,000	16	Rp 5,760,000
7. Entrance	(10 %) Rp 630,000	1	Rp 630,000
8. Expansion	(70 %) Rp 5,705,000	0	0
9. Plant	(100%) (Rp 250,000)	48	Rp 12,000,000
Total	-	91	Rp 66,110,000

Note: Percentages indicated in parenthesis show those of the estimated rehabilitation costs to the costs of new construction.

Table 3.2-5 Cost of Rehabilitation and Expansion of LPS

Items	Unit Cost (1)	No. of Depo to be Rehabilitated (2)	Total Cost (1) x (2) = (3)
1. Wall	(30 %) Rp 765,000	6	Rp 4,590,000
2. Office	(20 %) Rp 2,500,000	0	0
3. Drainage	(100%)Rp 2,150,000	7	Rp 15,050,000
4. Gate	(100%)Rp 1,400,000	0	0
5. Concrete floor	(40 %) Rp 1,480,000	19	Rp 28,120,000
6. Electricity & Water pipe	(30 %) Rp 360,000	0	0
7. Entrance	(10 %) Rp 225,000	1	Rp 225,000
8. Expansion	(70 %) Rp 5,705,000	8	Rp 45,640,000
9. Plant	(100%) (Rp 250,000)	96	Rp 24,000,000
Total	-	137	Rp 117,625,000

Note: Percentages indicated in parenthesis show those of the estimated rehabilitation costs to the costs of new construction.

2.3 Investment Schedule for Rehabilitation of Depo/LPS

It is proposed that the rehabilitation of Depo and LPS will be executed during 4 years period 1994/95 - 1997/98. An investment schedule is shown in the following table.

Table 3.2-6 Annual Investment Program for Depo/LPS Rehabilitation

Rehabilitaion Year	Wall	Office	Drainage	Gate	Concrete Floor	Electyicity & water pipe	Entrance	Expansion of LPS	Plant	Total
1994/1995	1.53 [2]	0 [0]	0.86 [2]	2.8 [2]	15.48 [9]	0.72 [2]	0.225 [1]	22.03 [4]	9 [36]	56.25
1995/1996	5.67 [3]	2.5 [1]	8.6 [4]	0 [0]	10.32 [6]	2.16 [6]	0.63 [1]	5.51 [1]	9 [36]	44.39
1996/1997	3.42 [3]	0 [0]	5.16 [4]	4.2 [3]	10.32 [6]	1.44 [4]	0 [0]	5.51 [1]	9 [36]	39.05
1997/1998	0.77 [1]	10 [4]	2.58 [2]	2.8 [2]	11.04 [6]	1.44 [4]	0 [0]	11.01 [2]	9 [36]	48.64
Total	11.39 [9]	12.5 [5]	17.2 [12]	9.8 [7]	47.16 [27]	5.76 [16]	0.86 [2]	44.06 [8]	36 [144]	184.73

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