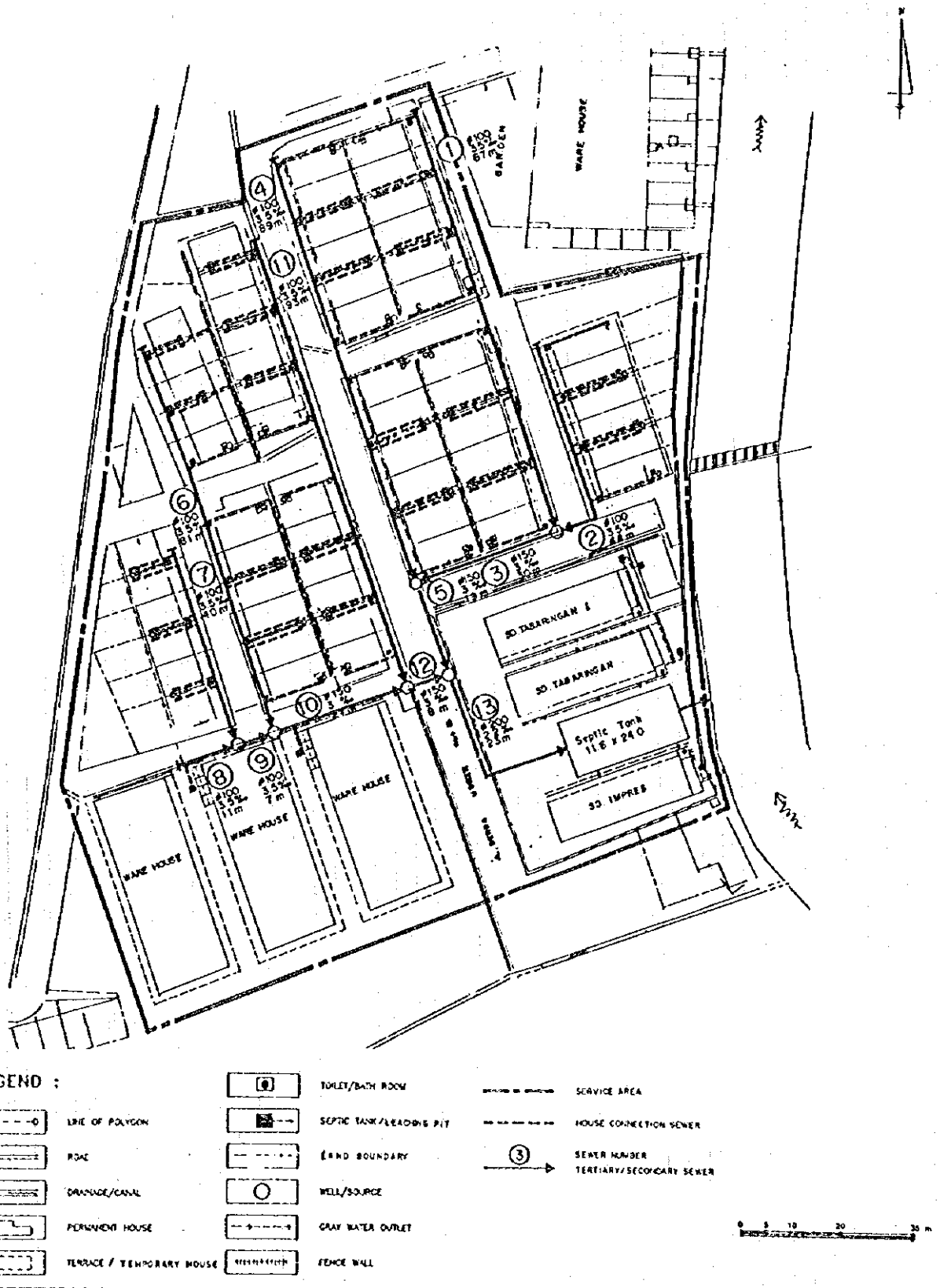

FIG. 5.42 Layout of SMS(B/G) at Totake

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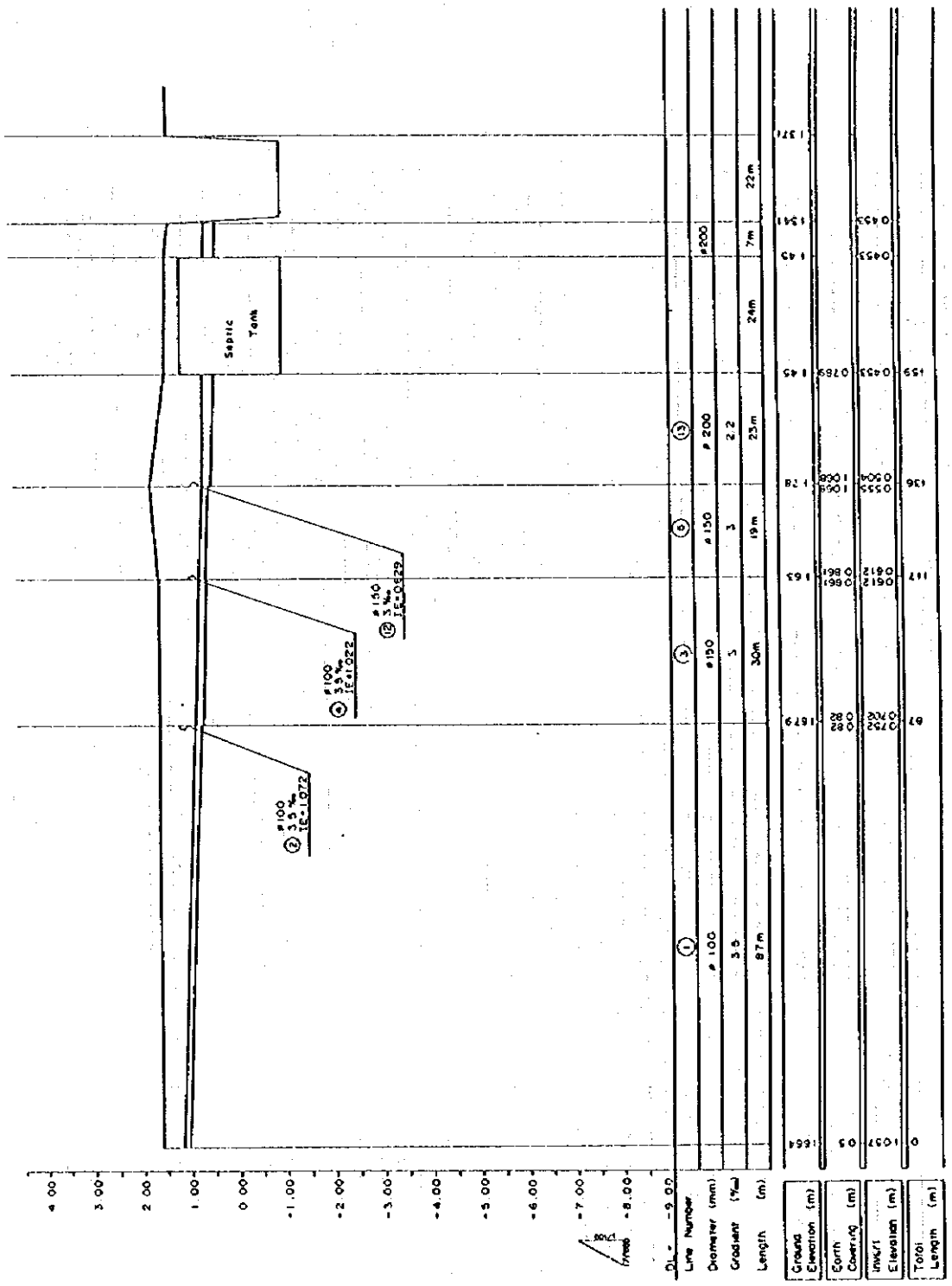

FIG. 5.43 Profile of SMS (B/G) at Totake

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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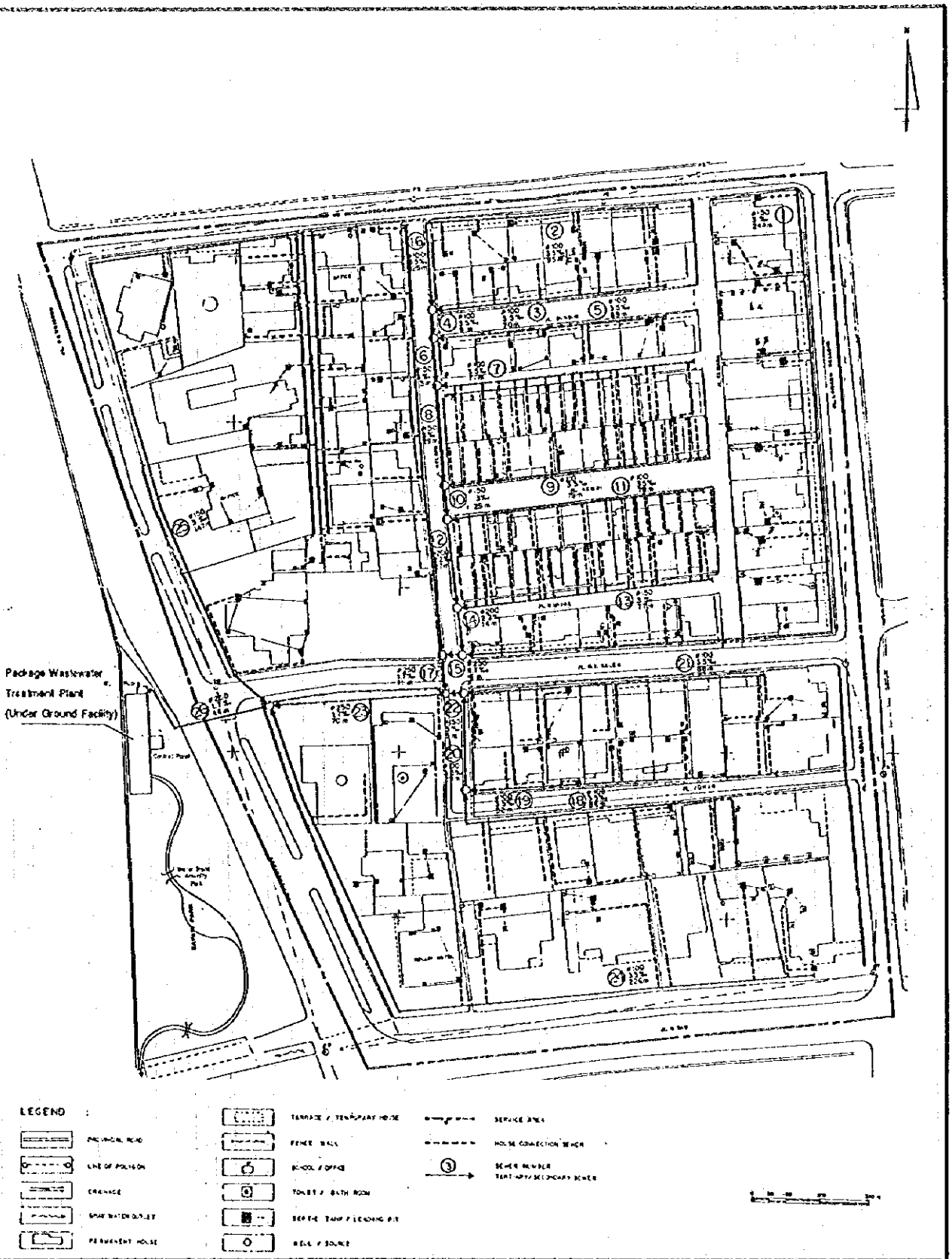

FIG. 5.44 Layout of SMS(B/G) at Losari

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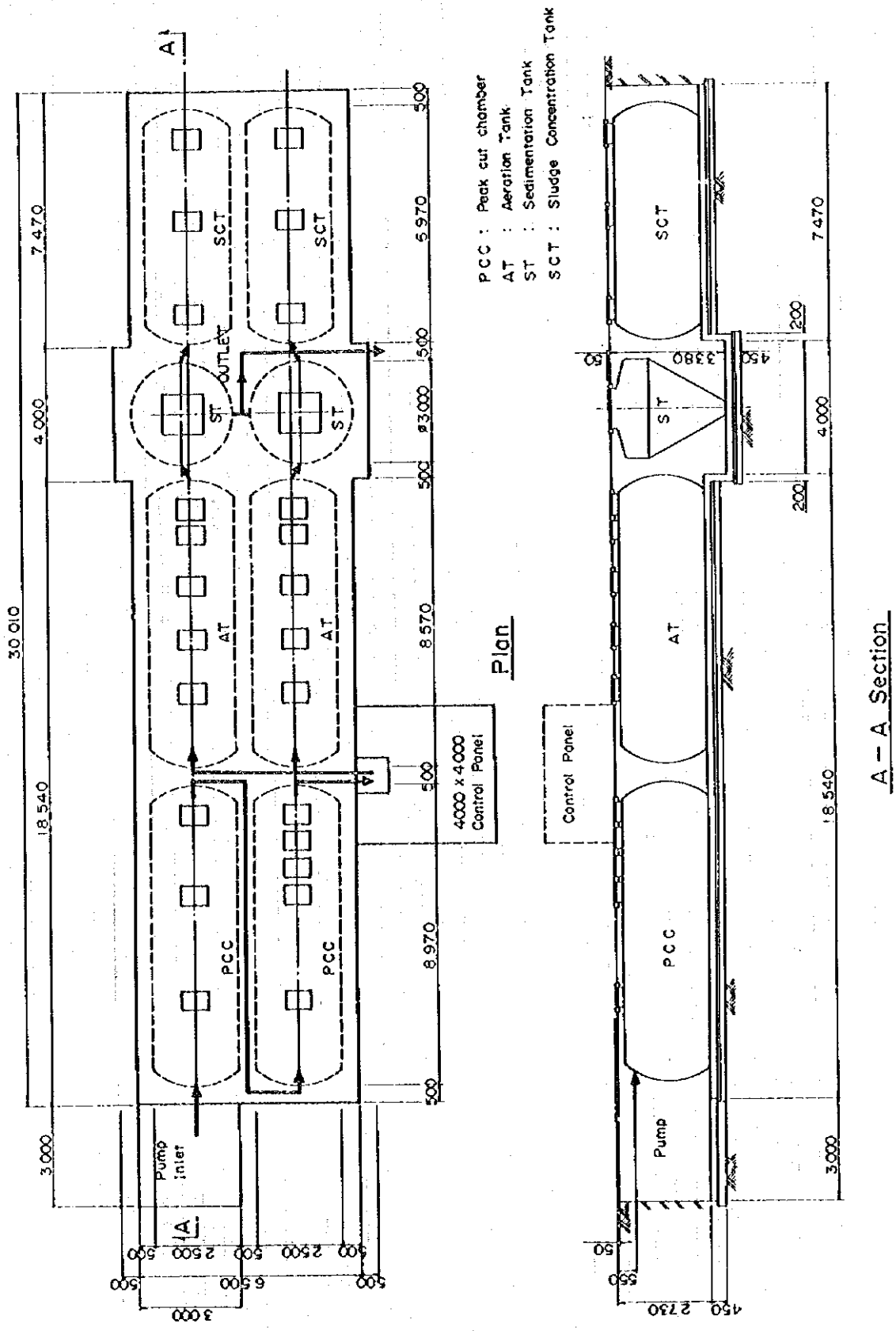

FIG. 5.45 Package Wastewater Treatment Plant at Losari

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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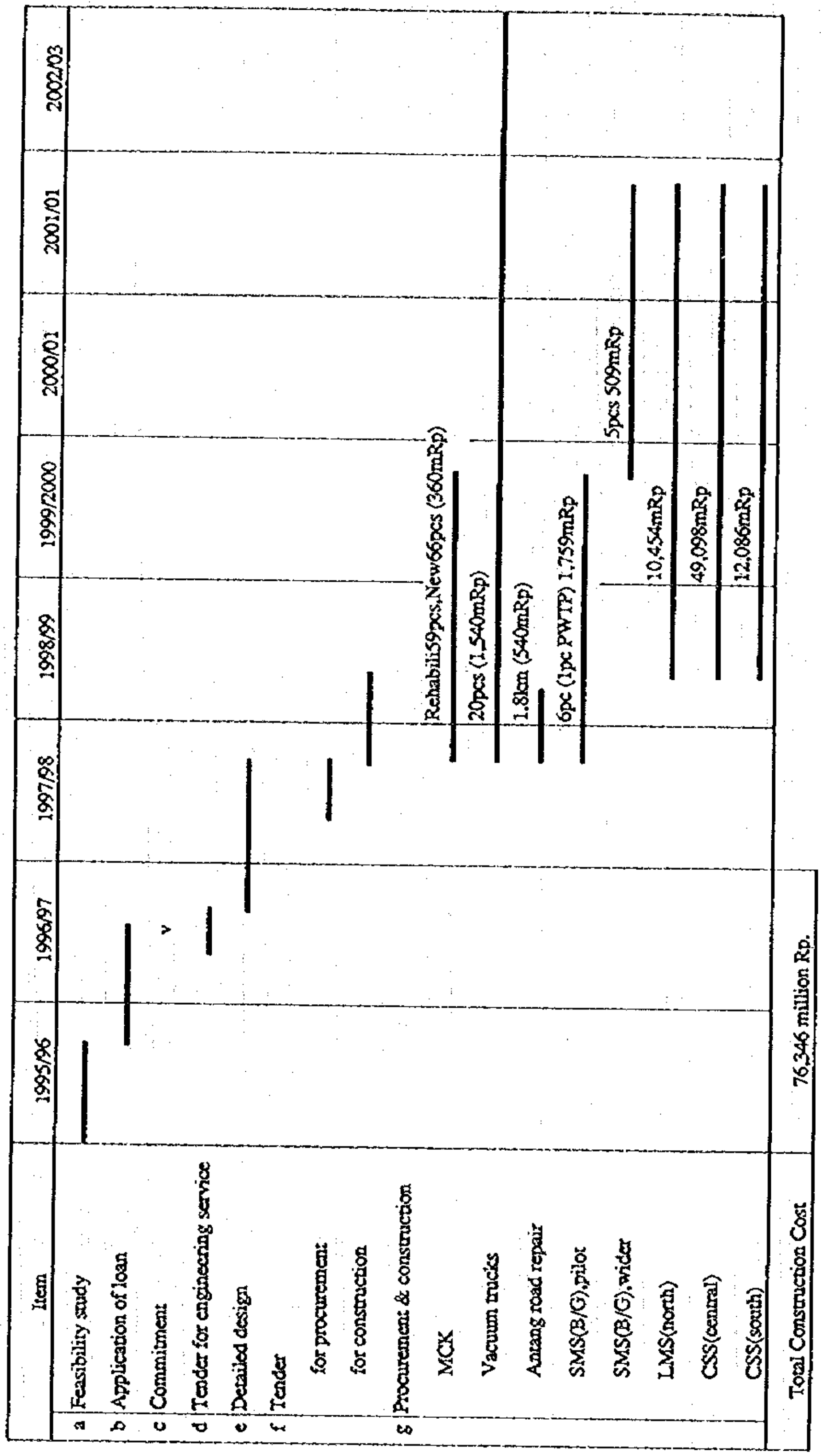

FIG. 5.46 Implementation Schedule of Feasibility Study Project

F/S Public Project (million Rp)

	1996-2000	2001-2005	2006-2015
Public toilet / SMS (B)	360 /360		
Procurement of vacuum trucks	1,540 / 1540		
Improvement of Antang STP	540 / 540		
Pilot Project of SMS (B/G)	2,268 / 2,268		
Sewerage System	71,638 / 71,638		

value: term cost/accumulation cost

M/P Public Project (million Rp)

	1996-2000	2001-2005	2006-2015
Public toilet / SMS (B)	360 /360		
Procurement of vacuum trucks	1,540 / 1540		4,774 / 6,314
Improvement of Antang STP	540 / 540		
Pilot Project of SMS (B/G)	2,268 / 2,268		
Sewerage System	71,638 / 71,638		470,166 / 541,804

value: term cost/accumulation cost

FIG. 5.47 Implementation Schedule of Wastewater Management Master Plan

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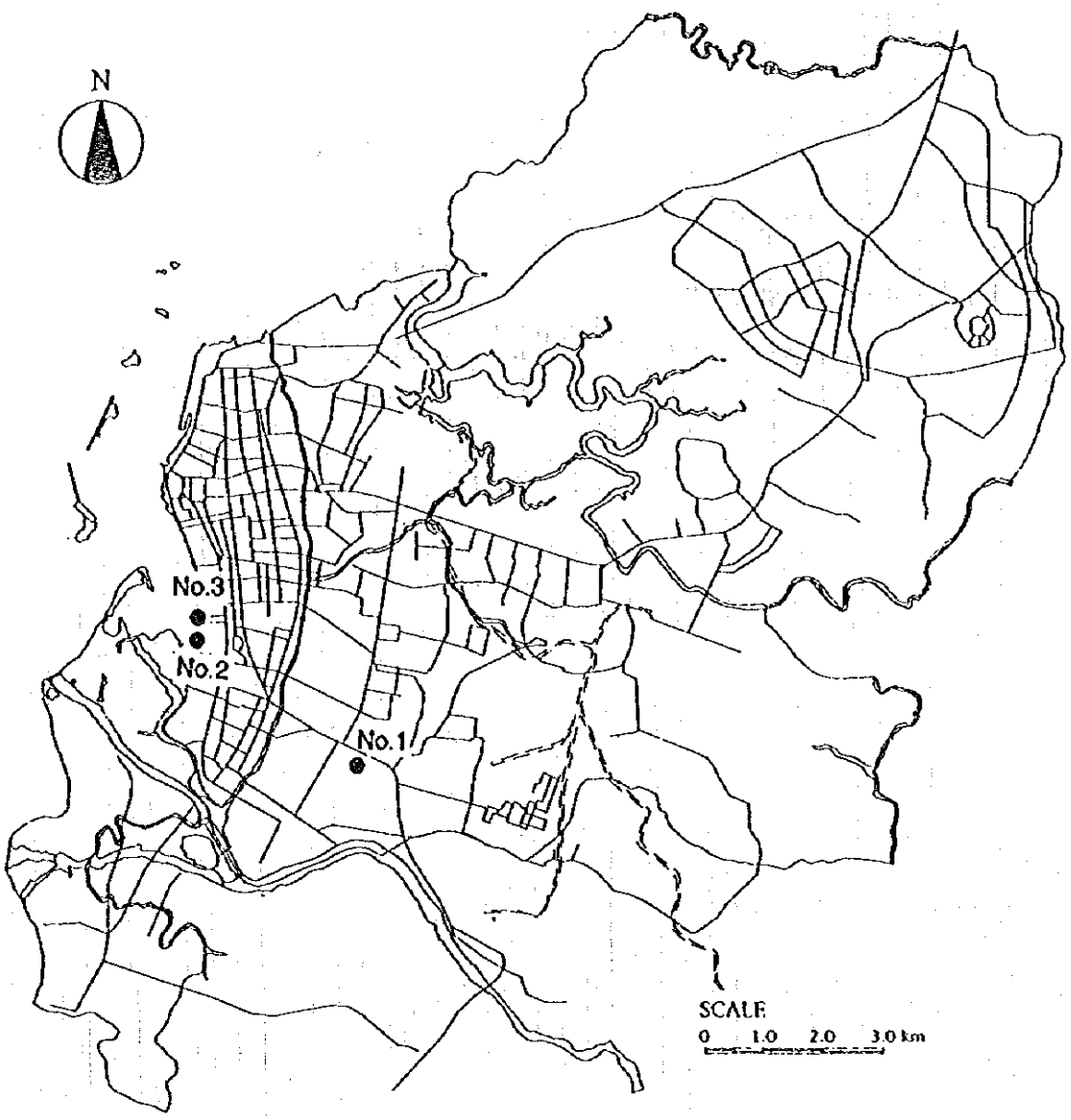

LEGEND

● Location of Survey Site for Septic Tank System

FIG. 5.48 Location of Survey Site for Septic Tank System

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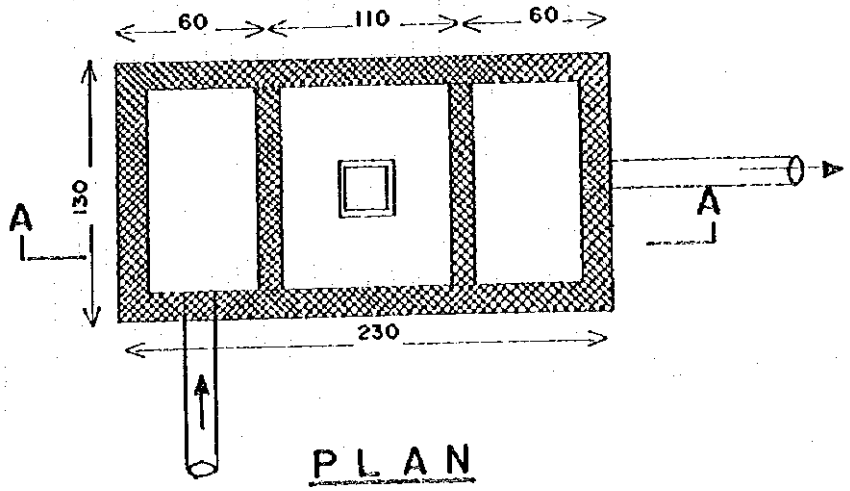
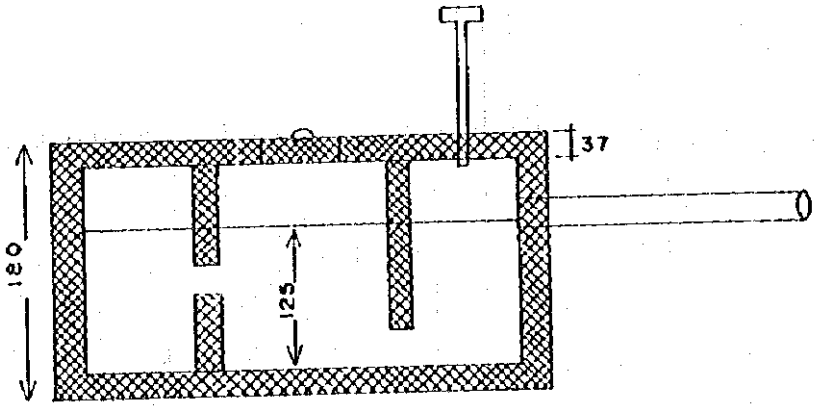


PLAN



CROSS SECTION A – A

FIG. 5.49(1)	Details of Septic Tank (Individual septic tank system)

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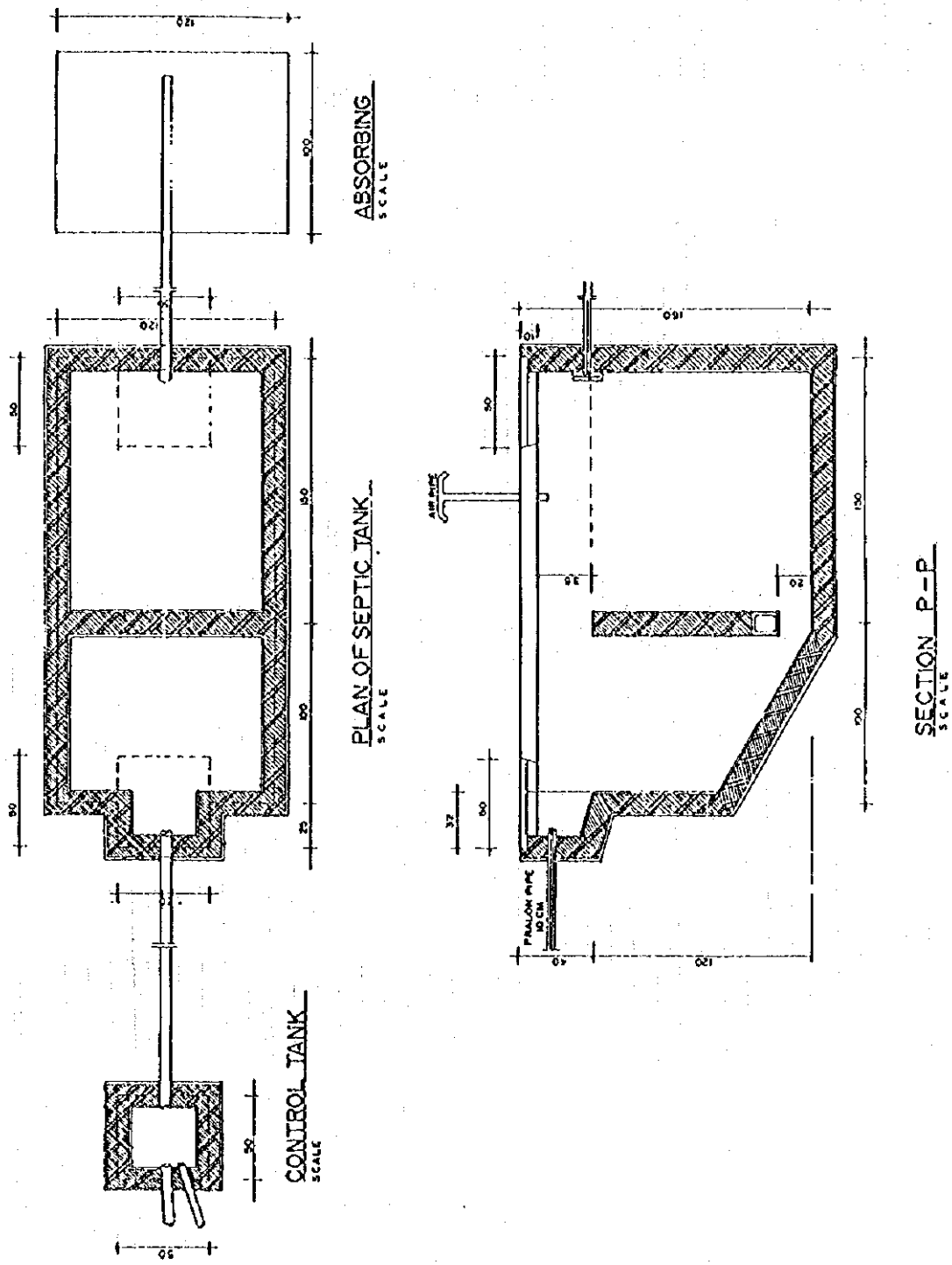

FIG. 5.49(2) Details of Septic Tank (Community septic tank at Rumah Susun)

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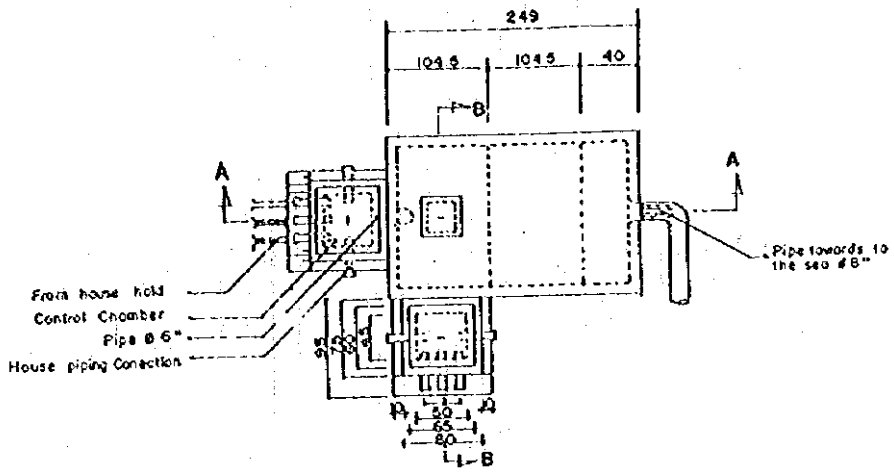
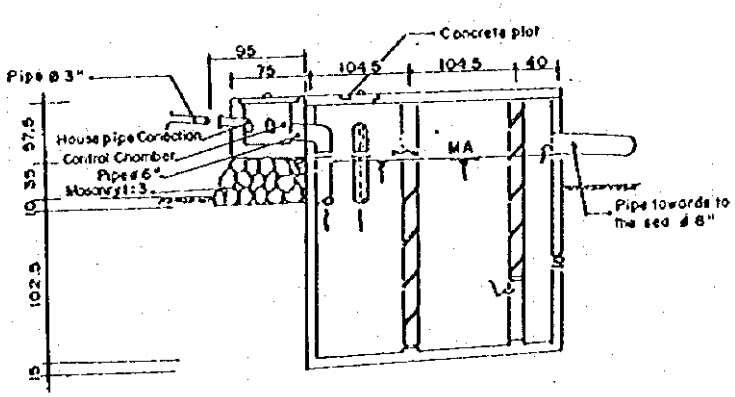
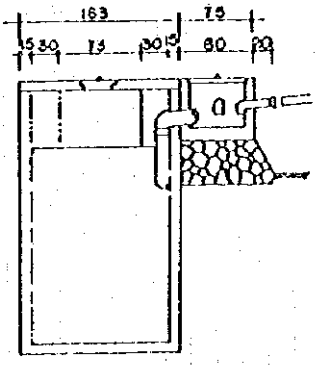


PLAN



SECTION A-A



SECTION B-B

FIG. 5.49(3)	Details of Septic Tank (Communal system in Kel. Panambungan)

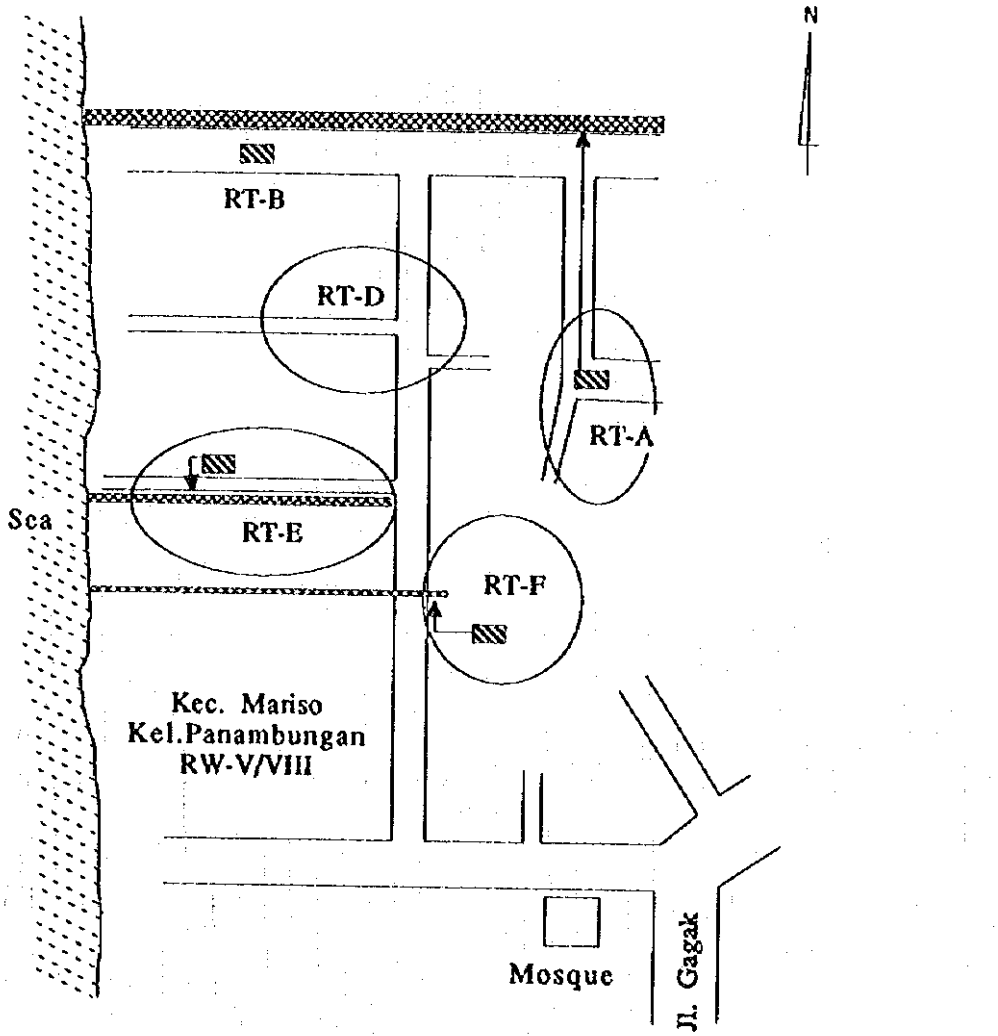


FIG. 5.50 Location of Survey Site for Communal System

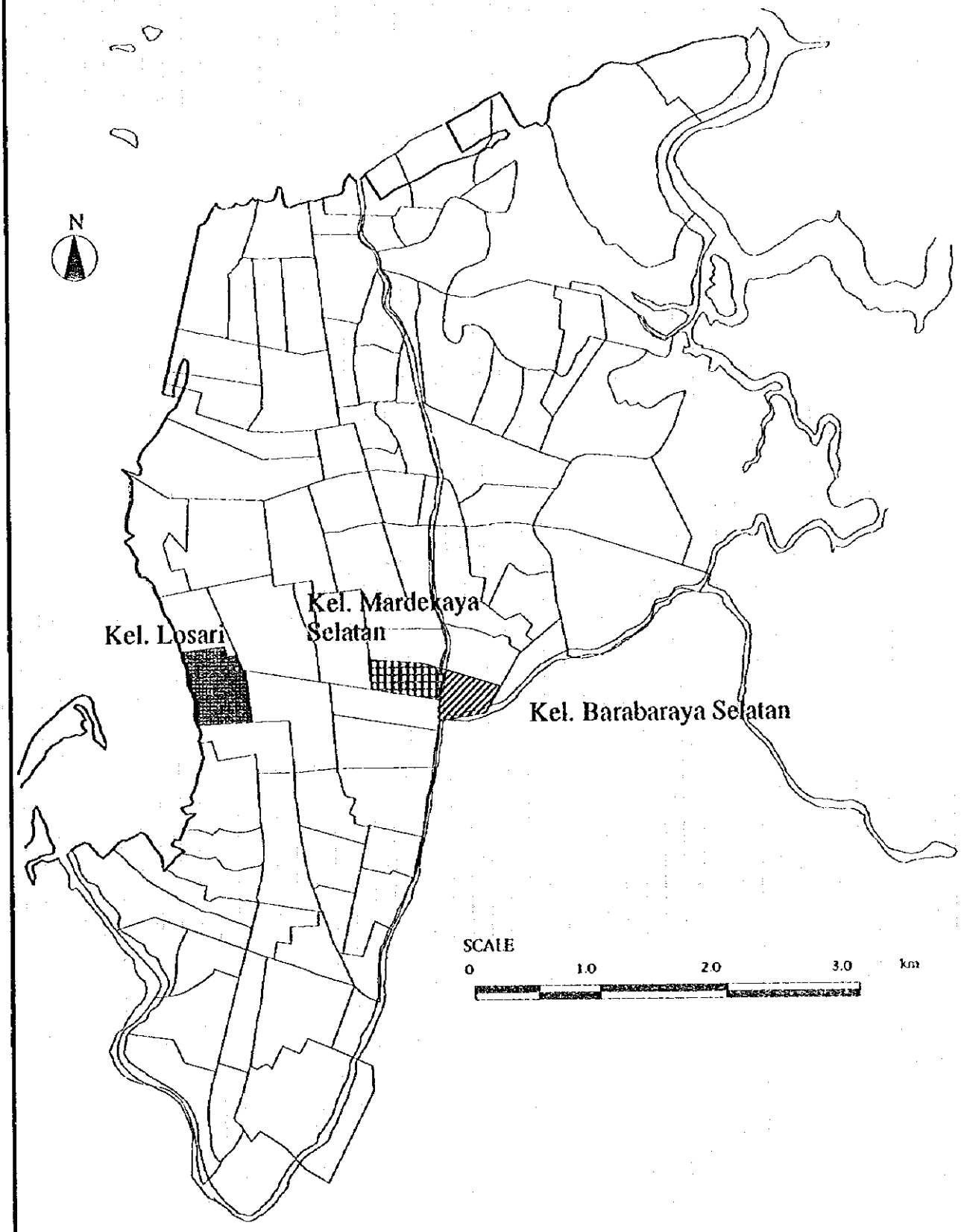


FIG. 5.51 Location of Survey Area for Data Base

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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VI SOLID WASTE MANAGEMENT PLAN

VI SOLID WASTE MANAGEMENT PLAN

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VI SOLID WASTE MANAGEMENT PLAN

1 Existing Condition

1.1 Authorities Involved

The collection of municipal solid waste from the temporary disposal sites in the city (TPS) and directly from in front of the properties in some parts of the city and its transportation to the final disposal site (TPA) is the responsibility of Dinas Kebersihan, the department of sanitation in Ujung Pandang municipality.

Community d at the Kelurahan levels collect the waste from properties in some areas and transport it to the TPS stations. These are basically the two authorities that provide solid waste collection and transport service in KMUP.

(1) Dinas Kebersihan

1) Structure of Dinas Kebersihan

Dinas Kebersihan was established in 1989 under a mayoral decree. It is composed of four sections; Program Research and Supervision, Operations, Retribution and Logistics Sections directly under the Director. The Deputy Director heads a Sub-Division for Administration. The Operations Section has three sub-sections as follows;

(a) Night Soil and Solid Waste Collection and Transport Section

(b) Ditch Cleaning Sub-Section

(c) Street Sweeping Sub-Section

2) Dinas Kebersihan staff

Dinas Kebersihan staffing in 1994/95 is shown in the following table. Of a total staff of 836, over 75% are contract staff, and 18% are engaged in management and administrative works. If drivers and workers engaged in night soil transport and street sweeping are subtracted, total drivers and workers operating solid waste collection and transport are 112 drivers and 233 workers. Workers and heavy equipment operators at the final disposal site are included in these figures.

All drivers belong to the Transport Sub-Section. Workers of that sub-section are also engaged in both solid waste and night soil transport. Further division of drivers and

workers by duty is as shown in the following.

Dinas Kebersihan Staffing

Section	Permanent	Contract	Total
1. Director	1	0	1
2. Administration Sub-Section	27	1	28
3. Operation Section			
Section Chief	1	0	1
3.1 Transportation Sub-Section	56	324	380
Sub-Section Chief	1	0	1
Supervisor	11	4	15
Driver	35	78	113
Worker	7	238	245
Staff	2	2	4
Temporary Assignment	0	2	2
3.2 Ditch Cleaning Sub-Section	27	96	123
Sub-Section Chief	1	0	1
Supervisor	9	0	9
Worker	17	96	113
3.3 Street Sweeping Sub-Section	22	172	194
Sub-Section Chief	1	0	1
Supervisor	7	12	19
Worker	14	157	171
Staff	0	3	3
4. Program Section	13	5	18
5. Retribution Section	47	32	79
6. Logistics Section	8	4	12
TOTAL	202	634	836

Operation Section Staff Allocation

	Supervisor	Driver	Worker
Solid Waste Transport	15	104	235
Ditch Cleaning	9	2	113
Street Sweeping	19	1	171
Night Soil Transport	-	6	10

(2) LKMD

LKMD is an NGO that operates on the Kelurahan level, however the Kelurahan appointed head also serves as the chairman of the LKMD. More on the LKMD shall be described in the following section.

1.2 Collection and Transport Operation System

(1) Technical Guidelines for the Activity (SOP)

The SOP document details SWM system to be implemented in KMUP. It defines the successive components of SWM namely discharge, collection, transport, and disposal, and then sets out the community and Dinas Kebersihan roles in the system. The document is supported by figures and charts to make it easier to understand. A brief summary of the document is as follows.

First: SWM components:

a. SW discharge

⇒ SOP proposes terminating usage of permanent fixed concrete bins constructed in front of houses in favor of non-permanent containers such as plastic, metal or wooden bins, and plastic bags.

⇒ Bin should be watertight, provided with a cover, and easy to empty.

⇒ Night soil, carcass, food and washing remains should not be put in bins, but should be buried.

b. Waste collection

⇒ Waste shall be collected from houses and put inside the TPS, until 05:00. After that no waste shall be placed there.

⇒ TPS shall be constructed with a volume of 3 to 4m^3, and emptied every day.

⇒ TPS should not be located as hindrance to traffic or in areas subject to flooding.

⇒ Isolated areas may have permanent TPS made of wooden sides.

c. Waste transportation

⇒ Waste transport trucks must be well maintained, checked before operation, cleaned at the end of the shift, and provided with cover.

⇒ Crew must be in uniform with gloves, masks, helmets and boots.

d. Final disposal site

⇒ Final disposal site should not become a source of odor, dust, noise, flies and rats for the nearby housing.

⇒ Site operation should not contaminate source of drinking water and should be located at a minimum distance of 200 m (distance may change depending upon geological structure) from any such source,.

⇒ Site should not be located on highland or area subject to flooding.

⇒ Facilities provided at site should include guard post, inspection gate, fences and drainage, signboard identifying site usage, and locations for disposal of each waste type.

⇒ Swift and good drainage should be provided, and leachate should be isolated.

⇒ Site records should be kept showing types and amounts of waste entering TPA, and sources of this waste.

e. Local waste management (self treatment)

⇒ To reduce volume of waste to be disposed of at TPA, self treatment may be done at plots with large yards or areas inhabited by not more than 50 persons per hectare.

⇒ Proposed self treatment methods are burial of organic waste, or its burning after drying up, storing or reusable waste items in a hole made of concrete or bricks, and burial of hazardous waste in a separate hole.

⇒ Holes dug for that purpose should be located at a minimum of 10 meters from drinking water sources, and in case of burning, it should be done at least 10 meters from public roads, in a hole.

<u>Second: Management of solid waste by LKMD (non formal organization)</u>

LKMD organizations are established on the Kelurahan level by the community as a non-governmental organization with the main functions of planning and implementing community development. However LKMD chairman is the Lurah (Kelurahan chief) who is a government employee. LKMD (*LEMBAGA KETAHANAN MASYARAKAT DESA*) may be roughly translated into Rural Community Solidarity

Organization.

SOP outlines the role to be assumed by LKMD and the community as summarized hereafter.

a. Waste discharge

⇒ Each house shall discharge its packed waste in its own container.

⇒ Discharged waste shall be collected by LKMD operated hand carts during the hours of 1700 to 0500. Waste should be discharged during that time.

⇒ Discharged waste of volume more than 2.5m^3, should be directly transported by discharger to TPA or a special arrangement made with Dinas Kebersihan subject to additional charge.

b. TPS

⇒ TPS location should be selected close to the service area considering hand cart operation, and guarantee efficient utilization by the blocks rotating usage of the TPS.

⇒ TPS should be provided with a signboard identifying discharge rules and schedule.

c. LKMD waste collection

⇒ LKMD hand cart collection service frequency shall be based on population served, waste types (organic waste should not be left uncollected for more than two days), service area, and TPS number.

⇒ LKMD collection service shall be between 1700 and 0500.

⇒ Citizens in places inaccessible to hand carts should take their waste directly to TPS, or to the stationary hand cart at determined time.

d. Community participation

⇒ Active and voluntary community participation to ensure that waste is collected and brought to a point where it can be picked up by the collection vehicle.

⇒ Encouragement of community participation in cleansing activity through

official, community and religious groups.

e. Management of cleansing retribution fee collection

⇒ Collection fees are collected based on the tariffs stipulated in the concerned regulations,

⇒ LKMD receives 40% of collected amount to cover costs of hand cart operation, tools, salaries, and maintenance of TPS and hand carts.

⇒ Data on residents and their classifications are collected by Lurah (Kelurahan chief) and sent to Dinas Kebersihan. Dinas Kebersihan prepared the receipts and LKMD is responsible for direct collection of the retribution fees from the residents.

Third: Dinas Kebersihan activity

a. Transport of waste to TPA

⇒ Transport of domestic waste from TPS to TPA with a frequency of 2-3 times per week, from 0500 to 0900.

⇒ Market waste is transported twice/day (morning and night) from main markets, once/day from secondary markets, and thrice/week from temporary markets.

⇒ Door-to-door service is provided to hospitals, industries, hotels, restaurants, offices thrice/week (or based on demand). Waste is collected from TPS facilities arranged by the discharger and taken to the TPA.

⇒ Drainage ditch clearings, street sweeping and grass cuttings are removed either from site of work or from TPS according to a schedule.

b. Operation of TPA

c. Management of Cleansing Activity Retribution

⇒ This activity is jointly managed by Dinas Kebersihan and LKMD.

⇒ Retribution fees are collected for collection and transport of routine waste, special waste, theater and movies waste, and night soil.

d. Supporting activities

⇒ Training and providing information on SWM.

⇒ Research and waste sampling.

⇒ Implementing SWM improvements.

Fourth: Additional guidelines on SOP

⇒ TPS can be developed into *DEPO SAMPAH* (Dipo), a building for waste transit provided with supporting facilities as guard post, washing facility, vehicle parking are, etc. A Dipo serves about 30,000 persons.

⇒ Citizens are allowed to cut trees/bushes (for bulky waste usually more than 2.5m^3) only on Fridays and Sundays, to be collected from a place specified by the Lurah.

⇒ DK provides 69 vehicles for collection from 443 TPS (of which 349 are concrete, 41 containers, and 53 open-space). (Figures according to December 1992).

⇒ DK provides direct collection services from houses on a number of protocol (main) roads.

⇒ DK transports hospital waste using two Dyna Rino covered vehicles (6 m^3). One is used for hazardous hospital waste and the other for ordinary waste.

⇒ DK operates one dump truck and loader during the night for transporting waste cleared from drains (*KERJA BAKTI*).

⇒ One vehicle is operated for street sweeping waste transport.

(2) LKMD operation

SOP defines the role of LKMD as collecting and transporting the waste from houses to the TPS. This role is deemed important and should be strengthened for the following reasons:

⇒ Develop citizens awareness of, and participation in SWM.

⇒ Support the insufficient vehicle capacity available to DK, by placing the waste at fixed locations and save DK effort of operating door-to-door collection.

⇒ And most important, this system is inevitable in poorly developed and low-income areas where DK vehicle access is not possible, and TPS or communal containers are placed at lengthy walking distances.

Recognizing the importance of understanding the role of LKMD the Study Team attempted to identify the resources available to them and their problems. Lack of any formal connection between DK and the various LKMD or any other counterpart agency meant that data on LKMD was not available to the Study Team in one place. Therefore questionnaire forms were dispatched to each of the 142 Kelurahan (response to the questionnaire was over 95%) and an interview survey was conducted directly with a number of them. Following is a description of the activities of the LKMD organizations.

1) Operation and equipment

While majority of Kelurahan recommend handcart service be in the evening (as proposed in SOP) the Team has been informed that in some areas collection takes place early in the morning before DK vehicle arrives at the TPS. Most collection is done on a rotation basis and residents are informed by community leaders on which days their waste shall be collected. In most areas where permanent bins are not available in front of houses, residents directly discharge waste into the hand cart as it passes their houses. However majority of discharged waste is mostly unpacked. This extends the loading time of DK vehicles at the TPS. One observation which requires attention is the emptying of handcarts at TPS or hauled containers. Workers do not observe SOP requirements to empty the waste inside the TPS or containers in most cases, and this creates very unpleasant conditions.

LKMD depends on hand carts and their operators for collecting waste from residences and bringing to collection points. In 1992 DK report the number of usable hand carts was quoted as 507. In a ADIPURA report for 1993/94 the figure fell to 377 (however it is not clearly stated if all these are usable). Both reports did not offer any figures about LKMD workers.

The Kelurahan Questionnaire survey showed that at present the available numbers of LKMD handcarts and workers were 330 and 354 respectively. Therefore the number of available handcarts has continued to fall during the past three years.

The chart, shown below, has been prepared based on the Kelurahan Questionnaire.

LKMD Collection Service Frequency

The chart notes that in spite of insufficient equipment and manpower, LKMD continue to offer regular service to over 65% of the population in the city. This underlines the importance of strengthening LKMD structure and resources as an important player in SWM in KMUP.

Fig. 6.1 shows the survey results by Kelurahan. Kelurahan located in the old part of the city where commercial and residential land use coexist (7 districts of Mariso, Ujung Pandang, Wajo and Ujung Tanah along the sea coast, and their bordering districts of Mamajang, Makassar and Bontoala) mostly reported daily collection service provided by LKMD.

Many Kelurahan south of the main east-west arterial road of Jl. Bawakareng - Jl. Urip Sumoharjo in the suburban Kec. Panakkukang also reported daily LKMD collection service. The balance of the Kelurahan in the old part of the city reported 3 d/week LKMD collection service. North of the above mentioned east-west artery, Kelurahan also reported the same frequency.

In the suburban Kec. Biringkanaya, LKMD collection service of 2-3 d/wk was reported in the three Kelurahan along KMUP's northern boundary and 2 Kelurahan south of the Kecamatan. KIMA industrial estate and Hassanuddin University complexes are respectively located in these two regions.

In conclusion it should be remembered that LKMD organizations are suffering from lack of resources as earlier explained, and therefore, in their answers to the Study questionnaire some Kelurahan may not have differentiated between what they plan to do and what they are actually accomplishing.

LKMD are also responsible for construction of about 350 TPS stations scattered in KMUP. However responsibility for maintenance of these stations is not clearly defined and most are in poor conditions.

No information on the breakdown of LKMD expenditure was available to the Study Team.

In the new retribution system introduced in October 1994, LKMD's role in collecting the retribution fees from the residents has ceased.

Also LKMD does not anymore receive a share of the collected fees.

Under this new system LKMD's Financial base has been considerably weakened.

(3) Dinas Kebersihan solid waste collection and transport operation

1) Equipment and operation system

DK tailors its solid waste operation system to the resources available to it. Under the present conditions of an aging and insufficient vehicle fleet it is not suprising that DK cannot provide full service coverage to KMUP. DK also finds it difficult to set a long term plan for its collection operation and vehicle routes change very frequently, depending on where the priority exists.

Bearing all this in mind, the equipment available to DK shall first be discussed followed by the operation system 'presently' applied.

a. Equipment

i Vehicles

The waste collection and transport vehicle fleet includes dump trucks and flat trucks of different sizes and hauled container trucks, but does not include compactor vehicles. Hauled container vehicles are in two types, armroll and multi loader. The former type is a recent introduction to the fleet. In 1994/95 DK increased its armroll vehicle fleet to 19 units. The oldest vehicles are 17 years old and average vehicle age is 7.5 years. The following table shows the vehicle fleet classified by type and age.

Vehicle Fleet by Type and Age

Vehicle Type	Cap.(m^3)	Number	Age(years)	Remarks
Kijang	3	8	17	32 out of total in
Kijang	3	16	15	operation
Kijang	3	1	13	
Kijang	3	6	9	
Kijang	3	2	8	
Kijang	3	4	2	
Chevrolet	3	1	13	
Isuzu Dump Truck	10	12	10	2 out of order
Rino Dump Truck	6	20	8	2 clearing ditches
Rino Flat Truck	6	10	3	1 street waste
Rino Covered Truck	6	11	2	1 out of order, 3 market
Rino Multi Loader	4	1	3	
Armroll	6	19	1	

The most recent vehicle additions to the fleet are the armroll vehicles which transport 6 m^3 containers. DK plans to increase its reliance on this vehicle type in the future.

ii Containers

Three types of containers are placed at communal stations in KMUP, the permanent TPS RC and other permanent structures, and hauled container types of 4 and 6m^3. The former is used for the multi-loader vehicle and the latter with the armroll vehicles. The total number of TPS (inclusive of containers) as reported by DK are as follows;

⇒	Armroll container	128
⇒	Multi-loader container	15
⇒	Wooden TPS	24
⇒	RC TPS	300
⇒	Fenced Open Space	37
⇒	Open space (with sign post)	12
⇒	Total	450

Of the some 400 TPS structures, about 50 only were constructed by DK, the remainder was constructed by LKMD.

b. Operation system

DK collects the waste brought to the communal stations by LKMD organizations in some areas, and also directly from in front of some houses located along major streets (door-to-door). In the 1994 ADIPURA report, DK reports that 16% of the waste it transports is collected directly from in front of the residences (door-to-door).

The collected waste is transported to the final disposal site at TPA by DK vehicle fleet. DK works 7 days a week, and operates two shifts, during the daytime and at night. Under this recently introduced plan (refer to *Fig.* 6.2) the old part of the city shall be served daily in the night time. Areas adjacent to the old city, extending east of Jl. Veteran are provided with daily daytime service. Other parts of the city are provided with irregular service. DK plans to gradually shift its major operation at night for the reasons explained to the Study Team as follows;

i. Avoid disturbing the city daytime activities by the waste collection operation.

ii. Operate waste collection vehicles more efficiently in the absence of the day time traffic congestion.

iii. Preserve the city's aesthetics by operating the service at night.

At present majority of the vehicles are used only during one shift. DK, in discussions with the Study Team explained its plans to operate the vehicles that are in good

condition two shifts.

*Fig.*6.3 has been prepared based on the Study survey results implemented at TPA for one week in September 1994. Drivers were interviewed as to collection locations of the waste they were hauling in. As the figure shows, DK is basically carrying out its plan in the old parts of the city, although not achieving daily collection in all parts.

2) Solid waste amount transported by DK

Amount of waste transported by DK is calculated on the precondition that all waste collected by DK is transported to the TPA.

A weigh bridge has recently been installed at TPA to measure waste amount entering the site. However due to electricity problems weigh bridge operation is often interrupted and there are no continuously records. At the TPA, DK staff record incoming vehicles by type on a daily basis and knowing vehicles haulage capacity in volume, compute the waste amount.

Based on the date of nine months (during February 1994 to June 1995) average daily waste amounts are;

Month		Average Daily Waste Amount		Remarks
		m^3/day	ton/day	
February, 1994	(wet)	1.090	327	DK data
March, 1994	(wet)	957	287	DK data
April, 1994	(wet)	968	290	DK data
May, 1994	(wet)	848	254	DK data
June, 1994	(dry)	884	265	DK data
July, 1994	(dry)	831	249	DK data
September, 1994	(dry)		202	Truck Scale
November, 1994	(wet)		262	Truck Scale
January, 1995	(wet)	977	293	Truck Scale
June, 1995	(dry)		281	Truck Scale

More waste enters the TPA during the wet season. This may be explained by the reduced self treatment by burning, heavier weight of wet waste, and use of waste for land reclamation during the dry season. Although not very conclusive, the data showed that more waste amount entered in June 1995 compared to one year before.

3) Extent of area served

Two surveys were conducted under this Study to identify extent of population served

and areas covered by DK survey. The first was the Kelurahan Questionnaire survey and the second was the survey for one week at the TPA.

In the first survey, each Kelurahan was questioned as to number of RW receiving DK collection service. The results were then translated into population figures and it was possible to calculate percentage of population served by each Kecamatan. The results are depicted in *Fig.* 6.4. The percentage shown in each Kecamatan means the population percent in that Kecamatan that enjoy DK service, irrespective of collection frequency. Therefore those served daily as well as those irregularly are both included. Once more the older Kecamatan of Mamajang, Ujung Pandang and Wajo were high at above 90%, followed by the other old neighboring Kecamatan. Average service ratio, as replied directly by the Kelurahan was 72% for the total KMUP population.

The second survey recorded waste origin by Kelurahan at the TPA for one week in September. The results were than aggregated into the Kecamatan level and waste amount collected by DK from each Kecamatan for one week was accordingly calculated. On the other hand the generated waste amount in each Kecamatan was estimated using the night time population figures and unit generation rate of 2.2 lit/cap/d. *Fig.*6.5 shows this survey's results.

The second survey showed a decrease in the KMUP population served by DK, to 50%. This survey period covered one week, and therefore waste collected at intervals of more than once per week are not included. The old city area enjoyed the highest collection service ratio.

The extent of collection service area was also estimated using the TPA data for the third week of May 1995. The results are shown graphically in *Fig.* 6.6.

The average daily waste amount collected is compared with both the total estimated generated waste (domestic + commercial + street + ditch) and domestic only estimated waste generated. The collected waste covers almost 95% of the generated domestic waste in the older Kecamatan of Mariso, Mamajanag, Makassar, U. Pandang, Wajo, and Bontoala. More efforts are needed on the part of Dinas Kebersihan to extend collection service to the suburban Kecamatan of Pannakukang, Biringkanaya and Tamalate where about 47% of total domestic waste is generated.

In terms of overall collection service retio, the average collected waste in May 1995 accounted for 57% of estimated total generated waste and 75% of generated domestic waste.

Finally, it should be noted that the islands belonging to KMUP receive no collection

service from DK. The population of these islands was about 1.1% of the total KMUP population in 1992. A visit by the Study Team to three islands revealed that islanders mostly burn their waste, and the ash is usually buried. Burning places vary from a large concrete bin in one island, to a designated open space in most other cases. One common location is usually determined and residents bring their waste to that place by themselves. But not surprisingly discharge of waste into the sea was also observed, but not on a large scale. Island officials are actively promoting residents cooperation in stopping such actions. Also the Study Team was informed that the island Lurahs attend periodic meetings arranged by DK along with the mainland Lurahs to discuss SWM, and sometimes receive guidance from DK. As explained to the Study Team, the islanders main concerns were having a continuous electricity supply and drinking water availability. SWM was not one of their priorities.

4) DK operation indices

In order to understand DK operation, records for six months of 1994 maintained at TPA were studied and one week's survey was conducted there by the Study in September. A time and motion survey for 10 vehicles, covering all types of vehicles and spread throughout the Kecamatan was conducted in August. The findings of these surveys are summarized in this section.

a. Vehicle Utilization

As reported daily waste volume transported into TPA by DK decreased from 1,090 m^3/d in February 1994, to 676 m^3/d in September of the same year. This was reflected on the trip number per vehicle which also fell during the same period, as shown in *Fig.* 6.7. The average trip number per vehicle dropped from just under 3 in February to 1.83 in September of the same year. While all vehicles showed a drop in trip number/veh., only in the case of multiloader type an increase was identified. The drops for both Isuzu and Rino are particularly worrisome because of the large haulage capacity of both types.

More effort on the part of DK is necessary to stabilize the trip number per vehicle, especially as the vehicle haulage capacity available to DK is already low.

b. Vehicle and Waste Arrival Frequency

Graphic presentation of the Study TPA survey is shown in *Fig.*6.8. While both vehicle arrival and waste arrival graphs follow the same pattern, daytime and night shifts are more closely divided in the case of the lower volume curve. This is explained by the larger vehicles used in the night shift and the pickup vehicles that are

mainly used during the day shift. Results of the survey show two peak hours, as follows;

Day shift: 10:00 ⇒ 11:00 21 vehicles and 101 m^3

Night shift: 24:00 ⇒ 01:00 11 vehicles and 64 m^3

Shift shares of the total vehicles and waste arriving at the TPA were as follows;

Shift	Vehicles	Volume
Day	67%	58%
Night	33%	42%

As can be seen from the survey results the majority of the waste is still being transported during the day shift. However DK has informed the Study team that they are planning to gradually increase the night time operation starting October, shifting the bulk of the transport to the night shift by the end of this year.

c. Collection Route Operation

The time and motion survey was implemented a couple of weeks after introduction of night time shift by DK in the old part of the city, as described earlier. Summation of the results is enclosed in *Table* 6.1.

Trip origin and destination

Majority of surveyed vehicles started from DK garage, situated just off Jl. Gen. Sudirman, however some trips originated from the driver's home and others from DK headquarters at Kec Bontoala, close to the intersection of Jl. Gen. Sudirman and Jl. Masjid Raya. At the end of the shift the vehicles returned to the same locations. Crew members were picked up near the points of origin, and accompanied the driver throughout the shift, going together to the TPA.

Crew number

All trucks are basically operated by a crew of one driver and three workers. One of the workers stands on top of the truck and piles up the waste the other two workers collect from containers and threw into the truck. Kijang has one worker less and Armroll only one worker. In principle hauled container vehicle requires only the driver, and a skilled driver may maneuver his vehicle to load and unload the container by himself, if the container is properly placed on paved ground. But the worker

observed during the survey helps in directing the driver, in addition to loading waste thrown around and under the container.

Shift time

Purpose of night shift introduction in the old city is to speed up waste collection operation. However it took a lengthy 9 hours for an Isuzu dump truck to complete one trip in Kec. Ujung Pandang. However the night shift operation cannot be judged by that vehicle alone, because a second Isuzu in a different part of the old city and also during the night shift made two trips in less than 7.5 hours.

Both Kijang vehicles were operated for less than 4.5 hours each, but each completed 3 trips. Although in terms of time, more trips may be accomplished during one shift, the poor vehicle conditions makes it difficult for DK to do that.

Armroll was also operated for less than 5 hours, but this was due to lack of hauled containers at the time. Although DK had only 10 containers located at the site, three Armroll vehicles were in operation. At the start of the Study, in July 1994 a preliminary time and motion survey (but without the weigh bridge) was performed for the Armroll. At that time only one vehicle of this type was in operation and 6 hauled containers were positioned in various parts of the city. Then the vehicle made six trips in a 10 hour shift.

Trip distance

The average trip distance for all the vehicles was 22.2 km. Not surprisingly the Armroll vehicle covered the longest distance in one shift, at 93 km, as it had the largest trip number.

Loading ttime at stations

Vehicles collected waste from;

- ⇒ Permanent bins or private containers (plastic bins/bags, wooden boxes, cardboard boxes, etc) from in front of houses and shops,
- ⇒ RC TPS stations and open space TPS stations, and
- ⇒ Hauled containers.

Unfortunately majority of the waste is unpacked and it takes a long time to collect waste and haul it on to the truck. The worst case are the large TPS stations where the vehicle spends 30 minutes to one hour to load the waste. The average RC TPS

volume measured during the survey was 8 m^3, and average required time to empty the TPS was 14 min/m^3. At that rate 2 hours would be required to empty an average sized TPS. The fact that workers are using their hands with no gloves and no boots, and damaged baskets does not help speed up the lifting of the waste.

On the other hand, it took on average 2 minutes to haul 1 m^3 of waste in the Armroll vehicle case, therefore proving the advantage of the hauled container system. It would take only about 10-12 minutes to haul almost the same amount of waste as compared to the TPS.

Vehicle loading capacity utilization

A better understanding of vehicle capacity utilization is possible after measuring vehicle loading weights over a reasonable length of time, and determining optimum loadings by vehicle types. These could then be compared with daily loading figures to determine whether vehicle are being properly loaded. In the absence of such long term figures maximum trip loading for each vehicle type measured during this survey was used to determine vehicle utilization efficiency. (refer to the following table.)

Vehicle Loading Capacity Utilization

Vehicle	Trips	Tot. Haul (Ton)	Max. Haul (Ton)	Vehicle Utilization (%)
Isuzu	5	11.28	2.9	78%
Rino Flat	2	2.06	1.3	79%
Rino D. Uncov.	6	9.44	1.8	87%
Kijang	6	4.13	0.9	76%
Rino D. Cov.	2	2.40	1.5	80%
Armroll	4	6.14	1.8	85%

The figures show that trip loadings are almost equal. This is confirmed by the fact that crews tend to load their vehicles as much as possible before ending a trip and returning to TPA.

Collection efficiency

The following table shows some indices that may be used to gauge collection efficiency by vehicle type. As Isuzu shifts already exceeded the 7 hr shift, there is no room for improvement of the 131 minutes required per ton under present conditions. on the other hand, Rino flat completed its shifts in 2/3rds of the working hours and there is potential for improvement. This can be observed when comparing with the Rino D Uncovered vehicle.

Collection Efficiency Indices

Vehicle	Min/Ton	Actual time/ 7 hr shift (%)	Ton/Crew member	Ton/shift
Isuzu	131	110%	0.94	3.76
Rino Flat	137	67%	0.52	2.06
Rino D. Uncov.	77	87%	1.18	4.72
Kijang	129	61%	0.69	2.07
Rino D. Cov.	168	96%	0.60	2.40
Amroll	44	65%	3.07	6.14

crew member, with 3 tons per member. This figure can easily double if proper discharge into the container is maintained and only the driver is assigned to the vehicle. The final column shows that even with operating Isuzu vehicles for a time exceeding the shift, the waste transported in an Isuzu shift, at 3.8 tons, was less than the 4.7 tons transported by the Rino D. Uncovered vehicle which did not even utilize its shift duration fully.

Vehicle routing

Fig. 6.9 shows the transport routes and the collection zones of the vehicles surveyed. All vehicles with origin or destination at the Depot used Jl. Urip Sumoharjo, the busiest east-west axis in the city. Trips to and from collection zones in the old city central and south Kecamatan accessed to the TPA through the collector streets as Jl. AB Lambogu, Jl. Rappocini Raya, and Jl. Landak Baru. Vehicles coming from Kec. Tallo and Ujung Tanah traveled to TPA along Jl. Urip Sumoharjo. The main north-south access used by the vehicles was Jl. Veteran.

For day time shift vehicles, surprisingly all faced congested morning traffic from the garage to collection zone, although starting time was early between 6 and 7 AM. Most had no delays due to traffic while on the collection route but most again experienced heavy traffic on trips from the collection zones to TPA and back.

On the other hand in the night shift, and especially after 10 PM traffic congestions were not reported to and from the TPA or within the zones.

General topics

- Lack of sufficient clothing for workers, in terms of boots, gloves, etc.
- Lack of tools to load waste into trucks.
- Poor condition of vehicles, such as no benzine tanks in Kijang (benzine is piped into motor from a 25 liter plastic bottle placed under the steering wheel), and

minor repair requirements such as stop lights and turning signals.

- Sorting during the work by the workers and selling to scavengers at TPA (this activity should not be stopped as it encourages recycling but it should not interfere with the collection work)

- Insufficient illumination during night time shift at the collection route and TPA.

(4) Waste collection and transport by others

The TPA survey has identified that of total waste transported into TPA in one week, only 4% (about 200 m^3/week) by volume was transported by haulers other than DK. All these other haulers were transporting their own waste using their own vehicles. Of that 4%, PT. ASINDOH transported 30% (about 58 m^3 during the week) from the new future city developed and maintained by that company in Kec. Panakkukang. The remaining amount was transported by other companies and businesses, such as a restaurant, bank, police and military, sugar factory, etc.

1.3 Street Sweeping Activity by DK and Ditch Cleansing

(1) Street sweeping

1) Present activity

Street sweeping is the responsibility of Dinas Kebersihan, and the responsibility falls on the Street Sweeping sub-section within the Operation Section. Headed by a chief, the sub-section has a staff of 19 supervisors and 171 sweepers. Of the sweepers, 77% are contract employees.

Work is divided into two shifts, the first from 5:00 AM to 8:30 AM, and the second from 1:00 PM to 4:00 PM. Each sweeper is assigned roughly 500 meters of road space to sweep per shift, on both sides. The sweepers are assigned to 9 of KMUP's 11 Kecamatan. There are no sweepers in Ujung Tanah and Biringkanaya. The bulk of the sweepers, over 94% are assigned to the city's six older districts.

Each sweeper uses a broom and a container to put the sweepings in. The sweeper empties the container into a TPS to be picked up by the waste collection truck. New fiberglass containers of approximately 90 liter capacities (80 units) have been introduced into service in September 1994. These are mounted on wheels and easy to manipulate by the sweepers. There are also 40 hand carts used by the sweepers, ranging in volume from 0.5 to 1.5m^3.

DK officials estimate that only about half of the sweepers have complete uniforms (overall, boots and cap). Sweepers are observed mostly without boots and none were seen with gloves on. Sweepers use their bare hands to scoop up the sweepings and empty them into the container.

DK has no mechanical sweepers and streets are not watered. They have no plans to purchase any heavy equipment for this activity. However one Dyna Rino truck ($6m^3$) haulage capacity is attached to this service.

Private sector and developers are also active in this activity. Some developers are responsible for sweeping in the housing projects they develop. Residents in areas where DK service is not extended also participate together under the RW/RT guidance. Shop keepers and their employees are often seen sweeping in front of their shops. Although this activity was observed by the Study Team during the dry season, sweeping is reportedly also carried out in the rainy season as well with little change.

2) Street sweepers required

Street sweeping is governed by the local government regulation no. 3/1990. Accordingly DK have explained that their objective is to sweep Class I streets twice a day, Class II streets once a day, and Class III streets once every two days. Street lengths by this classification are (based on Dinas PU 1993 survey);

Class I	121 km
Class II	112 km
Class III	87 km

In order to determine the required number of sweepers in KMUP, in the absence of any heavy equipment and plans to procure them, three options have been developed as follows;

	Class I Streets	Class II Streets	Class III Streets
Option 1	OK; twice/day NK; once/day	OK; once/2 days NK; once/2 days	OK; once/2 d NK; none
Option 2	OK; twice/day NK; once/day	OK; once/day NK; once/2 days	OK; once/2 d NK; once/2 d
Option 3	OK; twice/day NK; twice/day	OK; once/day NK; once/day	OK; once/2 d NK; once/2 d

Notes: OK ⇒ Old Kecamatan, NK ⇒ New Kecamatan

Option 3 follows DK objectives, but would obviously require a large number of street

sweepers. Option 1 is more realistic and basically calls for more efforts on the part of residents in new Kecamatan to take the full responsibility for street sweeping. Option 2 lies in between both options. The following table shows the manpower requirements by Kecamatan for each option.

Obviously it would be difficult and costly to hire 5 times the present staff to implement Option 3. Option 1 would be more realistic to attempt to achieve, although even with the lowest manpower requirement, it is still over 3 times the present staff number.

Number of Required Sweepers

	Road Length (Km)			Total Required Sweepers								
	Class	Class	Class	Option 1			Option 2			Option 3		
	I	II	III	Class I	Class II	Class III	Class I	Class II	Class III	Class I	Class II	Class III
				Twice/d	Once/d	Once/2d	Twice/d	Once/d	Once/2d	Twice/d	Once/d	Once/2d
Mariso	7	3	8	27	--	11	27	6	8	27	6	8
Mamajang	2	5	10	9	--	15	9	10	10	9	10	10
Makassar	15	7	6	61	--	13	61	14	6	61	14	6
U. Pandang	23	14	0	90	--	14	90	27	0	90	27	0
Wajo	12	7	0	46	--	7	46	13	0	46	13	0
Bontoala	9	8	0	35	--	8	35	15	0	35	15	0
Tallo	1	7	32	--	2	7	--	2	39	3	14	32
U. Tanah	0	1	6	--	0	1	--	0	7	0	1	6
Panakukkang	8	4	11	--	16	4	--	16	15	32	8	11
Tamalate	45	64	0	--	90	64	--	90	64	180	128	0
Biringkanaya	0	4	15	--	0	4	--	0	18	0	7	15
Sub Total	121	122	87	268	108	146	268	193	166	483	245	87
TOTAL	330			522			628			815		

(2) Ditch cleansing

1) Ditch cleansing sub-section

KMUP is served by a network of open ditches to discharge the rain water and human wastewater into the connecting rivers and sea. Needless to say these ditches must be kept clear in order to function properly. Unfortunately solid waste is often illegally discharged into the drains and they must be cleared frequently. For this activity DK maintains a sub-section under the operation section. This section is staffed by 9 supervisors and 113 workers.

2) Ditch cleansing operation

The major ditches that are regularly maintained are as follows;

a. Kali Makassar	2.75 Km	3 person
b. Haji Bau and Mongonsidi	1.50 Km	2 person
c. Kali Mawas	2.40 Km	3 person
d. Sungai Pareman, Poso, Kelara	1.20 Km	1 person
e. Muhammadiah and Salemo	1.25 Km	2 person
f. Tarakan	1.45 Km	1 person
g. Yosudarso, Sibula	1.75 Km	2 person
h. Hati Murni	3.25 Km	3 person
i. Cendrawasih	1.75 Km	2 person
j. Gaddong	1.25 Km	2 person
k. Kakatua	1.00 Km	1 person
Total	19.55 Km	22 person

Other ditches are cleaned occasionally based on area inspection and surrounding residents request. These include small drains and also drains running through slum areas.

Heavy equipment involved in this effort are a shovel loader (one unit) and one dump truck (6 m^3). Actual cleaning of the ditch is done by spades and the workers operate in very difficult working conditions. The removed dirt is usually left to dry before loading onto the trucks. In the rainy season drying takes a longer time obviously, but the work continues. Community participation in this activity is very common in many residential areas as evidenced by the Typical Analysis Study.

1.4 Final Disposal Site

(1) Tamangapa disposal site

1) Site description

a. Location

- Site Location : Jl. AMD, Kelurahan Tamangapa, Kecamatan Panakkukang (see *Fig.* 6.10)
- Land Area : 5 hectare
- Land Status : Ujung Pandang Municipality
- Distance from City Center : 14 km
- Distance from City Boundary : 2.0 km (boundary with Kab. GOWA)
- Distance from Residential Area : 0.2 km (housing complex of

PERUMNAS ANTANG)

- Distance from Closest River : 2.8 km (TALLO River)
- Distance from Airport : > 3 km

b. Facilities

- Access Road : b = 5m, l = 200m (asphalt paved) Access road portion which located inside TPA has approx. 11% slope, and is unpaved
- Entrance Gate : main gate is only one
- Site Fence : barbed wire, l = 82m, does not cover all site perimeter
- Inner Site Drainage : open cut
- Operation Road (temporary road)
- Surrounding Dike : north, east and southern side of TPA
- Lighting : limited to only 4 poles for all the site
- Guard House : located at gate
- Weigh Bridge : 30 ton capacity, newly installed by JICA's aid on June 1994
- Control Office : located beside weigh bridge
- Workshop & Garage : under construction on the north-west corner of the site
- Well : under construction, for car washing facility
- Leachate Collection Pipe : 2 pipes (l = 12m, depth = 2m) are installed, but are reported to have been damaged
- Leachate Pond : area = $12m^2$, maximum depth 3m, open cut
- Gas Collection Pipe : ht = 6m, PVC pipe, eight pipes are installed
- Incinerator : $2m^3$ capacity only hazardous medical waste is incinerated by Dinas Kesehatan (one time per month)

c. Site condition and surroundings

i. Surrounding area

East side of Tamangapa disposal site is a rice field. The rice production is limited to

once a year because of flooding during the rainy season, which dries up in the dry season. North of Tamangapa disposal site is a public housing complex, PERUMNAS ANTANG, and the distance is about 1.0 km. Another complex is located in the west side also, and the distance is about 0.2 km from TPA. Recently PERUMNAS ANTANG started to develop new housing complex which is located 0.6 km north from Tamangapa disposal site.

Land status of surrounding area is private land.

ii. Extension of Tamangapa disposal site

Recently, Dinas Kebersihan purchased one point nine one four (1.914) hectare of land for extension of Tamangapa disposal site by using 1994/95 local budget. For the location of this extension area, see the location map *Fig.*6.11. And also, Dinas Kebersihan planning to purchase zero point five (0.5) hectare of land to construct the new access road for easy access to the weigh bridge by using 1995/96 local budget.

iii. Estimated amount of the waste disposed in Tamangapa final disposal site

The operation of Tamangapa disposal site was started in March 1993. The amount of the waste disposed to the Tamangapa site from March 1993 up to June 1995 is estimated to approx. 125,000 ton. See the elevation and typical section drawing of the waste of Tamangapa final disposal site in *Fig.* 6.12.

iv. Surrounding area -1 (Flood water in the rice field of east side of Tamangapa)

During the rainy season, from November to April, rice field which located east side of Tamangapa disposal site is flood. Because of the continuous rain of this season, ,much amount of leachate is produced in the site and discharged to the rice field without any treatment. Average amount of the leachate is approx. 34 m3/ha/day. Because of the chemical effect of the leachate which discharged to the rice field, flooded water existing at the rice field is entrophicated. In the near future, the affect to the inhabitable of fishes, to the crop amount of rice and so on caused by the leachate is worried.

v. Surrounding area -2 (Mangara Swamp)

There is a swamp 1.0 Km east from the Tamangapa disposal site, namely Mangara swamp, and the area of this swamp is approximately 75 hectare. This swamp is directly connected to Tallo river, and the function of this swamp is the natural regulation pond to prevent the flood of Tallo river. For the location of Mangara swamp, see *Fig.* 6.10. The depth of the swamp is approx. 1-2 meter in the dry

season and 2-3 meter in the rainy season. Water quality of the swamp is backish, because the sea water flow into this area when the high tide (hearing data from fisherman working in this area).

2) Operation and maintenance

a. Operation commencement

The operation of Tamangapa disposal site was commenced on March 1993. According to Tamangapa records available to the team, it is estimated that 500,000 m^3 of solid waste has already been accepted there.

b. Operation method

Basic operation method of Tamangapa disposal site is, first, the waste is dumped by the collection vehicle to the open space near the recent dumping area of the site, and then, the waste is collected and hang up to the upper layer of the waste by using bulldozer and excavator. The top level of the waste, after the height of it reached approx. Two to three meter, is compacted b the bulldozer. However, this operation method is not done systematic and periodically.

c. Covering soil

In the recent dumping area, located north-east area of Tamangapa disposal site, waste is disposed and accumulated without any covering soil. While, waste full area, located south and north-west area of the site, also few covering soil is remaining. Because of this non-covering soil operation, the site emit a bad odor and much flies grown in the site and spread to the neighboring area. And also, because of the non-covering soil operation, rain water directly penetrate inside the waste stimulated in the final disposal site and much amount of the leachate is produced in the site.

d. Disposed waste

The following waste is accepted at Tamangapa disposal site.

- Domestic waste
- Street waste
- Cleansing of drainage ditches
- Construction waste

- Non-hazardous industrial waste
- Medical waste (both non-hazardous and hazardous) hazardous medical waste is incinerated in TPA

One week's survey at Tamangapa disposal site by the study revealed the types of waste being accepted at the site as shown in the following table. The dominant type is domestic waste with an average of 73% for the one week.

TPA also accepts waste from other organizations such as police and military, private developers, and state owned companies. However, during the study survey, the waste hauled in by organizations other than Dinas Kebersihan accounted for 3 - 5% of the total incoming waste.

e. Responsible organization

Operation and maintenance of Tamangapa disposal site is the responsibility of the Operational Section of Dinas Kebersihan, KMUP. Although this Section has three sub-sections responsible for transport of solid waste and night soil, street sweeping, and ditch cleaning respectively. It is significant to note that no sub-section is available for final disposal sites. Responsibility for the Tamangapa disposal site within the section does not appear to be clearly defined.

f. Personnel

19 persons from Dinas Kebersihan are engaged for operation and maintenance work of Tamangapa disposal site. Two shift service, day time shift and night time shift, is adopted for O & M work.

g. Heavy equipment

The following heavy equipment is operating in Tamangapa disposal site.

(kind of equipment)	(number)
Excavator	2
Bulldozer	2

Besides the above mentioned heavy equipment, two loaders and one mini-loader are belong to Dinas Kebersihan and these equipment are using for cleansing the open station of the waste etc. Further, one mini-loader and one bulldozer belong to Dinas Kebersihan are under repairing.

While, Dinas Kebersihan planning to purchase two (2) back-loaders by using 1995/96 President Instruction Budget (national budget / INPRES DATI II) for ditch cleansing.

h. Access road and operational road

On rainy season, condition of operational road inside Tamangapa site is fairly bad because of the mud, and it is difficult for collection vehicles to go up the access road which has approx. 11% slope, as explained by counterpart. Operational road, existing inside Tamangapa disposal site, is paved by mixture of gravel and soil. Because of the continuous rain of the rainy season, the condition of the operational road is fairly bad. Especially, the operational road access to the weigh bridge from the entrance is usually mud and difficult to go along. Efficient drainage system of the operational road is required.

i. Record keeping of collection vehicles

Departure time, hauler and type of vehicle are recorded for every collection vehicle entering into Tamangapa site by record keeper from Dinas Kebersihan. Recording of type, generation source and weight of waste has started at the end of September 1994, using truck scale and computer which has been donated by JICA.

j. Weigh bridge location

The weigh bridge location was selected bearing in mind utilization of the second entrance to the site. The second entrance is south-west corner of Tamangapa site. However issue of passing through private land, to access this entrance has not yet been solved. Accordingly, at present, weigh bridge access is somewhat difficult.

k. Site illumination

Site illumination is insufficient for the present night operation.

l. Operational effect to surroundings

On rainy season, several complaints occurred from surrounding residents for odor. While, on dry season, no complaint are reported.

m. Scavenger

35 scavengers are scavenging in Tamangapa disposal site and the number is gradually increasing. Their activity covers 12 hours a day. In addition buyers to purchase the scavenged materials from Tamangapa site are scattered in the site surroundings.

(2) Samata final disposal site

1) Site description

a. General condition

Samata disposal site is located in Kel. Samata, Kab. Gowa, 0.6Km south from the boundary between KMUP and Keb. Gowa, and 4.2Km south-east from Tamangapa disposal site. Tallo river flow east side of the site and tributary of Tallo river stream south and west side of the site. Mangara swamp is located 2.0 Km north from the site and the tributary of Tallo river mentioned above discharged to this Mangara swamp. The site is flat and average elevation is approx. 3.5m from the mean sea level and no significant flood is reported in the site (hearing data from the farmers working in this area). Two small villages are located east of the site, named Rappocidu and Bossolo, and access road to the villages is located along Talto river, east of the site. The site is a part of the covering area of the irrigation system, namely Kajenjeng, located in Tallo river and just east of Bossolo village. For the location map of Samata disposal site and surroundings, see *Fig.*6.10.

b. Land use and land productivity

Rice plant is produced from December to June for almost all area of the site and green been plant is produced from July to September for using approx. 50 % area of the site. From October to November, no production of the plant is reported. Recently, approx. 100 people are working throughout a year for plant production in the site area which is 65 hectare for Samata disposal site (Zone I).

c. Two villages located east side of Samata disposal site

Two villages, namely Rappocidu and Bossolo, are located east side of Samata disposal site. In Rappocidu, approx. twenty (20) households are living and in Bossolo approx. three (3) households are living recently. Most of the inhabitants of the villages are working as the farmer in Kel. Samata area. The access road, the width is approx. 3 - 4m, to these villages is located along Tallo river, east side of the site.

d. Electricity

Main electric cable of 150,000 voltage is existing along Jl.Muttalib Dg. Narang, located 1.5 Km west from the Samata disposal site. While, no main cable is existing in Jl. Veteran which is the access road to the site and also Jl. Macanda which is located 1.0 Km south from the site. For the location of the road mentioned above, see *Fig.* 3.4.7.

e. Water supply

No water supply system is existing surrounding area of the location of Samata disposal site. Most of the people living in this area using well and/or river water. *Fig.* 6.13 shows the existing water supply area in Sungguminasa city supplied by PDAM and future plan for next five years. At the present, water supply ratio of Sungguminasa city is 29%.

2) Access road

The following is the dimension of the existing road, namely Jl. Veteran, for access to Samata disposal site ;

- Length : 1500 m
- Width : 7 - 10 m
- Pavement : no paved (soil)
- Level : lowest point EL+3.0, highest point EL+11.0

In the rainy season, because of the continuous rain, the lower part of Jl. Veteran usually mud and make it difficult to path by the mobile. In several parts of the road, bed-rock exposed to the surface. Two bridges for pedestrian are located east end of the road.

3) Irrigation system, Kajenjeng

The irrigation system, named Kajenjeng, is located in Kel. Samata, east side of Bossolo village, and operated by using the flow of Tallo river. Kajenjeng was firstly constructed in 1967 and expanded in 1977. Kajenjeng irrigation system is operating on rainy season, from November to April, and contribute to the rice crop field located surrounding area.

Covering area of Kajenjeng is totally 523 hectare. The area is located in Kel. Samata (230 hectare for west side of Tallo river for which consist of KJ.1.1, KJ.1.2 and KJ.1.3 and 73 hectare for east side of Tallo river, MJ.1.1) and Desa Timbuseng (143 hectare which consist of MJ.1.2 and MJ.1.3) in Kab. Gowa and Kel. Tamangapa (77 hectare, KJ.1.4) in KMUP. Among these area, affected parts by construction of Samata disposal site (Zone I) is KJ.1.1 (65 hectare) and KJ.1.2 (100 hectare). For the location of Kajenjeng, see *Fig.* 6.10 and for the covering area of Kajenjeng, see *Fig.* 6.14.

4) Site for taking the covering soil

JICA Study Team and Counterpart Team researched one of the candidate site for taking the covering soil for Samata disposal site. This site which can be taken the covering soil is located in Kel. Samata, Kab. Gowa, between Jl. Veteran and Jl. Macanda, called "Bakung hill". Total area of the site is approx. 60 hectare. The east end of Bakung hill is just 0.4Km from the location of Samata disposal site. For the location of Bakung hill, see *Fig.* 6.10.

The potential amount of the soil which can be taken from Bakung hill is approx. 1.9 million m3 and geological feature of this soil is, from the surface, Lateritic Clay and Highly Weathered Surface Layer of the Bedrock. On the other hand, required amount of the covering soil for Zone-I of Samata disposal site (65 hectare) is approx. 1.6 million m3. Therefore, the amount of the covering soil for Samata disposal site (Zone I) can be covered from Bakung hill.

Since the last several years, some private companies take the soil from Bakung hill for reclamation of new housing complex, for example, Landok Baru in KMUP, Pao Pao in Keb. Gowa etc.

(3) Panakkukang Branch Office

1) General description of the site

Branch office of Solid Waste Management of KMUP, Panakkukang branch office, shall be located in Kel. Borong, Kec. Panakkukang, south of Jl. Borong Raya. Four (4) hectare are required for this branch office. *Fig.* 6.15 shows the location of the site for Panakkukang branch office.

The site is located part of the flood area and the elevation of this area is approx. 0.9 m above mean sea level (EL+0.9). The site belong to private land and has no plantation productivity recently. The canal is existing east side of the site and the flow of it is from south to north. The width of Jl. Borong Raya is approx. 13m, 7m of the center part of it is asphalt paved and others are the shoulder of the road.

2) Future Plan of this area

a. Road

Panakkukang branch office site was decided in consideration of the future plan of the road. Middle Ring Road will be located just west side of the site and Radial Road is planning to construct 0.4 Km north of the site.

b. Channel

Channel is existing just east side of the site of Panakkukang branch office. This channel, namely Antang Drainage Channel, will be improved in the near future under the Pampang River Improvement Project. (The study was done by JICA in 1994)

(4) Workshop (in Tamangapa)

1) Operation and maintenance

Recently, Dinas Kebersihan started the operation of the new workshop located in Tamangapa disposal site. The construction of this Tamangapa workshop was done by using IBRD loan budget, and completed in Nov. 1994. Recently, eight (8) personnel from Dinas Kebersihan is working in this new workshop. Before starting of Tamangapa workshop, repairing work, maintenance work etc. of the vehicles belong to Dinas Kebersihan were done by Dinas PU's workshop. All these duty for operation and maintenance of all vehicles belong to Dinas Kebersihan, for example waste collection vehicles, heavy equipment etc., were shifted from Dinas PU to Dinas Kebersihan recently. However, O/M work is not go into orbit yet, because, for example, electricity is not received yet in the workshop, lack of equipment for O/M work etc.

While, depot of above mentioned vehicles, belong to Dinas Kebersihan, is still using the depot located in Dinas PU's workshop site.

2) Equipment

Recently, Dinas Kebersihan purchased the following equipment for new workshop located inside Tamangapa disposal site by using local budget of 1994/95 (the amount is approx. Rp. 10,000,000.-).

(Equipment)	(Quantity)
- Compressor	1 unit
- Electric Welder	1 unit
- Carbide Welder	1 unit
- Tire Opener	1 unit
- Pulley / Lift (5 ton & 6 ton)	16 set
- Clamp	1 set
- Open End Wrench	1 set
- Hammer	1 set

No budget is allocated to purchase additional equipment for workshop, namely, local budget, IBRD loan budget etc., of year 1995/96. While, next five years plan of the budget, from 1996/97 to 2000/01, is now under preparation in Dinas Kebersihan. In this plan, the amount of Rp. 50,000,000.- is proposed to purchase the equipment for workshop, but the detail is not decided yet.

(5) Former disposal sites

For the location, operation period, dumping method and present land-use of former disposal sites in KMUP, see attached *Table* 5-3, and location map of each site, see *Fig.*6.16.

1.5 Potential Site for Final Disposal

(1) condition of potential site for final disposal

MINASAMAUPA concept has to be considered for the future plan of Solid Waste Management, because of the land limitation inside Ujung Pandang City, suggested by counterparts. After several discussion and site visits together with the counterparts from Dinners Kebersihan and BAPPEDA, KMUP finally selected the following six locations, include Kabupaten GOWA and MAROS, for potential site of final disposal of solid waste.

a. Extension of existing final disposal site

- Tamangapa	Kec. Panakkukang	KMUP
- Desa Mawang	Kec. Sombaopu	GOWA
- Bonto Mate'ne	Kec. Mandai	MAROS

b. Potential site

- Bulurokeng	Kec. BiringKanaya	KMUP
- Samata	Kec. Sombaopu	GOWA
- Palisi	Kec. Maros Baru	MAROS

For detail description of each site, see *Table* 6.4, and for the location, see *Fig.* 6.17 - *Fig.* 6.23.

(2) Candidate Sites for incineration plant and transfer stations

These facilities will be considered in the SWM alternatives for the Master Plan and may be adopted depending upon the evaluation results. Area required ranges between

2 - 4 hectares and location midway between the new disposal site and the city. The Counterpart Team have proposed sites south of J1. Urip Sumoharjo in Kel. Panaikang, Kec. Panakkukang. These are being considered at the time of preparing this report.

1.6 Recycling Activity

Due to the informal way this activity is implemented in KMUP it is difficult to exactly quantify the amount and items recycled here. Preliminary survey showed that this activity is broadly undertaken by four groups;

a) Scavengers at the TPA

b) Scavengers throughout the city

c) Buyers surrounding the TPA and buying from Scavengers

d) Agents scattered throughout the city and buying from Buyers and Scavengers alike

e) Users of the recycled items who are mostly outside the city

A survey of the TPA scavengers, six of the Buyers and 10 Agents was carried out by the Study and the amount of waste recycled by item was estimated. results of this survey are described hereafter.

(1) TPA scavengers

There are 31 scavengers active at the TPA, with ages ranging from 12 to 70 years old, 13 males and 18 females. They work during the day time from 7 AM for about 12 hours. They work in groups and independently. They carry the recycled items to the buyers scattered around the disposal site and sell it there, without any processing work.

Daily income of a TPA scavenger is reported to be about Rp. 9,200.

Scavengers are registered with Dinas Kebersihan, but there is no other official relationship between them and DK. Even the registration was done a number of years back and no updating has been done since then.

(2) Buyers

Buyers purchase the items from scavengers and resell to agents. They not only buy

from TPA scavengers, but also from scavengers from the city. Buyers basically buy and sell at their shop premises; scavengers come sell their items and Agents come and buy. No processing is done at the buyers shops.

Most of the interviewed buyers have been in this business for a number of years and when the present site was opened, moved to it from the old site. Only one of the six buyers was registered with DK.

(3) Agents

For the ten surveyed agents, the average number of years in this business was about 10 years. Agents buy from buyers and scavengers outside the TPA alike. Some agents also purchase recycled waste from other cities (approx. 35% of daily purchase).

Agents have pickups which are used to collect the purchased items. Items are washed and sorted out at the agents shops before selling them to the users. Agents shops were more permanent structures when compared with buyers shops, which are temporary structures.

It was difficult to follow the trail of the recycled items after they are sold by the agents. Agents reported that purchasers of the materials from them are located in Ujung Pandang and Surabaya. Mainly plastic, cardboard, aluminum, rubber and tin were shipped to Surabaya, although some plastic is being sold in KMUP.

Agents are not registered with DK.

(4) Recycling amount and prices

The following table shows an estimate of the waste recycling amounts. This estimate was reached by asking the Agents interviewed about their shares of the market. Based on their response the total was calculated. Totals were very close and the averages were adopted. Approximately 15 tons are recycled daily. Component shares are as follows;

Glass	47%
Cardboard	4%
Can	27%
Steel bar	4%
Iron	7%

The total recycled amount is approximately 3% of the generated waste amount in

KMUP.

Approximate Recycled Amounts Daily

(unit= Kg/d)

Recyclable Items	TPA Scavengers	KMUP Agents	Scav. Share
Plastic	168	808	21%
Glass	1,400	7,016	20%
Cardboard	80	567	14%
Aluminum	20	135	15%
Can	200	4,034	5%
Steel rebar	0	639	0%
Iron	0	1,009	0%
Rubber	0	251	0%
Tin	0	40	0%
Brass	0	100	0%
Copper	40	0	NA
Bones	0	401	0%
Total	1,908	15,000	13%

The following table shows the buying and selling prices for the recycled waste items.

Prices of Recyclable Items

(unit = Rp./Kg)

Recyclable	TPA Scavengers	Buyers		Agents	
Items	Selling	Buying	Selling	Buying	Selling
Plastic	250-300	250	325-400	250-350	350-450
Glass	25- 30	25	35-40	40	60
Cardboard	50	50	60-100	75-150	100-300
Aluminum	300-750	500-1100	750-1200	1000-1400	1100-1600
Can	30	25-30	40-60	50-80	70-125
Steel rebar		100-200	150-250	70-270	100-380
Iron		100	80-200	75-210	100-225
Rubber		200-250	300-350	300-350	350-400
Tin				400-700	525-750
Brass				2100-2500	2300-2600
Copper				NA	NA
Bones				225	260

1.7 Financing Conditions of SWM

(1) Present SWM financing

SWM financing comes from the budget allocated to Dinas Kebersihan and the collected retribution fee. Dinas Kebersihan (DK) budget, in the same manner as KMUP budget is divided into two components, Routine and Development. Figures for both KMUP and DK budgets for the past four years are shown in the following table.

KMUP and SWM Routine and Development Budgets (Rp. 1,000)

	1991/92	1992/93	1993/94	1994/95
1. KMUP Total	**45,992,753**	**60,439,287**	**66,044,737**	**80,690,606**
Routine	27,341,653	34,687,644	40,540,033	47,972,864
Development	18,651,100	25,751,643	25,504,704	32,717,742
2. DK Total	**1,949,465**	**3,143,950**	**4,557,923**	**4,972,039**
Routine	1,113,565	1,196,757	2,822,699	2,518,137
Development	835,900	1,947,193	1,735,224	2,453,902
3. DK share of KMUP	**4.2%**	**5.2%**	**6.9%**	**6.2%**
Routine	4.1%	3.5%	7.0%	5.2%
Development	4.5%	7.6%	6.8%	7.5%

Notes: 1991/92 Ã 1993/94 figures from ADIPURA report
1994/95 KMUP figures from KMUP BAPPEDA and SWM figures from Dinas Kebersihan

While total KMUP budget increased by 1.75 during the four years, increase in DK budget was larger at 2.55. Overall DK budget share of KMUP budget grew during the first three years to reach almost 7%, but then fell to just over 6% during the last year.

Routine component of the budget is used for operation and maintenance, while development component covers investments for new projects and purchasing of heavy equipment as vehicles. Office equipment purchasing, such as computer and stationary is done under routine budget. DK development budget increased by 2.9 times during the four years, but an exceptional increase of 2.33 times from 1991 to 1992 is noted. This may be explained by the introduction of a number of new waste collection vehicles; 4 Kijang and 11 Dyna Rino vehicles in 1992. In 1993 only three new vehicles were procured, Toyota Armroll, and this may explain the fall in development budget from 1992 to 1993.

On the other hand, reasons for the more than doubling of DK routine budget between 1992 and 1993 are not clear. However that situation appears to be exceptional as the

routine budget fell back from 1993 to 1994.

(2) DK 1993/94 expenditure and 1994/1995 budget

Table I.10 shows a breakdown of the 1993/94 expenditure and 1994/95 DK budget. Only routine expenditure was available for 1993/94. Loan repayments and equipment depreciation are not included in either the budget or expenditure. Routine budget plan for 1994/95 is greater than the actual expenditure in 1993/94 by 10%. Increase is mainly in vehicle and heavy equipment maintenance (+14%), solid waste collection and transport operation (+11%), and night soil transport operation (+16%).

Development budget for, and breakdown of 1994/95 budget was also received from DK and it was therefore possible to estimate shares of major items;

a. Routine budget

Salaries and allowances;	23%
Spare parts;	5%
Fuel and oil;	9%
Small equipment;	2%

b. Development budget

Purchase of new vehicles;	0%
Purchase of new containers;	5%
Final disposal site;	15%
New workshop and garage;	10%
Public toilet facilities;	7%

Breakdown of the 1994/95 routine budget by activity is not directly shown in the budget but can be estimated as shown in the following table.

DK Routine Budget Breakdown by Activity

	Solid Waste	Street Sweeping	Grass Cutting	Ditch Cleaning	Night Soil
1. Salaries, etc	331,049,610	83,477,466	15,177,721	102,449,617	31,341,089
2. Operation Cost	495,663,750	200,000,000	5,000,000	150,531,950	31,707,750
3. Spare parts	99,129,000	1,290,323	0	2,580,646	7,000,000
4. Fuel and Oil	453,036,429	2,632,678	6,261,936	5,265,356	36,268,602
5. Batteries, etc	128,563,000	1,400,000	0	2,800,000	8,210,000
6. Others	45,728,160	23,952,846	4,355,063	29,396,674	10,887,657
Total	1,553,169,949	312,753,313	30,794,720	293,024,243	125,415,098
Share of Tot. (%)	67%	14%	1%	13%	5%

The total amount of this table represents 92% of the routine budget. The remaining 8% is allocated to the other sections of Dinas Kebersihan. Expenses for the Retribution Section (mainly salaries) are included in the solid waste collection and transport activity.

As can be expected the major portion of the budget is used for the solid waste activity, while the remainder is almost evenly divided between ditch cleaning and street sweeping activities. This indicates the importance of ditch cleaning in KMUP. Night soil transport and disposal accounts for 5% of the budget.

(3) Retribution system

The three possible fees Dinas Kebersihan receives for its services are the waste collection fees, tipping fees at the TPA from haulers other than Dinas Kebersihan, and the night soil drainage activity. This section deals with the retribution fee collected for the waste collection and transport service. This may be estimated to represent over 90% of the total.

1) Retribution share of SWM expenses

The following table shows DK expenditure and income in the last four years. Retribution fee, Dinas Kebersihan's only substantial income accounted for just less than 10% of the total budget in 1993/'94. With only 27% coming from KMUP budget, Dinas Kebersihan has relied heavily in the past on outside sources to cover the shortfall in its budget. Outside sources include foreign loans (IBRD), Inpres program and other national programs.

Retribution Share of DK Budgets

	1991/92	1992/93	1993/94	1994/95
1. EXPENDITURE				
Routine	1,113,565,000	1,196,757,000	2,822,699,000	2,518,136,790
Development	835,900,000	1,947,193,000	1,735,224,000	2,453,902,000
Total	1,949,465,000	3,143,950,000	4,557,923,000	4,972,038,790
2. INCOME				
Retribution	304,094,000	377,772,000	396,661,000	NA
- % of Tot. Income	16%	12%	9%	NA
KMUP Budget	438,689,000	905,054,000	1,227,939,000	NA
- % of Tot. Income	23%	29%	27%	NA
Other Sources	1,206,682,000	1,861,124,000	2,933,323,000	NA
- % of Tot. Income	62%	59%	64%	NA

Source: ADIPURA, March 1994

Although the retribution amount collected has increased gradually the share of that amount in the expenditure continues to decrease, reaching 9% in 1993/94 budget.

Dinas Kebersihan estimates that actual amount of retribution collected that year is only 30% of the potential amount that could have been collected. That is why Dinas Kebersihan has decided to introduce a new retribution collection method as described hereafter.

The Study Team, in addition to the figures shown in the above table, has also received a second figure for retribution fees collected in 1993/94 from DK. The second figure is Rp. 284,526,825.00, which is 30% less than the ADIPURA figure in *Table* I.12. That figure would reduce the retribution share to 6%.

2) New retribution fee collection system

Starting Nvember 1994, DK collects the waste collection retribution fees through the collection offices of PLN Tariff levels applied are those stated in Law 3/1990. Therefore the new retribution fee system introduced a new fee collection system rather than raising of the tariff levels.

At present PLN has 142,325 customers, and if retribution fees are collected from all these customers, DK calculated the total amount collected in one month to be Rp. 141,226,500 (following table). At Rp. 1,694,718,000 annually, this sum would cover 34% of the 1994/95 budget, and retribution amount collected would be more than 4 times the previous year.

Dinas Kebersihan New Retribution Collection System

No.	Category	Consumer Number	Tariff (Rp/Month)	Total (Rp/Month)
	PUBLIC FACILITY			
1	S1	520	0	0
2	S2	1,150	0	0
3	S3	355	0	0
	RESIDENTIAL HOUSE			
4	R1: Temporary Building	89,905	500	44,952,500
5	R2: Semi Permanent Building	39,745	1,000	39,745,000
6	R3: Permanent Building	2,135	1,500	3,202,500
7	R4: Multi Storey Permanent Building	295	1,500	442,500
	BOARDING HOUSE			
8	U1: Class C	4,043	5,000	20,215,000
9	U2: Class B	2,849	7,500	21,367,500
10	U3: Class A	23	15,000	345,000
	HOTEL			
11	H1: Class A	65	7,500	487,500
12	H2: Class B	4	10,000	40,000
13	H3: Cottage, Inn, Mess	6	25,000	150,000
	RESTAURANT, BAR, STALL, MASSAGE			
14	I1: Restaurant Class III	1	10,000	10,000
15	I2: Restaurant Class II	134	15,000	2,010,000
16	I3: Restaurant Class I	239	20,000	4,780,000
17	I4: Other Class II	46	20,000	920,000
18	I5: Other Class I	1	20,000	20,000
	MEETING HALL, WAREHOUSE			
19	G1: Warehouse, Storage	793	3,000	2,379,000
20	G2: Meeting Hall, Wedding Reception	16	10,000	160,000
	TOTAL	142,325		141,226,500

Actual fee collected in February and March '95 reached about 85% of potential amount based on DK estimations.

(4) Estimate of SWM unit cost

SWM unit cost shall be estimated using the 1994/'95 budget figures.

Table shown in Artical 5.1.7 (1) shows that DK 1994/'95 budget as follows;

Routine = Rp. 2,518,137,000

Development = Rp. 2,453,902,000

Total = Rp. 4,972,039,000

These figures include the total activities of DK. In order to estimate the SWM cost, night soil transport and landscaping activities are deducted. Based on *Table* I.11, these activities account for 5% and 1% respectively of the routine budget. In the case of the development budget, other than SWM projects the sum allocated for public toilets was 7%. Therefore deduction of these figures from routine and development budgets will provide SWM budget.

In addition to the above, the expenses incurred by LKMD activity in collecting waste and bringing it to the TPS should be included in the SWM cost. LKMD expenses can be calculated as 40% of total retribution fees collected. Retribution fee figures appearing in *Table* I.12 represent the 60% received by Dinas Kebersihan. As the 1994/'95 retribution fee amount collected is not known, that of the previous years have been used to project the 1994/'95 retribution fee. Accordingly LKMD expenses are estimated as Rp. 301,384,000 in 1994/1995.

Therefore SWM portion in 1994/1995 budget may be estimated as follows;

Routine = Rp. 2,367,049,000 (other DK sections have been included)

Development = Rp. 2,282,129,000

LKMD costs = Rp. 301,384,000

Total SWM cost = Rp.4,950,562,000

On the other hand total solid waste collected and transported to TPA by DK is estimated based on the records of six months obtained from the TPA and the Study survey in September 1994. This figure is 333,540m^3 per year. Therefore, using the total SWM cost, unit cost will be Rp. 14,840/m^3. If the development cost is excluded, and furthermore costs for other DK activities of street sweeping, grass cutting and ditch cleaning are deducted (as shown in *Table* I.11) from the above Routine budget figure, the unit cost for solid waste collection and transport activity can be estimated as Rp. 5,960/m^3 (Rp. 18,630/ton assuming density of hauled waste as 0.32 t/m^3).

If the 1993/94 Routine expenditures and retribution fees sum collected (described in table shown in article 6.1.7 (2)) are used the unit price will be as follows;

Routine expenditure for waste transport = Rp. 1,618,006,080

Added LKMD expenditure = Rp. 189,684,550

Unit cost of waste transport ('93/'94) = Rp. 5,705/m^3 (Rp. 17,830/ton)

Results of this analysis are summarized as follows;

	Estimation Preconditions	Rp/m^3
(1)	1994/'95 total Development and Routine budget after excluding night soil transport and landscaping budgets	14,840
(2)	1994/'95 Routine budget after excluding Development, and deducting from Routine budget portions of night soil transport and landscaping	7,750
(3)	1994/'95 Routine budget after excluding Development, and deducting from Routine budget portions for night soil transport, landscaping, street sweeping, and drain cleaning	5,960
(4)	1993/'94 Routine expenditure after deducting expenditure portions of night soil transport and landscaping	7,380
(5)	1993/'94 Routine expenditure after deducting expenditure portions of night soil transport, landscaping, street sweeping, and drain cleaning	5,700

1.8 Regulations Governing the Activity

(1) General

In the report titled "DATA AND INFORMATION ON SOLID WASTE MANAGEMENT IN UJUNG PANDANG MUNICIPALITY, 1992/1993", prepared by Mr. Sommeng, former director of Dinas Kebersihan, the following regulation and operation standards are quoted;

a. Local Government Regulation 11/1987 on organizational structure and work program of Dinas Kebersihan KMUP.

b. KMUP Mayoral Decree 466/S.Kep/061.1/1989 on job description of Dinas Kebersihan sections and sub-sections.

c. Local Government Regulation 3/1990 on cleansing management in KMUP (referred to as PERDA 3/1990).

d. KMUP Mayoral Decree 2511/1990 on implementing PERDA 3/1990.

e. KMUP Mayoral Decree 3718/1991 on technical guidelines for implementing of PERDA 3/1990.

f. KMUP Mayoral Decree 3311/1992 on perfection of technical guidelines of Solid Waste Management (SWM) and collection of cleansing retribution fee.

g. KMUP Mayoral letter 14/658.5/Edar/HK/1991 on cleansing maintenance.

h. KMUP Mayoral letter 1256/660.2/HK/1991 on upgrading community participation in cleansing activity

i. KMUP Mayoral letter 16/658.5/DK/1992 with Standard Operational Procedure (SOP) book attached to each Kelurahan, to use the book as a reference for their operation.

j. Book on Standard Operational Procedures

k. Additional Guidelines on SOP for KMUP SWM

l. KMUP Mayoral Decree 2/1994 regarding revision of certain punishment aspects of PERDA 3/1990.

Of the above stated documents, the Study Team has available documents numbers a, c, i, j, k and l. The other documents were requested from the Counterpart Team but they explained that regulation 3/1990 was the sole one being followed and all other documents were related to it.

(2) Review of available documents

a. KMUP Mayoral Decree 11/1987

This decree defines the duties of the newly established Dinas Kebersihan and sets out the sections and sub-sections, while describing their functions.

b. PERDA no. 3/1990

This regulation sets out the SWM system in KMUP and the duties of citizens, community groups, and Dinas Kebersihan (DK). This system as described in the regulation is summarized as follows:

⇒ KMUP provides TPS and TPA sites.

⇒ Waste haulage from houses to TPS is coordinated by the citizens, Kelurahan and RW/RT heads.

⇒ DK is responsible for transporting waste from TPS to TPA.

⇒ Generators of more than 2.5m3 waste/day are responsible to transport their waste directly to TPA, or request special assistance from DK.

⇒ KMUP will be responsible for transport of construction waste.

⇒ Waste shall not be incinerated in areas not designated for this activity, at places less than 10 meters from public streets of buildings, and not in holes.

⇒ Waste shall not be disposed of in rivers, canals, ditches, beaches, public roads and centers, sidewalks, or other places.

⇒ Generators of hazardous waste shall equip their sites with special bins or tanks for accommodating that waste.

The regulation also sets out the retribution fee to be paid by dischargers by classification. Residents are classified into 4 categories, and fees range from Rp. 300/month to Rp. 1,500/month. Classifications cover hotels, businesses, industries, and commercial concerns. Night soil removal from tanks and wells shall cost Rp. 15,000. Dischargers who dispose of their waste directly to the TPA shall pay Rp. 500/m3.

c. KMUP Mayoral Decree 2/1994

This decree reduces the period stipulated for incarceration under PERDA 3/1990, for violators from 6 months to 3 months, while maintaining the fine of Rp. 50,000

d. KMUP Mayoral Letter 16/658.5/DK/1992

By this letter the Mayor instructs all heads of Kelurahan to use the Standard Operational Procedures on SWM as a guide to implement cleansing in their respective Kelurahan.

2 Field Survey

2.1 Survey for Solid Waste Amount and Composition

(1) Outline of survey

1) Unit Generation of solid waste

The survey was done by following manner.

- Weight and volume of generated waste at several selected areas in Ujung Pandang City was surveyed daily, for eight days continuously.
- Location of the sampling area are shown in *Fig* 6.24 and *Table* 6.5.
- Survey items are following ;

a. Residential area : High, Middle and Low income area

- number of houses and inhabitants
- floor area (m^2)
- weight and volume of generated waste (45 samples)

b. Commercial area : Department Store, Hotel, Restaurant and Shopping Street

- number of shops
- number of employees
- floor area (m^2)
- weight and volume of generated waste (15 samples)

c. Market area

- area of the market (m^2)
- number of stalls
- weight and volume of generated waste (4 samples)

d. Office area

- number of employee
- floor area (m^2)
- weight and volume of generated waste (4 samples)

e. Street Waste

- length and width of the street
- weight and volume of generated waste (2 samples)

2) Amount of solid waste at final disposal site

Measurement and recording of waste amount, type, origin, hauling vehicle, arrival and departure times was started end of September 1994 in TPA. However due to constant disruption of the electric supply the weigh bridge has yet to be used on a continuous basis. Fortunately during the Time and Motion survey, implemented in August the weigh bridge was operated.

3) Analysis of the solid waste

The survey was done by following manner ;

- Samples of this survey are same with unit generation survey sample
- Bulk density and Physical composition was done for seven days continuously : these analysis ware done inside TPA site
- For other analysis, mentioned below, two days sample were taken (Monday sample and Saturday sample) : these samples were sent to Jakarta and analyzed in Water supply and Environmental Sanitation Training Center in Bekasi Timur, Jawa Baret, because there are no big dryers in Ujung Pandang using for analysis.
- Sampling area and number

a.Residential area	: High income	1 sample/day
	: Middle income	1 sample/day
	: Low income	1 sample/day
b.Commercial area		1 sample/day
c.Market area		1 sample/day
d.Office area		1 sample/day

- Item of analysis

a. Bulk density

b. Physical composition (wet base)

c. Moisture content for each composition (for combustible and non-combustible waste)

d. Ash content for each composition (for combustible waste only)

e. Lower calorific value for each composition (for combustible waste only)

f. Elementary analysis for each composition (for combustible waste only) : Carbon(C), Hydrogen(H), Nitrogen(N), Sulfur(S), Chlorine(CI), Oxygen(O)

4) Program development for truck scale

Computer program was developed to record collection vehicles which inter into TPA together with solid waste amount measured by truck scale.

a. Vehicle code
b. Date and time
c. Area / generation source (Kecamatan and /or Kelurahan)
d. Weight of waste
e. Type of waste

Following report can be produced

a. Daily report
b. Monthly report
c. Yearly report

(2) Result of survy on solid waste amount and composition (wet season)

1) Unit generation rate

Results of unit generation rate surveys for solid waste amount in residential areas are shown in the following.

Unit Generation Rate and Bulk Density in Residential Area

Residential area	Generation rate (kg/capita)		Bulk density (kg/liter)	
	Dry season	Wet season	Dry season	Wet season
High income	0.423	0.390	0.214	0.345
Middle income	0.342	0.318	0.227	0.346
Low income	0.338	0.322	0.224	0.337

Unit generation rate in commercial area differs by type of generation source. Following is a result of the surveys in the wet season.

Unit Generation Rate of Commercial Waste

Commercial	Generation rate (kg/100m2 floor area)		Bulk density (kg/lit)	
Activity	Dry	Wet	Dry	Wet
a. Market	17.5	23.6	0.300	0.328
b. Department store	0.3	11.1	0.075	0.372
c. Hotel	0.1	0.8	0.129	0.314
d. Restaurant	0.5	14.9	0.121	0.510
e. Shopping street	1.2	1.1	0.130	0.254
f. Office	0.07	0.2	0.060	0.143
g. Street waste	0.5	0.2	0.229	0.304

2) Solid waste amount disposed of

Solid waste amount disposed of in November was measured at the weigh-bridge as shown in *Fig.*6.25. Average amount was 262 ton/day at that time.

Solid Waste Amount Disposed at Tamangapa Disposal Site

Weekday	September 1994		January 1995	
	Amount (m3)	Trip no.	Amount (m3)	Trip no.
Sunday	663	131	929	185
Monday	711	145	1,020	204
Tuesday	691	140	1,054	209
Wednesday	679	139	1,029	205
Thursday	745	154	1,062	211
Friday	740	150	1,032	200
Saturday	713	145	916	185
Average	706	143	1,006	200

3) Solid waste composition and chemical analysis

Fig. 6.26 and *Fig.* 6.27 show the results of survey in dry season and wet season respectively. Physical composition is almost the same. But moisture content in the wet season is 10% higher than that for the dry season. Following are some important indicators that are different for the dry season and wet season.

Solid Waste Composition

	Dry season	Wet season

a. Wet base composition		
Combustible	94.8%	94.6%
Non-combustible	5.2%	5.4%
b. Dry base composition		
Combustible	88.2%	85.8%
Non-combustible	11.8%	14.2%
c. Moisture content	58.3%	67.6%
d. Ash content	13.5%	10.3%
e. Organic content	28.2%	22.2%
f. Lower calorific value	(334kcal/kg)*	(820kcal/kg)
(Q=45V-6W)	917kcal/kg	594kcal/kg

Note: * Measurement may have some misunderstanding

(3) Estimation of solid waste amount and composition

1) General conditions of estimation

Since all generated waste is not collected and transported in KMUP at present, the solid waste amount has been estimated using unit generation rate obtained through the field survey conducted in this JICA study. It should be remembered that solid waste amount in wet season is reported to be greater than the respective amount in the dry season by about 10 to 20% in Indonesia. Future solid waste amount is estimated based on the forecast socioeconomic framework including future population and future land-use and taking into consideration the general tendency in many countries that upgrading in living standard will be accompanied with an increase in unit generation rate. Also it should be noted that increase of unit generation rate will be mainly in the field of commercial activity.

Also it is a general tendency for solid waste composition to change according to change in life style, specially in living standards. Experience in many countries shows that percentages of paper, plastic, metal, and glass will increase while percentage of putresible matter will decrease in the future.

2) Socioeconomic Framework

Population is forecast to be 1.52 million in 2005 and 2.2 million in year 2015, which is 2.2 times the population in 1992.

GRDP will increase not only according to increase in population but also the development of the regional economy. Growth of regional economy will be assumed based on several development scenarios considering future increase of GRDP per

capita as shown in the following table.

Economic Framework

	Unit	1993	1995	2000	2005	2010	2015
Population	1,000 person	1,020	1,090	1,270	1,520	1,870	2,200
a. Case A 4% increase							
GRDP	Rp. billion	1,171	1,267	1,541	1,875	2,281	2,775
GRDP/capita	Rp.1,000/capita	1,148	1,162	1,213	1,233	1,220	1,261
Ratio of GRDP/cap	1993 = 100%	100%	101%	106%	107%	106%	110%
b. Case B 6% increase							
GRDP	Rp. billion	1,171	1,316	1,761	2,356	3,153	4,220
GRDP/capita	Rp.1,000/capita	1,148	1,207	1,386	1,550	1,686	1,918
Ratio of GRDP/cap	1993 = 100%	100%	105%	121%	135%	147%	167%
c. Case C 8% increase							
GRDP	Rp. billion	1,171	1,366	2,007	2,949	4,333	6,366
GRDP/capita	Rp.1,000/capita	1,148	1,253	1,580	1,940	2,317	2,894
Ratio of GRDP/cap	1993 = 100%	100%	109%	138%	169%	202%	252%

Future land use is forecast as shown in the following.

Future Land use in KMUP (Unit : ha)

	1993	1995	2000	2005	2010	2015	2015/1992
Residential	4,395	4,684	5,405	6,127	7,564	9,000	204.8%
Commercial	296	326	399	473	587	700	236.4%
Industry	359	380	433	486	743	1,000	278.7%
Institution	1,025	1,048	1,105	1,162	1,231	1,300	126.8%
Open	373	391	434	478	559	640	171.5%
Road	680	726	843	960	1,180	1,400	205.9%
Vacant	650	600	472	345	191	37	5.7%
Dry land	2,450	2,332	2,037	1,743	936	130	5.3%
Paddy field	4,470	4,264	3,750	3,235	2,288	1,340	30.0%
Swamp	470	464	450	436	383	330	70.2%
Fish pond	1,429	1,383	1,268	1,153	936	720	50.4%
River	980	980	980	980	980	980	100.0%
Total	17,577	17,577	17,577	17,577	17,577	17,577	

3) Unit Generation Rate and Waste Amount

a. Domestic waste

According to the survey result in the dry season, unit generation rate of domestic waste was 0.34 kg/capita/day. As the solid waste amount in wet season is reported to be 10 to 20% greater than that of the dry season, 0.36 kg/capita/day is used as

average.

Unit generation rate will increase according to the upgrading of living standard in general. However increase rate is not so large. Therefore, yearly increase rate is set at 1% and accordingly unit generation rate in 2015 will be 0.45 kg/capita which is almost the same as the present generation rate of high income level.

Unit generation rate of domestic waste in Ujung Pandang is therefore estimated as follows;

Unit Generation Rate of Domestic Waste

(Unit: kg/capita)

	Dry season	Wet season	Average
1994	0.34	0.32	0.33
2005	0.38	0.32	0.35
2015	0.42	0.39	0.41

b. Commercial waste

Based on the result of the JICA survey, commercial waste is estimated as 60 ton/day (excluding office waste). Waste amount will increase according to increase in commercial activity. Commercial activity will not only increase due to population increase but also due to upgrading of living standard. Therefore, it is assumed that commercial activity will increase in parallel to increase in GRDP. It is further assumed that commercial area will increase together with increase in population and activity will increase in line with increase in GRDP per capita. Based on the above assumptions, solid waste amount will increase as follows considering realistic increase in the socio-economic framework.

Solid Waste Amount

Year	Unit generation rate per area	Commercial waste amount
1994	223 kg/ha	66 ton/day
2005	357 kg/ha	187 ton/day
2015	528 kg/ha	370 ton/day

c. Institution

Part of commercial waste will be produced by institutions. Institutional land-use growth is forecast at a lower rate than increase in population. Therefore institutional waste amount is estimated as follows;

Institutional Waste Amount

1994	15 ton/day
2005	28 ton/day
2015	45 ton/day

d. Other waste

Street waste amount is estimated based on the increase in forecast street area which is roughly proportional to population increase. Concerning ditch cleansing it is possible to assume that the waste amount from ditches in the future will be the same as present considering the future arrangement of ditches and also the likely reduction in waste amount discharged into ditches.

e. Total waste amount

Based on the above, the total waste amount will be as shown in the following table considering future increase in population, economic activity and also future increase of unit generation rate for domestic and commercial wastes.

Forecast Waste Amount (Unit: ton/day)

	Forecast Average Solid Waste Amount					
	1993	1995	2000	2005	2010	2015
Domestic waste	367	400	490	617	797	985
Commercial waste	66	84	128	187	266	370
Institution	15	16	19	23	28	35
Street sweeping	13	14	17	20	23	28
Ditch cleansing	10	10	10	10	10	10
Total	471	525	666	861	1,132	1,438
Industry	58	73	101	131	165	201
Other waste						
Grand total	529	598	767	992	1,296	1,640

4) Waste amount by Kecamatan

Waste amount generated by each Kecamatan is estimated based on population and land use distribution. The result is shown in the following table.

Waste Amount Generated Daily by Kecamatan

No.	Kecamatan	Waste Amount Generated (t/d)		
		1995	2005	2015
1	MARISO	28	38	45
2	MAMAJANG	33	41	48
3	MAKASSAR	46	62	74
4	U.PANDANG	25	29	38
5	WAJO	43	52	68
6	BONTOLA	35	46	54
7	TALLO	49	79	99
8	U.TANAH	29	39	64
9	PANAKKUKANG	82	146	287
10	TAMALATE	105	209	301
11	BIRINGKANAYA	48	122	362
	Total KMUP	525	862	1,439

5) Waste amount in Maros and Gowa

a. General

As it is difficult to obtain final disposal sites in KMUP, future disposal sites will be located outside KMUP. In this case, the final disposal site will be operated as an inter-municipal disposal site based on Minasamaupa (KMUP, Maros and Gowa) concept. The future solid waste amount to develop the final disposal plan in Minasamaupa area is estimated based on the Minasamaupa concept report. The development program up to the year 2010 on sanitation and solid waste in that report is as follows:

(a) Intentions and targets

i. Improve the quality of urban sanitation in accordance with urban improvement
ii. Improve solid waste service in order to be able to serve 85% of waste produced in Minasamaupa
iii. Improve the standard of public health in Minasamaupa areas

(b) Policy and main steps

i. Give priority to sanitation service for urban areas
ii. Cope with and control the pollution of groundwater, river and other canals
iii. Develop an alternative for strategic final waste disposal having small impact on the environment
vi. Improve collection service by encouraging community participation

v. Improve operational and maintenance system efficiently and effectively

(c) Components of the program

i. Begin the clean river program
ii. Develop sanitation facilities (septic tank, WC, etc.) and install sewage system
iii. Free the upper reaches of river from pollution
vi. Improve the integrated waste management between KMUP, Maros and Sungguminasa
v. Improve waste and sanitation facilities
iv. Develop a new final waste disposal site
iiv. Prepare the development of waste water processing center

b. Population increase

Total populations of Maros and Gowa are 202,000 and 210,000 persons in 1990 and are estimated to be 340,000 and 353,000 persons respectively in 2010. Populations of Maros and Gowa in 2015 are forecast to be 381,000 and 396,000 persons using the same increase ratio. Urban population in both areas are estimated up to the year 2010 in the above mentioned report and using the same increase ratio are estimated for 2015 as shown in the following table.

Urban Population Forecasts in Gowa and Maros

	1993	1995	2000	2005	2010	2015
Sungguminasa (Gowa)	58,296	61,280	69,773	79,000	90,000	101,000
Maros & Batang Ase (Maros)	50,085	52,649	59,946	68,000	93,000	117,000

c. Service population

Served populations in Maros and Gowa in 1993 were reported to be 17,000, and 40,000 and service ratios of total population were 8% and 18% respectively (service ratios of urban population are 34% and 68%). Considering the priority to provide solid waste collection service to the urban area and forecast low population density of less than 50 person/ha, service population is set based on the following principals.

i. By year 2005, collection service shall be provided to all the urban population.

ii. In 2015, collection service will be provided to all the urban population and surrounding villages. Service ratio is set at 40% of total population (almost 1.5 times the urban population).

d. Solid Waste Amount

Future solid waste amount is estimated using a unit generation rate that is assumed 1.2 times the unit generation rate of domestic waste used in KMUP.

Future solid waste amount will be as depicted in the following.

Gowa and Maros Forecast Solid Waste Amounts

	1993	1995	2000	2005	2010	2015
Unit generation rate	0.43	0.44	0.46	0.49	0.51	0.54
Maros & Batang Ase	7.3	11.3	21.7	33.4	56.5	82.3
Sungguminasa	17.2	20.5	29.2	38.9	60.8	85.5

(4) Solid wsaste composition

1) General

Forecast of solid waste composition was prepared based on the results of the field survey. Characteristics of solid waste in Ujung Pandang are summarized as follows.

i. High content of putrecsible matter

ii. Low non-combustible content such as metal and glass

iii. High moisture content and low organic content

vi. Low lower calorific value

2) Future change in solid waste composition

Solid waste characteristics are sensitive to changes in life style. Experience in many countries shows the following change tendencies:

i. Paper, plastic and metal will increase

ii. Putrecsible content, cinder, stone will decrease

iii. Moisture content will decrease and organic content increase

vi. Lower calorific value will increase

v. Bulk density will decrease

Records of Tokyo municipality from 1963 to 1980 and Taipei municipality from 1979 to 1991 show the following tendencies.

Waste Composition in Tokyo and Taipei

	Tokyo	Taipei	Set in KMUP
Paper	NA	+0.8%	+0.4%
Plastic	NA	+0.8%	+0.3%
Metal	NA	+0.2%	+0.1%
Moisture content	-0.05%	-0.7%	-0.3%
Ash content	-1.2%	-0.3%	-0.1%
Organic	+1.25%	+1.0%	+0.4%
Lower calorific value	+66 calorie	+61 calorie	Estimation
Bulk density	-0.003	-0.009%	-0.03

Note: NA = Not Available

As both examples are set in periods of rapid economical growth, changes for KMUP are assumed to be around half as shown in the same table.

3) Future Solid Waste Composition

Based on the above mentioned assumptions, future composition of KMUP domestic waste is estimated as shown in the following. The result shows that lower calorific value will exceed 1,200 kcal/kg after the year 2005.

Future solid Waste Composition of Domestic Waste

	1994	1995	2000	2005	2010	2015
Wet base weight						
Combustible						
Paper	10.31	10.71	12.71	14.71	16.71	18.71
Textile	0.81	0.81	0.81	0.81	0.81	0.81
Plastic	7.94	8.24	9.74	11.24	12.74	14.24
Rubber & Leather	0.07	0.07	0.07	0.07	0.07	0.07
Wood	0.96	0.96	0.96	0.96	0.96	0.96
Putrescible	66.76	65.96	61.96	57.96	53.96	49.96
Other (over 5mm)	4.74	4.74	4.74	4.74	4.74	4.74
Other (under 5mm)	3.24	3.24	3.24	3.24	3.24	3.24
Sub-total	94.83	94.73	94.23	93.73	93.23	92.73
Non combustible						
Metal	1.39	1.49	1.99	2.49	2.99	3.49
Glass	2.14	2.14	2.14	2.14	2.14	2.14
Ceramic	0.84	0.84	0.84	0.84	0.84	0.84
Stone	0.80	0.80	0.80	0.80	0.80	0.80
Sub-total	5.17	5.27	5.77	6.27	6.77	7.27
Total	100.00					
Moisture content	58.32	58.02	56.52	55.02	53.52	52.02
Ash content	13.52	13.42	12.92	12.42	11.92	11.42
Organic	28.2	28.56	30.56	32.56	34.56	36.56
Lower calorific value	917	937	1,036	1,135	1,234	1,333
Bulk Density	0.265	0.26	0.247	0.232	0.217	0.202

2.2 Topographic and Geological Survey

(1) Topographic survey

Topographic survey was done for Tamangapa disposal site, Samata disposal site (Zone I) and the access road to enter Samata site, by subletting PT. DACREA on July & August 1994 and May & June 1995 respectively, and the survey results were submitted. The purpose of the survey is to make the facility plan of Tamangapa and Samata disposal site.

The following is the specification of the topographic survey, and *Fig.* 6.28, *Fig.* 6.29 and *Fig.* 6.30 shows the part of the result of this survey.

1) Tamangapa disposal site

a. Plane table survey

- area : 75 hectare

- leveling survey : 10 m grid
- scale : 1/1000

b. Cross and longitudinal section survey
- section : 19 sections (100m pitch)
- scale : v = 1/100, h = 1/1000

c. Set the Bench Mark : 2 points

d. Plan drawing
- scale : 1/2500, 1/5000

2) Samata disposal site

a. Set the Bench mark
- seven (7) Bench marks (this number includes access road)

b. Plane table survey (spot leveling)
- 100 ha : 10m grid
- scale : 1/2500

c. Cross section survey
- 9 sections : 200m pitch
- scale : v = 1/100, h = 1/2500

d. Longitudinal section survey
- 7 sections : 200m pitch
- scale : v = 1/100, h = 1/2500

e. Plan drawing
- scale : 1/2500, 1/5000

3) Access road for Samata

a. Plane table survey (spot leveling)
- 20 hectare : 10m grid
- scale : 1/2500

b. Cross section survey
- 40 sections : 50m pitch
- scale : v = 1/100, h = 1/2500

c. Longitudinal section survey
- 1 section (along the existing road)
- scale : v = 1/100, h = 1/2500

d. Plan drawing : 1/2500, 1/5000

The topographic feature of Tamangapa and Samata site is described in the next article (2).

(2) Geology, topography and groundwater of final disposal site, Tamangapa and Samata

1) Topographic features

Tamangapa and Samata new final disposal sites situate in low-lying area apart from around 15 km from the sea. Gentle mounds (EL.+5m), low isolated residual hills of bedrock (EL.+ 20m to + 30m) and swamps (EL. less than + 1 m) distribute on the alluvial plain and they form various topographic features.

Watershed is recognized in north-south direction along the main road, namely Jl. Tamangapa Raya, connecting Kel. Samata and Kel. Tamangapa. As the both final disposal sites (hereinafter called TPA) of Tamangapa and Samata are situated in the eastern flank of the water division, surface water through both TPAs flows into the largest swamp called Mangara swamp, located to the east of Tamangapa final disposal site and to the north of Samata new final disposal site.

Tamangapa final disposal site is located on the gentle mound and flat alluvial plain (paddy field). The alluvial plain in Tamangapa site is usually inundated to form the pond which connects with the Mangara swamp in rainy season. The maximum inundated water depth is around 1.5m in east of Tamangapa final disposal site.

Samata new final disposal site is located on the flat alluvial plain (paddy field) which gently inclines toward north direction. Canal flows along the southern and the western edge of Samata new final disposal site. This canal discharges surplus water of Kajenjeng dam constructed on the Tallo river to the Mangara swamp. Small channel flows westerly in the center of Samata new final disposal site and meets with the canal in the west.

The swamp 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 natural regulation pond in case of flood. According to the inhabited fishermen's information, sea water intrudes up to the swamp and accordingly the water gets brackish in the swamp. The swamp enlarges in rainy season as shown in *Fig.* 6.32.

2) Geologic features

Geologic map including both Tamangapa final disposal site and Samata new final disposal site is shown in *Fig.* 6.31. As shown in this map, the geology of this area is composed of "Alternation of sandstone and claystone (Alt)", "Tuft brachia (Tb)", "Lateritic Clay (lt)" and Alluvial deposits (al)" from stragigraphically lower to upper.

a. Alternation of sandstone and claystone (Alt)

This layer can be correlated to marine sedimentary phase of Camba Formation. It is reported that the age of Camba Formation ranges Middle to Late Miocene of Tertiary.

Alt consist of fine alternation of sandstone and claystone with intercalation of conglomerate and tuff. This layer is highly consolidated and solid with few cracks in the fresh part. Highly weathered part of this layer exposes at the foot of the isolated hill as shown in the geological map. Alt underlies in the both final disposal sites as bedrock.

b. Tuff breccia (Tb)

This layer can be correlated to volcanic phase of Camba Formation. Tb consists of tuff breccia with intercalation of tuff occasionally including the large boulders (dia. 1m to 2m). Tb is conformably underlain by Alt.

Tb forms isolated hills standing to the west of Samata new final disposal site. Surface weathered part of Tb is being quarried for the reclamation of new housing complex. The highly weathered part of Tb is around 3 to 4m from the ground surface.

c. Lateritic clay (lt)

Lateritic clay is not layer from the standing point of geological aspects. This is surface part of bedrock which was suffered severe lateritization and turned into reddish brown cohesive clay.

Lateritic clay widely covers the surface of gentle mounds as shown in the geological map. It is inferred that lt is around 3 to 5m in thickness.

d. Alluvial deposits (al)

Alluvial deposits (al) fill up the ancient valleys and forms alluvial plain. Alluvial deposits mainly consist of cohesive soft clay. Sand layer and organic clay thinly covers on the alluvial deposits. It is inferred that the maximum thickness of al is more than 15m.

3) Groundwater

Groundwater levels were measured at thirty (30) existing wells after long rainy days during May 10th to 11th, 1995. The water level of inundated area reached maximum level (around EL. + 1.5m) during the measurement. Therefore, it can be recognized that the groundwater levels measured in these days represent the levels under the rainy

season condition.

The groundwater level contour line is shown in *Fig.* 6.32 based on the measured data. As shown in this map (*Fig.* 6.32), the groundwater flowing in the both TPA's will be finally discharged into the Mangara swamp. It seems that the groundwater divide is formed along the main road and there is no groundwater seepage crossing the divide.

(3) Soil investigation of final disposal site

1) Quantity and location of investigation

The table in next page shows items and quantity of the soil investigation and *Fig.* 6.33 shows the location of the soil investigation.

The field work started on May 19th, 1995 and completed on June 10th, 1995. The laboratory soil tests started on June 16th, 1995 and their results were presented by the beginning of July, 1995.

(4) Results of field investigation

1) Tamangapa/TPA

Boring points of Tamangapa/TPA are shown in *Fig.* 6.33. Representative geological profile is shown in *Fig.* 6.35. Which was prepared by projecting the boring results on cross section 6-6. Next table shows the soil mechanical properties of layers in Tamangapa/TPA.

Items and Quantity of the Soil Investigation

Soil Mechanical Properties in Tamangapa/TPA

Soil Type	γm (tf/m³)	e	Sr (%)	Wn (%)	PSD (%)	Consistency LL (%)	PL (%)	PI (%)	Compressibility Cc	Cv	Strength C (kg/cm²)	qu (kg/cm²)	Permeability (cm/sec)
Black clay (bc)	1.2~1.8	0.6~1.3	100.0	188.1~42.9	48.0~84.0	72.0	47.2	24.8	0.7~2.0	1×10^{-3} ~2×10^{-3}	0.17 ~0.25	0.23 ~0.30	2.4×10^{-5} ~1.1×10^{-7}
Lateritic Clay (lc)	1.6~1.8	1.2~1.9	86.1~96.9	42.7~71.0	83.0~92.0	59.1~82.5	33.2~60.7	17.3~35.5	0.2~0.4	7×10^{-3} ~1×10^{-2}	0.35~0.39	0.63~1.23	1.2×10^{-4} ~5.9×10^{-5}

γm=Unit Wight, e=Void Ratio, Sr=Degree of Saturation, Wn=Water Coutent, PSD=Silt/clay Content,
LL=Liquid Limit, PL=Plastic Limit, PI=Plastic Index, Cc=Compression Index,
Cv=Coefficient of Consolidation, C=Cohesion, qu=Unconfined compressive Strength,

TPA	Purpose	Investigation items		Quantity
Tamangapa	For Foundation	Field	Boring	15 m x 3 holes = 45 m
			SPT	22 times
			Permeability Test	1 test x 3 holes = 3 tests
			G/W Measurement	3 times x 3 holes = 9 times
			U.D. Sampling	2 samples x 3 holes = 6 samples
		Labo.	Mechanical Analysis	2 samples x 3 holes = 6 tests
			Lig. & Plastic Limit	2 samples x 3 holes = 6 tests
			Moist. Cont.	2 samples x 3 holes = 6 tests
			Consolidation Test	2 samples x 3 holes = 6 tests
			Direct Shear Test	2 samples x 3 holes = 6 tests
			Uncon. Comp. Test	2 samples x 3 holes = 6 tests
			Permeability Test	1 sample x 3 holes = 3 tests
Samata	For Foundation	Field	Boring	15 m x 6 holes = 90 m
			SPT	26 times
			Permeability Test	1 test x 6 holes = 6 times
			G/W Measurement	3 times x 6 holes = 18 times
			U.D. Sampling	2 samples x 6 holes = 12 samples
		Labo.	Mechanical Analysis	2 samples x 6 holes = 12 tests
			Liq. & Plastic Limit	2 samples x 6 holes = 12 tests
			Moist. Content	2 samples x 6 holes = 12 tests
			Consolidation Test	2 samples x 6 holes = 12 tests
			Direct Shear Test	2 samples x 6 holes = 12 tests
			Uncon. Comp. Test	2 samples x 6 holes = 12 tests
			Permeability Test	1 sample x 6 holes = 6 tests
Samata	For Soil Materials	Field	Pit Excavation	5 pits
			Disturbed Sampling	1 sample x 5 pits = 5 samples
			Undisturbed Sampling	1 sample x 5 pits = 5 samples
		Labo.	Mechanical Analysis	1 samples x 5 pits = 5 tests
			Liq. & Plastic Limit	1 samples x 5 pits = 5 tests
			Moist. Content	1 samples x 5 pits = 5 tests
			CBR Test (Compacted)	1 samples x 5 pits = 5 tests
			Compaction Test	1 samples x 5 pits = 5 tests
			Consolidation Test	1 samples x 5 pits = 5 tests
			Direct Shear Test (compacted)	1 samples x 5 pits = 5 tests
			Uncon. Comp. Test (Compacted)	1 samples x 5 pits = 5 tests
			Permeability Test (U.D)	1 samples x 5 pits = 5 tests
			Permeability Test (Compacted)	1 samples x 5 pits = 5 tests

a. Geology of foundation

As shown in *Fig.* 6.35, geology of Tamangapa/TPA is composed of following layers and parts.

- Paddy clay (pc)	Alluvial deposits which filled up ancient valley
- Loose sand layer (s)	- ditto -
- Soft black clay layer (bc)	- ditto -
- Lateritic clay (lc)	Severely weathered surface parts of bedrock
- Highly weathered part of bedrock	Highly weathered parts of bedrock
- Alternation of sandstone and claystone (Alt)	Fresh parts of bedrock

i. Paddy clay (pc)

Paddy clay is soft and black clay including roots and leaves of rice plants. Thickness of paddy clay is 1.5 m to 2 m. According to the soil test results conducted in Desa Samata/TPA, Cohesion of this layer is 0.2 kg/cm^2 to 0.3 kg/cm^2. Permeability of Paddy clay is low and it ranges 5 x 10^{-5} cm/sec to 8 x 10^{-6} cm/sec. Therefor it can be judged that the Paddy clay is impervious layer.

ii. Loose sand layer (s)

This layer is composed of brown to gray, fine grained and 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)

This layer is composed of black, soft and plastic clay with some organic substances. Thickness of this layer is around 8 m and N value is 2 to 4. Cohesion of this layer is estimated around 0.2 kg/cm^2. Its permeability coefficient ranges 2 x 10^{-5} cm/sec to 1 x 10^{-7} cm/sec and this layer can be judged as impervious layer.

iv. Lateritic clay (lc)

This part is composed of reddish brown, plastic and moderately stiff clay including organic substances and it distributes on the ground surface. Thickness of this layer is around 3 m and N value is around 10 in average. This layer was eroded out in the bottom of the ancient valley. Cohesion of this layer is estimated around 0.4 kg/cm^2 and the permeability coefficient ranges 1 x 10^{-4} cm/sec to 6 x 10^{-5} cm/sec and it can be judged as impervious layer.

v. Highly weathered part of bedrock

This part is composed of brown to gray and 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. Alternation of sandstone and claystone (Alt)

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

b. Permeability of foundation

In-situ permeability test was conducted in each borehole immediately after completion of drilling work. As for the test method, constant head method with water injection was employed. The test results are shown in the following table.

In-situ Permeability Test Result in Tamangapa/TPA

Borehole No.	Water Injection Rate (Q: cm^3/sec)	Rising Height of Water Level in Hole (h: cm)	Test Section Length (L: cm)	Permeability Coefficient (K: cm/sec)
BHT-1	476.2	4	1,440	8.0×10^{-2}
BHT-2	666.7	33	1,437	1.4×10^{-2}
BHT-3	588.2	253	1,115	1.9×10^{-3}

radius of hole (rw) = 3.3 cm

Calculation Formula : $K=\{Q\mathrm{Sinh}^{-1}(L/2rw)\}/2\pi hL$

As shown in the above table, very high permeability coefficient was obtained by the in-situ test. It is suggested that the permeability coefficient obtained by in-situ test dose not show the permeability of specific layer but gives average permeability of layers in the hole.

According to the soil test results, it is clarified that the permeability of paddy clay (pc), black clay layer (bc) and Lateritic clay (lc) is low. It is inferred that the permeability of the fresh bedrocks is also low because it has very few cracks. It is believed that the in-situ permeability test results represent the high permeability of loose sand layer and highly weathered part of the bedrock. Sample observation sagests that the loose sand layer(s) does not show very high permeability as magnitude of 1×10^{-2} cm/sec because it contains much silt. Consequently, it is

inferred that the highly weathered part of bedrock has high permeability and injected water mainly infiltrated into this part.

On the other hand, the highly weathered part of bedrock is being quarried for filling and embankment materials because its permeability greatly decreases after compaction. For this reason, it is inferred that the highly weathered part of bedrock will change to impervious liner after compaction treatment.

c. Strength and compressibility

Alluvial deposits distributed in the valley plain are poor in strength and compressibility as shown in the table. The maximum thickness of alluvial deposits is around 10 m and thickness greatly changes point to point as shown in *Fig.* 6.35. Such condition of foundation should be taken into consideration in future detailed design stage.

d. Groundwater

The groundwater surface gently inclines from mound side to plain area as shown in *Fig.* 6.34 and *Fig.* 6.35. Groundwater surface concavity (lowered 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.* 6.35).

Groundwater level is very shallow in the plain area and usually inundated during the rainy season. Such condition should be taken into consideration for the design of final disposal site.

2) Samata/TPA

Boring points and test pit points are shown in *Fig.* 6.33. Geological profiles are shown in *Fig.* 6.37 and *Fig.* 6.38. Next table shows the soil mechanical properties of layers in Desa Samata/TPA.

Soil Mechanical Properties in Desa Samata/TPA

Soil Type	γm (tf/m³)	e	Sr (%)	Wn (%)	PSD (%)	Consistency LL (%)	Consistency PL (%)	Consistency PI (%)	Compressibility Cc	Compressibility Cv	Strength C (kg/cm²)	Strength qu (kg/cm²)	Permeability (cm/sec)
Paddy clay (pc)	1.6~1.8	1.1~1.7	68.7~100.0	43.3~49.9	84.0~95.0	68.3~82.5	37.8~40.1	30.6~41.9	0.4~0.8	$2x10^{-4}$ ~$1x10^{-2}$	0.15 ~0.30	0.39 ~0.98	$2.7x10^{-5}$ ~$7.6x10^{-6}$
Gray Clay (lc)	1.5~1.8	1.0~2.9	90.2~100.0	35.8~112.5	82.0~97.0	62.6~124.0	30.8~54.8	30.4~51.3	0.2~0.8	$2x10^{-3}$ ~$3x10^{-2}$	0.10~0.44	0.21~1.90	$2.8x10^{-5}$ ~$2.5x10^{-7}$
Organic Clay (p)	1.6~1.7	1.3~1.7	96.9~71.0	35.0~63.3	89.0~90.0	88.4~128.4	47.2~62.1	26.3~81.2	0.5	$1x10^{-3}$ ~$8x10^{-2}$	0.12~0.39	0.08~0.19	$1.3x10^{-4}$ ~$1.3x10^{-6}$

Abbreviation = Same as Table in Tamangapa/TPA

a. Geology of foundation

As shown in *Fig.* 6.34 and 6.38, geology of Samata/TPA is composed of following layers and parts.

- Paddy clay (pc)	Alluvial deposits which filled up ancient valley
- Soft gray clay layer (gc)	- ditto -
- Soft organic clay layer (oc)	- ditto -
- Highly weathered part of bedrock	Highly weathered parts of bedrock
- Alternation of sandstone and claystone	Fresh parts of bedrock

i. Paddy clay (pc)

Paddy clay is soft and black clay including roots and leaves of rice plants. Thickness of paddy clay is 1.5 m to 2 m. Cohesion of this layer is 0.2 kg/cm^2 to 0.3 kg/cm^2. It permeability coefficient ranges 5 x 10^{-5} cm/sec to 8 x 10^{-6} cm/sec and it can be judged as impervious layer.

ii. Soft gray clay layer (gc)

This layer is composed of gray partly mottled brown, soft and plastic clay. Thickness of this layer is 2 m to 4 m and N value is 2 to 6. Cohesion of this layer is 0.1 kg/cm^2 to 0.4 kg/cm^2 and its permeability coefficient is 3 x 10^{-5} cm/sec to 3 x 10^{-7} cm/sec. It is assumed that this layer will act as impervious liner of the new final disposal site.

iii. Soft organic clay layer (oc)

This layer is composed of black and soft clay with abundant carbonized wooden pieces (peat). Maximum thickness of this layer is around 2 m and distributes south-western part of the TPA. N value of this layer is 2 to 3. Cohesion of this layer is 0.1 kg/cm^2 to 0.4 kg/cm^2 and its permeability coefficient is 1 x 10^{-4} cm/sec to 1 x 10^{-6} cm/sec.

iv. Highly weathered part of bedrock

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

v. Alternation of sandstone and claystone (Alt).

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

b. Permeability

In-situ permeability test was conducted in each borehole immediately after completion of drilling work. As for the test method, constant head method with water injection was employed. The test results are shown in the following table.

In-situ Permeability Test Results in Desa Samata/TPA

Borehole No.	Water Injection Rate (Q: cm^3/sec)	Rising Height of Water Level in Hole (h: cm)	Test Section Length (L: cm)	Permeability Coefficient (K: cm/sec)
BHT-1	434.8	8.1	1,420	3.7×10^{-2}
BHT-2	625.0	13.2	1,424	3.2×10^{-2}
BHT-3	500.0	10.0	1,474	3.3×10^{-2}
BHT-4	714.3	5.0	1,460	9.5×10^{-2}
BHT-5	149.3	6.0	1,484	1.6×10^{-2}
BHT-6	111.1	4.3	1,493	1.7×10^{-2}

radius of hole (rw) = 3.3 cm

As shown in the above table, very high permeability coefficient was also obtained in Desa Samata/TPA. It is inferred that the highly weathered part of bedrock has high permeability and injected water mainly infiltrated into this part by the same reason which was assumed in Tamangapa/TPA.

c. Strength and compressibility

Alluvial deposits widely distribute, on the plain and they are poor in strength and compressibility as shown in the table. Thickness of Alluvial deposits is 3 m to 8 m as shown in *Fig.* 6.37 and *Fig.* 6.38. Such condition of foundation should be taken into consideration in future detailed design stage.

d. Groundwater

The groundwater in Samata/TPA is flowing from southern mound area. The groundwater in Samata/TPA finally discharges into the Mangara swamp in the north.

There is no existing well in the downstream of the groundwater flow from the Samata/TPA.

The groundwater surface inclines very gently from south to north and the groundwater level situates at very shallow depth (GL - 7 cm to GL - 80 cm) as shown in *Fig.* 6.36 to 6.38. Such condition will not allow deep excavation work.

3) Soil material

Three kinds of soil materials are supposed for the embankment construction and soil covering works as follows.

i. Lateritic clay

ii. Paddy clay

iii. Highly weathered part of bedrock

The highly weathered part of bedrock properly contains clay, sand and gravels and such quality is good for covering work and embankment construction work in tem of trafficability. However, its out crop area is very limited as shown in *Fig.* 6.31 and it is only 3 m to 5 m in thickness. In addition to these matters, it has been already quarried as mentioned before. Therefore, it is judged that remaining volume of the highly weathered part of bedrock is too small to fulfill the supply of covering materials for Samata/TPA.

On the contrary, the lateritic clay and paddy clay (al) had enough quantity for the covering work. For this reason, soil samples were taken from test pits excavated on these layers as shown in *Fig.* 6.33 and soil tests were conducted in order to grasp the soil mechanical characteristics of these layers. The results of the soil tests are summarized in next table.

Properities of Soil Materials in/near Desa Samata/TPA

Soil Type	Wn (tf/m^3)	P.S.D	Consistency LL (%)	PL (%)	PI (%)	Compaction OMC (%)	MDD	After Compaction- C	qu (kg/cm^2)	CBR (%) 0.1"	0.2"	Permeability (cm/sec)
Paddy clay (pc)	10.9~ 24.5	84.0~ 85.0	55.0~ 68.5	35.0~ 53.9	14.6~ 20.0	32.3~ 33.6	1.3 ~ 1.4	1.5	2.7 ~ 3.0	5.7~ 6.4	5.9 ~ 6.0	5.0×10^{-6}~7.0×10^{-7} (4.8×10^{-5}~3.4×10^{-5})
Lateritic Clay (lc)	29.8~ 40.0	90.0 ~ 94.0	74.5 ~ 83.5	51.9~ 61.8	15.6~ 21.7	37.1 ~ 47.5	1.1 ~ 1.3	1.2 ~ 1.3	2.3 ~ 2.6	0.21~ 1.90	4.0 ~ 5.3	2.4×10^{-5}~6.6×10^{-7} (2.1×10^{-4}~8.6×10^{-7})

CBR = California Bearing Ratio, OMC = Optimum Moisture Content, MDD = Maximum Dry Density
* = Under Natural Condition (befor compaction

As shown in this table, in spite that both layers are not excellent materials in term of

trafficability it is judged that these matrials can be allowable for covering soil materials of TPA.

Comparing these two layers, paddy clay is slightly better than lateritic clay in quality. However, the groundwater is too shallow to make large excavation work in the paddy field. Therefore, it is concluded that the lateritic clay and highly weathered part of bedrock will fillful the requirement of covering soil which will be used for Samata/TPA.

3 Typical Analysis Study on Solid Waste Management

3.1 Introduction

(1) Preamble

In the context of the Master Plan and Feasibility Study on Wastewater and Solid Waste Management for the City of Ujung Pandang the Typical Analysis Study (hereafter referred to as TAS) for Solid Waste Management has been implemented.

This section describes the process of TAS from the preparation stage, through implementation and analysis.

(2) Objectives of TAS

TAS covers the SWM activities of discharge, collection and transport, ditch cleansing and monitoring system at the disposal site using weighbridge data. TAS has been divided into four sites, each with the following objectives.

1) Adequate use of armroll container system

- ◊ Suitability of container number provided
- ◊ Selecting container locations and maximum tolerable walking distances
- ◊ Determination of hand cart need and suitable system for operation
- ◊ Cooperation of citizens in bringing their waste to the container by themselves
- ◊ Increasing citizens awareness of container system and proper discharge methods

2) Introduction of fixed time discharge by plastic bin

- ◊ Studying fixed discharge time three days/week

◊ Replacement of permanent bin system by plastic bin system

◊ Determining suitability of open stations

3) Adequate ditch cleansing system

◊ More efficient ditch cleansing using excavator

◊ Identifying citizens willingness to participate in cleaning and maintaining ditch cleanliness

◊ Providing suitable collection service to eliminate waste dumping in ditch

4) Improvement of collection vehicle efficiency

◊ Maintaining complete data records of vehicle activity using TPA weigh bridge

◊ Analyzing data and making recommendations on necessary adjustments to the collection vehicle usage

◊ Training of Dinas Kebersihan staff on continuous operation of weighbridge and analysis of incoming data

(3) Study items and scheduling

TAS was implemented over a 12 week period starting from the last week of April, 1995. The implementation schedule was as follows;

Week / Work Item	4/24	5/1	5/8	5/15	5/22	5/29	6/5	6/12	6/19	6/26	7/3	7/10
1. Site selection	o	o	o	o	o							
2. Campaign				o	o							
3. Pre TAS Interview Survey					o							
4. TAS Implementation						o	o	o	o			
5. Post TAS Interview Survey										o		
6. TPA Weighbridge Study					o	o	o	o	o	o	o	o
7. Analysis/Final Report										o	o	o

The TAS study items are described as follows;

1) Site selection and present conditions survey

a. Suitable sites for TAS identified

b. TAS sites maps collected and updated

c. Latest socioeconomic data on TAS sites collected

d. Existing collection and ditch cleansing systems in each TAS site studied

e. Suitable locations for armroll containers (Site A) and open stations (Site B) considered

f. Collection vehicle routes planned

g. Technical system for TAS operation in each TAS site prepared

h. Plastic bins purchased and distributed in TAS site B

i. Photographic records of the TAS sites compiled

2) Campaign for explaining TAS to the citizens

a. TAS explained to civic leaders

b. TAS explained to the citizens at community meetings and individual visits

c. Explanatory leaflets prepared and distributed

3) Pre TAS interview survey at TAS sites

a. About 30% of households in each TAS site interviewed

b. Results input on computer disks and analyzed

4) Monitoring and modification of TAS operation

a. TAS operation monitored at each TAS site

b. Residents guided and encouraged to cooperate as necessary

c. Aspects of TAS modified as required during the operation

5) Post TAS interview

a. Same households interviewed before TAS were interviewed once more

b. Results input on computer disks and analyzed

6) Tamangapa disposal site

a. Existing weighbridge operation and records were reviewed

b. Suitable data collection and analysis system was prepared

c. Based on data analysis problem points concerning collection vehicles operation were analyzed

7) Analysis of TAS and compilation of final reports

a. TAS introduced system was evaluated

b. Improvements to the system were proposed based on experience gained

c. A time frame for gradually expanding TAS to other areas was considered

d. This final report describing TAS was prepared

(4) Participants involved in TAS implementation

Implementation of TAS was done jointly by JICA Study Team and Dinas Kebersihan. The duties of both parties were as shown in the following table. JICA Study Team was assisted by the Indonesian engineering firm of PT. Arkonin.