CHAPTER 3

FACILITY PLAN OF SOLID WASTE MANAGEMENT

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3.1 Project Components

3.1.1 Objective of the Project

Ujung Pandang is the gateway to the eastern part of Indonesia and the capital of South Sulawesi Province with a population 1,050,000 in 1994. It is expected to have a population of 1,520,000 in 2005. It is noted that Ujung Pandang was awarded the Adipura trophy in 1995 as a result of significant improvement in solid waste management in 1994. However, the amount of solid waste collected in 1994 was 255 ton/day and collection ratio was only 57% of generated waste. Therefore further effort is required not only to maintain the present level but also to cope with the rapid development, increase in population and increase in solid waste amount.

To create a clean and healthy environment for the metropolis in the future, further improvement of solid waste management of KMUP is indispensable providing necessary equipment and facilities for solid waste collection, street sweeping, ditch cleansing, final disposal and maintenance. The objectives of the project are

a. Expansion of collection service to 90 % of the population by 2005

b. Introduction of sanitary landfill system for solid waste disposal

c. Preparation of financial base based on new fee collection system

d. Establishment of PD Kebersihan to strengthen the institution side

e. Strengthen citizens participation and public sanitary education

f. Introduction of contracting out system in old Kechamatan

1) Target year 2005

2) Collection service

Year	1994	2000	2005
Service population	525,000	1,080,000	1,360,000
Collection ratio	57 %	85 %	90 %
Solid waste to be collected	Domestic and commercial waste		
waste amount	255 ton/day	541 ton/day	744 ton/day

3) Solid waste to be disposed of: Domestic waste, commercial waste and street waste

Waste amount disposed of	1994	2000	2005
	270 ton/day	571 ton/day	774 ton/day

Accumulated amount: 1,272,900 ton up to 2001
5,339,800 ton from 2002 to 2015

3.1.2 Components of the feasibility study project

According to the master plan prepared in this study and discussion between the Indonesian side and the Study Team, both sides agree that the expansion of the service area is an urgent issue not only in old Kechamatans and their surrounding area but also in the suburban Kecamatan. In addition to this, expansion of Tamangapa disposal site has become an urgent need because of the limited capacity of solid waste disposal. But it is desirable to carry out the expansion of Tamangapa disposal site through local funds because it is a pressing issue that cannot afford the long process associated with obtaining external funds. Components of the feasibility study project are set out as follows.

1) Expansion of collection service

Collection service shall be expanded and efficiency of the service shall be improved.

2) Improvement of street sweeping and ditch cleansing

Introduction of mechanical sweeper for main road and introduction of equipment for ditch cleansing.

3) Expansion of Tamangapa disposal site

Tamangapa disposal site shall be used until the year 2001. According to the Master Plan prepared in this study, Tamangapa disposal site shall be expanded up to 32 ha and improved as a semi-sanitary landfill site.

4) Construction of Samata inter-municipal disposal site

In consideration of MINASAMAUPA concept, an inter-municipal disposal site was proposed at the location of Kulurahan Samata, Kabupaten Gowa. The total area of Samata final disposal site will be 168 ha and it will be used more than 20 years. The site will be developed in three (3) stages and the first stage shall be operating from year 2002. Therefore, construction of the first stage which has an area of 65 ha, is a component of the feasibility study. Samata disposal site shall be constructed as a sanitary landfill site to prevent environmental pollution.

5) Construction of branch office

Considering the rapid development and increase of population in suburban Kechamatan in KMUP, Panakkukang branch office in Kampong Borong shall be constructed as soon as possible for the purpose of expanding the collection service in the suburban area. The recommended size of branch office is 4 ha considering future development of solid waste management facilities such as incineration plant, recycling facilities, etc.

6) Establishment of PD Kebersihan

Following in the footstep of Bandung and Medan, it is proposed to establish PD Kebersihan in KMUP to provide efficient collection service, to strengthen financial capability and to secure human resources up to the year 2005.

7) Introduction of a proper tariff system

The tariff system shall be revised to achieve equality of burden specially for commercial waste.

8) Introduction of contracting out system in old Kechamatan

Contracting out of solid waste collection shall be promoted and introduced in old Kechamatan.

Together with the above project, strengthening of citizen participation and public sanitary education will be included.

3.1.3 Schedule of the project

As the funding for this project is expected to come from external funds, the implementation process will start through submission of a project digest to BAPPENAS, through Cipta Karya, Ministry of Public Works and then proceed to application for a loan. When this project is accepted by some agency, a loan agreement will be made between the agency and GOI. After that, tenders for engineering service, detailed design, and construction and procurement will be called followed by construction and procurement.

Procurement and construction can start end of 1997/98 if the loan commitment is made by the middle of 1996. *Fig.* 3.1 shows the implementation schedule of feasibility study project.

3.2 Planning Condition of the Feasibility Study Project

3.2.1 Required time schedule

(1) Collection

As the master plan set the target of collection service ratio as 85 % in 2000 and 90 % in 2005, procurement of collection vehicles will be made at least two times, firstly in 1998 and secondly in 2001. In the year 1998, collection vehicles will be procured to fulfill requirements up to year 2000, then in year 2001 they will be procured to meet requirements up to year 2005.

Since collection vehicles used in KMUP are very old and insufficient at present, it is recommended to procure some vehicles using Indonesian funds in 1996 and 1997 to maintain and improve the collection service year by year. However, this project will include all the requirements for collection vehicles between 1996 to 2005 considering the financial constraints of KMUP.

(2) Final disposal

As the capacity of the present Tamangapa disposal site is small, expansion of this disposal site should be done in 1996 and 1997 making it difficult to use external funds. Because of this, it is recommended that part of the expansion be done using Indonesian funds, municipal and/or central government. However, the entire expansion of Tamangapa disposal site will be included in this project because of the large investment required for expansion and this will be done in the years 1998 and 1999. Also it is recommended to construct Samata disposal site in years 2000 and 2001 to start operation from year 2002 as described in the Master plan.

(3) Other components

Considering the constraints of funding in the short term, improvement of street sweeping and ditch cleansing will be fixed for the period between 1998 to 2001 and the construction of the branch office is fixed for the same period. Reorganization of Dinas Kebersihan to PD Kebersihan is set to be completed by year 2005 considering difficulties in mobilizing human resources and other factors. Concerning fee collection, tariffs will be revised in year 2000 and

2005. Contracting out of solid waste collection shall be introduces in the old Kechamatan.

3.2.2 Financial scale

According to the master plan, total investment cost between year 1995 to 2005 will be Rp. 62.7 billion. This will be the target investment cost.

3.2.3 Organizational set-up

According to the Master Plan, establishment of PD Kebersihan as the public enterprise for solid waste management is proposed instead of Dinas Kebersihan. Also, it is proposed that an organization shall be established for wastewater management including management of off-site and on-site system.

At present, Dinas Kebersihan is allocated for the following works.

a. Solid waste collection and disposal

b. De-sludging and sludge treatment

c. Street sweeping and ditch cleansing

After PD Kebersihan is established, its function will be limited to solid waste collection and disposal, street sweeping and ditch cleansing. Tentative measures for de-sludging and sludge treatment shall be considered until the new organization for wastewater management is established.

Although industrial waste shall in principal be disposed of by the generator themselves, guidance for proper disposal is indispensable to create a clean and healthy city. Also, it is recommended to accept non-hazardous industrial waste at municipal disposal sites to prevent illegal dumping of industrial waste. Therefore, PD Kebersihan shall be considered to have a function for guidance and control of industry waste.

3.2.4 Privatization

As mentioned in the Master Plan, a contracting out system shall be introduced for old Kechamatan. Also, operation of the disposal site and workshop shall be

contracted out in consideration of the efficient use of equipment. However, it should be noted that there are no companies interested in joining thie solid waste management sector in KMUP at present. Therefore, it is considered that the contracting-out system introduced up to 2005 will be only the operation of solid waste collection in old Kecamatan to maintain the flexibility of this plan. In this case, equipment shall be provided by KMUP. The project cost is estimated based on the direct operation because the contracting out will start only if it can offer lower costs than the direct operation.

3.3 Collection and Transport

3.3.1 Formulation of the collection and transport priority project

The priority projects, subject of this feasibility study (F/S) are the projects covered in the first decade of the M/P. These projects have been studied in more detail as shown in the flow chart in *Fig.* 3.2 and are described in the following sections.

3.3.2 Waste amount to be collected

The forecast amount of generated and collected waste in KMUP during the feasibility study project period is shown in the following table.

Year	Waste amount to be collected 6 d/week (t/d)	Percent of generated waste (%)	Ratio to 1995 waste amount collected (%)
1996	496	75	180
2000	678	85	250
2005	904	90	330

The amount of waste necessary to be collected in 2005 is more than three times the actual amount collected at present. This indicates the magnitude of the effort required to achieve the targets of the master plan.

3.3.3 Technical system

Different technical systems for waste collection and transport were studied in order to choose the most suitable systems for the M/P, as described in the following table.

Activity	Technical Systems			
1. Waste discharge	Door-to-door	Jali-jali	Open station	Armroll cont.
2. Primary collection		Manual (hand cart)		Mechanized (3-wheel motor veh.)
3. Vehicle types for secondary collection	Pick-up (3 m^3)	Tipper (10 m^3) Tipper (6 m^3)	Armroll (10 m^3) Armroll (6 m^3)	Compactor (15m^3) Compactor (10m^3)
4. Secondary transport	Direct haul		Transfer station	
5. Operation shift	1 shift: 7 d/week 6 d/week	1.5 shift: 7 d/week 6 d/week	2 shift: 7 d/week 6 d/week	

Selection was made based on the systems offering cost efficiency advantage and also compatibility with the conditions in KMUP. For example, two types of Armroll vehicles used to transport containers under the hauled container system were studied; those transporting 6 m^3 and 10 m^3 containers. While the larger capacity type offered the advantage of lower unit cost, the problem of narrow roads in Ujung Pandang in the developed, and even the newly developed areas, led to the selection of the smaller capacity vehicles.

As a result of the comparative study, the following systems were adopted;

(1) Waste Discharge

Combination of the above four systems with main reliance on armroll container and open station. Discharge in armroll container will be daily and waste will be loose or packed. On the other hand open stations (collection point for packed waste) will gradually replace door-to-door and TPS service and discharge of packed waste will be three days per week according to a fixed time schedule.

(2) Primary Collection

Primary collection service will be manual and maintained at the present level of around 400 hand carts.

(3) Secondary Collection Vehicles

The new vehicles to be procured up to the year 2005 shall be mainly tipper (6 m^3) and armroll (6 m^3). A small number of small tippers (3 m^3) shall be procured to serve parts of the old city.

(4) Secondary Transport

During the F/S period, the collected solid waste shall be hauled to the disposal site at Tamangapa and after 2002 to Gowa. Both sites are less than 20 kilometers from the city center and the study has shown that introduction of a transfer station to decrease transport costs is not warranted.

(5) Operation Shift

Extended shifts provided only small cost advantages and therefore one shift per day, 6 d/week option was selected.

3.3.4 Equipment requirement

(1) Equipment required annually

The collection and transport equipment required annually is shown in the following Table. The vehicle requirement has been calculated by Kecamatan and sub-Kecamatan (the three suburban Kecamatan have been broken down into 7 sub-Kecamatan). Based on the figures shown in the following table, the haulage capacity for the years 1996, 2000 and 2005 are calculated according to the following formula;

Haul Cap.(t) = Veh. no. x trip no./veh x 85% x capacity (m^3) x density (t/m^3)

In 1995 the average trip/vehicle shift for armroll and tipper was 5 and 1.7 respectively. It is estimated that the fixed time - three days/week - packed waste discharge system will shorten the trip time along the collection route by about 25% and thereby it will be possible to increase the trip number per shift. The trip number is gradually increased during the F/S period.

Year	Haulage Capacity (t/d)	% of required capacity
1996	Armroll : 40 veh x 5.6 trip/veh x 0.85 x 6 m³ x 0.26 t/m³ = 297 t Tipper : 71 veh x 2.3 trip/veh x 0.85 x 6 m³ x 0.30 t/m³ = 250 t	110%
2000	Armroll : 56 veh x 5.9 trip/veh x 0.85 x 6 m³ x 0.26 t/m³ = 438 t Tipper : 71 veh x 2.8 trip/veh x 0.85 x 6 m³ x 0.30 t/m³ = 304 t	109%
2005	Armroll : 65 veh x 6.7 trip/veh x 0.85 x 6 m³ x 0.26 t/m³ = 577 t Tipper : 73 veh x 3.4 trip/veh x 0.85 x 6 m³ x 0.30 t/m³ = 380 t	106%

(2) Existing Equipment

Present DK vehicle fleet has an average age of 9 years. Of the total 104 vehicles, on average 80% were operated in June 1995. If the number of vehicles not operated because of lack of police numbers is included, the average would be 86%. However the trip rate was low indicating that the vehicles are not in good condition for heavy duty operation.

The F/S project took the realistic approach of continuing to use the existing fleet, while taking into consideration the difficulty of significantly improving trip number per shift and purchase of new vehicles. The available equipment and possible duration of usage is shown in the following table.

Equipment	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
1) Armroll	19	19	19	19	19	19	10			
2) Dyna Rino DT	20	20	20	20						
3) Dyna Rino Flat	10	10	10	10	10	10				
4) Dyna Rino Covered	10	10	10	10	10	10	10	10	10	
5) Kijang	20	20	20	10						
6) Isuzu	10	10	10	10						
7) Containers	130	130	130	50						
8) Hand carts	200	200								

(3) Schedule for new equipment introduction

The procurement schedule for the new vehicles has been prepared assuming a vehicle life of 8 years, container life of 5 years and handcart life of 2 years.

The number of vehicles required to be introduced annually are described in the following table;

Based on the above table the total required equipment during the ten year F/S period by equipment type are;

⇒ Armroll = 80

⇒ Tipper (6 m^3) = 81

⇒ Tipper (3 m^3) = 8

⇒ Container = 916

⇒ Handcarts = 1,516

Equipment	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
1) Armroll	21	5	4	3	5	3	12	0	22	5
2) Tipper (6 m^3)	11	0	0	3	34	1	10	0	12	10
3) Tipper (3 m^3)	0	0	3	3	2	0	0	0	0	0
4) Container	148	32	27	104	83	166	55	41	112	148
5) Handcarts	229	200	0	229	200	0	229	200	0	229

3.3.5 Operation plan

(1) Discharge method

The M/P identified four discharge methods to be applied in KMUP;

a. Door-to-door

b. Open station (TPS)

c. Jali jali

d. Hauled container

In planning these discharge methods the following points were considered;

⇒ Speeding up operation on collection route

⇒ Maintaining clean and healthy environment in the living area

⇒ Extent of citizens cooperation

The items considered for each of the above criteria and the discharge system that may support each are briefly summarized in the following table. The Typical Analysis Study (TAS) conducted under this Study furthermore confirmed the following points;

⇒ Citizens acceptance of the extra costs involved in discharging waste packed in plastic bags or bins

⇒ Shorter collection route time when discharging waste packed in plastic bins and open stations

⇒ Citizens acceptance of hauled container system

⇒ Citizens acceptance of discharging waste three days per week

1. Speed up collection work	2. Maintain clean environment	3. Citizens cooperation
Consideration Items ⇒ Accumulate 2-3 days waste in fewer pick-up points ⇒ Decrease door-to-door service ⇒ Increase use of hauled container system ⇒ Collect waste in packed form	⇒ Discharge packed waste ⇒ Keep waste at TPS/open stations for minimum time ⇒ Maintain pick-up points clean	⇒ Discharge according to fixed time schedule ⇒ Discharge waste packed ⇒ Maintain pick-up points clean
Supportive Discharge Methods ⇒ Open station ⇒ Hauled container	⇒ Door-to-door ⇒ Jali jali ⇒ Hauled container	⇒ Open station ⇒ Hauled container

The extent each system will be applied and guidelines for selection of areas suitable for each are briefly described below;

Type	Frequency		Extent (%)			Suitable Area
	Daily	3 d/wk	1996	2000	2005	
Haul cont.	OO	O	55%	60%	62%	⇒ Densely populated areas ⇒ Difficult vehicle access ⇒ Markets and commercial areas ⇒ Middle and low income areas ⇒ New development areas ⇒ Within suitable walking distance
Door-to-door	O	OO	4%	3%	2%	⇒ Commercial areas ⇒ Business district ⇒ High income areas
Jali jali		OO	12%	13%	14%	⇒ Densely populated areas ⇒ Limited space availability for open stations or haul containers
Open station		OO	29%	24%	22%	⇒ Densely populated areas ⇒ New development areas ⇒ High and middle income areas

Under TAS an area originally served daily by door-to-door was converted into open station and packed waste discharge system with 3 days/week service. The process applied in selecting the TAS study areas and implementation process are reported on in the TAS report. Similar methods may be applied in order to expand the open station system with packed waste and decrease door-to-door service.

In a different TAS area the hauled container system was also studied and the problems associated with this system were identified and reported upon.

(2) Primary Waste Collection

As reported in the M/P primary collection using hand carts will be limited to areas where such service is absolutely necessary. About 420 hand carts with their workers have been included in the project for this purpose. This service will be supervised by DK and will complement the hauled container service. Residents with walking distances greater than 200 meters from the container location will be covered.

(3) Haul Container System

In line with the present KMUP policy, the haul container system will be gradually expanded to cover 60% of the collected waste by the year 2005 (at present about 30%). Main features of the operation at present may be briefly described as follows;

⇒ Collection of containers every 2-3 days in most areas and daily for containers serving market place, commercial areas and densely populated areas

⇒ Placing of more than one container in many stations

⇒ Armroll vehicle travels to the container location without an empty container, so a second trip to the same location is necessary to bring back the emptied container

⇒ Most containers are located beside public buildings (schools, offices, gardens, etc...) because of the difficulty of obtaining residents approval to place containers near their homes

⇒ Private hand cart services extended to some areas served by container

Under the project it is recommended that the operation be as follows;

⇒ As far as possible only one container shall be located at one site

⇒ Containers shall be emptied daily or maximum every other day

⇒ Vehicle operation may continue as at present

⇒ Hand cart service extended only for residents more than 200 meters from container

⇒ Container rotation system (one container used in more than one site on alternate days) studied under TAS, is not recommended unless there is a shortage of containers.

Daily waste amounts collected by haul container (HC) and by tipper (DT) for each Kecamatan in the years 1996, 2000 and 2005 are shown in the following table.

Kecamatan	1996			2000			2005		
	HC	DT	Tot	HC	DT	Tot	HC	DT	Tot
1. Mariso	15	13	28	22	16	38	24	15	39
2. Mamajang	18	16	34	25	19	43	26	16	42
3. Makassar	24	21	46	35	26	62	39	25	64
4. U. Pandang	11	8	19	14	10	24	19	11	30
5. Wajo	13	9	22	16	9	26	36	18	53
6. Bontoala	18	15	33	25	18	43	29	18	47
7. Tallo	27	25	52	39	28	68	50	32	82
8. U. Tanah	13	11	24	21	11	32	25	15	40
9. Panakkukang	45	41	85	69	46	115	95	58	153
10. Tamalate	57	49	106	97	62	159	136	83	219
11. Biringkanaya	25	21	46	44	25	69	81	47	128
KMUP Total	266	230	496	407	271	678	559	335	895

The number of containers required to be placed in each Kecamatan are as follows;

Kecamatan	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
1. Mariso	11	13	15	16	18	19	20	20	21	22
2. Mamajang	14	17	19	21	21	22	22	23	23	24
3. Makassar	16	18	20	22	24	26	29	31	34	36
4. U. Pandang	10	12	13	15	16	16	17	17	18	19
5. Wajo	18	20	21	23	24	26	28	30	32	34
6. Bontoala	18	20	21	23	24	25	25	26	26	27
7. Tallo	21	25	28	32	35	37	40	42	45	47
8. U. Tanah	12	13	15	16	17	18	20	21	23	24
9. Panakkukang	51	55	60	64	68	72	76	80	84	88
10. Tamalate	72	78	85	91	97	103	109	114	120	126
11. Biringkanaya	35	39	43	46	50	55	60	65	70	75
KMUP Total	278	308	338	367	394	419	445	470	496	521

(4) Manpower

Waste collection and transport work shall be operated during one shift a day, six days a week. The present system of operating about 60% of vehicles and personnel during the daytime and the remainder in the evening shift shall be continued.

The personnel required have been calculated as follows;

⇒ Supervisors = (Total vehicles)/15 + 20

⇒ Drivers = Total vehicles + 6 standby

⇒ Workers = (Armroll vehicle number x 1)
+ (Large tipper number x 4)
+ (Small tipper number x 3) + 10% standby

⇒ Hand cart workers = Handcart number x 1 worker

The required personnel are shown in the following table.

Personnel	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
1. Supervisor	25	25	28	28	28	29	29	28	29	29
2. Driver	95	95	138	138	138	141	144	134	148	148
3. Worker	305	305	391	389	386	391	393	381	399	399
4. Handcart workers	200	200	229	429	429	429	429	429	429	429
Total	625	625	786	983	981	990	995	972	1,005	1,005

3.3.6 Procurement plan

(1) Preconditions

It is assumed that KMUP will resort to EAR (external assistance request) to finance the project. The procurement plan has been prepared under the usual conditions applied in obtaining foreign loans as follows;

a. Loan duration for six years, i.e. from 1996 to 2001

b. Loan negotiations and procedural matters require two years, therefore actual procurement to start in 1998

c. To minimize processing work, procurement of the equipment required over the 1998 to 2001 period shall be implemented over three years; 1998, 2000 and 2001

(2) Procurement Schedule

Based on the above explanation, actual vehicle procurement can start only in 1998. The following table shows the equipment needed to be introduced annually from 1998 to 2005.

Equipment	1998	1999	2000	2001	2002	2003	2004	2005	Total
1. Amroll	29	3	5	3	12	0	13	0	65
2. Tipper (6 m^3)	11	3	34	1	10	0	1	10	70
3. Tipper (3 m^3)	3	3	2	0	0	0	0	0	8
4. Container	207	104	83	18	23	221	112	148	1,437
5. Hand cart	229	200	0	229	200	0	229	200	1,287

As actual procurement will be over the three years of 1998, 2000 and 2001, then number of vehicles to be procured shall be as follows;

⇒ in 1998 : Requirements in 1998 and 1999

⇒ in 2000 : Requirements in 2000 and 2001

⇒ in 2001 : Requirements from 2002 to 2005

While it may be possible to put forward the purchase of the collection vehicles required in the following years, and utilize the additional vehicles for other purposes, it is not recommended to purchase three years required containers in one year due to problems of storage. Therefore procurement of containers shall be as follows;

⇒ in 1998 : Requirements in 1998 and 1999

⇒ in 2000 : Requirement in 2000

⇒ in 2001 : New requirements from 2001 to 2005

The number of handcarts required annually is 429 and handcart life is two years. The procurement plan shall call for the purchase of 429 hand carts twice in 1998 and 2000, to cover the requirements from 1998 to 2001.

Accordingly the actual procurement schedule shall be as follows;

Equipment	1998	2000	2001	Total Procurement	Deficit
1. Amroll	32	8	25	65	0
2. Tipper large (6 m^3)	14	35	21	70	0
3. Tipper small (3 m^3)	6	2	0	8	0
4. Container	311	83	127	521	916
5. Hand cart	429	429	0	858	429

As shown in the above table, all vehicle requirements during the 1998 to 2005 period are covered in the procurement plan. On the other hand, KMUP will be required to purchase, in addition, some 900 containers and 400 hand carts to fully meet the equipment requirements in the above defined period.

(3) Cost of F/S Project

The investment and operation and maintenance costs have been calculated for the project based on the procurement plan explained in the previous sections. Unit prices used in the calculation (1994 prices) were as follows;

1) Investment costs

⇒	Amroll	Rp. 50,000,000
⇒	Tipper 6 m^3	Rp. 54,000,000
⇒	Tipper 3 m^3	Rp. 40,000,000
⇒	Container	Rp. 6,000,000
⇒	Hand cart	Rp. 650,000

2) Salaries

⇒	Supervisor	Rp. 4,400/day
⇒	Driver	Rp. 3,850/day
⇒	Worker	Rp. 3,300/day

3) Maintenance

Equipment maintenance costs are calculated as 40% of the equipment cost divided by the equipment life (in years). Equipment life is as follows;

⇒	Vehicles	8 years
⇒	Container	5 years
⇒	Hand cart	2 years

4) Depreciation

Depreciation is calculated as the equipment price divided by the equipment life.

5) Others

Miscellaneous costs are calculated as 4% of personnel and fuel costs. The results of the calculation are shown in the following table.

The overall cost is described in *Table* 3.1 and *Table* 3.2.

Item	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Sub-tot
A. Investment Cost (Rp. x 10^6)											
Armroll			1,600		400	1,250					3250
Tipper- $6m^3$			756		1,890	1,134					3780
Tipper- $3m^3$			240		80						320
Container			1,866		498	762					3126
Hand cart			279		279						558
Sub-Total			4,741		3,146	3146					11,034
B. Operation and Maintenance Cost (Rp. x 10^6)											
Sub-total	2,111	1,910	4,072	4,037	4,414	4,976	5,021	4,820	5,130	5,168	41,659
C. Unit Cost (Rp./ton)											
Unit cost			22,380	20,610	21,000	22,200	21,090	19,130	19,260	18,440	

The calculated operation and maintenance costs include operation of existing equipment and equipment procured under the project. As explained earlier, containers and hand carts will be purchased up to the year 2001. As the life of containers and hand carts is 5 and 2 years respectively, some of those purchased under the project will need to be replaced during the project life. It is considered that replacement can be done using the depreciation cost and therefore the depreciation of this equipment will continue to be calculated up to the end of the project duration, i.e. the year 2005.

Operation costs for 1996 and 1997 are calculated based on the assumption that no new equipment will be introduced during those two

years and collection and transport will continue to be operated with the existing equipment. Needless to say, it will be difficult to achieve the collection targets in those two years.

Average unit cost will be Rp. 20,510/ton. The unit cost will slightly decrease from a high of Rp. 22,400/ton in 1998 to Rp. 18,400/ton in the year 2005. This is due to the gradual introduction of more efficient discharge methods which are expected to bring down the cost.

3.3.7 Implementation of the priority project

The technical system and associated equipment required inclusive of the costs incurred are described in the above sections. The priority project has been studied based on forecasts of population, land use and development, and waste amount.

The priority project unfortunately could not go into details for application of technical system by Kelurahan and RT/RW. On the other hand the Typical Analysis Study (TAS) implemented under this Study examined the suggested technical systems in four Kelurahan representing low income Kampong area, middle income area with narrow streets, and middle to high income with formal development. The experience gained from the TAS is reported in the Supporting Report.

Dinas Kebersihan (DK), the municipal authority responsible for solid waste collection and transport, is recommended to take the following necessary actions to implement the priority project;

- ⇒ Preparing a work plan for the coming two years prior to the commencement of new equipment procurement. This work plan should be based on realistic targets and the utilization of the existing fleet should be modified as necessary to improve collection efficiency.
- ⇒ Collection of maps for each Kelurahan identifying land use, RW borders, and waste amount.
- ⇒ Identifying areas suitable for haul container system and locations for placing of containers.

⇒ Preparing collection routes for tippers based on increasing the trip number per shift and ensuring full waste haul amounts.

⇒ Preparing a plan for introduction of new discharge system using individual bins three days a week over a 2-3 year period.

⇒ Intensifying solid waste public campaigns with the civic leaders to gain citizens cooperation in gradually changing discharge system according to a prepared plan.

3.4 Improvement of Street Sweeping and Ditch Cleansing

3.4.1 Street sweeping

(1) Extent of service

At present the road network in KMUP is classified into three categories:

⇒ Class I : 121 km

⇒ Class II : 112 km

⇒ Class III : 87 km

The present objective of DK is to sweep Class I streets twice daily, Class II streets once a day, and Class III streets every two days.

This option was compared to two other assumed options and the number of manual sweepers was calculated for each as shown in the following table;

Option	Description	Required sweepers
Option 1	All KMUP: Class I : twice/d, Class II: once/d, Class III: once/2 d	815
Option 2	Old Kecamatan: Class I : twice/d, Class II: once/d, Class III: once/2 d Suburban Kecamatan: Class I : once/d, Class II: once/2 d, Class III: once/2 d	628
Option 3	Old Kecamatan: Class I : twice/d, Class II: once/2 d, Class III: once/2 d Suburban Kecamatan: Class I : once/d, Class II: once/2 d, Class III: None	330

The large number of sweepers required in all three options led the Study in the following direction;

⇒ Study introduction of mechanical sweepers to reduce required manual sweepers

⇒ Modify the scale of service to be provided by DK to a more manageable level

(2) Introduction of mechanical sweepers

The number of mechanical sweepers required under Option 1 were studied and estimated to be 9 units under the following conditions;

⇒ Vehicle daily sweeping length = 50 km

⇒ Vehicle capacity = 3.8 m^3

⇒ Sweeping length/trip = 10 km

⇒ Number of trips/vehicle shift = 5

Comparison of operation costs of employing over 800 manual sweepers, as opposed to running 9 mechanical sweepers found the cost of the latter to be less by about 40%.

However experience of Indonesian cities with use of mechanical sweepers is not so good so far due to technical problems in maintenance and operation. It is therefore necessary to consider introduction of a small number of mechanical sweepers while building up the technical skills at DK workshop needed for operating and maintaining the vehicles. Mechanical sweepers will be introduced for Class I streets.

(3) Extent of service level

Option I is too optimistic and will incur high costs. Therefore the M/P studied a fourth option as follows;

⇒ Daily sweeping of Class I and II streets, and once/2 days sweeping of Class III streets

⇒ Introduction of an option on the scale of option II but without differentiating between older and suburban Kecamatan, as follows; daily sweeping for Class I and II streets and once/2 d for Class III streets

(4) Priority project content

Based on the above the priority project shall be implemented and mechanical sweepers shall be introduced starting 1998. In total 3 sweepers shall be

introduced. The contents of the priority project are shown in the following table. The cost is described in *Table* 3.1 and *Table* 3.2.

	1998	1999	2000	2001	2002	2003	2004	2005	Total
1. Equipment procurement									
-Mechanical sweeper	1		1	1					3
-Hand cart	200		200						400
2. Personnel Total	207	207	211	216	216	216	216	216	
-Supervisor	2	2	2	3	3	3	3	3	
-Driver	2	2	3	4	4	4	4	4	
-Worker	3	3	6	9	9	9	9	9	
-Hand cart worker	200	200	200	200	200	200	200	200	

3.4.2 Ditch cleansing

(1) Technical System

The TAS study showed that the use of backhoe in ditch cleansing is an effective way to keep costs down. TAS also proved that the potential for community participation in this activity is very high.

The ditch cleansing priority project is based on the following assumptions;

⇒ With the increase in collection service ratio the amount of waste illegally discharged into ditches is not expected to increase

⇒ Two backhoes and dump trucks will be introduced

⇒ A work force will be separately assigned to clean ditches manually where it is not possible to employ the backhoe (the present work force of 100 workers + 10 supervisors will remain as necessary, but cost of this work force is not included in the priority project cost)

(2) Priority Project Description

The following table describes the priority project contents and cost is shown in *Table* 3.1 and *Table* 3.2.

	1998	1999	2000	2001	2002	2003	2004	2005	Total
1. Equipment procurement									
- Dump Truck	1	1							2
- Hand cart	1	1							2
2. Personnel Total	13	29	29	29	29	29	29	29	
- Supervisor	3	3	3	3	3	3	3	3	
- Driver	3	6	6	6	6	6	6	6	
- Worker	10	20	20	20	20	20	20	20	

3.5 Expansion of Tamangapa Disposal Site

3.5.1 Planning conditions

(1) Basic principles

Tamangapa disposal site is located in Kulurahan Tamangapa, Kecamatan Panakkukang, KMUP, 14 km from the city center. The operation of Tamangapa disposal site was commenced in March 1993 as the controlled landfill site, and the area is approx. 7 hectares. According to the Master Plan prepared in this study, Tamangapa disposal site shall be used until the year 2001 and expanded up to 32 hectare as a semi-sanitary landfill site. Accordingly, in consideration of the necessary function of Tamangapa disposal site as semi-sanitary landfill, the basic principles of the preliminary design have been conceived as follows.

i. The site plan and/or facility plan of the disposal site appropriately adjusted to the topographical and geological features, and surrounding environment.

ii. Tamangapa disposal site shall be improved as semi-sanitary landfill site to minimize the adverse environmental effects on surroundings.

iii. During and after completion of the waste filling, the disposal site shall not be the cause of pollution. Meanwhile, environmental effects from the existing part of Tamangapa disposal site shall be minimized.

iv. The completed sites shall be harmonious with the surrounding environment.

Fig. 3.3 shows the location and geological features of Tamangapa disposal site and surroundings including Samata disposal site.

(2) Design conditions

Tamangapa disposal site shall be used until the year 2001. According to this concept of the Master Plan, the site shall be expanded up to 32 hectares and improved as semi-sanitary landfill site.

Design conditions of expansion of Tamangapa disposal site are the following.

i.	Landfill area	:	32 hectares (including 7 hectares of existing site)
ii.	Landfill height	:	15 m (include covering soil)
iii.	Landfill capacity	:	1,520,000 ton
iv.	Period to be disposed	:	until the year 2001 (six years)
v.	Landfill method	:	Semi-sanitary landfill
vi.	Service area	:	whole area of KMUP
vii.	Waste amount to be collected	:	571 ton/day in 2000 (service ratio is 85 %)
viii.	Waste to be disposed	:	domestic waste, commercial waste, street waste, ditch waste and non-hazardous industrial waste from KMUP
ix.	Ultimate land use after waste disposed	:	Branch office and depot for SWM of KMUP etc.

(3) Topography and geology

1) Topographic features

Tamangapa disposal site is located on the low isolated residual hills of bedrock (EL.+20m to 30m) in the west, and on the gentle mounds and flat alluvial plain (paddy field) in the east. The alluvial plain in Tamangapa site is usually inundated to form a pond which connects with the Mangara swamp in the rainy season. The maximum inundated

water depth is around 1.5m at the eastern side of Tamangapa disposal site.

Mangara swamp is situated in the low lying area and its lowest point is 0.1m above mean sea level. The swamp connects with the Tallo river and it acts as a natural regulation pond in case of flood. According to the inhabiting fishermen's information, sea water intrudes up to the swamp and accordingly the water becomes brackish. The swamp enlarges in the rainy season.

2) Geologic features and ground water

a. Geologic features

As shown in *Fig.* 3.3, the geological profile of Tamangapa disposal site is composed of the following formations:

i. Paddy clay (pc): Alluvial deposits which filled up the ancient valley

Paddy clay is soft, black clay including roots and leaves of rice plants. Thickness of paddy clay is 1.5 m to 2 m. The permeability coefficient of this layer ranges from 5×10^{-5} cm/sec to 8×10^{-6} cm/sec.

ii. Loose sand layer (S): Alluvial deposits which filled up the ancient valley

This layer is composed of brown to gray, fine grained, very loose sand. Thickness of this layer is 1.5 m and N value is 4. It is supposed that this layer is one of the aquifers in the alluvial deposits.

iii. Black soft clay layer (bc): Alluvial deposits which filled up the ancient valley

This layer is composed of black, soft and plastic clay with some organic materials. Thickness of this layer is around 8 m and N value is 2 to 4. The permeability coefficient of this layer ranges from 2×10^{-5} cm/sec to 1×10^{-7} cm/sec.

iv. Lateritic clay (lc): Surface weathered part of the bedrock

This part is composed of reddish brown, plastic and moderately stiff clay including organic materials near the ground surface. Thickness of this layer is around 3 m and N value is around 10 in average. This layer was eroded out at the bottom of the ancient valley. The permeability coefficient of this layer ranges from1 x 10^{-4} cm/sec to 6 x 10^{-5} cm/sec.

v. Highly weathered part of bedrock: Surface weathered part of the bedrock

This part is composed of brown to gray, moderately stiff clay with sand and gravels (residual rock fragments). Thickness of this layer is 2 to 4 m and N value ranges 10 to 50.

vi. Alternations of sandstone and claystone (Alt): Surface weathered part of the bedrock

This layer is composed of gray to dark gray, fresh and hard alternations of sandstone and claystone with some intercalation of coarse sandstone and conglomerate. Alternation spacing is fine. This layer has very few cracks and forms sound and impervious bedrock in Tamangapa disposal site. The depth to this layer ranges from 3 m on the slope to 13 m on the plain.

b. Groundwater

The groundwater surface gently inclines from mound side to plain as shown in *Fig.* 3.4. Groundwater surface concavity (lower part of groundwater level) can be found in the mound slope and the groundwater level situated in the fresh bedrock at the concavity (See *Fig.* 3.4).

As mentioned in Section 3.5.1(3), inundated pond, which appears in Tamangapa disposal site in the rainy season, recharges the groundwater flowing westerly through the loose sand layer.

3.5.2 Facility plan

Fig. 3.5 shows the layout plan of the Tamangapa disposal site. Outline of the facilities, that is, main facilities, environmental protection facilities and safety facilities, are shown in *Table* 3.3. *Fig.* 3.5 and *Fig.* 3.6 shows facilities of Tamangapa disposal site.

(1) Main facilities

1) Access road

The existing access road is not suitable for Tamangapa disposal site, because of the following two reasons.

i. The slope of the existing access road is rather steep, therefore it is difficult and dangerous to access in the rainy season.

ii. The location of the existing access road is not suitable to use the weighbridge situated at the south-west end of the site.

Therefore, a new access road shall be constructed. The design conditions of the new access road are as follows.

i. The road shall be wide enough for two-way traffic.

ii. The road shall be asphalt paved.

iii. The shoulder, 1.0m width, and stormwater drainage shall be installed on both sides of the road.

iv. The width of the road is 9.0 m.

v. Stopping / waiting lane shall be settled for the collection vehicles along the road.

2) Onsite road and surrounding dike

The major functions of the onsite road are as follows.

i. To confine the waste which will accumulate to a height of 15 m.

ii. To confine flood water to prevent water penetrating inside the landfill site

iii. To minimize the amount of leachate by preventing stormwater inflow into the site from non-landfill area.

Also the onsite road shall be used for inspection and administration work. The design conditions of the onsite road are as follows.

i. The road width is 5.0 m at its crest, and 4.0 m will be concrete paved.

ii. The height of the road is 3.0 m at the plain field. (In the mound area, the road shall be constructed on the ground without embankment.)

iii. Stormwater drainage shall be located on both sides of the road. However, for the onsite road which is constructed in the mound area, drainage on one side is enough.

4) Partition dike

In order to operate the landfill site properly, a partition dike shall be constructed in the landfill area. The main purpose of the partition dike is to reduce the quantity of leachate by its barrier function, that is, to prevent rainwater flow into recent landfill area. Any other function of the partition dike are the same as for the onsite road mentioned in the previous section. The partition dike shall be designed in the following manner:

i. The dike width is 5.0 m at the crest of the dike, and 4.0 m shall be gravel paved.

ii. The height of the dike is 3.0 m.

iii. Stormwater drainage shall be located on both sides of the dike.

5) Operational road

To maintain good operating conditions and smooth dumping, an operational road shall be constructed in the landfill area.

The design conditions of the operational road are as follows.

i. The road width is 8.0 m at the crest of the road, and 6.0 m of it shall be gravel paved.

ii. The height of the road is 1.0 m from ground level.

iii. The slope on both sides of the road is 1 : 4, for easy access of heavy equipment and collection vehicles.

6) Stormwater drainage

When stormwater/rainwater flows into the landfill site, the volume of the leachate increases, requiring a large scale leachate treatment plant, which is uneconomical. Therefore, the main target of the construction of the stormwater drainage is the reduction of the amount of leachate. The purposes of the drainage system are listed below.

i. Eliminate the rainwater which flows into the landfill site from the outside.

ii. Eliminate the spring water which flows into the landfill site from the outside.

iii. Eliminate the rainwater which flows into the landfill area from the non-landfill area of the site which is divided by the barrier.

iv. Eliminate the rainwater which flows into the landfill area from the completed landfill area.

Stormwater drainage can be divided into three types in consideration of the location, that is, surrounding drainage, onsite drainage and drainage of the reclaimed area. The surrounding drainage is installed along the outside of the onsite road. Rainwater collected by this facility shall be discharged to the existing drain. Onsite drainage is installed inside the

landfill site, that is, along the part of the inside of the onsite road and both sides of the partition dike. The rainwater collected from the non-landfill area shall be discharged outside of the enclosing bund by using these facilities. The drainage for the reclaimed area is established after the completion of the final soil covering. The rainwater collected from this facility shall be discharged outside the enclosing bund.

The design condition of the stormwater drainage is as follows.

i. Concrete made U-shaped gutter shall be laid, and the structural dimension is 400W x 300D for stormwater drainage of the access road, and 700W x 500D for surrounding dike, that is, the onsite road and partition dike.

(2) Environmental protection facilities

1) Liner

At the eastern side of Tamangapa disposal site, which consists of flat paddy field, the upper soil layer is paddy clay (pc). The thickness of paddy clay is 1.5 to 2 m and the permeability coefficient ranges from 5×10^{-5} to 8×10^{-6} cm/sec as mentioned in article 3.5.1(3). As the paddy clay layer has low permeability, it will have a function as the liner.

However, stripping of the top layer and compaction is necessary because the paddy clay layer include roots and leaves.

At the western side of the Tamangapa disposal site which consists of the gentle mound, the upper soil layers are lateritic clay and highly weathered bedrock.

Lateritic clay shall be excavated and used for covering soil, and highly weathered bedrock shall be adopted as the liner. Although the permeability coefficient of highly weathered bedrock is high, by thorough compaction, the permeability of this layer can be greatly decreased and to become an impervious layer.

2) Leachate collection pipe

Gravity leachate collection facilities shall be installed in the landfill area for the purpose of collecting the rainwater which has become contaminated by waste (leachate), and lead it to the aeration pond which is located outside of the landfill area. In consideration of the topographical features of Tamangapa landfill area, the flow of leachate is basically from west to east, therefore the aeration pond shall be located at the eastern end of the site. Leachate collection facilities consists of horizontal and vertical leachate collection facilities. The planning condition of each leachate collection facility is as follows.

i. Horizontal leachate collection pipe shall be composed of perforated PVC pipe consisting of 400 mm dia., main pipe and 200 mm dia. sub/branch pipe. These pipes are arranged at the bottom of the landfill area. For the protection of these pipes, an earthen layer of 50 cm thickness shall be laid on top of the pipes. A flexible joint shall be used at the connection of the two pipes, main pipe and branch pipe.

ii. Vertical leachate collection facility will substitute for the vertical gas removal facilities and it shall be connected to the horizontal leachate collection pipes. For the planning condition of the gas removal facilities, see the following article "Gas removal facilities".

3) Gas removal facilities

Generally, several kinds of gas will be produced by organic substances contained in the reclaimed waste during the process of putrefaction and decomposition caused by microorganisms etc. which exist in the reclaimed waste layer. Main components of the gas produced in the landfill area are methane gas, carbonic acid gas and nitrogen which are colorless and odorless. In addition, although in small amounts, ammonia, hydrogen sulfide, methyl mercaptane, methyl sulfide etc. which are malodorous gases, are also produced. These gases cause inflammation and/or explosion

hazard, the destruction of the ecological system of plants, bad odors to the surroundings, etc.

For proper countermeasures, gas removal facilities shall be installed in the landfill area. The planning conditions of the gas removal facilities are as follows.

i. Vertical type gas prevention facility, which consists of steel net and timber frame, shall be set in the landfill area. This facility shall be installed in parallel with the reclamation operation.

ii. Horizontal type gas prevention facilities, which consist of PVC perforated pipe, 70 mm in diameter, and surrounding gravel, shall be laid below the final earth cover.

4) Leachate circulation system

Since the leachate, polluted water produced in the landfill site, will be the cause of contamination to the surrounding bodies of water, it is necessary to prepare the facilities to treat the leachate before discharge, as a pollution prevention measure.

a. Amount of leachate

The scale/capacity of the treatment plant depends on the amount of leachate.

Leachate amount shall be decided in consideration of the following conditions.

i. The amount of leachate differs greatly between the rainy season and the dry season.

- In the rainy season, specially in January and February, a large amount of leachate will be discharged, and requires a large-scale treatment plant.

- In the dry season, specially from June to October, no leachate is expected to be produced, therefore, no treatment plant operation is required.

ii. No reliable data regarding the amount of leachate is available in Indonesia.

Leachate amount is estimated based on the monthly rain fall, and by taking the average monthly rain fall data, as follows:

$Q = 10 \times C (I - E) A$

where
- Q = Leachate amount (m^3/day)
- C = Factor (set to 0.7)
- I = Average rainfall (mm/day)
- E = Average evaporation (mm/day)
- A = Landfill operation area (ha)

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Ave.
Rain (mm)	706	509	366	193	103	43	28	20	22	56	249	293	---
Leachate (m^3/ha)	140	105	63	23	2	0	0	0	0	0	35	46	34

b. Leachate treatment facilities

At the Tamangapa disposal site which is a semi-sanitary landfill in accordance with the concept of the master plan prepared by this study, leachate circulation system (aeration lagoon system) shall be adopted.

The facilities of the leachate circulation system are composed of the following:

i. Pump pit for leachate intake

ii. Aeration lagoon with aerator, recirculation pump etc.

iii. Discharge pit

The capacity of the aeration lagoon shall be designed to hold the amount of leachate produced in five days.

$34\ m^3/ha \cdot 28.0\ ha \cdot 5\ days = 4{,}760\ m^3$

5) Leachate discharge facilities

For the purpose of discharging the treated water to the catchment area of Tallo river, leachate discharge facilities shall be installed. The discharge point is located approx. 1.5 km north-east of the Tamagapa disposal site. The planning conditions of the leachate discharge facilities are as follows.

i. PVC pipe, 200 mm diameter, shall be installed along the discharge route.

ii. Beside the Leachate treatment plant, a pump station shall be constructed for the purpose of pumping the treated leachate and discharging it.

6) Buffer zone

Tamangapa disposal site is neat to a housing complex which is under construction, called Perumnas Antang, at the northern side of the site. Although the direction of the wind is mainly from north-west to south-east through out the year and the adverse environmental effects will not be great, as an environmental protection measure, a buffer zone will be planned between the housing complex and Tamangapa site.

Meanwhile, since the mound area of the Tamagapa site is forested. the trees can substitute for the buffer zone. *Fig.* 3.5 shows the area where the buffer zone shall be laid.

7) Monitoring facilities

Monitoring wells shall be installed at several appropriate points of the landfill site and surroundings in order to monitor the groundwater quality during the landfill operation and also after completion of the landfill. The diameter of the well shall be a minimum of 100 mm. For disaster prevention measures, monitoring of the groundwater quality shall be carried out periodically. *Fig.*3.5 shows the installation points of the monitoring wells.

(3) Safety facilities

For safety operation measures, the following facilities shall be installed in the landfill site.

i. Fence and gate

ii. Lighting and pole

3.5.3 Operation and maintenance

(1) Operational equipment

The equipment / machinery listed below shall be prepared for the purpose of loading, leveling and compaction of the waste and the covering material, maintenance of the site facilities such as the enclosing bund, operational road, etc., and excavation for drainage.

In accordance with the change of the disposal site from Tamagapa to Samata in the year 2002, all equipment/machinery listed below shall be shifted to Samata disposal site for its operation.

i. Landfilling of the waste

Truck type tractor (Bulldozer)	18 ton class	2 units

ii. Soil covering, transport of the covering soil and maintenance of the site facilities

Truck type tractor (Bulldozer)	18 ton class	1 unit
Excavator	0.7 m^3 class	1 unit
Dump truck	8 m^3 class	2 units

iii. Others

Pick up truck		2 units
Tank truck	GVW 7 ton	1 unit

(2) Personnel plan

The disposal site shall be managed and/or operated by the administrative, technical and operational personnel, as shown in the following organization chart. Total manpower of Tamagapa disposal site will be 29 persons in the year 2000.

(3) Landfill plan

1) Basic policy

The basic policies and/or purposes for the landfill operation are as follows.

i. The waste shall be spread and compacted sufficiently.
ii. The scattering of the waste shall be minimized.
iii. The diffusion of offensive odors shall be minimized.
iv. The breeding of harmful insects shall be minimized.
v. Stabilization of the waste shall be arranged within an early period.

Compaction of the waste is the essential work for extending the service life period of the landfill site, and also it can be helpful for shortening the subsidence of the ground after completion of the landfill. Further, in order to minimize the environmental effects on the surroundings, that is, scattering of the waste, diffusion of offensive odors and breeding of harmful insects, a proper operational system shall be adopted. And also, early stabilization of the landfill site shall be required for the ultimate land-use of the completed landfill site.

2) Landfill method

Generally, there are three kinds of landfill methods, open dumping, sandwich and cell methods. As the topographic feature of the Samata disposal site is flat and wide, and in consideration of the above mentioned basic policies of landfill plan, the "cell method" shall be applied to the Samata site.

Highly-compacted landfill can be expected by using the cell method. And also, as daily soil covering is applied under this method, the

adverse environmental effects on the surroundings, such as scattering of solid waste, diffusion of the offensive odors, breeding of harmful insects, etc., can be minimized.

Fig. 3.7 shows the conceptual operation of the cell method.

3) Covering soil

Together with the landfill operation by the cell method, covering soil which consists of daily covering, intermediate covering and final covering shall be carried out at proper times respectively. The main purposes of the covering soil are as follows.

Type of covering soil	Purpose	Thickness
Daily covering	Prevent scattering of waste Prevent diffusion of offensive odors Prevent breeding of harmful insects	20 cm
Intermediate covering	smooth landfill operation of vehicles minimize the leachate amount (as rainwater drainage in certain areas)	30 cm (total 50 cm)
Final covering	landscaping minimize the leachate amount ultimate land-use	50 cm (total 100 cm)

The covering soil shall be basically procured from the mound area of Tamagapa disposal site and Antang hill which is located 2.5 km north-east of the site. The soil amount which is available for covering soil from the Tamangapa site is approx. 230,000 m^3.

However, the required amount of covering soil for Tamangapa site is approx. 384,000 m^3. Therefore, 154,000 m^3 shall be procured from Antang hill. The geological features of this soil are Lateritic clay and highly weathered surface layer of bedrock which is suitable for the covering soil.

(4) Investment cost and operation and maintenance cost

Investment cost and operation & maintenance cost of Tamangapa disposal site in year 2005 is described in *Table* 3.1 and 3.2.

3.5.4 Ultimate land-use

(1) Basic conditions of ultimate use

Generally, at the landfill site, the following phenomena will observed continuously for a long period even after completion of the reclamation.

i. subsidence of the ground (approx. 5 years after landfill completion)
ii. production of gas (over 15 years after landfill completion)
iii. production of leachate

The above phenomena can sometimes be a hindrance to ultimate land-use, therefore, for the purpose of effective ultimate land-use of the landfill site, the following facilities shall be installed and operated in the landfill area from the beginning of the landfill. Also, these facilities can help to accelerate stabilization of the site conditions. Monitoring of the stability of the ground, the generated amount of gas and water quality of the leachate shall be carried out continuously until the site conditions are properly stabilized for the planned ultimate land-use.

i. drainage facilities for rainwater
ii. gas removal facilities
iii. leachate treatment plant

(2) Ultimate land-use plan

Generally, in the early period after completion of the landfill, the land-use of the disposal site is for farmland, park, athletic field, play ground, golf links, car park and so on.

Finally, after a long period, the site can be used for school, office, housing complex and so on.

In accordance with the concept of the Master Plan prepared under this study, Tamangapa disposal site shall be used as the branch office with the function of depot for the SWM of KMUP. Therefore, some part of the site will be used for this purpose in the ultimate land-use.

3.6 Construction of Samata Disposal Site Phase I

3.6.1 Planning conditions

(1) Basic principles

According to the Master Plan prepared in this study, Samata disposal site shall be constructed as an inter-municipal disposal site, for the waste generated from KMUP and Kab. Gowa in consideration of the MINASAMAUPA concept. Accordingly, in consideration of the necessary functions of Samata disposal site as sanitary landfill, the basic principles for the execution of the preliminary design for the feasibility study regarding Phase I of the Samata disposal site have been conceived as follows.

i. The site plan and/or facility plan of the disposal site shall be appropriately adjusted to the topographical and geological features, and the surrounding environment.

ii. Samata disposal site shall be constructed as sanitary landfill to prevent adverse environmental effects on the surroundings.

iii. During and after completion of the landfill, the disposal site shall not be the cause of pollution, nor endanger the health and safety of the surrounding residential people.

iv. The completed sites shall be harmonious with the surrounding environment.

v. The layout of the facilities for the disposal site shall take into consideration for smooth operation and maintenance.

vi. The administration facilities shall be located at the entrance area of the disposal site for easy control and supervision of the waste collection vehicles and of the operation flow of the landfill.

vii. Leachate treatment plant shall not necessarily be centralized. The location of this facility shall be decided in consideration of the topographic features and the discharge point of the leachate. Also, this

facility shall be located as far away as possible from the surrounding residential area.

Fig. 3.8 shows the location and geological features of Samata disposal site and surroundings.

(2) Design conditions

It is proposed to construct the Samata inter-municipal disposal site at the location of Kelurahan Samata, Kabupaten Gowa. The total area of Samata disposal site is 168 hectares and it can be used for more than 20 years. The site will be developed in three (3) phases, and the first phase will be operated from the year 2002. Accordingly, construction of the first phase project, which has an area of 65 hectares, is the subject of the feasibility study.

Design conditions of Samata disposal site Phase I are the following.

i.	Landfill area	:	65 hectares
ii.	Landfill height	:	15 m (including covering soil)
iii.	Landfill capacity	:	3,540,000 ton
iv.	Period to be disposed	:	2002 - 2012 (ten years)
v.	Landfill method	:	Sanitary landfill
vi.	Service area	:	entire area of KMUP and Sungguminasa area of Kab. Gowa
vii.	Waste amount to be collected	:	774 ton/day in 2005 (service ratio is 90 %)
viii.	Waste to be disposed	:	domestic waste, commercial waste, street waste, ditch waste and non-hazardous industrial waste from KMUP and Kab. Gowa
ix.	Ultimate land use after waste disposed	:	recreation and sports park

(3) Topography and geology

1) Topographic features

Samata disposal site is located 0.6 Km south of the boundary between KMUP and Kab. Gowa, and 4.2 Km south-east of the Tamangapa disposal site. The Tallo river runs 1.0 Km east of the site and a tributary of the Tallo river runs at the southern and western border of the site. A small channel flows westerly through the center of the site and meets the tributary in the west. Mangara swamp is located 2.0 Km north of the site and the tributary of the Tallo river mentioned above discharges into Mangara swamp. The site is located on a flat alluvial plain (paddy field) which slopes gently in a northerly direction, and its average elevation is approx. 3.5 m above mean sea level. Two small villages are located east of the site, namely Rappocidu and Bossolo. Bakung hill is located 0.4 km west of the site. The site is a part of the service area of the Kajenjeng irrigation system, located on the Tallo river just east of Bossolo village.

2) Geological features and groundwater

a. Geologic features

As shown in *Fig.* 3.8, the geology of Samata disposal site is composed of the following formations:

i. Paddy clay (pc): Alluvial deposits which filled up the ancient valley

Paddy clay is soft, black clay including the roots and leaves of rice plants. The thickness of paddy clay is 1.5 m to 2 m. The permeability coefficient of this layer ranges from 5×10^{-5} cm/sec to 8×10^{-6} cm/sec.

ii. Soft gray clay layer (gc): Alluvial deposits which filled up the ancient valley

This layer is composed of gray, partly mottled, brown, soft and plastic clay. Thickness of this layer is 2 to 4 m and N value is 2 to

6. The permeability coefficient of this layer ranges from 3×10^{-5} cm/sec to 3×10^{-7} cm/sec.

iii. Soft organic clay layer (oc): Alluvial deposits which filled up the ancient valley

This layer is composed of black, soft clay with abundant carbonized wooden pieces (peat). Maximum thickness of this layer is around 2 m and is distributed in the south-western part of the TPA. N value of this layer is 2 to 3. The permeability coefficient of this layer ranges from 1×10^{-4} cm/sec to 1×10^{-6} cm/sec.

iv. Highly weathered bedrock: The surface weathered part of the bedrock

This part is composed of brown to gray, moderately stiff clay with sand and gravels (residual rock fragments). Thickness of this layer is 1.5 to 3 m and N value ranges from 10 to 50.

v. Alternations of sandstone and claystone: Surface weathered part of the bedrock

This layer is composed of gray to dark gray, fresh and hard alternations of sandstone and claystone with some intercalation of coarse sandstone and tuff. Alternation spacing is fine. This layer has very few cracks and forms sound bedrock. The depth to this layer is 5 to 8.5 m.

b. Groundwater

The groundwater level inclines from south to north very gently and is located at very shallow depths (GL-7 cm to GL-80 cm) as shown in *Fig.* 3.8.

The groundwater flowing through Samata disposal site is recharged from the southern mound area. The groundwater flowing in the Samata site finally discharges into the swamp in the north, Mangara Swamp.

3.6.2 Facility plan

Fig. 3.9 shows the layout plan of Samata disposal site for the feasibility study project.

Outline of the facilities, that is, main facilities, environmental protection facilities and buildings, for the construction of Samata disposal site is shown in *Table* 3.4. *Fig.* 3.9 and *Fig.* 3.10 shows facilities of Samata disposal site.

(1) Main facilities

1) Access road

Jl. Veteran, (length is approx.1500 m), shall be improved as the access road of Samata disposal site. The function of this road shall be not only for access to the site but for the use of the surrounding inhabitants. In consideration of this, the design conditions of the access road are as follows.

i. The road shall be wide enough for two-way traffic and a side-walk.

ii. The road shall be asphalt paved.

iii. Storm water drainage shall be set on both sides of the road.

iv. The width of the road is 12.0 m.

v. Stopping / waiting lane shall be included for the collection vehicles near the entrance of the site.

Fig. 3.11 shows the access road plan of Samata disposal site.

2) Access road bridge

Access road bridge shall be constructed for smooth and safe access to Samata disposal site in the following manner:

i. The bridge shall be a concrete structure strong enough for heavy vehicles.

ii. Lane width is 10.0 m which consists of two-way traffic and a side-walk.

Fig. 3.11 shows the outline of access road bridge.

3) Onsite road

The major functions of the onsite road are as follows.

i. To confine the waste which will accumulate to a height of 15 m.

ii. Access for collection vehicles.

iii. To confine the flood water to prevent water penetrating inside the site

iv. To minimize the amount of leachate by preventing stormwater in flow into the site from the non-landfill area.

Also the onsite road shall be used for operation of the landfill work, inspection and administration work. The design conditions of the onsite road are as follows.

i. The road width is 5.0 m at its crest, and 4.0 m will be concrete paved.

ii. The height of the road is 3.0 m.

iii. Stormwater drainage shall be located on both sides of the road.

4) Partition dike

In order to operate the landfill site properly, a partition dike shall be constructed in the landfill area. The main purpose of the partition dike is to reduce the quantity of leachate by the barrier function, that is, to prevent rainwater flow into recent landfill area. Any other functions of the partition dike is the same as for the onsite road mentioned above. The partition dike shall be designed in the following manner:

i. The dike width is 5.0 m at the crest of the dike, and 4.0 m shall be gravel paved.

ii. The height of the dike is 3.0 m.

iii. Stormwater drainage shall be located on both sides of the dike.

5) Operational road

To maintain good operating conditions and smooth dumping, an operational road shall be constructed in the landfill area.

The design conditions of the operational road are as follows.

i. The road width is 8.0 m at the crest of the road, and 6.0 m of it shall be gravel paved.

ii. The height of the road is 1.0 m from ground level.

iii. The slope on both sides of the road is 1 : 4, for easy access of heavy equipment and collection vehicles.

6) Stormwater drainage

When stormwater/rainwater flows into the landfill site, the volume of the leachate increases, requiring a large scale leachate treatment plant, which is uneconomical. Therefore, the main target of the construction of the stormwater drainage is the reduction of the amount of leachate. The purposes of the drainage system are listed below.

i. Eliminate the rainwater which flows into the landfill site from the outside.

ii. Eliminate the rainwater which flows into the landfill area from the non-landfill area of the site which is divided by the barrier.

iii. Eliminate the rainwater which flows into the landfill area from the completed landfill area.

Stormwater drainage can be divided into three types in consideration of its location, that is, surrounding drainage, onsite drainage and drainage of the reclaimed area. The surrounding drainage is installed along the outside of the onsite road. Rainwater collected by this facility shall be discharged to the existing drain. Onsite drainage is installed inside the

landfill site, that is, along the inside of the onsite road and both sides of the partition dike. The rainwater collected from the non-landfill area shall be discharged outside of the enclosing bund by using these facilities. The drainage for the reclaimed area is established after completion of the final soil covering. The rainwater collected from this facility shall be discharged outside the enclosing bund.

The design condition of the stormwater drainage is as follows.

i. Concrete made U-shaped gutter shall be laid, and the structural dimension is 400W x 300D for stormwater drainage of the access road, and 700W x 500D for the surrounding dike, that is, the onsite road and partition dike.

(2) Environmental protection facilities

1) Liner

The upper layer of Samata disposal site is composed of paddy clay (pc) and soft gray clay (gc), and the thickness are 1.5 m to 2 m and 2 m to 4 m respectively. In accordance with the results of laboratory tests, the permeability of these layers ranges from 5×10^{-5} to 8×10^{-6} cm/sec and 3×10^{-5} cm/sec to 3×10^{-7} cm/sec respectively. Therefore, these layers are impervious.

At the Samata disposal site, as the permeability of the upper layer, which is paddy clay and soft gray clay, 3.5 m to 6 m thick from ground level is very low, a liner is not necessary. The effects of contamination of the leachate on underground water are considered very low.

On the other hand, the groundwater level is situated at very shallow depth, upper layer shall not be cut. However, as the permeability of the paddy clay is somewhat uncertain, because it includes roots and leaves of rice field, stripping the top layer and soil compaction shall be recommended for the construction stage.

2) Leachate collection pipe

Gravity leachate collection facilities shall be installed in the landfill area, for the purpose of collecting leachate and lead it to the leachate treatment plant which is located outside of the landfill area. In consideration of the topographical features of Samata landfill area, the flow of leachate is basically from east to west and from south to north, therefore the leachate treatment plant shall be located at the north-west end of the site. Leachate collection facilities are composed of horizontal and vertical collection facilities and leachate drain pipe. The planning condition of each leachate collection facility is as follows.

i. Horizontal leachate collection pipe shall be composed of perforated PVC pipe consisting of 400 mm dia. main pipe and 200 mm dia. sub/branch pipe. These pipes are arranged at the bottom of the landfill area and the maximum pitch of the branch pipe is 50 m. For the protection of these pipes, an earthen layer of 50 cm thickness shall be laid on top of the pipes. A flexible joint shall be used at the connection point of the two pipes, main pipe and branch pipe.

ii. Vertical leachate collection facility will substitute for the vertical gas removal facilities and it shall be connected to the horizontal leachate collection pipes. For the planning condition of the gas removal facilities, see the following article "Gas removal facilities".

iii. Leachate drain pipe shall be installed at the bottom of the landfill site and atong the inside of the onsite road, only on the western side of the landfill site. The purpose of this facility is to collect the leachate from the main pipe of the horizontal leachate collection pipes and to lead the leachate to the treatment plant. Leachate drain pipe shall be composed of a PVC pipe, 500 mm in diameter. A flexible joint shall be used at the connection point of the two pipes, namely the horizontal leachate collection main pipe and the leachate drain pipe.

3) Gas removal facilities

Generally, several kinds of gas will be produced by organic substances contained in the reclaimed waste during the process of putrefaction and decomposition caused by microorganisms etc. which exist in the reclaimed waste layer. The main components of the gas produced in the landfill area are methane gas, carbonic acid gas and nitrogen which are colorless and odorless. In addition, although in small amounts, ammonia, hydrogen sulfide, methyl mercaptane, methyl sulfide etc. which are malodorous gases, are also produced. These gases cause inflammation and/or explosion hazard, the destruction of the ecological system of plants, bad odors to the surroundings, etc.

For proper countermeasures, gas removal facilities shall be installed in the landfill area. The planning conditions of the gas removal facilities are as follows.

i. Vertical type gas prevention facility which consists of steel net and timber frame, shall be set at approx. 50 m intervals. This facility shall be installed in parallel with the reclamation operation.

ii. Horizontal type gas prevention facilities, which consist of PVC perforated pipe, 70 mm in diameter, and surrounding gravel, shall be laid below the final earth cover.

4) Leachate treatment plant

Since the Leachate will be the cause of contamination of the surrounding water bodies, it is necessary to prepare the facilities to treat the leachate before discharge, as a pollution prevention measure.

a. Amount of leachate

The scale/capacity of the treatment plant depend on the amount of leachate. An estimate of the leachate amount which is produced from the disposal site is described in the previous section, 3.5.2 (2) 4).

b. Leachate treatment facilities

At Samata disposal site, a sanitary landfill in accordance with the concept of the master plan prepared by this study, a sophisticated leachate treatment plant composed of bioremediation and physico-chemical treatment will be required.

However, in consideration of technical difficulties for operation and maintenance and financial aspects, the construction of a sophisticated treatment plant shall be recommended on a step by step basis. In accordance with this policy, as the first step of the leachate treatment plant, an improved aeration lagoon system shall be adopted at Samata disposal site Zone-1.

The facilities of the aeration lagoon system (improved) are composed of the following:

i. Primary settling tank

ii. Regulation tank

iii. Settling tank

iv. Aeration lagoon

v. Sedimentation tank

vi. Sludge tank

The capacity of the aeration lagoon shall be designed to hold the amount of leachate produced in five days.

$34\ m^3/ha \cdot 62.0\ ha \cdot 5\ days = 10,540\ m^3$

5) Leachate discharge facilities

For the purpose of discharging the treated water to the Tallo river, leachate discharge facilities shall be installed from the leachate treatment plant, along the northern side of the onsite road, to Tallo river which is located 1.2 Km east of the treatment plant. The planning conditions of the leachate discharge facilities are as follows.

i. PVC pipe, 200 mm diameter, shall be installed along the discharge route.

ii. Beside the leachate treatment plant, a pump station shall be constructed for the purpose of pumping up the treated water and discharging it into the river.

6) Monitoring facilities

Monitoring wells shall be installed at several appropriate points of the landfill site and surroundings in order to monitor the groundwater quality during the landfill operation and also after completion of the landfill. The diameter of the well shall be a minimum of 100 mm. For the disaster prevention measures, monitoring of the groundwater quality shall be done periodically.

(3) Buildings

The following facilities shall be constructed for the proper, smooth and safe operation of Samata disposal site. The principal functions and planning conditions for each facility are as follows.

1) Site office

Site office shall be constructed for the administration work of Samata disposal site. Floor area of the site office is 150 m2 and the structure is RC (reinforced concrete).

2) Weighbridge

Incoming waste carried by collection vehicles shall be weighed at the weighbridge for the proper operation of the Solid Waste Management System. The records will be used for future planning of the disposal site, and to determine the fee for incoming waste etc. Two units of weighbridge shall be installed at the entrance point of the site. Further, a gatehouse, floor area 30 m^2, shall be constructed for operating the weighbridge. The specifications of the weighbridge are as follows.

i. Weighing capacity: 30 ton / unit

ii. Load-cell type and four-point support system

iii. Automatic digital counter

iv. Control post with card reader

v. Connected computer with printer to input and arrange the data

3) Washing station

For the purpose of washing and cleaning the heavy equipment and/or collection vehicles periodically, a washing station shall be constructed at the administration area of the site. Regarding the washing facilities, high pressure spray, pump etc. shall be installed.

4) Safety facilities

For safety operation measures, the following facilities shall be installed in the landfill site.

i. Fence and gate

ii. Lighting and pole

iii. Control tower

iv. Parking lot

(4) Others

1) Diversion channel for Kajenjeng irrigation

The Kajenjeng irrigation system is located in Kel. Samata, Keb. Gowa, east side of Bossolo Village, and derives its water from the flow of Tallo river. Kajenjeng was firstly constructed in 1967 and expanded in 1977. Kajenjeng irrigation system mainly operates in the rainy season, from November to April, and contributes to the paddy fields located in the surrounding area.

The construction of Samata disposal site will interfere with the function of the Kajenjeng irrigation system. The total service area of Kajenjeng

is 523 hectares, and the area affected by construction of the disposal site is 307 hectares located in Kel. Samata, Kab. Gowa and Kel. Tamangapa, KMUP. For the purpose of minimizing the affected area of the Kajenjeng irrigation system, a diversion channel shall be constructed in accordance with the staged construction of the Samata disposal site.

3.6.3 Operation and maintenance

(1) Operational equipment

The equipment / machinery listed below shall be prepared for the purpose of loading, leveling and compaction of the waste and the covering material, maintenance of the site facilities such as enclosing bund, operational road, etc., and excavation for drainage.

i. Landfilling of the waste

Truck type tractor (Bulldozer)	18 ton class	2 units

ii. Soil covering, transport of the covering soil and maintenance of the site facilities

Truck type tractor (Bulldozer)	18 ton class	1 unit
Excavator	0.7 m^3 class	1 unit
Dump truck	8 m^3 class	2 units

iii. Others

Pick up truck		2 units
Tank truck	GVW 7 ton	1 unit

(2) Personnel plan

The disposal site shall be managed and/or operated by the administrative, technical and operational personnel, as shown in the following organization chart. Total manpower of Samata disposal site will be 29 persons in the year 2005.

(3) Landfill plan

1) Basic policy

The basic policies and/or purposes for the landfill operation are as follows.

i. The waste shall be spread and compacted sufficiently.

ii. The scattering of the waste shall be minimized.

iii. The diffusion of offensive odors shall be minimized.

iv. The breeding of harmful insects shall be minimized.

v. Stabilization of the waste shall be arranged within an early period.

Compaction of the waste is the essential work for extending the service life period of the landfill site, and also it can be helpful for shortening the period of ground subsidence after completion of the landfill. Further, in order to minimize the environmental effects on the surroundings, that is, scattering of the waste, diffusion of offensive odors and breeding of harmful insects, a proper operation system shall be adopted. And also, early stabilization of the landfill site shall be required for the ultimate land-use of the completed landfill site.

2) Landfill method

Generally, there are three kinds of landfill methods, open dumping, sandwich and cell methods. As the topographic feature of Samata disposal site is flat and wide, and in consideration of the above mentioned basic policies of landfill plan, the "cell method" shall be applied for the Samata site.

Highly-compacted landfill can be expected by using the cell method. And also, as daily soil covering is applied under this method, the adverse environmental effects on the surroundings, such as scattering of solid waste, diffusion of offensive odors, breeding of harmful insects, etc., can be minimized.

3) Covering soil

Together with the landfill operation by the cell method, covering soil, which consists of daily covering, intermediate covering and final covering, shall be carried out at proper times respectively. The main purposes of the covering soil are shown in the following table:

The covering soil shall be basically procured from Bakung hill which is located in Kel. Samata, between Jl. Veteran and Jl. Macanda, 0.4 Km west of Samata disposal site. The potential amount of soil which can be procured from Bakung hill is approx. 1.9 million m^3, and the geological features of this soil are Lateritic clay and Highly weathered surface layer of bedrock which is suitable for covering soil. On the other hand, the required amount of covering soil for Zone-I of Samata disposal site is approx. 1.6 million m^3. Therefore, the total amount of covering soil which will be used at Samata disposal site can be procured from Bakung hill.

Type of covering soil	Purpose	Thickness
Daily covering	Prevent scattering of waste Prevent diffusion of offensive odors Prevent breeding of harmful insects	20 cm
Intermediate covering	smooth landfill operation of vehicles minimize the leachate amount (as rainwater drainage in certain areas)	30 cm (total 50 cm)
Final covering	landscaping minimize the leachate amount ultimate land-use	50 cm (total 100 cm)

(4) Investment cost and operation cost

Investment cost and operation & maintenance cost of Samata disposal site in year 2005 is described in *Table* 3.1 and 3.2.

3.6.4 Ultimate land-use

(1) Basic conditions of ultimate use

Generally, at the landfill site, the following phenomena will observed continuously for a long period even after completion of the reclamation.

i. subsidence of the ground (approx. 5 years after landfill completion)

ii. production of gas (over 15 years after landfill completion)

iii. production of leachate

The above phenomena can sometimes be a hindrance to ultimate land-use, therefore, for the purpose of effective ultimate land-use of the landfill site, the following facilities shall be installed and operated in the landfill area from the beginning of the landfill. Also, these facilities can help to accelerate stabilization of the site conditions. Monitoring of the stability of the ground, the generated amount of gas and water quality of the leachate shall be carried out continuously until the site conditions are properly stabilized for the planned ultimate land-use.

i. drainage facilities for rainwater

ii. gas removal facilities

iii. leachate treatment plant

(2) Ultimate land-use plan

In consideration of the contribution to the surrounding residents, harmony with the existing landscape, and financial aspects, a combination of the following facilities is recommended for the ultimate land-use plan of Samata disposal site.

i. Administration and overall facilities
   - Administration office
   - Rest house
   - Parking

ii. Sports facilities
   - Athletic field
   - Football ground

- Baseball ground
- Tennis court
- Swimming pool
- Gymnasium
- Jogging & cycling road

iii. Park

- Children's park
- Recreation field / park
- Exhibition field
- Amusement park
- Open play-ground

Fig. 3.12 shows the conceptual ultimate land-use plan of Samata disposal site.

3.7 Construction of Panakkukang Branch Office

3.7.1 Planning conditions

The population of suburban areas in KMUP has a tendency to increase rapidly. For the purpose of expanding the collection service in this suburban area, Panakkukang branch office located in Kelurahan Borong, Kecamatan Panakkukang, KMUP, shall be constructed as soon as possible. In the concept of the Master Plan prepared under this study, the operation of this branch office shall be started in the year 2000. Two (2) hectares of land shall be reserved for the necessary facilities of this branch office, such as office building, parking lot etc., and in consideration of future development of solid waste management facilities such as incineration plant, recycling facilities, and so on, an additional two (2) hectares of land shall be secured at the same time.

The function of Panakkukang branch office according to the master plan is mainly as a depot for the collection vehicles and an administrative base for solid waste collection and transportation, street sweeping and ditch cleansing.

3.7.2 Facility plan

The following facilities shall be constructed for proper operation of Panakkukang branch office. The location of Panakkukang branch office is shown in *Fig.* 3.13. And *Fig.* 3.14 shows site plan of the branch office.

- Office building
- Annex building
- Parking lot
- Washing station
- Fuel station
- Safety facilities (fence & gate, lighting pole etc.)

Investment cost and operation & maintenance cost of Panakkukang branch office in 2005 is described in *Table* 3.1 and 3.2.

3.8 Establishment of PD Kebersihan

3.8.1 General

As mentioned in Master Plan, PD Kebersihan shall be established to expand solid waste collection service and to provide efficient service. Also it is desirable to establish PD Kebersihan together with implementation of priority projects planned to implement during 1996 to 2001. Since the priority projects include construction of an inter-municipal disposal site at Samata in Gowa, a new organization to operate Samata disposal site shall be set up at in year 2002.

3.8.2 PD Kebersihan

(1) Responsibility of PD Kebersihan

PD Kebersihan shall be established under KMUP to perform solid waste management in KMUP. Also it shall be responsible to operate Samata disposal site together with Kab. Gowa. Major task of PD Kebersihan is:

a. Provide collection, transportation and disposal of solid waste generated in KMUP (domestic, commercial waste, street waste and ditch cleansing waste)

b. Proper disposal of solid waste to be transported from Kab. Gowa and non hazardous industry waste at Samata disposal site excluding hazardous waste.

c. Guidance to industry and to business establishments for proper disposal of solid waste.

d. Guidance for recycling and volume reduction including the control of scavengers.

e. Contracting-out of certain services to private companies

It is noted that PD. Kebersihan will not be responsible for wastewater management including de-sludging that is performed by Dinas Kebersihan at present. It will be transferred to the new organization for wastewater management to be established.

(2) Organization

It is recommended that PD Kebersihan shall have an organization recommended as shown in *Fig.* 4.5. It is proposed that it has three (3) branch offices, and two (2) field office in 2015. Total required personnel will be 859 in the year 2005 as explained hereafter. As mentioned in the section 3.7, the branch office at Panakkukang shall be constructed and established by year 2001.

3.8.3 New organization of Samata disposal site

(1) General

Samata disposal site shall be operated as an inter-municipal disposal site. As mentioned above, it shall be also one of the field offices of PD Kebersihan of KMUP to be established. Therefore, a top level management organization between KMUP and Kab. Gowa shall be established and it should control all important management matters concerning Samata disposal site including cost allocation of both local governments. Following will be the basic conditions for the operation of Samata disposal site.

a. Construction cost of Samata disposal site will be prepared in priority project including land acquisition cost. The priority projects shall be initiated by KMUP.

b. Land acquisition will be done by the local government of Gowa regency using an allocated budget of the project and land itself will be belong to Gowa regency.

c. Operation of the Samata disposal site will be responsible mainly in PD Kebersihan of KMUP. However, staff of Gowa regency shall be joined for the operation especially in the field of public relation.

(2) Principal of cost sharing

Actually, full cost recovering of Samata disposal site may be difficult because of:

a. Tariff of the solid waste collection and the disposal service in KMUP is not enough at present. Therefore, KMUP has not enough income to full cost recovery in middle terms. Kab. Gowa is also of course.

b. High disposal cost will bring out for illegal dumping in anywhere in MINASAMAUPA area. Therefore, tipping fee shall be within affordability of residents and business establishments. To prevent illegal dumping, tipping (disposal) fee will be less than necessary fee for full cost recovering.

Concerning cost sharing between KMUP and Kab. Gowa, it shall be set based on the following principal considering difference of needs for Samata disposal site between KMUP and Kab. Gowa.

a. Operation cost except depreciation shall be shared based on solid waste amount to be disposed of. This means that Kb. Gowa shall pay the tipping of solid waste transported from Gowa regency.

b. Investment cost and interest of loan shall be born by KMUP. However, land acquisition cost shall be shared based on in proportion of solid waste amount to be disposed of, including part of interest for land acquisition.

c. Full cost of Samata disposal site shall be paid for receiving non-hazardous industry waste.

Of course there is another alternative that all costs are covered by KMUP without any burden of Kab. Gowa. In this case, KMUP shall bear 10% more the above case.

3.9 Introduction of Proper Tariff System

(1) Basic policy

Under the new fee system introduced in 1994, it is planed to collect around Rp. 1.7 billion (that is around 68 % of routine budget in 1994) and that consists of 62% from residential house, 30 % from boarding houses and the remaining 8 % from restaurants etc. As solid waste is estimated to be 72 % from domestic waste, 25 % from commercial activities and 3 % of other sources in 2005, the burden on residents and business establishments shall be revised to be fair. It means that the residents shall bear less than 72 % and the business establishments shall bear more than 25% considering cross subsidy to low income residents. Also it is noted that no subsidy to the business establishments will be the basic condition for promotion of privatization. The new fee collection system using electricity locket introduced in November 1994 is successfully implemented. Therefore it shall be continued and maintained and only tariffs shall be revised based on this system and based on the beneficially pay principal and the cross subsidy for low income people.

As described in the master plan, the basic policy for fee collection will be as follows:

a. Concerning domestic waste, operation and maintenance cost except depreciation shall be recovered in year 2000. Also, operation and maintenance cost except depreciation of final disposal site, shall be recovered by fee in the year 2005,

b. Concerning commercial waste, operation and maintenance cost except depreciation of the final disposal site shall be recovered by fee from the business establishments at year 2000 and all operation and maintenance costs shall be recovered in the year 2005.

c. Concerning non-hazardous industry waste which will be received at the municipal final disposal site, all costs for disposal shall be recovered. Transportation of it shall be done by the generators themselves.

(2) Tariff to be paid

According to the marginal cost calculation described in section 4.2, the following table shows the a basic tariff to recover all costs including repayment of interest.

Resident	8.3 billion/year	Rp 2,830/month/household
Business establishment	3.3 billion/year	Rp. 320/month/m2

3.10 Introduction of contracting out

(1) Basic policy

According to the master plan, the contracting out of solid waste collection in the old Kecamatan shall be introduced and promoted to create an efficient system. However, no companies are interested in joining in this field in KMUP at present. Therefore, the project plan is prepared based on the operation contract as a suitable form of the first step of contracting out to have flexibility for both the contracting out and the direct operation by KMUP. In this form, contractor shall carry out the service using equipment provided by KMUP based on the contract agreed between KMUP (PD Kebersihan) and the contractor. Many companies may be able to join in this form because of small capital cost required for the service. Of course, contracting out will be introduced only if the contractor can offer the lower cost than direct operation.

(2) Description of the contracting out

a. Area to be contracted out — Old 6 (six) Kecamatan

b. Population served by contractors — 458,699 person (30 % of total)

Kechamatan	Population (person)	Waste amount (ton/day)
Mariso	76,012	39
Mamajang	83,412	42
Makassar	125,020	64
U. Pandang	44,261	30
Wajo	43,484	53
Bontoala	86,510	47
Sub total	458,699	275

c. Solid waste amount — 275 ton/day (35 % of total)

d. Service of contractor — Primary collection

Collection and transportation

Maintenance of equipment

Management

(3) Allocation of the cost for contracting out

Concerning the operation and maintenance cost excluding depreciation, unit cost of solid waste collection is estimated to be 12,320 Rp/ton by direct operation in 2005. Therefore, contracting out of operation shall be introduced if the contractors will offer lower cost than this. When contracting out is successfully implemented, total amount of contracting out will be 1,206 million in 2005.

Allocation of the cost in 2005 unit : million Rp.

	Depreciation	Operation	Total
Direct operation	1,683	2,279	3,962
Contracting out	0	1,206	1,206
Total	1,683	3,485	5,168

(4) Creation of condition attractive to private companies

A local government, KMUP in the case is in a position to create incentive measures for private companies by regulation for example incentives related with tax payment. Also, it shall be require to get in touch with banks and local giant enterprises etc to find candidate private companies

(5) Reduction of government staffs

It is expected to reduce 649 persons by contracting-out as follows.

a. Staff of primary collection 429 persons

b. Drivers 48 persons

c. Collection staff 118 persons

d. Administration and other staff 54 persons

With 859 persons, PD Kebersihan will be able to attain 90 % of the collection ratio from the total population by contracting out.

Table 3.1 Investment Cost for Feasibility Study Project

(unit : Rp. x 10^6)

Year	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Sub total
a. Collection			4,741		3,146	3,146					11,033
b. Street sweeping			340		340	210					890
c. Ditch cleansing			168	168							336
d. Disposal											0
Tamangapa			2,810	2,650							5,460
Gowa					8,000	8,086					16,086
Equipment			1,450		360						1,810
Sub total			4,260	2,650	8,360	8,086	0	0	0	0	23,356
e. Office											0
Kampong Borong				1,976							1,976
Billingkanaya											0
Sub total				1,976	0	0	0	0	0	0	1,976
Total	0	0	9,509	4,794	11,846	11,442	0	0	0	0	37,591
f. Land acquisition											0
Disposal site	1,950	1,416		3,326							6,692
Office		300	300								600
g. Administration	36	150	150	150	150	150					786
h. Engineering service	214	1,500	1,000	1,000	500	500					4,714
i. Contingency											0
Price contingency											0
Physical contingency											0
j. Tax	220	337	1,096	927	1,250	1,209	0	0	0	0	5,038
Grand Total	2,420	3,703	12,055	10,197	13,746	13,301	0	0	0	0	55,421

Table 3.2 Operation and Maintenance Cost for Feasibiltiy Study Project

(unit : Rp. x 10^6)

Year	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Sub total
a Collection											
(1) Outside project											
Personnel	692	486	486	416	184	184	85	61	61	0	2,655
Fuel	648	673	693	713	410	421	224	102	118	0	4,000
Maintenance	275	249	249	209	102	102	52	27	27	0	1,292
Others	54	46	47	45	24	24	12	7	7	0	266
Depreciation	442	455	349	250	146	146	76	14	14	0	1,892
Sub total	2,111	1,909	1,824	1,631	866	877	449	211	227	0	10,105
(2) Project											
Personnel	0	0	587	642	859	871	977	1,005	1,013	1,051	7,005
Fuel	0	0	505	549	927	996	1,278	1,281	1,516	1,678	8,730
Maintenance	0	0	276	331	460	476	544	549	589	647	3,872
Others	0	0	44	48	71	75	90	91	101	109	629
Depreciation	0	0	837	837	1,233	1,683	1,683	1,683	1,683	1,683	11,322
Sub total	0	0	2,249	2,407	3,550	4,101	4,572	4,609	4,902	5,168	31,558
Total	2,111	1,909	4,073	4,038	4,416	4,978	5,021	4,820	5,129	5,168	41,663
b Street sweeping											
(1) Outside project											
Personnel	227	237	31	11	0	0	0	0	0	0	506
Fuel	0	0	0	0	0	0	0	0	0	0	0
Maintenance	20	20	6	4	0	0	0	0	0	0	50
Others	11	12	1	1	0	0	0	0	0	0	25
Depreciation	49	50	8	3	0	0	0	0	0	0	110
Sub total	307	319	46	19	0	0	0	0	0	0	691
(2) Project											
Personnel	0	0	215	215	219	225	225	225	225	225	1,774
Fuel	0	0	12	12	25	49	49	49	49	49	294
Maintenance	0	0	25	25	35	46	46	46	46	46	315
Others	0	0	11	11	12	14	14	14	14	14	104
Depreciation	0	0	70	70	96	122	122	122	122	122	846
Sub total	0	0	333	333	387	456	456	456	456	456	3,333
Total	307	319	379	352	387	456	456	456	456	456	4,024
c Ditch cleansing											
(1) Outside project											
Personnel	153	153	135	121	121	121	121	121	121	121	1,288
Fuel	6	0	0	0	0	0	0	0	0	0	6
Maintenance	3	0	0	0	0	0	0	0	0	0	3
Others	16	15	13	10	10	10	10	10	10	10	114
Depreciation	7	0	0	0	0	0	0	0	0	0	7
Sub total	185	168	148	131	131	131	131	131	131	131	1,418
(2) Project											
Personnel	0	0	18	32	32	32	32	32	32	32	242
Fuel	0	0	10	19	19	19	19	19	19	19	143
Maintenance	0	0	8	17	17	17	17	17	17	17	127
Others	0	0	3	5	5	5	5	5	5	5	38
Depreciation	0	0	21	42	42	42	42	42	42	42	315
Sub total	0	0	60	115	115	115	115	115	115	115	865
Total	185	168	208	246	246	246	246	246	246	246	2,283
d Final disposal											
(1) Outside project											
Personnel	35	35	0	0	0	0	0	0	0	0	70
Fuel	69	69	0	0	0	0	0	0	0	0	138
Maintenance	73	73	0	0	0	0	0	0	0	0	146
Others	99	106	0	0	0	0	0	0	0	0	205
Depreciation	851	906	0	0	0	0	0	0	0	0	1,757
Sub total	1,127	1,189	0	0	0	0	0	0	0	0	2,316
(2) Project											
Personnel	0	0	35	35	37	37	37	37	37	37	292
Fuel	0	0	69	69	91	91	91	91	91	91	684
Maintenance	0	0	73	73	91	91	91	91	91	91	692
Others	0	0	112	119	130	138	153	161	169	177	1,159
Depreciation	0	0	962	1,017	1,113	1,180	1,300	1,370	1,440	1,511	9,893
Sub total	0	0	1,251	1,313	1,462	1,537	1,672	1,750	1,828	1,907	12,720
Total	1,127	1,189	1,251	1,313	1,462	1,537	1,672	1,750	1,828	1,907	15,036
e Branch office											
(1) Outside project											
Personnel	389	389	389	389	389	389	389	389	389	389	3,890
Fuel	0	0	0	0	0	0	0	0	0	0	0
Maintenance	0	0	0	0	0	0	0	0	0	0	0
Others	117	117	117	117	117	117	117	117	117	117	1,170
Depreciation	0	0	0	0	0	0	0	0	0	0	0
Sub total	506	506	506	506	506	506	506	506	506	506	5,060
(2) Project											
Personnel	0	0	0	0	0	0	0	0	0	0	0
Fuel	0	0	0	0	0	0	0	0	0	0	0
Maintenance	0	0	0	0	0	0	0	0	0	0	0
Others	0	0	0	0	0	0	0	0	0	0	0
Depreciation	0	0	0	0	0	0	0	0	0	0	0
Sub total	0	0	0	0	0	0	0	0	0	0	0
Total	506	506	506	506	506	506	506	506	506	506	5,060
Grand Total	4,236	4,091	6,417	6,455	7,017	7,723	7,901	7,778	8,165	8,283	68,066
Outside project	4,236	4,091	2,524	2,287	1,503	1,514	1,086	848	864	637	19,590
Project	0	0	3,893	4,168	5,514	6,209	6,815	6,930	7,301	7,646	48,476

Table 3.3 Facility Outline of Tamangapa Disposal Site for Feasibility Study Project

Facility	Dimension	Unit	Quantity		Quantity
			Zone I	Zone II	
I. Main Facilities					
1 Access road	Road width : 11 m (asphalt paved)	m	97	--	97
2 Onsite road					
a. with dike	Road width : 5 m, h = 3 m (concrete paved)	m	674	454	1,128
b. without dike	Road width : 5 m (concrete paved)	m	252	585	837
3 Partition dike	Dike width : 5 m, h = 3 m (gravel paved)	m	375	--	375
4 Operational road	Road width : 8 m, h = 1 m (gravel paved)	m	885	712	1,597
5 Storm water drainage	U-shaped gutter 400W x 300D	m	194	--	194
	U-shaped gutter 700W x 500D	m	1911	1805	3,716
II. Environmental Protection Facilities					
1 Site total area (Stripping top layer and early compaction)	average : h = 1.0 m	ha	19	13	32
2 Landfill area		ha	17	11	28
3 Leachate collection pipe	PVC perforated pipe : dia. 200 mm	m	875	600	1,475
	PVC perforated pipe : dia. 400 mm	m	1285	1240	2,525
4 Gas removal facilities	PVC perforated pipe : dia. 70 mm (horizontal facility)	m	2160	1840	4,000
	Steel net etc. (vertical facility)	m2	1872 (24 unit)	2028 (26 unit)	3,900
5 Leachate circulation system (leachate treatment)	34 m3/ha/day (leachate amount)	LS	1	--	1
6 Leachate discharge facilities	PVC pipe : dia. 200 mm	m	1700	--	1,700
	Pump station	unit	1	--	1
7 Monitoring well		unit	2	1	3
III. Safety Facilities					
1 Surrounding works	Fence & gate, Lighting pole etc.	LS	1	1	1

Table 3.4 Facility Outline of Samata Disposal Site for Feasibility Study Project

Facility	Dimension	Unit	Quantity
I. Main Facilities			
1 Access road	Road width : 12 m (asphalt paved)	m	1,480
2 Access road bridge	Bridge width : 10 m (concrete bridge)	m	30
3 Onsite road (with dike)	Road width : 5 m, h = 3 m (concrete paved)	m	3,200
4 Partition dike	Dike width : 5 m, h = 3 m (gravel paved)	m	1,739
5 Operational road	width : 8 m, h = 1.0 m (gravel paved)	m	2,678
6 Storm water drainage	U-shaped gutter 400W x 300D U-shaped gutter 700W x 500D	m m	2,960 9,880
II. Environmental Protection Facilities			
1 Site total area (stripping top layer and earth compaction)	average : h = 1.0 m	ha	65
2 Landfill area		ha	61.1
3 Leachate collection pipe	PVC perforated pipe : dia. 200 mm PVC perforated pipe : dia. 400 mm PVC perforated pipe : dia. 500 mm	m m m	15,620 2,550 590
4 Gas removal facilities	PVC perforated pipe : dia. 70 mm (horizontal facility) Steel net etc. (vertical facility / 117 unit)	m m2	18,170 9,126
5 Leachate treatment plant (aeration lagoon system)	34 m3/ha/day (leachate amount)	LS	1
6 Leachate discharge facilities	PVC pipe : dia. 200 mm Pump station	m unit	1,100 1
7 Monitoring well		unit	3
III. Building and Accessories			
1 Office building		m2	150
2 Weigh bridge a. Building b. Facilities	 Load cell type, 30 ton capacity	 m2 unit	 250 2
3 Gate house		m2	30
4 Washing station a. Building b. Facilities	 	 m2 LS	 80 1
5 Surrounding works	Fence & gate, lighting facility etc.	LS	1

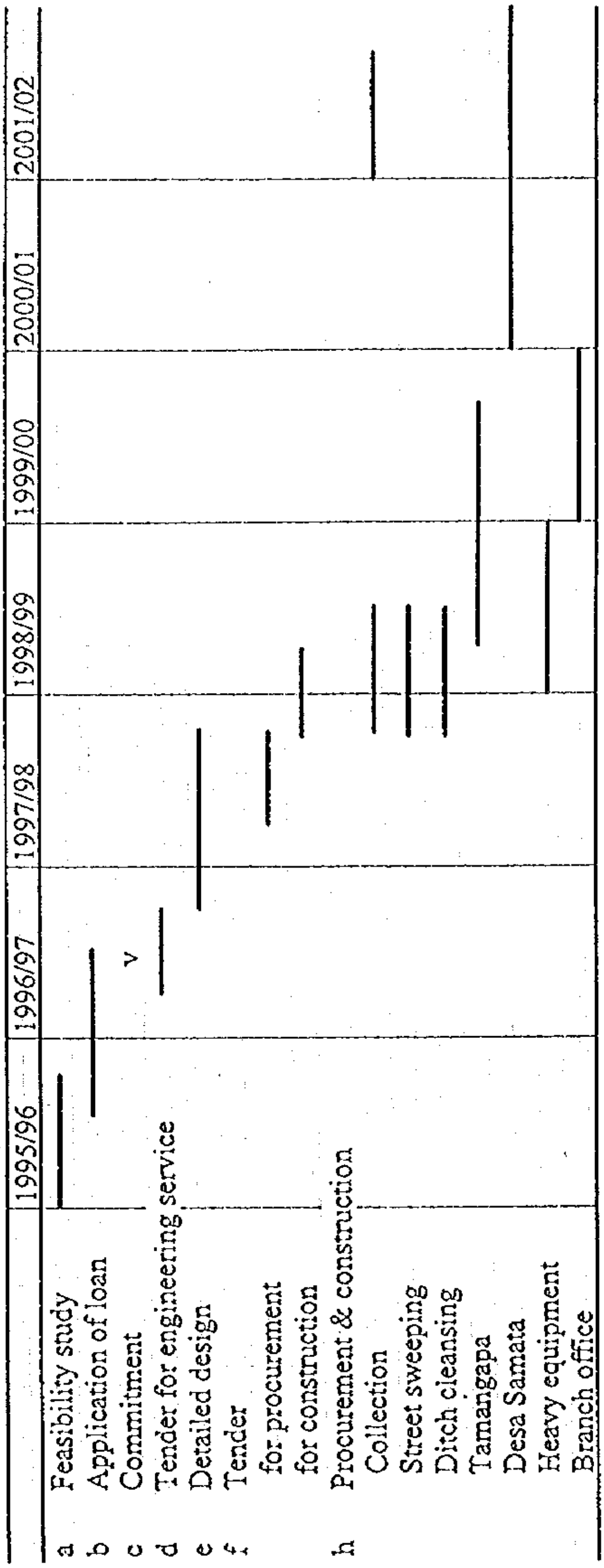

FIG. 3.1	Implementation Schedule of Feasibility Study Project

MASTER PLAN AND FEASIBILITY STUDY ON WASTEWATER AND SOLID WASTE MANAGEMENT FOR THE CITY OF UJUNG PANDANG IN THE REPUBLIC OF INDONESIA

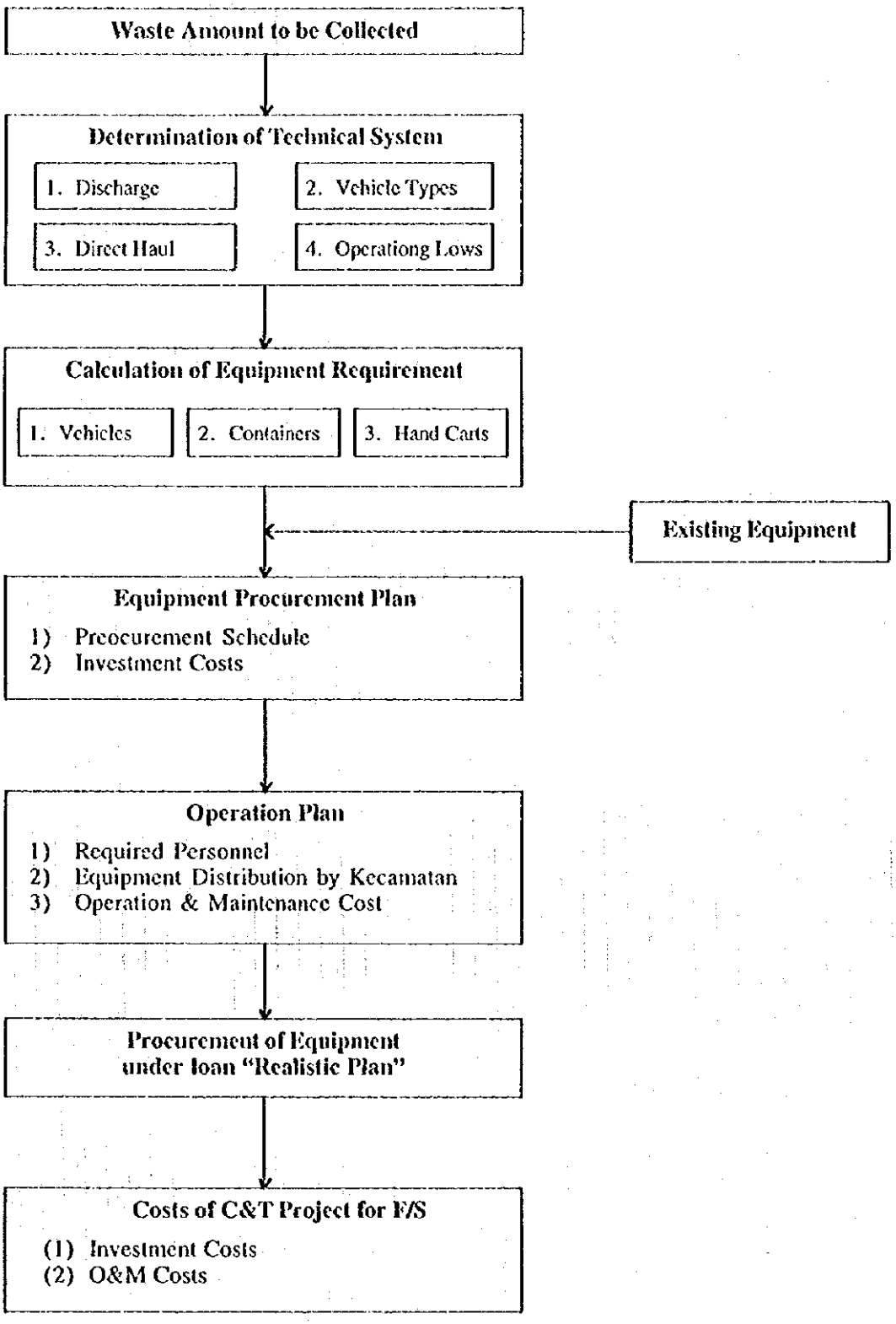

FIG. 3.2 Collection and Transport Priority Project Flow

MASTER PLAN AND FEASIBILITY STUDY ON WASTEWATER AND SOLID WASTE MANAGEMENT FOR THE CITY OF UJUNG PANDANG IN THE REPUBLIC OF INDONESIA

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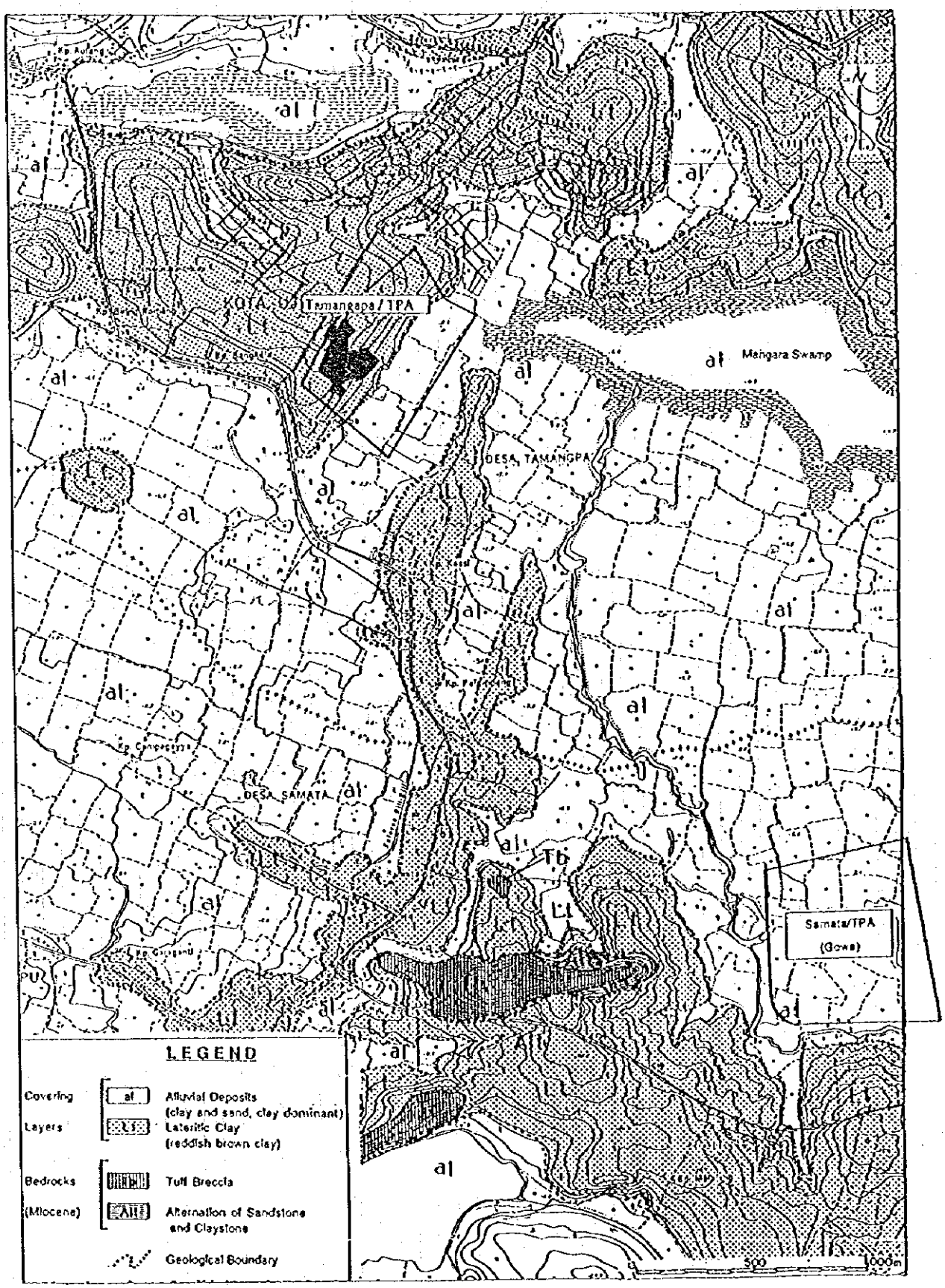

FIG. 3.3 Geological Feature of Tamangapa & Samata Area

MASTER PLAN AND FEASIBILITY STUDY ON WASTEWATER AND SOLID WASTE MANAGEMENT FOR THE CITY OF UJUNG PANDANG IN THE REPUBLIC OF INDONESIA

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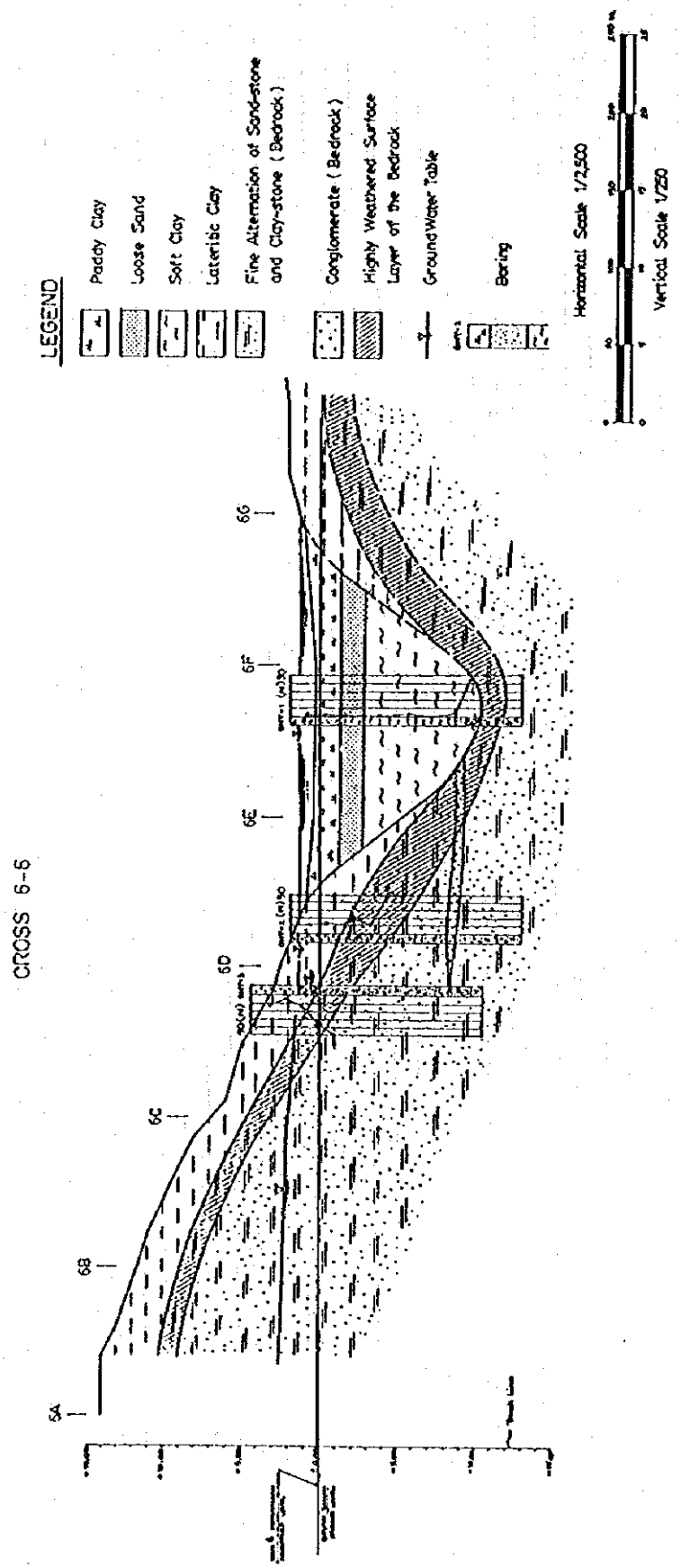

FIG. 3.4 Geological Profile of Tamangapa Disposal Site

MASTER PLAN AND FEASIBILITY STUDY ON WASTEWATER AND SOLID WASTE MANAGEMENT FOR THE CITY OF UJUNG PANDANG IN THE REPUBLIC OF INDONESIA

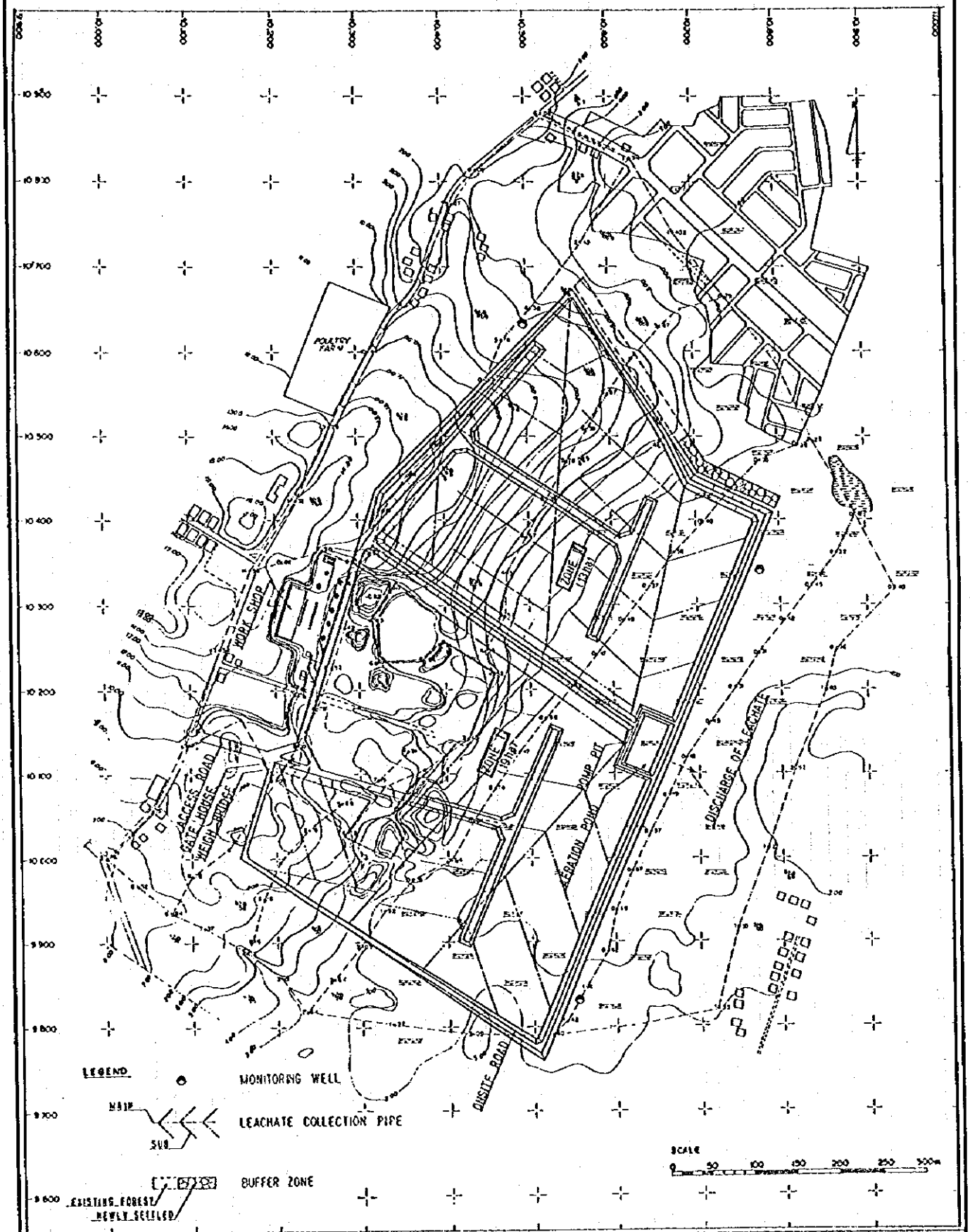

FIG. 3.5 Layout Plan of Tamangapa Disposal Site

MASTER PLAN AND FEASIBILITY STUDY ON WASTEWATER AND SOLID WASTE MANAGEMENT FOR THE CITY OF UJUNG PANDANG IN THE REPUBLIC OF INDONESIA

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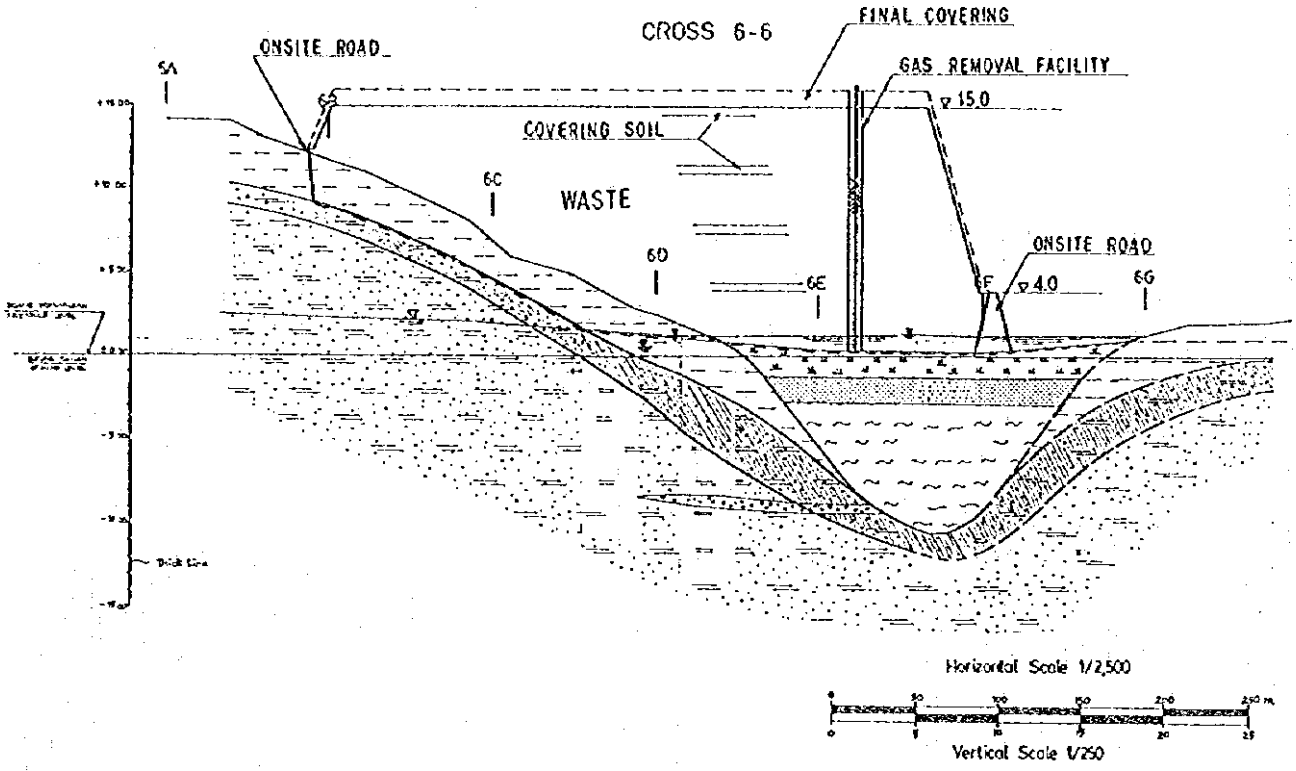
Typical Section of Tamangapa Disposal Site



Leachate Circulation System (Aeration Lagoon System)

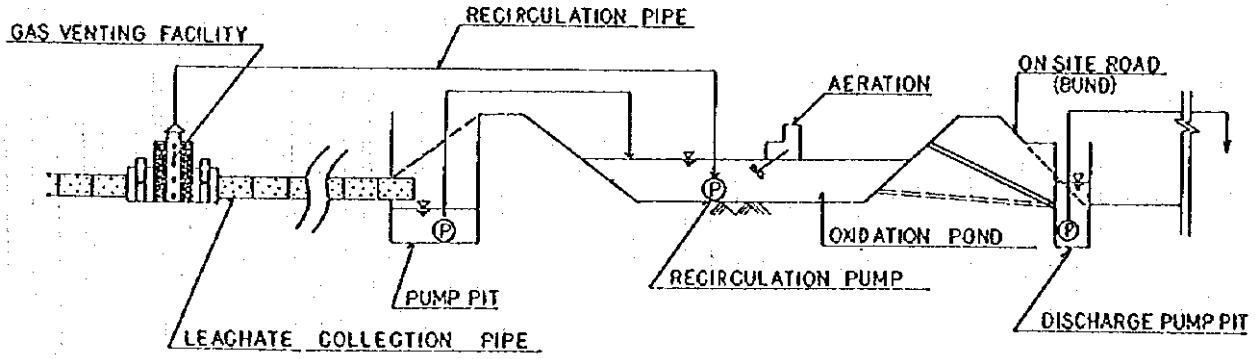


FIG. 3.6	Typical Facilities of Tamangapa Disposal Site

MASTER PLAN AND FEASIBILITY STUDY ON WASTEWATER AND SOLID WASTE MANAGEMENT FOR THE CITY OF UJUNG PANDANG IN THE REPUBLIC OF INDONESIA

JICA A.D.1995

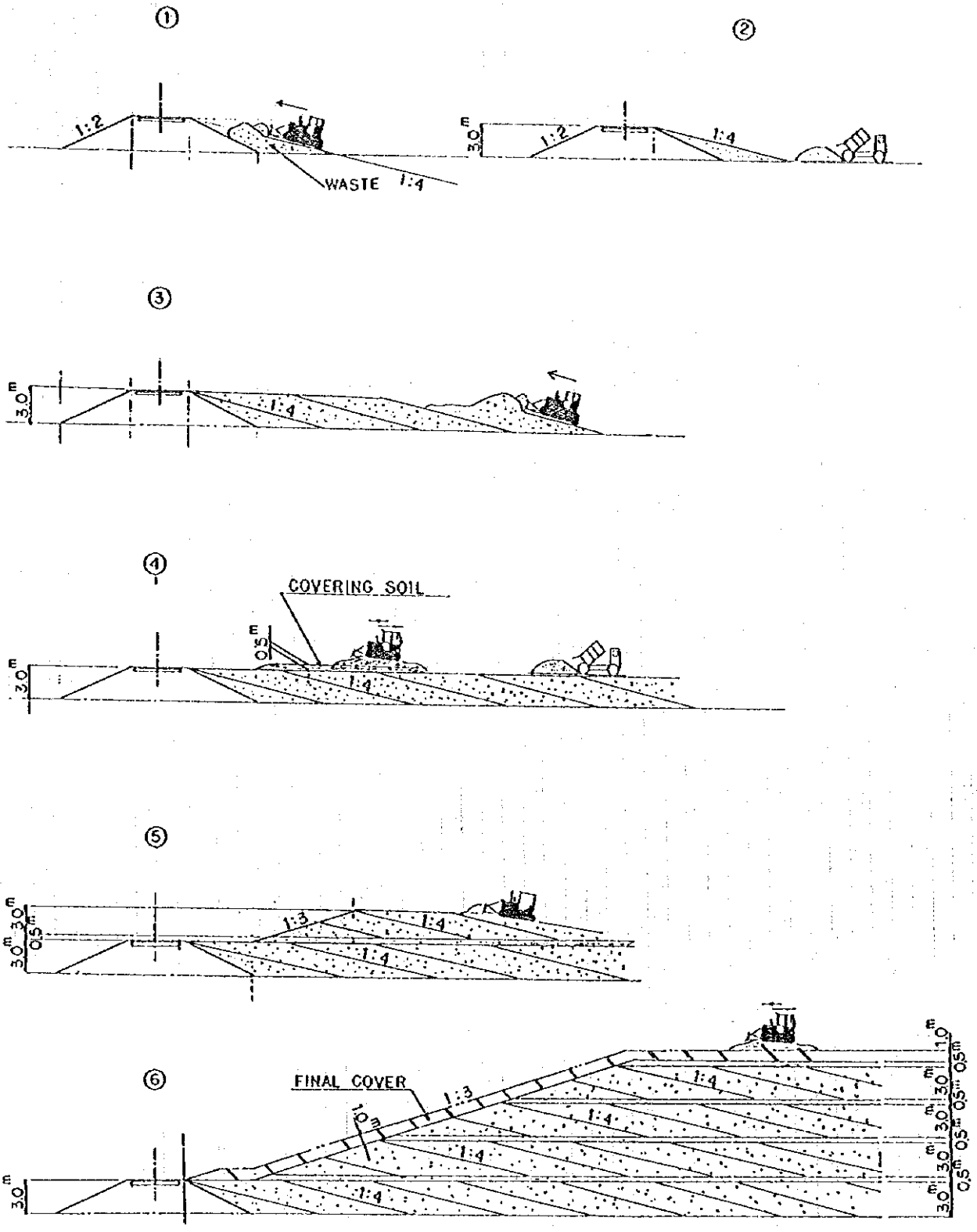


FIG. 3.7 Landfill Method of Final Disposal Site (Cell Method)

MASTER PLAN AND FEASIBILITY STUDY ON WASTEWATER AND SOLID WASTE MANAGEMENT FOR THE CITY OF UJUNG PANDANG IN THE REPUBLIC OF INDONESIA

JICA A.D.1995

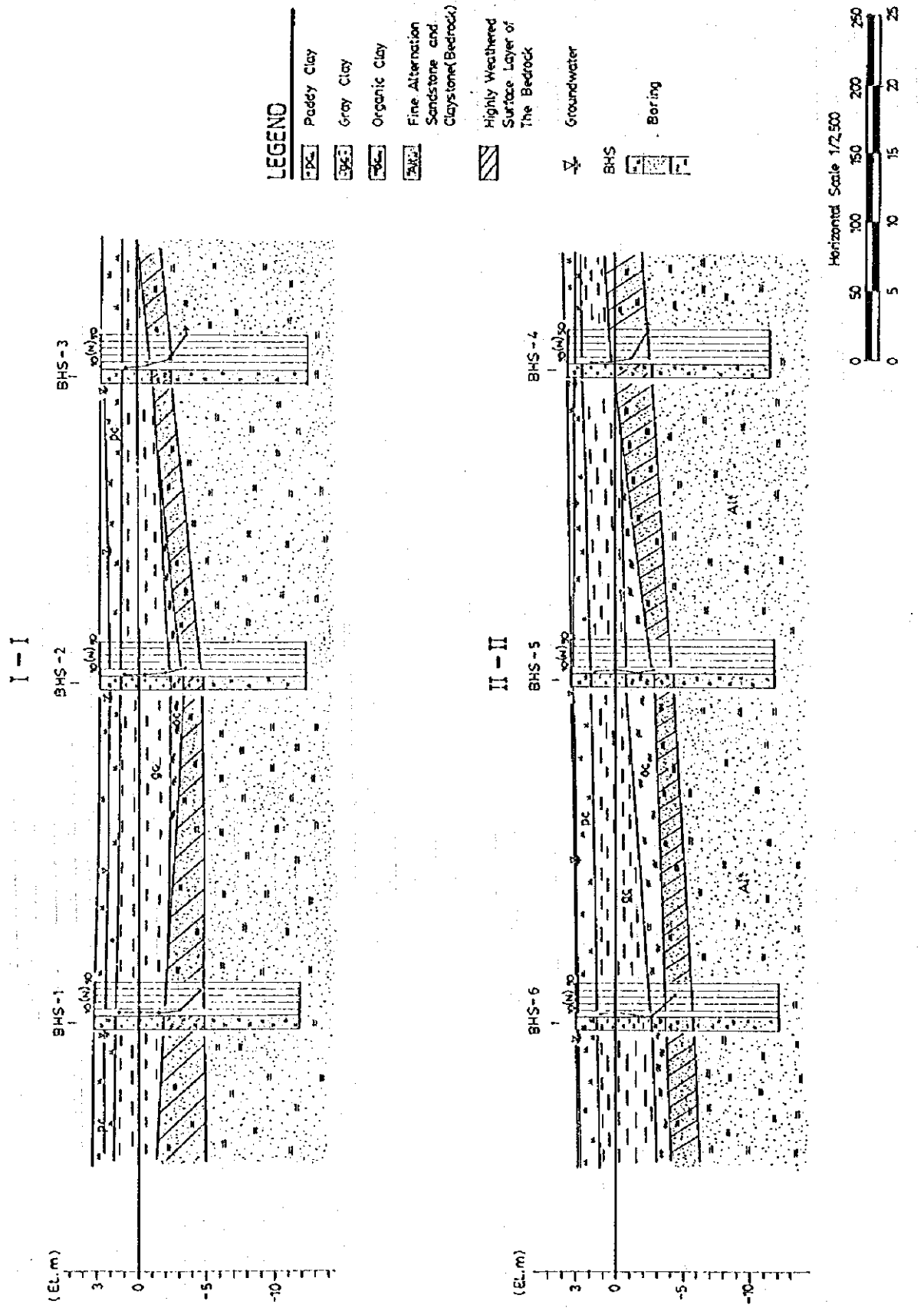


FIG. 3.8 Geological Profile of Samata Disposal Site

MASTER PLAN AND FEASIBILITY STUDY ON WASTEWATER AND SOLID WASTE MANAGEMENT FOR THE CITY OF UJUNG PANDANG IN THE REPUBLIC OF INDONESIA

JICA A.D.1995

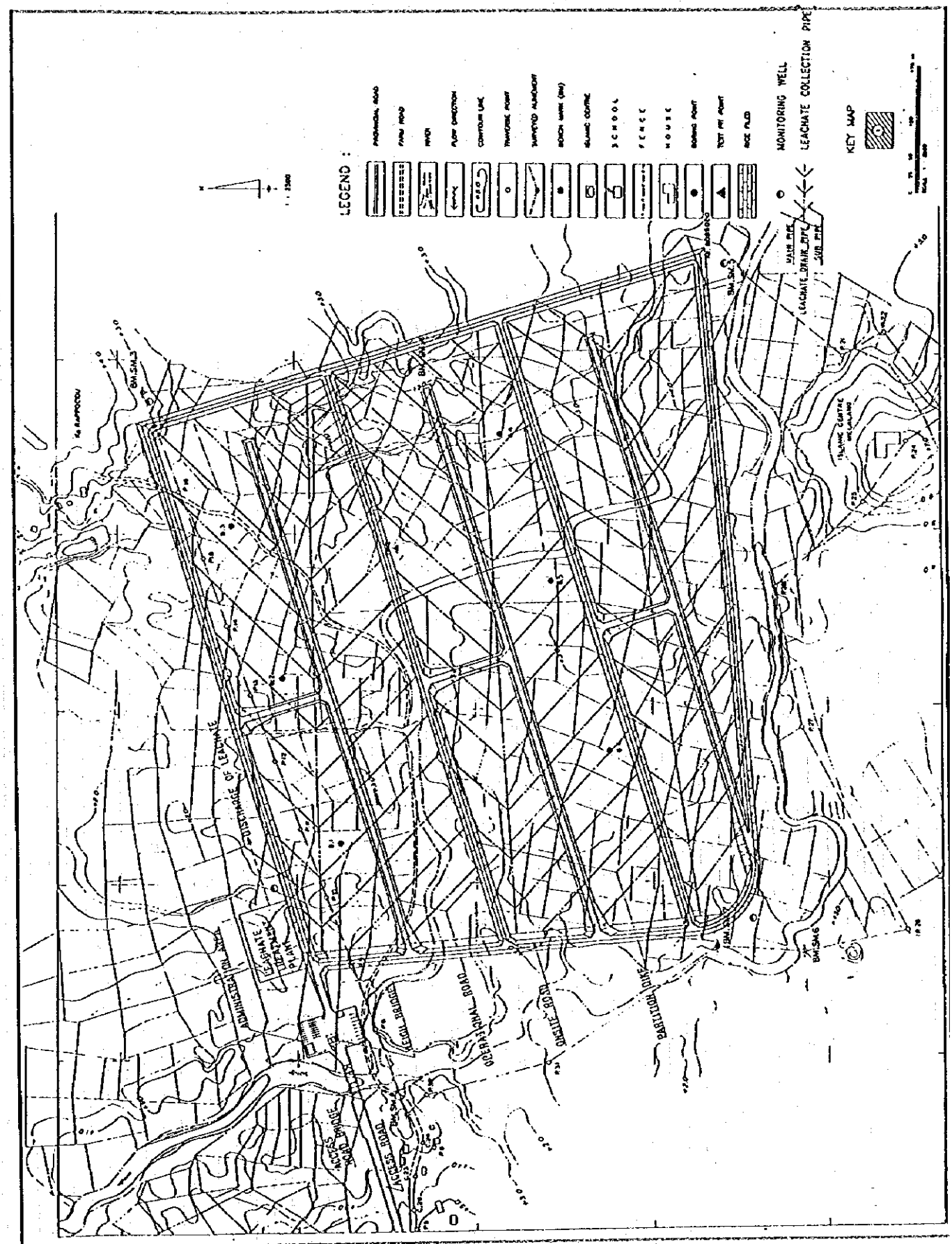
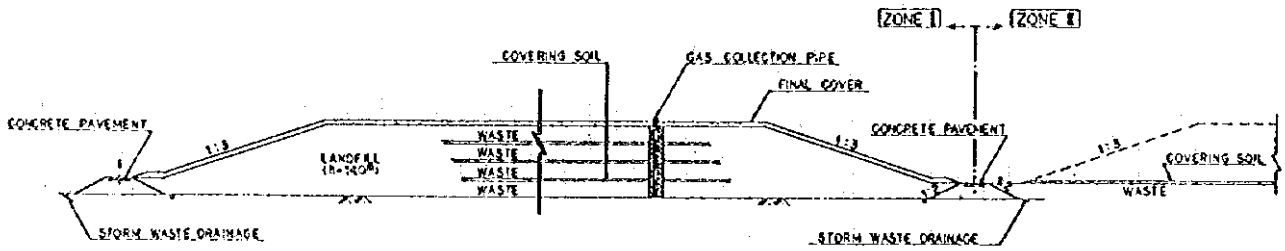


FIG. 3.9 Facility Plan at Samata Disposal Site

MASTER PLAN AND FEASIBILITY STUDY ON WASTEWATER AND SOLID WASTE MANAGEMENT FOR THE CITY OF UJUNG PANDANG IN THE REPUBLIC OF INDONESIA

JICA A.D.1995

Typical Section of Samata Disposal Site



Site Plan of Administration Area for Samata Disposal Site

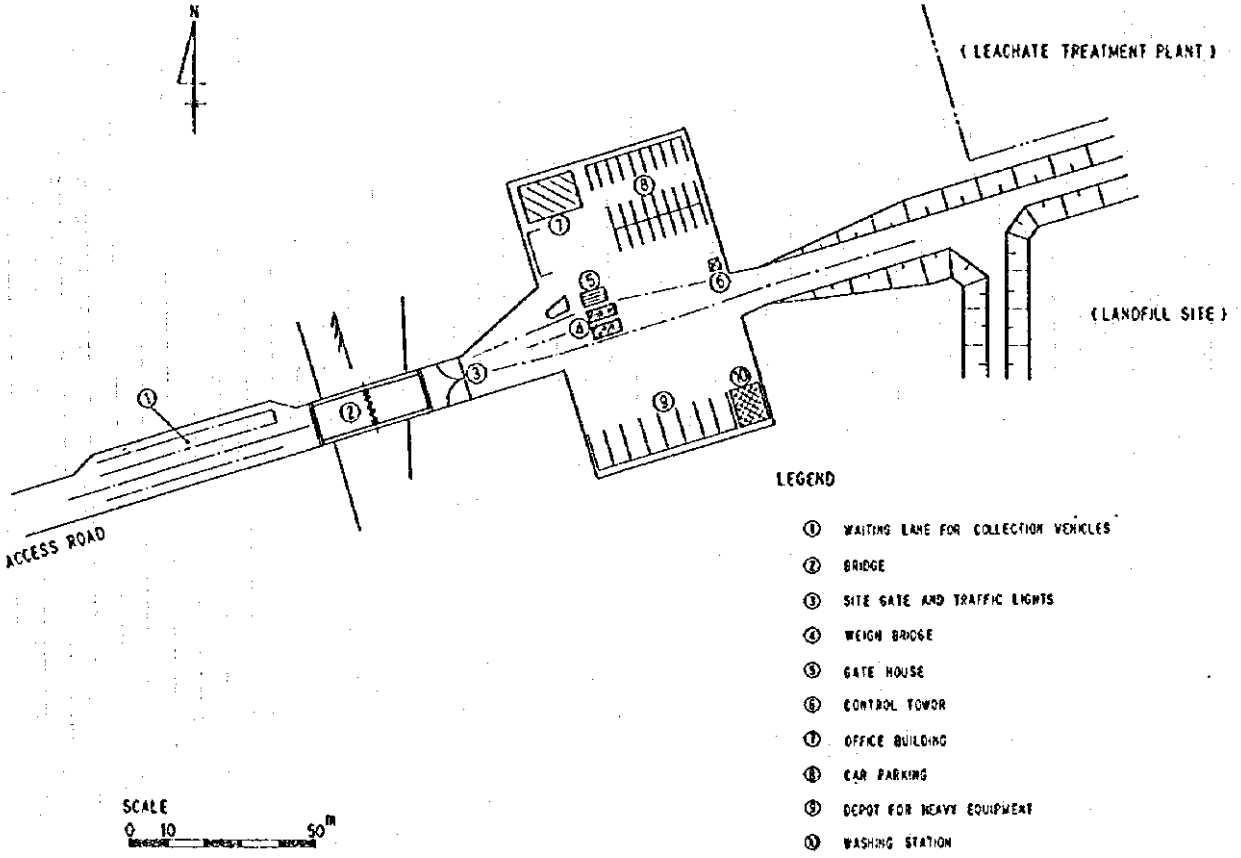


FIG. 3.10 Typical Facilities of Samata Disposal Site

MASTER PLAN AND FEASIBILITY STUDY ON WASTEWATER AND SOLID WASTE MANAGEMENT FOR THE CITY OF UJUNG PANDANG IN THE REPUBLIC OF INDONESIA

JICA A.D.1995

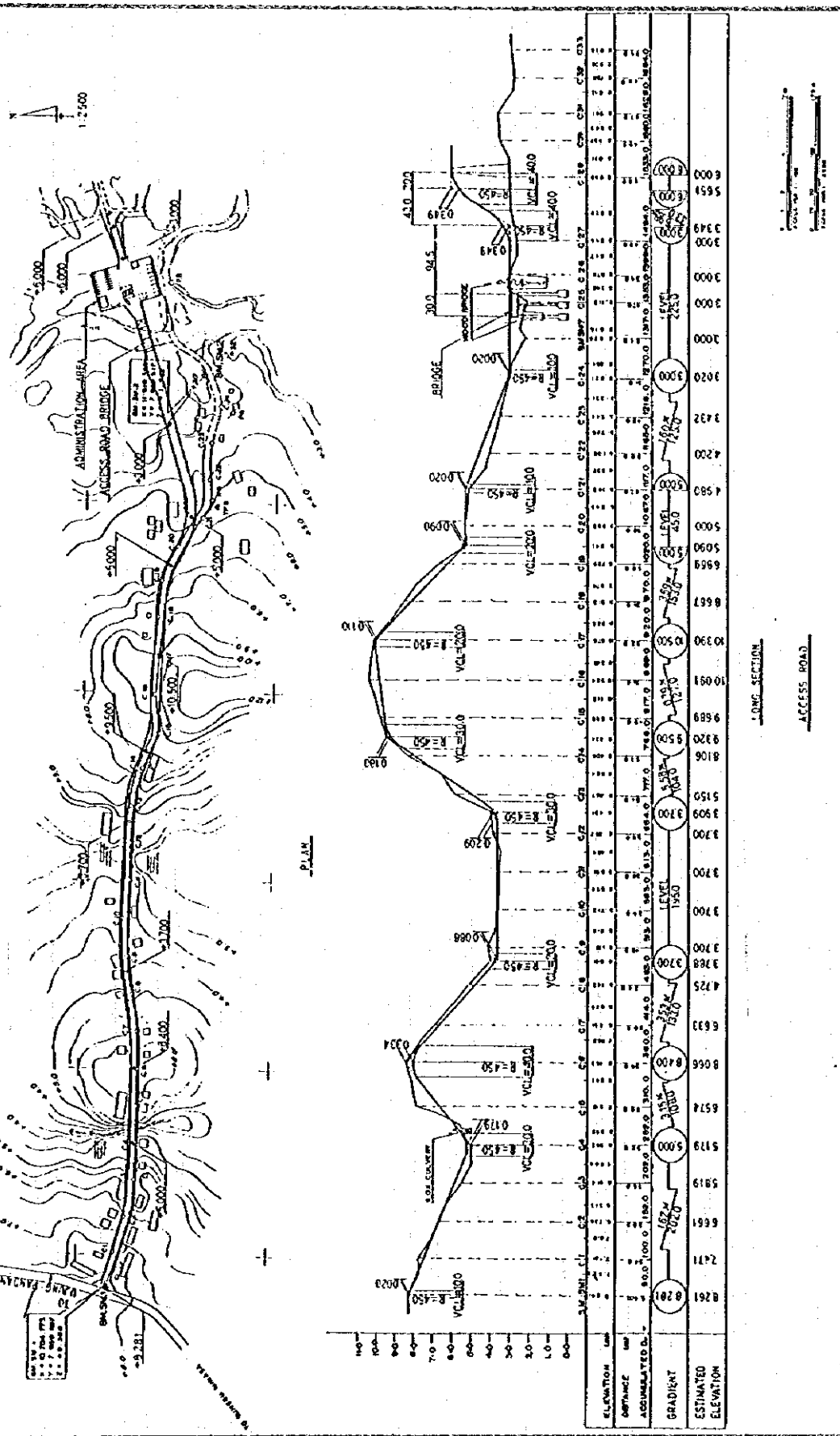


FIG. 3.11 Access Road Plan of Samata Disposal Site

MASTER PLAN AND FEASIBILITY STUDY ON WASTEWATER AND SOLID WASTE MANAGEMENT FOR THE CITY OF UJUNG PANDANG IN THE REPUBLIC OF INDONESIA

JICA A.D.1995

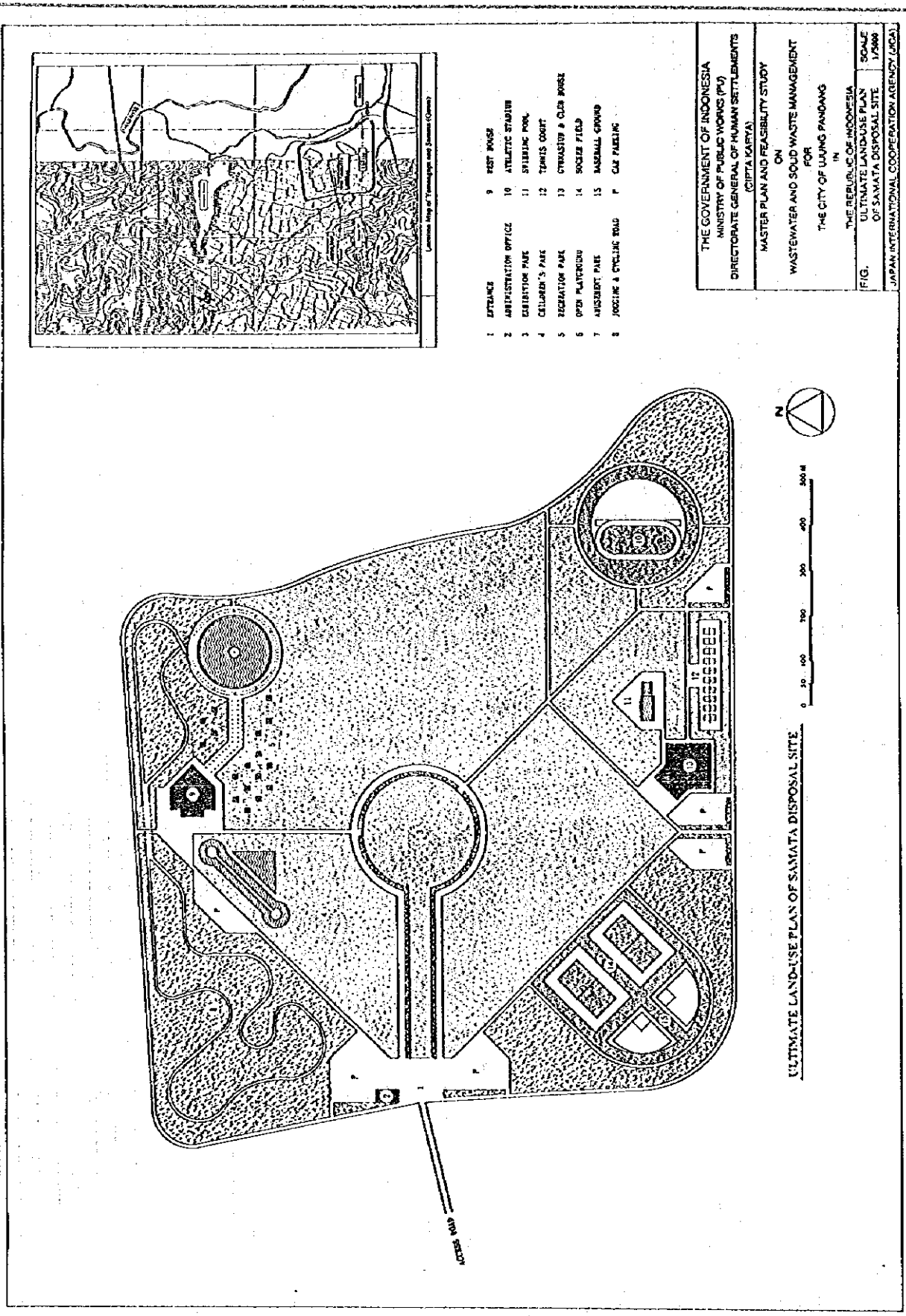


FIG. 3.12 Ultimate Land-use Plan of Samata Disposal Site

MASTER PLAN AND FEASIBILITY STUDY ON WASTEWATER AND SOLID WASTE MANAGEMENT FOR THE CITY OF UJUNG PANDANG IN THE REPUBLIC OF INDONESIA

JICA A.D.1995

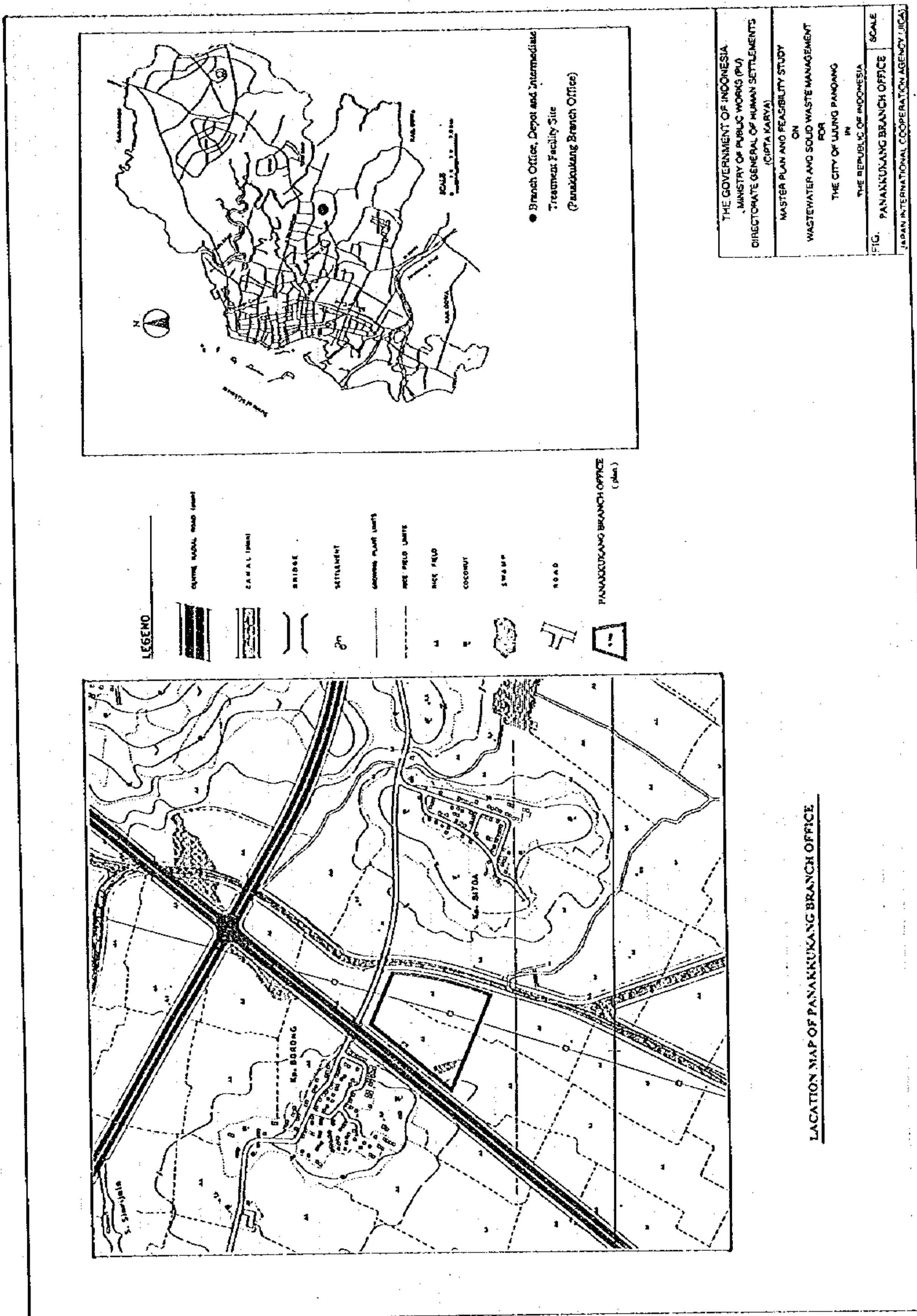


FIG. 3.13	Location of Panakkukang Branch Office

MASTER PLAN AND FEASIBILITY STUDY ON WASTEWATER AND SOLID WASTE MANAGEMENT FOR THE CITY OF UJUNG PANDANG IN THE REPUBLIC OF INDONESIA

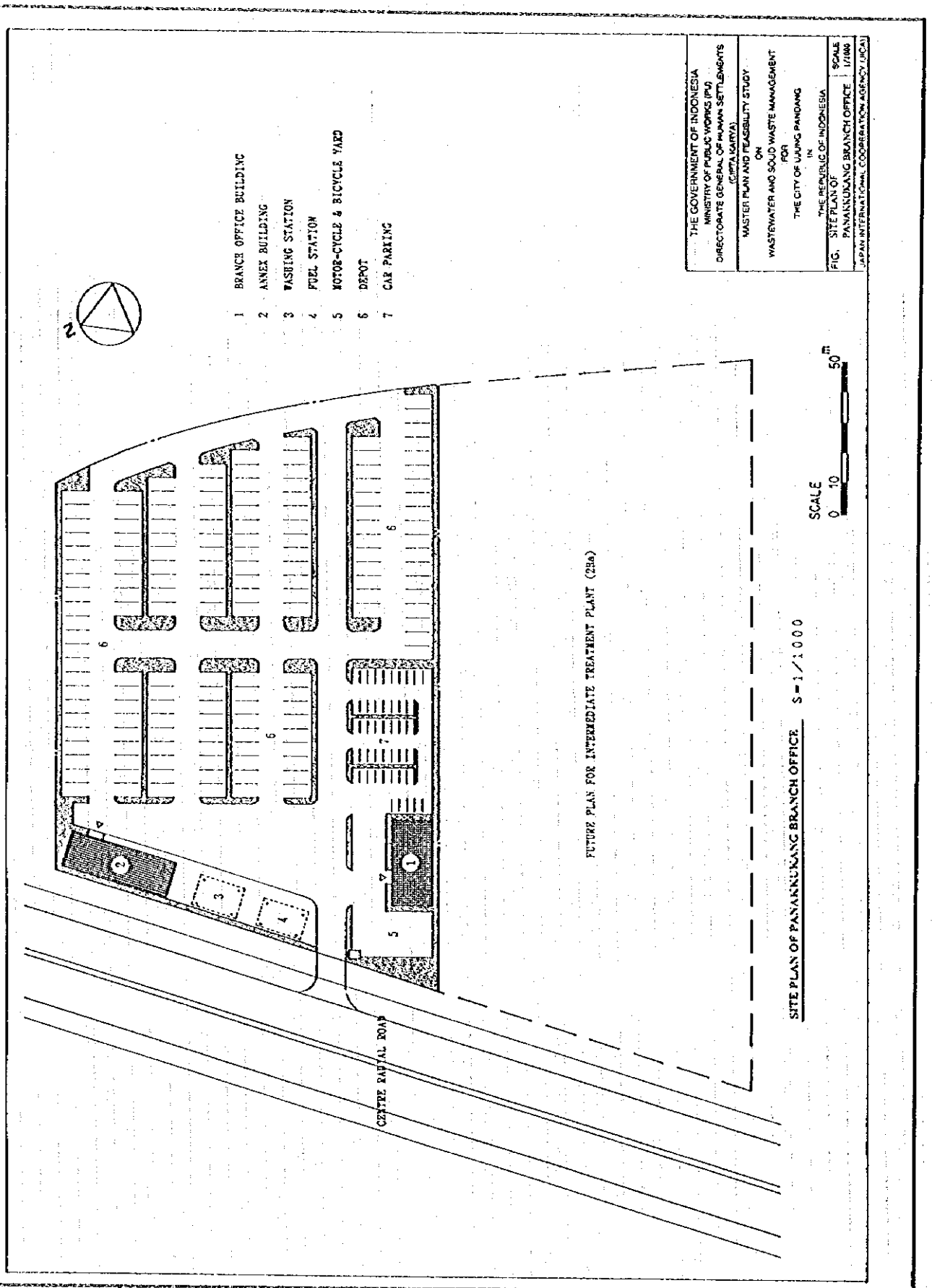


FIG. 3.14 Site Plan of Panakkukang Branch Office

CHAPTER 4
IMPLEMENTATION PROGRAM

CHAPTER 4 IMPLEMENTATION PROGRAM

4.1 Implementation Schedule

4.1.1 Wastewater management

The significant project components of wastewater management, for as the feasibility project, to be accomplished until the year 2005 are as follows :

1. Rehabilitation and construction and of public toilets (MCK)
2. Improvement of access road to Antang septage treatment plant
3. Procurement of additional vacuum trucks
4. Development of northern sewerage system
5. Development of central sewerage system
6. Development of southern sewerage system
7. Implementation of pilot project

The proposed implementation schedule of wastewater management project is shown in *Fig.* 4.1.

4.1.2 Solid waste management

The significant project components of solid waste management, as feasibility project, to be accomplished until the year 2005 are as follows :

1. Expansion and improvement to semi-sanitary landfill system of existing Tamangapa final disposal site
2. First stage development of Samata final disposal site as sanitary landfill system
3. Development of access road to Samata final disposal site
4. Procurement of required equipment to improve solid waste collection service level, that would include armroll, tipper, container and hand cart

The proposed implementation schedule of solid waste management project is shown in *Fig.* 4.2.

4.2 Financing Plan

4.2.1 Source and Flow of Funds for Local Governments

In support of local government efforts for provision of public services concerned, various external funding sources available will be overviewed. In pursuance of meeting region's urgent needs for sound human environment, local governments receives (i) foreign loans/grants, (ii) central/local government (state budget for revenue and expenditure-*APBN* transfers through sectoral development budgets-*DIPs*, Presidential Instruction-*INPRES*, provincial budget-*APBD* I) to their development accounts, and another central government transfer, vis-à-vis, subsidy to autonomous regions, or *Subsidi Daerah Otonomi-SDO* and assigned revenue (land and property tax, or *Pajak Bumi dan Bangunan-PBB*) to routine accounts.[1]

The Sectoral *DIPs* are sectoral expenditures allocated to central government technical ministries out of *APBN*. This sectoral grant does not go through *APBD* (I), being under the full control of the ministries from which it emanates. Physical outcomes of projects are consequently transferred to local governments as grants-in-kinds. Most of the urban infrastructure investments derives from *DIPs*, of which large bulk from the Ministry of Public Works (MOPW). During 1986-91, 54.7 percent of Indonesia's urban investment program came from *DIPs* with MOPW accounting for 96 percent.[2]

INPRES grants are central-local transfers authorized under presidential instruction, which comprises six categories, vis-à-vis, backward villages, villages, regencies (*kabupaten*), provinces, primary schools and public health centers.[3]. The general purpose of *INPRES* (villages, regencies, provinces), which is fully under the control of the recipient governments, are quasi-block grants and allocated per population of 5,000. During 1986-1991, *INPRES* accounted for 11 percent of Indonesia's urban investment program.

With agreements of the Ministers for Finance and Home Affairs, loan agreement (*RDA, SLA*) between provincial/local government and the central government can be effectuated. Largely due to a surge in foreign loans in combination with government new policy to channel 40 percent, in general, of foreign loan proceeds to local government as subsidiary loans, the number of loan agreement in this kind has grown since 1986.[4] Of the total urban infrastructure investment during 1986-91, loans accounted for 5.3 percent.

In addition, the *Subsidi Daera Otonomi* (*SDOs*) and the land and property tax (*PBB*) play in support of annual routine budget of local governments. *SDOs* are central government routine grants primarily for local government officials and centrally recruited local government employees' wages and salaries. As for the provincial government of South Sulawesi, around 40 percent of personnel costs is believed to be supported by *SDO* (1994). Unlike many other countries where the property tax is administered by local governments, *PBB* is levied by the central government while previously 65 percent of the total revenue was transferred back to the local government where it originated.

In the 1994 budget, the central government revised the distribution of the land and property tax (*PBB*) with a view to strengthening the revenue base, thereby enhancing financial autonomy and institutional capabilities of provincial and local governments. While the previously earmarked 10 percent of the proceeds for the central government is written-off, all proceeds above the collection fee (9 percent of the total *PBB* revenue) are transferred to provincial and local level governments.

Besides those fiscal transfers noted above, own-source revenues (*PAD*) constitute a little part of total local government revenue. This comprises local taxes, user charges, profits from regional enterprises and other miscellaneous income. It is estimated that in 1990 about 24 percent of routine revenue of provinces and 6 percent of those of local governments were met by locally generated revenues. In 1993, own revenues accounted for 35.6 percent of the total income of provincial governments (Rp.7,979 billion)[5]. Of these, in average, about 80 percent of local government taxes come from six taxes out of nine categorical taxes, inter alia, hotel and restaurant, street lighting, entertainment, advertisement, business registration, and slaughterhouse taxes.[6]

Fund flows for the urban sanitation sector in Indonesia is illustrated as *Fig.* 4.3.[7]

4.2.2 Affordable Fund for the Project

(1) Assumptions

As previously noted in the Master Plan Report, the affordability of the city in the implementation of the sanitation subsector project proposed has been duly scrutinized with a view to initially setting out the size of the Project. The following financial framework readily presents the

possible fund raised for the City of Ujung Pandang for which the lack of affordable credit is considered to be one of the serious constraints to upgrade the urban sanitation services. A summarized financial assumptions are forwarded as follows.

1) Key Socio-Economic Indicators

Real GDP/GRP growth per annum	5.5 percent in average
City Economy	0.4 percent and 22.1 percent of the national and provincial economy, respectively
Weighted Average Household income	Rp.3,034,000 per annum
Annual Population growth	3.56 percent in average

2) Elasticity

Unit elasticity of fund supply with regard to real GDP growth

3) Sources of Funds

As noted above, the two interrelated sectors in economy are considered such that the public sector denotes funds from any governmental bodies (APBN, INPRES, DIPs, APBD I and II) and the private sector funds from beneficiaries in the service areas (Willingness to Pay, Beneficiaries' contribution and Capital works charge). Foreign aid funds are implicitly included in the state fund in the form of sub-loan, equity investment and grant to the local government/prospective executing agencies. Presumably, no external private funds in conjunction with any private sector partnership projects are in sight for the analysis.

4) Investment Outlays

The investment outlays in the sanitation subsectors concerned commence in 1996 with benefits attributable to the preceding activities in the following year. Meanwhile, the investment in the off-site sewerage system may set forth later years.

5) Private Sector Participation

As partly noted in (3) above, a kind of surcharge, namely, *beneficiaries contribution* and *capital works charge* are requested to the direct beneficiaries of the Project in support of self-reliant and financially sound management of the sewerage service undertaking in the city.

6) A present factor of annuity factor (a reciprocal of Capital Recovery Factor)

$$a(i,n) = \frac{(1+i)^n - 1}{i(1+i)^n}$$

where i : annual interest rate, n: repayment period

The detailed model configuration and assumptive parameters will be referred to in the Supporting Report attached to the Master Plan Report.

(2) Affordable Fund

In the context of the foregoing, and with an annuity of Rp.13.5-15.5 billion (US$6-7 million), the affordable fund for Ujung Pandang city will be set forth at around Rp.101.25 billion (US$45 million), thus making it possible for the project to be formulated at around Rp.168.75 billion (US$ 75 million) with grant of Rp.67.5 billion (US$ 30 million) as given. Concerning the possible variances of the estimates, see the Supporting Report attached to the Master Plan Report.

4.2.3 Financing Plan

The proposed financing plan associated with the proposed Project scope is shown in below. The own fund of Rp.6.6 billion ($3.0 million) raised by the city will meet about 4 percent of the total capital requirement of Rp.175.4 billion ($77.9 million). In addition, debt servicing accrued to interest during construction (IDC) will be responsible for the city government. Disaggregating the remaining balance, a large chunk of Rp.101.2 billion ($45 million) emanates from loan fund followed by the central government transfer of Rp.67.5 billion ($30 million), each of these accounting for 58 percent and 38 percent, respectively.

	Foreign	Local	Total (Rp. billion)
Loan	35.4	65.8	101.2
Central Government Transfer	23.6	43.9	67.5
City Own Fund	2.3	4.3	6.6
Total (Rp. billion)	61.3	114.0	175.3