In order to meet increase demand of eastern area of Jakarta, from 1999 to 2005, 3m3/sec is received from TJC, in addition to the required capacity of 14 m3/sec from TJC up to the year 1999. It is recommended that, for implementation of Canal 3 construction, capacity and schedule of construction be subjected to review by DGWRD in prior to construction implementation.

4.3.3 Groundwater Condition in Jakarta

Groundwater is widely used for domestic purpose and industrial use in and around the served area in Jakarta and acting as supplemental source of public water supply. As the groundwater potential is limited, the use of groundwater will decrease when the expansion proejcts of water supply are carried out. However, groundwater use will continue until such proejcts are completed and the public water supply covers the whole requirement. In view of the above situation, the present condition of groundwater use and the possibility of utilization of groundwater for potential demand are reviewed in a broad way as described below.

1) Present Groundwater Use

The control of groundwater development in the city was enacted in 1975. The municipality enforced the installation of water meters at 2,208 production wells in March, 1983. The groundwater consumers are charged on the basis of the quantity they extract. For a new groundwater development, the owner needs a permission from PDAM before drilling of the well. The DEG, Bandung assists the hydrogeological evaluation of the well, and then a water meter will be installed and charged by PDAM. The controlled maximum groundwater extraction of the well is 200 l/min, that is not more than 300 m3/day/well.

This practice is, at present, applied as a measure for regulating groundwater extraction. In respects to groundwater conservation and land subsidence, a groundwater study is in progress by DEG and some areawise groundwater features will be revealed which might be usefull for developing improved regulation of water use in quantity by area. Efforts should be made to proceed further study, following the present study, for identifying areawise groundwater problems, and to prepare more specific regulation on groundwater control. For regulating groundwater, appropriate groundwater charges are also to be taken into account.

Figs.4.8 and 4.9 illustrate registered groundwater production in five districts of Jakarta city based on the PDAM data in August, 1983. The total groundwater production in 1982 was 26.2 million m3/year from 2,171 registered wells. The average production rate of the well ranges from 22 to 53 m3/day/km2. These figures suggest hydrogeological low aquifer potentiality of the area.

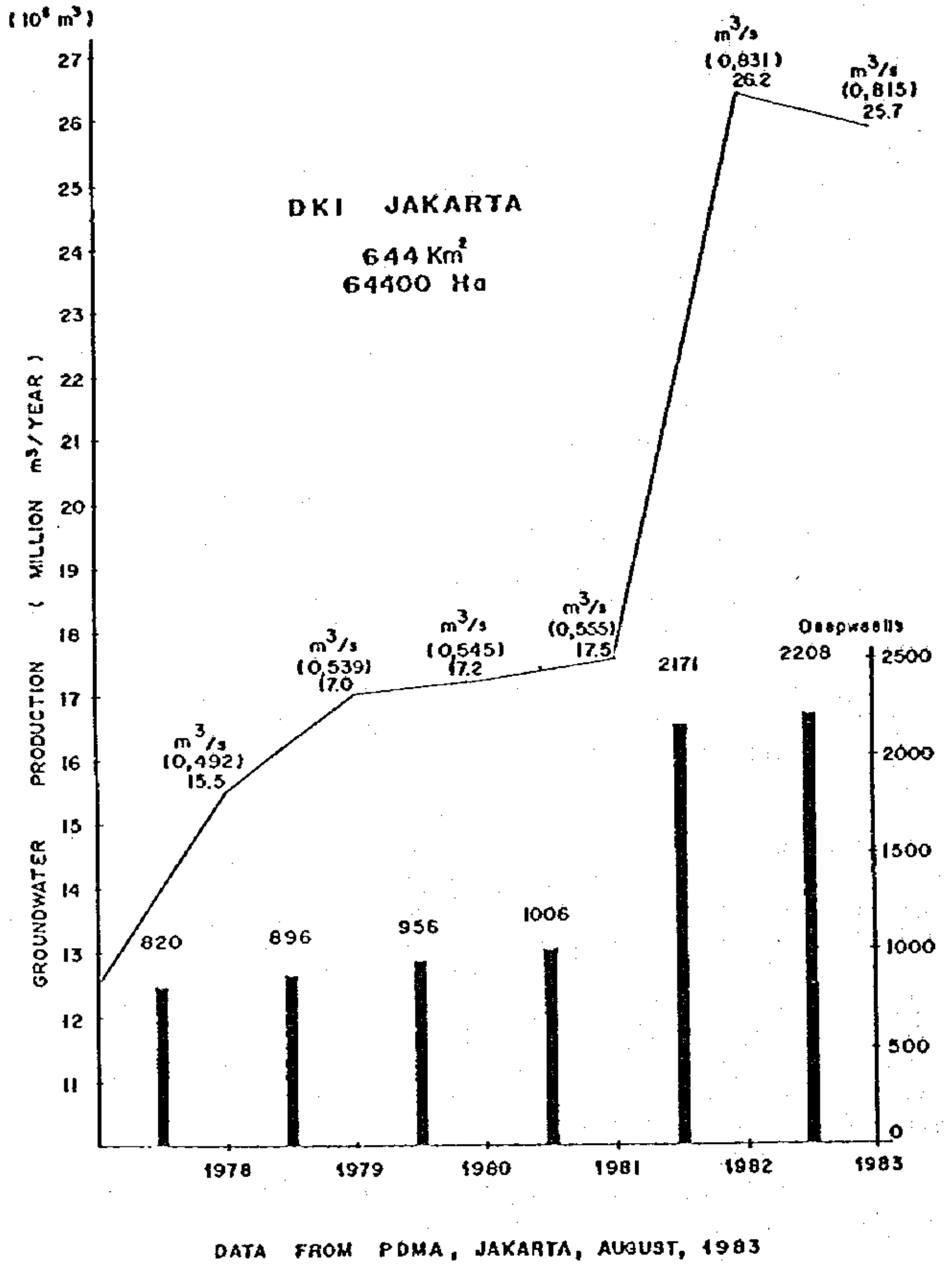


FIG 4.8	REGISTERED GROUNDWATER PRODUCTION IN JAKARTA CITY 1978 - 1983
JAKARTA WATER SUPPLY DEVELOPMENT PROJECT	JICA

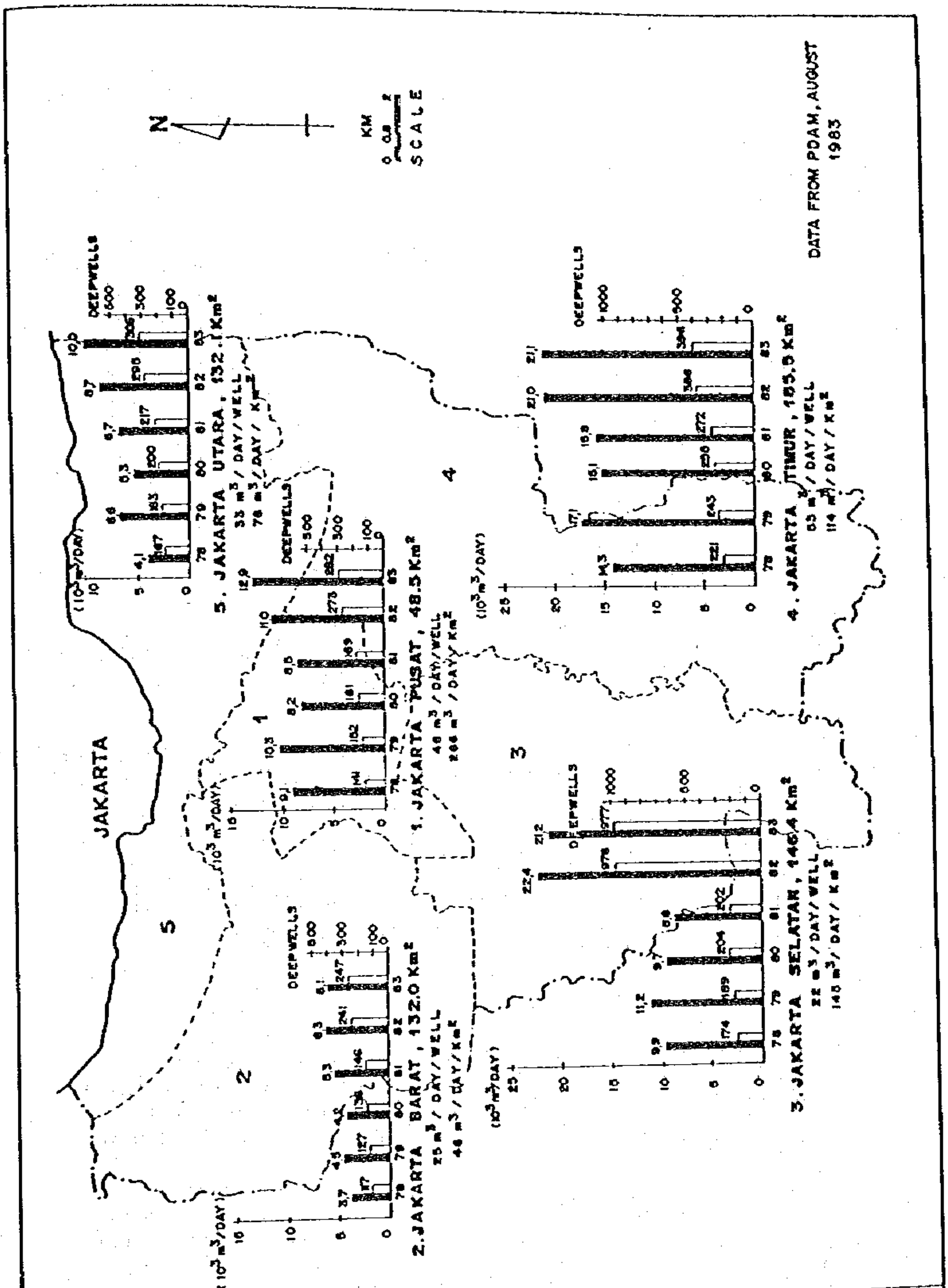


FIG 4.9	REGISTERED GROUNDWATER PRODUCTION IN JAKARTA CITY, 1978 - 1983
JAKARTA WATER SUPPLY DEVELOPMENT PROJECT	JICA

2) Potential Groundwater Recharge and Requirement

Groundwater recharge is provisionally calculated in the following manner: (1) recharge of unconfined and semiconfined aquifers as a product of groundwater table fluctuation, storage coefficient and area concerned, and (2) confined aquifer as the horizontal flow rate depending on the hydrodynamic characteristics of the aquifer. For detailes, refer to Appendix MIII-1. The results area as follows:

A. Recharge of Unconfined and Semiconfined Aquifers
   a) North of Jakarta Area (Rn): 86.4×10^6 m3/year
   b) South of Jakarta Area (Rs): 129.0×10^6 m3/year

B. Recharge of Confined Aquifer
   a) Confined Aquifer of 20 m to 140 m (Qh1)
      Qh1 = 26.3×10^3 m3/day
   b) Confined Aquifer of 140 m to 240 m (Qh2)
      Qh2 = 15.8×10^3 m3/day

C. Total
   A + B = 231×10^6 m3/year
   = 634×10^3 m3/day
   = 7.3 m3/sec

The above figures are equivalent to 358×10^3/year/km^2, 984 m3/day/km2 and 11.4 l/sec/km2, assuming that the area concerned is 644.5 km2.

On the other hand, the potential groundwater requirement is as presented in Figs. 4.10A and 4.10B. Fig. 4.10A illustrates the groundwater potential demand from 1980 to 2005 and the heaviest abstraction from groundwater is about 745,000 m3/day, (8.6 m3/sec) in 1990. The groundwater demand grows larger from 1980 to 1990, and decreases gradually from 1990 to 2005 because the piped water will replace primarily the non-domestic groundwater uses. On the other hand, domestic use of groundwater may slightly increase due to the expansion of residential area.

Fig. 4.10B also illustrates the groundwater potential demand from 1980 to 2005 in Zones I, II and III. The groundwater extraction of Zones I and II will decrease from 1990 to 2005, especially non-domestic use, due to strengthening of piped water in the service area. Zone III will depend much on groundwater for domestic and non-domestic uses ranging from 4.2 m3/sec in 1990 to 4.5 m3/sec in 2000.

Comparing the potential groundwater recharge and requirement, there may arise some shortage of groundwater in 1990 by about 111×10^3/day (1.2 m3/sec), maximum, gradually decreasing up to 2000. When the proposed projects are completed in 2005, there will be no groundwater shortage.

3) Conclusion

As described so far, there is a limit in groundwater potentiality, which was provisionally calculated as 634 x 10^3 m3/day from the available data. On the other hand, demand for groundwater is quite large; presently its potential is almost exhausted by the existing groundwater users, and in the future the estimated demand gradually exceeds the potential. Further, in case the execution of projects or the water demand deviates from the water supply master plan, the gap between the demand and potential of groundwater my widen. Even under such situations, as much poetntial groundwater as possible must be reserved to secure drinkable water for population who inhabit outside of the served area or cannot connect with the public water mains. To meet the above requirement, the following are recommendable.

(1) The existing large users of groundwater should be encouraged, or forced if required, to shift to the public water supply. To this end, regulations on groundwater use must be strengthened by revising groundwater charge to a necessary level, or prohibiting its use.

(2) New extraction of groundwater in large quantity should be prohibited.

(3) Groundwater investigation should be continuously carried out with regard to its potential availability, and its distribution in the project area.

(4) Distribution pipelines should be extended with priority to areas where groundwater is found not available.

Fig. 4.10A GROUNDWATER POTENTIAL DEMAND (BY CONSUMER)

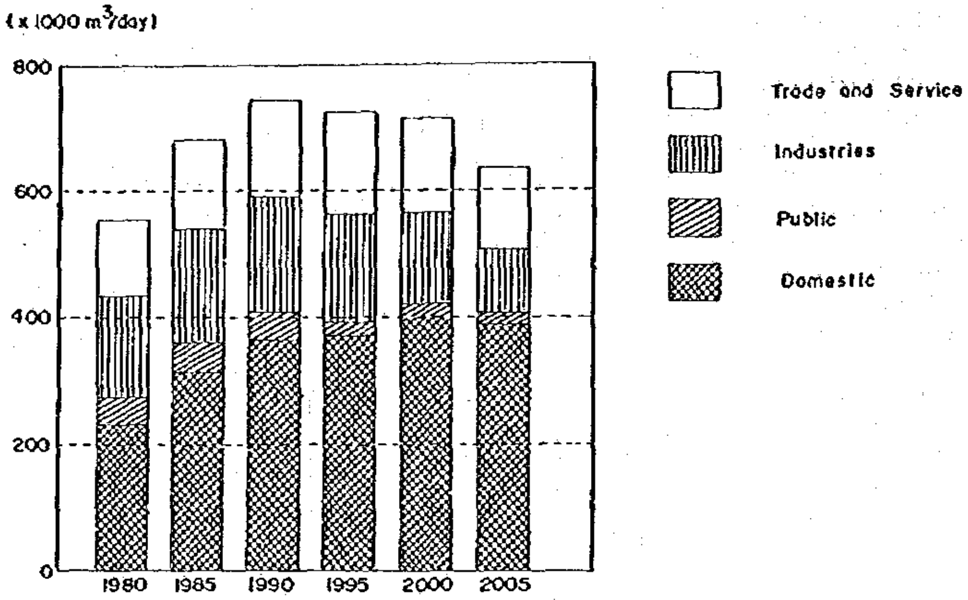


Fig. 4.10B GROUNDWATER POTENTIAL DEMAND (BY ZONE)

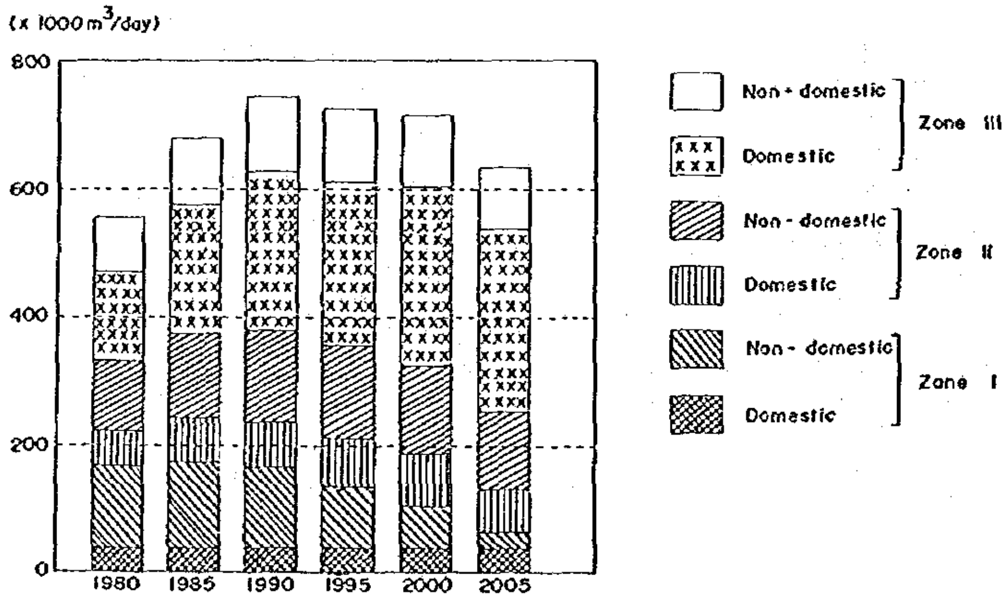


FIG 4.10 GROUNDWATER POTENTIAL DEMAND	
JAKARTA WATER SUPPLY DEVELOPMENT PROJECT	JICA

4.4 Raw Water Quality and Treatment Process

Raw water qualities and treatment processes, proposed for the water supply system to be constructed in the Master Plan period, are briefly described in the following subsections (for details, refer to Appendix Appendices MIII-2 and MIV-7). The description is solely for the purpose of master planning of the future water supply system, and it must be noted that further continuous survey of water quality is indispensable to finalize the treatment methods, and more appropriate methods are to be sought for at the time of implementation.

The water supply system to be constructed includes the following sub-systems and details will be presented in Section 4.6.

a. WTC System
   i. For 1st phase of second stage at 1990
   ii. intake source : WTC at Buaran
   iii. Water quantity : 3 m3/s

b. Cisadane system
   i. For 1st phase of second stage at 1990
   ii. Water source : Cisadane river at serpong
   iii. Water quantity : 3 m3/s

c. TJC system
   i. For 2nd phase of second stage at 1993
   ii. Water source : TJC at Bekasi
   iii. Water quantity : 5 m3/s

d. Cisadane Dam System
   i. For 1st phase of third stage at 1999
   ii. Water source : Cisadane Dam at Cirangkap
   iii. Water quantity : 5 m3/s

e. TJC System
   i. For 1st phase of third stage at 1999
   ii. Water source : TJC at Bekasi
   iii. Water quantity : Water quantity : 1 m3/sec

f. Cisadane Dam System
   i. For 2nd phase of third stage at 2002
   ii. Water source : Cisadane Dam at cirangkap
   iii. Water quanity : 5 m3/s

g. TJC system
   i. For 2nd phase of third stage at 2002
   ii. Water Source : TJC as Bekasi
   iii. Water quantity : 2 m3/s

4.4.1 WTC System

1) Raw Water Quality

Quality chractoristics of raw water at Buaran are summarized below.

a. Quality items to be treated are mainly Turbidity, Color, Organic Matter, Iron, Manganese, Ammonium and Bacteria.

b. Total Iron, total Manganese, BOD and Ammonium and Faecal Coli are also to be treated.

2) Treatment Process

Treatment processes proposed based on the quality characteritics are as follows:

(1) Pre-chlorination
Pre-chlorination will be applied for oxidizing and remocving color, dissolved organic substances, Iron, Manganes, Ammonium and Faecal Coli.

(2) Coagulation using Alum and Piolymer
Alum will be used to coagulate and settle suspended solids and oxidized matters by pre-chlorination. Polymer will be applied with Alum in the dry season as suspended solids in the season are supposed to be light. Polimer, which is use at present by Jakarta WAter Supply and other countries was considered for the coagulation aid in this study from the economical advantage, however the usage at polymer is to be further studied during detailed design stage considering disadvantage of it as described in Appendix MIV-7.

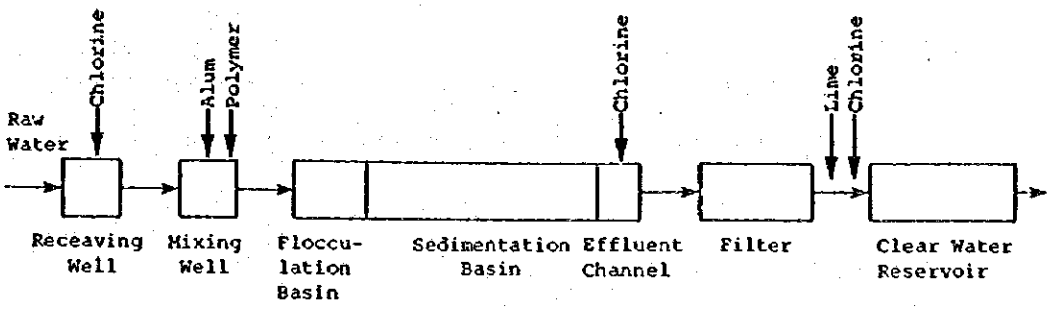
(3) Imtermediate chlorination
Intermediate chlorination will be applied to remove remaining Manganese and Bacteria in the clarified water at filter bed.

(4) pH control
pH control by post-lime will be applied to adjust pH value of finished water to more than 7.

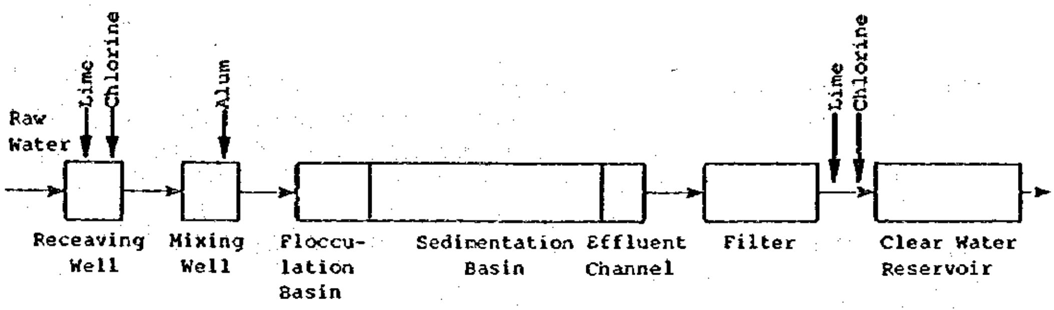
(5) Disinfection
Disinfection of the finished water by post-chlorine will be employed to the extent residual chlorine will remain in the distributed water.

(6) Treatment processes proposed are shown on Fig. 4.11.

1) WTC System



2) Cisadane System



3) TJC System

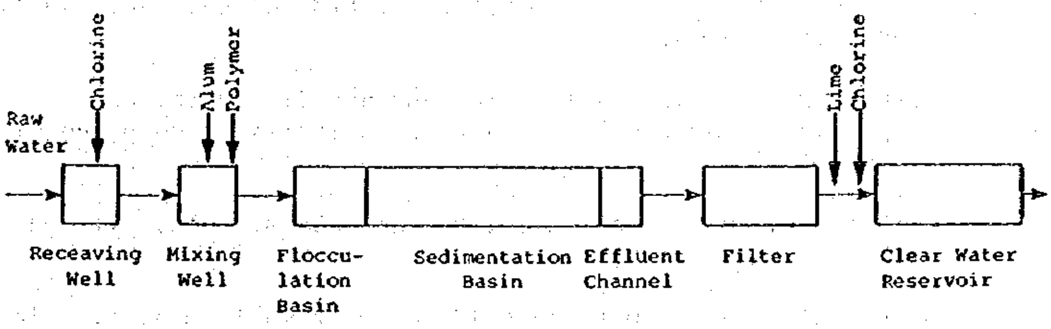


FIG 4.11 PROPOSED TREATMENT PROCESSES

JAKARTA WATER SUPPLY DEVELOPMENT PROJECT | JICA

4.4.2 Cisadane System

1) Raw Water Quality

Characteristics of the Cisadane River water at Serpong, near the proposed intake site, are as follows:

a. Quality items to be treated are mainly Turbidity, Color, Organic Matter, Iron, Manganese, Ammonium and Bacteria
b. pH value is changable and sometimes is below 7.
c. Turbidity and color values are widely changeable.

2) Treatment Processes

Treatment processes proposed according to the above quality charactoristics are as follows:

(1) Coagulation using Alum
Alum will be dosed to coagulate suspended solid.

(2) pH control
Post-lime will be applied to adjust pH value of the water to more than 7.

(3) Disinfection
Disinfection of the finished water by post-chlorine will be applied to the extent residual chlorime to remain in the distributed water.

(4) Treatment processes proposed are shown on Fig.4.11.

4.4.3 TJC System

1) Raw Water Quality

Water of the proposed TJC at Bekasi will be composed of only water from the Jatiluhur Dam so that the water quality will be similar to that of the Dam. Characteristics of the water quality are summarized below.

a. Turbidity value was usually low and not fluctuate, but suspended solids was light because it is mainly composed of algae.

b. Pollutants, such as Ammonium, BOD and Faecal Coli, will be present but not much.

c. Dissolved Iron was between 0.17 and 0.72 mg/l. 0,37 mg/l in average.

d. Coli and Organic Matter were above the Drinking water Standard.

e. pH snd Alkalinity were rather high, 7.4 and 54 mg/l in average respectively.

2) Treatment Processses

(1) Pre-chlorination
Pre-chlorination will be constantly required for removing Color, Organic Matter and other pollutants

(2) Coagulation using Alum and Polymer
Alum and Polymer will be dosed to coagulate and settle light suspended solids. Polymer usage is to be further reviewed with the some reason described in WTC system.

(3) pH Control
Post-lime will be constantly dosed to adjust pH value of finished water to more than 7.

(4) Disinfection
Disinfection of the finished water will be applied by using chlorine.

(5) Treatment processes of the system proposed are shown on Fig. 4.11.

4.4.4 Cisadane Dam System

Utilization of water impounded in the dam, which is to be constructed upstream of the Cisadane River, is proposed for Third Stage proejct. Because of this situation, no data of water quality is presently available. Therefore, for this planning of future water treatment, the treatment methods proposed for TJC water will be provisionally employed. However, it is subject to change at a later stage when the dam construction and the implementation of the water supply project materialized.

4.5 Immediate Program

All works required to recover the designed capacity of the existing water supply system and to meet the urgent water demand immediately are inclusively described under this heading, and are proposed for an early execution as practicable. The works are further grouped into Rehabilitation Works,, Improvement Project and Immediate Project as described in the following sections.

4.5.1 Rehabilitation Works

The rehabilitation program for the reduction of water losses t be executed immediately up to the year 1990 includes replacement of old meters, old service connections and old distribution pipelines, and leakage abatement. Outline of proposed rehabilitation works is as follows:

(1) Replacement of water meter (1985 to 1990)

- Replacement of total of 74,000 water meters ranging 1/2" to 2" in diameter

8,400	for new installation for unmetered service connections
55,900	for old meters more than 10 year
5,400	for defective meters and buried meters
4,300	for emergency

- Total costs: Equivalent in Rp. 3,235 million

(2) Replacement of distribution pipelines (1986 to 1990)

- Replacement of old distribution pipes installed in 1920's, total length of 20 km of secondary mains and 180 km of tentiary mains

- Removal of old trunk mains, total length of 33 km ranging from 350 mm to 600 mm in diameter.

- Total costs: Equipvalent in Rp. 13,377 million

(3) Replacement of old service connection (1985 to 1990)

- Replacement of total of 10,000 old service connection in old service area and northern part

- Total costs: Equivalent in Rp. 842 million

(4) Leakage abatement (1986 to 1990)

- Leakage abatement study including rehabilitation/replacement of old pipeline and corroded pipeline, and leakage detection and repair program (1986 to 1987)

- Training for leakage survey including assessment of the effect (1988 to 1990)

- Total costs: Equivelent in Rp. 5,189 million

4.5.2 Improvement Project

Improvement Project includes 1) Normalization of Pejompongan Plant I, 2) Raw Water Conveyance System, 3) Short Term Improvement Project, and 4) Improvement of distribution pipelines. The item 1) project has been in progress by PDAM, and the items 2) project is to be carried out by DGWRD, outside of Cipta Karya. The remainder are to be executed within the frame of the present Master Plan.

1) Pejompongan Plant I

Pejompongan Plant I was constructed in 1957 by the financing aid of the French Government. Since operation of the plant, no systematic rehabilitation nor improvement has been made except an employment of gas chlorine dosing. Due to wear and tear of the equipment and sticking of plastic films on the impellers of pump, functions of equipment in intake and treatment have been deteriorating year by year. So, PDAM Jaya started with its own fund normalization of equipment separated into four phases covering replacement of mechanical and electrical equipment based on the master plan of rehabilitation proposed by Degremont, France. Outline of the proposed rehabilitation program is as follows:

(1) Phase 1 (completed in 1983): for intake facilities.

- Replacement of flashboard weir in intake bay and fixed bar screen
- Installation of new coarse screen, automatical removing type.
- Replacement of travelling desuldge girder.
- Installation of new fine screen in front of suction bellmouth of raw water pump
- Replacement of raw water pumps (six units)
- Total costs: approximately Rp. 470 million.

(2) Phase 2 (in 1984): for treatment equipment. Shipment of equipment will be made in March 1984.

- Replacement of motor and driving gear of accelerators
- Replacement of operation and indication devices and valves of filter
- Replacement of compressors and air-blower pumps, and backwash pumps
- Replacement of parts of distribution pumps.
- Total cost: approximately Rp. 1,750 million.

(3) Phase 3 (in 1985): for chemical feeding equipment

- Replacement of whole chemical feeding equipment.
- Installation of Polyelectrolite feeding equipment.
- Installation of activated carbon feeding equipment.
- Total cost: approximately Rp. 620 million.

(4) Phase 4 (in 1986): for whole electrical equipment

- Alteration of voltage of power receiving 20 KV.
- Replacement of electrical equipment for power substation.
- Installation of instrument.
- Total cost: more than Rp. 1,500 million.

Civil works on the improvement such as replacing filter sand or washing filter sand, repairing filter under-drain system and constructing the buildings for additional chemical feeding system will separately be conducted by PDAM Jaya.

Furthermore, minor maintenance and repair of the existing facilities shall be made other than the upgrading works which include cleaning or replacement of filter sand, overhaul of chemical pumps, repair of chemical feeding pipes and lining of alum tanks by PDAM Jaya.

2) Raw Water Conveyance Systems for the Existing Plants

Based on the recommendation, by the present study, of the alteration of direct intake from the West Tarum Canal, DGWRD undertook the feasibility study on raw water protection and transmission facilities for Jakarta Water Supply as a series of the West Tarum Canal Enlargement Project from May 1984 to August 1984. Outline of the Project is briefed below:

(1) Pejompongan system

- Intake site	:	Buaran treatment Plant
- Intake facilities	:	Conjoint construction of intake bay, channel and equipment with Buaran plant
- Raw water pumps	:	4 pumps, Q 2.0 m3/sec x H 25 m (1-standby)
- Transmission main	:	ø 2,000 mm x 20 km, prestressed concrete pipe
- Total costs	:	US$ 33.3 million, including construction cost, contingency and land acquisition/compensation costs

(2) Pulogadung system

- Intake site	:	At the crossing point with the Buaran River
- Intake facilities	:	Intake bay and equipment, by gravity
- Transmission main	:	ø 2,100 mm x 7.8 km, preastressed concrete pipe

- Total costs : US$ 13.4 million, including construction cost, contingency and land acquisition cost

Operation cost and a part of capital investment will be charged to PDAM Jaya as a raw water tariff, which is to be agreed between POJ and DKI Jakarta.

3) Short Term Improvement Project

The raw water improvement project, described in the preceding section, will solve the deteriorated condition of raw water. Until the time of its completion, however, raw water to the existing treatment plants will become worse year after year. To cope with this situation, an urgent measure to be taken is planned as described in the following.

Difficulties in the water treatment under the present situation of pollution are 1) plastic films contained in the raw water, and 2) Ammonimu Nitrogen (NH_4-N) and organic matters. Regarding the item 1), improvement work by PDAM is currently under way, and regarding the item 2) removal of such matters is proposed to be made by way of chlorination, as described below.

(1) Strengthening chlorination

The study on water quality and treatment (for details refer to Appendix MIII-2) recommended to strengthen chlorination, after comparing several methods to remove pollutants. The reasons for this recommendation of chlorination were as follows:

(a) Chlorination is very effective in removing pollutants.

(b) Operators are used to chlorination in three stages, i.e., pre-, intermediate and post-chlorination, and they have practical skill in this method.

(c) The equipment for chlorination is expected to be fully and effectively used, even after the raw water improvement work is completed.

Based on the results of study so far made, dosage rates of chlorine planned are as shown on the table below. In the meantime, to avoid an over-investment for such a rather short term need, the maximum capacity of the equipment is determined to correspond to the requirement of the WTC water.

Proposed Chlorine Capacity (Additional) (max. ppm)

	Pejompongan I	Pejompongan II	Pulogadung
Pre-chlorine	8	6	5
Intermediate-chlorine	2	2	0
Post-chlorination	0	0	2

Existing Chlorine Capacity (max. ppm)

Pre-chlorine	2	4	5
Intermediate-chlorine	0	0	2
Post-chlorination	2	4	1

(2) Cost estimate of strengthening chlorination

Items and estimated cost for additional chlorination equipment are shown on Tables 4.12 and 4.13.

Table 4.12 Additional Chlorination Equipment

Description	Pejompongan * I & II	Pejompongan I	Pejompongan II	Puogadung
1. Chlorinator & Evaporator	Chlorinator 200 kg/h x 2 sets	Evaporator 50 kg/h x 2 sets	-	Evaporator 300 kg/h x 2 sets
2. Weighting Equipment	Scale 6 ton x 2 sets crane 2 ton x 1 set	Scale 4 ton x 1 set Hoist 2 ton x 1 set	-	
3. Neutralization Equipment	1 lot	1 lot	1 lot	-
4. Booster Pump	2 sets	-	-	2 sets
5. Building	New building 540 m2	Remodeling 245 m2	Remodeling 195 m2 New building 72 m2	-

Note : * Equipment will be installed for pre-chlorination of the raw water transmitted directly from the WTC.

Table 4.13 Cost Estimate for Additional Chlorination Equipment

Unit : US$ 1,000 / Rp. million

Items	Pejompongan I & II	Pejompongan I	Pejompongan II	Pulogadung
	(US$)	(US$)	(US$)	(US$)
1. Chlorinator & Evaporator	80	44	-	151
2. Weighting Equipment	58	20	-	-
3. Neutralization Equipment	96	96	89	-
4. Booster Pumps	9	-	-	-
5. Piping and Others	51	31	13	27
6. Contingency (approx. 10 %)	29	19	10	19
Sub-Total	323	240	112	206
	(Rp.)	(Rp.)	(Rp.)	(Rp.)
7. Installation & Inland cost	29	42	11	20
8. Building	15	6	4	2
9. Contingency (Approx. 10 %)	15	6	4	2
Sub-Total	166	60	41	22
Total (Equivalent in Rp.)	Rp.489	Rp.300	Rp.153	Rp.228
Grand Total			Rp. 1,170 million	

4) Improvement project of distribution pipelines

For full utilization of avialable water production, augmentation of distribution networks on small diameter pipelines is required in the existing service area. The length of secondary and tertiary pipes required is estimated based on the total length needed for distributing water to cope with the warer demand. Additional secondary and tertiary pipes to be installed in every year are shown on Table 4.14.

Table 4.14 Length of Additional Secondary and Tertiary mains

Unit: km

Secondary Mains

Year	Present	PDAM 1/	IP-226 2/	IP-245 2/	Additional 3/	Total	Accumulated length
1984	310	20	-	-	-	330	330
1985		-	21	-	-	21	351
1986		-	-	21	-	21	372
1987		-	-	20	-	20	392
1988		-	-	-	20	20	412
1989		-	-	-	18	18	430
1990		-	-	-	18	18	448
1991		-	-	-	21	21	469
1992		-	-	-	21	21	490
1993		-	-	-	10	10	500

Tertiary Mains

Year	Present	PDAM 1/	IP-226 2/	IP-245 2/	Additional 3/	Total	Accumulated length
1984	2,860	70	-	-	-	2,930	2,930
1985		-	115	-	-	115	3,045
1986		-	115	-	-	115	3,160
1987		-	117	-	103	220	3,380
1988		-	-	-	230	230	3,160
1989		-	-	-	250	250	3,860
1990		-	-	-	375	375	4,535
1991		-	-	-	375	375	4,910
1992		-	-	-	375	375	4,910
1993		-	-	-	450	450	5,360

Note:
1/ To be installed by PDAM with own fund
2/ Ongoing First Stage Project
3/ To be installed by the present project up to the year 1989 as underlined, and after 1990 by the First Phase of Second Stage Project

Total costs are estimated as follows:

Items		F/C (US$1,000)	L/C (Rp.million)
Secondary mains			
ø 200 - ø 250	38 km	1,290	1,112
Tertiary mains			
ø 50 - ø 150	583 km	5,206	5,776
"	347 km*	-	3,159
Contingency **		3,471	6,805
Total		9,967	16,852

Note: * Pipe materials has been purchased by ongoing project of First Stage

** Including physical contingency and price contingency

4.5.3 Immediate Project

The Immediate Project is conceived on the condition that :

1) the present gap between the supply capacity and the potential water demand should be filled as early as possible,

2) a supply source of 2.2 m3/sec will become available as a result of the WTC enlargement around the end of the year 1988, and

3) to minimize the construction cost, the existing distribution networks including distribution mains to be installed by the said time should be used without any additional pipe-laying works.

The Immediate Project is separately discussed in detail in Appendix MIV-2, and so, the outline of the Project is presented below.

1) Water Source

The WTC is the only existing system with the possibility of feeding additional raw water to the City of Jakarta. DGWRD planned to enlarge the existing Canal for the purpose of meeting the short term needs of water for Jakarta. The enlarged capacity of the Canal is to be 19 m3/sec including raw water of the existing treatment plants, flushing use and raw water for the new treatment plant.

Allocation of water is as follows :

- Existing treatment plant	10.6 m3/sec *
- Immediate Project	2.2 m3/sec *
- Flushing use	5.0 m3/sec
- Loss in the Canal	1.2 m3/sec
Total	19.0 m3/sec

*) Raw water quantity includes 10% losses in the treatment plant

2) Raw Water Intake

Location of intake site is selected at the south bank of the Canal and upstream of the crossing with the Jati Kramat River considering the following :

(1) Water quality at the proposed site is generally good, and concentrations of organic matters, an indicator of pollution, are low, compared with other locations along the WTC.

(2) Raw water intake by gravity is possible.

(3) Acquisition of land with an area of more than 5 hectares is not difficult for proposed treatment plant, as the area consists of uncultivated and paddy field.

(4) Drainage of waste water from treatment processes can be made to the Jati Kramat River.

3) Treatment Plant

Water quality of the Canal is shown on Table 3.6 covering all analytical items. The Canal crosses the rivers of Cibeet, Cikarang and Bekasi on its way to Jakarta and finally its water quality will be affected by the Bekasi river water. The Canal water has low concentration of Ammonium, COD and Fecal Coli at the intake site at present.

The water quality of the Canal is investigated 2-3 times per month by the Institute of Hydraulic Engineering (DPMA), DGWRD at present, so that on the basis of these data available, the treatment process and chemical dosage is planned.

It is considered that highly turbid water from Bekasi river will flow into the Canal in the wet season. Therefore, the treatment process shall be fit for the fluctuation of turbidity. Taking into account the present treatment technique and based on water quality data available so far, the following process and chemical applications are proposed presently. At the detailed design stage, however, further review will be needed on the basis of uptodate data for the raw water quality.

(1) Alum and Polymer : To remove suspended solid by Alum and accelerate settling velocity of the floc by polymer.

(2) Pre-chlorine : To oxidize organic matters and dissolved iron.

(3) Intermediate-chlorine : To prevent Fecal Coli from propagating in the sand bed of filter and oxidize remaining pollutant in the clarified water.

(4) Post-chlorine : To disinfect filtered water

(5) Post-lime : To control pH value to non-corrosive level.

The chemical dosage rate is estimated based on the result of coagulation test as shown below :

Chemical Application (ppm)

Chemicals	Max.	Aver.	Min.
Pre-chlorine	10	4-5	1
Intermediate-chlorine	3	1-2	0
Post-chlorine	3	1-2	0
Alum	70	30	10
Polymer (as Zuklur)	0.1	0.03	0
Post-lime	24	15-20	-

The Canal is exposed to pollutions of dengerous industrial wastewater due to inflow of the Bekasi River water and domestic pollutions due to open and unprotected conditions. For these foreseeable pollutions, the following measures are recommendable:

(1) For industrial pollutions, to investigate the location of factories, dengerous chemicals used and treatment of their effluent, and general monitoring of some changes of chemical qualities by fish tank in the treatment plant.

(2) For domestic pollutions, to install fences for protection of dumping of rubbish and drainage and sewage for rainfall and domestic wastewater and establishment of refuse collection system in the area along the Canal.

4) Distribution Main

Distribution main (1,100 mm diameter) is to be laid at a road on the north bank of the Canal and divides into two directions : west and north at interconnection of Jalan Jend. M.T. Haryono and Jalan Jeno. Panjaitan. West line (1,000 mm diameter) will be connected with the existing main (1,000 mm diameter) at Kuningan Barat area and north line (900 mm diameter) with the existing main (800 mm diameter) at Jatinegara. In the pipeline, sluice valves will be installed at branch point of the main and interconnecting point with the existing main.

As water is to be distributed to present service area through the existing trunk and secondary mains, no consideration of installation of secondary and tertiary mains is made under this Project. However, secondary and tertiary mains considered necessary are incorporated in the work of those mains for full utilization of available production discussed in the preceeding section 4.5.1 Improvement Project.

All facilities proposed for the Immediate Project are shown on Table 4.15 and Figs. 4.12 and 4.13.

5) Cost Estimate

The project cost and operation and maintenance cost for the plant and distribution system are estimated broken down into foreign exchange and local currency components as follows:

(1) Project Costs

Foreign Exchange Components: for equipment in the intake bay and treatment plant, pipe materials, and engineering cost to be paid in foreign currency.	US$17 million

Local Currency Component: Civil work, pipelaying works local handling and transportation charges for imported materials and engineering cost to be covered by local currency	US$15.45 million
Total	US$32.45 million

(2) Operation and Maintenance Costs (per annum)

Personnel cost	Rp. 60.2 million
Power cost	Rp. 345.3 "
Chemical cost	Rp. 970.0 "
Maintenance cost	Rp. 51.7 "
Total	Rp. 1,427.2 million

Table 4.15 Water Supply Facilities for Immediate Project

Item	Description
Max Daily Demand	2.0 m3/sec (Average daily demand)
Intake/Treatment Flow Rate	2.1 m3/sec
A. Land Acquisition	
1. Intake/Treatment Plant Site	100,000 m2 (including land for raw water pumping station on 2nd stage)
2. Distribution Mains Site	11,000 m2
B. Intake	
1. Intake bay	B 15.5 m x B 5.5 m x L 20 m x 1 Bay (for common use with intake facilities of the Pejompongan for Raw Water Improvement)
2. Raw water channel	B (2.5 x 2) m x D 3.8 m x L 123 m x 1 channel (ditto)
3. Raw water main	ø 1,500 m x L 28 m x Single Line, Water meter, Flow controller
C. Treatment Plant	
1. Receiving well	B 6.2 m x L 5.0 m x D 6.0 m V = 186 m3 1 well RT = 1.5 min overflow weir
2. Mixing well	B 4.0 m x L 2.0 m x D 4.0 m V = 32 m3 2 well RT = 30 sec with overflow weir
3. Flocculation Basin	B 23.4 m x L 10.8 m (divided to 3 compartments) x H 2.5 m V = 630 m3 4 units RT = 20 min with mechanical flocculator
4. Sedimentation Basin	Horizontal flow type W = 24.4 m x L 64.9 m x D 3.5 m V = 5,600 m3 4 units Rt = 3 hrs mean velocity = 0.37 m/min with sludge scraper
5. Rapid Sand Filter	Conventional type Area of bed 67.3 m2 18 units, flow rate = 6.25 m3/m2/hr surface wash pump 14.0 m3/min x 20 m x 75 KW x 2 sets backwash tank, B 8.0 m x L 17.6 m x H 2.5 m V = 350 m 2 units (on the chenical building) backwash pump 12 m3/min x 15 m x 45 KW x 2 sets
6. Clear water reservoirs	B 42.25 m x 33.25 m x D 4.0 m x 2 = 11,200 m3 Rt = 1.5 hrs
7. clear water pump well	Attached to clear water Reservoir
8. Chemical Building	Basement floor : 324 m2 Lime solution tank First floor : 972 m2 Storage and feeding equipment of lime and chlorine Second floor : 216 m2 Electrical room, chemical examination room, other
9. Waste water pond	W 10.0 m L 32.0 m x D 2.5 m V = 800 m3 2 units with drain pump 18.5 KW x 3 sets
10. Chemical feeding system	Alum, lime and chlorin
D. Distribution	
1. Pumping Station	BF : Pump room A = 720 m2 1 F = Electric control room A = 720 m2
2. Distribution pump	60 m3.min x 54 m x 750 kw x 3 sets including 1 standby
3. Distribution main	DIP ø 1,100 L = 7,600 m DIP ø 1,000 L = 5,800 m DIP ø 900 L = 3,400

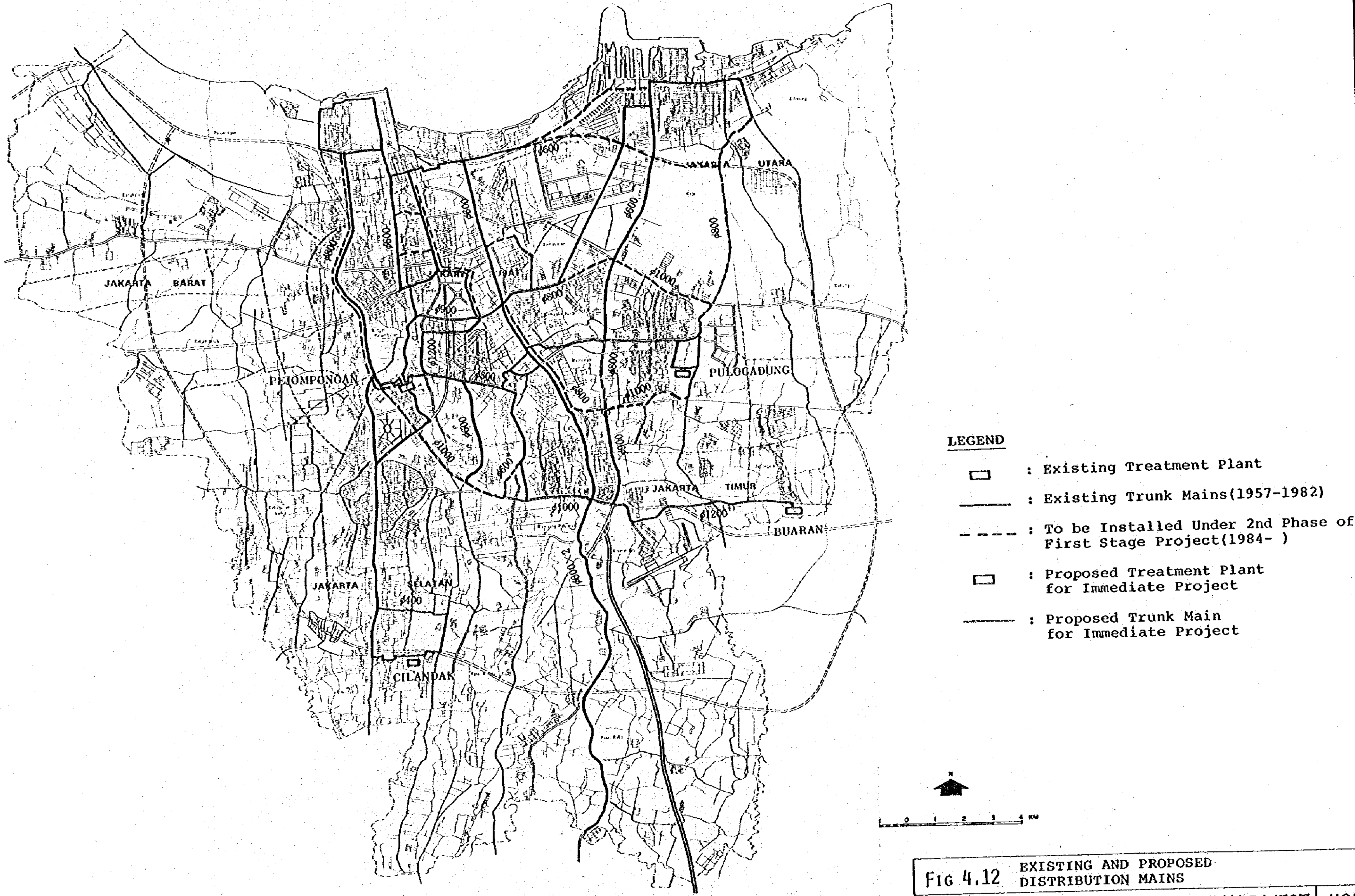


FIG 4.12 EXISTING AND PROPOSED DISTRIBUTION MAINS

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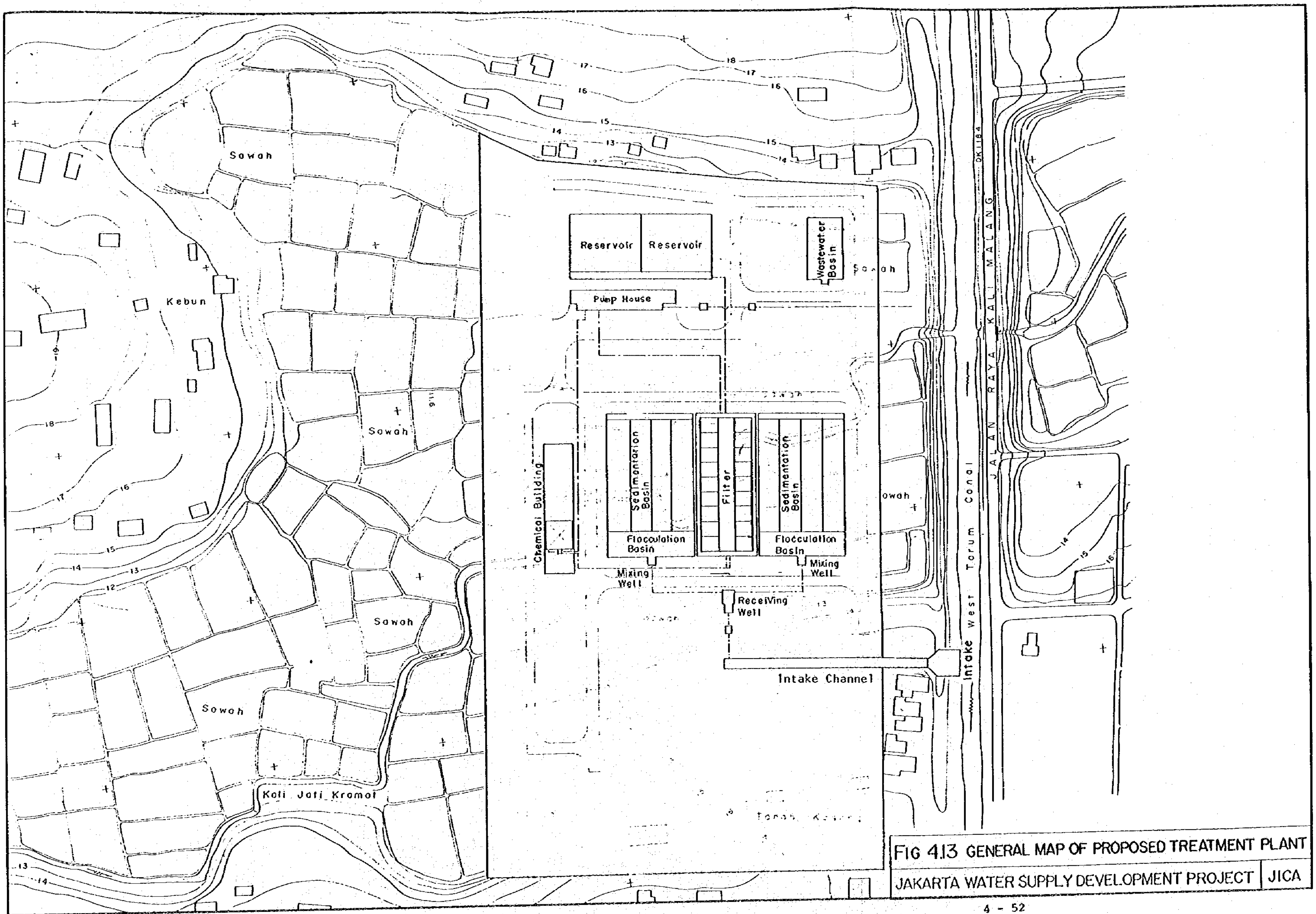

FIG 4.13 GENERAL MAP OF PROPOSED TREATMENT PLANT

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4.6 Future Expansion Program

The long range plan of the extension of the Jakarta Water Supply System shall be executed in a series of projects in accordance with the growth of water demand. All the projects are planned taking into consideration the urgency, period of construction work and amount of the fund.

4.6.1 Basic Concept of Future Water Supply System

General Description on System

Based on the findings and discussions so far described, the future water supply system to be implemented on a long term is conceived as follows.

1) Water Sources

For immediately required water supply expansion, water resources which are assured by Water Resources Department will be utilized. They are the West Tarum Canal, and the Cisadane River.

For medium range future water requirement, TJC, which is now under planning, will be utilized. At the time of completion of TJC, the raw water for the above from the West Tarum Canal will be altered to divertion from the TJC.

For long range future water requirement, there are two possible water sources, namely, TJC and the Cisadane River. Construction of the latter is still in the initial study stage although the former is already scheduled. However, the Cisadane River will be employed for the present planning, since the Cisadane System is found more economical by a preliminary study. (For details refer to Appendix MIV-4).

2) Water Treatment

Considering the water pollution advanced to the extent of the capability of the existing water treatment plants, the future water intake sites will be located where water may possibly not undergo mich pollution. Treatment methods, therefore, of the present practice will be used for the new system, but subject to review by future detailed study.

As water of the TJC will be composed of only water from the Jatiluhur Dam, Water quality in the TJC will be similar to that of Dam. Conventional treatment methods will be employed for planning of new system subject to further review during detailed design stage.

Utilization of water impound in the Ciasadane dam, which is to be constructed upstream of the Cisadane River, is proposed in later stage. Due to no date of water quality is presently available, the treatment methods proposed for the TJC water will be provisionally applied for planning of future water treatment, however, subject to change at the later stage when the data concerned be available.

3) Water Distribution

A new concept will be introduced for water distribution of the expanded water supply system, that is, zoning system. For details, refer to Appendix MIV-3. The zoning system will improve overall operation control and facilitate leakage control. The system will be gradually implemented along with the implementation of the expansion projects or avoid large investments concentrating within a short period.

The present supply capacity is far behind the water demand, and besides, the potential water demand is daily growing. Considering this situation, the target time when the supply capacity will catch up with the demand will be set at a decade ahead and time to cover the demand will be at the year 2005. Up to that time, plural numbers of expansion projects will be planned to narrow the gap between supply and demand, aiming at earlier effects with rather small funds. This approach cannot eliminate the inconvenience of the public immediately, but will gradually lessen it.

As discussed in the preceeding section, the water requirement in the year 2005 is estimated at 31.5 m3/sec in average for 8,784,000 population served (total population in DKI boundary of 11,999,000). Against this water requirement, the following plan of the extension works is proposed:

1) The immediate Project for the purpose of narrowing the gap between supply and potential water demand in the existing service area as expeditiously as possible by using 2.0 m3/sec water available from the West Tarum Canal enlarged.

2) The Second Stage Project, succeeding to the present ongoing First Stage Project, to proceed further extension of the service area and to eliminate chronic water shortage in the service area.

3) The Third Stage Project to meet the water requirement to be increased after the Second Stage Project.

The Immediate Project is described in detail in section 4.5.3, Immediate Project. The features of each extension projects of the Second Stage and Third Stage are described in section 4.6.3 and 4.6.4.

4.6.2 Design Criteria

1) Intake and Treatment Plant Capacity

Capacity of intake and treatment plant is determined as 107 % plant production capacity considering water losses during treatment process. Water losses during raw water transmission is not considered.

2) Fluctuation in Water Demand

Day Maximum Water Demand and Hourly Maximum Demand are determined considering past records of consumption pattern and scale of water supply system as follows.

Day Maximum Water Demand : 115 % of day average water demand

Hourly Maximum Water Demand : 130 % of day maximum water demand

3) Treated Water Transmission Main

Treated water transmission mains are sized to supply day maximum demands or production capacity from new plants.

4) Distribution Facilities

- The distribution system is designed to deliver hourly maximum flow.

- Operation storage is sized to meet the fluctuation in demand in excess of the maximum flow, with effective capacity of operational storage as 3 hours' maximum demand. Operational storage is to reserve water which can be drawn upon during those hours of the day when distribution system demand are high and then replenished during the night when the system demand are low.

- Distribution Pipelines
  Distribution pipelines will be classified into three categories by pipe sizes and purposes, that is, trunk main, secondary main and tertiary pipe.

  The trunk main forms distribution network to distribute water to the whole supply area, the sizes of trunk mains are ø 300 mm in diameter and larger. The secondary mains, ø 250 mm and ø 200 mm in diameter, distribute water within a grid formed by the trunk mains. The tertiary pipes, ø 150 mm in diameter and smaller, are for supplying water to consumers directly.

- The distribution trunk mains are sized to provide a minimum pressure of 1.7 kg/cm2 at the end of the main. The secondary main and the tertiary pipes are sized to provide a minimum pressure of 0.75 kg/cm2 at service connection which supply water up to the second floor with flow rate of 0.15 l/sec.

- The maximum system pressure is 7.5 kg/cm2.

5) Coefficient for Hydraulic Calculation

Hazen-Williams "C" values of 130 and 120 are used for sizing new transmission mains and distribution pipelines respectively and 100 and 110 is applied to old pipelines considering the age and condition of the pipelines.

4.6.3 Second Stage Project

The existing water production, 10.8 m2/sec after completion of the First Stage Project in 1987 and 12.8 m3/sec after the Immediate Project in 1988, is still below the water demand of 14.9 m3/sec projected in 1988. The Second Stage Project is therefore, intended to cover the water demand required with a construction of a new treatment plant in the eastern and western parts of the City within a period of about 10 years. And along with the establishment of the new plant, rehabilitation and improvement works of the existing facilities to abate the existing leakage and improve the raw water quality and treatment process were planned as discribed in the Immediate Program. By this project total production is to be increased at 11.0 m3/sec and total capacity becomes to 23.3 m3/sec. Upon completion the project, three mini-plants are to be put in the standby for emergency use, and Ciburial spring water of 300 l/sec is to be supplied for Depok area.

(1) Target of the Project

a. Target year : 1995
b. Population served : 6,523,000
   (Total population in DKI 9,949,600)
c. Served area : 383 km2 (additional 100 km2)
d. Supply Capacity : 23.3 m3/sec in total
   Existing, 12.3 m3/sec
   Additional, 11 m3/sec
e. Phases of implementation : 2 phases

(2) Water Source

Water resources for the Jakarta have been assured by Directorate General of Water Resource Development for immediate requirement up to the 1990 and medium range requirement up to 1995. The Second Stage Project is implemented by two phases step and each water source to be utilized is as follows:

First Phase : 3,000 l/sec from the WTC enlarged
3,000 l/sec from the Cisadane River
Second Phase : 5,000 l/sec from the TJC

At the time of completion of the TJC, 4,000 l/sec for production capacities of the existing Pulogadung Plant, 2,000 l/sec for the Immediate project and the above 3,000 l/sec from the WTC are to be altered to diversion form the TJC.

(3) Location of Treatment Plant

The raw water source consists of two systems from east and west sides in the City. Accordingly the locations of plants are also selected in the areas of east and west respectively. In order to avoid taking in raw water contaminated along the WTC, intake site is selected at a point upstream of the WTC. The study on selection of the plant site was made considering the advantages of operation and maintenance, future expansion, power supply and construction costs (for details, refer to Appendix MIV-5 and 6), and plant site of each side is proposed as follows:

Phase	Raw Water Source	Location of Treatment Plant	Production Capacity	Year Completion
First Phase	Enlarged West Tarum Canal (WTC) at Buaran	Buaran	3 m3/sec	1990
"	Cisadane River at Serpong (Weir)	Lebakbulus	3 m3/sec	1990
Second Phase	TJC at Bekasi	Cakung	5 m3/sec	1993

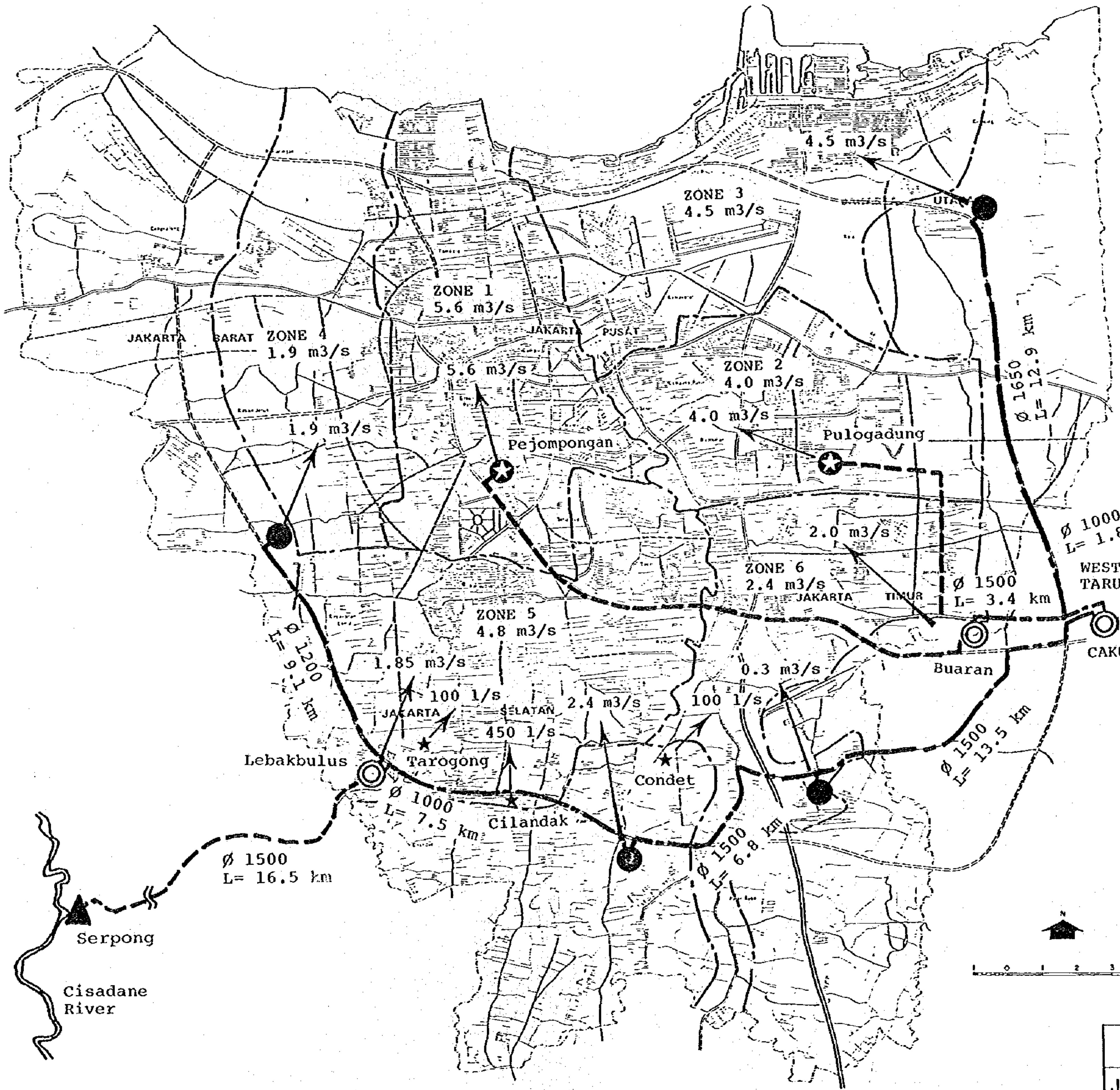
General layout of the water supply system of the Second Stage is shown on Fig. 4.14.

(4) Water Distribution

The existing water supply system of Jakarta is large in served area and complicated in network of pipeline with many supply sources. As a result of this magnitude and complication, the operation of the water supply system is not necessarily easy, and it is difficult in an emergency case to deliver water to places where water is wanted. Considering the above condition of the water supply system, a basic improvement of the supply system was studied in the course of preparation of the master plan (for details refer to Appendix MIV-3). The served area will be reorganized eventually into six supply zones in the Second Stage. Each zone is to be supplied by the existing treatment plant or a distribution center, newly established.

(5) Proposed Facilities

The major facilities planned on the basis of the design criteria are as shown on Table 4.16.



	First Phase (1990) (m3/s)	Second Phase (1995) (m3/s)
WATER SOURCE		
West Tarum Canal (WTC)	15.6	6.0
Cisadane River (CSR)	3.2	3.2
Tarum Jaya Canal (TJC)	-	14.9
Total	18.8	24.1
TREATMENT PLANT		
Pejompongan	5.6 (WTC)	5.6 (WTC)
Pulogadung	4.0 (WTC)	4.0 (TJC)
Buaran (Immediate)	2.0 (WTC)	2.0 (TJC)
Buaran	3.0 (WTC)	3.0 (TJC)
Lebakbulus	3.0 (CSR)	3.0 (CSR)
Cakung	-	5.0 (TJC)
Total	17.6	22.6

LEGEND

- : Existing Treatment Plant
- ★ : Existing Mini Plant
- : Proposed Treatment Plant
- : Proposed Distribution Center
- : Proposed Raw Water Intake
- : Proposed Raw Water Transmission Pipeline
- : Proposed Treated Water Transmission Pipeline
- : Boundary of Supply Zone

FIG 4.14 GENERAL LAYOUT OF SECOND STAGE PROJECT

JAKARTA WATER SUPPLY DEVELOPMENT PROJECT | JICA

Table 4.16 Proposed Facilities

Facilities	Second Stage Project	Third Stage Project
1. Raw Water Intake	Intake Capacity Q = 1.2 m3/sec	
2. Raw Water Transmission		
1) Serpong - Lebakbulus		
a. Transmission Pipe	ø 1,500 mm x L 16.5 km	
b. Transmission Pump	Q48m3/min x H50m x 550 kW x 6 units	
2) Bekasi (Canal 1) - Cakung	B4.7m x H2.3 m x L6.7km	
3) Cakung - Buaran	B3.8m x H1.9m x L4.9km	
3. Water Treatment Plant		
1) Buran Plant	Production Capacity Q = 3.0 m3/sec	
2) Lebakbulus Plant	Production Capacity Q = 3.0 m3/sec	Production Capacity Q = 10.0 m3/sec
3) Cakung Plant	Production Capacity Q = 5.0 m3/sec	Production Capacity Q = 3.0 m3 sec
4. Treated Water Transmission		
1) Buaran - R1		
a. Transmission Pipe	ø1,500mm x L3.4km, ø1,650mm x L12.9km	
b. Junction Well	D 13 m x H 6.0 m (RC made)	
c. Transmission Pump	Q45m3/min x H24m x 250kW x 6 units	
2) Cakung - R 1		
a. Transmission Pipe	ø 1,000 mm x L 1.8 km (up to J.Well)	ø 1,100 mm x L 14.7 km
b. Transmission Pump	Q23m3/min x H19m x 100kW x 6 units	Q24m3/min x H16m x 100kW x 6 units (Pumps are installed from the Second Phase)
3) Cakung - R 2		
a. Transmission Pipe	ø 1,500 mm x L 13.5 km	
b. Transmission Pump	Q52m3/min x H42m x 480kW x 6 units	
4) R 2 - R 3		
a. Transmission Pipe	ø 1,500 mm x L 6.8 km	
b. Transmission Pump	Q47m3/min x H30m x 310kW x 6 units	Q16m3/min x H21m x 80kW x 6 units (replaced in the second phase)
5) R 3 - Lebakbulus		
a. Transmission Pipe	ø 1,000 mm x L 7.5 km	ø 1,100 mm x L 7.5 km
b. Transmission Pump	(by gravity)	Q42m3/min x H30m x 280kW x 6 units (Pumps are installed from the Second Phase)
6) Lebakubulus - R 4		
a. Transmission Pipe	ø 1,200 mm x L 9.1 km	ø 1,500 mm x L 9.1 km
b. Transmission Pump	(by gravirty)	Q71m3/min x H 8m x 120kW x 6 units (pumps are installed from the Second Phase)
7) R 4 - R 5		
a. Transmission Pipe		ø 1,350 mm x L 13.6 km
b. Transmission Pump		Q36m3./min x H15m x 120kW x 6 units
5. Distribution Facilities		
1) Pejomongan System (zone 1)		
a. Distribution Trunk Main	ø 300 - ø 900mm, L = 53 km	ø 300mm, L = 5 km
2) Pulogadung system (zone 2)		
a. Distribution Trunk Main	ø 300 - ø 600mm, L = 37 km	ø 300mm, L = 9 km
3) Buaran/Cakung System (Zone 6)		
a. Operational Reservoir	11,000 m3 (at Buarang Plant)	17,000 m3 (at Cakung Plant)
b. Distribution Pump	Q36m3 min x H54m 450kW x 2 units (at Buarang Plant)	Q47m3min x H54m x 570kW x 3 units Q24m3/min x H54m x 290kW x 2 units (at Cakung Plant)

Facilities	Second Stage Project	Third Stage Project
c. Distribution Trunk Main	ø 300 - ø 1,000mm, 1 L = 25km	ø 300 - ø 1,200mm, L = 48km
4) R - 1 System (zone 3)		
a. Operational Reservoir	49,000 m3	18,000 m3
b. Distribution Pump	Q78m3/min x H59m x 1,100kW x 6 units	Q50m3/min x H59m x 670kW x 3 units
	Q39m3/min x H59m x 550kW x 2 units	Q25m3/min x H59m x 340kW x 2 units
c. Distribution Trunk Main	ø 300 - ø 1,800mm, L = 46 km	ø 300 - ø 1,200mm, L = 34 km
5) R - 2 System (zone 9)	4,000 m3	22,000 m3
a. Operational Reservoir	Q9.4m3/min x H65m x 150 kW x 3 units	Q35m3/min x H25m x 210kW x 6 units
b. Distribution Pump	Q4.7m3/min x H65m x 75 kW x 2 units	Q18m3/min x H25m x 110kW x 2 units
		ø 400 - ø 1,200mm, L = 23 km
c. Distribution Trunk Main		
6) R - 3 System (zone 8)	26,000 m3	17,000 m3
a. Operational REservoir	Q42m3/min x H22m x 210kW x 6 units	Q47m3/min x H22m x 240kW x 3 units
b. Distribution Pump	Q21m3/min x H22m x 110kW x 2 units	Q24m3/min x H22m x 130kW x 2 units
ø 300 - ø 1,500mm, L = 23 km	ø 300 - ø 1,000mm, L = 23 km	
c. Distribution Trunk Main		
7) Lebakbulus System (zone 7)	20,000 m3	18,000 m3
a. Operational Reservoir	Q32m3/min x H48m x 370kW x 6 units	Q50m3/min x H48m x 550 kW x 3 units
b. Distribution Pump	Q16m3/min x H48m x 190kW x 2 units	Q25m3/min x H48m x 280kW x 2 units
	ø 300 - ø 1,500mm, L = 51 km	ø 300 - ø 900mm, L = 25 km
c. Distribution Trunk Main		
8) R - 4 System (zone 5)	21,000 m3	25,000 m3
a. Operational Reservoir	Q33m3/min x H52m x 400kW x 6 units	Q72m3/min x H52m x 850kW x 3 units
b. Distribution Pump	Q17m3/min x H52m x 200kW x 2 units	Q36m3/min x H52m x 430kW x 2units
	ø 300 - ø 1,500mm, L = 54 km	ø 300 - ø 1,200mm, L = 37 km
c. Distribution Trunk Main		
9) R - 5 System (zone 4)		26,000 m3
a. Operational Reservoir		Q42m3/min x H50m x 480kW x 6 units
b. Distribution Pump		Q21m3/min x H50m x 240kW x 2 units
		ø 300 - ø 1,200mm, L = 21 km
c. Distribution Trunk Main		
10) Secondary Main	ø 200 - ø 250 mm, L = 200 km	ø 200 - ø 250 mm, L = 200 km
11) Tertiary Main	ø 50 - ø 150 mm, L = 3,400 km	ø 50 - ø 150 mm, L = 3,600 km

4.6.4 Third Stage Project

After the second Stage Project, the extension work will be proceeded under the Third Stage Project targeted in the year 2005. The Project will be executed by two phases implementation.

(1) Target of the Project

a.	Target Year	:	2005
b.	Population served	:	8,784,000 (Additional 2,261,000)
	Total population in		DKI 11,999,000
c.	Served area	:	454 km2 (Additional 71 km2)
d.	Supply capacity	:	36.3 m3/sec in total
	Existing	23,300	1/sec
	Additional	13,000	1/sec
e.	Phases of implementation	:	2 phases

(2) Water Source

According to the water resource development programs, for long range future water requirement in the Jakarta water supply, the Cisadane River Development Program is recommended constructing dams at Parung Badak and Sodong upstream the river. Bisides, the TJC planned to cope with the mid-term requirement was planned at 30 m3/sec in maximum capacity and had still surplus capacity for future requirement. The raw water quantities required in the year 2000 and 2005 are shown below:

Description	1995	2000	2005
Pulogadung Plant	4.3 m3/sec	4.3 m3/sec	4.3 m3/sec
Buaran Plant			
Immediate Program	2.1	2.1	2.1
First Phase	3.2	3.2	3.2
Labakbulus (Cisadane) First Phase	3.2	3.2	3.2
Cakung Plant			
Second Phase	5.4	5.4	5.4
Third Stage Program (Cisadane and TJC)	-	6.4	13.9
Total	18.2	24.6	32.1

Note: a. Raw water quality is calculated inclusive of 7 % losses for the production capacity of the plants.

b. Total quantity, 16.5 m3/sec, out of 18.2 in 1995 relies on the TJC.

Raw water required for the Third Stage Extension Program will rely on the Cisadane River Development. However, considering that the TJC has still surplus for the planned capacity, the following three cases as future water source are studied, that is,

a. Raw water of 13.9 m3/sec required up to the year 2005 relies on the TJC.

b. Raw water of 13.9 m3/sec relies on the Canal 3 from the Cisadane basin.

c. Raw water of 13.9 m3/sec relies on the Canal 2 from the Jatiluhur dam.

As the result of the study, the Cisadane River is employed for the present planning, since the Cisadane system is found more economical by the preliminary study.

For conveyance of raw water from the Cisadane basin, the following conditions must be satisfied:

a. Water level of receiving well in the treatment plant is about 40 m in elevation from sea level.

b. Planned raw water quantity from the Cisadane basin is 10.7 m3/sec (13.9 m3/sec in total requirement minus 3.2 m3/sec for the First Phase of Second Stage from the Cisadane River at Serpong). 3.2 m3/sec will be provided by the TJC.

c. Treatment plant site is proposed in Kel. Lebakbulus near the treatment plant to be constructed by the First Phase of Second Stage Program.

(3) Location of Treatment Plant

As described in the preceeding paragraph, the future water sources are proposed for the Cisadane River and TJC for the Third Stage Extension Program. Location of the plants is proposed as follows:

Stage and Phase	Raw Water Source	Location of Treatment Plant	Production Capacity	Year Completion
First Phase	Cisadane River at Cilagkap (Dam)	Lebakbulus	5 m3/sec	1999
"	TJC at Bekasi	Cakung	1 m3/sec	1999
Second Phase	Cisadane River at Cilangkap (Dam)	Lebakbulus	5 m3/sec	2002
"	TJC at Bekasi	Cakung	2 m3/sec	2002

General Layout of the water supply system of the Thrid Stage is shown on Fig. 4.15.

(4) Water Distribution

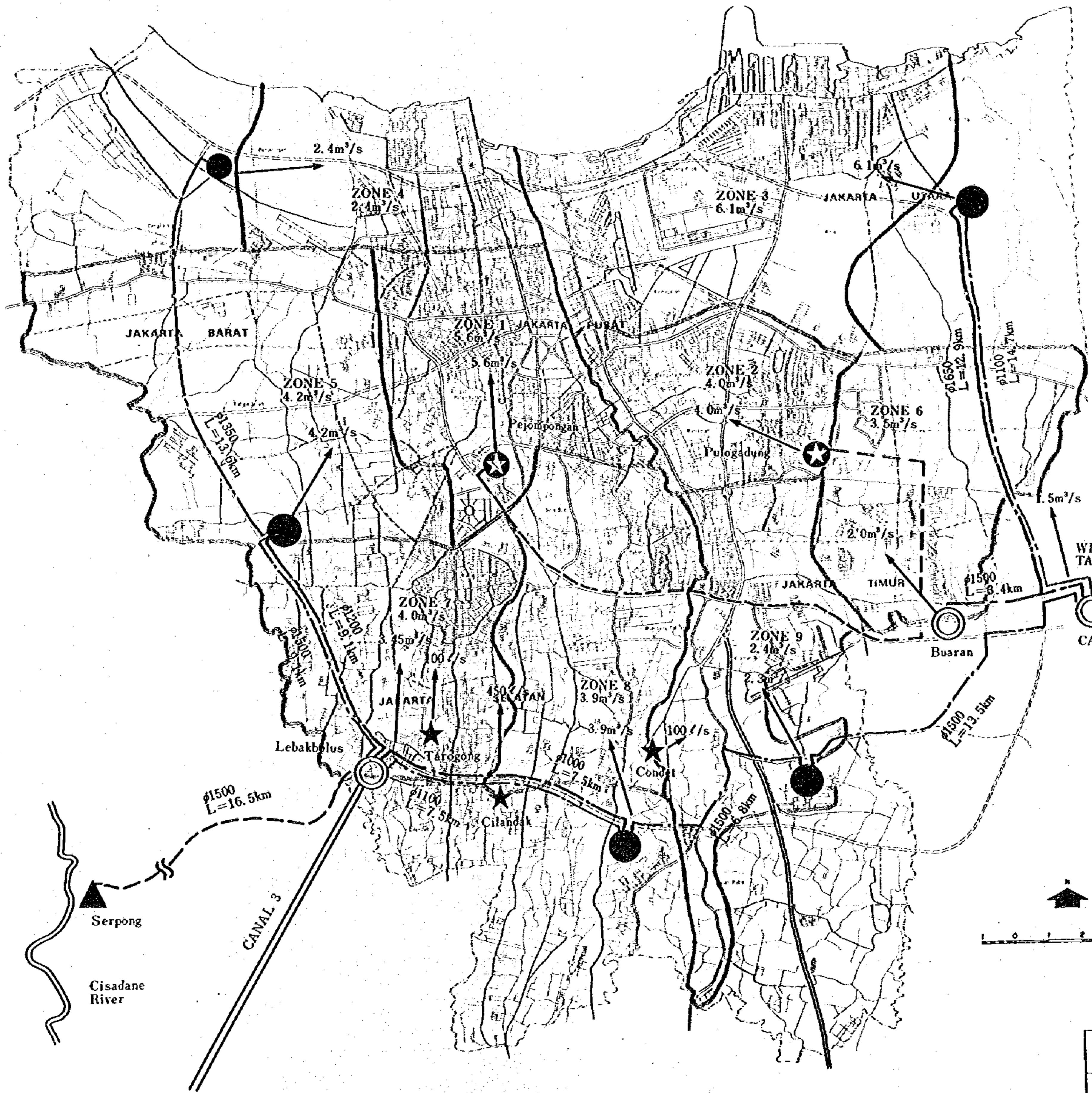
The service area will be reorganized into nine supply zones in the Third Stage and each zone will be supplied from the treatment plant or distribution center. For this stage, three additional distribution centers to two centers planned in the Second Stage are proposed in north-eastern and southern areas.

(5) Proposed Facilities

The proposed major facilities are shown on Table 4.6.

(6) Effect of Raw Water Supply only from the East for the Third Stage Project

The present Master Plan proposed to take raw water from both east and west of the project area, putting emphasis on uninterrupted water supply to Metropolis even under unforeseen emergency, and also economy of the project, as already studied in Appendix MIV-4. However, it is not undeniable that there may be a possibility of delay of the Cisadane Basin development. If such delay should be known well before the commencement of the Phase 1 project of Stage II, the future water supply system proposed herein should be reviewed and altered as required.



	Second Stage (1995) (m3/s)	Third Stage (2005) (m3/s)
WATER SOURCE		
West Tarum Canal (WTC)	6.0	6.0
Cisadane River (CSR)	3.2	3.2
Tarum Jaya Canal (TJC)	14.9	18.1
Canal 3 (C.3)	-	10.7
Total	24.1	38.0
TREATMENT PLANT		
Pejompongan	5.6 (WTC)	5.6 (WTC)
Pulogadung	4.0 (TJC)	4.0 (TJC)
Buaran (Immediate)	2.0 (TJC)	2.0 (TJC)
Buaran	3.0 (TJC)	3.0 (TJC)
Lebakbulus	3.0 (CSR)	3.0 (CSR)
	-	10.0 (C.3)
Cakung	5.0 (TJC)	8.0 (TJC)
Total	22.6	35.6

LEGEND

- : Existing Treatment Plant
- : Existing Mini Plant
- : Proposed Treatment Plant
- : Proposed Distribution Center
- : Proposed Raw Water Intake
- : Proposed Raw Water Transmission Pipeline (Second Stage)
- : Proposed Treated Water Transmission Pipeline (Second Stage)
- : Proposed Treated Water Transmission Pipeline (Third Stage)
- : Boundary of Supply Zone

FIG 4.15 GENERAL LAYOUT OF THIRD STAGE PROJECT

JAKARTA WATER SUPPLY DEVELOPMENT PROJECT

4.6.5. Service Connections and Meter Installation

1) Service Connections

According to the billing records, there wew approximately 112,000 services in the year 1980, 120,000 number of the service connection in the year 1981, 126,000 number in the year 1982, and 134,000 number in May 1983. The service connections which are required at 5 year intervals for the Master Plan are developed, considering treatment production in respective years, PDAM's present practice of new connection installation and future capability which would be supported by appropriate logistics and time lag of completion of secondary and tertiary pipelines, and are presented in Table 4.17 (For details refer to Appendix MIV-8).

Table 4.17 Schedule of Service Connection

DOMESTIC SERVICE CONNECTION			NON-DOMESTIC SERVICE CONNECTION	TOTAL NO. OF CONNECTION	INCREMENT
YEAR	RESIDENTIAL	PUBLIC HYDRANT			
1980	92,177 1)	1,149 1)	18,360 1)	111,686	0
1981	99,797 1)	1,231 1)	19,079 1)	120,107	8,421
1982	105,119 1)	1,197 1)	20,168 1)	126,474	6,367
1983	111,451 2)	1,417 2)	21,106 2)	133,974	7,500
1984	120,460	1,560	21,980	144,000	10,026
1985	131,720	1,780	23,500	157,000	13,000
1986	150,280	2,060	24,660	177,000	20,000
1987	175,810	2,360	28,830	207,000	30,000
1988	205,830	2,690	32,480	241,000	34,000
1989	237,500	3,030	37,470	278,000	37,000
1990	272,800	3,300	41,870	318,000	40,000
1991	309,810	3,760	47,430	361,000	43,000
1992	347,470	4,190	54,340	406,000	45,000
1993	387,540	4,620	60,840	453,000	47,000
1994	428,310	5,050	67,640	501,000	48,000
1995	470,830	5,480	74,690	551,000	50,000
2000	691,320	7,950	117,730	817,000	266,000
2005	954,010	15,090	175,900	1,145,000	328,000

Note: 1) Existing Number of Connection
2) " as of May '83

2) Meters

It is recommended that the PDAM standarize all the house meters on Multi-jet type with dial type meter, as practices at present, for 1/2" - 1-1/2" water meter and Waltman type meter for 2" and above (Type of meter proposed is discussed in Appendix MIV-9). The number of meter installations which are required up to the year 2005 are projected at 5 year invervals and are presented in Table 4.18.

Some of the existing service connections are not provided with meters, and meters of many service connections are damaged and do not work properly. As of July 1983, 8517 connections out of 135,300 were not metered. Program of placement of meters on existing unmetered connections and existing damaged meters to be replaced is discussed in rehabilitation program in the Master Plan. Those meters are required to be purchased in addition to the proposed number of meters shown in Table 4.18.

Table 4.18 Schedule of Meter Installation (For New Connection)

Year	Meter Size 1/2"-1 1/2" Number of Meter	Additional Required	Meter Size 2" - 16" Number of Meter	Addition Required Meter	Total Number of Meter	Total Additional Required Meter
1983	126,095	0	688	0	126,783	0
1984	134,800	8,705	700	12	135,500	8,717
1985	147,760	12,960	740	40	148,500	13,000
1986	167,660	19,900	840	100	168,500	20,000
1987	197,510	29,850	990	150	198,500	30,000
1988	231,340	33,830	1,160	170	232,500	34,000
1989	268,150	36,810	1,350	190	269,500	37,000
1990	307,950	39,800	1,550	200	309,500	40,000
1991	350,740	42,790	1,760	210	352,500	43,000
1992	395,510	44,770	1,990	230	397,500	45,000
1993	442,280	46,770	2,220	230	444,500	47,000
1994	490,000	47,760	2,460	240	492,500	48,000
1995	539,790	49,750	2,710	250	542,500	50,000
2000	804,460	264,670	4,040	1,330	808,500	266,000
2005	1,130,820	326,360	5,680	1,640	1,136,500	328,000

Note:

1. Data source for year 1983 : Bidang Pemasaran (Customer Service), Direktur Usaha (Marketing), PDAM
2. Number of meters for each size is developed, considering past records since January 1982 through July 1984.
3. 8,517 number of connection out of total 135,300 in July 1983 are unmetered and are excluded from the total numbers of meter. However, almost all these connection are for house connection and small commercial connection and is assumed to be smaller size, 1" or below
4. Total number of meters include the existing number of meters and additionally installed meters of new connections
5. The schedule for installation of total 8,517 meters, unmetered connection (rounded 8,500) is discussed in the rehabilitation program in the master plan

4.6.6 Public Hydrant

According to the policy of DKI Jakarta, the following area will be given high priority for installation of public hydrants, namely, areas where population is dense; piped water hardly reaches; groundwater is not available; inhabitants are mainly of lower income group; and land for the hydrant installation is available. Approximately 100 numbers of new public hydrant are scheduled to be installed in year 1984 under this policy.

Government target on number of persons per public hydrant is 200, although the estimated average number of persons per public hydrant in the year 1980, is 900 - 1,000 based on the assumption of per capita demand of 10 lpcd and existing number of connection in operation of 871 out of registered numbers of 1,149 and average consumption per month of 272,100 m3/mon (9.07 m3/day).

It is proposed that the number of persons per public hydrant be gradually reduced from 1,000 in 1980 to 750 in 1990, and further to 200, the Government target in 2005. Based on this the proposed number of public hydrant is projected.

Increased number of connections which are required up to the year 2005 are presented in Table 4.17.

Public hydrant location is distributed to provide piped water to the low income groups that will not have service connections. Number of public hydrants proposed are distributed to each Kotamadya considering water demand for Low income groups and are shown in Table 4.19.

Table 4.19 Public Hydrant Distribution

Area	Schedule of Public Hydrant					
Kotamaya	1984 (Aug 1984)	1985	1990	1988	2000	2005
PUSAT (Central)	466	500	790	1,120	2,430	2,280
TIMUR (East)	86	190	520	950	1,440	3,120
BARAT (West)	481	500	770	1,330	2,100	4,410
SELATAN (South)	57	120	350	670	960	1,610
UTARA (North)	419	470	870	1,410	2,020	3,670
Total	1,509	1,780	3,300	5,480	7,950	15,090

The present practice of public hydrants, namely, water vendors are selling water exclusively taking water through the hydrant, is proposed to be gradually abolished, by installing hydrants from which residents take water directly. The improvement schedule of the hydrants for this purpose are presented in Table 4.20.

Table 4.20 Improvement Schedule of Hydrants Murni (Hydrant used for Public use through water vendor)

Area Kotamadya	Existing Numbber (Aug. 1984)	Improvement Schedule 1985	1986	1987	1988	1989	1990
PUSAT (Central)	77	7	10	15	15	15	15
TIMUR (East)	6	-	-	-	2	2	2
BARAT (West)	94	9	15	15	15	20	20
SELATAN (South)	3	-	-	-	-	-	3
UTARA (North)	231	11	40	45	45	45	45
Total	411	27	65	75	77	82	85

The number of connection shown in the above Table 4.20, are proposed to be installed in addition to the new increase hydrant.

A typical sketch of a proposed public hydrant system is shown in Fig. 4.16.

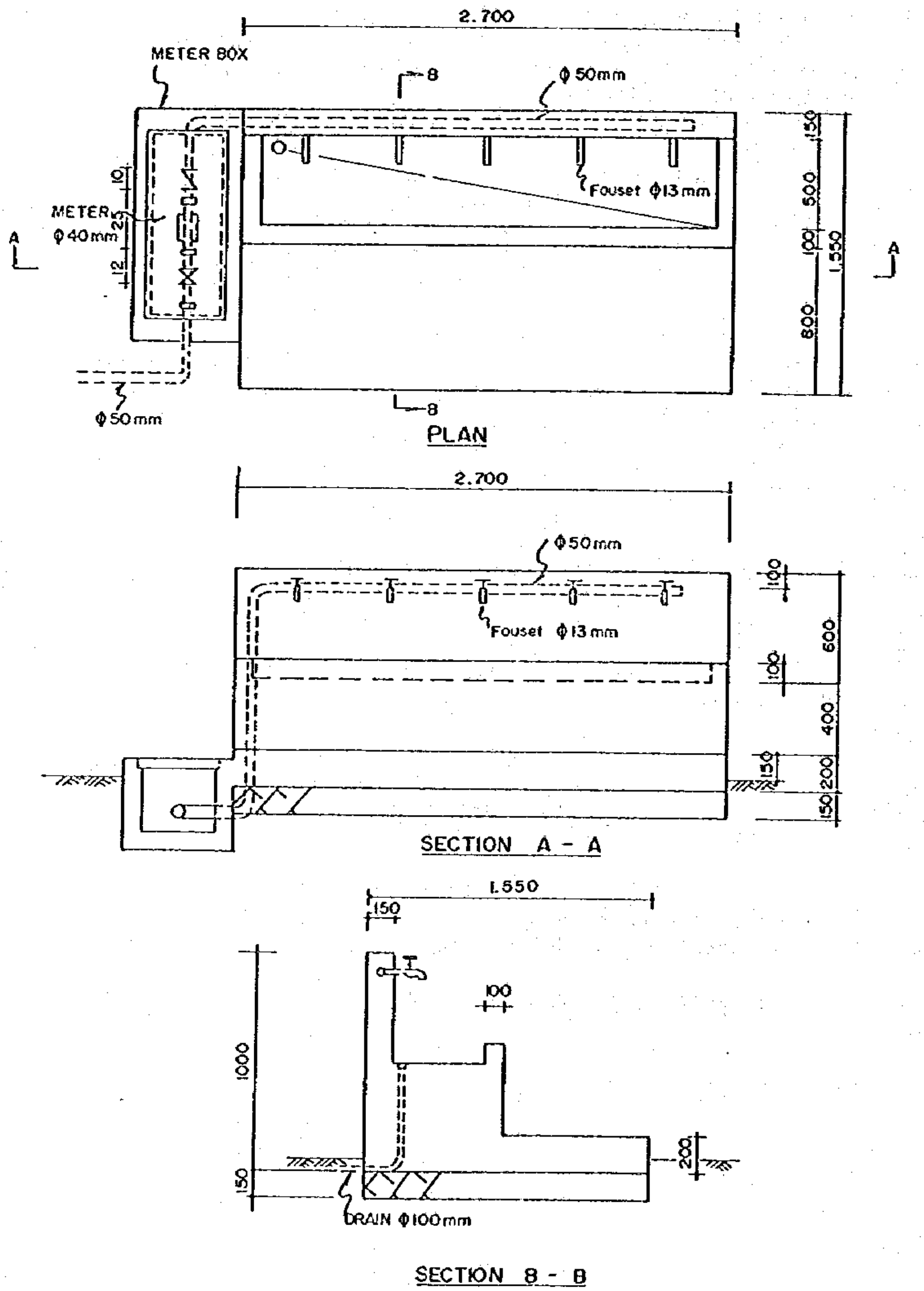


Fig 4.16 PROPOSED PUBLIC HYDRANT SYSTEM

JAKARTA WATER SUPPLY DEVELOPMENT PROJECT	JICA

4.6.7 Meter Repair Shop and Meter Storage

The present conditions of operation and maintenance of the meter repair shop and meter storage are discussed in Section 3.7__.

For improving present meter reparing work, it is proposed that additional meter test facility and machines be furnished as shown below.

Items	Capacity	Numbers
a. Meter Test Facilities (For Larger meters)	2" - 12"	1
b. Sand bluster	0.5 - 1.0 KW	2
c. Gasket cutting machine Gasket for Flanged type larger meter		2
d. Universal Type milling Machine Used for beveling gear for larger meters		1

It is proposed that a meter test facilities for larger meters, sand bluster, and gasket cutting machine will be installed under First Phase project. A univeral type milling machine is proposed to be furnished sometime after the year 2000 or around when the numbers of larger meter placed on service pipeline is increasing and repair and testing requirement of the meters become high and frequent.

Space of the Repair Shop

Space for test bench and testing seems large enough at present and also in near future until the year 1995 or around. However, the work place for reparing should be enlarged and the existing machines should be placed with sufficient space provided to ensure safety in work.

Layout of proposed enlargement of repair shop is shown in Fig. 4.7 with proposed enlargement of the shop.

In addition to the existing test bench for small size meter, 2 numbers by the year 2000 and further 3 numbers by the year 2005 are required. These additional test benchs are proposed to be installed at the office space presently used and office space is moved to upstairs of the present meter shop or as an alternatives a new shop with floor space of about 300 m2 be constructed during Third Stage.

In order to meet increased need of repair and maintenance of meters future, approximately 3 and 4 times of repair and maintenance staff will required by year 2000 and 2005 respectively.

Meter Storage

It is recommended to provide more space for storage and access. Further, the storage for large size meter shall be provided, separately from small size meter, with chain block or crane.

The layout of meter storage is shown on Fig. 4.17.

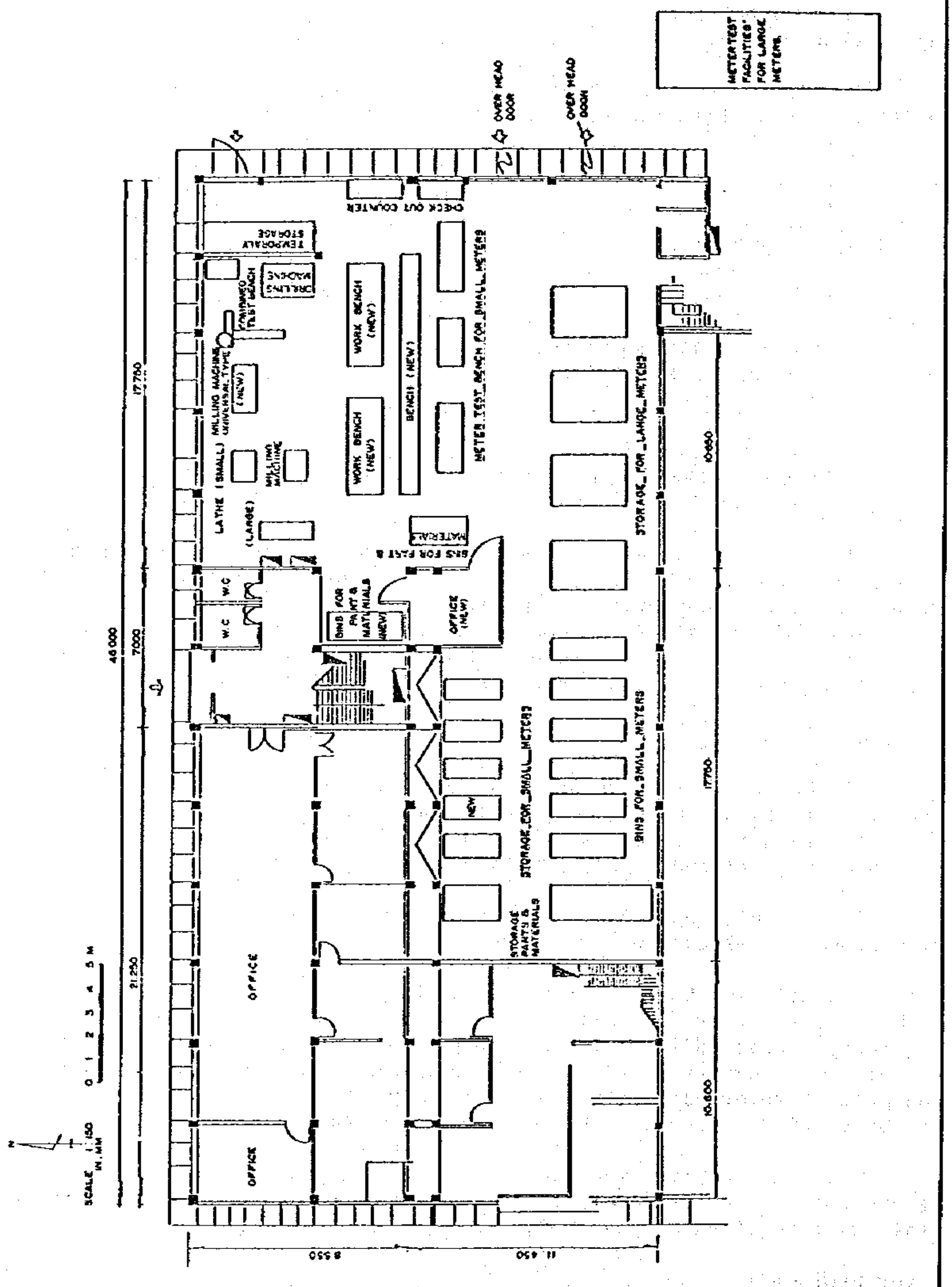


FIG 4.17 GENERAL LAYOUT OF METER REPAIR SHOP

JAKARTA WATER SUPPLY DEVELOPMENT PROJECT | JICA

4.7 Cost Estimate

The project cost estimates of each stage of the Master Plan are calculated and presented in Table 4.21, broken down into foreign and local currency components.

The total costs for the Second Stage Project including land cost, power receiving cost, administration cost, engineering services fee and contingencies amounts to Rp.723 billion or US$721 million equivalent and those for the Third Stage Project, Rp.1,103 billion or US$ 1,099 million equivalent. The costs are estimated based on the rate as of March 1984.

Estimates for all civil works are based on the prevailing market price of materials and labours in Jakarta, while for supplies of materials and plant equipment are based on the international bidding or international shopping procedures.

The local currency component comprises the costs for local labours and materials locally produced, handling and local transportation of imported materials, tax and overhead cost for civil works and expartriate's local expenditures.

The foreign currency component includes imported materials and equipment (CIF price), small sizes of pipe materials locally produced and foreign currency component of expartriate services fee.

Physical contingencies of 10 per cent are added to the basic costs of materials and works and price contingencies to both basic cost and physical contingency for overall period of the project. Price contingencies applied for local currency component are 15 percent for 1984, 11 percent for 1985, and 7 per cent per annum thereafter, and for foreign currency component are 7.5 per cent for 1984, 7.0 per cent for 1985, and 6.0 per cent thereafter.

Table 4.21 Cost Estimate of The Project

UNIT : F/C '000 US$
L/C million Rp.

Description	SECOND STAGE						THIRD STAGE	
	First Phase		Second Phase		Total			
	F/C	L/C	F/C	L/C	F/C	L/C	F/C	L/C
1. Raw Water Intake								
1) Serpong	2,970	1,780	-	-	2,970	1,780	-	-
2. Raw Water Transmission								
1) Serpong - Lebackbulus	10,201	3,721	-	-	10,201	3,721	-	-
2) Canal 1 end - Cakung	-	-	-	6,353	-	6,353	-	-
3) Cakung - Buaran	-	-	-	3,822	-	3,822	-	-
Sub-total	10,201	3,721	-	10,175	10,201	13,896	-	-
3. Treatment Plant								
1) Buaran	7,020	7,970	-	-	7,020	7,970	-	-
2) Lebakbulus	7,411	6,651	-	-	7,411	6,651	24,000	24,400
3) Cakung	-	-	12,000	12,400	12,000	12,400	7,200	7,320
Sub-total	14,431	14,621	12,000	12,400	26,431	27,021	31,200	31,720
4. Treated Water Transmission								
1) Buarang - DC, R1	13,907	4,504	-	-	13,907	4,504	-	-
2) Cakang - DC, R1	-	-	948	810	948	810	5,842	2,680
3) Cakung - DC, R3	-	-	10,352	3,467	10,352	3,467	-	-
4) DC, R2 - DC, R3	-	-	5,474	2,029	5,474	2,029	167	19
5) DC, R3 - Lebakbulus	-	-	2,310	1,038	2,310	1,038	3,849	1,744
6) Lebakbulus - DC, R4	3,606	1,325	-	-	3,606	1,325	6,207	2,391
7) DC, R4 - DC, R5	-	-	-	-	-	-	7,499	3,049
Sub-total	17,513	5,829	19,084	7,344	36,597	13,173	23,564	9,883

(Continued)

Description	SECOND STAGE						THIRD STAGE	
	First Phase		Second Phase		Total			
	F/C	L/C	F/C	L/C	F/C	L/C	F/C	L/C
5. Distribution Facilities								
1) Pejompongan System	4,825	4,015	785	751	5,610	4,766	274	260
2) Pulogadun System	1,786	1,633	1,118	1,050	2,904	2,683	510	482
3) Buaran/Cakung System	2,960	3,413	736	710	3,696	4,123	11,577	9,577
4) Dc, R 1 System	14,885	11,031	3,540	3,718	18,395	14,749	8,813	7,329
5) DC, R 2 System			439	483	439	483	7,269	7,418
6) DC, R 3 System			9,097	7,711	9,097	7,711	2,936	3,680
7) Lebakbulus System	9,527	7,747	965	971	10,492	8,718	4,970	5,209
8) DC, R 4 System	9,812	7,734	2,371	2,304	12,183	10,038	7,139	7,157
9) DC, R 5 System	-	-	-	-	-	-	7,986	7,321
Sub-total	43,765	35,573	19,051	17,698	62,816	53,271	51,474	48,433
10) Secondary Main	3,177	2,911	4,411	3,406	7,588	6,317	6,786	5,853
11) Tertiary Main	13,393	14,860	16,967	18,823	30,360	33,683	32,148	35,665
Sub-total	16,570	17,771	21,378	22,229	37,948	40,000	38,934	41,518
Construction Cost	105,450	79,295	71,513	69,846	176,963	149,141	145,172	131,554
6. Land Aquisition								
1) Serpong Intake Station	-	56	-	-	-	56	-	-
2) Raw Water Transmission	-	460	-	-	-	460	-	-
3) Raw Water Canal								
Canal 1 end - Cakung	-	-	-	370	-	370	-	-
Cakung - Buaran	-	-	-	245	-	245	-	-
4) Treatment Plant								
Buaran	-	1,280	-	-	-	1,280	-	-
Lebakbulus	-	1,719	-	-	-	1,719	-	5,720
Cakung	-	-	-	2,000	-	2,000	-	1,200

(Continued)

Description	SECOND STAGE						THIRD STAGE	
	First Phase		Second Phase		Total			
	F/C	L/C	F/C	L/C	F/C	L/C	F/C	L/C
5) Distribution Center								
DC, R1	-	386	-	-	-	386	-	231
DC, R2	-	-	-	55	-	55	-	105
DC, R3	-	-	-	115	-	115	-	90
DC, R4	-	245	-	-	-	245	-	115
DC, R5	-	-	-	-	-	-	-	253
Sub-total	-	4,146	-	2,785	-	6,931	-	7,714
7 Power Receiving								
1) Serpong Intake Station	-	600	-	-	-	600	-	-
2) Treatment Plant								
Buaran	-	-	-	-	-	-	-	-
Lebakbulus	-	620	-	-	-	620	-	920
Cakung	-	-	-	680	-	680	-	520
3) Distribution Center								
DC, R1	-	620	-	-	-	620	-	420
DC, R2	-	-	-	500	-	500	-	480
DC, R3	-	-	-	460	-	460	-	440
DC, R4	-	400	-	-	-	400	-	440
DC, R5	-	-	-	-	-	-	-	520
Sub-total	-	2,240	-	1,640	-	3,880	-	3,740
8. Administration Cost (2%)	-	1,714	-	1,485	-	3,199	-	2,860
9. Engineering Cost	7,382	2,379	5,006	2,095	12,388	4,474	10,162	3,947
TOTAL (1 - 9)	112,832	89,774	76,519	77,851	189,351	167,625	155,334	149,815

(Continued)

Description	SECOND STAGE						THIRD STAGE	
	First Phase		Second Phase		Total			
	F/C	L/C	F/C	L/C	F/C	L/C	F/C	L/C
10. Contingencies								
1) Physical Contingency	11,283	8,978	7,652	7,785	18,935	16,763	15,533	14,982
2) Price Contingency	62,885	79,248	75,829	111,364	138,714	190,612	321,133	444,203
Sub-total	74,168	88,226	83,481	119,149	157,649	207,375	336,666	459,185
Total Project Cost	187,000	178,000	160,000	197,000	347,000	375,000	492,000	609,000

4.8 Implementation Schedule

The implementation of the present water supply project is carefully planned and arranged for the purpose of satisfactory execution taking into account the present conditions of the ongoing projects. The implementation shall be undertaken by stagewise construction in order to avoid a heavy investment to execute at one time the construction of entire facilities for the future program in the year 2005. Two stages of implementation are recommended with Second Stage for the target year 1995 and Third Stage in 2005.

The reason of two stages implementation is summarized as follows :

(1) In general, in planning waterworks facilities, the target year will be set considering 10 years time ahead, on the basis of economical scale of facilities.

(2) In the year 1995, maximum daily water demand is found to be approximately half of the ultimate water demand. It is reasonable to divide the stage and set the target in 1995.

(3) The cost of investment will be justified on the basis of financial viability.

(4) The provisions of local budget can be facilitated.

The Second Stage Project is proposed to be executed by two phases in its implementation, namely, First Phase and Second Phase, and starts from the First Phase Program as a next extension project.

With the feasibility study for the First Phase of Second Stage Project, loan negotiation for the external resource is to be conducted with the lending agency/ies. Upon negotiation the project is scheduled to commence in July 1986 with the engineering service for detailed design of the facilities of 15 months duration, and successively the tendering is to be done for procurement of equipment and materials and construction of civil works. Treatment plant will start for operation in 1991 and the project be completed by the end of 1993. The Second Phase of Second Stage Project will be commenced with reviewing present Master Plan and preparing the feasibility study, and whole works are to be completed by middle of 1997.

The Third Stage Program is scheduled to commence with the engineering services for a feasibility study and followed by an appraisal by the lending agency, loan negotiation, detailed design engineering, and tendering and construction of civil works, and to be completed in the year 2005.

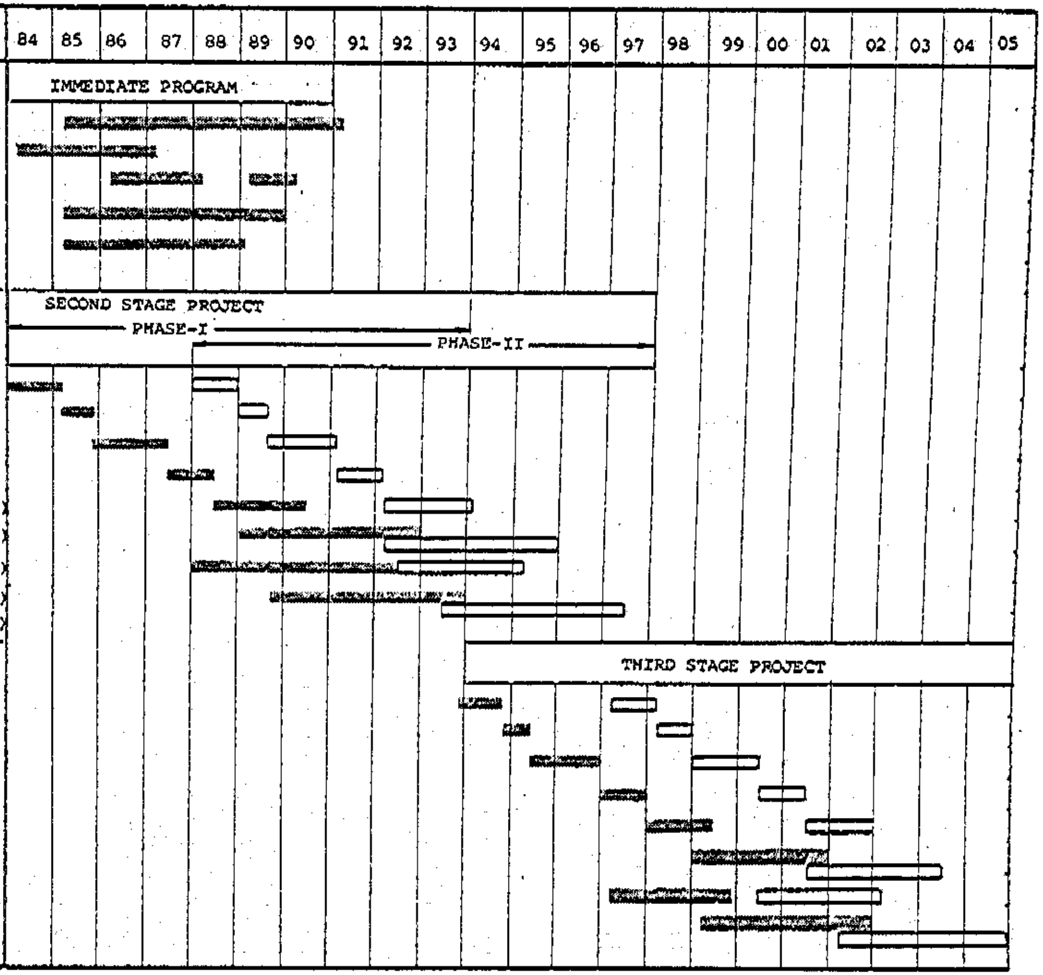
Before the commencement of Third Stage Program, particularly, the review for a future development of the water supply system shall be performed at the stage or feasibility study for Third Stage Program on the basis of the tendency of population growth, past records of water consumption and development of each service area.

The implementation schedule for the whole plans are shown in Table 4.22.

JAKARTA WATER SUPPLY DEVELOPMENT PROJECT

Table 4.22 MASTER PLAN IMPLEMENTATION SCHEDULE

Program	Period (M)	Cost (Rp. Bill)
IMMEDIATE PROGRAM		
1) Rehabilitation Works of D/P	72	13.25
2) Improvement of Pejompongan Plant I	36	4.34
3) Short Term Improvement	36	1.17
4) Improvement of Distribution Pipelines	57	18.23
5) Immediate Project	46	26.89
Sub-total		63.88
SECOND STAGE PROJECT		
1) Review of M/P and Preparation of F/S	20(12)	-
2) Appraisal and Loan Negotiation	8(8)	-
3) Selection of Consultants and D/D	19(18)	-
4) Tendering/Award of Contract	12(12)	-
5) Manufacturing/Shipping of P/E	24(18)	29.14(17.92)
6) Manufacturing/Shipping of Pipes	48(46)	95.47(66.59)
7) Construction of Civil Works	42(33)	28.11(22.46)
8) Pipelaying Works	52(48)	53.42(63.18)
Sub-total		206.14(170.15)
THIRD STAGE PROJECT		
1) Review of M/P and Preparation of F/S	12(12)	-
2) Appraisal and Loan Negotiation	8(8)	-
3) Selection of Consultants and D/D	18(18)	-
4) Tendering/Award of Contract	12(12)	-
5) Manufacturing/Shipping of P/E	18(18)	46.97
6) Manufacturing/Shipping of Pipes	36(36)	124.09
7) Construction of Civil Works	33(33)	58.89
8) Pipelaying Works	46(46)	105.91
Sub-total		335.86



Note : M/P : Master Plan
F/S : Feasibility Study
D/D : Detailed Design Engineering

D/P : Distribution Pipelines
P/E : Plant Equipment

Cost : shown in Rp. Billion in present cost as of March 1984.
( ) : Phase II

4.9 PDAM Proposed Organization

This section deals with a future proposed organization to be set up for PDAM by way of improving and modifying the existing one to attain maximum efficiency and economy of its system management and operation and to facilitate construction and implementation of the future water supply development.

On the basis of review of the present structure of PDAM organization which was presented in Chapter 3, alternative structures were studied and evaluated. Such alternative structure were considered in the light of the following principles:

- Improvement of organization structure with an appropriate number of staff,

- Improvement and strenghening of the divisional make up for sound operation,

- Upgrading of water service for customers.

4.9.1 Alternative Structure

The operation of water service in PDAM has been expanded due to the growth of population served and expansion of the facilities. To meet the changing requirement, water service operation has been decentralized from Central Office to Branch Offices in field. Reflecting this, structure of organization and administration has been modified accordingly to meet increasing needs in the field offices. As a result of this decentralization of administration, there are 13 field offices located in the city. These field offices are; 6 Branch Offices, 6 Unit Offices for specially assigned areas, and 1 Rayon. Besides, PDAM is also undertaking operation and maintenance of 4 treatment plants and 6 mini plants (Instalasi). The present structure is shown in Fig. 3.14 in Chapter 3.

Central office in Pejompongan is the center of administration, conducting planning and designing for distribution and connections, technical, and customer service, billing and collection, procurement, water meter administration, accounting and personnel affairs in administration. While, meter reading, collection of water bills, installation of house connection and minor repair works are conducted in field office. The operation of treatment plants and mini plants are handled independently by Instalasi.

The decentralized operations, however, requires strict management including direction and supervision by the Central Office, and if proper management is not maintained in the Central Office, operation of the Branch Offices would not function well. In the present organization, these field offices are under the direct control of the President Director, and due to this, required coordination with other divisions in the Central Office is not sufficiently maintained, and there are several problems existed between the Central Office and Branch Offices as to communication, direction and order and information system. Alternative for organization modification, therefore, should be considered and evaluated keeping the above in mind.

1) Alternative 1

The alternative intends to keep close administrative and operational coordination between the Central Office and Branch Offices and Instalasi. Therefore, operation of Branch Offices is shifted from direct control of the President Director to the related divisions to attain full coordination through required operational direction and supervision. Production Division in Technical & Production should be improved and conduct strict supervision for operations in Instalasis and Mini Plants which will be under the Production Divisions. Logistic Division under Business will be shifted to Technical and Production and conduct activities with coordination with other technical divisions. The Branch Offices and Units will be placed under Business which will suprervise branches operation to the fullest extent. Under this arrangement, it is intended to provide prompt service to customers and at the same time to improve and upgrade procedures of meter reading and operation of billing and collection. Inspection Division and Research and Development Division will also be strengthened to conduct strict monitoring of operation in each division covering not only technical but financial, and to carry out research work respectively. Other divisions and sections will be remained same. Fig. 4.18 shows alternative structure 1.

2) Alternative 2

This alternative is intended to rearrange areas of Production Division and Technical Division and Branch Offices by shifting divisions. Same as alternative 1, Instalasis and Mini Plants should be placed under Production Division, and Branch Offices and Units will be placed under Business. In addition, project coordination and monitoring will be provided in Technical & Production to participate future extension project from planning stage to implementation stage. In the case of alternative 2, Logistic Division will be shifted to Administration and Finance to maintain coordination with Finance and Accounting Division. Under this shift, control of equipment and materials will be expected. Other divisions and sections will be remained same. Fig. 4.19 shows alternative structure 2.

3) Alternative 3

This alternative is more strengthened structure than the alternatives 1 and 2. The alternative is intended to strengthen areas of Technical/Production and Business. In order to strengthen the Technical & Production, this is divided into Engineering and Planning, and Production and Operation respectively. Under the new Engineering and Planning Directorate, Design Divison and Constuction Division is newly provided, in addition to the existing Technical Planning Division. Under the Production and Operation Directorate, Mechanical and Electrical Services Division is provided. Distribution is remained same under Production and Operation Directorate. At the same time, Business is improved and changed into Service Directorate. Customer Service is upgraded into division level and perform operations of customer service. Customer Complaints Section now

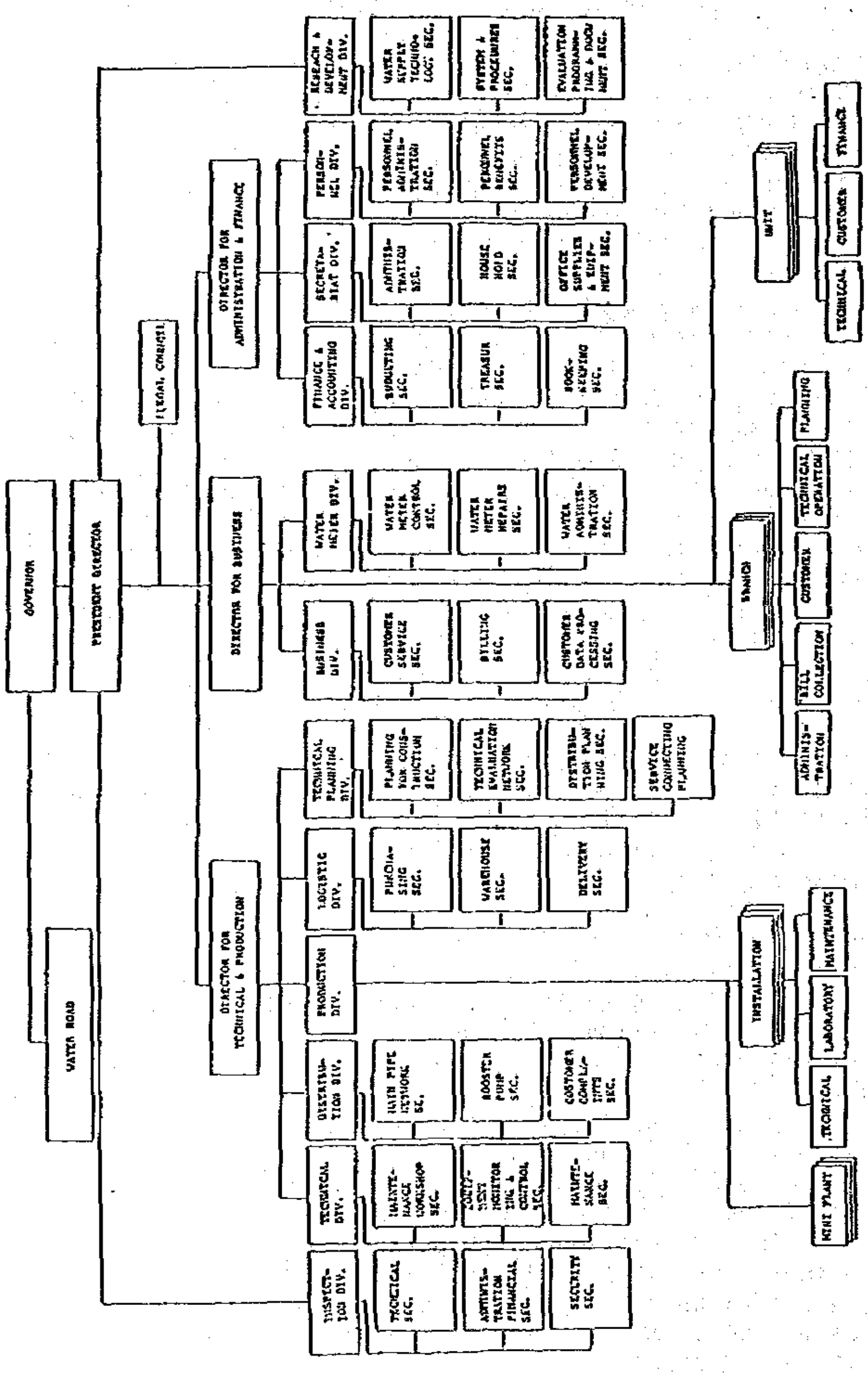


FIG 4.18 MODIFIED ORGANIZATION STRUCTURE ALTERNATIVE 1

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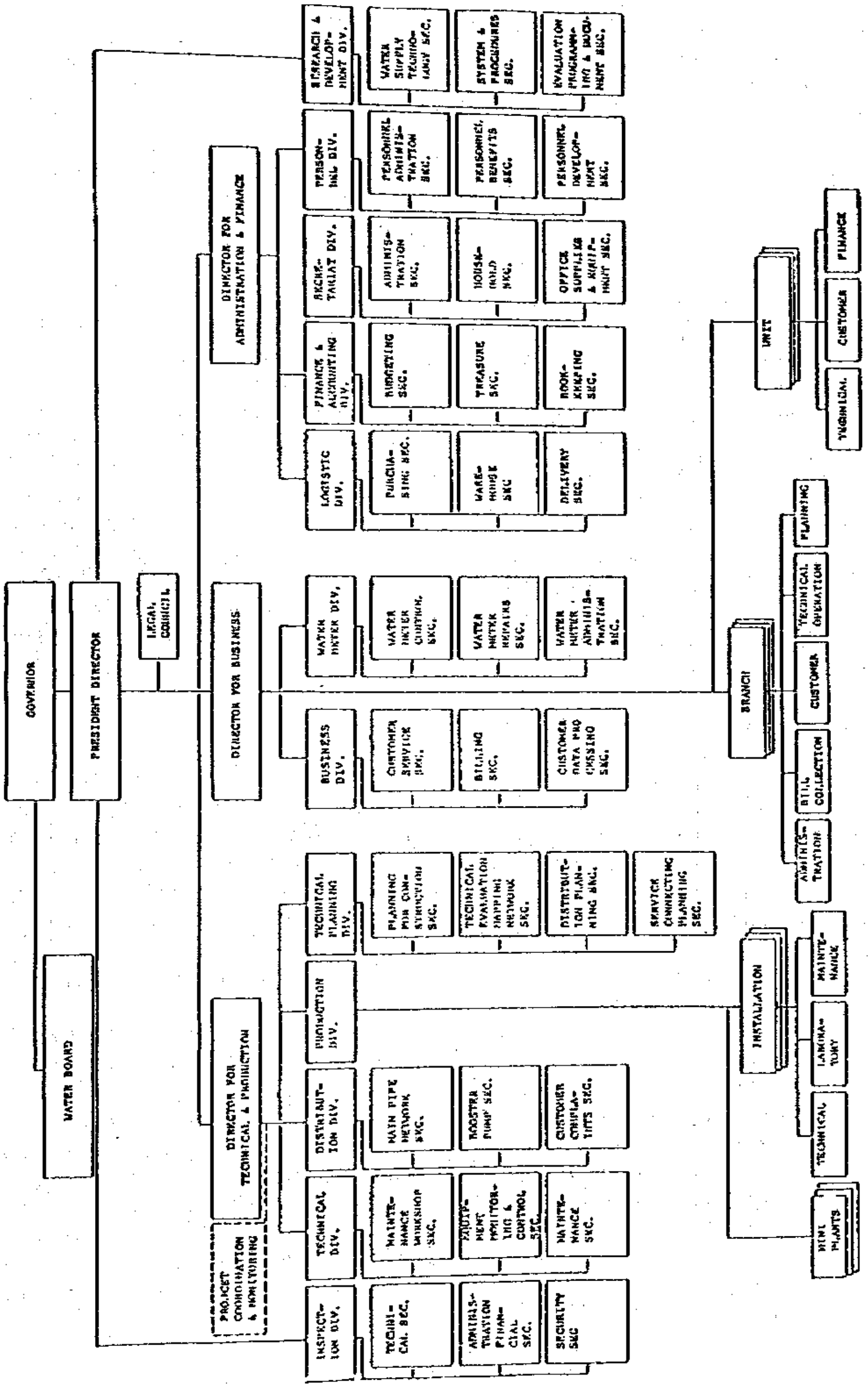

FIG 4.19 MODIFIED ORGANIZATION STRUCTURE ALTERNATIVE 2

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under Distribution Division is shifted under this Customer Division. Also, operations of Branch Offices is direct control under the new Service Directorate. By this arrangement, effective and quick services to the customers is expected. Logistic now under business is shifted to Administration and Finance. Other function is remained same. Fig.4.20 shows alternative structure 3.

4.9.2 Proposed Organization and Modification Required

1) Proposed Organization

All the above alternatives are considered along the improvement of the existing organization. As mentioned earlier, alternatives are intended to attain good management in the organization to cope with the future extension program by strengthening of operation and maintenance and improvement of water supply service. Table 4.23 shows comparision of alternative structure modification. Alternatives 1 and 2 are intended to change the structure minimum, while alternative 3 required more changes and upgrading. Consideration is, however, given to avoid a drastic change of the present structure, as paying attention of not causing overall disturbance in the existing organization, still encouraging maximum implementation possibility. It is therefore recommended for PDAM to employ alternative 3, for future modification.

2) Modifications Required

The proposed structure can be implemented in stages and modified to meet future requirements in order to justify the major problems of expansions and rehabilitation envisaged in the Master Plan. In accordance with the proposed organization, restructuring including creation of new divisions and sections, shifting and regrouping of the existing organization should be implemented.

(1) Creation of Engineering and Planning Directorate.

In order to strengthen the existing Directorate of Technical & Production, the Directorate is divided into Engineering and Planning and Production and Operation respectively to conduct works of technical planning and operation separately. Under the new Engineering and Planning Directorate, Design Division and Construction Division is newly provided in addition to the existing Technical Planning Division. Under the Production and Operation Directorate, also Mechanical and Electrical Services Division is provided in addition to Headworks Operation and Maintenance Division and Distribution Operation and Maintenance Division.

(2) Upgrading of Service Directorate

The former Business Directorate will be upgraded and changed into Service Directorate to be improved and directly involved in customer service activities including meter reading, and billing and collection with an objective of providing prompt service to customers together with an

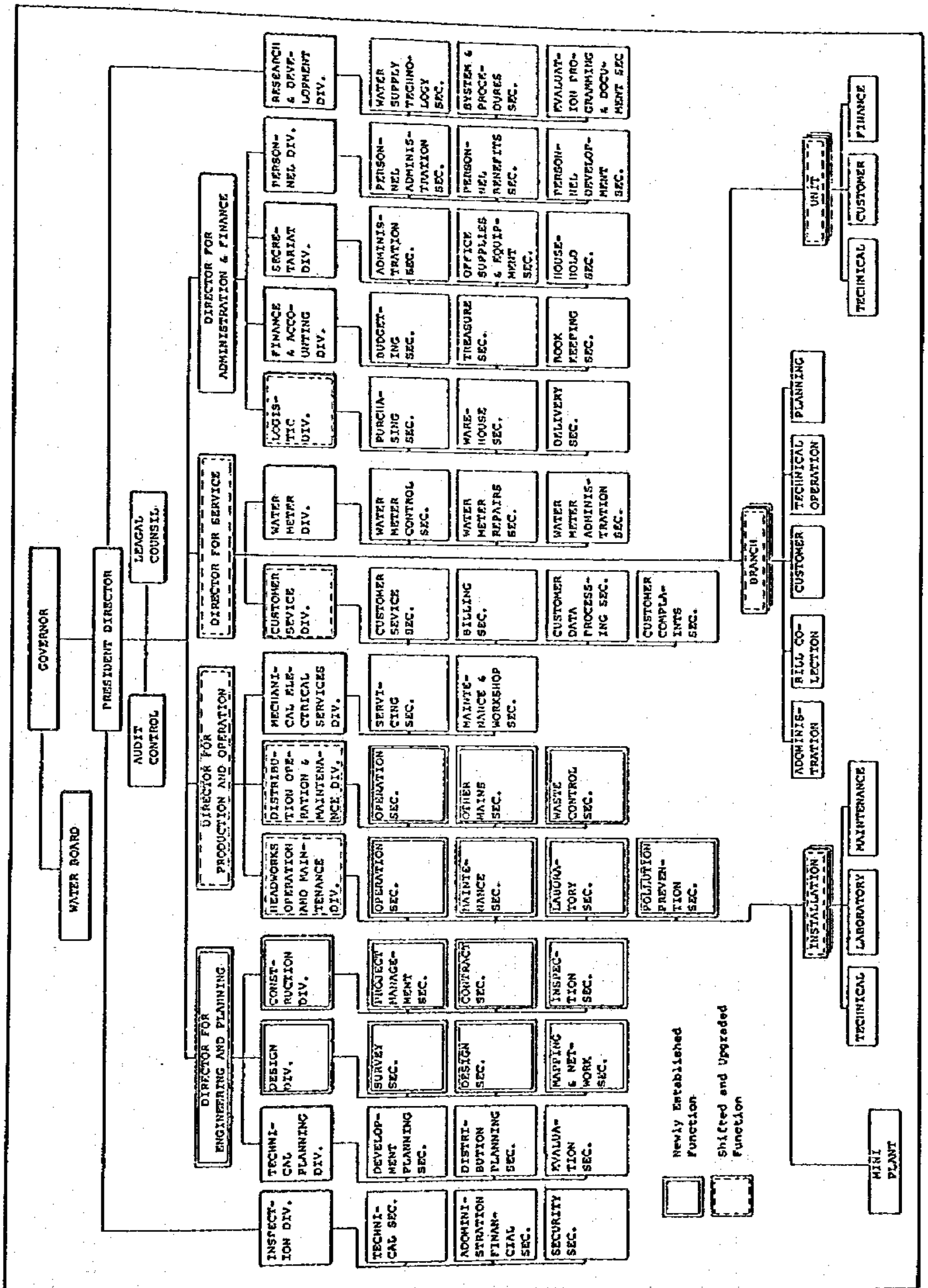

FIG 4.20 MODIFIED ORGANIZATION STRUCTURE ALTERNATIVE 3

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Table 4.23 Comparison of Alternative Structure Modification

Factors	Alternative 1	Alternative 2	Alternative 3
1. Coordination between Central Office and Branch Offices	- Improved better and close, since line of organization is shifted from President Director to the level of related existing division.	- Same as Al. 1	- Strengthened and improved, since line of organization is shifted from President Director to related newly provided division and existing division.
2. Organization Modification Required	- Logistic Division is shifted from the line under Business to the line under Technical & Production. - Branches and Units are under Business. - Installation/Mini-Plants are under Production Division, Technical & Production. - Legal Section under Secretariat is reformed newly in Legal Council independently under the line of President Director.	- Logistic Division is shifted from the line under Business to the line under Administration & Finance. - Branches and Units are under Business. - Installation/Mini-Plants are under Production Division, Technical & Production. - Legal Section under Secretariat is reformed newly in Legal Council independently under the line of President Director. - Project Coordination & Monitoring are provided when required under Technical & Production.	- Technical & Production will be divided into Engineering and Planning and Production and Operation. Under Engineering and Planning, new divisions of Design and Construction are provided. - Under Production and Operation, new divisions of Headworks Operation and Maintenance and Mechanical and Electrical Services are provided. - Business is modified to Service. - Logistic Division is shifted from the line under Business to Administration and Finance. - Audit Control and Legal Council are formed independently under the line of President Director.
3. Degree of Organization Change	- Minimum	- Minimum	- Significant, but not drastic.
4. Maximum Implementation Possibility	- Better	- Better	- Best

improvement and upgrading of procedures of metér reading and billing and collection. The Customer Service Division has been created in stead of Marketing Division in the Service Directorate. The Logistic Division is shifted from the Service Directorate to the Administration and Finance Directorate. The Customer Complaints Section now under the Distribution Division is shifted under this Customer Division.

(3) Shift of Line Organization of Branch Offices, Installation, and Units.

The operation and daily activities of Branch Offices, Special Units and Rayons are now under direct management of the President Director. Considering the fact that the importance of operational activities in Branch Office and Unit is increasing because of the current management system of decentralization, the line of direction should be shifted from the President Director to the respective division of the Directorate. The operation of Branch Offices and Units was arranged under control of new Service Directorate, receiving necessary direction and supervision from Director of Service. The operation of Instalasi including mini plants was shifted under the Production Division of the Production and Operation Directorate to receive strict supervision. This arrangement leads Instalasi to achieve the target of maximum operation at the respective plants to meet the required standards of water production.

The functions of newly proposed directorate, divisions and sections are enumerated below.

It is noted that the evaluation of the existing divisions of Inspection, and Research and Development was also made in the overall function of PDAM organization. There might be a possibility to absorb the Inspection into the function of Audit Control and the Research and Development into the function of Technical Planning Division. However, it is considered too early to make such an amalgamation of this stage when evaluated the current functions and responsibilities of the both divisions. It is recommended, therefore, that possibility and timing of such amalgamation should be practiced in conjunction with the detailed study of PDAM management consultant in a later stage.

ENGINEERING AND PLANNING

TECHNICAL PLANNING DIVISION

- Prepares plans and designs of PDAM facilities
- Progress technical standards for new works and ensures conformity
- Coordinates and controls technical research in PDAM
- Supervises, monitors and evaluates technical performance and reports on them

DESIGN DIVISION

- Plans, Manages and coordinations surveys and designs work
- Conducts surveys for construction and pipe laying works
- Prepares design and documents for tender
- Prepares maps and drawings and keep good control of them

CONSTRUCTION DIVISION

- Conducts project administration and monitoring
- Maintains progress of project in conformity with construction schedule
- Maintains coordination among parties concerns to keep planned progress of construction projects

PRODUCTION AND OPERATION

HEADWORKS OPERATION & MAINTENANCE DIVISION

- Conducts monitoring on raw water quality and quantity
- Operates and maintains treatment processes and related facilities and takes actions based on reports from laboratory
- Coordinates with related agencies on raw water sources
- Coordinates with Distribution Division on water production
- Monitors water quality of treatment plants and each treatment plant

DISTRIBUTION OPERATION & MAINTENANCE DIVISION

- Conducts maintenance of existing transmission and distribution
- Makes precautions for accidents and also actions against accidents occured on distribution pipelines
- Coducts detection of leakage on existing pipes
- Conducts analysis of causes of leakage including loss of water

MECHANICAL & ELECTRICAL SERVICES DIVISION

- Conducts routine machanical and electrical equipment operations
- Performs maintenance and minor repairs on equipment

SERVICE

CUSTOMER SERVICE DIVISION

- Maintains records of water consumption and account receivable
- Conducts billing procedures
- Examines and evaluates meter standing and customers data from Branch and Units

WATER METER DIVISION

- Verifies the accuracy of water meters and tests and calibrates water meters
- Oversees the installation of water meters to unmetered connections under the metering program

4.9.3 Staff Development Plan

1) Staff Development

PDAM management structure was proposed to reinforce its function and staff further up to the level that can facilitate future expansion of the system and organization. Such structural reinforcement was, on the basis of review and analysis, considered in the following areas of PDAM.

- Overall management should be upgraded to meet the present operation policy of decentralization.

- Functions on supervisory, regulatory and research should be restructured to measure the achievement of the planned management goals.

- Functions on planning and operation should be strengthened by reinforcing their structure and manpower.

- Present low productivity and imbalanced staff of engineering and administration should be rectified.

PDAM staff development is to be implemented considering;

- to fulfill required number of staff in the newly established divisions and functions.

- to reinforce manpower in the areas of engineering and production.

- to meet personnel requirement program in short, medium and long term range.

2) Proposed Staffing Plan

Taking into account organization modification required and staff development requirement, staffing plan up to the year 2005, target year of the present Master Plan, required in each of divisions and sections in the revised PDAM organization, is developed to ensure the implementation of the proposed water supply expansion program. The estimation of number of personnel required is based on the necessity of the respective work and is developed on the assumption from the increase of future production capacity and also increase of service connections and population served or simply increase of customers. The analysis of past data on personnel development in PDAM was also taken into consideration.

The number of personnel required in each of the level of division of the Directorate are estimated from the year 1985 up to 2005 and presented in Table 4.24 as guidelines in determining in number of staff with qualifications to conduct assigned work in the functions.

Table 4.24(A) Proposed Staffing Plan (1)

YEAR	MANAGE	ENGINEER	PRODUCT	SERVICE	RESERCH	FINANCE	INSPECT	BRA.UNIT	MINI-P	INSTALL	AUDIT	LEGAL	TOTAL	YEAR
	0	0	0	0	0	0	0	0	0	0	0	0	0	
	0	0	0	0	0	0	0	0	0	0	0	0	0	
1984	4	86	198	101	116	175	42	908	121	257	8	9	2025	1984
1985	4	93	199	112	116	175	44	972	138	264	8	9	2134	1985
1986	5	104	221	126	118	177	46	1074	138	272	8	9	2298	1986
1987	5	122	247	148	138	198	47	1250	138	277	8	9	2587	1987
1988	5	144	269	172	160	207	56	1351	138	277	8	9	2796	1988
1989	5	167	291	198	183	216	62	1457	138	347	8	9	3081	1989
1990	5	187	359	227	212	226	71	1568	138	346	8	9	3356	1990
1991	5	211	359	269	246	243	80	1659	109	484	8	9	3682	1991
1992	5	244	359	290	270	254	82	1787	109	484	8	9	3901	1992
1993	5	269	359	324	302	266	84	1901	109	484	8	9	4120	1993
1994	5	295	403	358	334	278	85	2018	109	560	8	9	4462	1994
1995	5	328	403	393	367	287	92	2159	109	560	8	9	4720	1995
1996	5	354	536	430	400	289	100	2281	109	610	8	9	5131	1996
1997	5	386	536	467	400	289	108	2402	109	610	8	9	5329	1997
1998	5	418	536	505	400	294	115	2521	109	610	8	9	5530	1998
1999	5	449	536	544	400	298	123	2643	109	610	8	9	5734	1999
2000	5	483	553	584	400	308	131	2782	109	814	8	9	6186	2000
2001	5	517	556	626	400	313	141	2932	109	814	8	9	6430	2001
2002	5	553	556	669	400	316	148	3084	109	814	8	9	6671	2002
2003	5	591	556	716	400	323	163	3258	109	945	8	9	7083	2003
2004	5	632	556	765	400	328	173	3428	109	945	8	9	7358	2004
2005	5	676	556	818	400	330	176	3621	109	945	8	9	7653	2005

Table 4.24(B) Proposed Staffing Plan (2)

DESCRIPTION	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
1) MANAGEMENT STAFF	4	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
PRESIDENT DIRECTOR	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
DUPTY DIRECTOR																						
- Engineering	-	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
- Production	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
- Services	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
- Adomi. & Finance	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2) ENG. & PLANNING	86	93	104	122	144	167	187	211	244	269	295	328	354	386	418	449	483	517	553	591	632	676
TECH. PLANNING DIV.	42	46	52	59	70	81	92	104	122	132	145	160	174	190	205	221	237	254	272	291	311	332
- Senior Engineer	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
- Associ. Engineer	1	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
- Technicians	5	5	5	5	5	5	10	10	10	10	10	10	15	15	15	15	15	15	15	15	15	15
- Office Staff	35	36	42	49	60	71	77	89	107	117	130	145	154	170	185	201	217	234	252	271	291	312
DESIGN DIV.	21	23	25	29	34	40	46	52	59	65	72	80	87	95	103	110	119	127	136	145	155	166
- Senior Engineer	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
- Associ. Engineer	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
- Technicians	3	3	3	3	3	3	5	5	5	5	5	5	7	7	7	7	7	7	7	7	7	7
- Office Staff	15	17	19	23	28	34	38	44	51	57	64	72	77	85	93	100	109	117	126	135	145	156
CONSTRUCTION DIV.	23	24	27	34	40	46	49	55	63	72	78	88	93	101	110	118	127	136	145	155	166	178
- Senior Engineer	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
- Associ. Engineer	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
- Inspectors	2	2	2	3	3	3	5	5	5	7	7	7	7	7	7	7	10	10	10	10	10	10
- Technicians	3	3	3	5	5	5	5	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
- Office Staff	15	16	19	23	29	35	36	40	48	55	61	71	76	84	93	101	107	116	125	135	146	158
3) PRODUCT & OPERATION	198	199	221	247	269	291	359	359	359	359	403	403	536	536	536	536	553	556	556	556	556	556
HEADWORKS O & M DIV.	48	49	49	51	51	51	53	53	53	53	53	53	63	63	63	63	63	63	63	63	63	63
- Senior Engineer	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
- Associ. Engineer	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
- Assist Engineer	6	6	6	8	8	8	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
- Technicians	10	10	10	10	10	10	10	10	10	10	10	10	15	15	15	15	15	15	15	15	15	15
- Hydrochemist	4	5	5	5	5	5	5	5	5	5	5	5	10	10	10	10	10	10	10	10	10	10
- Office Staff	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
DISTRI. O & M DIV.	119	119	141	163	185	207	270	270	270	270	314	314	437	437	437	437	454	457	457	457	457	457
- Senior Engineer	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
- Associ. Engineer	2	2	2	2	2	2	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
- Assist. Engineer	5	5	7	9	11	13	14	14	14	14	20	20	20	20	20	20	20	23	23	23	23	23
- Technicians	19	19	29	39	49	59	104	104	104	104	128	128	128	128	128	128	140	140	140	140	140	140
- Office Staff/Work.	92	92	102	112	122	132	147	147	147	147	161	161	284	284	284	284	289	289	289	289	289	289
M & E SERVICES DIV.	31	31	31	33	33	33	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36
- Senior Engineer	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
- Associ. Engineer	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
- Technicians	5	5	5	7	7	7	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
- Office Staff	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23

Table 4.24 (C) Proposed Staffing Plan (3)

DESCRIPTION	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
4) SERVICE	101	112	126	148	172	198	227	269	290	324	358	393	430	467	505	544	584	626	669	716	765	818
COSTOMER SERVICE DIV	46	57	71	93	117	143	172	198	225	259	293	328	365	402	440	479	514	556	599	641	690	738
- Chief of Staff	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
- Adomi. Assistant	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
- Public Relat. Spec	5	5	5	7	7	7	7	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
- Computer Speci.	5	5	5	7	7	7	7	10	10	10	13	13	13	13	13	13	13	13	13	13	13	13
- Office Staff	30	41	55	73	97	123	152	172	199	233	264	299	336	373	411	450	485	527	570	612	661	709
WATER METER DIV.	55	55	55	55	55	55	55	71	65	65	65	65	65	65	65	65	70	70	70	75	75	80
- Chief of Staff	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
- Adomi. Assistant	3	3	3	5	5	5	5	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
- Office Staff	51	51	51	49	49	49	49	60	54	54	54	54	54	54	54	54	59	59	59	64	64	69
5) RESERCH & DEVELOPMEN	116	116	118	138	160	183	212	246	270	302	334	367	400	400	400	400	400	400	400	400	400	400
- Senior Engineer	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
- Associ. Engineer	1	1	1	3	3	3	3	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
- Assist Engineer	6	6	6	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
- Programmer Speci.	2	2	2	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
- Statictic. Speci.	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
- Office Staff	104	104	106	116	138	161	190	222	246	278	310	343	376	376	376	376	376	376	376	376	376	376
6) ADOMINI. & FINANCE	175	175	177	198	207	216	226	243	254	266	278	287	289	289	294	298	308	313	316	323	328	330
LOGISTIC DIV.	38	38	38	47	47	47	47	53	53	53	53	53	53	53	58	62	66	71	74	81	86	88
- Chief Purch. Offic	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
- Purchasing Officer	2	2	2	5	5	5	5	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
- Inventory Officer	3	3	3	6	6	6	6	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
- Contract Adomi.	2	2	2	5	5	5	5	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
- Office Staff	30	30	30	30	30	30	30	30	30	30	30	30	30	30	35	39	43	48	51	58	63	65
FINANCE & ACCOUNT DV	55	55	55	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60
- Chief of Staff	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
- Budget Officer	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
- Account Officer	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
- Accountants	2	2	2	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
- Office Staff	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
SECRETARIAT DIV.	40	40	40	40	40	40	40	40	40	40	40	40	42	42	42	42	42	42	42	42	42	42
- Chief Secretaty	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
- Adomi. Assistant	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
- Secretary	3	3	3	3	3	3	3	3	3	3	3	3	5	5	5	5	5	5	5	5	5	5
- Office Staff	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33
PERSONNEL DIV.	42	42	44	51	60	69	79	90	101	113	125	134	134	134	134	134	140	140	140	140	140	140
- Chief of Pers.Offi	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
- Assist Pers. Offic	3	3	3	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
- Office Staff	38	38	40	45	54	63	73	84	95	107	119	128	128	128	128	128	134	134	134	134	134	134
7) INSPECTION DIV.	42	44	46	47	56	62	71	80	82	84	85	92	100	108	115	123	131	141	148	163	173	176
- Senior Engineer	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
- Chief of Inspecter	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
- Inspectors	1	1	1	1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
- Assist. Adomini.	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
- Office Staff	36	38	40	40	47	53	62	71	73	75	76	83	91	99	106	114	122	132	139	154	164	167

Table 4.24(D) Proposed Staffing Plan (4)

DESCRIPTION	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
8) BRANCH & SPECIALUNIT	908	972	1074	1250	1351	1457	1568	1659	1787	1901	2018	2159	2281	2402	2521	2643	2782	2932	3084	3258	3428	3621
BRANCH OFFICES	80	81	84	96	104	113	120	123	133	140	165	178	191	202	214	225	237	253	267	293	300	318
- Chief of Staff	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
- Associ. Engineer	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
- Adoministrator	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
- Assist.Engineer	12	13	16	21	24	28	30	32	36	40	42	46	49	53	56	59	63	67	71	76	81	86
- Field Tech.	50	50	50	57	62	67	72	73	79	82	105	114	124	131	140	148	156	168	178	199	201	214
SPECIAL UNIT	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28
- Assosiate Engineer	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
- Adoministrator	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
- Assistant Engineer	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
- Field Technicians	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
OFFICE STAFF	800	863	962	1126	1219	1316	1420	1508	1626	1733	1825	1953	2062	2172	2279	2390	2517	2651	2789	2937	3100	3275
- Installator	100	135	190	285	310	335	360	365	395	410	410	440	450	460	465	470	490	510	530	550	580	610
- Meter Reader	144	157	177	207	241	278	318	361	406	453	501	551	602	654	707	761	817	876	937	1002	1071	1145
- Bill Collector	102	112	126	148	172	198	227	258	290	324	358	393	430	467	505	546	584	626	669	716	765	818
- Clerk	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400
- Adomini. Staff	54	59	69	86	96	105	115	124	135	146	156	169	180	191	202	213	226	239	253	269	284	302
9) MINI PLANT	121	138	138	138	138	138	138	109	109	109	109	109	109	109	109	109	109	109	109	109	109	109
- Associ. Engineer	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
- Asistant Engineer	8	9	9	9	9	9	9	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
- Adoministrator	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
- Technicians	82	94	94	94	94	94	94	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69
- Office Staff	7	8	8	8	8	8	8	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
- Workers	22	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
10) INSTALLATION	257	264	272	277	277	347	346	484	484	484	560	560	610	610	610	610	814	814	814	945	945	945
- Associ. Engineer	3	3	3	3	3	4	4	4	4	4	5	5	5	5	5	5	7	7	7	8	8	8
- Asistant Engineer	12	12	12	12	12	15	14	20	20	20	23	23	23	23	23	23	26	26	26	29	29	29
- Adoministrator	3	3	3	3	3	4	4	6	6	6	7	7	7	7	7	7	9	9	9	10	10	10
- Technicians	172	177	182	187	187	235	235	332	332	332	386	386	386	386	386	386	540	540	540	640	640	640
- Office Staff	12	12	12	12	12	16	16	22	22	22	26	26	26	26	26	26	34	34	34	38	38	38
- Workers	55	57	60	60	60	73	73	100	100	100	113	113	163	163	163	163	198	198	198	220	220	220
11) AUDIT CONTROL	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
- Auditor Chief	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
- Auditor	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
- Office Staff	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
12) LEGAL COUNCIL	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
- Legal Officer	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
- Assistant	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
- Office Staff	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5

Table 4.24(E) Proposed Staffing Plan (5)

	JOB GROUP	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
T	X- Top Management	4	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
T	1- Senior Engineer	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
T	2- Associ. Engineer	31	34	34	36	36	37	39	41	41	41	42	42	42	42	42	42	44	44	44	45	45	45
T	3- Assistant Engineer	56	58	63	76	81	90	94	100	104	108	119	123	126	130	133	136	143	150	154	162	167	172
T	4- Technicians	299	316	331	350	360	418	473	547	547	547	625	625	637	637	637	637	803	803	803	903	903	903
T	5- Field Technicians	57	57	57	64	69	74	79	80	86	89	112	121	131	138	147	155	163	175	185	206	208	221
T	6- Hydrochemist	4	5	5	5	5	5	5	5	5	5	5	5	10	10	10	10	10	10	10	10	10	10
T	7- Adoministrator	31	31	31	37	37	38	38	47	47	47	48	48	48	48	48	48	50	50	50	51	51	51
T	8- Economist	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
T	9- Accountants	4	4	4	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
T	10- Computer Speci.	5	5	5	7	7	7	7	10	10	10	13	13	13	13	13	13	13	13	13	13	13	13
T	11- Programmer Speci.	2	2	2	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
T	12- Purchosing Officer	3	3	3	6	6	6	6	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
T	13- Statictic. Speci.	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
T	14- Public Relat. Spec	5	5	5	7	7	7	7	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
T	15- Inventory Officer	3	3	3	6	6	6	6	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
T	16- Budget Officor	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
T	17- Auditor	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
T	18- Legal Officer	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
T	19- Secretary	3	3	3	3	3	3	3	3	3	3	3	3	5	5	5	5	5	5	5	5	5	5
T	20- Clerk	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400
T	21- Adomini. Staff (B)	54	59	69	86	96	105	115	124	135	146	156	169	180	191	202	213	226	239	253	269	284	302
T	22- Bill Collector	102	112	126	148	172	198	227	258	290	324	358	393	430	467	505	546	584	626	669	716	765	818
T	23- Installator	100	135	190	285	310	335	360	365	395	410	410	440	450	460	465	470	490	510	530	550	580	610
T	24- Meter Reader	144	157	177	207	241	278	318	361	406	453	501	551	602	654	707	761	817	876	937	1002	1071	1145
T	25- Office Staff	604	622	663	719	813	914	1017	1126	1217	1320	1440	1557	1777	1854	1936	2018	2120	2211	2300	2411	2516	2618
T	26- Workers	77	82	85	85	85	98	98	125	125	125	138	138	188	188	188	188	223	223	223	245	245	245
T	27- Chief of Pers.Offi	5	5	5	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
T	28- Inspectors	6	6	6	7	9	9	11	11	11	13	13	13	13	13	13	13	16	16	16	16	16	16
T	TOTAL STAFF	2025	2134	2298	2587	2796	3081	3356	3682	3901	4120	4462	4720	5131	5329	5530	5734	6186	6430	6671	7083	7358	7653

This staffing plan was proposed on the assumption that the production increase of the plant will be made according to the phased program and total number of connection will be increased in order to distribute produced water to customers. The total staff required in the year 1990, 1995, 2000 and 2005, up to the end of the Master Plan is 3,356, 4,720, 6,186, and 7,653, respectively. The estimates indicate that staffing plan is so arranged as to keep the level of a minimum number required to the extent possible.

As discussed in earlier section, the present personnel condition is not necessarily satisfactory. Particularly problems exist in distribution of personnel indicating that engineering functions are extremely facing shortage of engineers and technicians. To rectify the problems, much attention was paid for upgrading the staff level in engineering functions in the proposed staff plan. It is important that staff planning activities should be carried out on a continuous basis and the plan should be revised periodically as changing conditions require. Manpower plan of PDAM major category is shown in Table 4.25.

Table 4.25 Manpower Plan of Major Category

Staff Category	1984	1990	1995	2000	2005
Engineer	101	147	179	201	231
Technicians	299	473	625	803	903
Field Technicians	57	79	121	163	221
Hydrochemist	4	5	5	10	10
Accountants	4	8	8	8	8
Bill Collectors	102	227	393	584	818
Installators	100	360	440	490	610
Meter Reader	144	318	551	817	1,145

Vigorous efforts will be required to recruit the required numbers of qualified staff scheduled, and to achieve the target of the proposed staffing plan as intended, PDAM is required to develop:

- Allocation of necessary budget on the basis of recruitment policy.

- Having concensus on necessary recruitment among divisions in PDAM and an approval from DKI Water Board.

- Arrangement for improved salaries to attract the competent professionals as required for future assurance of maximum level of water supply operations.

- Administering the position classification and pay plan and fringe benefits.

- Administering the personnel transaction records of advancement and promotion, demotion, transfer and layoff.

- Provision of complete personnel records and audit of the entire system for a continuing check on audit of payrolls against the roster of employees.

- Formulation of necessary training program to achieve the manpower plan.

In case PDAM will face difficulties in future to conduct installation of connections and meters by its in-house staff, it is advisable for PDAM to introduce a system of sub-contract with qualified contractors registered in PDAM's list to attain targets of installation of connections as recommended.

5. CONCLUSION AND RECOMMENDATION

5. CONCLUSION AND RECOMMENDATION

1) Future Extension Program

The Water Supply Master Plan of the City of Jakarta proposed a long term development program up to the year 2005, and recommended its implementation by stages, namely, Second Stage succeeding to First Stage Project now in progress and Third Stage. Each Stage is executed by further two Phases to avoid the heavy investment taking into consideration the construction period of the Project. Outline of the Project in each Stage is briefed below:

Description	Second Stage Project	Third Stage Project
Target Year	1995	2005
Total Population	9,949,600	11,998,900
Population Served	6,523,000	8,784,000
Served Area (km2)	383	454
Supply Capacity	Total 23.3 m3/sec Existing 12.3 m3/sec Additional 11.0 m3/sec	Total 36.3 m3/sec Existing 23.3 m3/sec Additional 13.0 m3/sec
Phase of Implementation	2 phases	2 phases
Water Source	WTC 3.2 m3/sec Cisadane R. 3.2 m3/sec TJC 5.3 m3/sec	Canal 3 10.7 m3/sec TJC 3.2 m3/sec
Location of Treatment Plant	Buaran, Lebakbulus and Cakung	Lebakbulus and Cakung
Major Facilities - Raw water intake and transmission	Raw water main ø1500 x 16.5 km Raw water canal Cap. 20 m3/s x 6.7 km Cap. 11 m3/s x 4.9 km	-
- Treatment Plant	Buran 3.0 m3/s Lebakbulus 3.0 m3/s Cakung 5.0 m3/s	Lebakbulus 10.0 m3/s Cakung 3.0 m3/s
- Treated water transmission	ø1000 to ø1650 x 55 km	ø1100 to ø1500 x 45 km
- Distribution	Service area: 6 zones Distribution center: 2 Distribution pipeline: Trunk mains, ø300 to ø1800 x 289 km Secondary/tertiary mains, ø50 to ø250 x 3,600 km	Service area: 9 zones Distribution center: 5 Distribution pipeline: Trunk mains, ø300 to ø1200 x 202 km Secondary/tertiary mains, ø50 to ø250 x 3,800 km
- Total costs	Equivalent in Rp.723 billion including price contingency of Rp. 330 billion	Equivalent in Rp.1,103 billion including price contingency of Rp. 767 billion

2) First Phase Program of Second Stage Project

It was recommended that the feasibility study is performed for the First Phase of Second Stage Project to meet the water demand up to the year 1990 as an immediate extension project by the reasons that raw water has been assured by DGWRD for water requirement and the investment cost is not always unaffordable amount in financing of the foreign and local currencies components.

3) Water Source

Development of water resources has been repeatedly studies by the Government covering of the region of Cisadane-Jakarta -Cibeet for the past several years. Present water supply master plan was prepared on the basis of the said study as available water sources. Raw water from both east and west of the project area was proposed in the Master Plan putting emphasis on uninterrupted water supply to Metropolis and also economy of the project. Water sources and its timing for the Jakarta water supply, are (1) enlargement of the WTC for short requirement up to the year 1990, (2) Construction of the TJC and the Cisadane River at Serpong for mid-term requirement up to 1999, and (3) the Cisadane River development and TJC for long-term requirement after 2000. Future water development program should be implemented as scheduled, as well as the WTC enlargement project to cope with additional raw water for Pulogadung Plant in 1987 and Buaran Plant in 1989.

Further, the Cisadane basin study is scheduled to commence in middle of 1985 and complete in 1987. The allocation of raw water in future should be further reviewed, taking into account the result of the study.

4) Immediate Program

The following works identified as the Immediate Program should be executed as soon as practicable to alleviate present poor water supply conditions and to make full utilization of the production capacity available from Pulogadung Plant (3,000 l/sec) and Buaran Plant (2,000 l/sec).

(1) Rehabilitation works for the water losses reduction

a. Replacement of old and defective water meter and installation of new meter for unmetered service connection (1985 - 1990).
   Total costs : Rp. 3,235 million

b. Replacement of old distribution pipes installed in 1920's (1986 - 1990)
   Total costs : Rp. 13,377 million

c. Replacement of old service connections (1986 - 1990)
   Total costs : Rp. 842 million

d. Leakage abatement study and training of leakage survey (1986 - 1990)
   Total costs : Rp. 5,189 million

(2) Relocation of the intakes of existing treatment plants for raw water improvement (to be implemented by DGWRD, 1986 - 1990). The construction and operation costs are to be charged as the raw water tariff from POJ to PDAM

(3) Short term improvement for water treatment (strengthening chlorination, 1986 - 1989)
    Total costs : Rp. 1,170 million

(4) Improvement of distribution pipes for secondary and tertiary mains for full utilization of available water production (1985 - 1989)
    Total costs : Rp. 26,859 million

(5) Immediate Project for production increase of 2,000 l/sec (1985 - 1988)
    Total costs : Rp. 37,148 million

5) Improvement of operation of the existing plants

Present treatment condition in the plants is not always good; Ammonium, Organic Matter, Color and Faecal Coli are not satisfactorily removed. Appropriate chemical dosing to cope with the raw water quality should be performed inclusive of strengthening of chlorination. Especially, for improving present undesirable treatment conditions, the following are recommended:

(1) Analyses of water quality

i. Quantitative analysis of Ammonium should be carried out daily at the Pejompongan I and II to grasp raw water condition and apply appropriate chemical dosage.

ii. Water quality of the clarified water in some parameters should be measured at the Pulogadung to know treatment condition every day.

iii. Daily analysis of Faecal Coli in the clarified, filtered and finished waters of the three plants should be carried out together with analysis of free and combined residual chlorines.

(2) Training of plant operators

i. Making up operation manual on chemical application, desludge and backwash of each treatment plant

ii. Training of operators for chemical application and operation of treatment facilities

iii. Training of laboratory staff on water quality analysis and its implications

iv. Organizing close operation between plant operator and laboratory staff

6) Population projection

Total population forecast in the year 2005 was provided with 12 million persons in the DKI Jakarta Master Plan in accordance with the Jabotabek Metropolitan Development Plan (JMDP). It is anticipated that if some of those programs under JMDP or City Master Plan were not implemented or delayed then this target population would be realized in the 1996 to 1998. Therefore, monitoring the progress of JMDP and the population growth before 1995 is definitely necessary for the Water Supply Master Plan.

7) Water requirement

The water requirement was estimated on the basis of projected population served and unit demands for domestic and non-domestic uses actually from past record. The projection was also performed for the case of; i) large population growth in future is forecasted due to delaying implementation of the Jakarta Strategic Development, ii) the Government Policy of Pelita IV is applied, and iii) percentage of middle and higher income groups and per capita demand for domestic use are not increased as was expected. If the Jakarta Strategic Development Plan was not implemented as scheduled or delayed, water requirement in the year 2005 will come up in 1996 or around. Then, periodical review of population served and unit water demands is recommendable.

8) Groundwater

There is a limit in groundwater potentiality in Jakarta area. On the other hand, demand for groundwater is quite large; presently its potential is almost exhausted by the existing groundwater users, and in the future the estimated demand gradually exceeds the potential. Further, in case the execution of projects or the water demand deviates from the water supply master plan, the gap between the demand and potential of groundwater my widen. Even under such situations, as much potential groundwater as possible must be reserved to secure drinkable water for population who inhabit outside of the served area or cannot connect with the public water mains.

To meet the above requirement, the following are recommandable.

(1) The existing large users of groundwater should be encouraged, or forced if required, to shift to the public water supply. To this end, regulations on groundwater use must be strengthened by revising groundwater charge to a necessary level, or prohibiting its use.

(2) New extraction of groundwater in large quantity should be prohibited.

(3) Groundwater investigation should be continuously carried out with regard to its potential availability, and its distribution in the project area.

(4) Distribution pipelines should be extended with priority to areas where groundwater is found not available.

9) Institution and Organization

Major capital works of water supply system are constructed by the central government under terms and condition of repayment of capital costs, and PDAM Jaya concentrates operation and maintenance of the facilities after turned over from the central government. The present arrangement and practice of water supply undertaking will continue for sometime considering incapacity of the present PDAM engineering force and capital investment finance.

With respect to water resources development and raw water supply and protection, an independent water management institution is recommended to be established with staff of representatives from the respective agencies concerned to organize integrated and coordinated plan of water resources development.

It is essential for PDAM to improve its organization and administration system for better operation and maintenance of facilities to be expanded in the Second Stage. Three alternatives of PDAM structure were evaluated, and among them, alternative 3 was recommended for future modification, proposing (i) creation of Engineering and Planning Directorate, (ii) upgrading of Service Directorate, and (iii) shift of line of organization of Branch Offices, Instalasis and Units together with specifications of job.

The proposed number of personnel required in each of the level of division of the Directorate in different qualifications was estimated and presented as guidelines in determining in number of staff to conduct assigned work in the functions.

In order to meet the expansion of the systems in the Second Stage Project, PDAM is required:

(1) To maintain and/or upgrade level of service.

(2) To attain maximum utilization of the existing water supply facilities through efficient and effective control of every possible resources.

(3) To provide its customers with required services at the lower possible costs.

(4) To ensure further establishment of system of financial self-supporting.

10) Financial Aspects

PDAM's financial performance in the past several years, especially after the tariff revision in May 1983, appears to be sound, generating comfortable profits and making substantial contribution to DKI budget.

In order to further strengthen PDAM's financial capabilities for generating sufficient funds to meet the financial requirements of forthcoming expansion and improvement projects, the review of financial matters of this master plan study suggests that efforts should be forcused on the following issues:

In the light of vast financial requirements for meeting the people's needs for drinking water supply and recent stringent financial conditions of the central government, PDAM's capabilities to share the burden of investment costs must be strengthened. In this connection:

(1) Tariff should be reviewed every year and revision, if necessary, should be made with greater flexibility. Affordability, in addition to PDAM's financial requirements, should be carefully examined in determining the water rate and connection charges. Furthermore, tariff should be designed not to discourage people currently relying on ground water to use piped water.

(2) Administrative loss of revenues, i.e., delinquencies in paying water bills and administrative unaccounted-for water should be reduced to a greater extent.

(3) Meter installation, propoer meter maintenance, and correct meter reading should be regarded as a prerequisite for reducing the administrative loss.

The funds generated by PDAM should be used solely for expansion and improvement of water supply facilities and should not be taken out of PDAM to use for other purposes. In this connection:

(4) Tax obligations imposed on PDAM should be reconsidered by the authorities concerned.

(5) Contribution to DKI budget also should be reconsidered.

(6) Surplus funds should be accumulated in the hands of PDAM in order to flexibly meet the varying levels of cash outlay. It would happen, depending upon schedule of investment and repayment, that substantial cash surplus is generated in some years and serious shortages in other years.

In order to effectively invest the generated funds and to determine the degree of dependence on outside financial sources, it is necessary to prepare appropriate financial planning based on data and information which correctly reflect the existing financial operation and performance. In this connection:

(7) Medium and long-term financial plan should be prepared. Such plan should continuously be revised taking into consideration changes in later years.

(8) Accrual basis accounting should be fully implemented.

(9) Assets including inventories should be appropriately recorded paying particular attention to their aquisition date and valuation.

(10) External audit by public accountant should be recognized, and be fully utilized, as an effective means to establish appropriate accounting systems and practices.

The two-year program of a detailed management study covering most of the above items is now under way by PDAM consultants and is expected to be completed by the end of 1984. The study is supposed to make recommendations and to prepare an implementation program for improvement. It is expected that PDAM will pay due attention to the study results and take actions in accordance with the recommendations wherever relevant.

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