

社会開発調査部報告書

No. 2

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
DIRECTORATE GENERAL OF HUMAN SETTLEMENTS (CIPTA KARYA)
MINISTRY OF PUBLIC WORKS (PU)
GOVERNMENT OF INDONESIA

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

FINAL REPORT

MAIN REPORT

PART I MASTER PLAN

MARCH 1996

FACING CONSULTANTS INTERNATIONAL, TOKYO
YACHYO ENGINEERING CO. LTD., TOKYO

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MAIN REPORT - PART I MASTER PLAN

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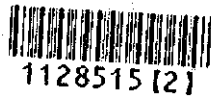
MAIN REPORT

PART I : MASTER PLAN

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PACIFIC CONSULTANTS INTERNATIONAL, TOKYO

YACHIYO ENGINEERING CO., LTD., TOKYO



**In this report project cost is estimated at June 1995 price
and at an exchange rate of 1 US\$ = Rp. 2,250 (= ¥100)**

PREFACE

In response to a request from the Government of the Republic of Indonesia, the Government of Japan decided to conduct a master plan and feasibility study on wastewater and solid waste management for the city of Ujung Pandang and entrusted the study to the Japan International Cooperation Agency (JICA).

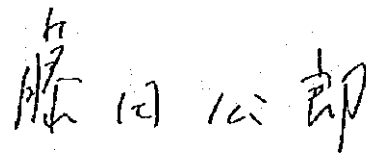
JICA sent to Indonesia a study team headed by Mr. Ryuji Yanai of Pacific Consultants International (PCI) five times between June 1994 and February 1996.

The team held discussions with the officials concerned of the Government of Indonesia, and conducted field surveys at the study area. After the team returned to Japan, further studies were made and the present report was prepared.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of Indonesia for their close cooperation extended to the team.

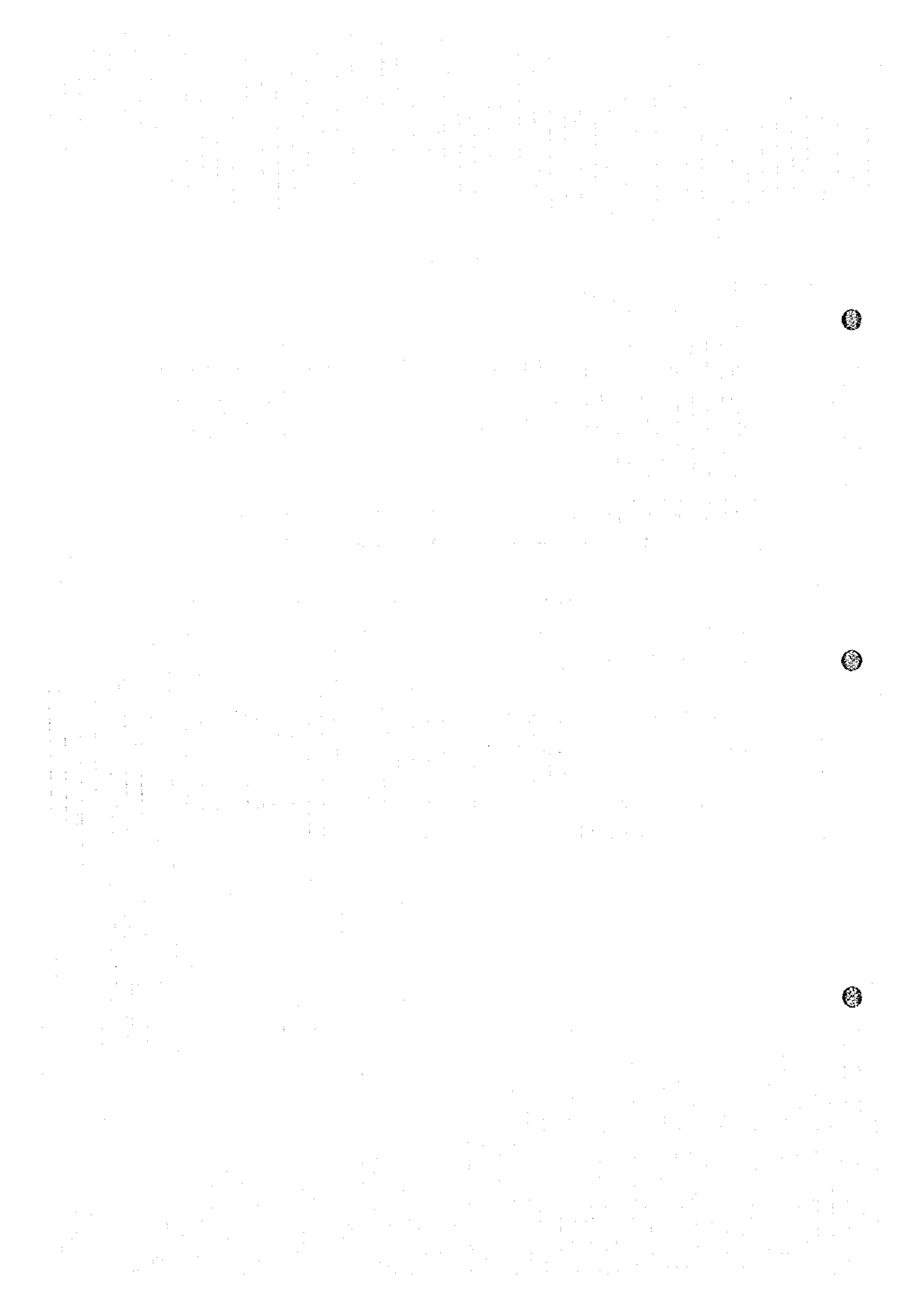
March 1996



Kimio Fujita

President

Japan International Cooperation Agency



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

March 1996

Mr. Kimio Fujita
President
Japan International Cooperation Agency

LETTER OF TRANSMITTAL

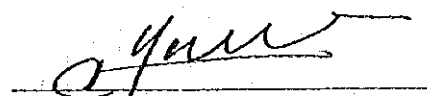
Dear Sir,

We are pleased to submit herewith the final report entitled "MASTER PLAN AND FEASIBILITY STUDY ON WASTEWATER AND SOLID WASTE MANAGEMENT FOR THE CITY OF UJUNG PANDANG". This report has been prepared by the Study Team in accordance with the contract signed on 14 June 1994, 24 April 1995 and 1 November 1995 between the Japan International Cooperation Agency and Pacific Consultants International in association with Yachiyo Engineering Co., Ltd.

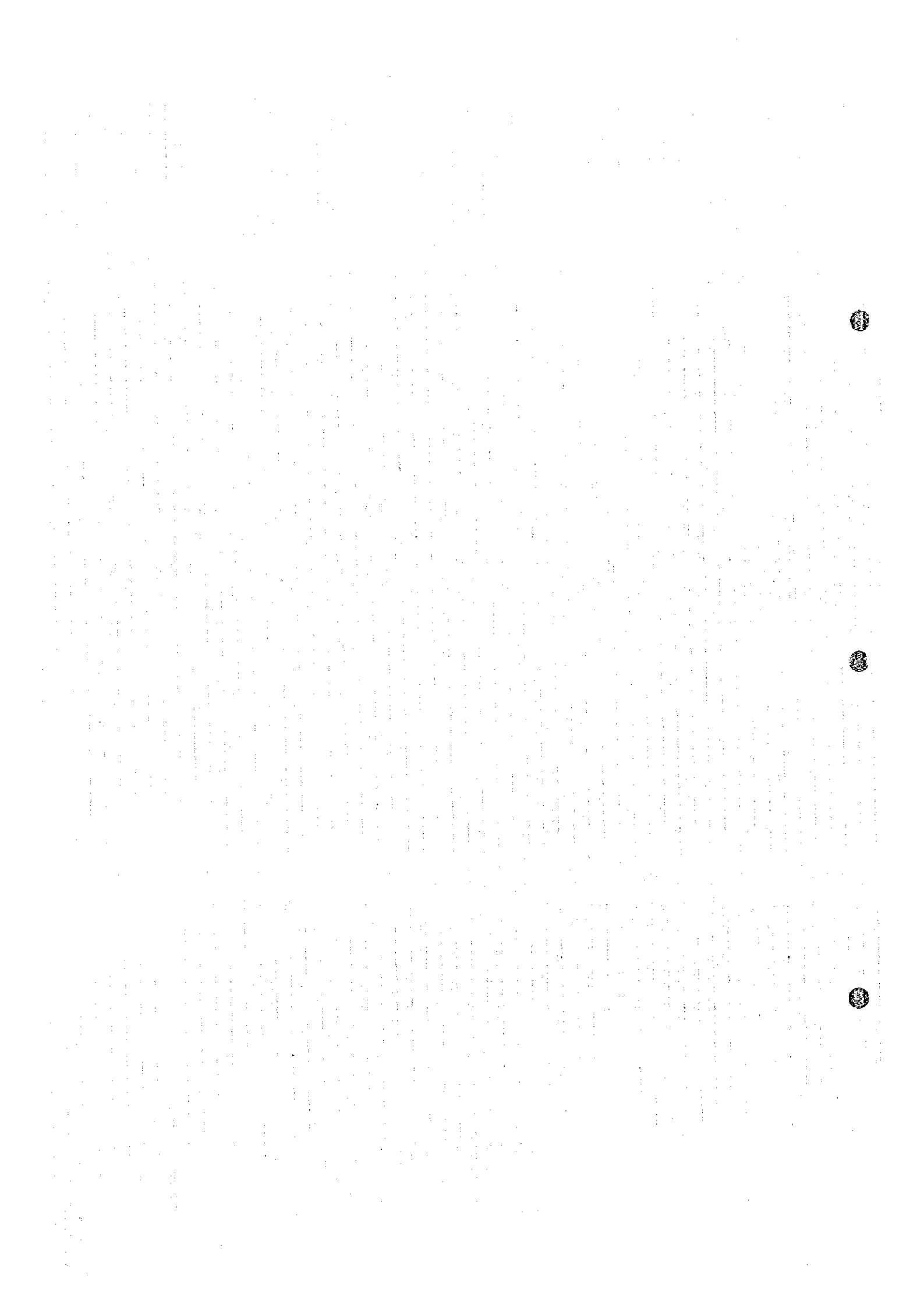
The report, based on the results of analysis of existing condition of wastewater and solid waste management in Ujung Pandang, presents a master plan and feasibility study of wastewater and solid waste management, and an alternative study for wastewater management. The report consists of Executive Summary, Main Report and Supporting Report. The Executive Summary briefly illustrates the findings of the entire Study. The Main Report, in three (3) parts, presents the master plan (Part I), feasibility study (Part II) and alternative study (Part III). The Supporting Report describes in details the technical aspects of the master plan and feasibility study. Moreover, the relevant data and drawings are compiled as the Data Book & Drawing.

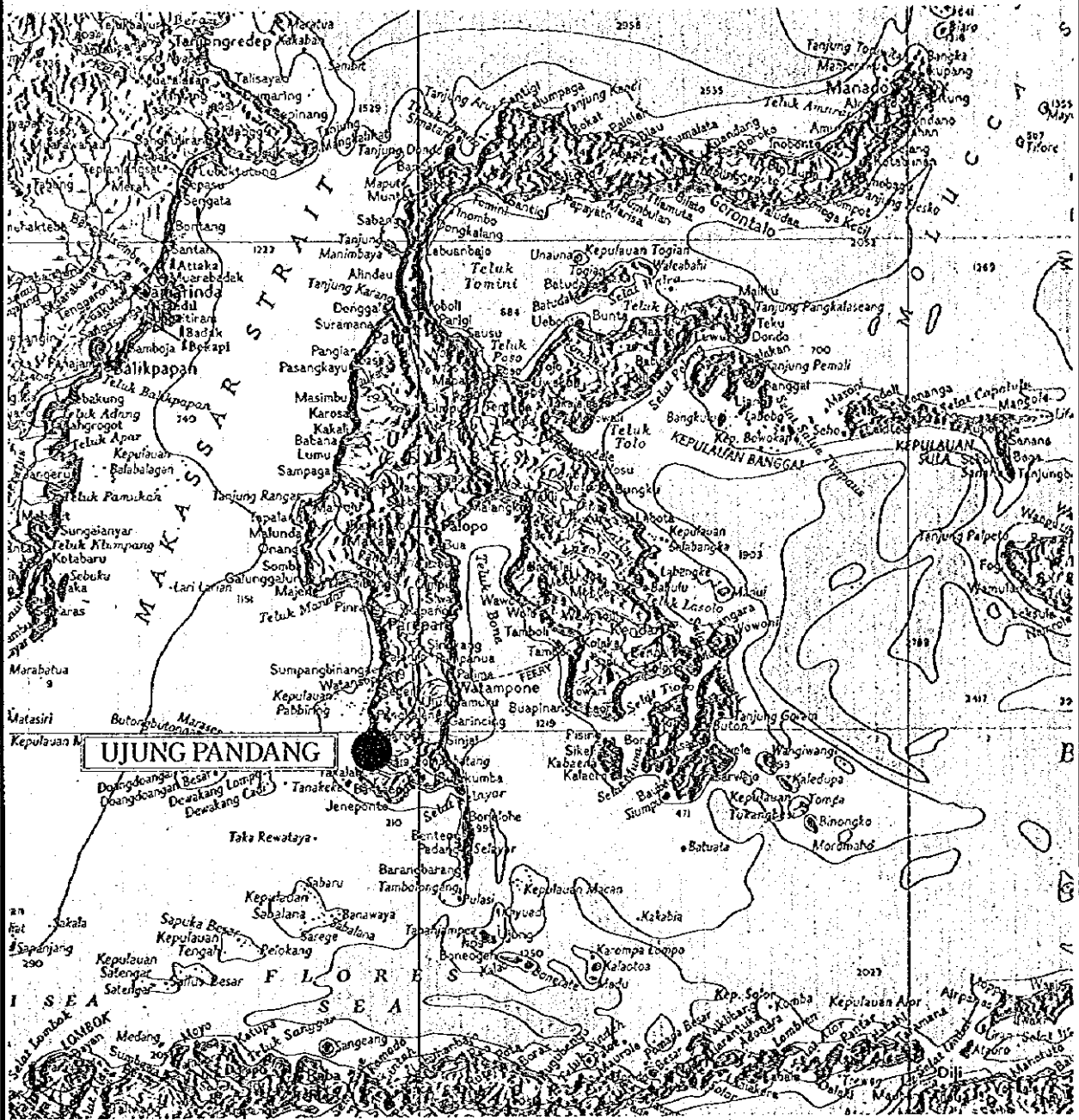
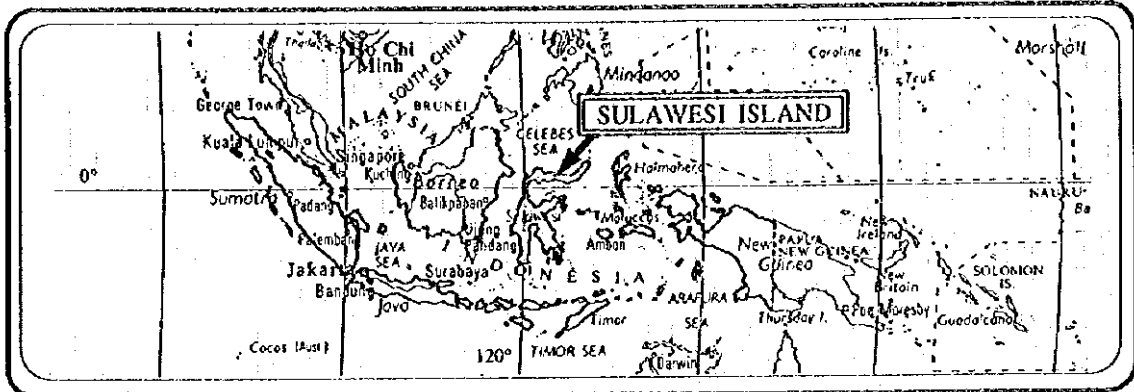
All members of the Study Team wish to express grateful acknowledgment to the personnel of your Agency, Advisory Committee, Ministry of Foreign Affairs, Ministry of Construction, Ministry of Health and Welfare and Embassy of Japan in Indonesia, and also to officials and individuals of the Government of Indonesia for their assistance extended to the Study Team. The Study Team sincerely hopes that the results of this study will contribute to the socio-economic development and environmental sanitation improvement in Ujung Pandang, the gateway to East Indonesia.

Yours faithfully,



Ryuji Yanai
Team Leader





LOCATION MAP



SUMMARY

1. Introduction

The Municipality of Ujung Pandang (KMUP), the provincial capital of South Sulawesi, is the largest city in Eastern Indonesia and would continue to take a leading role in the development of Eastern Indonesia. The population of KMUP has rapidly increased from 0.75 million in 1985 to 1.00 million in 1992, and is estimated to grow further to 1.52 million in 2005 and 2.20 million in 2015. The urban area has considerably expanded with an annual increasing ratio of over 10% since 1979.

Environmental sanitation service of KMUP is under the jurisdiction of Dinas Kebersihan (Cleansing Department), however the service level is far from satisfactory. The existing service level of solid waste collection is estimated to be 57% of total solid waste generation, and still worse in the field of wastewater management as there is no service except for quite insufficient septage collection. Consequently the highly urbanized central part of the city encounters severe environmental sanitation problems, which have been spread to the whole city with the recent rapid urbanization of the suburban area.

Hence, the formulation of a comprehensive wastewater and solid waste management plan has become necessary to improve environmental sanitation of the area.

Under these circumstances, the Government of Indonesia requested the Government of Japan in 1993 to conduct a full-scale study for the improvement of environmental sanitation (wastewater and solid waste management) of KMUP. Responding to the request, this Study was carried out by the Study Team of the Japan International Cooperation Agency (JICA) in collaboration with the Directorate General of Human Settlements (Cipta Karya), Ministry of Public Works and KMUP from June 1994 to February 1996.

The Study Area, shown in *Fig.1*, is the Municipality (city) of Ujung Pandang (KMUP) with an area of about 176 km². Nevertheless, if a facility planned in the Study is located beyond the administrative boundary of KMUP, such an area would also be incorporated in the Study Area.

The objectives of the entire Study are as follows :

- To formulate a master plan aiming at the year 2015 for improvement of wastewater and solid waste management in KMUP.
- To conduct a feasibility study aiming at the year 2005 on the high priority projects selected from the master plan.
- To conduct an alternative study for wastewater management.

This is a Summary of the master plan for wastewater and solid waste management, conducted conforming the foremost of the above three (3) objectives (Part I of Main Report). The feasibility study for wastewater and solid waste management and alternative study for wastewater management are dealt with, respectively, in Part II and Part III of Main Report.

2. Master Plan for Wastewater Management

2.1 Existing Conditions

In the Study Area many households have on-site facilities like septic tanks and leaching pits to treat blackwater, but almost all of the facilities are estimated to be unsatisfactory to mitigate groundwater from contamination. In addition to this, there are people who lack any sanitation facilities. Concerning graywater there are no treatment facilities. The existing public service of wastewater management is only insufficient septage collection service by Dinas Kebersihan.

The present environmental conditions of water bodies are as follows:

(1) Surface water

The BOD level in most of Panampu-Jongaya canal, the largest water body in the urban area of KMUP, is measured to be in the range of 120 ~ 180 mg/l, and this figure is far above the least permissible standard limitation of 30mg/l as BOD. Moreover bacterial pollution, measured as total coliform, exceeds 10^3 No./100ml, with a maximum of about 10^6 No./100ml.

(2) Groundwater

Bacterial pollution of groundwater in the entire Study Area is rather widespread, therefore it is not suited for direct potable use with no treatment, since they do not meet the required bacteriological quality for such direct potable use as per Classification-A of the usage based national water quality standards of the Ministry of Environment.

(3) Sea water

The coast line along the city center is somewhat polluted visibly. Pollution due to floating solid wastes also noted in these coastal sea waters. Bacterial pollution of coastal waters was found to be significant. High Total Coliform levels exceeding 10^3 No./100 ml are noted in the river mouth areas and the near coastal sea waters.

2.2 Planning Conditions

Wastewater generation in the Study Area is estimated to increase from 78,000 m³ in the year 1992 to 237,000 m³ in 2005 and 362,000 m³ in 2015. This rapid increase reflects, in addition to population increase, the extension of water supply service. Accordingly pollution load generation in terms of BOD in the Study Area is estimated to increase from 24,000 kg/day in the year 1992 to 56,000 kg/day in 2005 and 79,000 kg/day in 2015.

2.3 Proposed Short Term Plan up to the year 2005

Basic strategy for formulating short term wastewater management plan consists of following five (5) steps.

- i) To identify the no-toilet areas and find out appropriate schemes for providing basic toilet facilities for such areas.
- ii) To demarcate the most recommendable technical options according to the characteristics of each area.
- iii) To find out schemes for each area to be served by the most recommendable technical option.
- iv) To optimize public sector project schemes so as to maximize private sector participation.
- v) To determine the priority projects which will be completed until the year 2005 as public sector project schemes.

For no-toilet areas located in slum areas, Small Modular System (B) (hereafter called as SMS(B))/public toilet is most recommendable. If the physical condition is suitable for installing house connection sewer, SMS(B) could be recommendable on the condition that user could provide ones own water closet, otherwise public toilet shall be provided.

Summary

Except for no-toilet areas, demarcation of the most recommendable technical options consists of following two (2) steps.

- i) To separate out the areas where leaching pit can be applied.
- ii) To separate out the areas where septic tank with leaching field can be applied.

The criteria for leaching pit are that population density is less than 100 persons/ha and critical groundwater table level is deeper than 4 m from ground level.

The criteria for septic tank with leaching field is the specific pollution load generation from all sources other than blackwater be less than 2.7 kgBOD/day/ha. In this area, water quality level of 60 mgBOD/l can be obtained with only blackwater treatment by septic tank with leaching field.

Following table shows schemes of recommendable technical options for each area.

Characteristics of Area				Schemes of Wastewater Management	
Specific Type	Ground water	Population Density	Specific BOD	Private Sector	Public Sector
Slum Area				No schemes	Provision of SMS(B)/Public Toilet
Non Slum Area and Non Housing Complex	Deeper than 4 m	Less than 100 persons/ha	Less than 2.7 kg/d/ha	Residents should provide Leaching Pit when they construct or renew their housing.	Establishment of Guidelines and Regulations. Monitoring.
	Shallower than 4 m	More than 100 persons/ha	More than 2.7 kg/d/ha	Residents should provide Septic Tank with Leaching Field satisfying standard when they construct or renew their housing.	Establishment of Guidelines and Regulations. Monitoring.
No schemes				Off-site system with secondary treatment shall be installed so far as conditions permit.	
Housing Complex				Housing Developer should provide Developer Modular System satisfying standard in their own housing estates.	Establishment of Guidelines and Regulations. Monitoring.

The area located beyond housing estates and needs to be covered by off-site systems is the most difficult area to be improved. Moreover, it is obvious that pollution load generation in such an area causes severe water quality deterioration. Accordingly, this area is need to be studied in more detail as the Priority Area.

Following three (3) systems are selected as technical options for the Priority Area.

- a. Small Modular System (B/G) using Package Wastewater Treatment Plant (hereinafter called as SMS (B/G) using PWTP)
- b. Large Modular System (hereinafter called as LMS)
- c. Conventional Sewerage System (hereinafter called as CSS)

Among these three (3) systems, both LMS and SMS (B/G) using PWTP have not been demonstrated in Indonesia. In case of LMS, there are no significant distinction from CSS. But SMS (B/G) using PWTP is a very unique system and hence pilot scale demonstration prior to full scale introduction is strongly recommended. Considering this point, the strategies for the Priority Area are as follows.

- i) To determine the optimum LMS/CSS development plan based on the result of prioritizing and consideration of topographic condition and cross-subsidy
- ii) To introduce SMS (B/G) using PWTP in pilot scale as an effort to investigate its practicability, especially with respect to O&M requirement
- iii) To improve O&M of existing sanitation facilities for the non-served area of off-site system

Determination of LMS/CSS development area has been based on population density, public land use ratio, average income level and distance from potential site of treatment facility.

Zoning of proposed Short Term Plan up to the year 2005 is shown in *Fig. 2*:

2.4 Proposed Master Plan up to the year 2015

The criteria for demarcation of short term plan can still be applied to formulate Master Plan with the inclusion of additional criterion that the specific pollution load discharge shall be less than 1.8 kg BOD/day/ha, in order to achieve required water quality standard of 30 mg/l in terms of BOD.

Basically the schemes of master plan are continuous development of the short term plan. The entirely new scheme is the integration of modular system into conventional sewerage system. This integration will be necessary for all modular systems located within the conventional sewerage system development area.

Schemes of Master Plan after completion of Short Term plan is shown below.

Characteristics of Area			Schemes of Wastewater Management	
Specific Type	Groundwater	Specific BOD	Private Sector	Public Sector
Non Housing Complex	Deeper than 4 m	Specific BOD load except for blackwater is less than 1.8 kg BOD/d/ha	Residents should provide Leaching Pit when they construct or renew their housing.	Monitoring.
	Shallower than 4 m	Specific BOD load except for blackwater is more than 1.8 kg BOD/d/ha	Residents should provide Septic Tank with Leaching Field satisfying standard when they construct or renew their housing.	Monitoring.
No schemes			Off-site system with secondary treatment shall be installed.	
Housing Complex			Housing Developer should provide Developer Modular System satisfying standard in their own housing estates.	Monitoring. For the area enclosed in sewerage system, Integration into Conventional Sewerage System shall be done.

Zoning of the proposed Master Plan (2015) is shown in Fig. 3.

For an off-site system with secondary treatment, CSS is selected as optimum system considering its cost efficiency and practicability. The optimum development plan of CSS has been determined based on the alternative study. For alternative study, CSS development area is divided into five (5) zones as follows.

Sewerage Zone	Design Wastewater Discharge
Northern zone	53,600 m ³ /day
Central zone	63,400 m ³ /day
North-eastern zone	26,300 m ³ /day
Southern zone	41,000 m ³ /day
South-eastern zone	77,700 m ³ /day
Total	262,000 m ³ /day

Among the various combinations of above divided zones, the plan comprising of three sewerage zones shown in *Fig. 4* has been selected as the optimum development plan.

As the treatment system, aerated lagoon is recommended due to its simplicity and operational flexibility. Moreover, the stabilization pond system recommended in the Short Term Plan can be easily upgraded to aerated lagoon with installation of aerators.

The total investment cost of the proposed Master Plan for wastewater management is estimated to be Rp.551.3 billion including the cost of house connection and the annual O&M cost is estimated to be Rp. 9.8 billion, both at 1995 price. The cost breakdown is shown in *Table 1*. These costs do not include price and physical contingencies.

2.5 Priority Projects for Feasibility Study

Among all schemes of the short term plan, following components requires direct investment by public sector.

- a. Provision of SMS (B)/ public toilet
- b. Procurement of vacuum trucks
- c. Rehabilitation of access road to Antang septage treatment plant
- d. Construction of CSS
- e. Pilot project for SMS (B/G)

These components are selected as priority projects for Feasibility Study.

3. Master Plan for Solid Waste Management

3.1 Existing Conditions

Dinas Kebersihan (DK) is responsible for solid waste management in KMUP, with the exception of industrial waste. DK is also in charge of street sweeping, ditch cleansing and desludging. The waste is collected and transported to the final disposal site at Tamangapa and amounts to 270 ton/day on average. As the solid waste generated is estimated at about 471 ton/day, excluding industrial waste, the disposed amount is only 57% of the total generated waste bearing in mind that KMUP operates only one (1) disposal site.

3.2 Solid Waste Amount and Composition

Based on the results of surveys and observation of the waste amounts entering Tamangapa disposal site by type, the waste amount is estimated to be 471 ton/day, excluding industrial waste, and this figure is estimated to increase to 861 ton/day in the year 2005 and 1,438 ton/day in 2015, due to the growth of socio-economic framework and increase of unit generation rate.

Characteristics of solid waste composition in KMUP are summarized as follows.

- a. High content of putrescible matter (67% by wet base)
- b. Low non-combustible content such as metal and glass (5%)
- c. High moisture content (58% in dry season, 68% in wet season)
- d. Low calorific value (920 Kcal/kg in dry season, 590 Kcal/kg in wet season)

Solid waste characteristics are sensitive to changes in life style, and experience in other countries shows the following tendencies in future.

- a. Paper, plastic and metal will increase
- b. Putrescible content, cinder, stone will decrease
- c. Moisture content will decrease and organic content will increase
- d. Lower calorific value will increase
- e. Bulk density will decrease

In line with these tendencies, the future composition of domestic waste is estimated. The result shows that lower calorific value will exceed 1,200 kcal/kg after the year 2005, and also in future moisture content will be high and lower calorific value will be low during wet season.

3.3 Target of Master Plan

The targets of solid waste management (SWM) are to provide speedy, efficient and economical service to collect solid waste from areas where it is generated and dispose of it in a sanitary manner, in order to provide the citizens with a sound sanitary environment. The targets may be broken down into short and long terms as follows.

- Short term targets
 - a. Expand collection service to 90% by the year 2005 using an efficient collection system
 - b. Implement semi-sanitary followed with sanitary landfill disposal system

- c. Provide a SWM financial base based on new fee collection system
 - d. Strengthening of institutional set-up
 - e. Strengthen public sanitary education and citizens participation
 - f. Introduction of private sector participation
- Long term targets
 - a. Expand collection service to 95% by the year 2015 using an efficient collection system
 - b. Implement sanitary landfill disposal system
 - c. Promotion of waste volume reduction
 - d. Provide a SWM financial base
 - e. Strengthen public sanitary education and citizens participation
 - f. Expansion of private sector participation

3.4 Proposed Short Term Plan up to the year 2005

The most important issue is to upgrade the collection service ratio to 90% by the year 2005. Also for the near future, the only possible location for the final disposal of solid waste is the present Tamangapa site. The new disposal site, Samata, shall start operation in 2002.

Proposed Short Term Plan is described below.

(1) Collection and Haulage

Four types of discharge and collection systems shall be applied; door - to - door, open station, Jali - Jali, and communal container. Dump truck and armroll truck shall be mainly used and primary collection will be provided only where vehicle accessibility is very low and at places where pick-up points are located too far from dischargers. All waste discharged to open stations or door - to - door shall be packed. Collection frequently shall be at least 3 days in a week.

(2) Final disposal site

As a final disposal site, Tamangapa disposal site shall be utilized with extension. Semi-sanitary land fill method will be applied. There is no need to introduce a transfer station and direct hauling shall be employed.

(3) Street sweeping and ditch cleansing

Daily sweeping of class I and class II streets and every other day sweeping of class III streets are proposed. Mechanical sweepers will be used to sweep class I streets only. Concerning the ditch cleansing, in addition to continue the present work method backhoe operation will be introduced to improve working conditions and efficiency. An accurate inventory of ditch network is recommended to be undertaken.

(4) Other Activities

SWM institution shall be improved through upgrading of Dinas Kebersihan (DK) to PD Kebersihan and introduction of contracting - out to the private sector. In addition a new branch office will be set up at Panakkukang to cope with the rapid housing development in the suburban areas.

The new fee system introduced in 1994 will be continued, and the tariff level shall be adjusted to fairly distribute the burden and strengthen the SWM financial base.

3.5 Proposed Master Plan up to the year 2015

As the potential site for final disposal sites which can be utilized until the year 2015, following three (3) sites have been selected.

- a. Samata (Gowa)
- b. Maros
- c. Bulurokeng (KMUP)

Based on these three (3) potential sites, following alternatives were formulated.

- Alt-1. All collected waste of KMUP shall be disposed of in Gowa
- Alt-2. All collected waste of KMUP shall be disposed of in Maros
- Alt-3. All collected waste of KMUP shall be disposed of in Gowa and Maros
- Alt-4. Transfer Station shall be constructed and all collected waste of KMUP shall be disposed of in Maros
- Alt-5. The waste collected from the central area of KMUP shall be incinerated and ash and other waste shall be disposed of in Gowa and Maros
- Alt-6. All collected waste of KMUP shall be disposed within KMUP

Flows of collected waste amount under each alternative are shown in *Fig. 5*.

Based on technical and financial evaluation, Alternative 1 was selected as the optimum one. Proposed Master Plan is described below.

(1) Collection and transport

Collection service ratio will continue to be upgraded to 95% of the total population of KMUP. The compactor vehicle (10 m³) is recommended since it is more cost efficient than tipper and armroll considering the distance of more than 15 km between Samata disposal site and central city.

(2) Final Disposal site

Expansion of the Samata disposal site will be implemented, and Zone 2 will start operation in 2012.

(3) Street sweeping and ditch cleansing

To avoid increasing the number of manual sweepers, in addition to Class I streets a part of the Class II streets will also be mechanically swept. The short term plan for ditch cleaning shall be continued.

(4) Other Activities

The second branch office, Biringkanaya will be constructed, as soon as possible because of the rapid development of the residential area.

The tariff level shall be continued to be adjusted with the target of cost recovery realization.

The future solid waste flow along with Master Plan is shown in *Fig. 6*. The location of the final disposal sites and branch offices is shown in *Fig. 7*.

The total investment cost of the proposed Master Plan for solid waste management is estimated to be Rp. 126.4 billion and the annual O&M cost is estimated to be Rp. 14.2 billion, both at 1995 price. The cost breakdown is shown in *Table 2*. These costs do not include price and physical contingencies.

3.6 Priority Projects for Feasibility Study

Up to the year 2005, important projects concerning solid waste management according to the implementation schedule are as follows.

- a. Further expansion of collection service through procurement and renewal of collection equipment and introduction of more efficient collection system
- b. Construction of Samata landfill site in Zone I
- c. Construction of branch office
- d. Institutional reorganization to PD Kebersihan
- e. Proper tariff system
- f. Introduction of contracting - out in the old Kecamatan

The above six (6) projects are selected as the project components of the Feasibility Study based on this Master Plan of solid waste management.

4. Evaluation of Master Plan

4.1 Environmental Evaluation

(1) Mitigation of water pollution

The pollution load discharge under the conditions of both "with" and "without" the proposed Master Plan, in the year 2015, is compared as shown below.

Area	Pollution Load Discharge (kgBOD/day)	
	WITH Master Plan	WITHOUT Master Plan
On-site System Area	18,500	18,500
Off-site System Area	3,700	37,400
Total	22,200	55,900

Under "with Master Plan" condition, specific pollution load discharge will remain less than 1.8 kgBOD/day/ha based on the Kelurahan-wide data.

As a result, the proposed Master Plan for wastewater management up to the year 2015 will ensure the water quality of surface water bodies in the whole Study Area to be less than 30 mg BOD/l.

Besides, the proposed Master Plan for wastewater management is expected to contribute to the mitigation of groundwater pollution presently caused by inadequate treatment of blackwater, not only in the off-site area but also in the on-site area.

(2) Improvement of living environment

Present total generation of solid waste in KMUP is 471 ton/day except industrial waste, and the amount of uncollected waste by Dinas Kebersihan reaches 200 ton/day except industrial waste, resulting in a collection ratio of about 57%.

Future total generation of solid waste of the whole Study Area in the year 2015 is estimated at 1,438 ton/day, except industry waste, which is more than 3.1 times the present one. It is obvious that existing capacity of solid waste collection service would be extremely inadequate and consequently illegal dump sites would proliferate further resulting in severe deterioration of living environment, if no countermeasure is undertaken.

With the completion of the proposed Master Plan for solid waste management, the whole Study Area except for those area with low population density less than 50 persons/ha will be covered by regular solid waste collection service. Consequently illegal dump sites will disappear in the whole Study Area.

In conclusion, the proposed Master Plan for solid waste management will contribute to improvement of living environment of the Study Area to a great extent.

4.2 Institutional Evaluation

(1) Wastewater management institution

The type of the institution is one of the directorates in the organization structure of PDAM. Revision of Perda No. 6/1974 and of mayor decree No. 21./P/II/1976 makes it legally possible to set up the type of the institution. The total number of personnel of PDAM in 2015 is figured out to be 1,910 persons, of which 250 persons are proposed for the wastewater directorate to achieve 100% of wastewater collection service ratio in the year 2015. The organization chart is shown in Fig. 8.

(2) Solid waste management institution

The type of the institution is PD based upon the issuance, promulgation and legislation of a new Perda, since it was drafted by the municipality. Solid waste collection in old Kecamatan and new housing areas shall be contracted out up to 50% of collection. The total number of personnel of PD Kebersihan in the year 2015 is figured out to be 975 persons as the maximal number to accomplish 95% of waste collection service ratio considering contracting out of collection service. The organization chart is shown in *Fig. 9*.

4.3 Financial and Economic Evaluation

With the prospective project beneficiaries pertaining to the present and future industrial, commercial and residential consumers in sight, the project comprising the two components of wastewater and solid waste is in line with the strategy adopted by the government to achieve important social and economic policy goals in the eastern region of the country.

Available fund projection for the project period shows that the total funds available for the sanitation subsectors in KMUP, within the time-slice of 20 years, will be Rp.237.6 billion as per 1995 price up to the year 2005, of which about 65 percent of funds emanates from the public sector. In addition, Rp.490.9 billion from the year 2006 up to the year 2015 would arise from both of the public and the private sectors, combining to a total of Rp.728.5 billion at maximum.

With this and an estimated annuity of Rp.13.5 billion to Rp.15.8 billion, thus making it possible for the project to be formulated, on SLA (Subsidiary Loan Agreement) re-lending terms and conditions, at maximum Rp.180.0 billion in association with grant from the central government and fiscal transfer from the provincial government and/or equity participation standing at Rp.67.5 billion and Rp.11.3 billion, respectively.

5. Recommendation

(1) Immediate Implementation of Master Plan

The result of the Study indicates that without effective measures to restore environmental sanitation it would be impossible to avoid further aggravation of the environmental condition. In order to mitigate the progressing deterioration of environmental sanitation in the Study Area, an immediate implementation of the proposed Master Plan is required.

Accordingly, it is recommended to commence adequate financial procurement to initiate the master plan as soon as possible.

(2) Enhancement of Environmental Awareness

The result of the Study shows that people's awareness on deterioration of environmental sanitation is still quite low. A very significant attribution of this lack of environmental awareness is the illegal dumping of solid waste in ditches and drains and discharge of toilet waste to public water bodies.

Hence, enhancement of environmental awareness including public health education is strongly recommended as the key of environmental sanitation improvement.

(3) Development of Surface Water Quality Monitoring System

At present there are no monitoring stations of surface water quality in KMUP. For understanding the trend in time series and to expedite the necessary environmental improvement measures, establishment of permanent monitoring stations and measurement of water quality at regular time interval is very necessary. Hence, it is recommended to develop monitoring system of surface water quality. This program shall include the training of monitoring staff.

(4) Improvement of Industrial Waste Management

The characteristics of industrial waste vary widely and are recognized as one of the major source of pollution associated with rapid industrial development. From this view point, industrial waste especially hazardous waste shall be treated adequately. Hence it is recommended that regulations to enforce installation of adequate treatment facilities by industries be implemented by the concerned governmental institution.



Table 1 Total Cost of Proposed Master Plan for Wastewater Management

1. Investment Cost Unit : Billion Rupiah

Project Component	1996~2005	2006~2015	Total
Sanitary Improvement	2.44	4.77	7.21
SMS (B/G)	2.27	0	2.27
Sewerage System	55.68	405.29	460.97
Sub-total	60.39	410.06	470.45
Land Acquisition	8.16	8.14	16.30
Administration	1.11	8.11	9.22
Engineering Service	6.68	48.63	55.32
Total	76.35	474.94	551.29

2. Annual O&M Cost Unit : Billion Rupiah / year

Project Component	2005	after 2015
Sanitary Improvement	1.31	0.53
SMS (B/G)	0.03	0
Sewerage System	1.11	9.22
Total	2.45	9.75

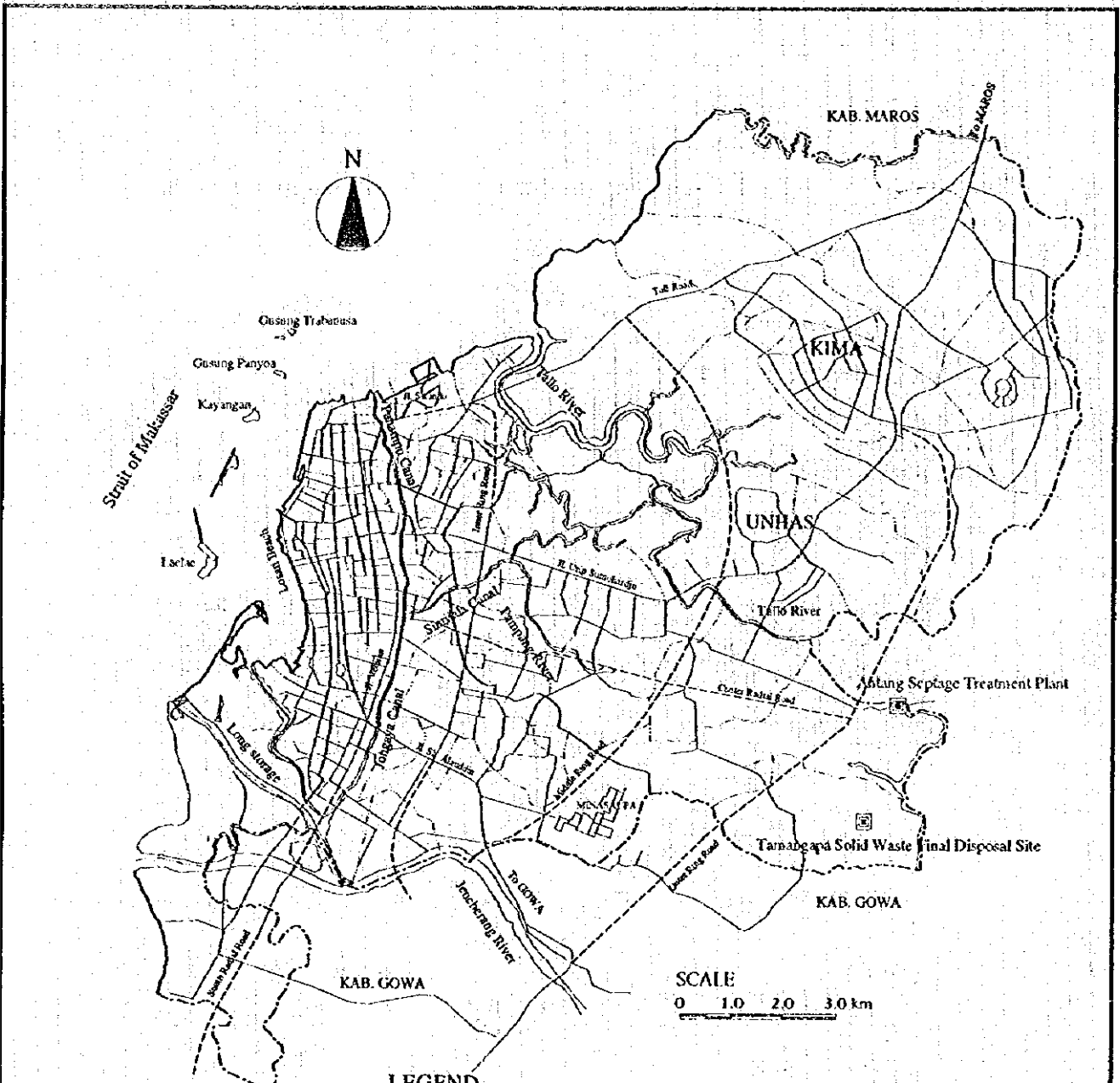
Table 2 Total Cost of Proposed Master Plan for Solid Waste Management

1. Investment Cost Unit : Billion Rupiah

Component	1996~2005	2006~2015	Total
Collection	15.62	27.97	43.58
Street Sweeping	1.25	1.71	2.96
Ditch Cleansing	0.34	0.11	0.46
Disposal	26.40	27.59	53.99
Office	1.58	0	1.58
Sub-total	45.20	57.38	102.57
Land Acquisition	6.66	2.80	9.46
Administration	0.90	1.15	2.05
Engineering Service	5.42	6.89	12.31
Total	58.19	68.21	126.40

2. Annual O&M Cost Unit : Billion Rupiah / year

Component	2005	2015
Personnel	1.72	2.17
Fuel	1.85	2.71
Maintenance	0.55	1.16
Depreciation	3.32	7.52
Others	0.41	0.62
Total	7.85	14.17



LEGEND

- CITY BOUNDARY
- KECAMATAN BOUNDARY
- KELURAHAN BOUNDARY

FIG. 1 Study Area

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

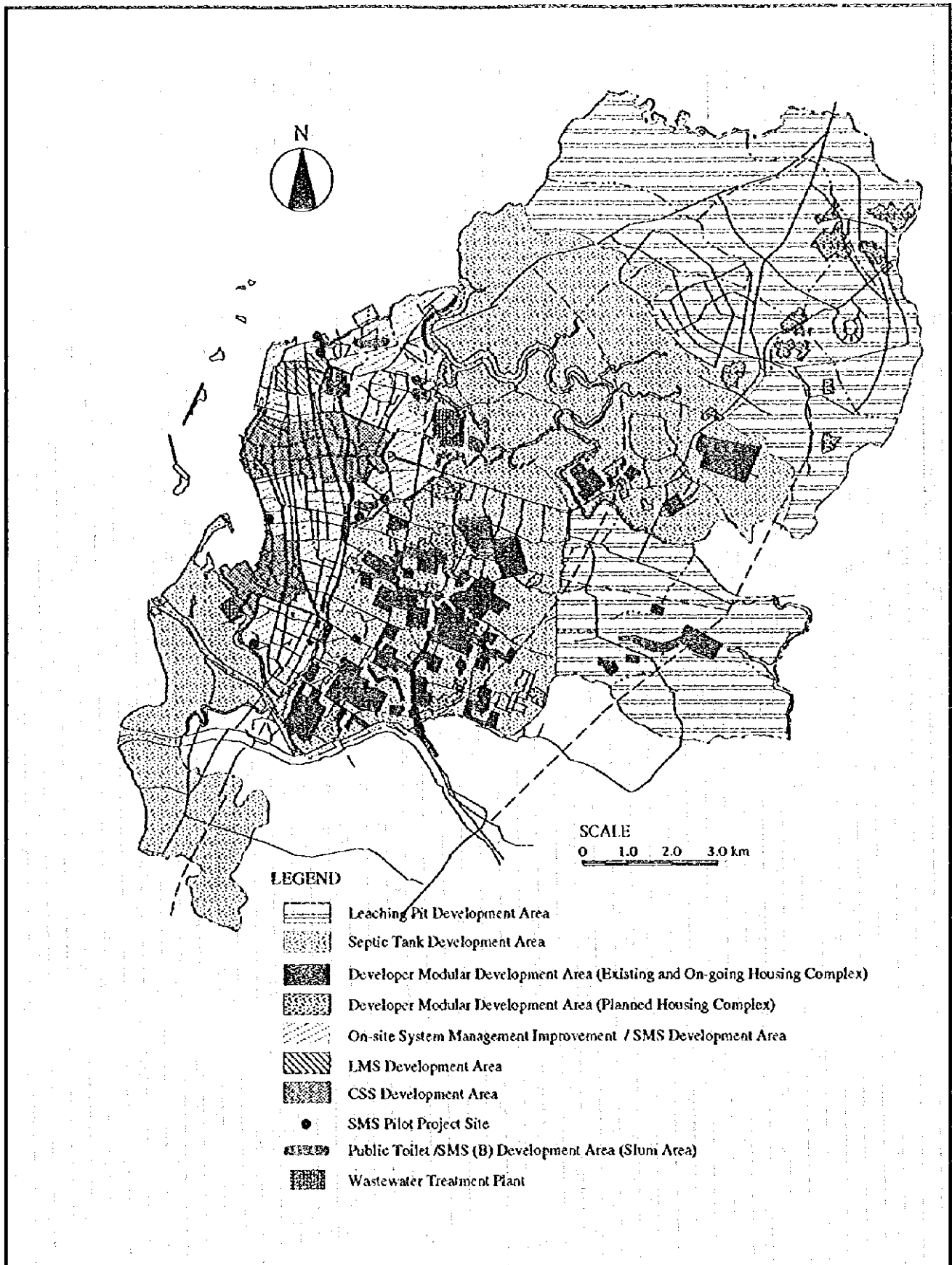


FIG. 2

Short Term Wastewater Management Plan in 2005

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

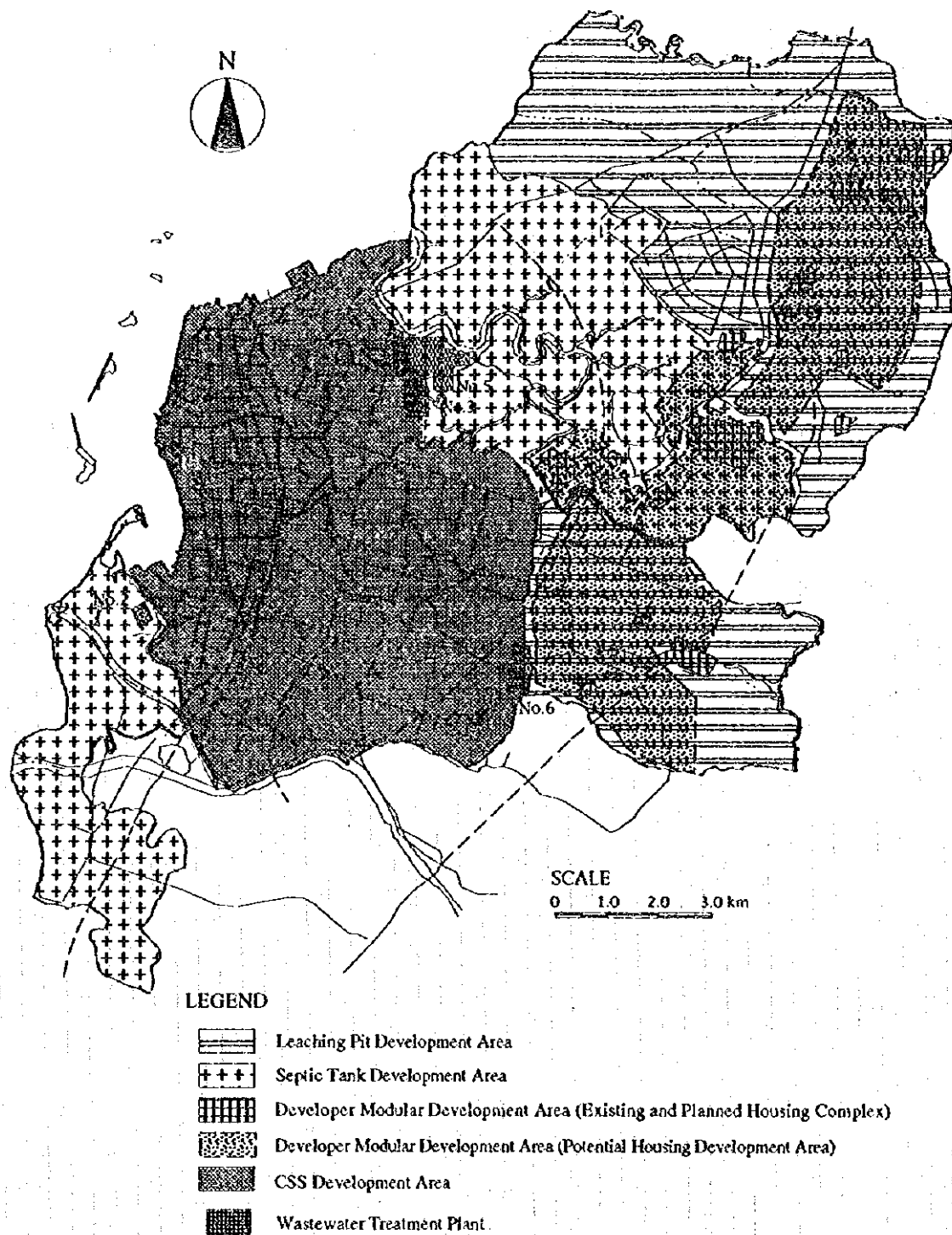


FIG. 3

Master Plan of Wastewater Management in 2015

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

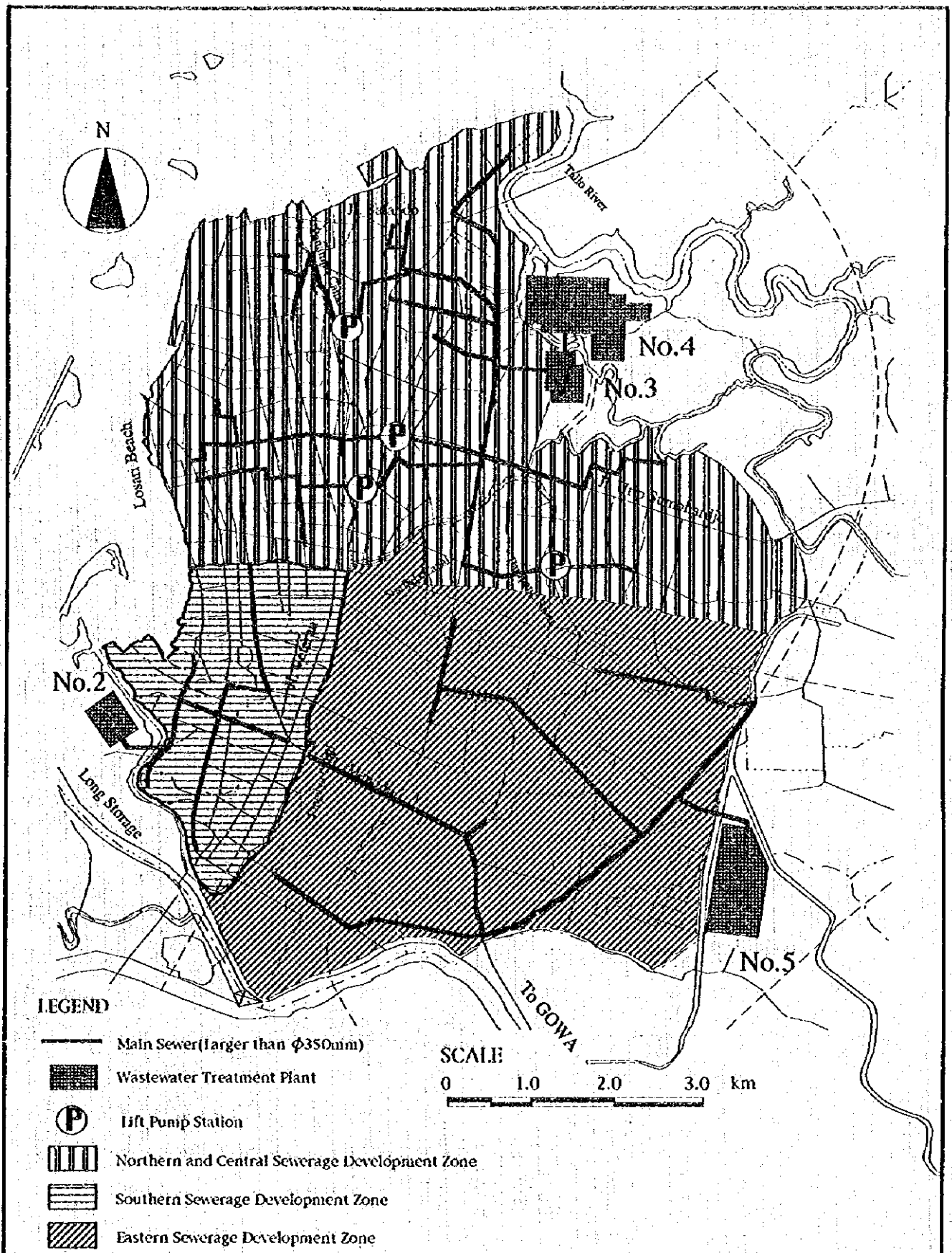
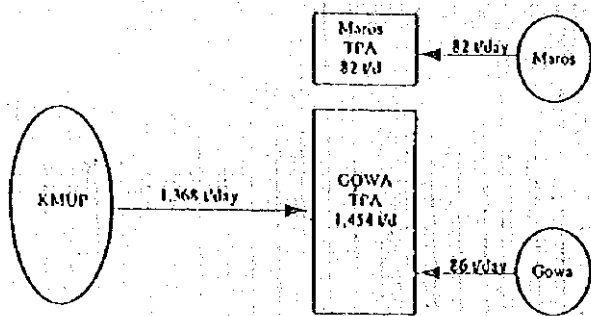


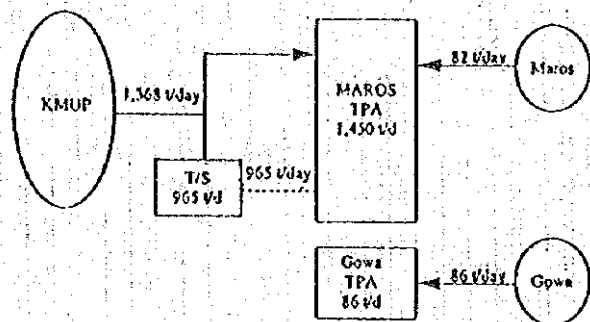
FIG. 4

Optimum Sewerage Development Plan

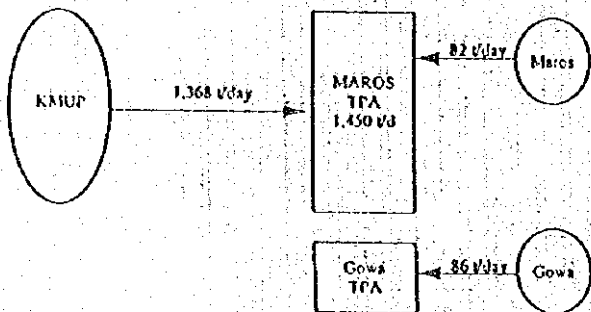
MASTER PLAN AND FEASIBILITY STUDY ON WASTEWATER AND SOLID WASTE MANAGEMENT FOR THE CITY OF UJUNG PANDANG IN THE REPUBLIC OF INDONESIA



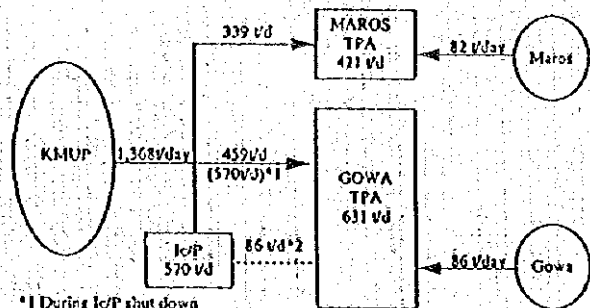
Alternative 1 - GOWA Disposal Site



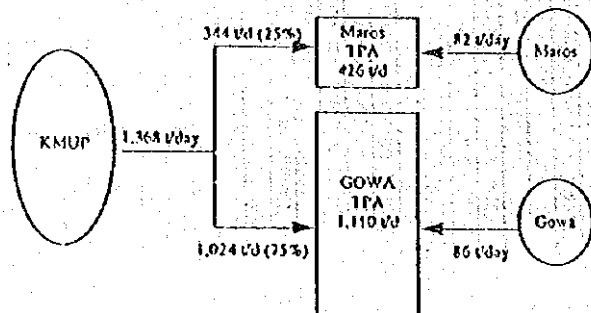
Alternative 4 - T/S and MAROS Disposal Site



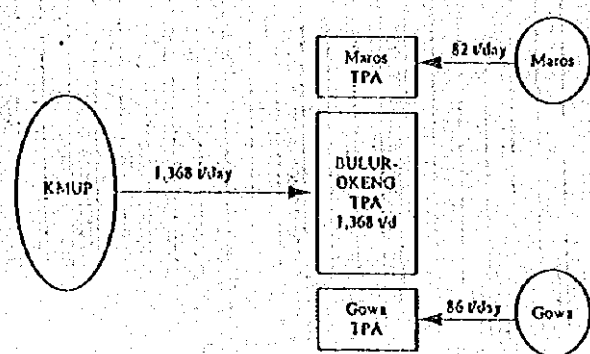
Alternative 2 - MAROS Disposal Site



Alternative 5 - UT and GOWA & MAROS Disposal Sites



Alternative 3 - GOWA and MAROS Disposal Site



Alternative 6 - BULUROKENG Disposal Site

FIG. 5

Solid Waste Management Alternatives in 2015

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

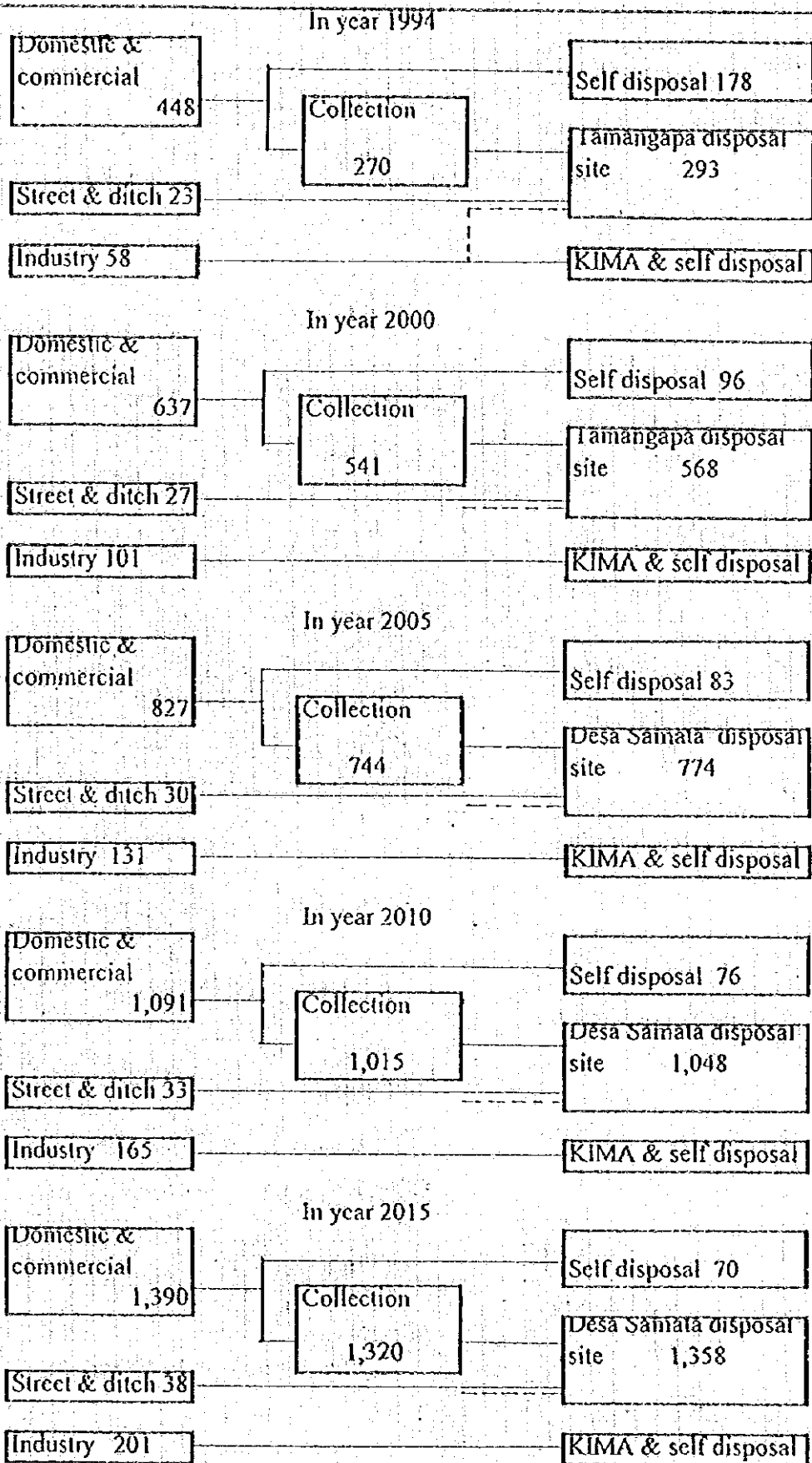
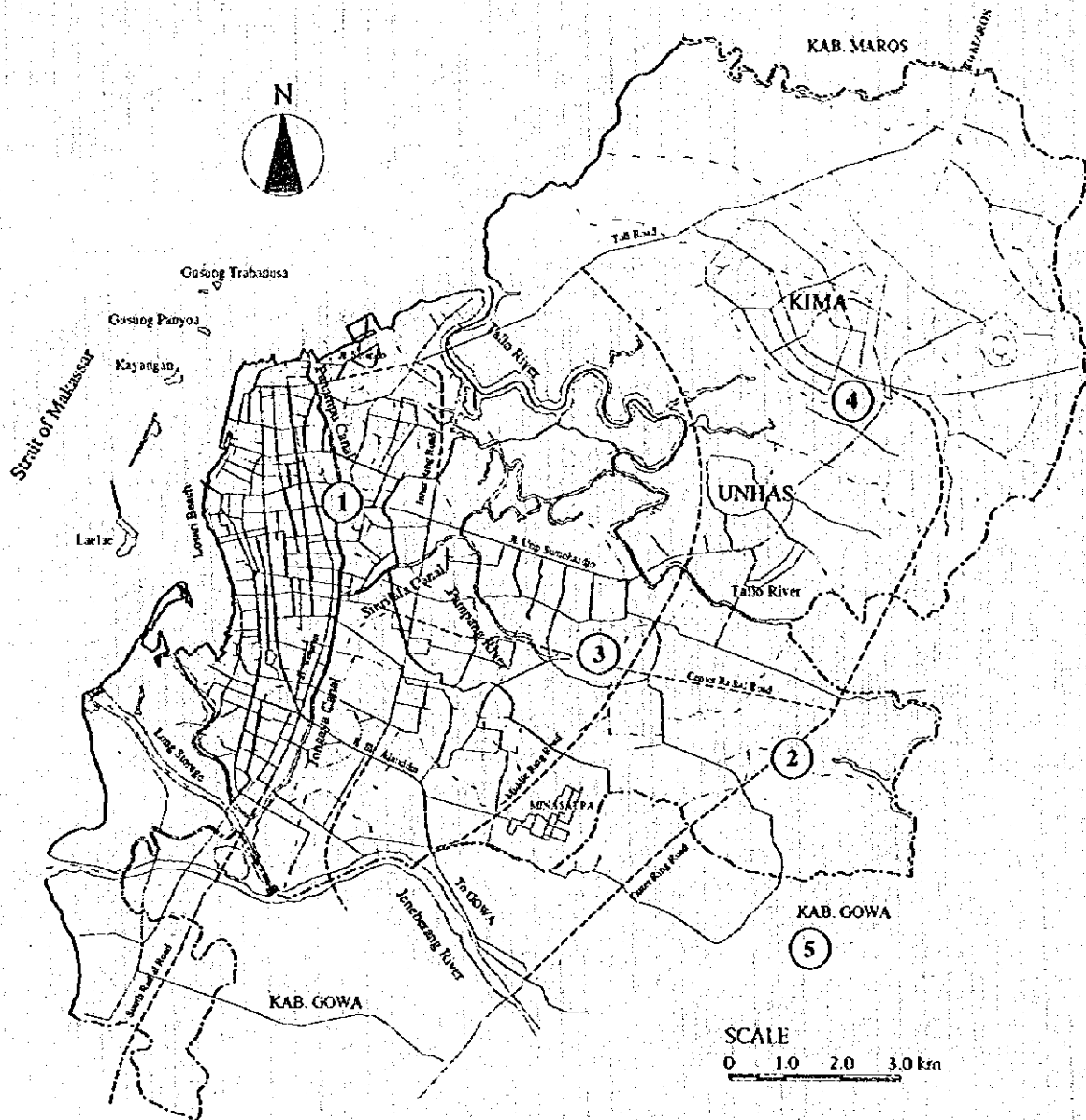


FIG. 6

Solid Waste Flow

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



LEGEND

- ① Headquarters and Branch Office
- ② Tamangapa Disposal Site Workshop and Depot
- ③ Branch Office, Depot and Intermediate Treatment Facility Site (panakkukang Branch Office)
- ④ Branch Office (Biringkanya Branch Office)
- ⑤ Samata Disposal Site

FIG. 7

Location of Final Disposal Sites and Branch Offices

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

Organization Chart of PDAM in 2015

Total: 1,910 persons

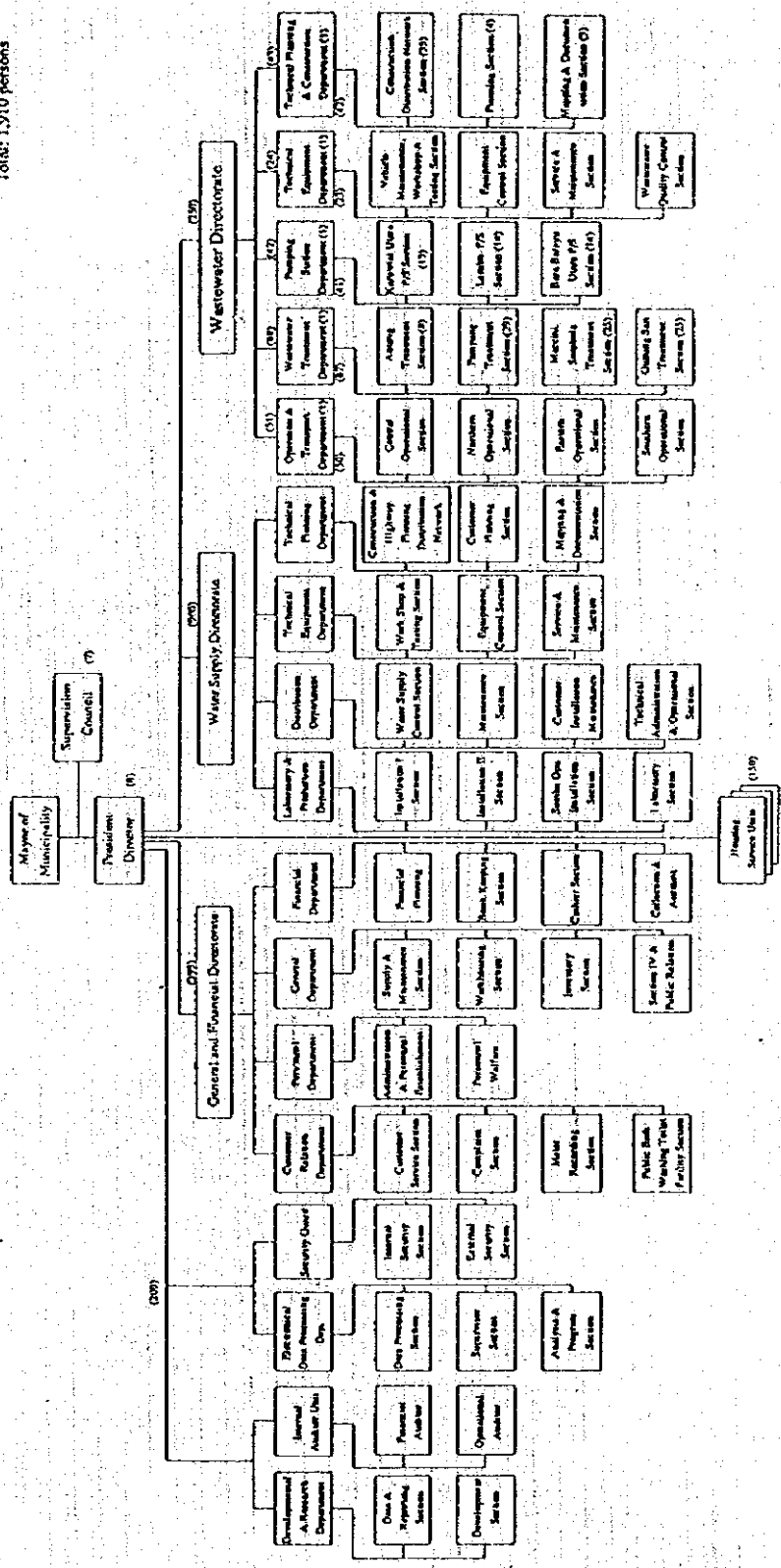


FIG. 8

Organization Chart of PDAM in 2015

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

Organization Chart of PD Kebersihan, KMUP in 2015
(Alternative III)

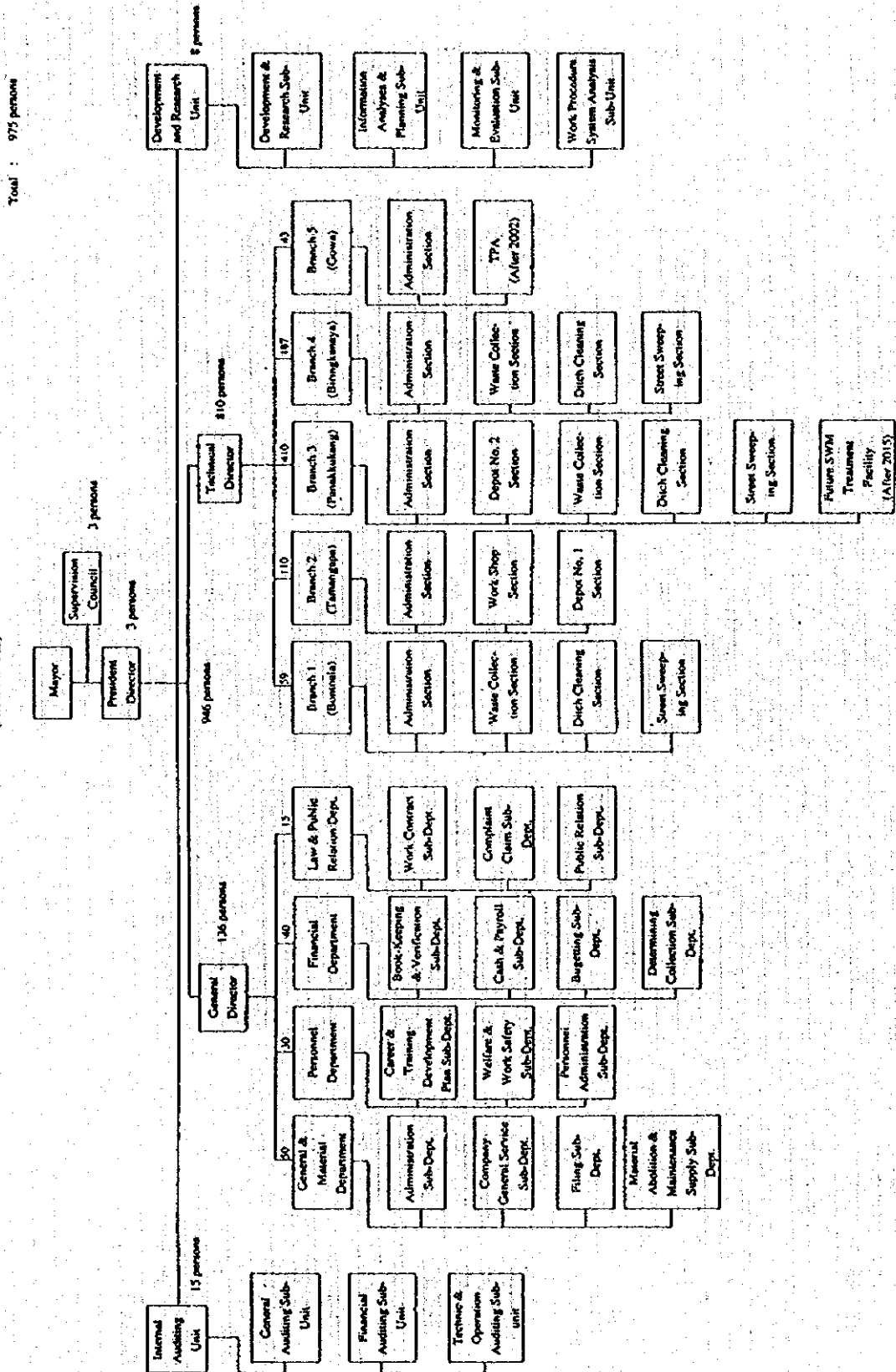


FIG. 9

Organization Chart of PD Kebersihan, KMUP in 2015

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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ABBREVIATIONS AND ACRONYMS

(in alphabetical order)

1. ADIPURA : Evaluation system of the city cleanliness
2. AMDAL : Environmental impact assessment process
3. ANDAL : Environmental impact assessment study
4. APBD : Annual local government development budget
5. APBN : Annual central government development budget
6. BANDES : Village aid plan
7. BAPEDAL : Environmental impact control agency
8. BAPPEDA : Local development planning agency
9. BAPPENAS : National development planning agency
10. DIP : Budget proposal for project
11. DK : Dinas Kebersihan (Cleansing department)
12. IUIDP : Integrated Urban Infrastructure Development Program
13. KANWIL : Provincial branch of department of central government
14. KIP : Kampung Improvement Program
15. KMUP : The Municipality (city) of Ujung Pandang
16. LKMD : Village social activity group
17. MINASAMAUPA : Ujung Pandang, Maros and Gowa metropolitan area
18. PERUMNAS : Public housing authority
19. PD : Regional enterprise
20. PDAM : Local government water supply enterprise
21. PKK : Woman's education plan

- 22. PLN : State electricity enterprise
- 23. PLP : Environmental sanitation division
- 24. PU : (Ministry of) Public works
- 25. PUSKESMAS : Public Health Center
- 26. RDTRK : Land arrangement plan
- 27. REPELITA : Five-year development plan
- 28. SLA : Subsidiary Loan Agreement
- 29. SOP : Standard Operation Procedure
- 30. SWM : Solid Waste Management
- 31. TPA : Final disposal site
- 32. TPS : Temporary disposal site
- 34. UNHAS : Hasanuddin University
- 35. WWM : Wastewater Management

DEFINITION OF TECHNICAL TERMS

A. Wastewater Management

1. On-site System : The system treating wastewater within each building lot.
2. Off-site System : The system collecting and treating wastewater from multiple number of building lots.
3. Package Wastewater Treatment Plant (PWTP) : The compact blackwater and graywater treatment system which can obtain high BOD removal efficiency. The popular treatment processes of this system are an anaerobic filter-contact aeration process and separate contact aeration process.
4. Small Modular System (B) : The system consisting of collection system, septic tank and leaching bed to collect and treat black water from about 20 households.
5. Small Modular System (B/G) : The off-site system that serves about 1 RT (250 people) with collection and treatment system for both blackwater and graywater. The treatment system will be abandoned after integration into conventional sewerage system.
6. Large Modular System : The off-site system that serves about 10,000 ~ 50,000 people with collection and treatment system for both blackwater and graywater. The treatment system will be abandoned after integration into conventional sewerage system.

- 7. Developer Modular System : The off-site system with collection and treatment system for both blackwater and graywater covering a housing complex constructed by developer.
- 8. Small Scale Sewer : The separate collection system from each household to main sewer constructed under foot path or housing lot at a shallow depth less than 1.0 m.
- 9. Interceptor Sewer : The collection system that receives gray water from road side ditch during dry weather.

B. Solid Waste Management

- 1. Primary Collection : Solid waste collection from houses and transport to communal stations or TPS using hand cart or small satellite vehicle.
- 2. Secondary Collection : Solid waste collection from communal stations and generator premises and transport to final disposal site or intermediate treatment facilities.
- 3. Semi-sanitary Landfill : The solid waste disposal system which requires leachate collection, re-circulation and pre-treatment (aeration) facility and gas removal facility in addition to the necessary facilities of control landfill.

CHAPTER 1

INTRODUCTION

CHAPTER 1 INTRODUCTION

1.1 Background

The Municipality of Ujung Pandang (KMUP) is the provincial capital of South Sulawesi. It is the largest city in Eastern Indonesia and is also expected to play a leading role in the development of Eastern Indonesia. KMUP is located in the south-western part of Sulawesi Island and at a distance of about 1,300 km to the east of Jakarta.

The population of KMUP has been increased rapidly. This rapid increase of population has caused serious environmental problems, and the city used to be once ranked low on ADIPURA (evaluation system of the city cleanliness) among municipalities with similar size in Indonesia.

Through strenuous efforts, KMUP was awarded ADIPURA Certificate in 1994 and ADIPURA Trophy in 1995 respectively. However, the city does not have a clear and effective mid-term and long-term plan regarding the environmental sanitation improvement and there are not few environmental sanitation problems to be improved.

Though the central part of KMUP, called as "the Old City", has been highly urbanized and densely populated, there are no graywater treatment facilities. As a result, water quality of ditches, canals and coastal sea waters has been deteriorated severely, and illegal dumping of solid waste due to insufficient solid waste collection service has aggravated this situation. In addition to this, recent rapid growth of the suburban part of KMUP has spread the social and environmental problems to whole city area.

Under these circumstances, the Government of Indonesia (GOI) requested the Government of Japan in 1993 to conduct a full-scale study for the improvement of environmental sanitation (wastewater and solid waste management) of KMUP. Responding to the request, Japan International Cooperation Agency (JICA) dispatched a preparatory study team to Indonesia in December of 1993, and reached an agreement on S/W (scope of work) with GOI. The full scale study commenced in June 1994 and completed in March 1996.

1.2 Purpose and Scope of the Study

1.2.1 Purpose

The purpose of the Study are as follows :

- To formulate a master plan aiming at the year 2015 for the improvement of environmental sanitation (wastewater and solid waste management) of KMUP.
- To conduct a feasibility study aiming at the year 2005 on the high priority projects selected from the master plan.
- To conduct an alternative study for wastewater management

For these purposes, the present conditions have been thoroughly examined and analyzed, and technical, financial, socio-economic and institutional studies have been conducted.

This report deals with only the Master Plan study. The Feasibility Study and Alternative Study are dealt with separately, respectively, in Feasibility Study report and Alternative Study report. This report which includes both Master Plans of wastewater and solid waste management, discusses the optimum plans and combination of both subsectors, and recommends the best solution, including institutional and financial aspects to realize the optimum plans.

1.2.2 Study Area

The Study Area is the Municipality (city) of Ujung Pandang (about 176 km²). The map of the Study Area is shown in *Fig.1.1*. But some areas beyond the city boundary have been included, in case wastewater treatment plant or solid waste disposal site is planned beyond the administrative boundary of KMUP. The Study has been discussed from the view point of an inter-municipal alternative for wastewater and solid waste management, if needed, including the neighboring municipalities of Gowa and Maros.

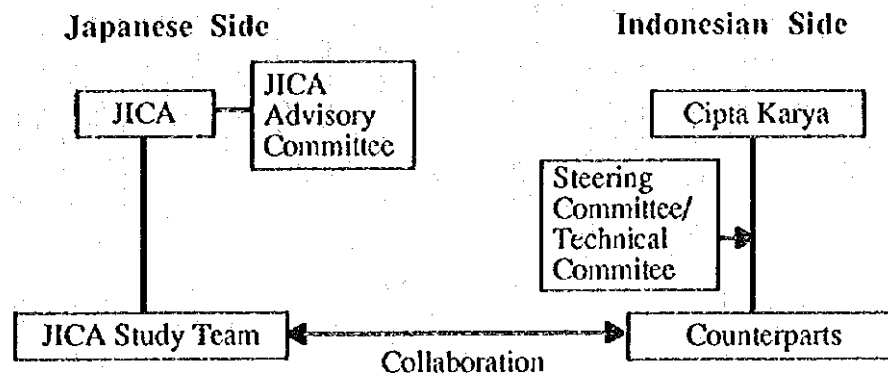
1.2.3 Scope of the Study

The wastewater included in the Study is domestic wastewater from households and offices, commercial and industrial wastewater which is not hazardous. But the Study dose not include disposal and management of stormwater, according to the S/W.

Solid wastes included in the Study are those from households, offices, factories, hospitals, etc. and from roads and drains. But the Study does not include hazardous industrial wastes requiring special treatment and disposal.

1.3 Study Organization

The Study has been jointly executed by both the JICA Study Team and the Indonesian Counterparts in close consultation with the Steering and Technical Committees as well as the JICA Advisory Committee under the organization shown below. Members of these Committees, Indonesian Counterparts and JICA Study Team are listed in Appendix.



1.4 Study Reports

The reports prepared in the Study are as follows:

- i) Main Report : English version
- ii) Summary Report : English version and Indonesian version
- iii) Supporting Report : English version
- iv) Data Book : English version

The main report presents the results of the whole Study briefly. It consists of three parts : Part I is Master Plan for Wastewater and Solid Waste Management, Part II is Feasibility Study on Wastewater and Solid Waste Management and Part III is Alternative Study for Wastewater Management. This report is the Part I of the main report.

The summary report presents an executive summary of the main report.

The supporting report describes in detail the technical aspects of the master plan and feasibility studies and the data book contains basic data / information and the relevant drawings of the Study.

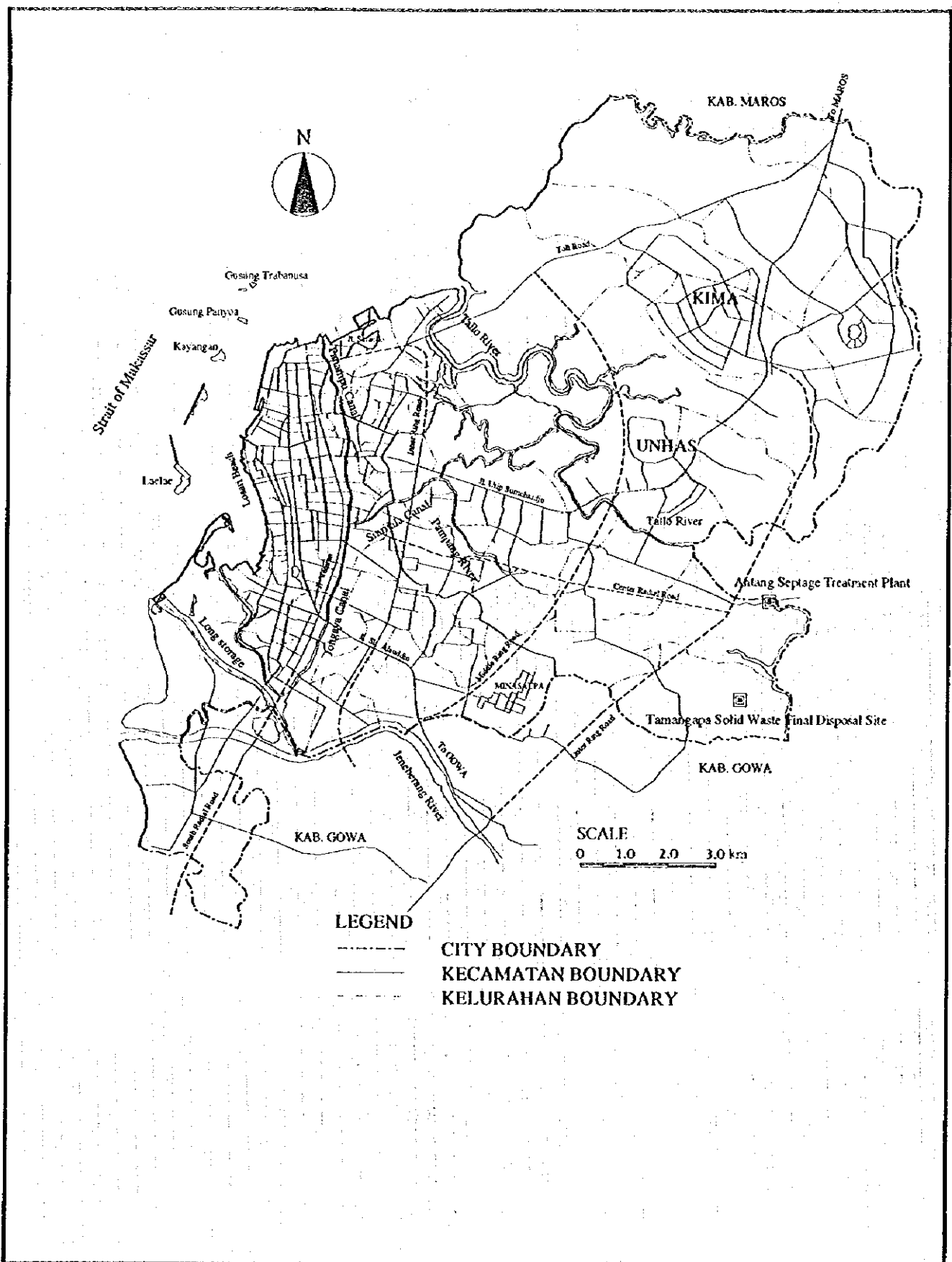
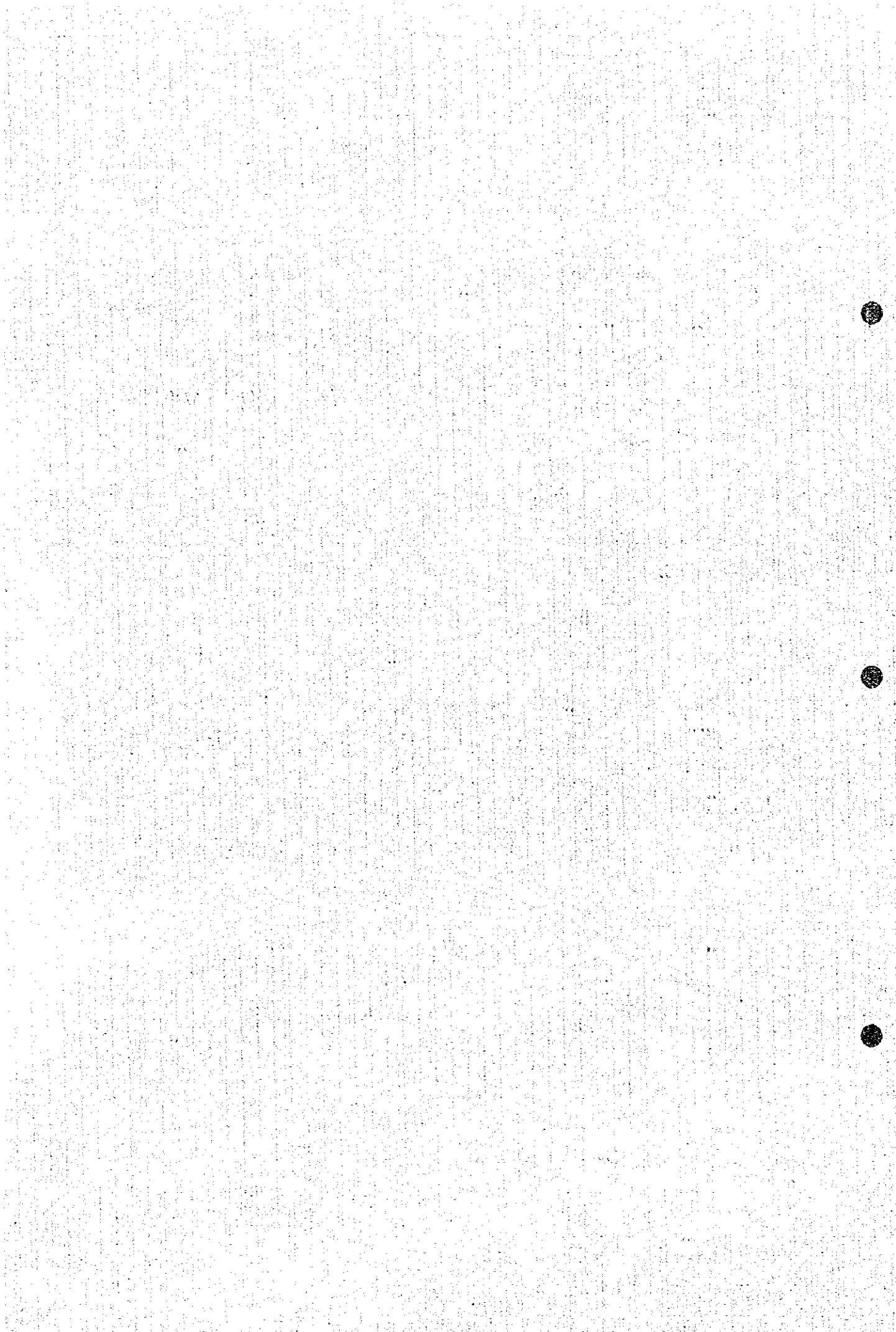


FIG. 1.1 Study Area

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

CHAPTER 2

EXISTING CONDITIONS



CHAPTER 2 EXISTING CONDITIONS

2.1 Natural Conditions

2.1.1 Topography and geology

The Study Area faces Makassar Strait in west side. The western part is low lying with an elevation in the range of between 0 to 5 m, and is encompassed by Tallo river in the north and Jeneberang river in the south. The eastern and northern parts located on the right side of Tallo river have relatively high elevation of 5 to 25 m. The slope of the Study Area ranges from 0 to 5 % along the east-west direction.

The Study Area is composed of alluvial sediment of Jeneberang river and volcanic materials of Lampobattang mountain. The sedimentation of Jeneberang river is still in progress which causes the spread out of the coast line in the south western part of the Study Area.

2.1.2 Meteorology

The Study Area lies in tropical monsoon climate zone, having two distinct seasons; the rainy season from November to April and the dry season from May to October. Annual average rainfall is about 2,000 ~ 2,500 mm and about 75% of it occurs in rainy season.

The annual average humidity is about 80%, and the monthly average humidity is about 85% in the rainy season and about 75% in the dry season.

The annual average temperature is about 28°C, slightly fluctuating throughout the year.