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REPUBLIC OF INDONESIA
MINISTRY OF PUBLIC WORKS (DPU)
DIRECTORATE GENERAL OF
HUMAN SETTLEMENT (CIPTA KARYA)

UJUNG PANDANG
WATER SUPPLY DEVELOPMENT PROJECT

VOLUME II
MAIN REPORT FOR MASTER PLAN
AND
VOLUME III
SUPPORTING REPORTS FOR MASTER PLAN

NOVEMBER 1985

JAPAN INTERNATIONAL COOPERATION AGENCY

REPUBLIC OF INDONESIA
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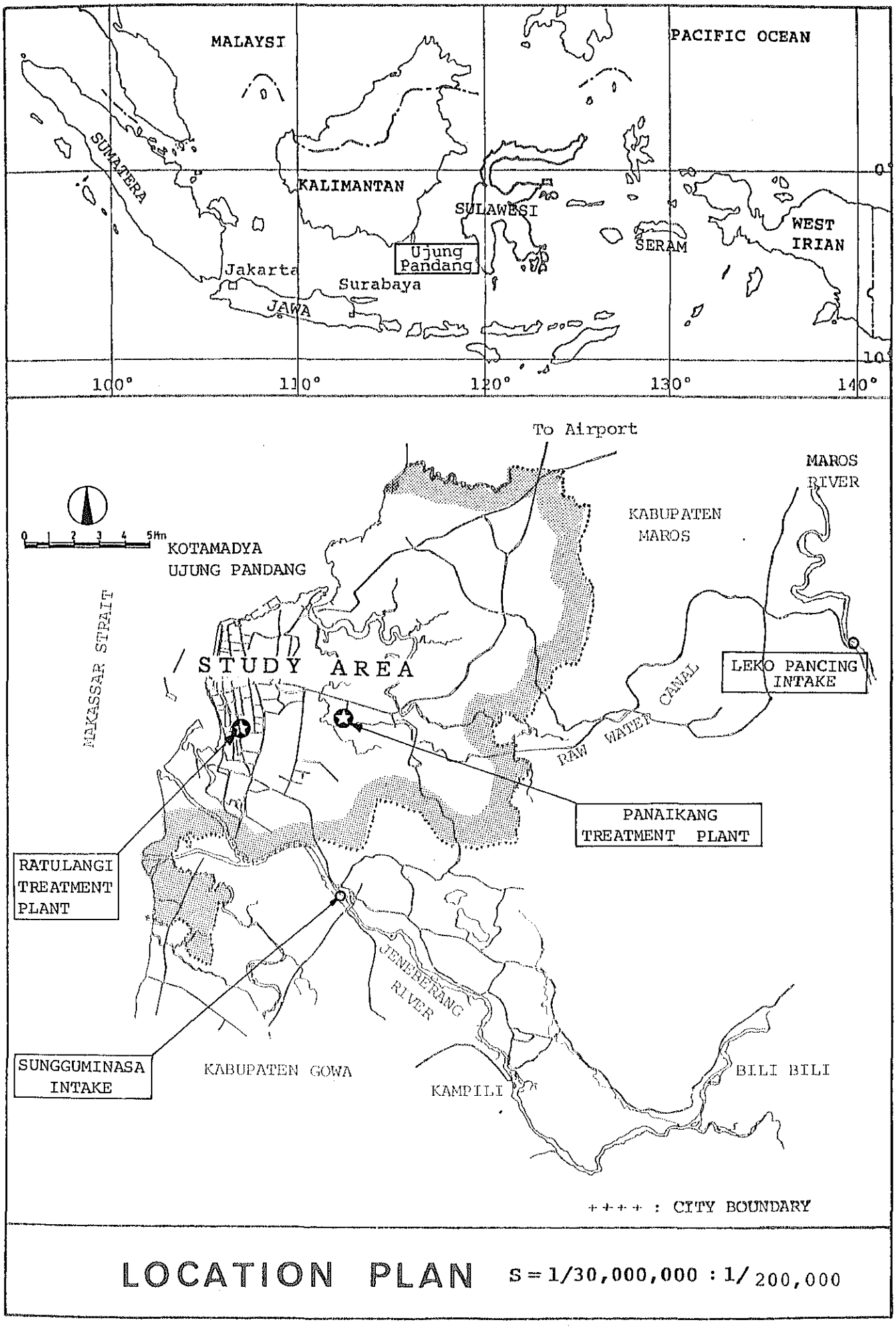

LOCATION PLAN S = 1/30,000,000 : 1/ 200,000

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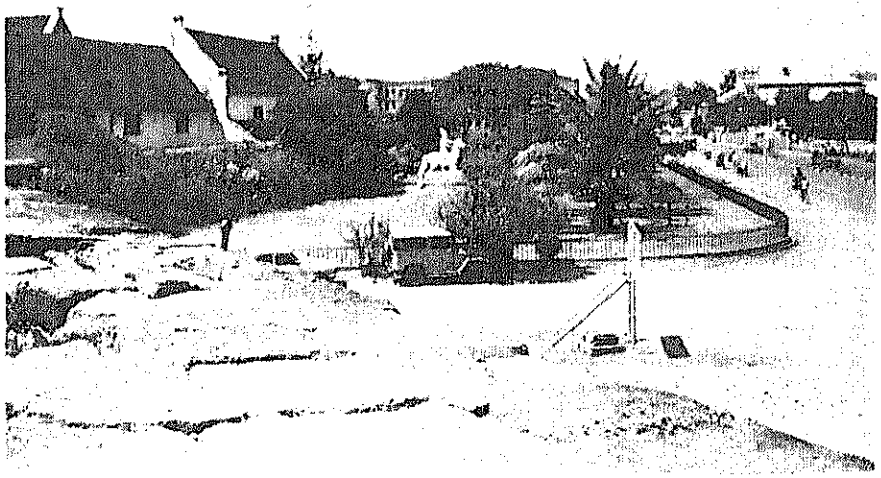
ABBREVIATIONS

GOI	- Government of Indonesia
CIPTA KARYA	- Directorate General of Human Settlement, Ministry of Public Works of the Republic of Indonesia
DAB	- Directorate of Water Supply in CIPTA KARYA
BAPPEDA	- Board of Planning and Development of Ujung Pandang
PDAM	- Ujung Pandang Water Supply Enterprise
JICA	- Japan International Cooperation Agency
WHO	- World Health Organization
REPELITA IV	- The Fourth Five-Year Development Plan
The Team	- JICA Study Team

mm	- millimeters
cm	- centimeters
m	- meters
km	- kilometers
m2, sq m	- square meters
km2, sq km	- square kilometers
m3,cu m	- cubic meters
cm/sec	- centimeters per second
m/sec	- meters per second
m3/sec, cu m/sec	- cubic meters per second
m3/min, cu m/min	- cubic meters per minute
m3/h, cu m/h	- cubic meters per hour
m3/day, cu m/day	- cubic meters per day
l/sec	- liters per second
l/day	- liters per day
l/c/d	- liters per capita per day
kg/cm2, kg/sq cm	- kilograms per square centimeter
kw	- kilowatt
ha	- hectare
%	- percent
°C	- degrees centigrade

mg/l	- milligrams per liter
μ ℧ /cm	- micromho per centimeter
PH	- potential of hydrogen
°D	- German system of degree of hardness
mm/year	- millimeters per year
PVC	- polyvinyl chloride pipe
ACP	- asbestos cement pipe
CIP	- cast iron pipe
DIP	- ductile iron pipe
GSP	- galvanized steel pipe
SP	- steel pipe
dia.	- diameter
no/nos.	- number/s
IFGL	- Interest Free Government Loan
DLNI	- Domestic Loan at Normal Interest rate

SUMMARY



A HISTORIC SPOT OF
BENTENG UJUNG PANDANG

SUMMARY

In the course of master plan study, all the related regional plannings in Kotamadya Ujung Pandang to 2005 and the National Guidelines prepared by Cipta Karya were reviewed.

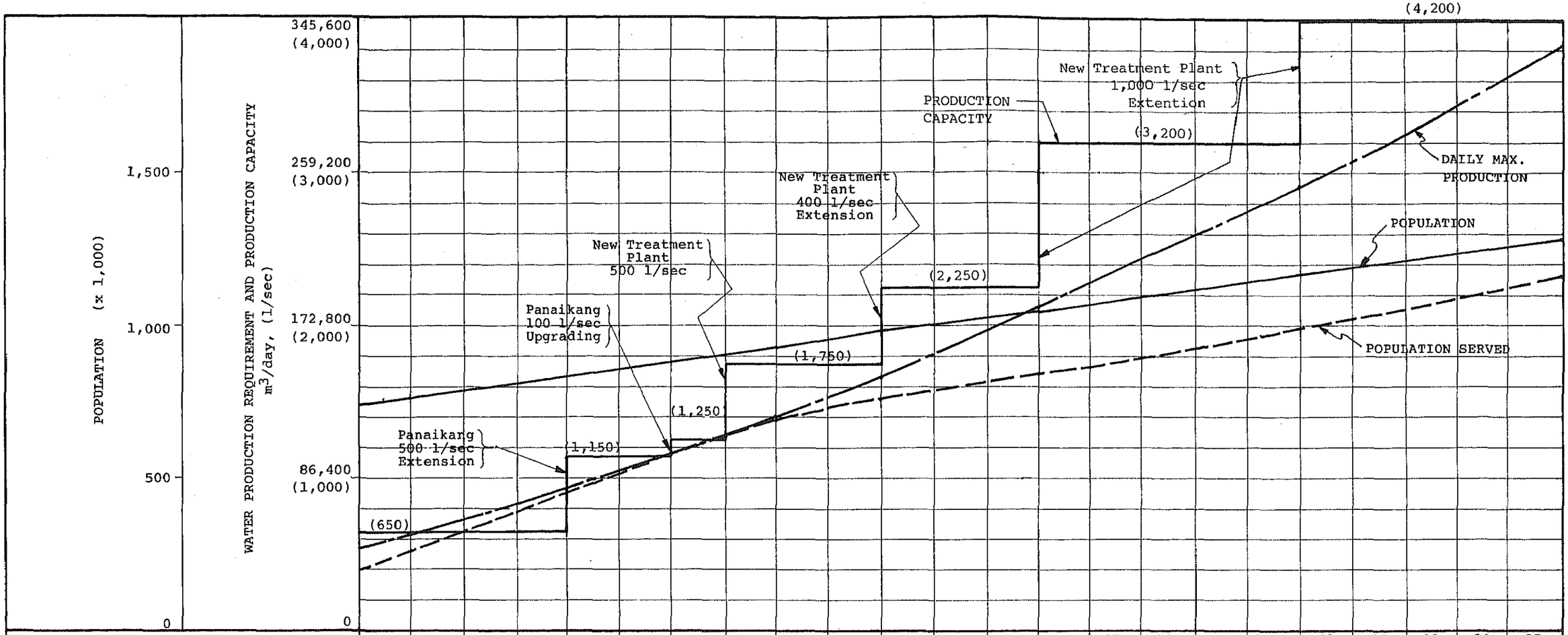
Population of Kotamadya Ujung Pandang is projected to increase from 0.7 million to 1.3 million by 2005. Present water supply is far behind the targets envisaged in the National Guidelines. People are suffering chronically from water shortage and obliged to use shallow well ground water in unsanitary condition.

This Report proposes a long term water supply plan and also identifies the first stage programme inclusive of immediate rehabilitation work. This immediate rehabilitation work is to be initiated as early as possible. Water supply plan to 2005 is separated into two: Stage I Project (1985-1995) and Stage II Project (1990-2005). Each Project is further divided into two programmes, i.e., Phase 1 and Phase 2. Long-term water source for Stage II project is the Bili-Bili Dam to be constructed by 1995, while Stage I project relies on the irrigation water at the existing Bili-Bili intake in addition to the present water sources at Leko Pancing of the Maros river and at Sungguminasa of the Jeneberang river.

The outline of water supply master plan for Ujung Pandang is summarized in Table 1 and Figures S1 and 2.

TABLE 1 OUTLINE OF WATER SUPPLY MASTER PLAN

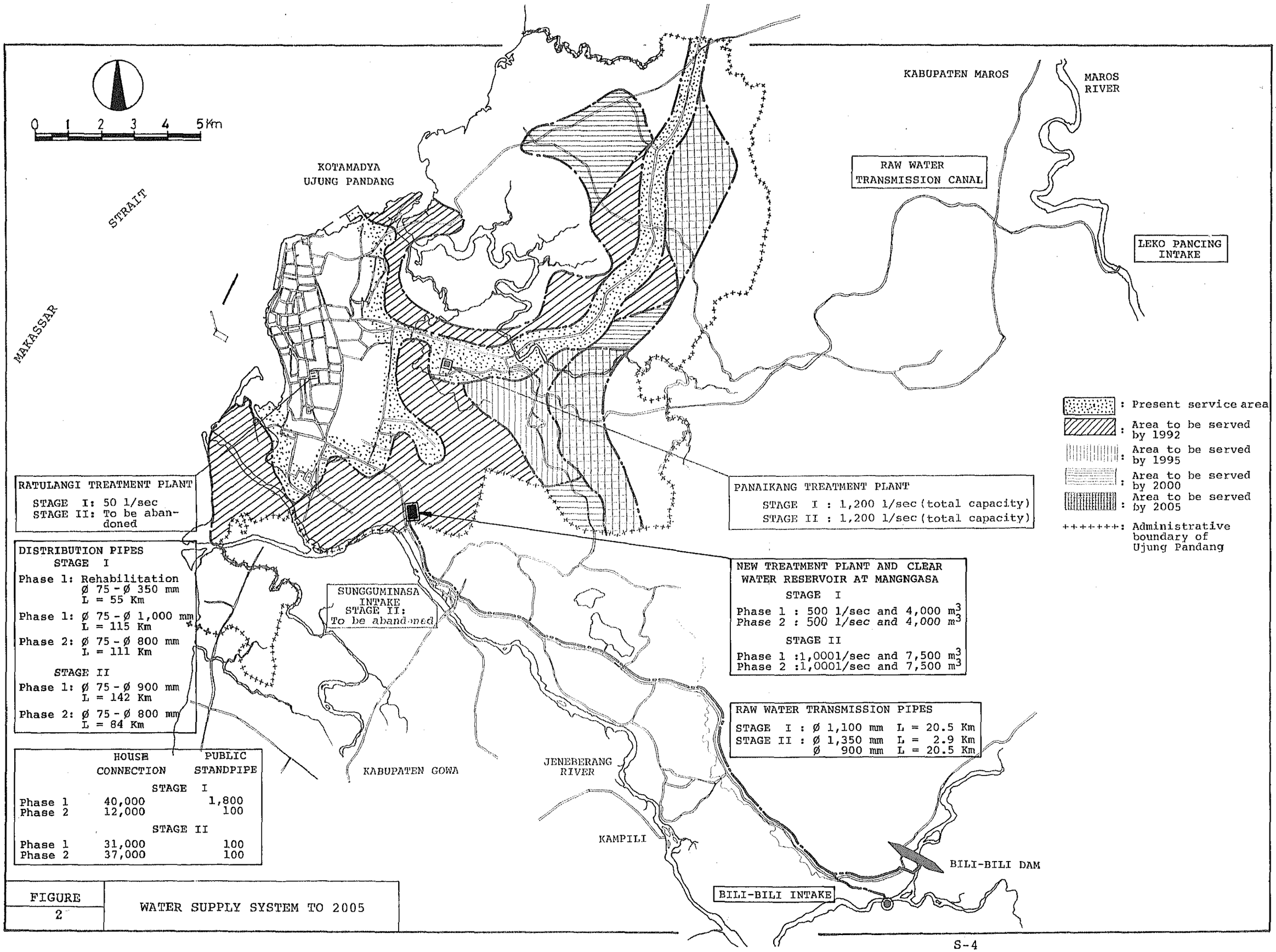
Items	STAGE I		STAGE II	
	Phase 1 (1985-1992)	Phase 2 (1988-1995)	Phase 1 (1990-2000)	Phase 2 (1994-2005)
Service area (ha)	7,530	8,150	9,220	9,950
Population projected	976,000	1,050,000	1,171,000	1,286,000
Population Served	752,000	840,000	995,000	1,157,000
Service Ratio (%)	77.0	80.0	85.0	90.0
Water Production (m^3/day)	146,000	184,000	253,000	326,000
Water Production Per Capita (l/c/d)	194	219	254	282
Main Works Proposed	- Rehabilitation Work - Leakage Reduction Work - Upgrading of Panaikang Plant (100 l/sec) - Intake Facilities - Transmission Pipe - New Mangngasa Treatment plant (500 l/sec) - Distribution Facilities - House Meters and Standpipes	- Extension of Treatment Plant (500 l/sec) - Distribution Facilities - House Meters and Standpipes	- Bili-Bili Dam - Intake Facilities - Transmission Pipe - Extension of Treatment plant (1,000 l/sec) - Distribution Facilities - House Meters and Standpipes	- Extension of Treatment Plant (1,000 l/sec) - Distribution Facilities - House Meters and Standpipes
Project Cost (excluding price contingency)				
Foreign (x 1,000 $)	15,649	6,889	32,864	7,775
Local (x million Rp)	19,914	5,377	36,594	6,058
Total (x million Rp)	37,128	12,967	72,745	14,611



YEAR	83	84	85	86	87	88	89	1990	91	92	93	94	95	96	97	98	99	2000	01	02	03	04	05
CONSTRUCTION AND DISBURSEMENT SCHEDULE (Billion Rp.)			0.5	2.0	8.0	9.0	9.0	8.1	0.5			72.7						14.6					
				STAGE I Phase 1					STAGE I Phase 2														
								1.0	4.0	5.0	3.0												
STAGING AND PHASING			STAGE I Phase 1								STAGE I Phase 2			STAGE II Phase 1					STAGE II Phase 2				
POPULATION (x 1,000)	768							927		976			1,050					1,171					1,286
POPULATION COVERAGE (%)	34.1							75.0		77.0			80.0					85.0					90.0
POPULATION SERVED (x 1,000)	262							695		752			840					995					1,157
PER CAPITA DEMAND (DOMESTIC USE) (l/c/d)	65							100		113			127					147					162
TOTAL WATER REQUIREMENT (x 1,000 m^3/day)	27							97		117			147					202					261
ACCOUNTED-FOR WATER (%)	50							80		80			80					80					80
PRODUCTION (Daily Max. x 1,000 m^3/day)	54							121		146			184					253					326
RAW WATER REQUIREMENT (m^3/sec)	0.94							1.64		1.92			2.44					3.24					4.19

FIGURE 1

WATER SUPPLY PLAN TO 2005



	HOUSE CONNECTION	PUBLIC STANDPIPE
	STAGE I	
Phase 1	40,000	1,800
Phase 2	12,000	100
	STAGE II	
Phase 1	31,000	100
Phase 2	37,000	100

FIGURE 2 — WATER SUPPLY SYSTEM TO 2005

RECOMMENDATIONS

JL. JENDRAL SUDIRMAN, A MAIN STREET
OF KOTAMADYA UJUNG PANDANG

RECOMMENDATIONS

For successful implementation of the project proposed in the master plan, and accomplishing the target aimed at, there are some important issues that must be carried out or realized. If not, it may not be expected that the project will produce satisfactory results as desired.

In consideration of the above, recommendations, deemed necessary, are prepared herein under the following three headings: 1) for PDAM, 2) for Kotamadya Ujung Pandang, and 3) for other Authorities concerned.

1. PDAM

The following are desired to be carried out of PDAM's own accord.

1) Periodical Review of Master Plan

In preparing the present water supply master plan, some assumptions were inevitably made owing to insufficiency of necessary data, and furthermore, the projected development of the area, together with water consumption, may possibly differ from the actual future development. Therefore, review and revision of the present report is recommended to be made from time to time, at least once a year after the commencement of the operation of Phase 1, and before implementation of the subsequent Phases.

The following items, among others, are to be reviewed every year.

- Total population
- Population served
- Production and consumption
- Per capita consumption

2) Measure to be Taken Immediately

Reduction of leakage and wastage is the most effective measure to substantially increase water supply. As water shortage in the service area is presently acute, it is recommended that PDAM concentrates its efforts on reduction of leakage and wastage and starts the work immediately. Water thus saved can alleviate the suffering of the customers. Besides, the financial position of the enterprise will accordingly be improved.

Measures to be taken are as follows:

(1) To repair leaks in no time, as found; to this end to patrol the service area.
(2) To install meters at all connections, and replace defective meters.
(3) To procure tools and equipment necessary for the above works.
(4) To mobilize, organize and train staff to be assigned for the above tasks.
(5) To establish regulations to define the responsibility of the customers in maintaining their service systems.
(6) To conduct public education on conservation of piped water, sanitary water use and others.

3) Recruitment of Engineers and Technicians

The present population served is relatively small compared with the total population, and further the target of future water supply is set rather high in accordance with the intention of the National Guidelines. Hence, substantial expansion of the water supply system is planned in the master plan. When PDAM is reviewed from the above viewpoint, its staffing is considered not sufficient to cope with the anticipated increase of work load to result from the execution of the proposed project.

Therefore, it is advised to strengthen the staff by recruiting engineers and technicians qualified in technology and skill, in due course.

4) Financial and Administrative Support

The present project requires a huge amount of funds in local and foreign currencies. Regarding the financing of the local portion, in particular the central and local governments' financial assistance in loan/equity is pre-requisite for successful implementation of the project. In this connection, PDAM has to make every effort in getting thorough understanding and full support thereof.

On the other hand, it is time-consuming to get through all the complicated formalities of the above financing, and also the implementation procedures such as inviting bids, awarding contracts, etc. Therefore, PDAM has to endeavor to obtain full support of the central government for expeditious processing.

2. Kotamadya Ujung Pandang

Considering that both drinking water and living environment are to be improved side by side to achieve the purpose of enhancing public health, it is desired that the Municipality take adequate measures for the following.

1) Maintenance of Shallow Wells

Households as many as 90% of the total are currently relying on shallow wells for a part of their domestic use. The present field survey indicates that the location of wells is often so close to the pit latrines or refuse dumps that there are many cases of well water contamination by coliform organisms. This could result in infectious water borne diseases, spreading through the community.

To protect shallow wells from contamination, the division of the municipal government responsible for public health is advised to take the following measures:

(1) To monitor water quality of shallow wells, and to disinfect them as required.
(2) To prepare a standard design of shallow wells for the use of the public.
(3) To undertake public education on use of the shallow well and construction of sanitary shallow wells.

3. Authorities Concerned

Since PDAM/Municipality is not in a position to manage the water source for the water supply, it is desired that the Authorities concerned extend their cooperation to PDAM/Municipality in the following matters.

1) Construction of Bili-Bili Dam

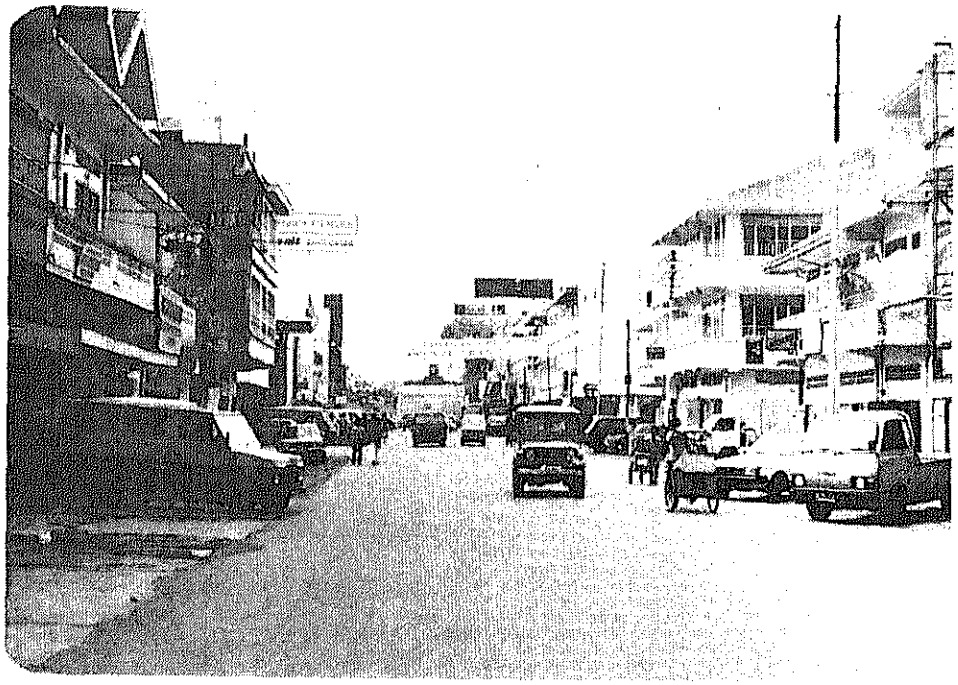
Without the construction of Bili-Bili Dam, a sole future water source for Ujung Pandang, the problem of water shortage cannot be solved, nor the planned development of the Municipality be realized. It is, therefore, strongly wished that the Authorities concerned give due consideration to this problem and expedite the construction of the Dam. On the other hand, in the detailed design of the Dam to be shortly undertaken, it is also wished that the raw water demand of 2.8 m3/sec in 2005 of Ujung Pandang, estimated by the present study, be counted in the dam capacity, if technically and financially possible.

2) Water Management

If withdrawal of the Jeneberang river water is possible at Sungguminasa, as it is today and in the future as well, a vast amount of saving in the construction cost of the water supply system will be realized to the benefit of PDAM and the local/central governments. This will be practicable, only when a comprehensive water management of the said river is established to enable all the water users with water right to take in water as permitted. From the above standpoint, the Authority in charge of water resources is hoped to establish such institution of water management.

CHAPTER I

INTRODUCTION



JL. IRIAN, A COMMERCIAL CENTER
OF KOTAMADYA UJUNG PANDANG

CHAPTER I
INTRODUCTION

1. AUTHORIZATION

The Contract for the Engineering Services (the Work) on Master Plan and Feasibility Study for Ujung Pandang Water Supply Development Project was made between the Japan International Cooperation Agency (JICA) and the Nihon Suido Consultants Co., Ltd. (the Consultant) on July 1984. The work was earlier requested by the Government of Indonesia to the Government of Japan, and the latter decided to undertake the Work through JICA within the frame of the international cooperation programme.

This Report on the Master Plan for Ujung Pandang Water Supply Development Project was prepared in accordance with the terms of reference of the Contract stated above, while the Work consist of two parts, namely, preparation of the Master Plan for the Ujung Pandang Water Supply Development Project and preparation of the Feasibility Study of the initial portion of the project identified in the said master plan.

2. OBJECTIVE AND SCOPE

The objective of the Work is to establish a comprehensive water supply plan for the Ujung Pandang Water Supply Development Project for a long term period up to the year of 2005, including preparation of a project having a highest priority, which will be studied with regard to its technical and financial feasibility.

The scope of the master plan covers:

(i) Phase I : Master Plan Study

a. Data collection and analysis
b. Definition of served area for planning
c. Estimation of population
d. Estimation of water demand
e. Study of existing facilities
f. Study of water sources
g. Socio-economic evaluation
h. Rough estimation of cost for construction, operation and maintenance
i. Planning of appropriate water supply system
j. Study of organization, operation and management plan
k. Preparation of implementation program
l. Identification of the project for the Feasibility Study.

(ii) Phase II: Feasibility Study

a. Definition of project area
b. Estimation of population to be served
c. Estimation of water demand
d. Study of improvement of existing facilities
e. Study for water sources
f. Design criteria
g. Layout of facilities
h. Study of facilities
h. Study for alternative plans
i. Preliminary design
j. Study of construction materials, labour force and construction ability of local contractors
k. Preparation of construction method and procurement method of materials and equipment
l. Estimation of cost of construction, operation and maintenance

m. Estimation of benefits
n. Economic Studies and Financial analysis
o. Study of tariff system
p. Study of organization, operation and management plan
q. Preparation of implementation schedule

3. COMPILATION OF THE REPORT

The present Report on Master Plan Study for Ujung Pandang Water Supply Development Project was prepared based on the data and information available at present and the results of studies and field reconnaissance conducted by the Team.

This Report consist of eight Chapters. The latest data are provided in each Chapter, which are basically as of 1983, unless otherwise stated. The cost data related to the first phase project is to be reviewed and revised during the period of the Feasibility Study.

CHAPTER II

DESCRIPTION OF THE AREA

PLEASANT STREET WITH MANY TREES

CHAPTER II

DESCRIPTION OF THE AREA

The study area is defined as the administrative area of Ujung Pandang in the Scope of Work. This chapter describes major natural and socio-economic features of the study area. Most of data in this chapter are quoted from the statistics (1983) by BAPPEDA.

1. LOCATION

Ujung Pandang is located on the south western part of the South Sulawesi Province on Sulawesi island. The distance from the study area to the capital Jakarta in Java island is around 1,300 km away to the west. The main transportations connecting the study area with Jakarta are the airline and the vessel.

2. NATURAL ENVIRONMENT

2.1 Topography

The study area faces the Makassar strait. The flat land comprising alluvial plains is broad from the west coast to the east with around 20 km width at an altitude between 1 m to 5 m above mean sea level, and also the ground level of the outskirts extending to the north-eastern part of the urban area varies from approximately 10 m to 20 m.

The Tallo and the Jeneberang rivers flow through the study area. The former meanders at the northern part of the area and forms many swamps everywhere along the course. The latter flows on the south side along the boundary of the study area.

2.2 Geology

Alluvial deposits consisting of claysand and gravel are distributed in the level tract at the western coast, while hills and mountains surrounding the administration area is covered by sedimentary rocks such as lime stone, volcanic breccia, tuff, sand stone and silt stone. Concerning geological structure of bedrock, pyreclastic rocks and marine sedimentary rock deposited preceding alluvial deposits such as river gravel and sand. The geological longitudinal section shows flat formation or a small inclination westwards.

Groundwater level in the urban area varies between 0 m to 2 m above mean sea level while the north-eastern part of the area shows relatively higher level of 4 m to 5 m above mean sea level. During the dry season, groundwater level falls down by 1 m to 3 m comparing to the rainy seasons.

2.3 Climate

Climate conditions in the area are dominated by tropical monsoons. The north-east monsoon brings much rainfall during its dominant season between November and March hence this period is defined as the rainy season. On the other hand, the south-west monsoon blowing between May and August brings less rainfall than the north-east monsoon and the corresponding period is known as the dry season.

The mean annual rainfall is estimated at 4,000 mm in the mountainous area surrounding the study area and 3,000 mm in the study area.

The temperature has a very small fluctuation through the year and the mean monthly figures of average daily data ranges between 25 °C and 27 °C.

These figures are presented in Table 2.1.

3. SOCIO-ECONOMIC CONDITIONS

3.1 Economy

The study area, the administrative area of Ujung Pandang, has a very important position in economic activity of eastern Indonesia as well as South Sulawesi.

The biggest agricultural production in this area is rice, of which production in 1983 was 14,390 tons, while corns, cassavas, peanuts and vegetables such as string beans, cucumber, etc. are also produced in the field where regular irrigation is not needed.

Shrimps and fishes are cultivated in fish ponds and their production in 1983 was 1,484 tons, while production by sea fishery in 1983 was 13,373 tons.

Main industries are situated around the harbour and the north east of the city and composed of mainly flour mill, shrimps cold storage industry, shipyard industry, etc. The number of factories was 1,996 in 1983 and about 80% of them are classified as small factories.

To encourage the industrial development in South Sulawesi, Industrial Estate is under construction at the north side of the city. Main factories to be constructed are those for food, textile, chemistry and others. The total area of the Estate is planned to be 224.3 ha.

Ujung Pandang has the biggest harbour in Sulawesi. The main goods handled at the Ujung Pandang harbour are sugar, rattan, copra, spices and timber which are produced in the hinter land. The volume of loading at the harbour in 1983 amounted to approximately 750 thousand tons for export corresponding to 1.3 times as much as in 1979, and 1,700 thousand tons for import and 1.2 times as much as in 1979.

The Soekarno and the Hatta harbours are equipped with 56,000 m2 warehouses and passenger terminal buildings.

The composition of the employment according to data by Census is showing Table 2.2. The rate of working opportunity is nearly 30%.

3.2 Social Background

The main ethnical groups are the Makassarese, Buginese and large numbers of people from Jawa and Bali as well as Chinese. The religion of most of inhabitants is Islam. The composition ratio of Islamites, Catholics, Protestants, Hindus and Buddhists is 84%, 3%, 9%, 1%, 3% respectively.

The present land utilization is shown on Figure 2.1 and each utilization area is shown in Table 2.3. The built up area accounts for 15% of the total.

The total population in 1983 was 768,000 persons, estimated based on Census Data, and its average growth rate is 2.72% per year. The average population density is 42 persons per hectare and a population density map is shown on Figure 2.2. Nearly 75% of population are living in the old city area which accounts for 15% of the whole area.

House conditions in the area classified into three types. The first is permanent houses, the second is semi-permanent houses of which floor and wall portion are built of brick and concrete and the last is non-permanent houses made of timber. These compositions are 23%, 21% and 56% respectively.

Enrollment in elementary, junior and senior high schools in 1983 were 121,614 persons, 59,790 persons, 33,044 persons respectively. Table 2.4 shows the ratio of

each enrollment to total population. There are 30 universities including academies of which total enrollments were 63,235 in 1983.

3.3 Infrastructure

Although Hasanuddin airport is located outside of Ujung Pandang administration area, this airport largely contributes to the activities of the area. In 1983, the passengers arrival of 352 thousand persons and departure 393 thousand were reported. There are two main harbours, namely the Soekarno and the Hatta. The vessels that utilized these harbours amounted to 3,100 in 1983. There are 2 main roads connecting Ujung Pandang and other cities. One is for Maros and the other is for Sungguminasa. The number of vehicles with four wheels registered was 64 thousand in 1983.

The population served by the water supply system is estimated at 262 thousand people, less than 35% of total population in 1983. The production capacity of two existing water treatment plants is 0.65 m3/sec. Unaccounted-for water estimated accounts for about 50% of the total because of the deteriorated pipeline, the insufficiency of the metering, etc. Most of inhabitants suffering from lack of piped water depend on the shallow well.

The drainage system is so poor that a continuous heavy rain in the rainy seasons causes sometimes flood in low-lying places in the area, because of the low and flat topography through the area.

A complete electric network is provided throughout the old town area while the other area where the electricity is not still supplied is provided with electricity by small generator sets. Customers in 1983 totaled nearly 73 thousands.

4. PUBLIC HEALTH CONDITIONS

Incidence of diseases in Ujung Pandang is shown in Table 2.5. Both malaria and eye disease are decreasing gradually while skin disease and the digestive organ disease are prevalent as ever. There are nine hospitals and 48 drugstores in Ujung Pandang. The number of bed is 3,274 equivalent to a bed per 225 population and 4 ambulances are available.

Garbage from houses, shops, offices and others is collected by small dumping cars every day and dumped to an open area near the Tallo. Available dumping trucks count 41 at present. The garbage of markets is collected at ten locations to transfer to the final disposal site near the Tallo by 5 numbers of dumping truck every day.

Ujung Pandang has no sewage treatment system. Two nightsoil transportation trucks with a capacity of 2.5 m3/unit are available. Almost all the public utilize septic tanks or pit latrines.

TABLE 2.1 MEAN MONTHLY RAINFALL AND TEMPERATURE
(1974 - 1983)

Month	Rain Fall (mm)	Temperature (°C) (Average Daily)
Jan.	750	25.6
Feb.	588	25.7
Mar.	444	26.0
Apr.	181	26.3
May	90	26.5
Jun.	60	26.1
Jul.	47	25.7
Aug.	7	26.2
Sep.	20	26.8
Oct.	74	26.5
Nov.	246	26.6
Dec.	579	25.9
	Total 3,086	Mean 26.2

Source: Penyelidikan Masalah Air

TABLE 2.2 COMPOSITION OF EMPLOYMENT

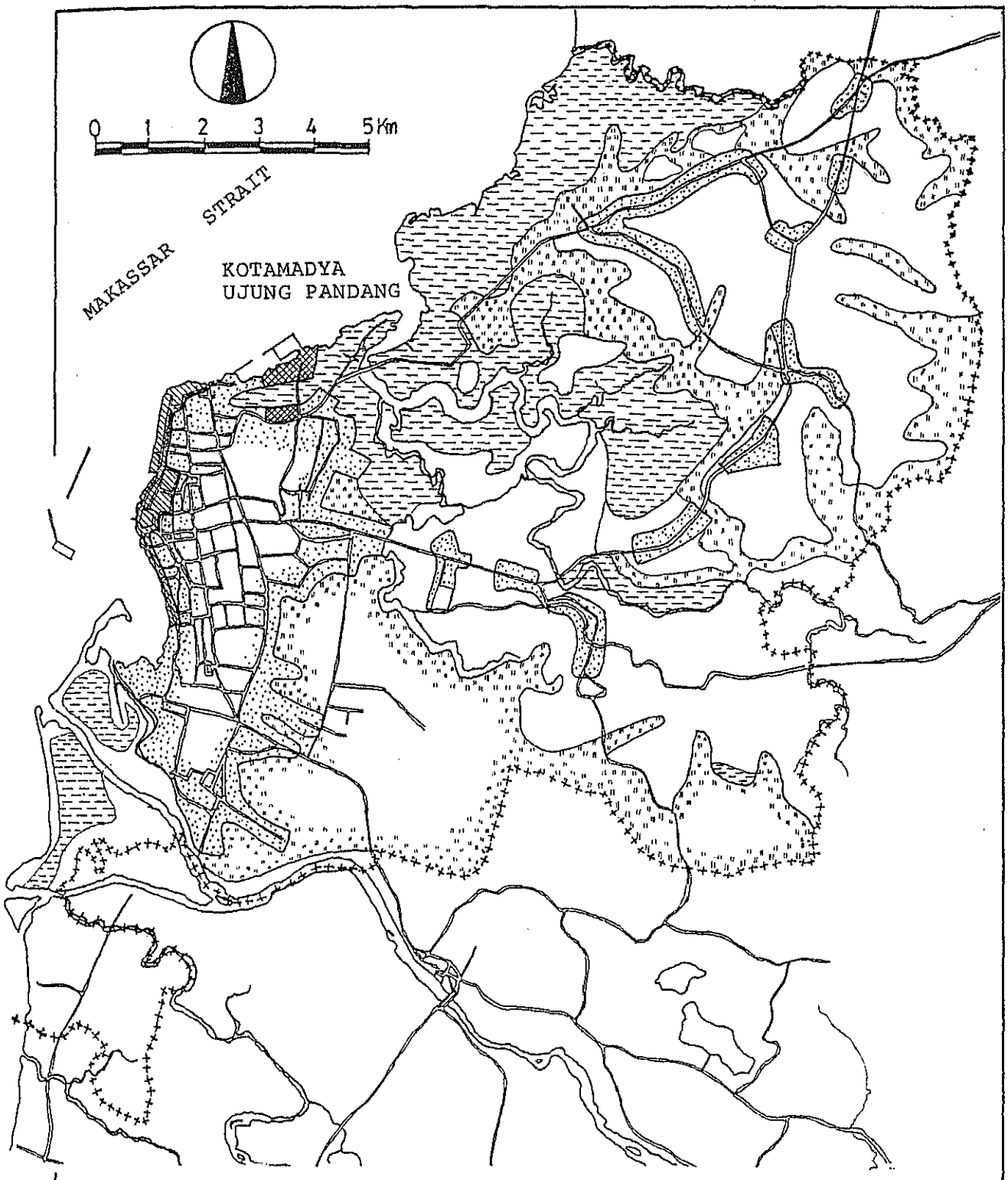
- Fishermen (beach)	: 13.5 %
- Industrial labours	: 4.98%
- Professionals	: 0.04%
- Hotel/Restaurant employees	: 0.09%
- Transportation drivers	: 0.76%
- Public officials	: 24.34%
- Services employees	: 14.1 %
- Armed Forces men	: 7.58%
- Others	: 30.61%
Total	:100.00%

Source: Kotamadya Ujung Pandang
basic design (1984/85 - 1988/89)

TABLE 2.4 NUMBER OF STUDENTS
(1983)

School	Students	% to total population
Elementary School	121,614	16.5
Junior High School	59,790	8.1
Senior High School	33,044	4.5

Source : Visuality Data by BAPPEDA (1983)



LEGEND

- : Commerce
- : Industry
- : Residence
- : Swamp
- : Paddy
- : Others

FIGURE	PRESENT LAND USE
2.1	

TABLE 2.3 THE AREA OF TOWN LAND UTILIZATION

No.	Type of utilization	Area	Remarks
1.	Housing	1,632.1 ha	9.29 %
2.	Business	167.2 ha	0.95 %
3.	Industrial	64.8 ha	0.37 %
4.	Service	233.5 ha	1.38 %
5.	Empty land already reserved	42.4 ha	0.24 %
6.	Rice-fields	5,807.4 ha	33.05 %
7.	Village housing	889.2 ha	5.06 %
8.	Fish-ponds	2,022 ha	11.51 %
9.	Mixed gardens	3,470 ha	19.75 %
10.	Underbrush forest	20.4 ha	0.12 %
11.	Teak forest	513.6 ha	2.92 %
12.	Palm forest	1,046.4 ha	8.00 %
13.	Swamps	60.8 ha	0.35 %
14.	Beaches/Sand ground	179.6 ha	1.02 %
15.	Roads, Rivers etc.	1,427.6 ha	8.03 %
	T o t a l	17,577 ha	100.00 %

Source : Kotamadya Ujung Pandang basic design (1984/85 - 1988/89)

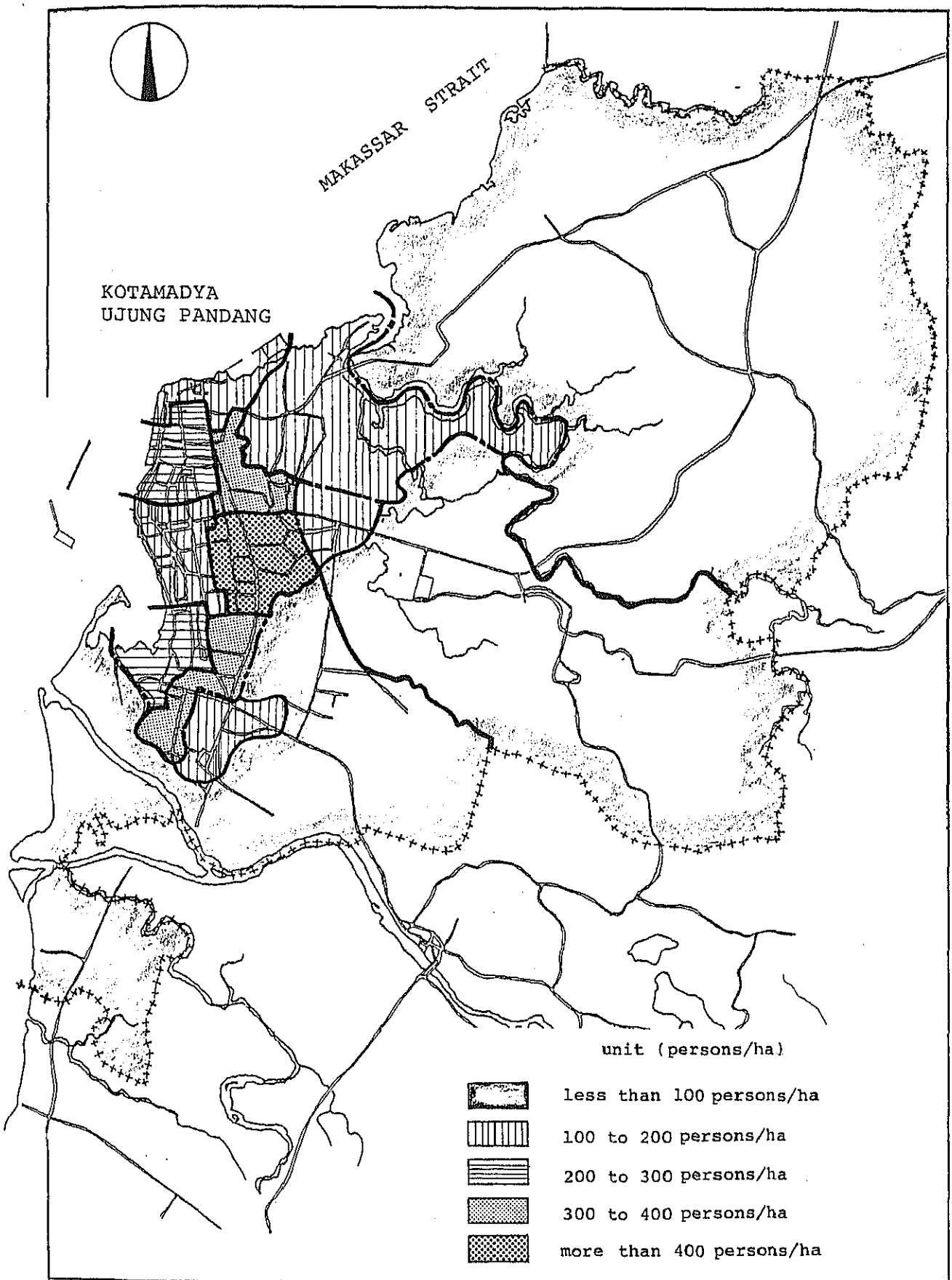


FIGURE	POPULATION DENSITY (1983)
2.2	

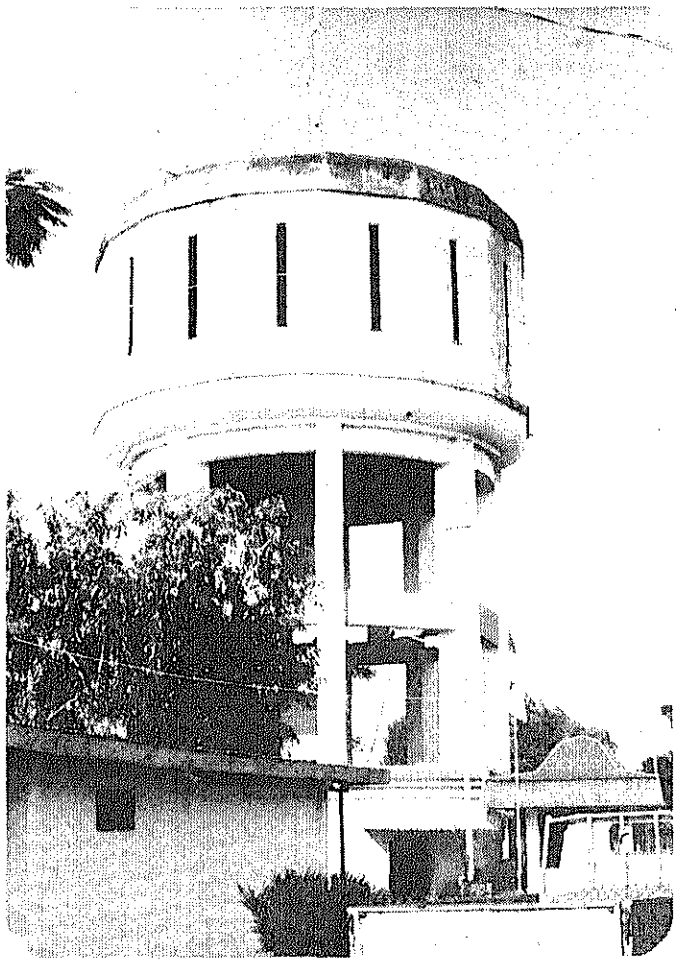
TABLE 2.5 INCIDENCE OF DISEASES

YEAR	CHOLERA	TYPHUS	DIARHEA	WORM DISEASE	SKIN DISEASE	MALARIA	EYE DISEASE
1977	701	108	17,786	-	16,592	2,750	7,860
1978	591	-	22,266	5,768	19,119	4,066	15,200
1979	-	170	32,499	8,153	45,939	3,361	22,132
1980	1,184	230	42,145	7,259	74,630	3,799	26,186
1981	-	204	33,184	2,218	50,690	1,347	12,528
1982	-	184	22,399	1,400	66,024	1,605	7,449
1983	363	189	30,363	4,962	64,489	1,407	9,996

Source : Ujung Pandang Public Health of Service (1984)

CHAPTER III

EXISTING WATER SUPPLY



ELEVATED TANK AT RATULANGI
CONSTRUCTED IN 1924

CHAPTER III

EXISTING WATER SUPPLY

1. GENERAL

Water supply in Ujung Pandang dates back to 1924 when the administrative area of the municipality was rather small and had been called as Kota Makassar.

A water treatment plant of 50 l/sec in capacity was developed at Ratulangi extracting the Jeneberang river water by pumping. This Ratulangi system was composed of several facilities, i.e., intake facilities at Sungguminasa, a transmission pipeline of around 7 km in length, a receiving well, sedimentation basins, filters and an elevated tank. It supplied treated water to a limited number of households near the treatment plant. The first expansion of the Ratulangi system was completed in 1940's. Sedimentation basins and rapid sand filters constructed in the expansion works are being currently operated by PDAM.

The second expansion works to develop a new water supply system at Panaikang were carried out in 1977. This Panaikang system with a capacity of 500 l/sec takes raw water from the Maros river and transmits to the Panaikang treatment plant through a canal by gravity. The plant consists of raw water pumping facilities, a clarifier, filters, clear water reservoirs and a pumping station. In 1983, the capacity of the plant was upgraded to 600 l/sec with an additional capacity of 100 l/sec. Further, the system is scheduled to expand its capacity by constructing treatment facilities of 500 l/sec by the year of 1986.

A general plan of the above existing systems is shown on Figure 3.1. Illustrations to support this plan with additional information on the existing systems are also presented on Figure 3.2.

In the succeeding sections, water sources, treatment facilities and distribution networks of the existing system will be outlined with necessary maps and data.

2. WATER SOURCES

A schematic diagram of water utilization system in and around the project area is prepared based on review of the existing data and field survey conducted by the Team, as shown on Figure 3.3.

The major sources for the existing water supply systems are the Jeneberang and the Maros rivers. Another water source for the people in Ujung Pandang is shallow well groundwater. According to the present survey, about 90% of total households utilize shallow wells to supplement their daily consumption. Hence, in the following subsection, these three water sources will be focussed on to describe their typical features such as yields and discharge, water quality and seasonal fluctuations.

2.1. The Jeneberang River

The Jeneberang river originates in the Bawakaraeng mountain east of Ujung Pandang and flows down through the southern part of Ujung Pandang emptying into the Makassar strait. It has a catchment basin of 727 km2 and a length of 75 km. The Sungguminasa intake of the Ratulangi system is located at the lower reaches of the Jeneberang river, about 9 km upstream from its river mouth. The river is about 200 m in width and its elevation is about 4 m above sea level near Sungguminasa. The intake is designed as free from sea water.

The river water is currently used as water source for irrigation, industry and water supplies. Among these intake structures and facilities, that of PDAM is located at the most downstream of the river. When the river flow is very small particularly in the dry season, water depth sometimes decreases to one or two centimeters, affecting seriously the system operation. The quantity of river water available at this intake was estimated at 75 l/sec in terms of five-year probability based on the existing records of flows.

Regarding quality of the river water, the Team carried out water sampling tests several times to clarify microbiological and chemical characteristics of the river water, which are shown in Table 3.1. It indicates that raw water quality does not exceed the maximum permissible limits of the Indonesian Raw Water Quality Standard and does not give any significant effects to the treatment process of the system. Raw and Drinking Water Quality Standards adopted by Indonesia and WHO are shown in Appendix IV.

2.2 The Maros River

The Maros river arises in the Lawekang mountain and runs down from east to west between Maros and Ujung Pandang, joining many tributaries. It has a catchment basin of approximately 650 km2 and a length of 80 km. The Leko Pancing weir located at 30 km north-east of Ujung Pandang was constructed in 1977 to divert the river water to the transmission canal. It is at an elevation of about 26 m above sea level, whereas the intake of Panaikang treatment plant is 4 m. The location of the weir is high enough to transmit raw water by gravity.

The weir is operated by PDAM to take constantly 2,000 l/sec of the river water except when the river flow is fairly small. As seen in the case of the Jeneberang river, the raw water of the Maros river also drops to a low level during the dry season having no discharge over the weir. It was also observed that the water, once submerged into the ground, came out again at several hundred meters downstream of the weir. The raw water available at Leko Pancing for water supply is computed at about 900 l/sec in terms of five-year probability from the existing data. The data also shows reforestation, undertaken by authorities concerned since 1969, have a beneficial effect on the discharge of the Maros River.

The raw water quality of the Maros river is analyzed in the same manner as the case of the Jeneberang river. The results of water testing, which are also shown in Table 3.1, indicate that the water is less polluted microbiologically as compared with the Jebenerang river water, while chemical characteristics of the water are almost similar.

2.3 Groundwater

Groundwater level in the area varies between 0 m to 2 m above mean sea level in the urban area and 4 m to 5 m in the northern part of the area. The electrical conductivity distribution map of groundwater is shown on Figure 3.4, which shows that groundwater with electrical conductivities more than 1,000 $\mu\mho$/cm (minimum value for salty taste) are distributed widely to the inland area of Ujung Pandang.

The majority of the people in Ujung Pandang depend on shallow wells although yields of each well are fairly small. In addition, several community wells exist particularly in the sub-urban area where PDAM does not supply treated water. Such shallow wells are not necessarily maintained in sanitary conditions, because of 1) their close location to the pit latrines and 2) lack of hygienically appropriate maintenance. Prevalent type of existing shallow wells is referred to in Appendix V to this report. Microbiological tests of shallow well groundwater indicate that about 50% of wells are contaminated by coliform organisms. It is, therefore, recommended that the division under the municipal government which is responsible for public health should give adequate guidance and advice on maintenance of shallow wells to the users and also monitor periodically the conditions thereof.

3. WATER TREATMENT FACILITIES

3.1 Ratulangi System

The water source for the Ratulangi system is the Jeneberang river. The system is composed of Sungguminasa intake facilities and Ratulangi treatment plant. Plan of Ratulangi plant is shown on Figure 3.5.

Major facilities presently operated are one receiving well, two pumps with one standby to pump up raw water to a mixing chamber, three sedimentation basins (horizontal type) and eight rapid sand filters. Most of the other facilities in the plant are no longer in use.

Since there are no data available regarding production capacity of the Ratulangi system, the capacity of each facility was estimated on the basis of site survey, as shown in Table 3.2. The capacity of filters is 190 l/sec, the largest, and that of the transmission pipeline is merely 75 l/sec, the least. It should be noted that more than 30% of the intake water are lost during flowing down through the pipelines. The production capacity of the system, accordingly, decreases to 50 l/sec taking into consideration some inplant losses and water for routine maintenance of the system.

Major facilities have outlived their durable years. So, further investment to this system is to be made carefully. Expensive system rehabilitation should be avoided. On the other hand, efforts to achieve effective control and maintenance should be made, which are not costly.

The existing system, despite its age, is producing clear water within an acceptable level of the Indonesian drinking water standard. Table 3.3 shows physical and chemical characteristics of the treated water.

In the meantime, the system has an additional water source. Rain water gathered into a swamp in the PDAM yard are transmitted through channel to the receiving well by gravity. This source, although not available at the dry season, contributes to the increase of water production of the system.

3.2 Panaikang System

The Panaikang system, newly constructed in 1977, consists of Leko Pancing intake facilities, a transmission canal, a raw water pumping station, a mixing chamber, clarifiers, filters, clear water reservoirs and a distribution pumping station.

The raw water of the Maros river is diverted at Leko Pancing weir and delivered to the raw water pumping station in Panaikang treatment plant through the canal of 29 km in length, which is composed of several sections, i.e., open channel, inverted syphon and tunnel.

In spite of 3,400 1/sec design capacity of Leko Pancing weir, capacity of the canal is 1,900 1/sec at present from the results of the site survey. Due to the excessive water losses at the canal, particularly at the open channel and the inverted syphon at the downstream, the raw water reaching to Panaikang treatment plant decreases to 70% according to the field survey conducted several times.

Panaikang treatment plant is located on an eastern hillock about 5 km from the center of the Municipality and at an elevation of 17 m above sea level. Figure 3.6 shows a general plan and flow diagrams of Panaikang treatment plant, and dimension of facilities are shown in Table 3.4.

The Panaikang system with a capacity of 500 l/sec was designed and constructed with the aid of French Government and started its operation in 1977. In 1983, capacity of the facilities was upgraded to 600 l/sec with an additional 100 l/sec in order to keep pace with the increasing water demand.

This plant consists of five steps of treatment process: a mixing chamber for dosing chemicals, a solid contact clarifier with pulsation (pulsator), five units of rapid sand filters, a chamber for post-chlorine and two clear water reservoirs.

Table 3.5 shows physical and chemical characteristics of the water at several points of the treatment plant.

In 1983, some modification works to upgrade plant capacity from 500 l/sec to 600 l/sec were carried out at raw and clear water pumps and chemical dosing equipments. Aluminum sulfate is currently used as chemical coagulants. It is desirable that rate of chemical dosage is determined by the staff properly, on the basis of results of the periodical jar-testing. Although flocks in the clarifier are frequently carried over into the filters due to the expansion of the treatment capacity and the rise of raw water temperature, the quality of filtered water is kept within an acceptable level of the standard.

Clear water after dosing of post-chlorine is stored in the reservoirs which have a total capacity of 10,000 m3. This storage capacity appears sufficient to meet the hourly variation of water requirements, even if the system is expanded to 1,100 l/sec in 1986. It was confirmed by the survey on hourly variation of supplied water, of which results are given on Figure 3.7. It shows the ratio of hourly maximum demand to the average ranges from 1.20 to 1.30.

Regarding mechanical equipments in the plant, several pumps and blowers are installed for extracting raw water, back-washing filter media, feeding chemicals, and for delivering clear water from the reservoirs to the consumers. Although these pumps and blowers are all functional and operated properly, the distribution pumps have been placed out of service from the PDAM's experience. High water pressure by pumping once caused great many leaks from the deteriorated pipelines.

Other instruments are flow meters at the intake and outlet of the pumping station. They are, however, all out of order after a few years of use and are left unrepaired due to the lack of spare parts.

The operations of these pumps and blowers require a large quantity of power. PDAM is sometimes obliged to stop operation due to the frequent power failure of the power plant. According to the officials of BAPPEDA, this shortage of capacity of power plants will be completely solved in the near future by the construction of new power plant at Bakaru, planned to provide electricity to the whole area of South Sulawesi Province.

4. DISTRIBUTION SYSTEM

4.1 Old and New Distribution Networks

The distribution system in Ujung Pandang is divided into two, i.e., old and new systems based on the year of their installation. They are shown on Figure 3.8. The old distribution network was developed in 1920's and the new in 1970's and 1980's.

Roughly, treated water from the Ratulangi system is supplied through the old network to the residential and commercial area at southern and western parts of the built-up area. And the new system supplies treated water to northern and eastern parts and the surrounding area of the old system. These two systems are interconnected at several points.

Water levels of the elevated tanks at Ratulangi plant and the storage reservoirs at Panaikang plant were gauged by the Team to assess the present situation of the distribution networks. Their water levels fluctuate between 19 m to 25 m and 12 m to 17 m respectively.

The existing pipelines have a total length of 404 km, seemingly insufficient to supply treated water to the customers as compared with the records of water supplies in Japan as summarized in Table 3.6.

The pipe materials used for the old systems are predominantly cast iron and those for the new system are galvanized iron in small diameter, and ductile cast iron in relatively large diameter. Recently, PDAM is using PVC pipes for the service pipelines because of their easy handling and installation.

The results of the present water pressure survey show that most of the service area are supplied with excessively low water pressure as given on Figure 3.9. There are a lot of customers in the service area who cannot obtain piped water through house connections in the daytime unless extracting by house pumps. It is attributable to the fact that production capacity of the existing system is not enough to meet the water requirements in addition to the following:

1) Panaikang treatment plant, although distributing clear water by gravity at present, is located at ground level of around 15 m, not high enough for gravity distribution.

2) Water consumptions are increasing year by year,

3) Big consumers such as the existing power plant and the harbour are supplied by pumping directly from the treatment plant through their own pipes although production capacity is limited, and

4) A large amount of water leakage from the distribution network exists especially at the diversion to the house connections.

These are also schematically shown on Figure 3.10. Related to item 3) explained above, PDAM will start providing clear water from the Panaikang system directly to Industrial Estate in mid 1985. Supplying water to Estate will make the situation worse unless prompt actions for increasing water production and/or reducing water losses are undertaken by PDAM.

4.2 Valves and Fire Hydrants

In the new distribution network, there exist approximately 50 valves with diameter ranging from 100 mm to 1,000 mm to control and change water flow. There are no data regarding location of valves in the old distribution network. Moreover, many valves have been covered with asphalt pavement inadvertently by road works, carried out so far.

Fire hydrants, although installed in the new network in 1977, do not work properly because of low water pressure in the pipelines. About 15 fire hydrants of the total 45 are for water supply to the harbour, where treated water is supplied from the Ratulangi system by pumping through the pipeline installed thereby.

Once fire occurs, fire engine trucks carry water from Ratulangi plant to the place where needed. They rush to-and-fro between the plant and the site of fire.

5. HOUSE CONNECTIONS AND PUBLIC STANDPIPES

There are 26,275 connections as of December, 1983, out of which house connections are 25,013 or 95.2%, connections for social bodies including public standpipes are 555 or 2.1% and connections for non-domestic are 707 or 2.7%.

As illustrated on Figure 3.9, people in approximately 40% of the service area are suffering from the water shortage due to the low water pressure in the distribution networks. In such area, the people are likely to install pumping equipment to obtain more water.

It seems that most of water losses are taking place at service pipes of small diameter. It was confirmed and examined through the household and public standpipes survey and also direct excavation at several points of house connections.

Further, surveys made several times, endorsed PDAM's initial information on illegal water use that people tend to extract supplied water after removing the installed meters. Such households are about 20% of total.

As to installation of the public standpipes, several financing sources/agencies concerned are involved. Standard designs adopted are diverse: types of KIP, MCK, UNICEF, PEMDA, AMD, and BANGDES. These abbreviations represent respective financing sources/structures. The designs for prevalent KIP and UNICEF types are shown on Figure 3.11. Standpipes are sometimes occupied by one household because of their close locations. In view of the distribution of the public standpipes, communication among the agencies concerned are hardly conducted. Furthermore, maintenance of the public standpipes are generally entrusted to the people, resulting in unsanitary condition around the standpipes.

6. WATER PRODUCTION AND CONSUMPTION

Present conditions of water production and consumption are of vital necessity in planning the future water supply system. PDAM, for the purpose of the financial management, usually estimates quantity of water production and consumption from the data on pumping records and revenues from the water sales although the estimates from such data are not necessarily accurate.

In consideration of the above, field surveys as itemized below were carried out during the present study to obtain data regarding water production and consumption.

1) Survey on hourly variation of water production,
2) Survey on water losses at the existing canal,
3) Survey on capacity and dimension of water supply facilities,
4) Household survey, and
5) Public standpipe survey.

Results of the surveys are presented on the following table, which relate to water production and consumption.

Item	Quantity	Remarks
Intake Rate at Leko Pacing	1,540 l/sec	- based on survey 2)
Flow Rate at Panaikang	1,080 l/sec	- survey 2)
Water Production at Panaikang	650 l/sec	- survey 1)
Intake Rate at Sugguminasa	75 l/sec	- survey 3)
Intake Rate at Ratulangi	35 l/sec	- survey 3)
Total Production	685 l/sec	- surveys 1) and3)
Per Capita Consumption (house connection)	97 l/c/d	- survey 4) and PDAM records
Per Capita Consumption (public standpipe)	30 l/c/d	- survey 5)
Water Consumption 1/	24,600 m3/day	- based on records of water sold

1/ ; PDAM records show that average daily consumptions are 16,400 cu m/day in 1980, 20,600 cu m/day in 1981, 22,100 cu m/day in 1982, and 24,600 m/day in 1983.

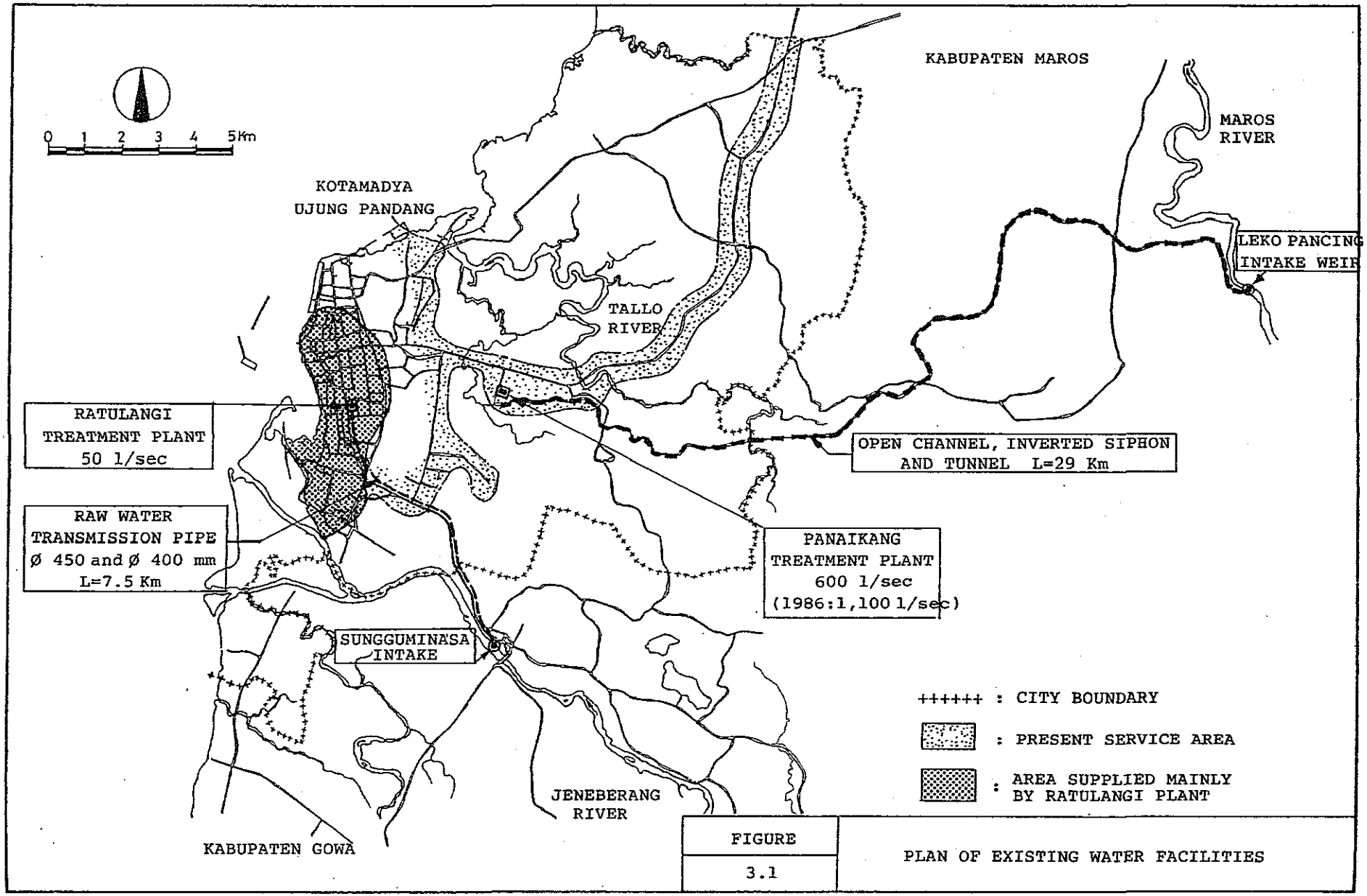
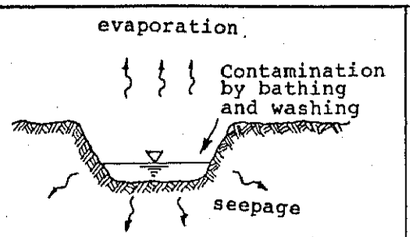
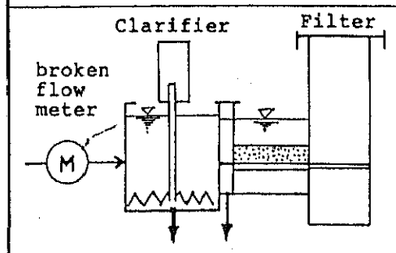


FIGURE	PLAN OF EXISTING WATER FACILITIES
3.1	

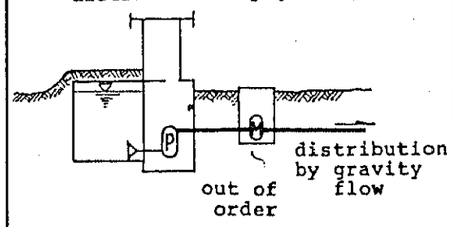


Water losses at existing channel

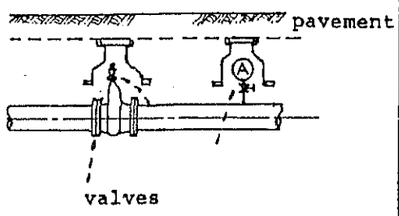


Inplant losses as drain and backwashing water

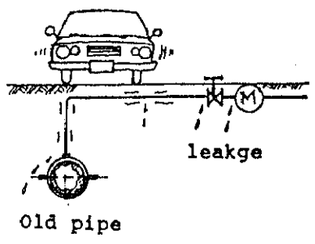
Defective bulk meter and distribution by gravity

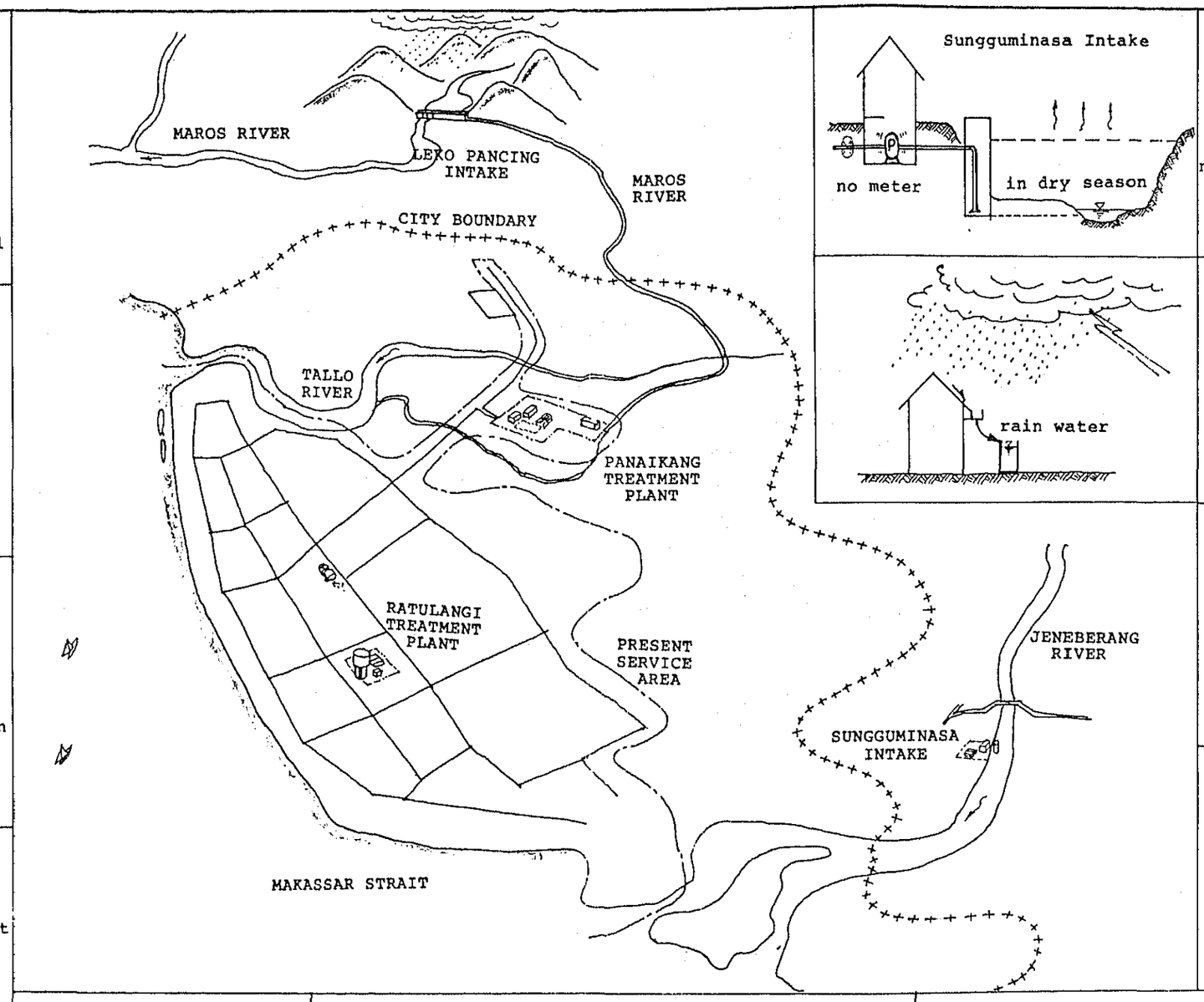


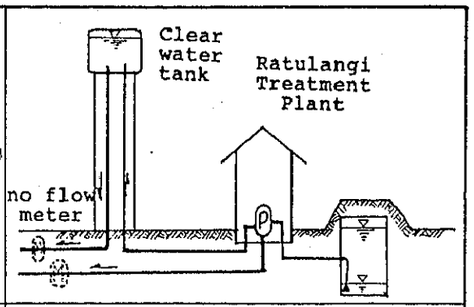
Valves covered by pavement

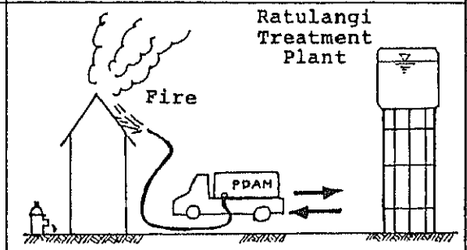


Water leakage at the service pipe

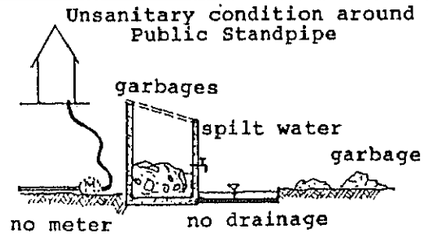




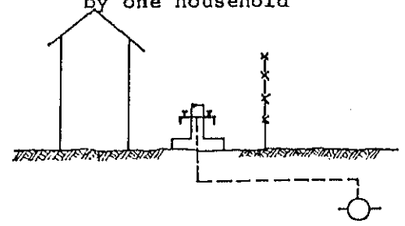




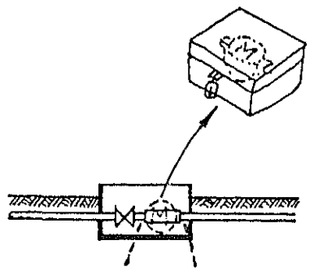
Unsanitary condition around Public Standpipe



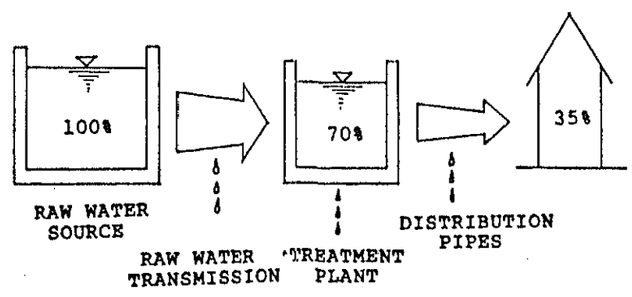
Public standpipes owned by one household

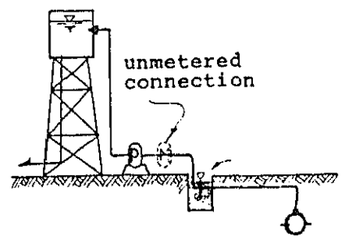


Meters removed by consumers



Raw water and water sold





Service pipe installed in the ditch and without meter

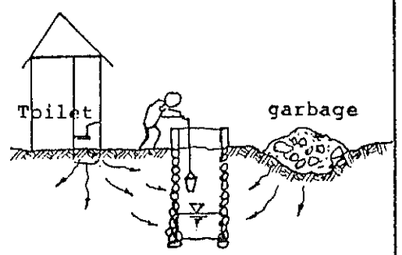


FIGURE	ILLUSTRATION
3.2	EXISTING WATER SUPPLY SYSTEM

TABLE 3.1 WATER QUALITY ANALYSIS OF SUNGGUMINASA AND LEKO PANCING

I t e m s		Jeneberang River Sungguminasa Intake		Maros River Leko Pancing Intake	
		Dry Season	Rainy Season	Dry Season	Rainy Season
Water Temperature	°C	25.0～29.2	24.2～29.5	26.0～28.6	24.2～25.8
PH		7.2～ 7.4	7.0～ 7.2	7.2～ 7.4	7.4～ 7.6
Turbidity	Degree	22～ 175	55～ 630	5～6	8～ 21
Electric Conductivity	$\mu\mho$/cm	-	-	163～165	-
Alkalinity	mg/l	48～60	28～54	60～86	54～70
Total Hardness	°D	2.9	1.5～ 2.5	3.5	3.1～ 4.0
Chlorine Ion	mg/l	6～7	4～6	1～2	1～2
Ammonia	mg/l	0.08～0.10	0.06	0.04～0.06	<0.04
Dissolved Iron	mg/l	0.20～0.30	0.25	0.20～0.30	0.10～0.20
Manganese	mg/l	0.03	<0.03	0.03～0.05	<0.03～0.03
Coliform Group	N/100 ml	300～1,300	300～1,600	500～800	0～500
Total Colonies	N/ml	1,584	792～1,512	92～728	408～588
Dissolved Oxygen	mg/l	-	6.6～6.8	-	7.2～7.6
Potassium Permanganate consumed	mg/l	-	6.3～138.1	-	2.3～8.3
C O D	mg/l	-	1.6～34.5	-	0.6～2.1

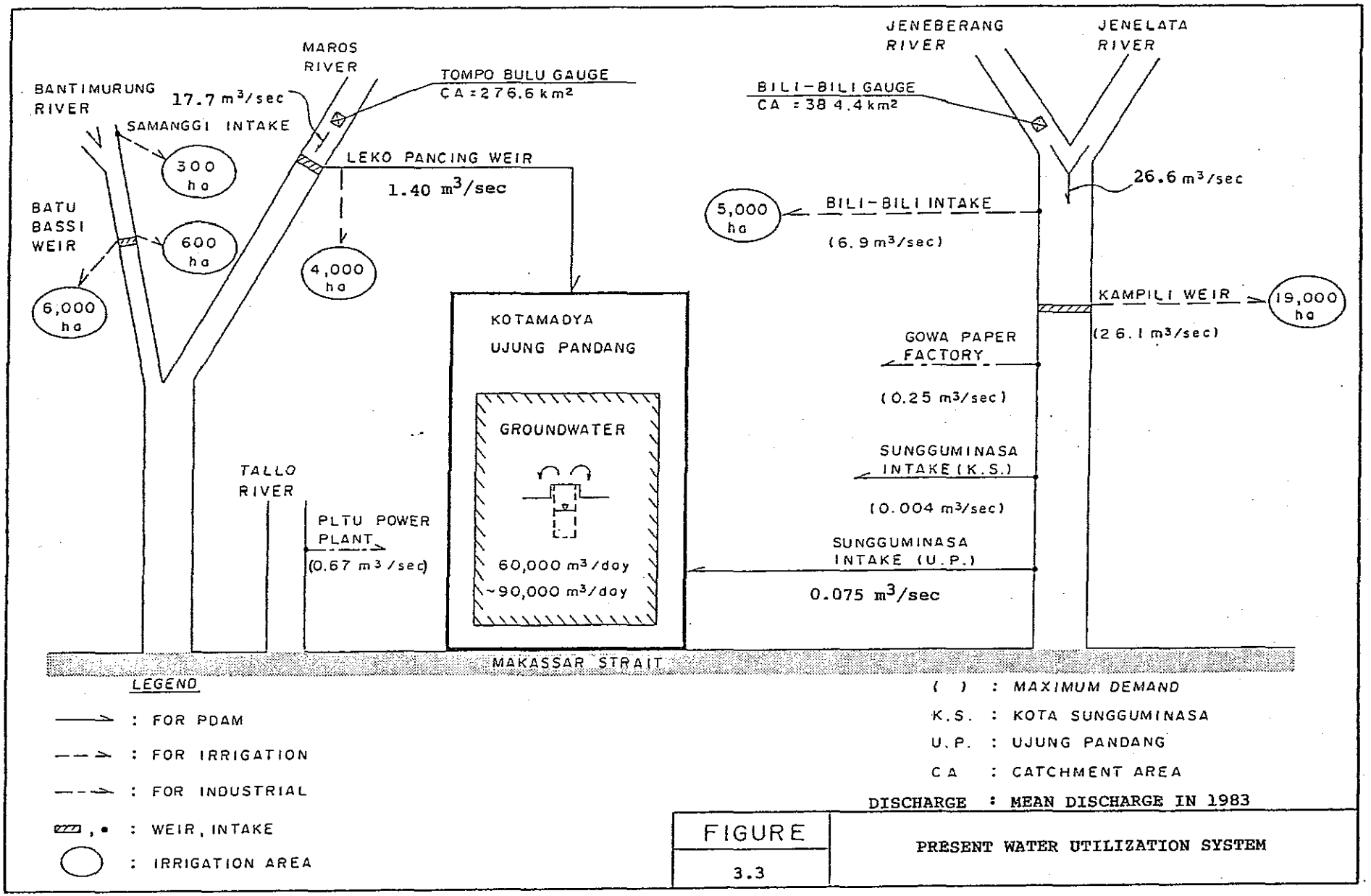


FIGURE 3.3

PRESENT WATER UTILIZATION SYSTEM

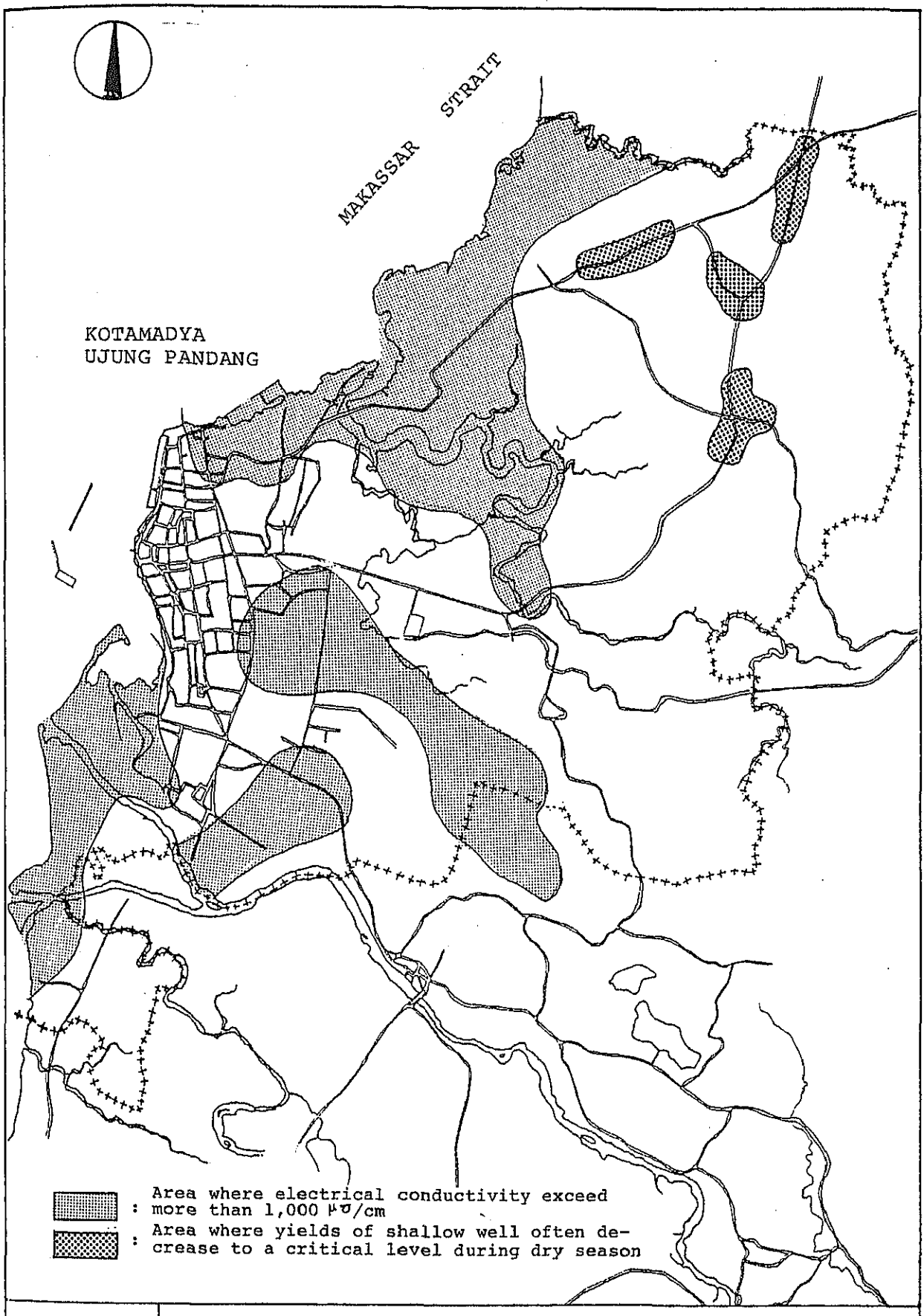


FIGURE	CONDITIONS OF GROUNDWATER
3.4	

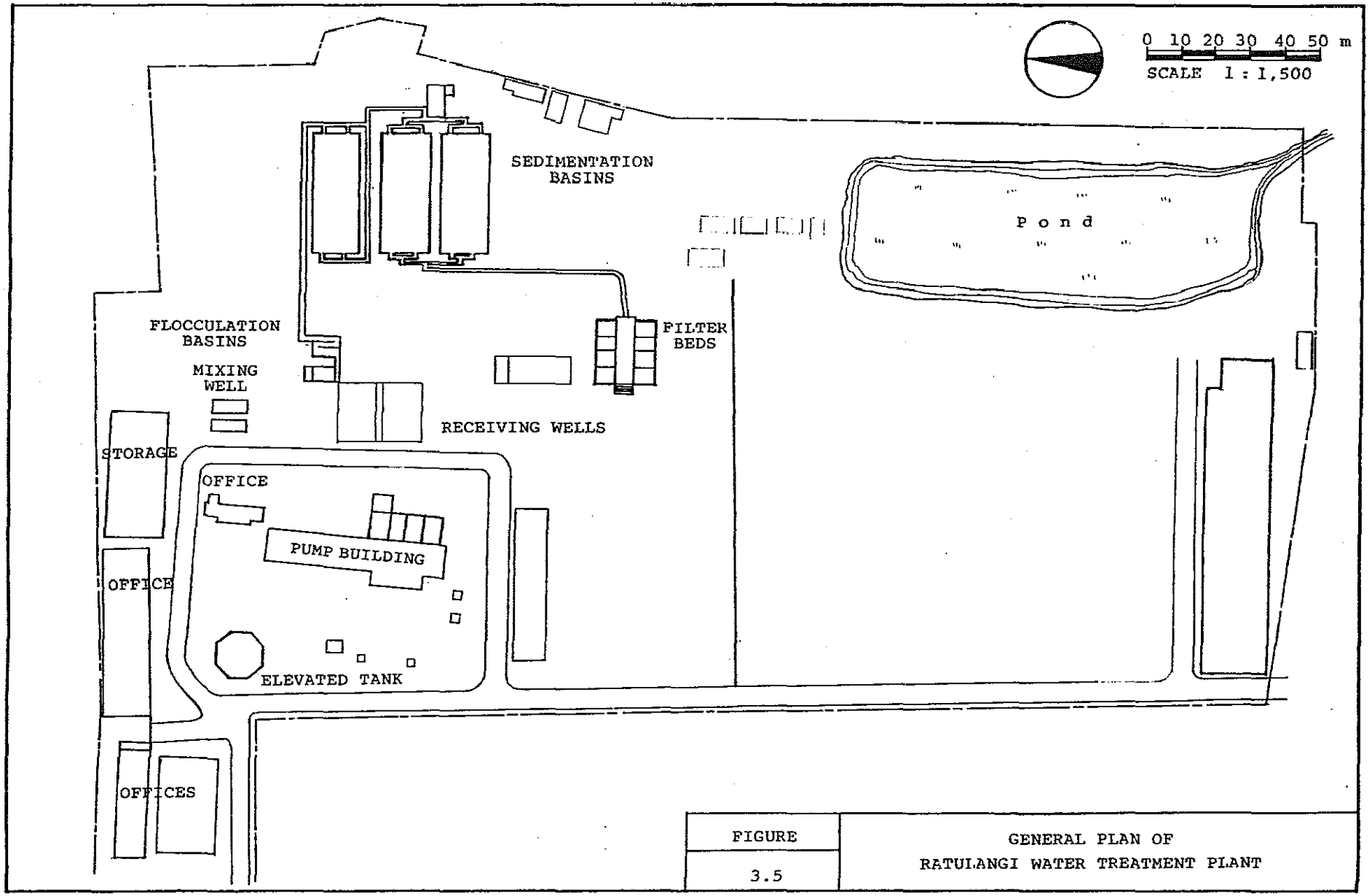


FIGURE	GENERAL PLAN OF RATUIANGI WATER TREATMENT PLANT
3.5	

TABLE 3.2 EXISTING FACILITIES OF RATULANGI SYSTEM

Facilities	Dimension	Capacity
1. Sungguminasa intake		
- Intake tower	Dia. 2.9 m x depth 8.5 m	
- Intake pump building	160 m^2	
- Presedimentation basin	12.7 m x 6.80 m x H 2.75 m	130 l/sec (11,300 m^3/day, V=7 cm/s)
- Intake pumps	270 m^3/h x 15 m x 1 unit and 150 m^3/h x 10 m x 2 units	
2. Raw Water Transmission Line		75 l/sec
	concrete pipe Ø 18 inch (Ø 450 mm)	Approx. 6,900 m
	cast iron pipe Ø 16 inch (Ø 400 mm)	Approx. 600 m
3. Ratulangi Water Treatment Plant		
- Receiving well	12 m x 5 m x H 4.25 m x 1 unit	500 l/sec (43,200 m^3/day, retention time 1.5 min.)
- Mixing well	3.2 m x 2.9 m x H 0.82 m	95 l/sec (8,200 m^3/day, retention time 1 min.)
- Flocculation basin	open channel	70 l/sec (6,000 m^3/day, retention time 10 min.)
- Sedimentation basins	36 m x 15 m x H 3.0 m x 3 basins	
- Filter beds	4.9 m x 4 m x 8 beds	190 l/sec (16,500 m^3/day, filtration rate 120 m/day and 1 bed standby)
- Clear water reservoir	20 m x 20 m x H 5.0 m	1,800 m^3
- Elevated tank	Dia. 12.5 m x H 6.0 m	750 m^3
- Pump Building		Approx. 500 m^2

TABLE 3.3 WATER QUALITY ANALYSIS OF RATULANGI TREATMENT PLANT

I t e m s		Dry Season		Rainy Season	
		Raw Water	Treated Water	Raw Water	Treated Water
Water Temperature	°C	27.5 ~ 30.0	29.0 ~ 29.5	27.0	26.8
PH		7.2 ~ 7.6	7.2 ~ 7.4	6.8	7.0
Turbidity	Degree	25 ~ 155	3 ~ 4	73	3
Alkalinity	mg/l	46 ~ 84	44 ~ 68	120	70
Total Hardness	°D	2.7 ~ 3.9	3.0 ~ 4.0	7.7	5.6
Chloride Ion	mg/l	7	7	-	-
Ammonia	mg/l	0.06 ~ 0.10	< 0.05	0.06	< 0.05
Dissolved Iron	mg/l	0.15 ~ 0.30	0.05 ~ 0.10	0.25	0.10
Manganese	mg/l	0.03	< 0.03	0.03	< 0.03
Coliform Group	N/100 ml	200 ~ 1,200	0	1,100	0
Total Colonies	N/ml	696 ~ 2,060	0 ~ 7	2,016	6
Residual Chlorine	mg/l	-	0.2 ~ 0.4	-	0.2
Potassium Permanganate consumed	mg/l	-	-	7.8	3.8
C O D	mg/l	-	-	2.0	1.0

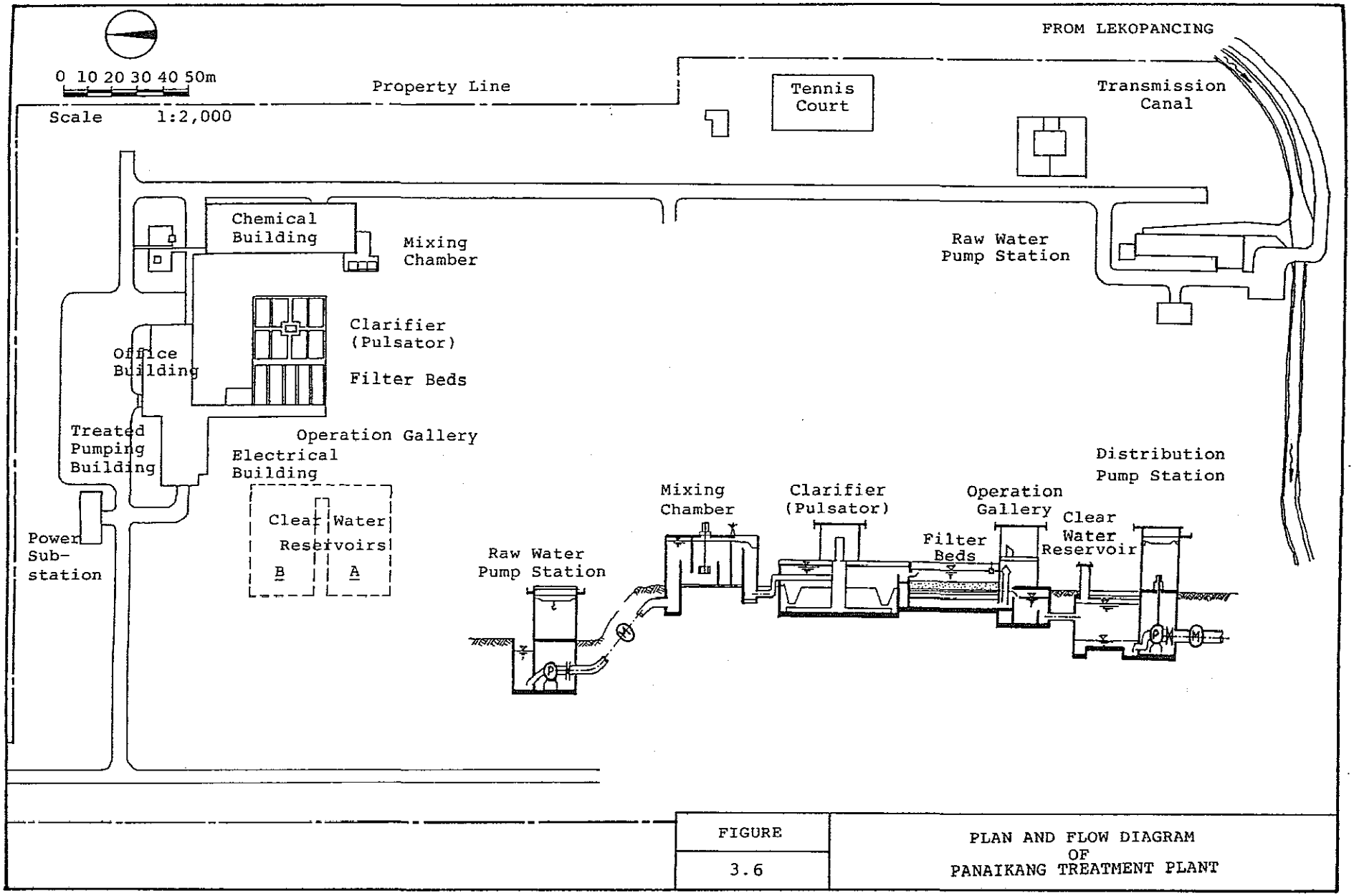


FIGURE	PLAN AND FLOW DIAGRAM OF PANAIKANG TREATMENT PLANT
3.6	

TABLE 3.4 EXISTING FACILITIES OF PANAIKANG SYSTEM

Facilities	Dimension		Capacity
1. Leko Pancing Intake			
- Intake gate	width 6.1 m x 4 unit		
- Culvert	1.5 m x H 2.4 m x L 210 m		3.4 m^3/sec
2. Transmission Canal	- Open	20,927 m	
	- Siphon	5,276 m	
	- Duct	1,986 m	1.9 m^3/sec
	- Tunnel	583 m	
	- Open with lining	128 m	
	Total	28,900 m	
3. Panaikang Treatment Plant			
- Raw water pumps	2.160 m^3/h x 19.1 m x 141 kw x 2 unit 570 m^3/h x 25 m x 1,450 rpm x 2 unit		
- Mixing chamber	4.75 m x 9.5 m x H 2.7 m		retention time 4 minutes
- Clarifier	27.0 m x 23.4 m x H 4.3 m up flow rate 57 mm/min		retention time 1.2 hours
- Filter beds	15.18 m x 4.8 m x 5 beds 72 m^2/bed		filteration rate 142 m/day
- Clear water reservoir	25 m x 40 m x H 5.0 m x 2 unit volume 10,000 m^3		retention time 4.6 hours
- *Distribution pumps*	1,800 m^3/h x 44 m x 262 kw x 2 unit 60 1/sec x 60 m x 1,450 rpm x 3 unit		

TABLE 3.5 WATER QUALITY ANALYSIS OF PANAIKANG TREATMENT PLANT

Items		Dry Season		Rainy Season	
		Raw Water	Treated Water	Raw Water	Treated Water
Water Temperature	°C	25.5 ~ 28.0	26.5 ~ 28.5	25.5 ~ 28.7	26.0 ~ 28.9
PH		7.8	7.2	7.4 ~ 7.6	6.8 ~ 7.0
Turbidity	Degree	22 ~ 55	2 ~ 3	20 ~ 55	3
Alkalinity	mg/l	60 ~ 72	50 ~ 60	56 ~ 64	48 ~ 56
Total Hardness	°D	3.0 ~ 3.8	3.1 ~ 3.8	3.2 ~ 3.9	3.1 ~ 4.0
Chloride Ion	mg/l	2	2	2 ~ 3	-
Ammonia	mg/l	0.06	< 0.05	0.06 ~ 0.08	< 0.05
Dissolved Iron	mg/l	0.20 ~ 0.30	0.05 ~ 0.10	0.10 ~ 0.20	0.10
Manganese	mg/l	0.03 ~ 0.05	< 0.03 ~ 0.03	< 0.03 ~ 0.03	< 0.03
Coliform Group	N/100 ml	200 ~ 6,200	0	1,400 ~ 1,600	0
Total Colonies	N/ml	350 ~ 840	2	798 ~ 1,260	0
Residual Chlorine	mg/l	-	0.05 ~ 0.8	-	0.3 ~ 0.6
Potassium Permanganate consumed	mg/l	-	-	3.3 ~ 5.2	0.8 ~ 2.8
C O D	mg/l	-	-	0.8 ~ 1.3	0.2 ~ 0.7

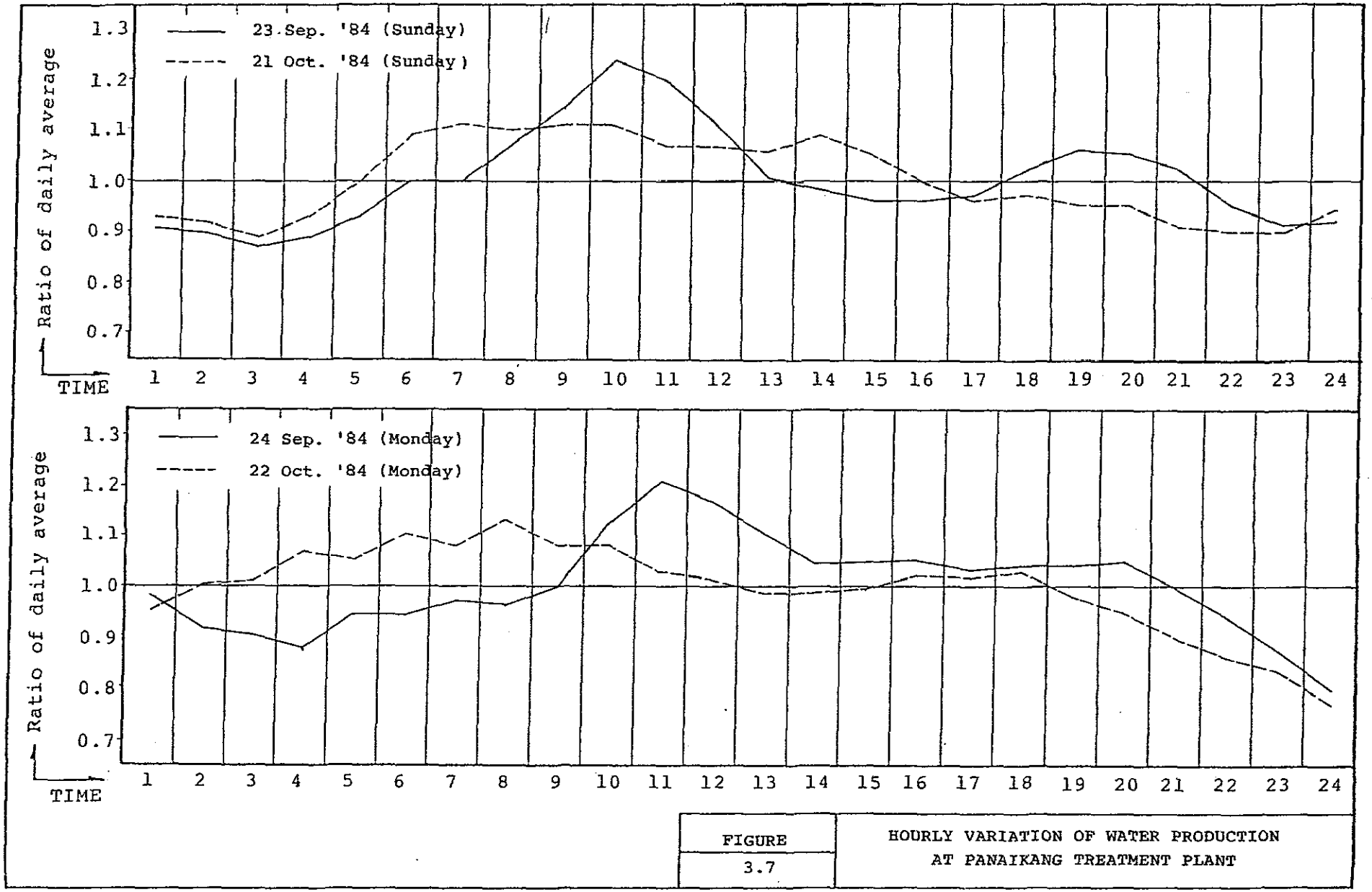


FIGURE	HOURLY VARIATION OF WATER PRODUCTION AT PANAIKANG TREATMENT PLANT
3.7	

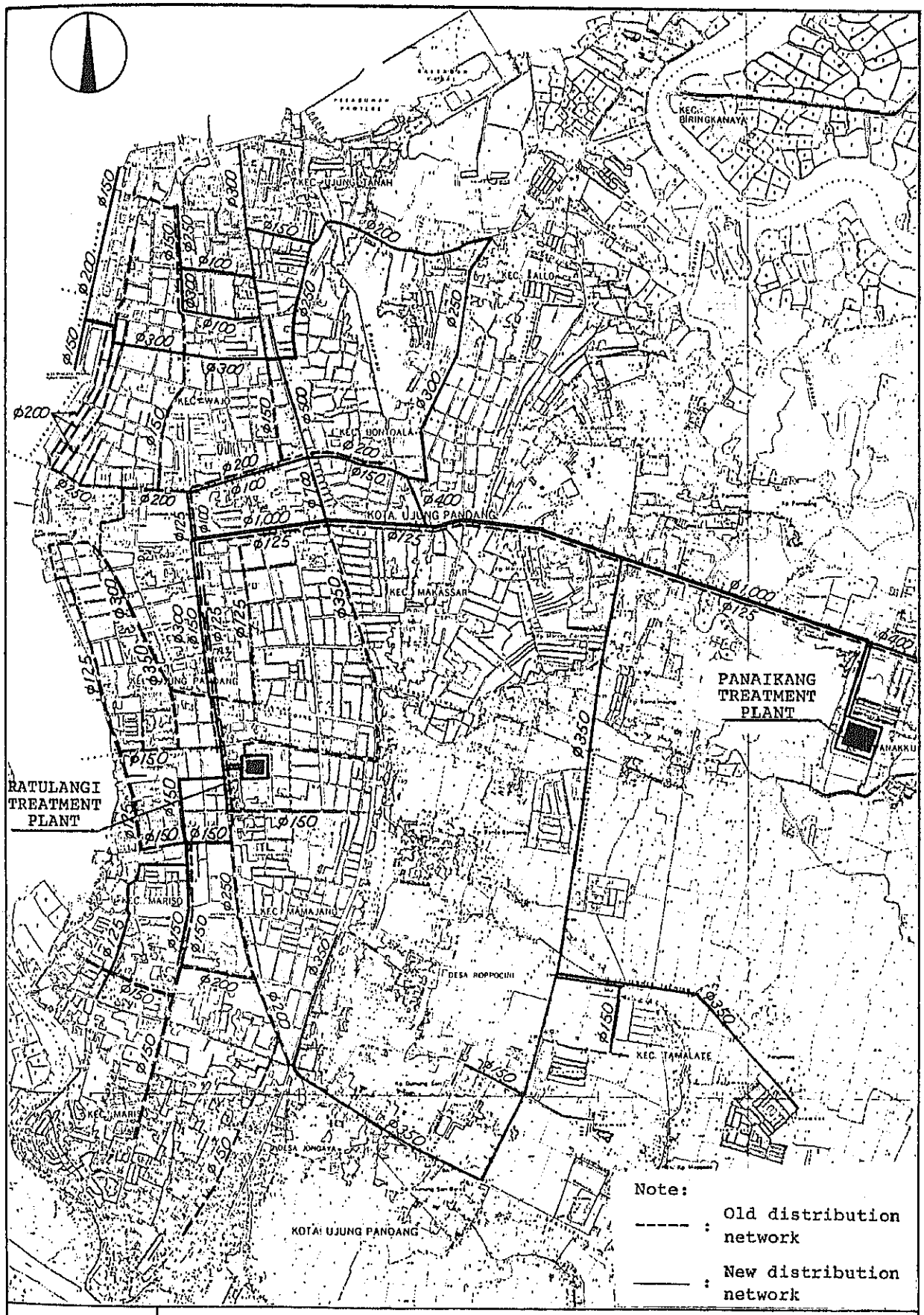


FIGURE	EXISTING DISTRIBUTION NETWORKS
3.8	

TABLE 3.6 LENGTH AND DIAMETER OF THE EXISTING PIPELINE

Dia. (mm)	Old System (m)	New System (m)	Total (m)
1,000		5,392	5,392
700		602	602
500		876	876
450	715		715
400		1,080	1,080
375	3,325		3,325
350		7,776	7,776
315		3,348	3,348
300	1,340	3,810	5,150
250	1,630	4,900	6,530
200	9,340	10,634	19,974
150	13,485	15,054	28,539
125	6,890	1,420	8,310
100	15,155	48,553	63,708
75	27,790	46,158	73,948
50	2,022	172,449	174,471
Total	81,692	322,052	403,744

Pipe length per population served

Ujung Pandang : 1.5 m/person
Same scaled water supply in Japan : 2.4 m/person

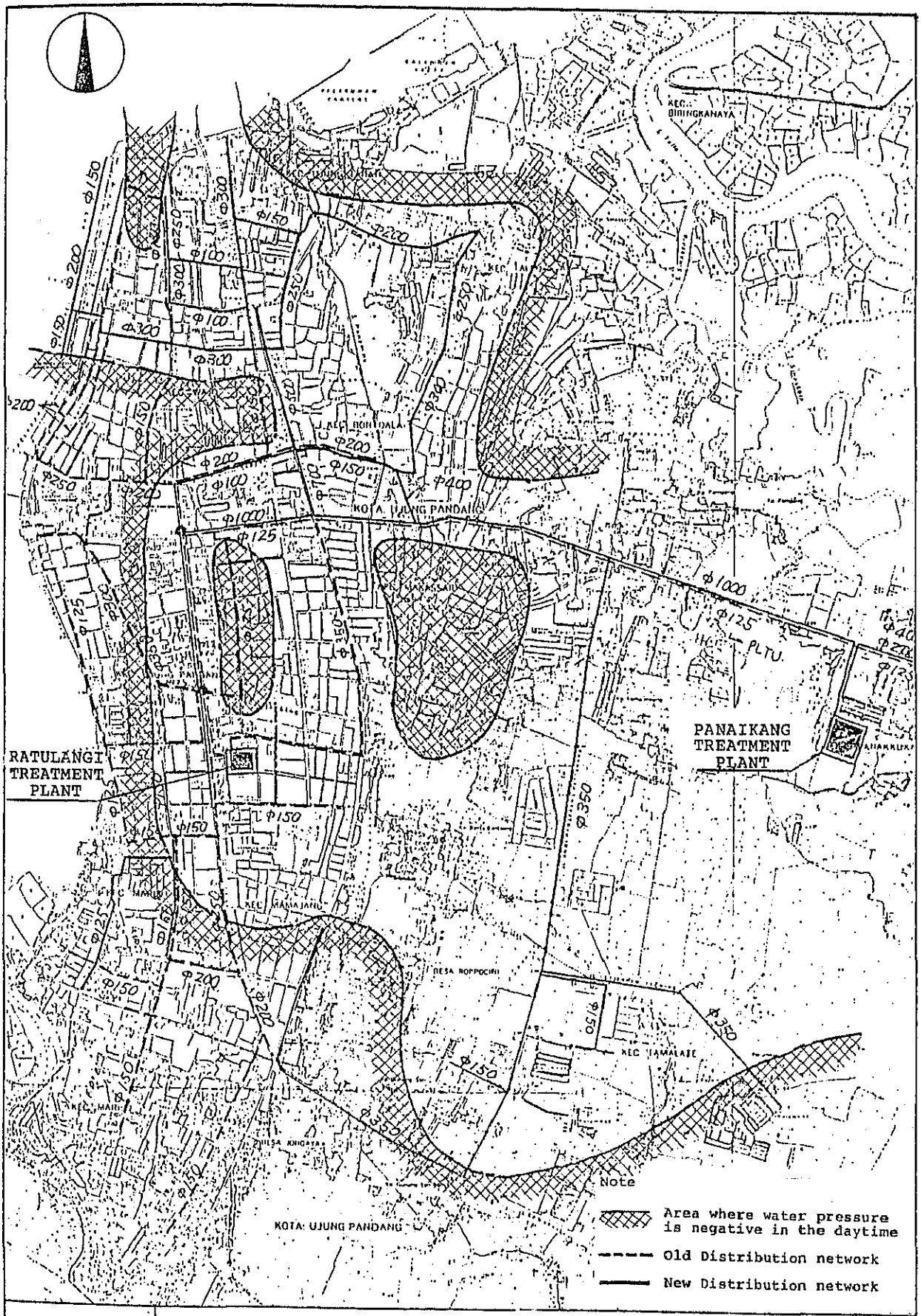


FIGURE	PRESENT WATER PRESSURE OF DISTRIBUTION NETWORK
3.9	

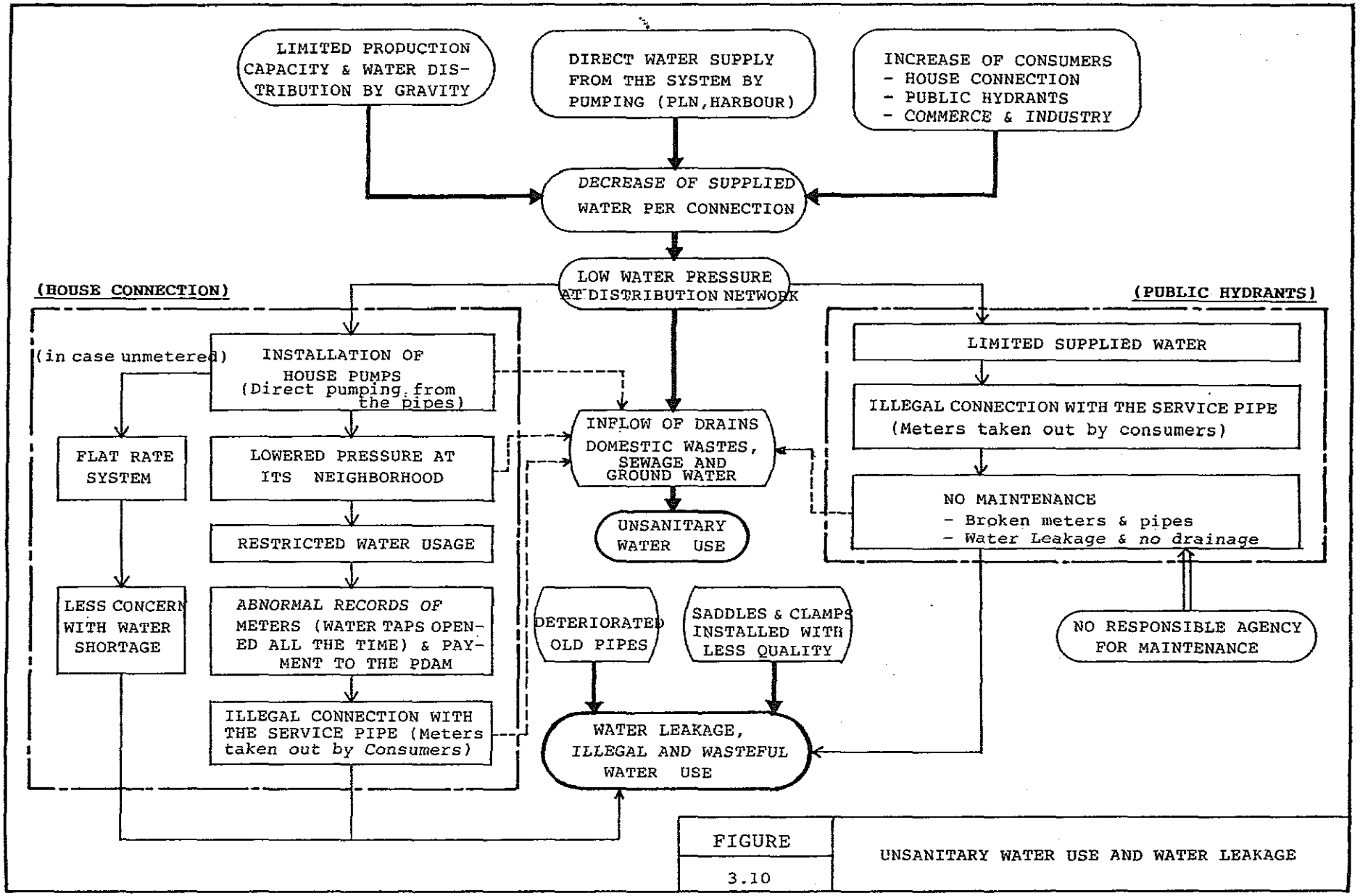
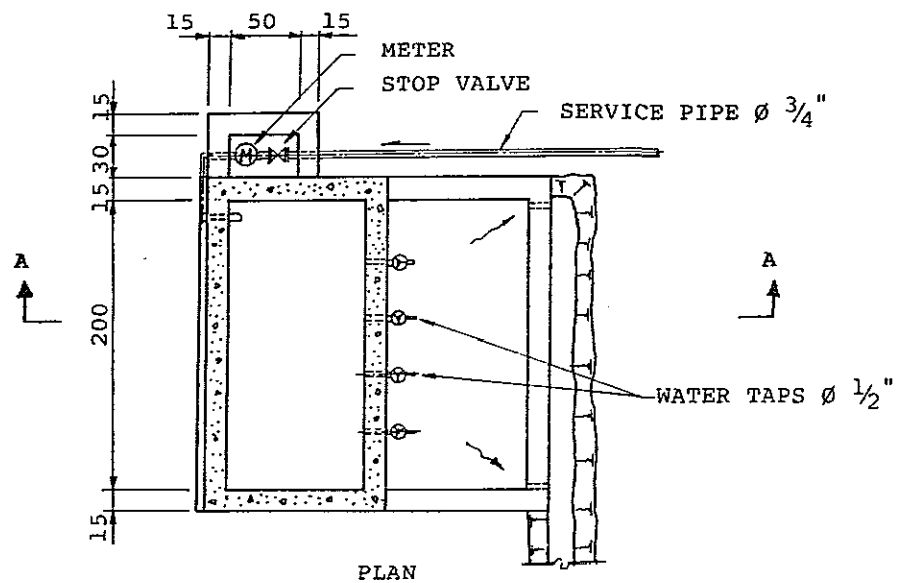
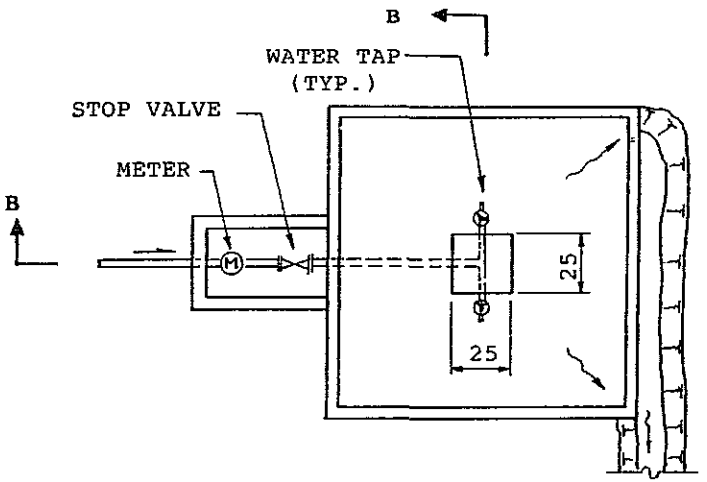


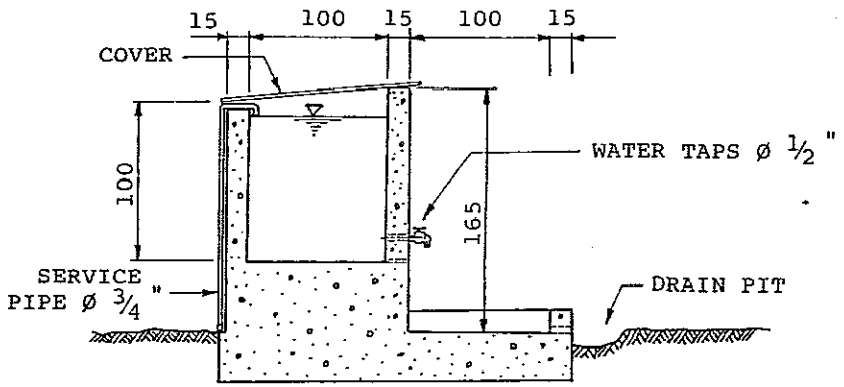
FIGURE 3.10 UNSANITARY WATER USE AND WATER LEAKAGE



PLAN

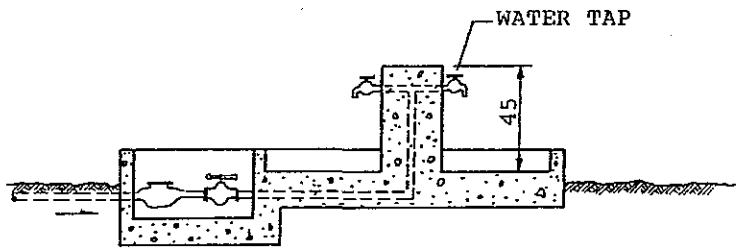


PLAN



SECTION A-A

PUBLIC TAP TYPE 2 (BAK UMUM)



SECTION B-B

PUBLIC TAP TYPE 3 (UNICEF TYPE)

NOTE : UNIT CM

FIGURE	TYPICAL TYPE OF PUBLIC STANDPIPES
3.11	

CHAPTER IV

POPULATION AND WATER REQUIREMENTS

SMALL ALLEYS OFTEN SEEN
IN KOTAMADYA UJUNG PANDANG

CHAPTER IV

POPULATION AND WATER REQUIREMENTS

1. GENERAL

1.1 Basic Considerations

One of the basic factors for planning a water supply system is water demand, and further the water demand relates to population, not to mention other water demands of industries, etc. To project future water demand, this Chapter reviews the past trend of population growth and water usage, prepares models for projection based on the review and analysis, and then forecasts the future population and water demand. In this text of the Master Plan Report, major features of all the above procedures are briefly described, since the details thereof are presented in Supporting Reports ('Population Projection' or 'Water Requirement').

1.2 Processes Adopted

As regards population, two projections are made, namely projection of total population and population of kecamatan/ kelurahan [1/]. Processes to project are as follows:

i) To analyze characteristics of the past population growth based on data and information.

ii) To build models for projection which are consistent with the characteristics of population growth and able to consider government policies and other factors.

1/ Both of these are administrative units. "Kecamatan" means a subdistrict of Kotamadya, composed of several "kelurahans" (village).

iii) To simulate future population growth, taking into account housing estate plans and others.

On the other hand, regarding water demand projection, all available data are collected, and in addition, some field surveys are conducted to obtain data on water usage and sanitary conditions. Based on the review of the above data and the survey, projection of future water demand is made.

2. PRESENT POPULATION AND WATER DEMAND

2.1 Total Population Growth

The salient characteristics of population growth in Ujung Pandang are summarized as follows:

i) Recently, considerable migration has been occurring. The population increase during 1976 to 1980 due to migrants is estimated to have a share of more than two thirds of total growth.

ii) Those migrants are supposed to be composed of the younger generation, especially the age group of 15 to 24.

2.2 Population Growth in Kecamatans

In view of characteristics of population growth, all kecamatans are classified into two groups, namely, Urban Area and Suburban Area. These groups are listed in Table 4.1, and their locations are shown on Figure 4.1. The characteristics of each group are summarized below.

i) Urban Area
   - This area has already been built up, and further housing development may not take place.
   - Age group of 15 to 24 years has a rather large share in the total population, due to migration of younger people.
   - Population growth in the outer kecamatans of this area is more likely.

ii) Suburban Area

- Inspite of rapid population growth owing to housing estates, the population density of this area still remains so low that it can accept new housing.
- Typical families account for the majority of the residents.
- The increase of population in each kecamatan is mainly due to the increase of houses to be newly constructed.

2.3 Present Situation of Water Consumption

The results of analysis on monthly accounted-for water show the following characteristics.

i) Monthly consumptions are nearly constant in each year, indicating no cyclic or seasonal fluctuations.

ii) Because of insufficient production capacity and much distribution losses, water requirements of the consumers are not met sufficiently.

2.4 Population Served

Population served and the coverage by water supply of each kecamatan are based on the data of connections and the result of household survey.

KECAMATAN	POPULATION*	POPULATION SERVED	COVERAGE (%)
1. Mariso	53,000	19,000	35.5
2. Mamajang	74,000	10,000	14.1
3. Ujung Pandang	43,000	24,000	56.1
4. Makassar	107,000	36,000	33.5
5. Wajo	48,000	27,000	57.0
6. Bontoala	68,000	33,000	49.1
7. Tallo	86,000	20,000	22.7
8. Ujung Tanah	44,000	18,000	41.6
9. Panakkukang	80,000	23,000	28.4
10. Tamalate	130,000	46,000	35.1
11. Biringkanaya	35,000	6,000	16.5
Total	768,000	262,000	34.1

* These figures in 1983, taken from statistics, are revised by the Team.

Various analyses suggest that there is a relation, between service types (for example, house connection; public standpipe) and the structure types of house: That is, people supplied by house connections live in houses of permanent structure. On the contrary, people in wooden houses depend mainly on standpipes or their neighbors for treated water.

2.5 Water Consumption by Usage

Present situation of water consumption is summarized as follows:

i) Domestic consumption exceeds non-domestic one by a ratio of two to one. Most part of the former is house connection use and nearly 60% of the latter is consumed by armed forces.

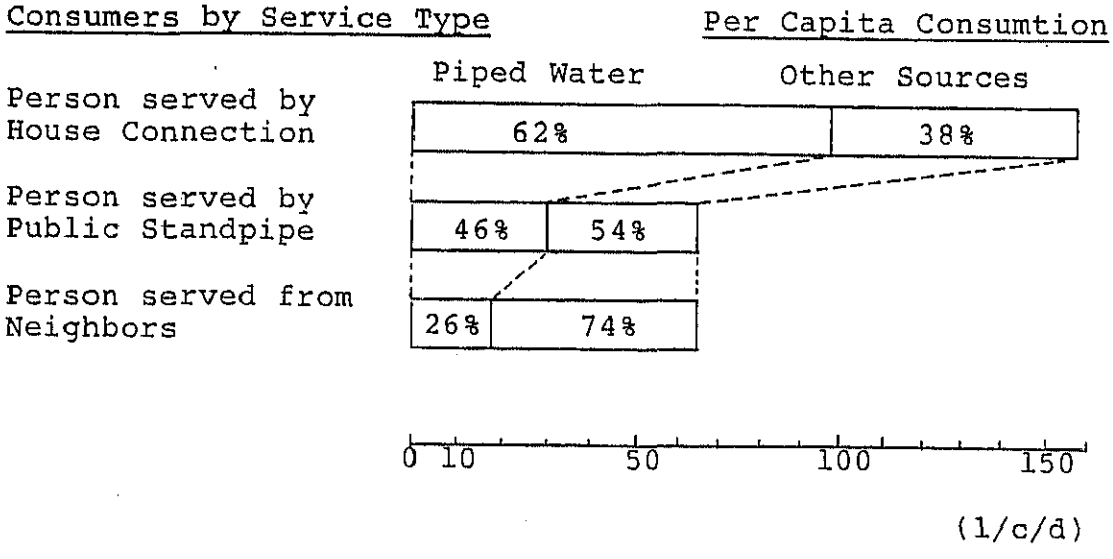
ii) Per capita consumption is estimated as shown below:

House connection : 105 l/c/d/ 1/

Public Standpipe : 30 l/c/d/

2.6 Per Capita Consumption by Water Source

Analysis of the results of field survey and statistical data show that inhabitants are using water from the following sources on average.



1/ This figure includes the average amount of water for neighbors supply.

2.7 Water Consumption and Income Level

The relation between water consumption and income level of households which is fundamental information to the further study was also assessed in the course of household survey. Typical issues are presented hereunder.

i) Households in high income level consume much water than those in low income.

ii) Average monthly income in Ujung Pandang is estimated Rp.98,000, varying from a low of Rp.1,000 to a high of Rp.1,000,000. Monthly income of 50% of the households is as low as Rp.75,000.

iii) Average monthly income of households lived in permanent, semi-permanent and temporary (wooden) houses are estimated Rp.100,000, Rp.80,000 and Rp.50,000 respectively. It means that housetypes which partly explain their living environments also suggest their income levels.

3. POPULATION PROJECTION

3.1 Projection Method and Model Building

Population projection model is developed in consideration of characteristics described in sub-section 2.1. The features of the model are summarized as below:

i) The model handles three factors of population growth, i.e., fertility, mortality and migration in respective way.

ii) Births are counted by multiplying population of reproducing ages by reproduction rate.

iii) Deaths are calculated by totaling the deaths by age group.

iv) The model inputs the total number of migrants as an exogenous factor.

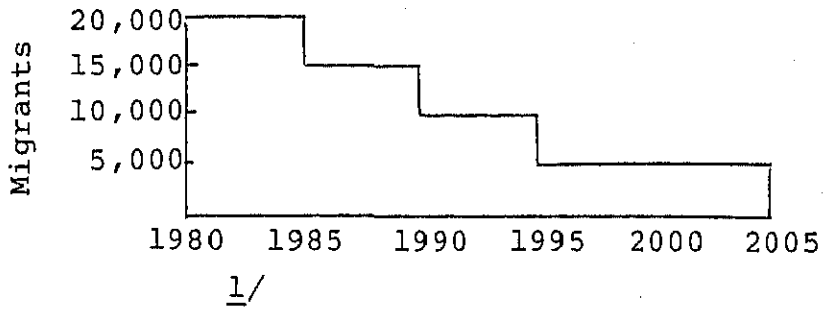
The model parameters to be adopted such as reproduction rate, mortality rate and the rate of migration allocation to age were fitted in so as to represent past population growth. Average migrants per annum in 1976-1980 were estimated at 20,000.

3.2 Population Projection and Population for Planning

Future population up to 2005 were forecasted through the model inputting migration as an exogenous factor. Two possible migration cases are considered, namely, higher migration, and lower migration. They are:

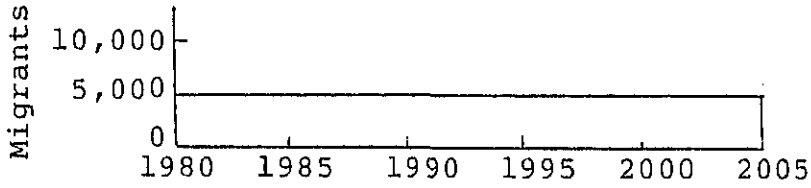
1/ For projection, 1980 is employed as the starting point, considering reliability of population data.

i) Higher Case : Case where it takes time to reduce the migration



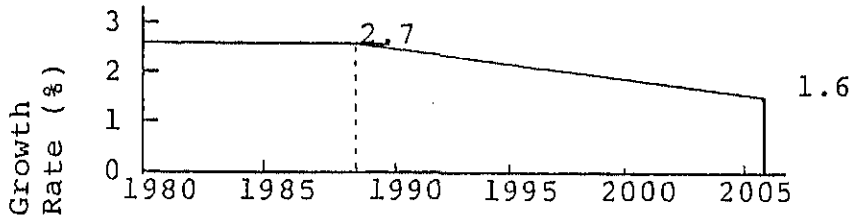
1/

ii) Lower Case : Case where the measures for migration control are effective from the very beginning.



In addition, a case of crude growth rate was prepared from the information of the authority concerned.

iii) Crude Growth Case



These results, as illustrated on Figure 4.2, indicate the population in 2005 rises to the extent from 1,200,000 to 1,460,000. Regarding Crude Growth Case, the curve runs between Higher and Lower Cases.

1/ For projection, 1980 is employed as the starting point, considering reliability of population data.

Conclusively, Crude Growth Case was selected for planning. The population pyramid of this case is shown in Figure 4.3. populations adopted for the planning are as shown below:

1990	1992	1995	2000	2005
927,000	976,000	1,050,000	1,171,000	1,286,000

Note: Above figures are also confirmed by BAPPEDA

4. AREAWISE POPULATION PROJECTION

4.1 Projection Method

The process of population projection by zone (kecamatan/kelurahan) is composed of 3 steps. The first step is projection for 2 Areas : Urban and Suburban. The second is allocation of each Area's population to kecamatans. As for Suburban Area, there is a third step to distribute population of kecamatans to each kelurahan similarly to the second step.

In allocation processes the models for projection assume basically that those tendencies mentioned in subsection 2.2 continue through the future.

(A) Projection of Population of Two Areas (cf. Figure 4.4)

i) There will be continuous housing development in Suburban Area, which accomodates families from Urban Area and also outside the city.

ii) Migration in Urban Area is mainly composed of 1) young immigrants from outside Ujung Pandang and 2) emigrants to housing estate in Suburban Area.

iii) Natural population growth by births and deaths occur both in Urban and Suburban Area. These are calculated applying the model developed in subsection 3.1.

(B) Allocation of Population to kecamatan/kelurahan

i) Urban Area

Annual increase in this Area including both natural growth and migration is distributed among 8 kecamatans based on past trends.

ii) Suburban Area

Migrants into this area are allocated to kecamatans/kelurahans in proportion to the number of new houses planned every year.

4.2 Population Projection

Population from 1981 to 2005 in kecamatans/kelurahans were projected using the above method and inputting housing estate Plan in Suburban Area.

The results are summarized in Tables 4.2 and 4.3. They show two distinct growth, that is, small growth of 90,000 in Urban Area and explosive growth of 430,000 in Suburban Area. In 2005, the population of Suburban Area exceeds that of Urban Area owing to urbanization in kecamatan Tamalate and Panakkukang.

5. PROJECTION OF WATER REQUIREMENTS

Regarding the target of water supply, the National Guideline specifies per capita consumption, which is to be attained within REPELITA IV. In planning the future water supply system, therefore, these target figures will be observed, as will be described in the following sections.

Meanwhile, in the present study, a projection by another approach which is considered applicable to Ujung Pandang is made so as to know the appropriateness of application of the Guideline.

5.1 Water Requirements for Domestic Use

National targets for water supply and sanitation in REPELITA IV (1990) are provided in 'The Directory for Composition of Clean Water Supply and Sanitary Environment Program for the Regional Level', published in 1983.

This guideline sets forth such factors as population coverage (75%), per capita demand (refer to table below) 1/, etc. which are to be accomplished by 1990.

Service Type	City Category (Population in thousand)		
	Metro (more than 1,000)	Large City (500-1,000)	Medium Town (100-500)
Per capita Demand in House Connection	210	170	150
Per Capita Demand in Public Standpipe	30	30	30
Total Average Domestic Per Capita Demand	120	100	90

1/ Besides these factors, allowance of unaccounted-for water is provided as 20 %.

In master planning, the following is assumed to project water consumptions after REPELITA IV.

i) Population Coverage : to increase gradually in future.

ii) Total Average Per Capita Demand : to increase mainly due to the share extension of house connections against standpipes.

iii) Ratio of Unaccounted -for Water : to be constant after the target of 20% being attained.

Due to the difficulty of deciding each factor separately with reasonable grounds, sets of assumed figures of these factors, as a whole, are evaluated and compared. Points of evaluation are:

(i) Residents' ability to pay for piped water
(ii) Annual investment

Conclusively, the water supply plan as shown in Table 4.4 is taken for the master planning.

5.2 Water Requirements for Non-domestic Use

Non-domestic water requirements are calculated in two components: one is the requirement in the newly planned industrial estate at kelurahan Daya, and the other is that in other places.

The programmed water requirement by the industrial estate is taken into the planning with a slight modification in timing of the requirement. Regarding the period beyond the program, a similar water requirement to the above is allowed for in the planning.

Requirement in other areas is projected using the following formulas:

(Piped) Water Requirement = Total Demand X Demand Coverage Ratio of Piped Water (4.1)

Total Demand = Employee in Secondary and Tertiary Industry X Demand per Employee (4.2)

Demand Coverage Ratio of Piped Water = Regional Coverage Ratio X Qualitative Coverage Ratio (4.3)

% of employee served

% of piped water requirement to total unit

The results of projection of non-domestic water requirements are shown in Table 4.5 including other factors concerned.

To summarize all the results of projection of domestic and non-domestic water requirements including the population projection, Table 4.6 and Figure 4.5 are prepared.

6. DISTRIBUTION OF FUTURE REQUIREMENTS

6.1 Projection of Population by House Type

Distribution of future water requirements is made utilizing the projected population by house type in each area. This is based on the grounds mentioned below:

i) The results of the data analyses of household survey suggest the existence of the relationship between types of service of water supply and the structures of house.
ii) The data of house types by kecamatan/kelurahan are available.
iii) Houses planned at housing estate are of permanent structure and also designed to be served by direct connection.

The result of the population projection by house type indicates the high percentage of permanent structure in kecamatans Ujung Pandang and Panakkukang.

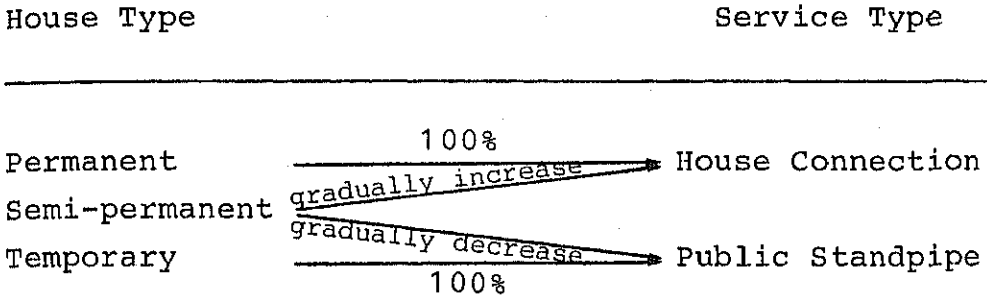
6.2 Distribution of Future Requirement

(A) Distribution of domestic requirements

The procedures are:

i) To project population served by zone in service area (refer to Figure 5.1) taking into consideration present population coverage, conditions of ground water, standards of living, etc. (refer to Table 4.7)

ii) To classify the served population into two service types assuming the following relationship among service types and structure types of house.



iii) To total the values obtained by multiplying population as calculated in ii), by per capita demand of each type.

(B) Distribution of non-domestic requirements

To distribute non-domestic water requirements to areas, the following consideration and assumption are made:

Consideration: Non-domestic water requirements except industrial requirement can be classified into the following two categories.

1) Requirements which are in proportion to the growth of population, such as, of shops, supermarkets, mosques.
2) Requirements which are inversely proportionate to, or unrelated with the population growth, such as, of industries, universities.

Assumption : There will arise a great increase of requirements of the above two categories in kecamatans of Tamalate, Panaikang and Biring-kanaya, because of expected rapid population growth and socio-economical development.

Distribution of non-domestic water requirements is made by the following processes, based on the above consideration and assumption.

i) To allocate total requirements between two categories, i.e.,
   a) demands to be divided among all kecamatans, and
   b) those divided among the three suburban kecamatans, in consideration of future population of each kecamatan.

The result is as shown in the table below:

	1990	1992	1995	2000	2005
Requirement to be Distributed among All Kecamatans (a)	14,500	16,300	19,500	26,600	34,000
Requirement to be Distributed Among the Three Kecamatans (b)	1,600	2,300	3,500	6,700	11,400
					(m3/day)

ii) To distribute two kinds of requirements among kecamatans/ kelurahans, namely:
   - Requirement (a) : To distribute in proportion to present consumption.
   - Requirement (b) : To distribute in proportion to future population.

(C) The results of distribution

The results are shown in Table 4.7, suggesting the distinct increases of domestic and non-domestic requirements in those three kecamatans, i.e., the rising share of total requirement from 33% in 1983 to 56% in 2005.

TABLE 4.1. CHARACTERISTICS OF AREAS AND KECAMATANS

AREA/KECAMATAN	AREA 1983 (ha)	POPULATIN 1980	FAMILLES 1980	POPULATION DENSITY 1980 (per ha)	FAMILY SIZE 1980	POPULATION GROWTH RATIO (%/YEAR) 1971-1976	1976-1980
1. Mariso	182	52,685	8,329	290	6.3	-0.38	3.13
2. Mamajang	225	71,560	11,211	318	6.4	2.19	1.79
3. Ujung Pandang	263	44,102	6,869	168	6.4	-1.73	-1.88
4. Makassar	252	102,973	17,628	409	5.8	1.11	4.26
5. Wajo	199	49,186	7,555	247	6.5	-0.33	-1.93
6. Bontoala	210	68,073	10,518	324	6.5	0.41	1.39
7. Tallo	583	78,193	14,262	134	5.5	5.51	9.38
8. Ujung Tanah	594	42,514	7,513	72	5.7	0.79	3.36
SUB TOTAL (Urban Area)	2,508	509,286	83,885	203	6.1	0.91	2.48
9. Panakkukang	4119	68,022	11,750	17	5.8	5.42	9.33
10. Tamalate	2944	99,502	16,253	34	6.1	2.63	13.27
11. Biringkanaya	8006	31,655	6,396	4	4.9	2.60	4.02
SUB TOTAL (Suburban Area)	15,069	199,179	34,399	13	5.8	3.56	10.19
TOTAL	17,577	708,465	118,284	40	6.0	1,47	4,38

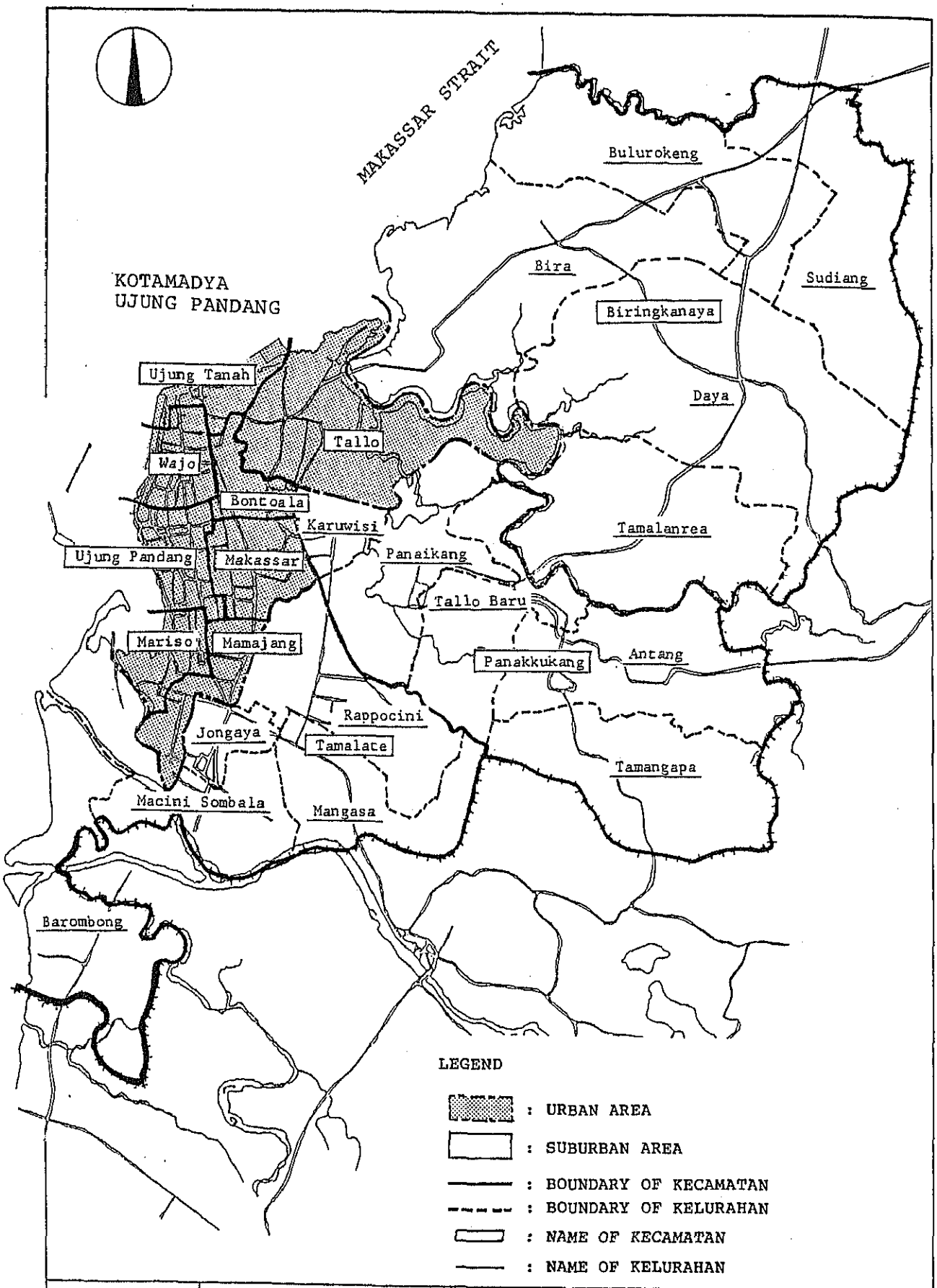


FIGURE	URBAN AND SUBURBAN AREA
4.1	

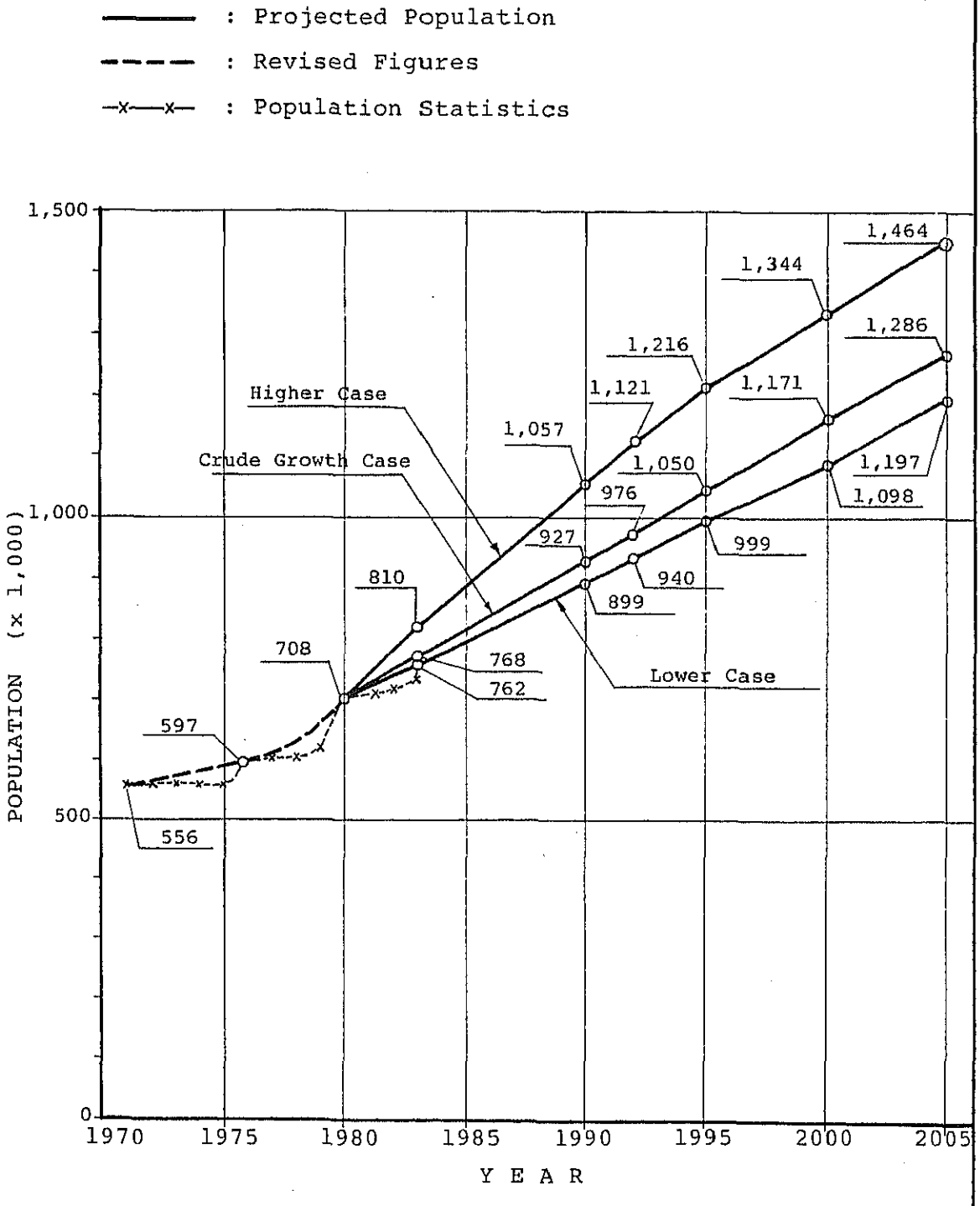


FIGURE	PROJECTED POPULATION
4.2	

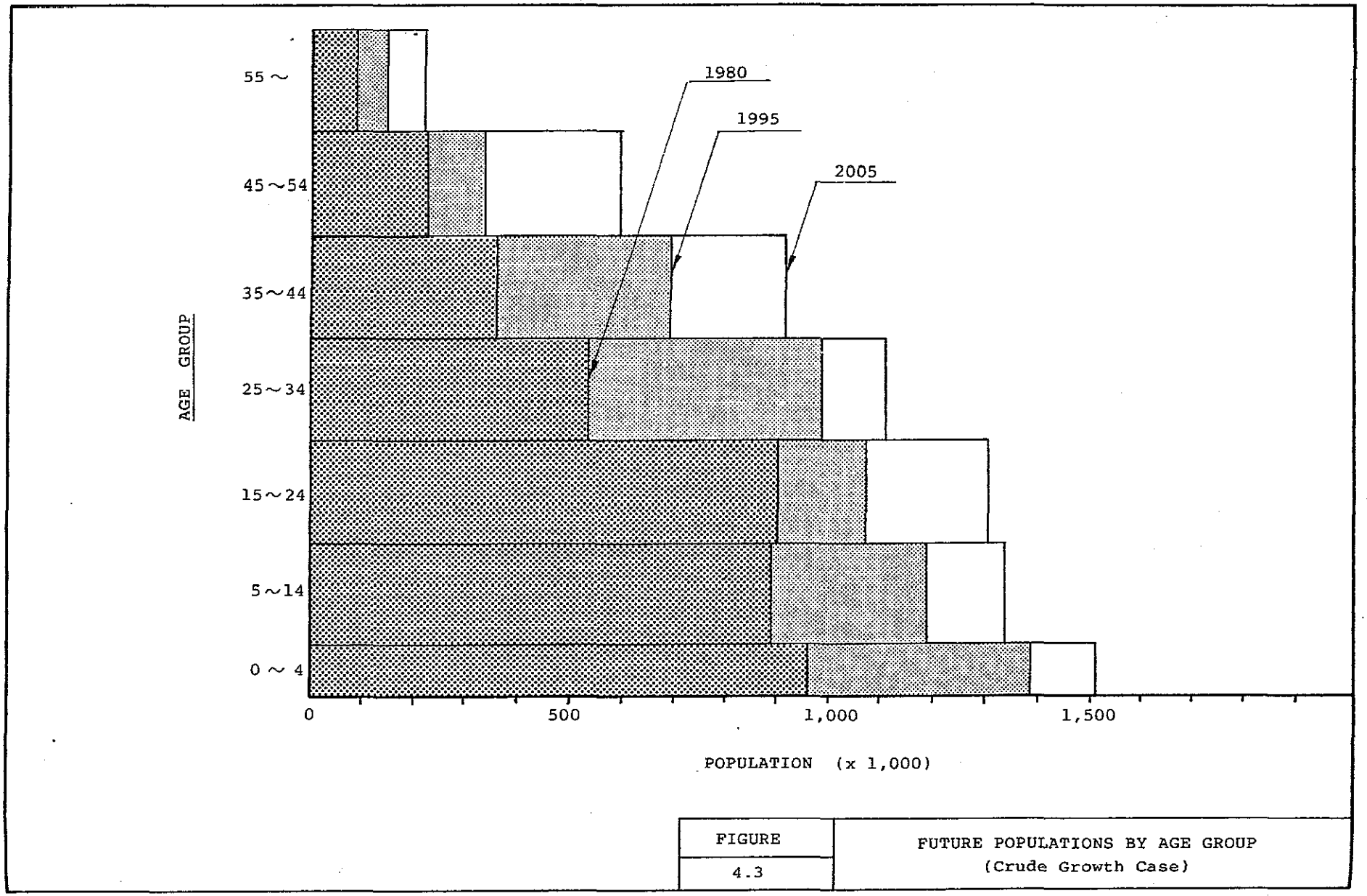


FIGURE	FUTURE POPULATIONS BY AGE GROUP (Crude Growth Case)
4.3	

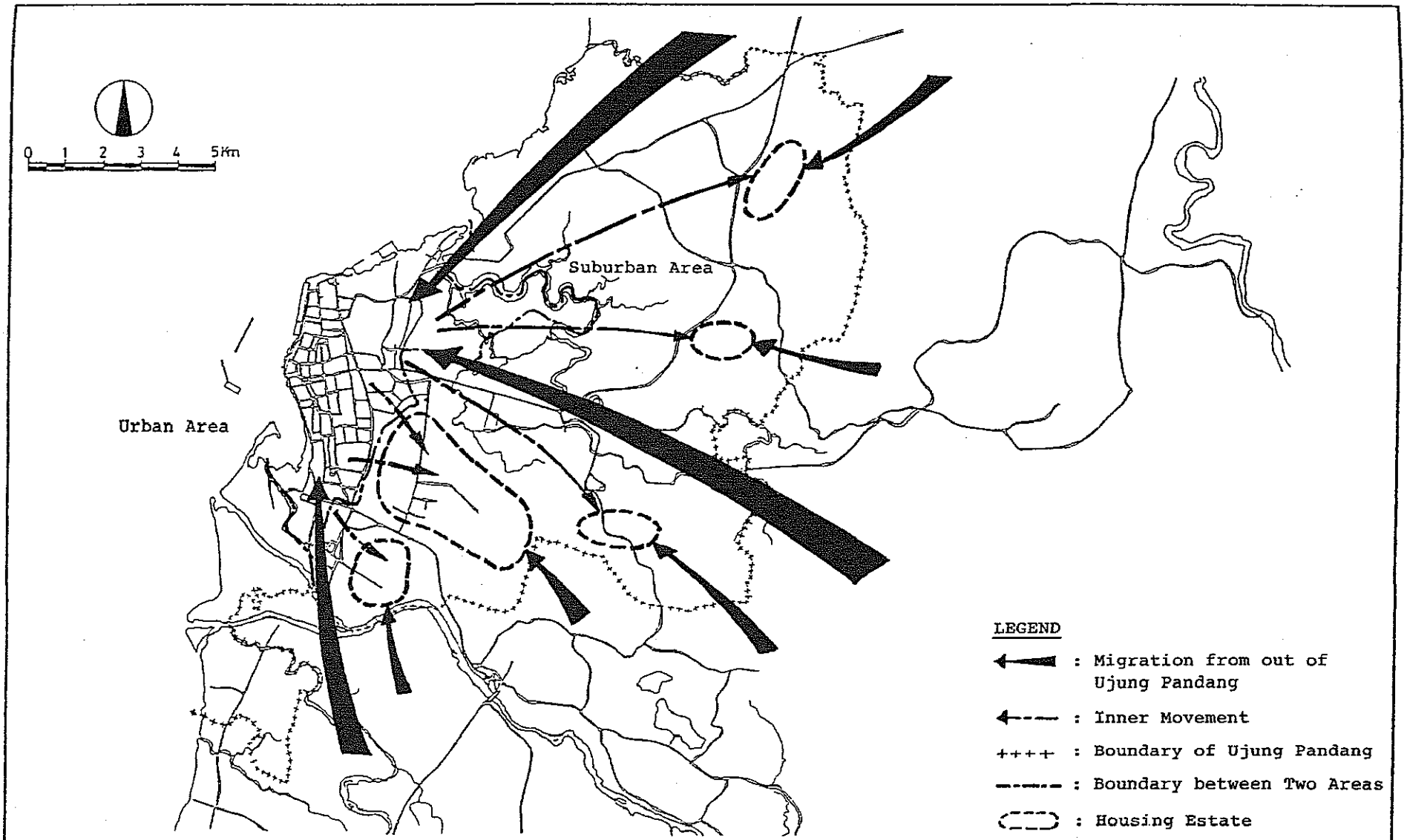


FIGURE	CONCEPTION OF POPULATION ALLOCATION
4.4	BETWEEN TWO AREAS

TABLE 4.2. PROJECTED KECAMATAN POPULATION

KECAMATAN	Year 1980	1983	1990	1992	1995	2000	2005
1. Mariso	52,685	53,000	55,000	56,000	56,000	57,000	58,000
2. Mamajang	71,560	74,000	79,000	81,000	84,000	88,000	90,000
3. Ujung Pandang	44,102	43,000	40,000	39,000	37,000	35,000	34,000
4. Makassar	102,973	107,000	116,000	120,000	124,000	131,000	134,000
5. Wajo	49,186	48,000	46,000	45,000	44,000	42,000	41,000
6. Bontoala	68,073	68,000	69,000	69,000	70,000	70,000	71,000
7. Tallo	78,193	86,000	102,000	107,000	116,000	129,000	133,000
8. Ujung Tanah 1)	42,514	44,000	47,000	48,000	50,000	52,000	53,000
SUB TOTAL(Urban Area)	509,286	523,000	554,000	565,000	581,000	602,000	614,000
9. Panakkukang	68,022	80,000	130,000	143,000	164,000	199,000	235,000
10. Tamalate	99,502	130,000	196,000	217,000	248,000	302,000	358,000
11. Biringkanaya	31,655	35,000	47,000	51,000	57,000	68,000	79,000
SUB TOTAL(Suburban Area)	199,179	245,000	373,000	411,000	469,000	569,000	672,000
TOTAL	708,465	768,000	927,000	976,000	1.050,000	1.171.000	1.286.000

1) These figures include population in islands, projected by assuming no migrant during the period of projection. Present and future population are as follows :

Population in islands	7,340	8,000	9,000	9,000	9,000	10,000	10,000

TABLE 4.3. PROJECTED KELURAHAN POPULATION IN SUB URBAN AREA

KECAMATAN/ KELURAHAN	Year						
	1980	1983	1990	1992	1995	2000	2005
1. KEC. PANAKKUKANG	68,022	80,000	130,000	143,000	164,000	199,000	235,000
1-1 Karuwisi	21,836	23,000	31,000	32,000	34,000	36,000	39,000
1-2 Panaikang	26,883	35,000	51,000	56,000	62,000	67,000	71,000
1-3 Tallo Baru	10,407	11,000	15,000	17,000	22,000	42,000	51,000
1-4 Antang	4,926	5,000	10,000	10,000	10,000	11,000	12,000
1-5 Tamangapa	3,970	6,000	23,000	28,000	36,000	43,000	62,000
2. KEC. TAMALATE	99,502	130,000	196,000	217,000	248,000	302,000	358,000
2-1 Mangngasa	14,076	15,000	39,000	44,000	51,000	66,000	84,000
2-2 Rappocini	34,341	57,000	77,000	86,000	99,000	121,000	150,000
2-3 Jongaya	30,878	33,000	41,000	45,000	51,000	55,000	59,000
2-4 Macini Sombala	12,187	17,000	29,000	32,000	37,000	49,000	53,000
2-5 Barombong	8,020	8,000	10,000	10,000	10,000	11,000	12,000
3. KEC. BIRINGKANAYA	31,655	35,000	47,000	51,000	57,000	68,000	79,000
3-1 Daya	9,936	11,000	12,000	12,000	13,000	14,000	15,000
3-2 Sudiang	6,074	6,000	8,000	11,000	15.000	22,000	30,000
3-3 Bira	5,017	5,000	6,000	6,000	6,000	7,000	7,000
3-4 Tamalanrea	5,138	7,000	13,000	14,000	15,000	16,000	17,000
3-5 Bulurokeng	5,490	6,000	8,000	8,000	8,000	9,000	10,000
TOTAL (Suburban Area)	199,179	245,000	373,000	411,000	469,000	569,000	672,000

TABLE 4.4 WATER REQUIREMENTS FOR DOMESTIC USAGE

Description	1983[1/]	1990	1992	1995	2000	2005
Population (x 1,000)	768	927	976	1,050	1,171	1,286
Population Coverage (%)	34.1	75.0	77.0	80.0	85.0	90.0
Served Population (x 1,000)	262	695	752	840	995	1,157
Served by House Connection	153	487	542	630	775	927
Served by Public Standpipe	33	208	210	210	220	230
Ratio Between Service Type (%) House Connection	58.4	70.0	72.0	75.0	78.0	80.0
Ratio Between Service Type (%) Public Standpipe	12.6	30.0	28.0	25.0	22.0	20.0
Average Demand Per Capita (l/c/d)	65	100	113	127	147	162
House Connection	97	130	145	160	180	195
Public Standpipe	30	30	30	30	30	30
Water Requirements (m^3/day)	17,000	70,000	85,000	107,000	146,000	188,000
House Connection	15,000	64,000	79,000	101,000	139,000	181,000
Public Standpipe	1,000	6,000	6,000	6,000	7,000	7,000

1/ In 1983, there exists the third kind of served population: 76,000 population served from neighbors with per capita demand of 17 liter (about one thousand requirement).

TABLE 4.5 WATER REQUIREMENTS FOR NON-DOMESTIC USAGE

Description	1983	1990	1992	1995	2000	2005
Population of 15 - 54 Age (x 1,000)	440	545	573	616	700	782
Ratio of Employment (%)	30	35	37	40	45	50
Employee (x 1,000)	132	191	212	246	315	391
Employee in Industrial Estate (x 1,000)	0	20	25	32	43	55
Regional Coverage Ratio in Other Area (%)	75	85	87	90	95	98
Other Employee in Service	99	145	163	193	258	329
Demand Per Employee (l/c/d)	-	550	524	516	519	509
Water Requirements in Industrial Estate (m^3/day)	0	11,000	13,100	16,500	22,300	28,000
Demand Per Employee (l/c/d)	125	130	132	135	143	150
Qualitative Coverage Ratio (%)	80	85	86	88	90	92
Unit Demand for Piped Water (l/c/d)	100	111	114	119	129	138
Water Requirements in Other Area (m^3/day)	9,900	16,100	18,600	23,000	33,300	45,400
Total Water Requirements (m^3/day)	9,900	27,100	31,700	39,500	55,600	73,400
Average Demand Per Employee (l/c/d)	100	164	169	176	185	191

TABLE 4.6 WATER REQUIREMENTS (SUMMARY)

Description	1983	1990	1992	1995	2000	2005
Population (x 1,000)	768	927	976	1,050	1,171	1,286
Population Coverage (%)	34.1	75.0	77.0	80.0	85.0	90.0
Served Population (x 1,000)	262	695	752	840	995	1,157
Water Demand Per Capita (l/c/d)	65	100	113	127	147	162
Domestic Water Requirements (m^3/day)	17,000	70,000	85,000	107,000	146,000	188,000
Non-domestic Water Requirements (m^3/day)	10,000	27,000	32,000	40,000	56,000	73,000
Total Water Requirements (m^3/day)	27,000	97,000	117,000	147,000	202,000	261,000
Domestic Demand to Total (%)	63.0	72.2	72.6	72.8	72.3	72.0
Total Water Requirements Per Capita (l/c/d)	103	140	156	175	203	226
Accounted-for Water to Production (%)	50.0	80.0	80.0	80.0	80.0	80.0
Water Production (m^3/day)	54,000	121,000	146,000	184,000	253,000	326,000
Water Production (m^3/sec)	0.63	1.40	1.69	2.13	2.92	3.78
Water Production Per Capita (l/c/d)	206	174	194	219	254	282

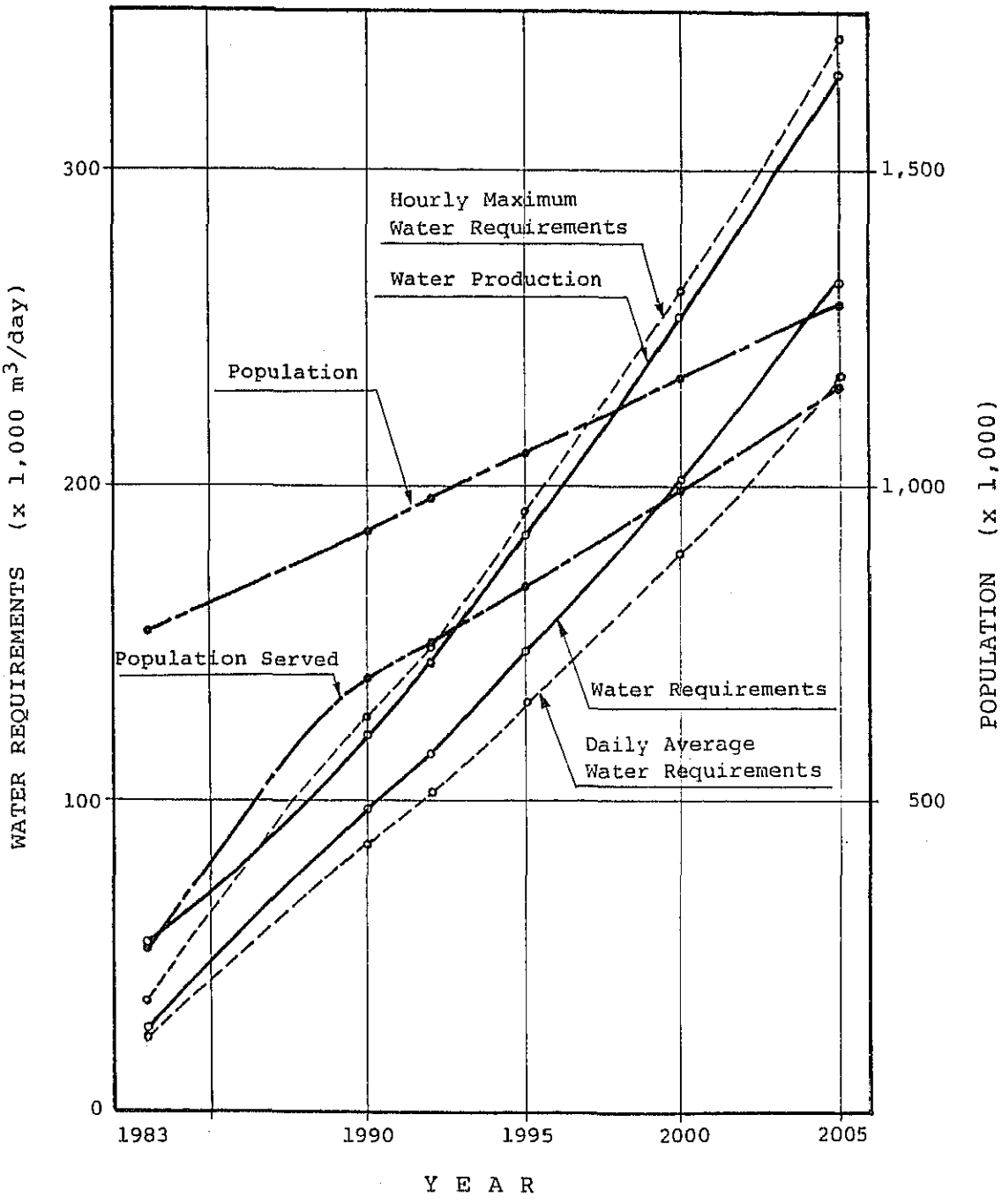


FIGURE	WATER REQUIREMENTS AND POPULATION
4.5	

TABLE 4.7 SERVED POPULATION & WATER REQUIREMENT

KECAMATAN/KELURAHAN	1983	1990	1992	1995	2000	2005
1. Mariso	20,000	43,000	45,000	47,000	51,000	54,000
	1,400	4,500	5,100	6,000	7,400	8,600
	900	1,300	1,500	1,800	2,400	3,100
	2,300	5,800	6,600	7,800	9,800	11,700
2. Mamajang	11,000	60,000	64,000	71,000	80,000	85,000
	700	5,800	6,900	8,500	10,600	12,000
	1,300	1,900	2,100	2,600	3,500	4,500
	2,000	7,700	9,000	11,100	14,100	16,500
3. Ujung Pandang	19,000	35,000	35,000	36,000	35,000	34,000
	1,400	4,400	5,000	5,600	6,300	6,600
	800	1,200	1,300	1,600	2,100	2,700
	2,200	5,600	6,300	7,200	8,400	9,300
4. Makassar	37,000	98,000	104,000	111,000	124,000	130,000
	2,100	9,300	10,900	12,900	16,600	19,300
	900	1,300	1,500	1,800	2,400	3,100
	3,000	10,600	12,400	14,700	19,000	22,400
5. Wajo	27,000	42,000	43,000	43,000	42,000	41,000
	1,800	4,900	5,500	6,200	7,000	7,800
	1,400	2,100	2,300	2,800	3,800	4,800
	3,200	7,000	7,800	9,000	10,800	12,600
6. Bontoala	34,000	57,000	59,000	62,000	65,000	69,000
	2,100	5,400	6,300	7,400	9,000	10,700
	500	700	900	1,000	1,300	1,700
	2,600	6,100	7,200	8,400	10,300	12,400
7. Tallo	20,000	80,000	87,000	97,000	113,000	123,000
	1,300	4,700	6,200	8,400	12,200	15,400
	200	300	400	400	500	700
	1,500	5,000	6,600	8,800	12,700	16,100
8. Ujung Tanah	18,000	35,000	37,000	39,000	42,000	43,000
	1,000	2,400	3,000	3,800	5,300	6,800
	300	400	500	600	800	1,000
	1,300	2,800	3,500	4,400	6,100	7,800
9. Panakkukang	24,000	75,000	88,000	113,000	157,000	198,000
	1,600	8,800	11,500	16,500	25,400	34,500
	1,100	2,200	2,600	3,400	5,300	7,800
	2,700	11,000	14,100	19,900	30,700	42,300
a/Karuwisi	8,000	26,000	27,000	30,000	33,000	37,000
	550	3,200	3,700	4,650	5,800	7,050
	350	750	800	900	1,100	1,450
	900	3,950	4,500	5,550	6,900	8,500
b/Panaikang	11,000	40,000	45,000	52,000	60,000	66,000
	750	4,600	5,850	7,650	10,050	12,200
	500	1,150	1,300	1,550	2,050	2,600
	1,250	5,750	7,150	9,200	12,100	14,800
c/Tallo Baru	5,000	9,000	11,000	14,000	29,000	38,000
	300	1,000	1,350	1,850	4,600	6,600
	250	300	350	400	950	1,500
	550	1,300	1,700	2,250	5,550	8,100
d/Antang	0	0	1,000	3,000	7,000	9,000
	0	0	150	350	950	1,250
	0	0	50	150	250	350
	0	0	200	500	1,200	1,600
e/Tamangapa	0	0	4,000	14,000	28,000	48,000
	0	0	450	2,000	4,000	7,400
	0	0	100	400	950	1,900
	0	0	550	2,400	4,950	9,300
10. Tamalate	46,000	155,000	174,000	203,000	260,000	330,000
	3,300	18,200	22,700	29,300	42,400	58,300
	700	1,900	2,300	3,200	5,400	8,500
	4,000	20,100	25,000	32,500	47,800	66,800
a/Mangngasa	1,000	30,000	34,000	40,000	56,000	78,000
	100	3,700	4,700	6,100	9,600	14,550
	0	350	450	600	1,100	1,950
	100	4,050	5,150	6,700	10,700	16,500
b/Rappocini	35,000	69,000	77,000	90,000	113,000	146,000
	2,450	8,300	10,350	13,500	19,100	27,000
	550	850	1,050	1,400	2,350	3,700
	3,000	9,150	11,400	14,900	21,450	30,700
c/Jongaya	10,000	34,000	38,000	43,000	48,000	55,000
	750	3,900	4,800	6,100	7,600	9,250
	150	350	450	600	900	1,300
	900	4,250	5,250	6,700	8,500	10,550
d/Macini Sombala	0	21,000	24,000	28,000	40,000	47,000
	0	2,250	2,800	3,550	5,850	7,200
	0	300	300	500	900	1,350
	0	2,550	3,100	4,050	6,750	8,550
e/Barombong	0	1,000	1,000	2,000	3,000	4,000
	0	50	50	50	250	300
	0	50	50	100	150	200
	0	100	100	150	400	500
11. Biringkanaya	6,000	15,000	16,000	18,000	26,000	50,000
	400	1,600	1,900	2,400	3,800	8,000
	1,800	13,800	16,300	20,300	28,100	35,500
	2,200	15,400	18,200	22,700	31,900	43,500
a/Daya	4,000	8,000	8,000	9,000	11,000	13,000
	300	950	1,050	1,300	1,800	2,200
	1,200	12,450	14,800	18,350	24,950	30,050
	1,500	13,400	15,850	19,650	26,750	32,250
b/Sudiang	0	0	0	0	0	12,000
	0	0	0	0	0	2,050
	0	0	0	0	0	1,350
	0	0	0	0	0	3,400
c/Bira	0	0	0	0	3,000	5,000
	0	0	0	0	350	650
	0	50	50	50	100	100
	0	50	50	50	450	750
d/Tamalanrea	2,000	6,000	7,000	8,000	10,000	13,000
	100	600	800	1,050	1,300	2,050
	600	1,100	1,250	1,700	2,850	3,500
	700	1,700	2,050	2,750	4,150	5,550
e/Bulurokeng	0	1,000	1,000	1,000	3,000	7,000
	0	50	50	50	350	1,050
	0	200	200	200	200	500
	0	250	250	250	550	1,550
TOTAL	262,000	695,000	752,000	840,000	995,000	1,157,000
	17,100	70,000	85,000	107,000	146,000	188,000
	9,900	27,100	31,700	39,500	55,600	73,400
	27,000	97,100	116,700	146,500	201,600	261,400

NOTE:

From top to bottom

1) Served Population
2) Domestic Water Requirement (m^3/day)
3) Non-domestic Water Requirement (m^3/day)
4) Total (m^3/day)