3.6.2 Master Plan Study on Surface Water Sources

(1) Procedure for Master Plan Study

The master plan study on surface water resources development to supply municipal and industrial (M&I) water uses to the DKI Jakarta was made to preliminarily formulate the most attractive and favorable development plan from the scenarios and their alternatives, which were obtained by combining the dam schemes and conveyance systems recommended by the JWRMS and the SCCIWR, in consideration with the future water supply conditions to the Tangerang-Serang area.

The following is the procedure for the master plan study and its flowchart is shown in **Figure-362.1** :

1) Inventory of the existing water sources and development plans of water sources and conveyance systems
2) Study on necessity of immediate measure for water sources
3) Selection of scenarios
4) Establishment of future water demand
5) Study on Scenario I
   a) Selection of alternative water resources development plans
   b) Water demand - supply balance analysis
   c) Establishment of implementation schedule of water sources and conveyance systems
   d) Financial analysis
   e) Comprehensive evaluation
   f) Final selection of proposed water resources development plan for Scenario I
   g) Proposed water resources development plan for Scenario I
   h) Unit raw water cost
6) Study on Scenario II
   a) Formulation of water resources development plan
   b) Water demand - supply balance analysis
   c) Establishment of implementation schedule of water sources and conveyance system
   d) Proposed water resources development for Scenario II
   e) Unit raw water cost
7) Final selection of proposed water resources development plan

Figure-362.1 PROCEDURES FOR MASTER PLAN STUDY ON WATER RESOURCES DEVELOPMENT PLAN (1/2)

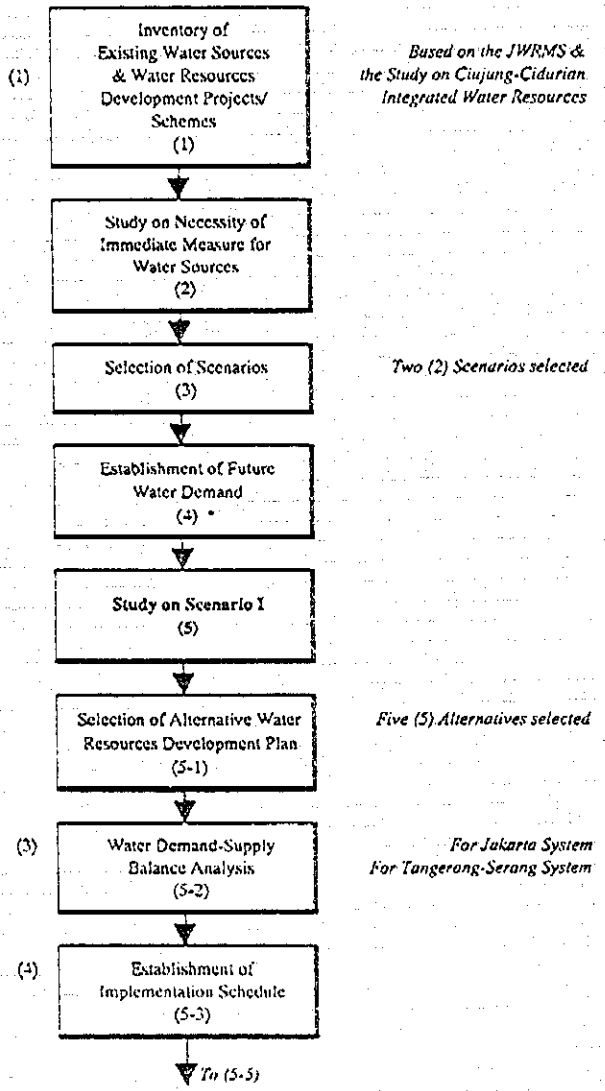
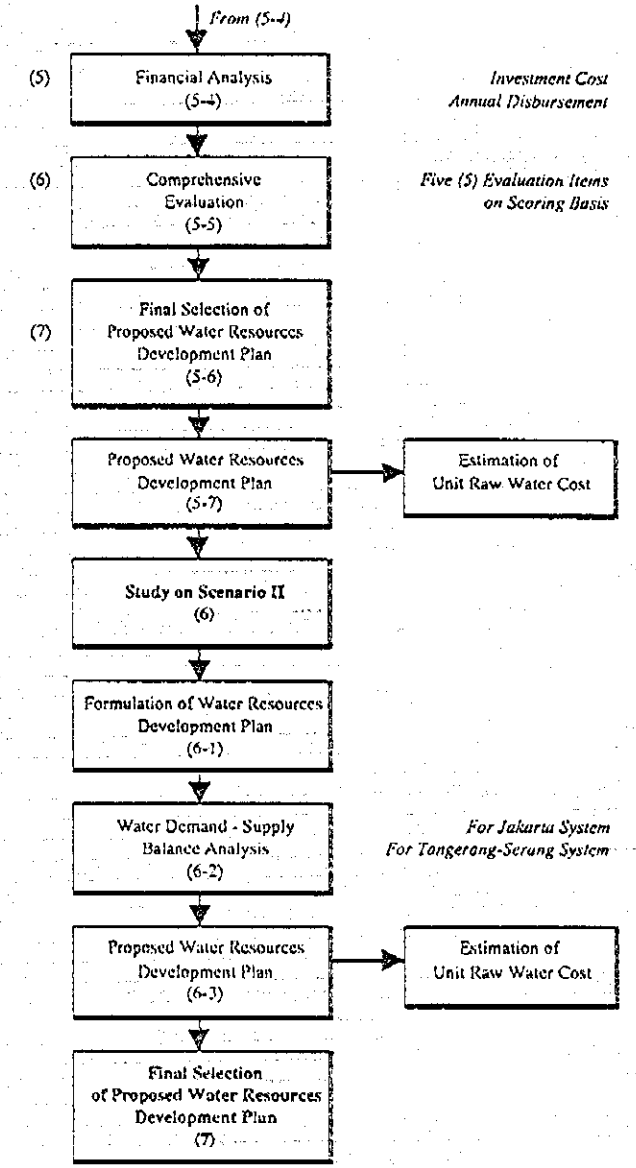


Figure-362.1 PROCEDURES FOR MASTER PLAN STUDY ON WATER RESOURCES DEVELOPMENT PLAN (2/2)



(2) Inventory of the Existing Water Sources and Development Plans of Water Sources and Conveyance Systems

As mentioned in the preceding Section 3.6.1, the Jabotabek Water Resources Management Study (JWRMS) and The Study on Ciujung-Cidurian Integrated Water Resources in Indonesia (SCCIWR) have proposed to implement several water sources and conveyance systems to meet future water demand. Taking into due consideration of the output of the said Study Reports, the following inventory of the existing water sources and development plans of water sources and conveyance systems was prepared for the purpose to formulate the most optimum and practical development plan in this master plan study :

Existing Water Sources

a) West Tarum Canal (Citarum River) : 16.1 m^3/sec
b) Serpong Treatment Plant (Cisadane River) : 2.8 m^3/sec

Development Plans

a) Conveyance 2 Scheme (Jatiluhur Dam/Reservoir, Citarum river) :
Phases I to III : 10 m3/sec each
(Canal 2 to be renamed as Conveyance 2)
(Pre-feasibility Study completed in 1984)

b) Karian Dam/Reservoir Scheme (Ciujung river) :
Phases I : 14.6 m3/sec Phase II : 3.3 m3/sec
(Feasibility Study completed by JICA in 1995)

c) Pasir Kopo Dam/Reservoir Scheme (Ciujung river) : 8.2 m3/sec
(Feasibility Study completed by JICA in 1995)

d) Tanjung Dam/Reservoir-Canal Scheme (Cidurian river) : 9.7 m3/sec
(Feasibility Study completed by JICA in 1995)

e) Cilawang Dam/Reservoir-Canal Scheme (Cidurian river) : 4.1 m3/sec
(Feasibility Study completed by JICA in 1995)

f) Karian-Serpong Conveyance System (KSCS)
(Feasibility Study completed by JICA in 1995)

(3) Study on Necessity of Immediate Measure for Water Sources

1) Required Period for Completion of First Implementation

The following two (2) alternative water sources and conveyance systems were considered as the first implementation in consideration of the recommendation by the JWRMS and the SCCIWR :

a) Karian Dam/Reservoir and Karian-Serpong Conveyance System Scheme (Karian Scheme)
b) Conveyance 2 Scheme

The required period till completion of the scheme/project was assumed, counting the periods for the required procedures and actions as follows :

(Unit : Year)

		Karian Scheme	Conveyance 2 Scheme
Feasibility study		-	2
Procedures for environmental assessment & Financial arrangement for compensation	:	2	2
Settlement of resettlement with inhabitants including establishment of resettlement areas	:	3	2
Construction works		4	3
Total	:	9	9

It is noted that the period for the procedures for environmental assessment and financial arrangement for compensation, and settlement of resettlement with inhabitants would cover financial arrangement for construction for two (2) years and preparation of tender documents including detailed design for two (2) years. The said results indicates that the completion time for both Karian Scheme and Conveyance 2 Scheme will be at end of 2005 after 9 years from 1997.

2) Necessity of Immediate Measure for Water Source

It is projected as mentioned in latter Section (5) that the capacity of the existing facilities can cover the water demand up to 2001, while the Karian Scheme and Conveyance 2 Scheme is scheduled to be completed at the end of 2005. Under such conditions, it is emphasized that an

immediate measure of water sources is essentially needed to cover deficit of water demand after 2002. In this future situation, the Study Team proposed to implement the upgrading, in quantity aspect of the West Tarum Canal to provide 5 m^3/sec in addition to 16.1 m^3/sec of the existing capacity. The preliminary study showed that the said upgrading work can be completed at the end of 2001 after five (5) years from 1997, assuming financial arrangement for two (2) years, preparation of tender documents and tender procedures for two (2) years and construction works for two (2) years.

In this connection, it is noted that the present upgrading plan of the West Tarum Canal recommended by the JWRMS has only water quality aspect.

The said proposal has been frequently discussed between the Study Team and Jatiluhur Authority as the implementing agency and finally confirmed by the Steering Committee Meeting held on November 23, 1995.

3) Further Immediate Measure due to Delay of First Implementation

In case that delay of the first implementation, especially the Karian Scheme, may occur due to difficulty of procedures for environmental assessment and land acquisition and resettlement in reservoir area which may cause extension of entire implementing period before construction period, further immediate measure shall be taken as soon as possible.

In such situation, the Steering Committee suggested in the Meeting held on May 24, 1996 several potential water resources for study on their possibility as water sources for such further immediate measure. Among these potential resources, the Steering Committee confirmed to provide further 5 m^3/sec, totally 10 m^3/sec, of raw water from the West Tarum Canal to the Jakarta Water Supply System.

Further, the Study carried out the study on possibility as water sources for other potentials suggested by the Steering Committee as mentioned below :

a) Increasing efficiency of irrigation water use
b) Katulanpa Irrigation System
c) River course storing
d) Storage by estuary weir

a) Increasing efficiency of irrigation water

Increased efficiency of irrigation water use has been considered in providing additional 10 m^3/sec from the West Tarum Canal as above-mentioned. Other irrigation conveyance systems such as Cisadane Main Canal, Solokan Barat Main Canal, Cidurian Main Canal, Ciujung Main Canal are providing mainly irrigation water to the owned areas with gradually increasing their efficiency and some irrigation conveyance systems are allocating water to the rural water supply system. In such situation and conditions, it is considered that there is no possibility to provide water to the Jakarta Water Supply System from other irrigation conveyance systems. It is noted that the JWRMS has never recommended to use water to the Jakarta Water Supply System from other irrigation conveyance system than the West Tarum Canal, considering the said situation and conditions. In addition, it is mentioned that many reports concerned to the irrigation conveyance systems have studied, aiming to obtain efficient and effective use of water for the owned area, but no for outside the owned area.

b) Katulampa Irrigation System

The Katulampa Irrigation System is located, extending from south-east of Bogor toward west of DKI Jakarta. The existing irrigation area, having about 4,600 ha, is served directly from the Katulampa intake. The entire canal network also serves a domestic water supply in the Empang area.

The Feasibility Study on Cisadane River Basin Development, Directorate General of Water Resources Development (DGWRD), 1987, has concluded according to the proposal made in the Pre-feasibility Study stage that the development of the Ciliwung water resources will not economically attractive to meet the municipal, industrial and other demands up to 2025. It is noted that this conclusion has been still maintained by the DGWRD up to date. This conclusion has stated that the current use of its water resource primarily by the Katulampa intake cannot be made more efficient. Further, the said conclusion interprets that as the efficiency of the current use of water resources would be already maximized for this irrigation system and its associated communities, the Ciliwung water resources cannot provide water supply for outside the Katulampa Irrigation System.

c) River Course Storing

Generally, the seasonal regulation of river runoff, which is to provide firm water for irrigation and M & I water uses in dry season, requires much capacity in more than 50 million m3 order depending on amount of annual runoff and topography. For this purpose, reservoir is created by dam. It is noted for reference that firming-up discharge in dry season is resulted from reservoir operation simulation study, using river runoff and reservoir effective storage capacity. In case of river course, it is very clear that the said capacity is physically not possible to be obtained under the conditions of its width, depth, gradient and length. While, in flood control aspect, retardation for reducing magnitude of peak flood can be sometimes expected in river course, but the said retardation does not substantially control flood. In addition, reservoir provides flood control space adding to other purposes and its provision is determined under requirement of its purpose to downstream reach.

Under such considerations, it is concluded that river course storing does not meet purpose for providing an additional or supplemental water for water supply in dry season. It is further noted that the previous report including the JWRMS have never recommended supplementing water by river course storing, since it is supposed that this is not practical water source as above-mentioned.

d) Storage by Estuary Weir

Firstly, it is reported that no previous reports including the JWRMS have proposed to implement construction of estuary weir for intake purpose for M & I water supply.

There are several existing estuary weirs in Japan and several estuary weirs are still awaiting to proceed construction works. The existing estuary weirs were constructed and completed for the purposes of 1) flood control and drainage in surrounding area, 2) prevention of seawater intrusion for downstream irrigation area, 3) firm water supply for irrigation area, and 4) M & I water supply. It is in situation that the proposed estuary weirs in Japan have encountered a difficulty to proceed their immediate construction works due to the difficulty of settlement on environmental impact assessment with local government and inhabitants. The said

difficulty may result to take a long time to commence construction works and/or to abandon their implementations.

Under such references, it is agreed that estuary weir construction would be one of water resources development measure to supplement implementation of the existing water resources development plans as listed as above inventory. However, water resources development on estuary weir construction will not pray role to supplement deficit water supply, which will be caused due to delay of the said two (2) First Implementation, due to the reasons that it will take required time (about 13 to 14 years or more) for its implementation and completion taking the following steps and procedures, if these steps and procedures are possibly taken, and also that this water development is still unforeseenable to be taken up as a further measure at present, since it is not sure whether or not the following steps and procedures can be continuously proceeded up to completion of project :

i) As no reports on water resources development to construct estuary weir have been proposed up to date, integrated estuary water resources study (like master plan study) is initially needed. (3 to 4 years including financial arrangement for the study and feasibility study)

ii) In compliance with the recommendation made by master plan study, feasibility study for the priority project/projects is needed to make financial arrangement. Following the said study, environmental impact assessment (analysis) and resettlement study is carried out. (2 years)

iii) Settlement of environmental impact assessment and resettlement study including financial arrangement for compensation for land and construction of resettlement area including facilities is completed by the governmental agencies concerned. (2 years)

iv) Land acquisition for priority area for construction is settled with inhabitants and priority resettlement area shall be completed. (2 years)

v) Construction works are commenced and completed. (4 years)

e) Conclusion

In the light as above-mentioned, it is concluded that other potentials than the further 5 m3/sec suggested by the Steering Committee are not applicable as the further immediate measure due to delay of the First Implementation.

(4) Selection of Scenarios

The following two (2) scenarios were considered for formulation of an attractive and practical water resources development plan :

Scenario I :

Water Resources Development Plan in case that the First Implementation is proceeded and completed on schedule. In this Scenario, introduction of the water source of 5 m^3/sec supplied through the West Tarum Canal as the initial immediate measure is preceded before the First Implementation. Under such conditions, optimization study for selecting the most attractive development plan is made for several alternative development plans.

Scenario II :

Water Resources Development Plan in case that the First Implementation is delayed to be proceeded. For this plan, the water source of additional 5 m^3/sec supplied through the West Tarum Canal as the further immediate measure to be substituted before completion of the First Implementation. The water resources development plan for Scenario II after the First Implementation is formulated, based on the most attractive development plan optimized in Scenario I, in consideration of the integrated sufficiency of water supply to the eastern and western areas and future treatment facilities plan.

(5) Future Water Demand

The municipal and industrial (M&I) water demand and agricultural water requirement in the north Banten and Jabotabek areas were projected by the JWRMS and reviewed by the Study on Ciujung-Cidurian Integrated Water Resources. While, the demand projection for the DKI Jakarta was made based on the accumulated and updated data and information in accordance with the Terms of Reference as mentioned in the Main Report, Paragraph 3.5, separately from those projected by the JWRMS. In such background, the newly projected demand for the DKI Jakarta area by the Study and the projected demand for the Tangerang and Serang areas under Strategy G-5 by the JWRMS were applied to the water demand-supply balance analysis. The water demand for each target year is as follows :

Table-362.1 WATER DEMAND

Demand Area	1995	2000	2005	2010	2015	2019
DKI Jakarta	13.89	17.47	22.42	31.68	43.58	49.26
Bekasi	2.32	3.26	4.42	7.79	10.58	13.33
Bogor N	0.74	1.26	2.00	2.83	3.87	4.50
Bogor SE	1.26	2.11	3.37	5.79	7.89	9.58
Bogor WS/S-W	0.53	0.63	0.84	1.47	2.11	2.53
Tangerang	3.58	5.05	7.68	10.31	11.75	12.42
Serang	3.47	4.63	7.26	9.58	12.84	14.53
Total without Bogor	**24.00**	**31.68**	**43.79**	**62.19**	**82.62**	**94.04**

(6) Study on Scenario I

1) Selection of Alternative Water Resources Development Plans

The following basic assumption and conditions were applied to select alternative water resources development plans :

a) To satisfy continuos sufficiency of water supply capacity to meet water demand for DKI Jakarta for whole period
b) To satisfy sufficiency of water supply capacity to meet water demand for DKI Jakarta in Target Year (2019)

c) Inventory of the existing water sources and development plans of water sources and conveyance systems as referred to in Section (2).

d) The upgrading of West Tarum Canal, in quantity aspect, to provide 5 m^3/sec is put into operation at the beginning of 2002.

e) The Karian Dam/Reservoir Scheme and Conveyance 2 Scheme was assumed to be commissioned in 2006 as mentioned in Section (3).

f) No alternative having full water supply from the water sources in the Ciujung and Cidurian river basins to the DKI Jakarta without Conveyance 2 was considered, since there is no availability of other sources than said the water sources to meet water demand for the Tangerang and Serang area and accordingly, the said alternative is not practical to be selected for plan formulation of the water resources development plan.

Based on the said assumption and conditions, the following five (5) alternative water resources development plans was selected for Scenario I and their supply flowcharts are shown in **Figure-362.2 :**

Alternative A : Independent Supply System - I

For DKI Jakarta Area	:	*Conveyance 2*
For Serang-Tangerang	:	Karian Dam & Tanjung Dam

Alternative B & C : Independent Supply Systems - II & III

For DKI Jakarta	:	*Conveyance 2 & Karian Dam*
- First Implementation	*- B :*	*Conveyance 2*
	C :	*Karian Dam*
For Serang-Tangerang	:	Pasir Kopo Dam, Tanjung Dam & Cilawamg Dam

Alternatives D & E : Integrated Supply Systems - I & II

For DKI Jakarta	:	*Conveyance 2* *Karian Dam* *(Integrated with Tangerang/Serang)* *Tanjung Dam* *(Integrated with Tangerang)*
- First Implementation	*- D :*	*Conveyance 2*
	E :	*Karian Dam*
For Serang	:	Karian Dam & Pasir Kopo Dam

2) Water Demand-Supply Balance Analysis

The water demand and supply balance analysis was made for five alternative plans, based on the projected water demand.

3) Implementation Schedule of Water Source and Conveyance System Schemes

The water demand-supply balance resulted the implementation schedule of water source and conveyance system schemes for the respective alternatives as shown in **Annex-36.**

4) Financial Analysis

The financial analysis in the evaluation of the respective alternative development plans was made by demonstrating the estimate of total investment, total present worth of annual disbursement of project/scheme costs in 1996 and capitalized annual project/scheme cost in 2001, when the Upgraded West Tarum Canal as the first implementation scheme is completed and commissioned. It is noted that the project/scheme (construction) costs and their annual disbursements were obtained by the following sources :

a) Upgraded West Tarum Canal : Newly and roughly estimated
b) Conveyance 2 : Obtained from Draft Pre-F/S Report (Thames Water International) & Report on Cibeet Irrigation, Flood Control and Water Supply Study (NEDECO, 1982)
c) Dams and Conveyance Schemes in Ciujung-Cidurian River Basin : Obtained from Study Report on Ciujung -Cidurian Integrated Water Resources in Indonesia (JICA, 1995)

The results of the financial analysis are summarized as follows :

Table-362.2 RESULTS OF FINANCIAL ANALYSIS

ALTERNATIVE	A	B	C	D	E
Total Investment (US$ 10^5)	2,301.00	2,279.60	2,279.60	2,117.80	2,117.80
Total Present Worth (US$ 10^5)	*791.12*	*861.39*	*675.49*	*643.56*	*654.80*
- Ranking -	- 4 -	- 5 -	- 3 -	- 1 -	- 2 -
Arithmetic Average Disbursement (US$ 10^5)	143.81	119.98	119.98	124.58	124.58
Capitalized Annual Cost (US$ 10^5)	*148.05*	*150.77*	*118.23*	*117.46*	*119.51*
- Ranking -	- 4 -	- 5 -	- 2 -	- 1 -	- 3 -

5) Comprehensive Evaluation

The comprehensive evaluation of alternative water resources development plans in consideration with the future water supply conditions to the Tangerang-Serang area aims to formulate the most attractive and favorable development plan. The evaluation applied scoring criteria for the following evaluation items (Full score : 100) :

i) Continuos sufficiency of water supply capacity to meet water demand for Tangerang-Serang area for whole period (Full score : 15)
ii) Sufficiency of water supply capacity to meet water demand for Tangerang-Serang area (Full score : 15)
iii) Integrated water supply system for DKI Jakarta area and Tangerang-Serang area or independent water supply systems (10)
iv) Total present worth of annual disbursement of project/scheme costs in 1995 (Full score : 40)
v) Capitalized annual cost (Full score : 20)

The evaluation results are summarized as follows :

Table-362.3 RESULTS OF COMPREHENSIVE EVALUATION

ALTERNATIVE	A	B	C	D	*E*
(1) 15	15 Sufficient	0 Insufficient	0 Insufficient	0 Partially insufficient	15 Sufficient
(2) 15	15 Sufficient	8 Insufficient	8 Insufficient	15 Sufficient	15 Sufficient
(3) 10	0 Independent System	0 Independent System	0 Independent System	10 Integrated System	10 Integrated System
(4) 40 - Ranking -	20 - 4 -	15 - 5 -	30 - 3 -	40 - 1 -	35 - 2 -
(5) 20 - Ranking -	5 - 4 -	5 - 5 -	15 - 2 -	20 - 1 -	15 - 3 -
Comprehensive Evaluation *Score* *Ranking*	*55* *3*	*28* *5*	*53* *4*	*85* *2*	***90*** ***1***

The comprehensive evaluation resulted that the Alternative E obtained the highest score out of the five (5) selected alternative.

6) Final Selection of Proposed Water Resources Development Plan for Scenario I

As stated in the preceding Sub-section 4), the results of the comprehensive evaluation under the scoring criteria indicated that the Alternative E was formulated to be the most attractive development plan. It is further noted that the total score for the Alternative E is slightly higher than that of the Alternative D, while the financial aspect for the Alternative D is slightly more favorable than that for the Alternative E. Such evaluation results might give the selection of the proposed development plan to either the Alternative D or Alternative E. However, the Alternative E was finally selected as the proposed development plan due to the following considerations and aspects on addition to the comprehensive evaluation under the scoring criteria. :

a) *Present Status of Study Level for Implementation of Karian Dam/Karian-Serpong Water Conveyance System (hereinafter called as "Karian Scheme") and Conveyance 2 Scheme*

It is firstly noted that the Karian Scheme has been proposed as the first implementation in the Alternative E, while the Conveyance 2 Scheme has been taken up the first implementation in the Alternative D.

The present status of the study level for the Karian Scheme, on which the study in pre-feasibility level was completed under the JICA's financing in February 1995, is more advanced than that for the Conveyance 2 Scheme, on which only the preliminary study had been completed in 1984. The Study Report on Ciujung-Cidurian Integrated Water Resources Development recommended the stagewise development of the dam/reservoir schemes, in which the Karian Scheme has been given the first priority to implement. While, no further report for promoting implementation of the Conveyance 2 Scheme has been completed up to date since the preparation of the said preliminary report, though it has been informally informed that a private enterprise is preparing a report on this scheme for financing arrangement. Such status indicates that the Karian Scheme might be given higher priority for the first implementation than the Conveyance 2 Scheme.

b) Financial Aspect

As the construction cost of the Conveyance 2 Scheme was roughly estimated based on the rough design and work quantities in the Study, the said cost estimate level is lower than that ofd the Karian Scheme, for which the cost estimate was made based on more detailed design and work quantities in the Said Study report (JICA). The financial aspects based on such cost conditions might not substantially control the selection of the proposed development plan, but it could be used as a indicator in the comprehensive evaluation. It is noted that the financial indicators for the Alternative E with the Karian Scheme consisting of the total present worth and capitalized annual cost is only 2 percent higher than those of the Alternative D with the Conveyance 2 Scheme. The said consideration might give almost same condition to select the first implementation.

c) Integrated Consideration with Sufficiency of Water Supply Capacity for Tangerang/Serang Area

The selection of the Alternative D will result insufficiency of the water supply capacity for the Tangerang area till 2009, when the Karian Scheme as the second implementation is to be completed, unless other source is developed separately from the Conveyance 2 Scheme as the first implementation in the Alternative D. It is noted that development of only groundwater abstraction is conceivable as other source. While, insufficient water supply capacity for the Tangerang area in the Alternative E will continue till 2005, when the Karian Scheme as the first implementation in the Alternative E is to be completed as the shortest implementation time span, which means to be the advanced development with four (4) years compared with the Alternative D. This condition might have more advantageous consideration to select the Alternative E as the proposed development plan than that of the Alternative D. The said advantage was considered as the item (1) in the comprehensive evaluation as shown in the above summary table.

d) Conclusion

Under the results of the comprehensive evaluation under the scoring criteria and the considerations as above-mentioned, it is concluded that the Alternative E has been

proposed as the prospective water resources development plan to meet the future water demand not for the DKI Jakarta area but also for the Tangerang/Serang area.

The Alternative Development Plan E consists of the implementation of the following construction series :

For DKI Jakarta :
Karian Dam
(Integrated with Tangerang/Serang)
Conveyance 2, Phase I
Conveyance 2, Phase II
Tanjung Dam
(Integrated with Tangerang)

For Serang *Pasir Kopo*

7) Proposed Water Resources Development Plan for Scenario I

The following are the proposed phasing development plan of the water resources to meet increasing water demand for the DKI Jakarta :

Phase I	:	Upgraded West Tarum Canal (Citarum river) *to be completed in 2001*
Phase II	:	Karian Dam & Karian-Serpong Conveyance System (Ciujung river) *to be completed in 2005*
Phase III	:	Conveyance 2, Phase I (Jatiluhur Dam, Citarum river) *to be completed in 2008*
Phase IV	:	Conveyance 2, Phase II (Jatiluhur Dam, Citarum river) *to be completed in 2011*
Phase V	:	Tanjung Dam & Karian-Serpong Conveyance System (Cidurian river) *to be completed in 2015*

The following are the results of the water demand-supply analysis for proposed development plan as illustrated in **Figure-362.3** and the raw water supply pattern to Jabotabek area in 2019 based on the results of the water demand-supply analysis is shown in **Figure-362.4** :

Table-362.4 SUMMARY OF WATER DEMAND-SUPPLY BALANCE ANALYSIS FOR SCENARIO I

Item	1995	2000	2005	2010	2015	2019
(1) Supply Capacity	16.10	18.90	23.90	36.00	44.80	51.50
(2) Demand	13.89	17.47	22.42	31.68	43.58	49.26
(5) Balance (Reservation)	2.21	1.43	1.48	4.32	1.22	2.24

Phase I Development (Immediate Measure)

The phase I development as an immediate measure is to upgrade the existing West Tarum Canal for increasing the supply capacity from 21.1 m^3/sec to 26.1 m^3/sec, out of which 21.1 m^3/sec is allocated to supply for M&I water demand for the DKI Jakarta. The upgrading consists of dredging and excavation inside the canal, of which both right and left side faces are reinforced by sheet piles, to expand flow capacity.

Phase II Development

The components of the phase II development are :

1) Karian multipurpose dam scheme in Ciujung river,
2) KSCS I between Karian Dam and treatment plants for Tangerang area with maximum capacity of 14.6 m^3/sec including intake structure and Ciuyah tunnel with length of 1.2 km and concrete type waterway with length of 36.5 km,
3) KSCS III between treatment plants for Tangerang area and treatment plants for DKI Jakarta with maximum capacity of 14.9 m^3/sec including pumping station and PC pipe and steel type waterway with length of 11.9 km, and
4) River improvement work for middle reach of Ciujung river between Pamayaran weir and Rangkasbitung.

Phase III Development

The phase III development is to construct the Conveyance 2 - Phase I consisting of intake structure at the Jutiluhur Reservoir for Phases I and II having maximum capacity of 20 m^3/sec, concrete lined open canal for phases I and II, concrete piped non-pressure waterway for Phase I with maximum capacity of 10 m^3/sec and appurtenant structures such as intake and outlet basins including pumping equipment and steel pipes for crossing the rivers, drop structures, emergency spillway, bridges, etc. The total waterway length was assumed to be 75 km.

Phase IV Development

The phase V development is to construct the Conveyance 2 - Phase II composing an additional concrete piped non-pressure waterway having length of 30 km to provide the maximum supply capacity of 10 m^3/sec and appurtenant structures.

Phase V Development

The phase VI development consists of the Tanjung Dam in the Cidurian river, Tanjung Canal between the Tanjung Dam and KSCS II with length of 4.3 km and KSCS II between destination of Tanjung Canal and treatment plants for the Tangerang area along the KSCS I, having maximum capacity of 9.7 m^3/sec.

8) Unit Raw Water Cost

The unit raw water cost was estimated for the proposed development plan under the following assumption and conditions, for reference :

i) Annual financial cost : a) repayment of loan and b) operation and maintenance (O&M) cost
ii) Payment term :
   a) Annual interest rate : 3 %
   b) Repayment period : 30 years including 10-year grace period, immediately after commissioning of projects/scheme
iii) Operation and maintenance cost : 0.5 % of total investment cost
iv) Covered area for water demand
   a) DKI Jakarta before Karian Dam commissioned in 2006
   b) DKI Jakarta and Tangerang from 2006 to 2008 when the conveyance 2 completed
   c) DKI Jakarta, Tangerang and North Bogor from 2009 to 2013 when Karian dam commissioned for Serang
   d) DKI Jakarta, Tangerang, Serang and North Bogor after 2014
v) Unit raw water cost = (Total annual cost)/(Water demand)

The summary of the estimation of unit raw water cost is as follows :

Table-362.5 SUMMARY OF UNIT RAW WATER COST FOR SCENARIO I

	1995	2000	2005	2010	2015	2019
Annual Cost (US$ 10^3)	6,042	7,003	8,053	41,317	53,634	104,086
Water Demand (m^3/sec)	13.89	17.47	22.42	44.82	73.08	82.81
Unit Raw Water cost (Rp/m^3)	30	28	25	64	51	87

Figure-362.2 ALTERNATIVE RAW WATER SUPPLY SYSTEMS

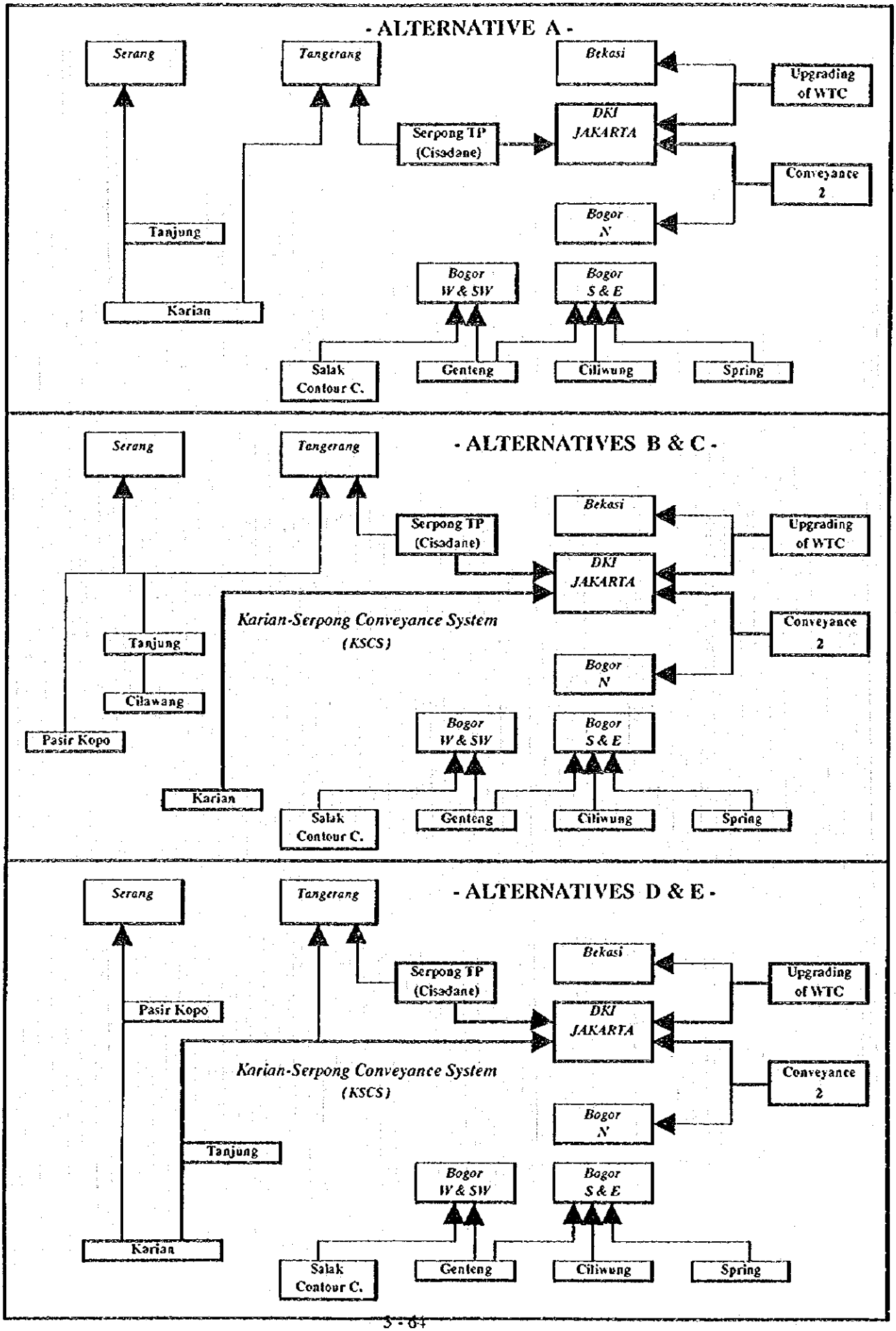


Figure-362.3 WATER DEMAND - SUPPLY BALANCE FOR SCENARIO I

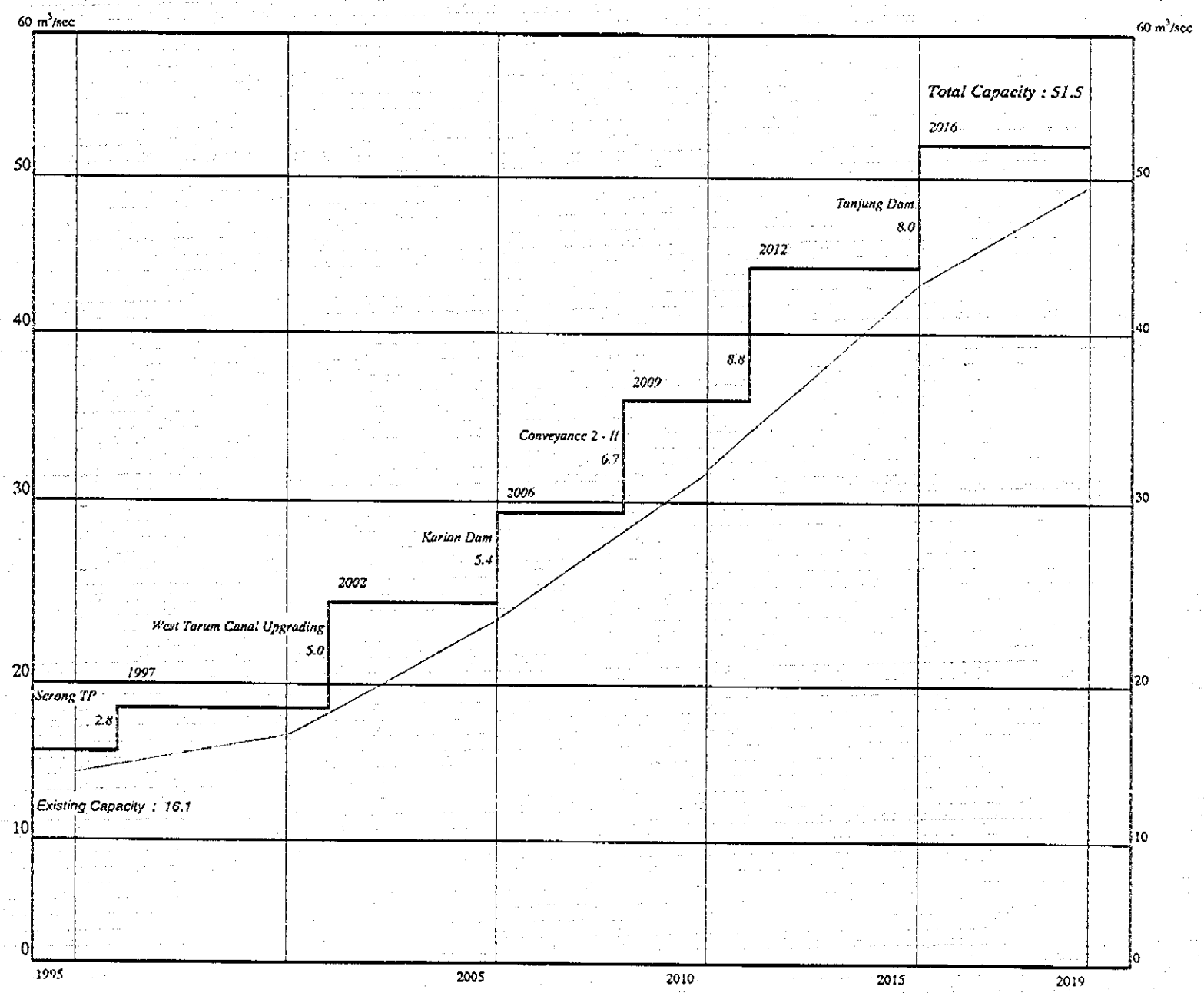
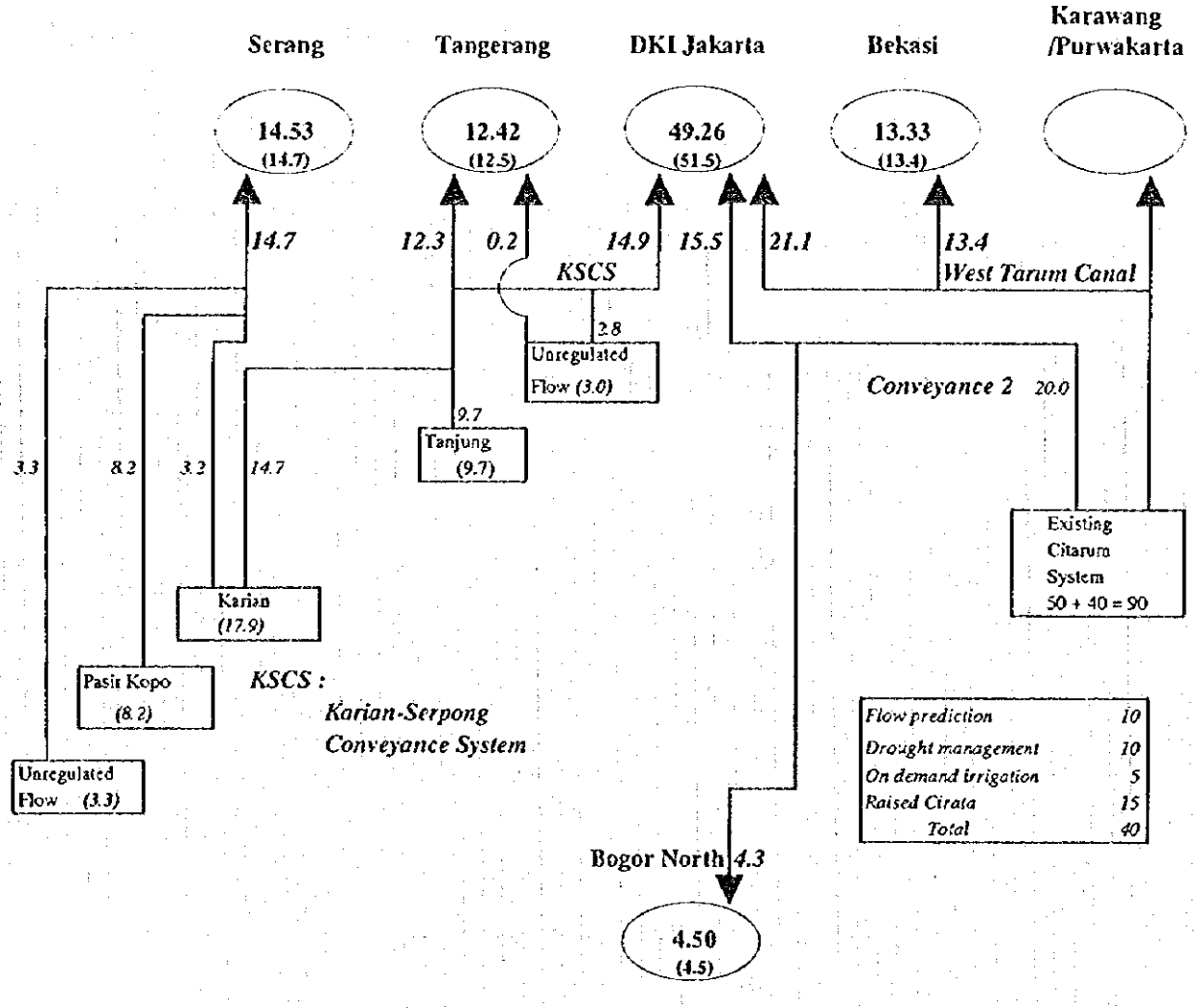
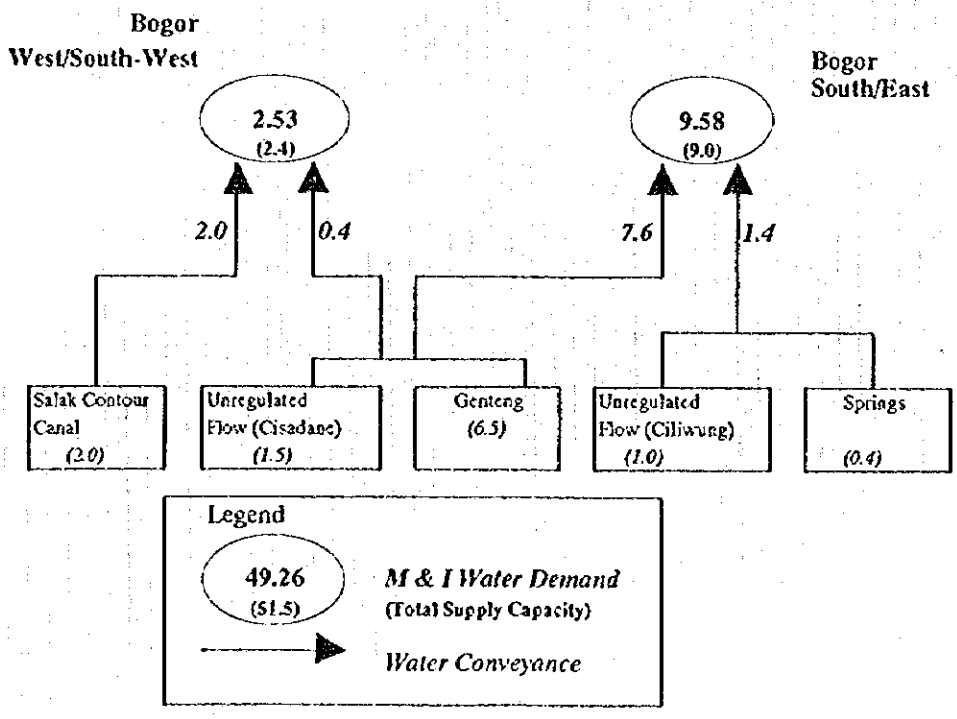


Figure-362.4 RAW WATER SUPPLY PATTERN TO JABOTABEK AREA IN 2019
FOR SCENARIO I





(7) Study on Scenario II

1) Formulation of Water Resources development

The following is the phasing development for Scenario II, which was preliminarily obtained by substituting the further immediate measure having 5 m^3/sec of additional capacity to be supplied by the West Tarum Canal before commissioning of the Karian Dam/Reservoir through KSCS in the phasing development for Scenario I proposed in the preceding Section (6) :

Phase I	:	Upgraded West Tarum Canal (Phase I) (Citarum river)
Phase II	:	Upgraded West Tarum Canal (Citarum River)
Phase III	:	Karian Dam & Karian-Serpong Conveyance System (KSCS) (Ciujung river)
Phase IV	:	Conveyance 2, Phase I (Jatiluhur Dam, Citarum river)
Phase V	:	Conveyance 2, Phase II (Jatiluhur Dam, Citarum river)
		Tanjung Dam & Karian-Serpong Conveyance System (KSCS) (Cidurian river)
		- No commissioning needed before 2019 -

The preliminary water demand-supply balance indicates that the Tanjung Dam-KSCS Scheme is not required to be commissioned before the target year 2019. Under such condition, it was formulated as follows that the Conveyance 2 is implemented in one (1) phase having an capacity of Phase II in order to be able to put into operation the Tanjung Dam-KSCS before the target year 2019, in consideration of the integrated sufficiency of water supply to the eastern and western areas and future treatment plan facilities plan as referred to in Scenario I.

Phase I	:	Upgraded West Tarum Canal Phase I (Citarum river)
Phase II	:	Upgraded West Tarum Canal, Phase II (Citarum River)
Phase III	:	Karian Dam & Karian-Serpong Conveyance System (Ciujung river)
Phase IV	:	Conveyance 2 (Jatiluhur Dam, Citarum river)
Phase V	:	Tanjung Dam & Karian-Serpong Conveyance System (Cidurian river)

2) Water Demand - Supply Balance Analysis

The water and supply balance analysis was made, based on the projected water demand as given in Section (6) and the phasing development plan as mentioned in the preceding Sub-section (7) 1).

The following are the summary of the water demand-supply analysis for proposed development plan as shown in **Table-362.8** and as illustrated in **Figure-362.6** :

Table-362.6 SUMMARY OF WATER DEMAND-SUPPLY BALANCE ANALYSIS FOR SCENARIO II

Item	1995	2000	2005	2010	2015	2019
(1) Supply Capacity	16.10	18.90	23.90	34.30	45.00	51.70
(2) Demand	13.89	17.47	22.42	31.68	43.58	49.26
(5) Balance (Reservation)	2.21	1.43	1.48	2.62	1.42	2.44

3) Proposed Water Resources Development Plan for Scenario II

The following are the proposed phasing development plan of the water resources to meet increasing water demand for the DKI Jakarta :

Phase I : Upgraded West Tarum Canal, Phase I
(Citarum river)
to be completed in 2001

Phase I : Upgraded West Tarum Canal, Phase II
(Citarum river)
to be completed in 2005

Phase II : Karian Dam & Karian-Serpong Conveyance System
(Ciujung river)
to be completed in 2008

Phase III : Conveyance 2
(Jatiluhur Dam, Citarum river)
to be completed in 2011

Phase V : Tanjung Dam & Karian-Serpong Conveyance System
(Cidurian river)
to be completed in 2015

Phase I -1 Development (Initial Immediate Measure)

The phase I-1 development as the initial immediate measure is to upgrade the existing West Tarum Canal for increasing the supply capacity from 21.1 m^3/sec to 26.1 m^3/sec, out of which

21.1 m^3/sec is allocated to supply for M&I water demand for the DKI Jakarta. The upgrading consists of dredging and excavation inside the canal, of which both right and left side faces are reinforced by sheet piles, to expand flow capacity.

Phase I-II Development (Further Immediate Measure)

The Phase I-II development as the further immediate measure is to further upgrade the existing West Tarum Canal for increasing the supply capacity from 26.1 m^3/sec to 31.1 m^3/sec, out of which 26.1 m^3/sec is provided for M&I water demand for the DKI Jakarta.

Phase II Development

The components of the phase II development are :

1) Karian multipurpose dam scheme in Ciujung river,
2) KSCS I between Karian Dam and treatment plants for Tangerang area with maximum capacity of 14.6 m^3/sec including intake structure and Ciuyah tunnel with length of 1.2 km and concrete type waterway with length of 36.5 km,
3) KSCS III between treatment plants for Tangerang area and treatment plants for DKI Jakarta with maximum capacity of 14.9 m^3/sec including pumping station and PC pipe and steel type waterway with length of 11.9 km, and
4) River improvement work for middle reach of Ciujung river between Pamayaran weir and Rangkasbitung.

Phase III Development

The phase III development is to construct the Conveyance 2 consisting of intake structure at the Jutiluhur Reservoir having maximum capacity of 15 m^3/sec, concrete lined open canal, concrete piped non-pressure waterway and appurtenant structures such as intake and outlet basins including pumping equipment and steel pipes for crossing the rivers, drop structures, emergency spillway, bridges, etc. The total waterway length was assumed to be 75 km.

Phase IV Development

The phase VI development consists of the Tanjung Dam in the Cidurian river, Tanjung Canal between the Tanjung Dam and KSCS II with length of 4.3 km and KSCS II between destination of Tanjung Canal and treatment plants for the Tangerang area along the KSCS I, having maximum capacity of 9.7 m^3/sec.

7) Unit Raw Water Cost

The unit raw water cost was estimated for the proposed development plan under the following assumption and conditions, for reference :

i) The project/scheme (construction) cost is referred to in Sub-section (8) 3).
ii) Annual financial cost : a) repayment of loan and b) operation and maintenance (O&M) cost
iii) Payment term :
a) Annual interest rate : 3 %

b) Repayment period : 30 years including 10-year grace period, immediately after commissioning of projects/scheme

vi) Operation and maintenance cost : 0.5 % of total investment cost

v) Covered area for water demand
   a) DKI Jakarta before Karian Dam commissioned in 2009
   b) DKI Jakarta and Tangerang from 2009 to 20011 when the conveyance 2 completed
   c) DKI Jakarta, Tangerang and North Bogor from 2012 to 2015 when Karian dam commissioned for Serang
   d) DKI Jakarta, Tangerang, Serang and North Bogor after 2016

vi) Unit raw water cost = (Total annual cost)/(Water demand)

The summary of the estimation of unit raw water cost is as follows :

Table-362.7 SUMMARY OF UNIT RAW WATER COST FOR SCENARIO II

	1995	2000	2005	2010	2015	2019
Annual Cost (US$ 10^3)	6,042	7,003	8,053	29,067	50,434	100,108
Water Demand (m^3/sec)	13.89	17.47	22.42	44.82	73.08	82.81
Unit Raw Water cost (Rp/m^3)	30	28	25	45	48	83

(8) Final Selection of Proposed Water Resources Development Plan

1) Necessary Procedures and Action prior to commencement of Construction Works for Karian Dam-KSCS Scheme

The important point to finally select the proposed development plan in this master plan is whether or not the Karian Dam-KSCS Scheme as the First Implementation is delayed to proceed necessary procedures to be taken and completed prior to commencement of the construction works. For this discussion, immediately necessary action is listed up as follows, referring to the "Chapter 9 Proposed Action Plan" in the Study on Ciujung-Cidurian Integrated Water Resources in Indonesia (February 1995, JICA), Main Report :

i) Establishment of environmental monitoring and management unit (EMMU), consisting of environmental unit (EU) and environmental monitoring and

management committee (EMMCC), to successfully execute the resettlement of local residents in the affected area by the proposed scheme.

ii) Necessary procedures for commencement of environmental impact assessment

According to the latest information from the concerned agencies including the Steering Committee, the Director General of Water Resources Development, Ministry of Public Works in close corporation of Director General of Human Settlement and Environmental Impact Management Agency has not yet taken necessary action on the said items up to date and it is not sure when these action be taken. The following are the further procedures and actions :

iii) Financial arrangement for consultancy services and construction cost
vi) Consultancy (engineering) services on definite study and detailed design including preparation of tender documents
v) Tender procedures and contracting
vi) Environmental impact study and resettlement study
vii) Financial arrangement for land acquisition and resettlement cost
viii) Construction and completion of resettlement area including facilities as the minimum requirement before commencement of the construction works

In such circumstances, the Steering Committee clarified in compliance with the questionnaire made by JICA with his letter to the Director General of Human Settlement dated July 15, 1996 that the Karian Project is expected to be completed at the end of Year 2008, assuming the required periods for the concerned procedures and actions as shown in **Figure-362.5.**

2) Future View and Consideration on Implementation of Further Upgrading

The further upgrading of the West Tarum Canal would easier proceed action on Items vi) to viii) compared with the Karian Dam-KSCS Scheme, since it may have much less difficulty on land acquisition and resettlement by utilizing the existing facilities and land in maximum. It might be said that the further upgrading of the West Tarum Canal has more advantage than that of Karian Scheme only in this light. While, in technical aspect, it has many items to be studied for practical implementation, which may result longer period. because only availability of water of 5 m^3/sec is committed and actual study is not made in this study. In this connection, it is emphasized to avoid misunderstanding that the reason of adopting the Karian Scheme as the First Implementation instead of the further upgrading of the West Tarum Canal is mentioned as follows :

i) The feasibility study on the Karian Scheme with formalization of its report makes sure to proceed easier procedure for implementation and it will save time for its procedures. While, implementation of the further upgrading of the West Tarum Canal has never been recommended by any previous report and its study level is quite low.

ii) Earlier implementation of the Karian Scheme has been repeatedly emphasized by the formal reports since 1980's in integrated development consideration with sufficiency of water supply to the DKI Jakarta and Tangerang-Serang area in the western region.

3) Selection of Scenario

Although a critical point to finally select proposed water resources development plan between Scenarios I and II is not clearly found as far as the said two considerations 1) and 2), it is provisionally concluded to proceed a feasibility study for the immediate project that the water resources development plan in Scenario II be recommended in this master plan due to the following consideration :

i) As the starting date of procedures for environmental impact assessment for the Karian Dam-KSCS Scheme is not sure, the required period up to commencement of the construction works is unforseenable. In addition, required period for procedures and actions for environmental impact assessment and resettlement is not clear, since no formal schedule on these procedures and actions is not yet established by the concerned agency due to non-establishment of the environmental monitoring and management unit (EMMU).

ii) It is confirmed that the further upgrading of the West Tarum Canal having an additional 5 m^3/sec supply capacity has been committed by the Steering Committee held on May 24, 1996. In such fact, it is understood that necessary procedures and actions to proceed the above immediate measure prior to the implementation of the Karian Scheme has been committed to be timely taken by the concerned governmental agencies.

4) Proposed Water Resources Development Plan

The following are the proposed development plan for the water resources finally selected in this master plan study :

Phase I	:	Upgraded West Tarum Canal, Phase I (Citarum river) *to be completed in 2001*
Phase I	:	Upgraded West Tarum Canal, Phase II (Citarum river) *to be completed in 2005*
Phase II	:	Karian Dam & Karian-Serpong Conveyance System (Ciujung river) *to be completed in 2008*

Phase III : Conveyance 2
(Jatiluhur Dam, Citarum river)
to be completed in 2011

Phase V : Tanjung Dam & Karian-Serpong Conveyance System
(Cidurian river)
to be completed in 2015

(9) Indonesian Water Resource Development Plan in Western Area of Jakarta

The Indonesian side has studied the possibility of water resources development in the western area of Jakarta such as the Cisadane, Cidurian, and Cimanceuri river basins by constructing rubber dams and or by other effective means.

Material provided by the Indonesian side concerning the development plan mentioned above is attached in **Annex-36**.

Figure 362.5 IMPLEMENTATION SCHEDULE FOR KARIAN DAM - KSCS PROJECT

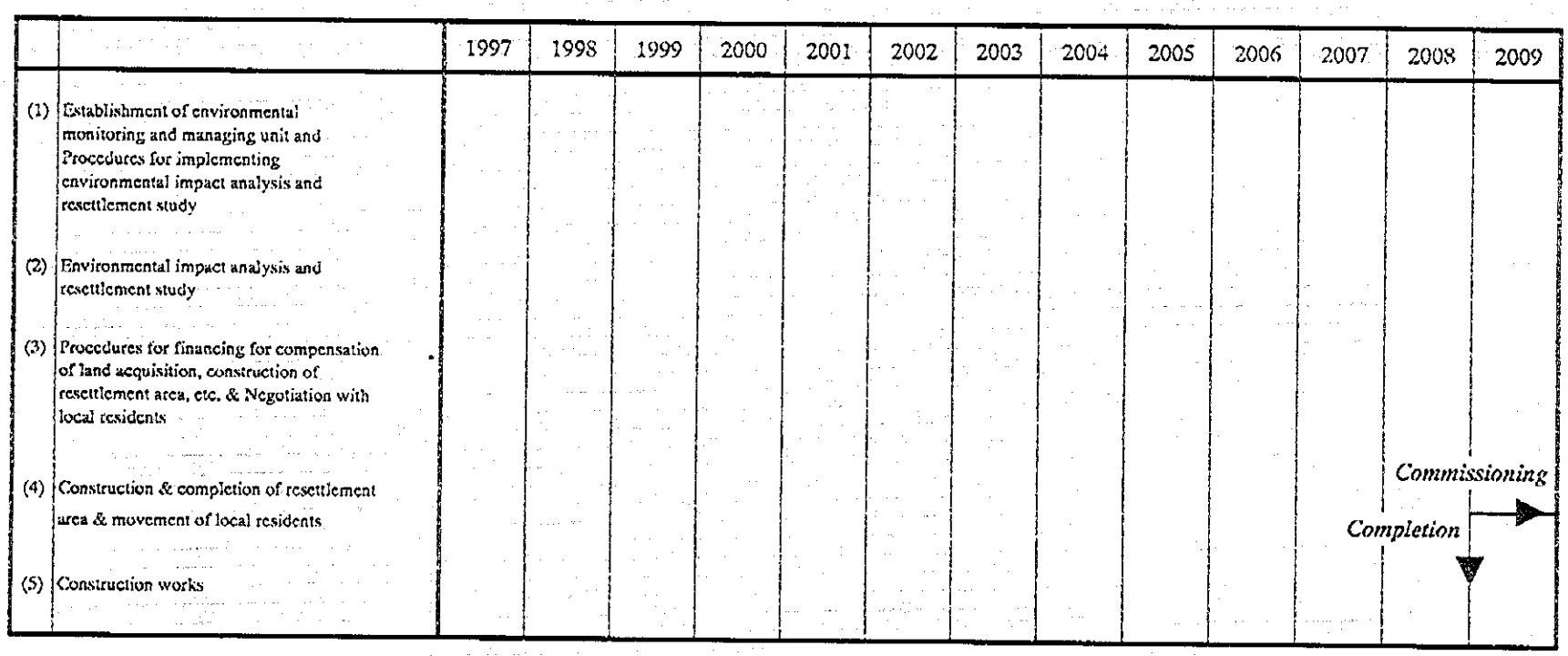


Table-362.8 WATER DEMAND-SUPPLY BALANCE FOR DKI JAKARTA WATER SUPPLY SYSTEM FOR SCENARIO II

(Unit : m³/sec)

Item	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
1. West Tarum Canal																															
Potential Supply Discharge	21.10	21.10	21.10	21.10	21.10	21.10	21.10	26.10	26.10	26.10	26.10	26.10	26.10	26.10	26.10	26.10	26.10	26.10	26.10	26.10	26.10	26.10	26.10	26.10	26.10						
Treatment Plant Capacity	*16.10*	*16.10*	*16.10*	*16.10*	*16.10*	*16.10*	*16.10*	*21.10*	*21.10*	*21.10*	*21.10*	*26.10*	*26.10*	*26.10*	*26.10*	*26.10*	*26.10*	*26.10*	*26.10*	*26.10*	*26.10*	*26.10*	*26.10*	*26.10*	*26.10*						
2. Conveyance 2																															
Potential Supply Discharge	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.95	11.75	11.54	11.33	11.22	11.01	10.90	10.70						
Treatment Plant Capacity	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*10.70*	*10.70*	*10.70*	*10.70*	*10.70*	*10.70*	*10.70*	*10.70*						
3. KSCS																															
Potential Supply Discharge	0.00	0.00	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	7.64	10.39	9.89	9.47	9.16	17.74	17.18	16.61	15.97	15.41	14.95						
Treatment Plant Capacity	*0.00*	*0.00*	*2.80*	*2.80*	*2.80*	*2.80*	*2.80*	*2.80*	*2.80*	*2.80*	*2.80*	*2.80*	*2.80*	*2.80*	*8.20*	*8.20*	*8.20*	*8.20*	*8.20*	*8.20*	*8.20*	*14.90*	*14.90*	*14.90*	*14.90*						
4. Total Treatment Plant Capacity	16.10	16.10	18.90	18.90	18.90	18.90	18.90	23.90	23.90	23.90	23.90	28.90	28.90	28.90	34.30	34.30	34.30	45.00	45.00	45.00	45.00	51.70	51.70	51.70	51.70						
5. Demand in DKI Jakarta	13.89	14.61	15.33	16.04	16.76	17.47 *1.0469*	18.46	19.45	20.44	21.43	22.42 *1.05112*	24.27	26.13	27.98	29.83	31.68 *1.07161*	34.06	36.44	38.82	41.20	43.58 *1.06583*	45.00	46.42	47.84	49.26 1.03113						
6. Balance (4-5)	2.21	1.49	3.57	2.86	2.14	1.43	0.44	4.45	3.46	2.47	1.48	4.63	2.77	0.92	4.47	2.62	0.24	8.56	6.18	3.80	1.42	6.70	5.28	3.86	2.44						

Figure-362.6 WATER DEMAND - SUPPLY BALANCE FOR SCENARIO II

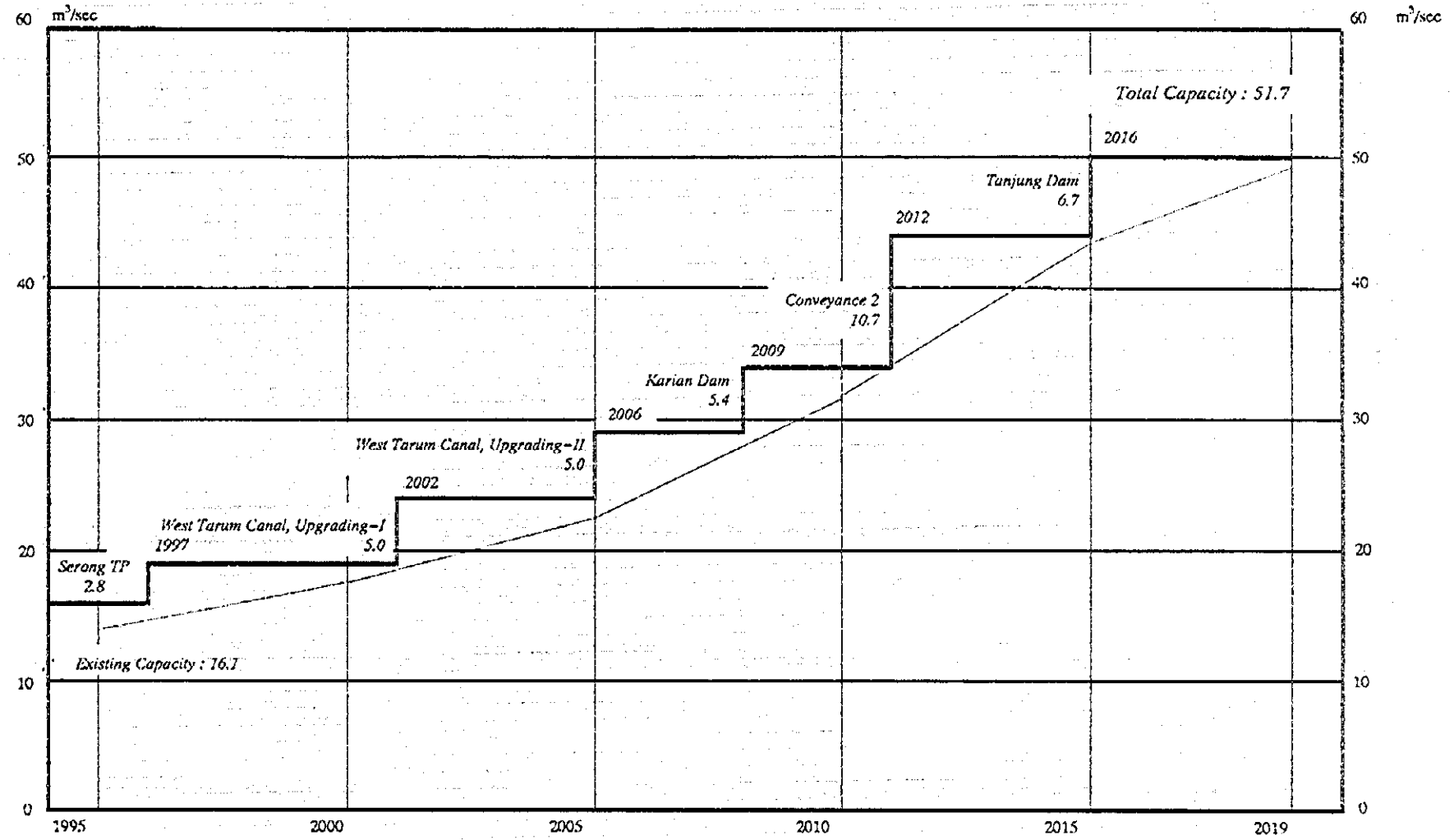
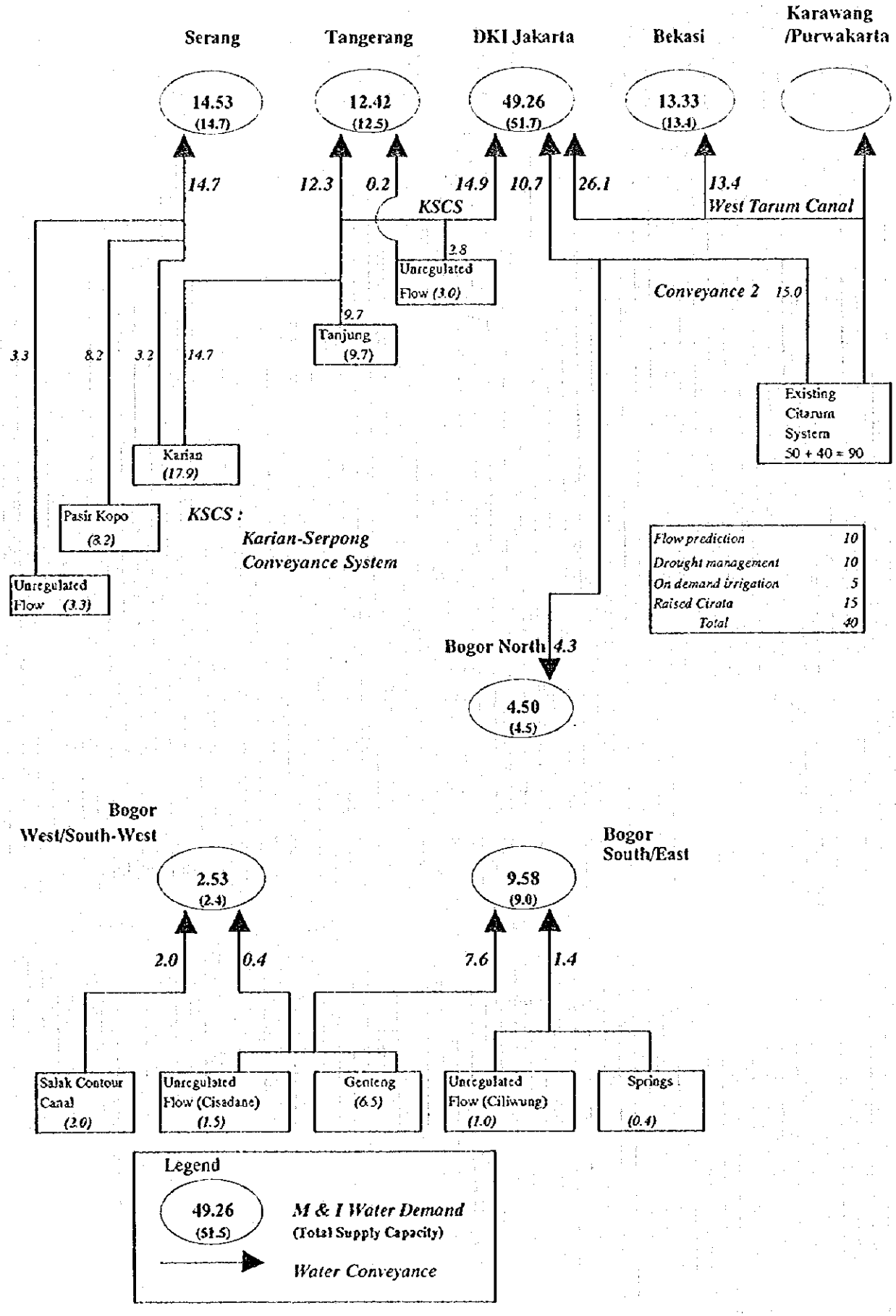


Figure-362.7 RAW WATER SUPPLY PATTERN TO JABOTABEK AREA IN 2019
FOR SCENARIO II



3.6.3 Future Groundwater Abstraction and Management

The groundwater study has been made in several reports since 1970's, out of which only the Feasibility Study on Cisadane River Basin Development studied and presented the provisionally recommendable permissive yield (sustainable yield) of groundwater abstraction for future water requirement in Jabotabek area employing the appropriate concept and criteria in consideration of the physical, economic and environmental aspects. In such circumstances, the Study applied the concept and criteria in the said Feasibility Study for estimation of the permissive (sustainable) yield of groundwater abstraction for future water demand in the DKI Jakarta and its surrounding areas.

(1) Concept of Permissive (Safe or Sustainable) Yield

The allowable amount of groundwater abstraction was defined as "Permissive (Safe or Sustainable) Yield", which means to maximum abstraction amount without producing an undesired result, based on "Sustainable Development Concept". The factors covering the Permissive Yield consist of I) economic consideration of abstraction from basin, ii) quality of groundwater, iii) water right in and around the basin, and iv) land subsidence.

(2) Procedure for Estimate of Permissive Yield

Figure-363.1 present the procedure for estimate of permissive yield of groundwater abstraction applied to the Study.

(3) Zoning of Groundwater Basin

The DKI Jakarta and its surrounding basin having an area of 2,730 km^2 was divided into three (3) zones, A, B and C, from the northern area toward the southern area considering both hydrology and present abstraction conditions of groundwater as shown in **Figure-363.2**.

(4) Evaluation of Permissive Yield and Establishment of Unit Permissive Yield

The evaluation of permissive yield was made in the Feasibility Report on Cisadane River Development based on the simulation models of confined aquifer system and the consideration and the following results of the evaluation was obtained :

Zone	Area (km^2)	Recharge (m^3/sec)	Unit Recharge (lit./sec/km^2)	Permissive Yield (m^3/sec)	Unit Permissive Yield (lit./sec/km^2)
A	225	2.0	8.8888	0.7	3.1111
B	341	6.9	20.2346	2.4	7.0381
C	78	1.6	20.5128	0.5	6.4103
Total	**644**	**10.5**		**3.6**	

(5) Target Year to be reduced to Permissive Yield

The timing of deduction of groundwater abstraction largely depends on the completion of new and extended piped water supply networks in unserved piped water areas. While, in environmental aspect, especially for Zone A, a target year to reduced to the permissive yield should be established in order to avoid accumulation of further unfavorable conditions. The establishment of the target year would be a guideline for timing to complete the said new piped water networks. In such light, the following target years were provisionally established for the water demand forecast :

Zone A

Further Development of groundwater is stopped immediately and the present conditions of groundwater abstraction is maintained till the year of 2004. In the year of 2005, the present amount of groundwater abstraction is reduced to the permissive yield.

Zones B and C

Increasing water demand is met by groundwater to be supplied by the existing and further developed facilities till the year of 2005 and thereafter, supply capacity of groundwater is gradually and linearly decreased to the permissive yield till the year of 2015.

Zone	1995	2000	2004	2005	2015	2019
A	PR	PR	PR	0.7	0.7	0.7
B	GPR	GPR	GPR	GPR	2.4	2.4
C	GPR	GPR	GPR	GPR	0.5	0.5
Total	-	-	-	-	**3.6**	**3.6**

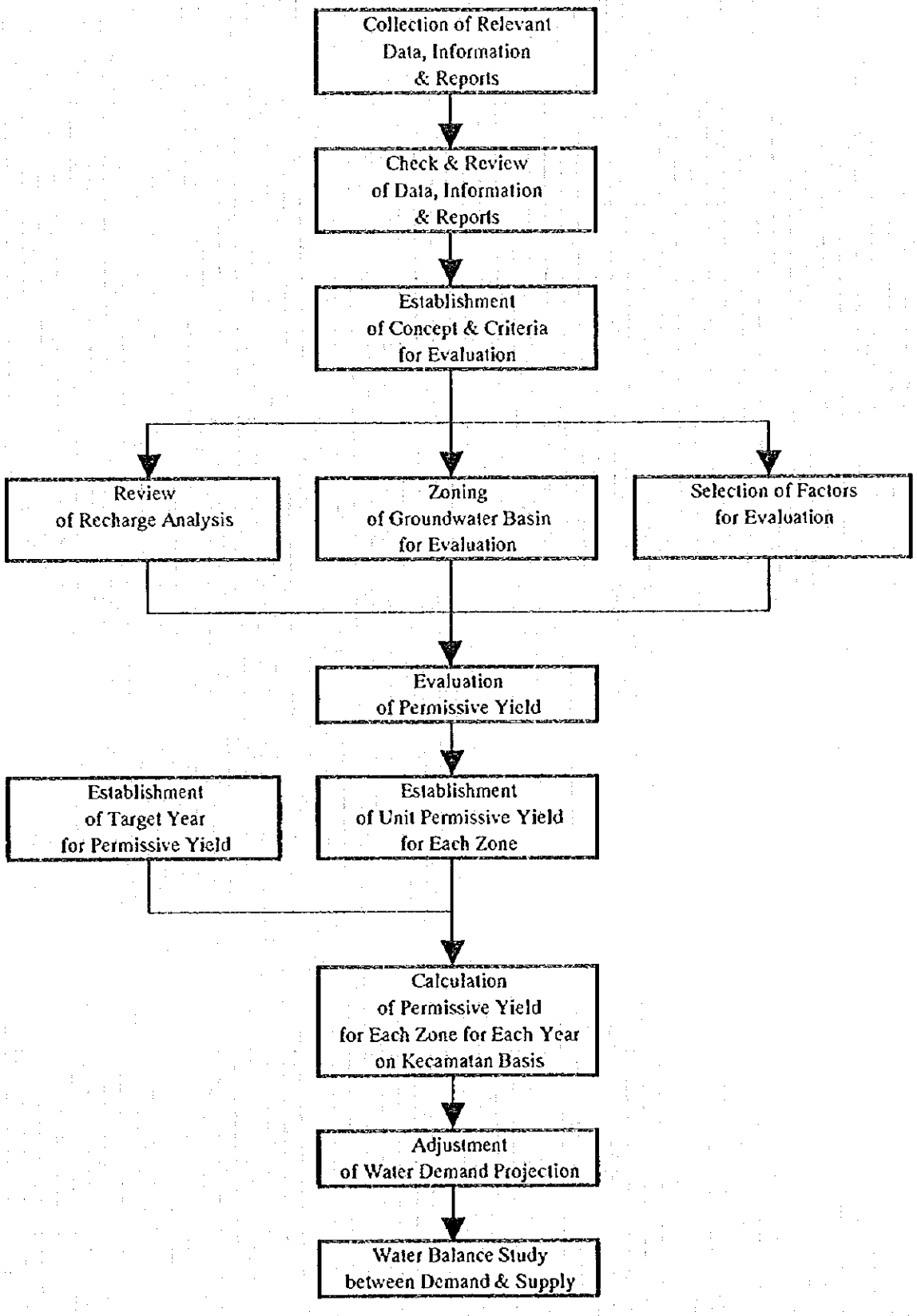
PR : Present requirement of groundwater abstraction
GPR : Groundwater Potential Requirement

Based on the unit permissive yield and target year, the yearly permissive yield of groundwater abstraction was calculated for the re-established three (3) zones on the basis of Kechamatans as given below :

(Unit :lit./sec)

Year	DKI Jakarta	Fringe Area	Total
1995	9,654	1,928	11,518
2000	11,492	2,977	14,469
2005	7,659	3,864	11,523
2010	5,363	2,644	8,007
2015	3,067	1,423	4,490
2019	3,067	1,423	4,490

Figure-363.1 ESTABLISHMENT OF PERMISSIVE YIELD OF GROUNDWATER FOR FUTURE WATER DEMAND



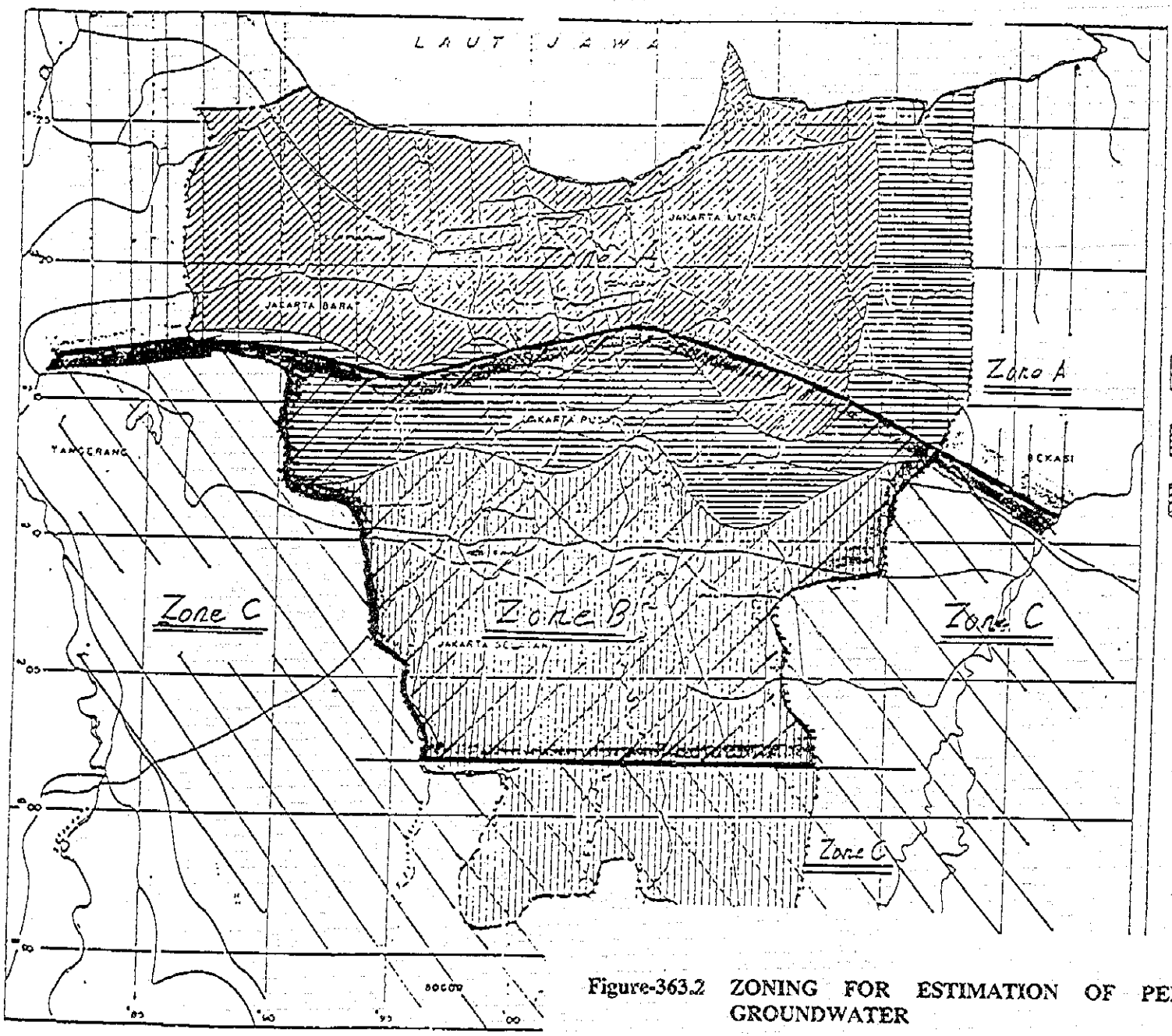
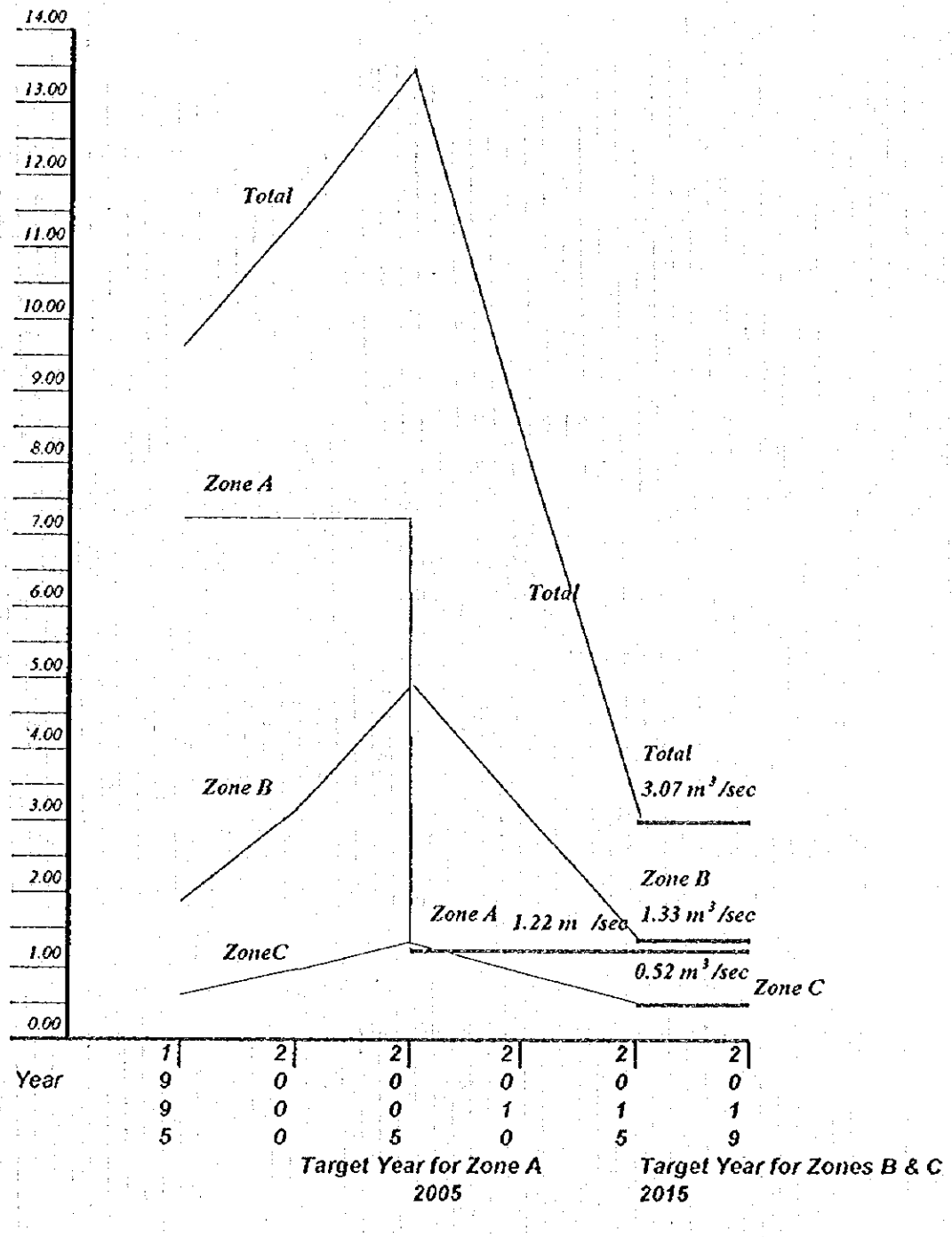


Figure-363.2 ZONING FOR ESTIMATION OF PERMISSIVE YIELD OF GROUNDWATER

Figure-363.3 YEARLY FLOW OF PERMISSIVE YIELD



3.7 WATER SUPPLY FACILITIES

Conditions and circumstances of present Jakarta Water Supply System has been changed compared with the conditions as of JICA 1985 Master Plan as listed below. It is, therefore, necessary to revise Jakarta Water Supply Development System prepared by JICA 1985 Master Plan in order to meet present conditions and future water demand.

3.7.1 Basic Policy

(1) Basic Policy

Future service area is discussed and defined in the previous **Section 3.4** and future Water Supply System in the service area is planned based on the Day-Maximum water demand and considering concepts as follows.

- to make simple and economic system as much as possible
- to use existing facilities as much as possible
  (facilities which are under implementation are considered to be existing facilities, i.e., Cisadane Treatment Plant, Distribution Centers R4 and R5 are considered as existing facilities)
- to divide service area into two systems, west and east sides conforming to the concept of the Private Sector Participation
  (however, interconnecting facilities will be considered for emergency)
- to apply existing zoning system basically
- to supply water for each zone from one distribution center or treatment plant
  (in the case that existing capacity of distribution center or treatment plant is not enough for one zone, additional distribution center will be considered)

(2) Zoning

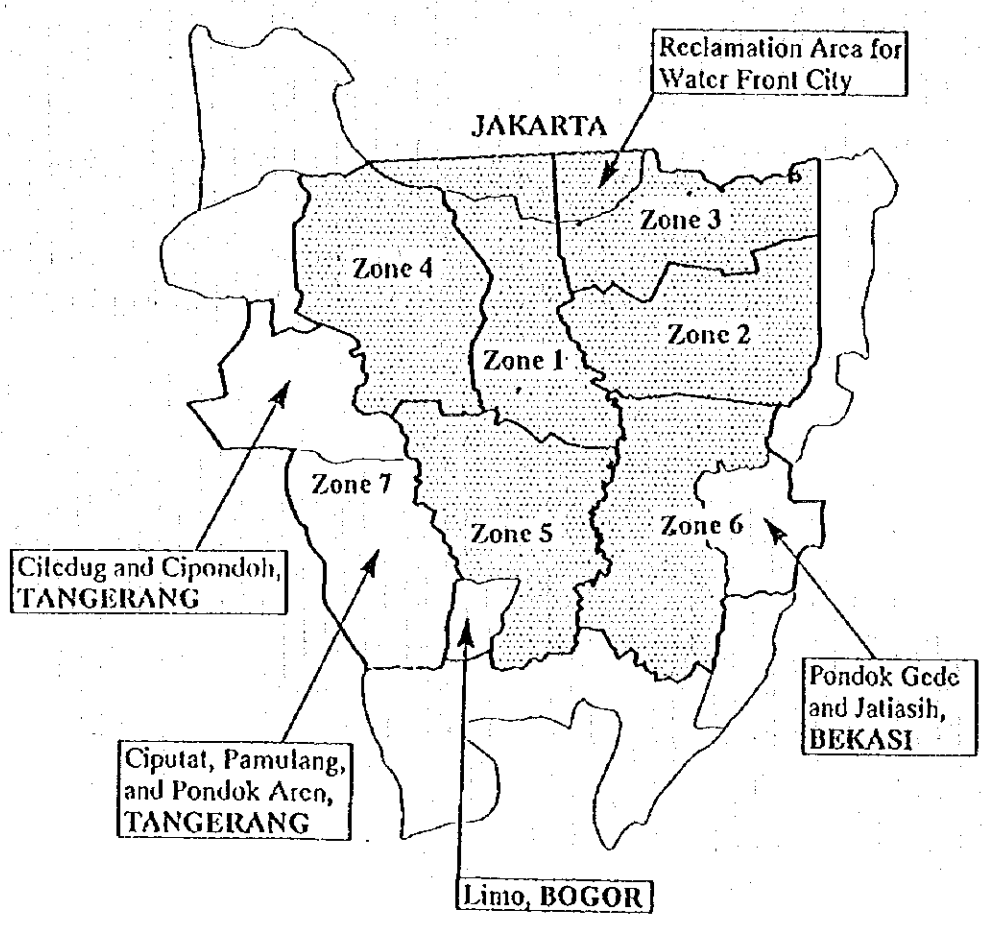
DKI Jakarta area is divided into six distribution zones at present. In 1995, PAM JAYA has rearranged a new zoning system which also consists of six distribution zones, and will officially

apply this new zoning from 1996. In addition to zones in DKI Jakarta, Kecamatan of Kotamadya and Kabupaten Tangerang in the service area, Ciledug, Cipondoh, Ciputat, Pamulang, and Pondok Aren, are proposed to be included in the new zone, Zone 7. Other Kecamatan of Kabupaten Bogor and Bekasi in the service area are treated to be included in the distribution zones of PAM JAYA as follows.

Kabupaten Bogor :	Limo	:	Zone 5
Kabupaten Bekasi :	Pondok Gede	:	Zone 6
	Jatiasih	:	Zone 6

The Study is, therefore, conducted based on the new zoning system consisting of seven zones as shown in **Figure-371.1.** Basically, each distribution zone is considered to be independent distribution system which is supplied water from one distribution center or one treatment plant.

Figure-371.1 ZOING SYSTEM OF THE STUDY AREA



3.7.2 Water Treatment Facilities

(1) Zonal Demand

Future water demand in each Kecamatan was estimated in **Section 3.5**. For planing the Jakarta Water Supply System, demand in each zone was calculated based on the demand of each Kecamatan, and result of calculation is shown in the following sub-sections.

Served population in each zone is obtained as shown in **Table-372.1** and **Figure-372.1**. Day-Average demand in each zone is calculated based on Day-Average demand in each Kecamatan as shown in **Table-372.2**.

The Day-Maximum Water Demand which is the basic figure for facility planing is calculated by considering the peak factor which is applied to 1.15 times of Day-Average Demand and Non Revenue Water (NRW) as mentioned in **Section 3.5**. Results of calculation of Day-Maximum Water Demand is shown in **Table-372.3**.

As mentioned in **Section 3.5**, it is necessary to additionally supply treated water of total 2,955 l/sec to the new reclamation area of Water Front City in 2019. The reclamation area will be supplied from Zone 1 and Zone 3 as shown in **Table-372.4**. Day-Maximum Water Demand including demand of the reclamation area for Water Front City is obtained as shown in **Table-372.5** and **Figure-372.2**. **Figure-372.3** shows Day-Maximum Demand and balance between existing production capacity and future Day-Maximum Demand in 2019 in zonal map.

(2) Alternative Study

1) Possibility of Treatment Plant at Jatilhur Dam

Recent preliminary study on Conveyance 2 System by one private consortium recommended to construct a new water treatment plant at Pasir Gombong beside the Jatilhur Dam site far from Jakarta City and treated water is transmitted to Jakarta through the Conveyance 2.

Table-372.1 Served Population in Each Zone

(x 1,000)

	1995	2000	2005	2010	2015	2019
Zone 1	602	990	1,240	1,493	1,592	1,573
Zone 2	577	885	1,283	1,757	1,834	1,845
Zone 3	561	626	745	864	878	883
Zone 4	219	486	988	1,548	1,660	1,732
Zone 5	91	434	605	868	1,489	1,573
Zone 6	181	624	772	1,001	1,693	1,809
Zone 7	0	0	0	352	1,460	1,884
West	912	1,910	2,832	4,261	6,201	6,763
East	1,319	2,135	2,800	3,623	4,405	4,537
Total	2,231	4,045	5,632	7,884	10,606	11,300

Note : Zone 5 & 6 include Bogor and Bekasi in Study Area, respectively.
Zone 7 is Tangerang in Study Area.

Figure-372.1 Served Population in Each Zone

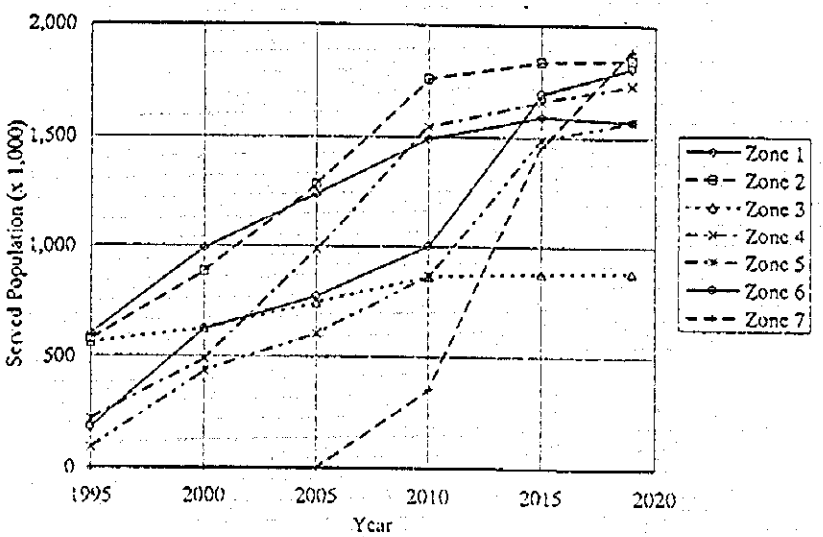


Table-372.2 Day-average Water Demand of Each Zone in the Study Area

(l/sec)

	1995	2000	2005	2010	2015	2019
Zone 1	1,815	2,548	3,314	4,112	4,943	5,211
Zone 2	1,179	1,811	2,552	3,420	4,388	4,641
Zone 3	1,163	1,404	1,659	1,923	2,205	2,315
Zone 4	509	1,148	1,911	2,795	3,818	4,125
Zone 5	275	828	1,475	2,353	3,543	3,892
Zone 6	375	937	1,581	2,458	3,765	4,165
Zone 7	0	0	0	813	2,537	4,242
West	2,600	4,524	6,700	10,073	14,840	17,471
East	2,717	4,152	5,792	7,802	10,358	11,121
Total	5,318	8,676	12,492	17,874	25,198	28,592
UFW	53.5%	40.0%	30.0%	28.0%	26.0%	25.0%
P.Factor	1.15	1.15	1.15	1.15	1.15	1.15

Table-372.3 Day-maximum Water Demand of Each Zone in the Study Area

(l/sec)

	1995	2000	2005	2010	2015	2019
Zone 1	4,490	4,884	5,444	6,568	7,681	7,991
Zone 2	2,917	3,472	4,193	5,463	6,819	7,116
Zone 3	2,876	2,691	2,725	3,072	3,426	3,550
Zone 4	1,260	2,200	3,139	4,464	5,933	6,325
Zone 5	681	1,588	2,423	3,758	5,506	5,968
Zone 6	928	1,795	2,597	3,926	5,851	6,387
Zone 7	0	0	0	1,298	3,942	6,505
West	6,431	8,671	11,007	16,088	23,062	26,789
East	6,721	7,958	9,516	12,461	16,097	17,052
Total	13,151	16,629	20,522	28,549	39,158	43,841

Table-372.4 Day-maximum Water Demand of Reclamation Area for Waterfront City

	1995	2000	2005	2010	2015	2019
Total	0	0	777	1,532	2,280	2,955
Zone 1	0	0	527	1,039	1,547	2,005
Zone 3	0	0	250	493	733	950

Table-372.5 Day-maximum Water Demand of Each Zone in the Study Area (including Waterfront City)

(l/sec)

	1995	2000	2005	2010	2015	2019
Zone 1	4,490	4,884	5,971	7,607	9,228	9,995
Zone 2	2,917	3,472	4,193	5,463	6,819	7,116
Zone 3	2,876	2,691	2,975	3,564	4,160	4,500
Zone 4	1,260	2,200	3,139	4,464	5,933	6,325
Zone 5	681	1,588	2,423	3,758	5,506	5,968
Zone 6	928	1,795	2,597	3,926	5,851	6,387
Zone 7	0	0	0	1,298	3,942	6,505
West	6,431	8,671	11,534	17,128	24,608	28,793
East	6,721	7,958	9,766	12,954	16,830	18,002
Total	13,151	16,629	21,299	30,081	41,438	46,796

Figure-372.2 Day-maximum Water Demand of Each Zone in the Study Area

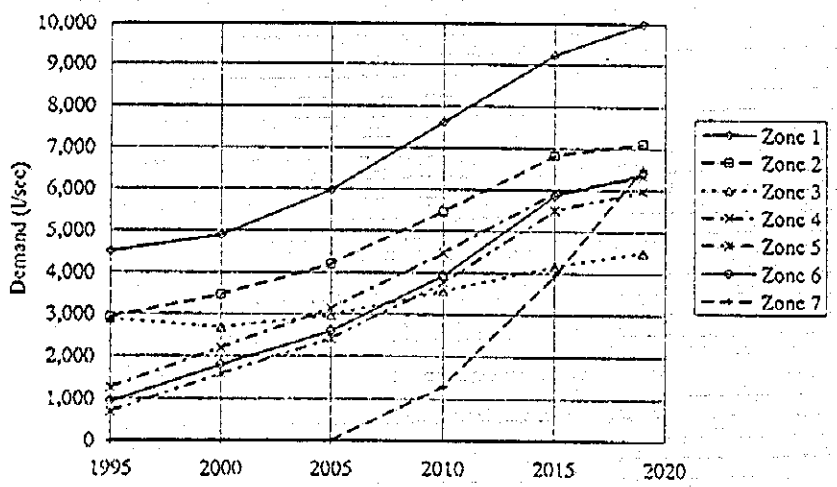
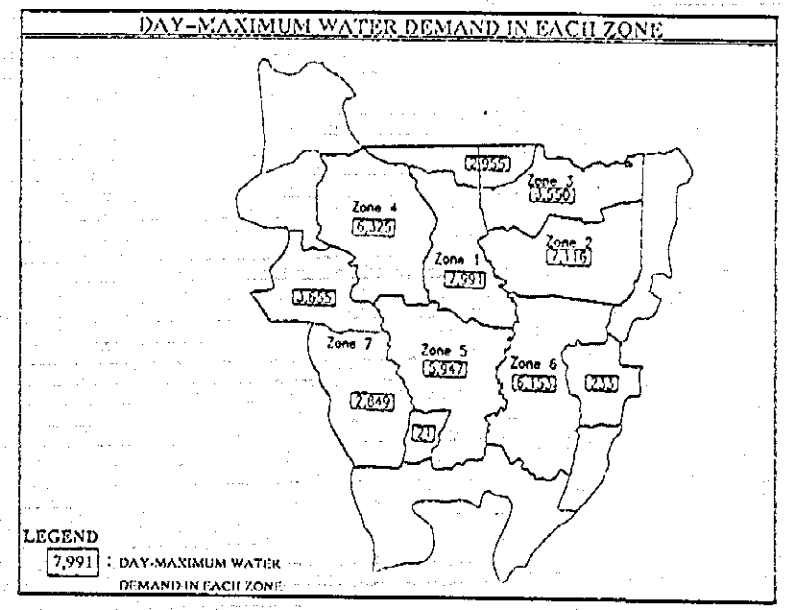
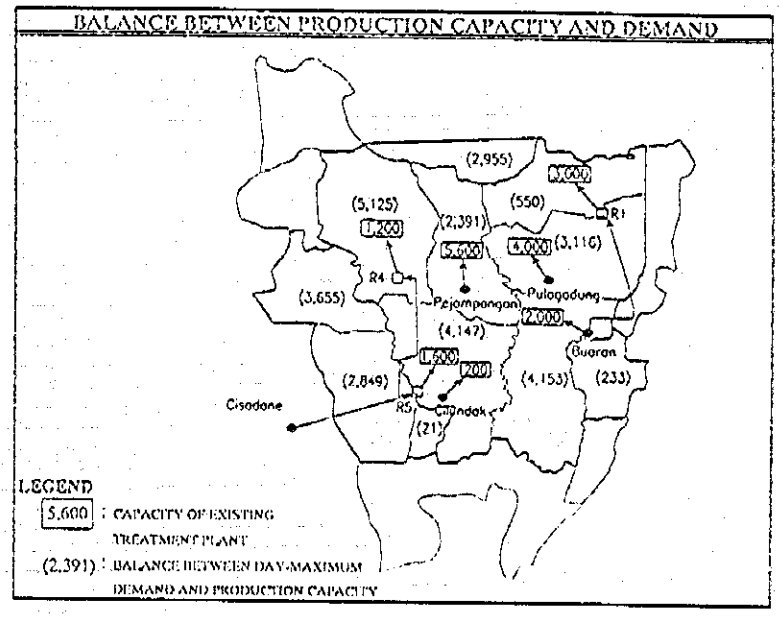


Figure-372.3

DAY-MAXIMUM WATER DEMAND IN EACH ZONE





Following maters were considered.

i) Cost comparison

Comparing the cost required for each option such as;

Option 1 (Recommended Option by the preliminary study)

Construct a new treatment plant at Pasir Gombong beside the Jatilhul Dam and treated water is conveyed from Pasir Gombong to Babakan in the south of Jakarta. Conveyance 2 is treated water transmission of which length is about 52.5 km.

Option 2

Construct a new treatment plant at Babakan in the south of Jakarta. Conveyance 2 is raw water transmission of which length is about 52.5 km from Jatilhur Dam to Babakan.

Total costs for Options 1 and 2 will become as follows.

Option 1 : 954,750 Million Rp.
Option 2 : 687,775 Million Rp.

More detail explanation is shown in **Annex-37.**

ii) Elasticity of Conveyance 2

It is recommended to convey raw water from Jatilhur to Jakarta through Conveyance 2 in order to maintain elasticity of the Conveyance 2. When small scale industrial estate or agricultural area along the Conveyance 2 required water, raw water may be able to share to these demand area. However, if the Conveyance 2 convey treated water only for drinking water supply, these water demand will not be satisfied.

iii) Far from Service Area

The location of water treatment plant is usually decided at the upstream of the service area. Treated water will be distributed in the service area along the water flow from upstream to down stream. However, in this case, area between Jatilhur and Jakarta City is rural area and does not included in the service area of PAM JAYA, and furthermore, the distance from Jatilhur to

Jakarta City is more than 50 km. Water treated at the Jatilhur just pass by the area between Jatilhur and Jakarta without distribution of the treated water.

To secure sound operation of treatment plant, it is recommended to locate the treatment plant at near or in the service area. In the case that the treatment plant is constructed far from the service area and required long treated water transmission, serge control will be required.

iv) Difficulties on quick response for emergency

All chemicals and materials required including spare parts should be transfer 50 km from Jakarta to Jatilhur. In addition to the difficulties of routine activities because of long distance from Jakarta, it should be noted that quick response against sudden accident will be very difficult in terms of dispatching specialist or engineer or transferring required parts.

Based on the results of consideration as stated above, the option which recommends construction of new treatment plant at Jatilhur is "NOT INCLUDED" as an alternative plan in this study.

2) Original and Revised Alternative Study

The first alternative study, Original Alternative Study, was conducted based on the original water resource development plan which was called **"Scenario I"** in the previous **Section 3.6.** In the Scenario I scheme, it was proposed that the Jakarta water supply system should rely on not only water resources from eastern side which is Jatiluhur Dam but also from western side of Jakarta. Based on this principle, it was proposed to utilize raw water from the western side, Karian Dam through KSCS System, for the Part Two, Second Phase of the Second Stage as shown on **Table-372.6.**

For this Scenario I, the Steering Committee commented that the possibility of implementation of Karian Dam development plan which was the water resource for Part Two, Second Phase of the Second Stage, has become low because of resettlement problems. For the substitution of the raw water from the Karian Dam, the Committee confirmed to allocate additional 5 m3/sec and further 5 m3/sec, totally 10 m3/sec, of raw water from the West Tarum Canal (WTC) to the Jakarta Water Supply System.

Table-372.6 SCENARIO I
ORIGINAL SCHEME OF FUTURE WATER RESOURCE

Part	Phase	Stage	Water Resource	Quantity** (l/sec)	Year of Inauguration	West/East
One	Second	Second	WTC	5,000	2002	East
Two	Second	Second	KSCS*	5,000	2006	West
One	First	Third	Conveyance 2	5,000	2009	East
Two	First	Third	Conveyance 2	9,300	2012	East
-	Second	Third	KSCS*	5,000	2016	West

Note : * : Karian Serpong Conveyance System
** : Figures shown above do not include water loss at treatment plant. Actual amount will be larger approximately 5 - 10 %.

Based on the comments and confirmation of the Steering Committee, revised scheme of the future water resources development **"Scenario II"** was prepared as shown on **Table-372.7**.

Table-327.7 SCENARIO II
REVISED SCHEME OF FUTURE WATER RESOURCE

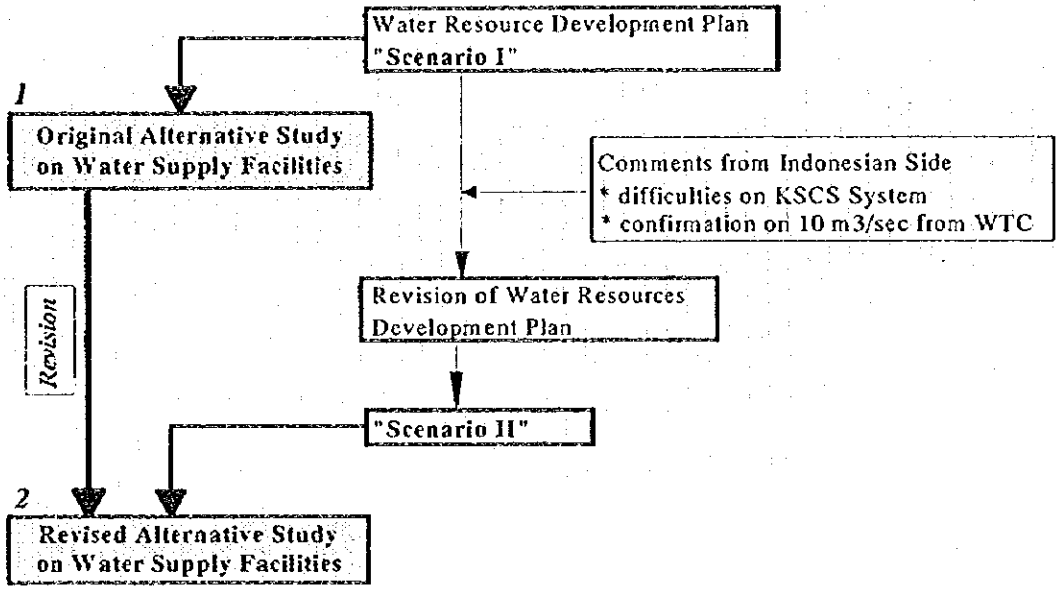
Part	Phase	Stage	Water Resource	Quantity** (l/sec)	Year of Inauguration	West/East
One	Second	Second	WTC	5,000	2002	East
Two	Second	Second	WTC	5,000	2006	East
One	First	Third	KSCS*	5,000	2009	West
Two	First	Third	Conveyance 2	9,300	2012	East
-	Second	Third	KSCS*	5,000	2016	West

Note : * : Karian Serpong Conveyance System
** : Figures shown above do not include water loss at treatment plant. Actual amount will be larger approximately 5 - 10 %.

The details of Scenario I and II are described in the previous **Section 3.6**.

Because of alternation of raw water resource development scheme from the Scenario I to the Scenario II, original alternative study on water supply facilities was also revised as shown on **Figure-372.4**.

Figure-372.4 PROCESS OF REVISION OF ALTERNATIVE STUDIES



3) Original Alternative Study on Water Supply Facilities

In the Original Alternative Study, totally five alternatives were compared and as the results of the Study, original proposed system which was prepared based on the original scheme of the water resources development, Scenario I, is shown on **Figure-372.5.** This shows overall system including existing treatment plants and distribution centers, required new/expansion treatment plants and distribution centers, and its treated water transmission systems. **Table-372.8** shows the summary of proposed new system.

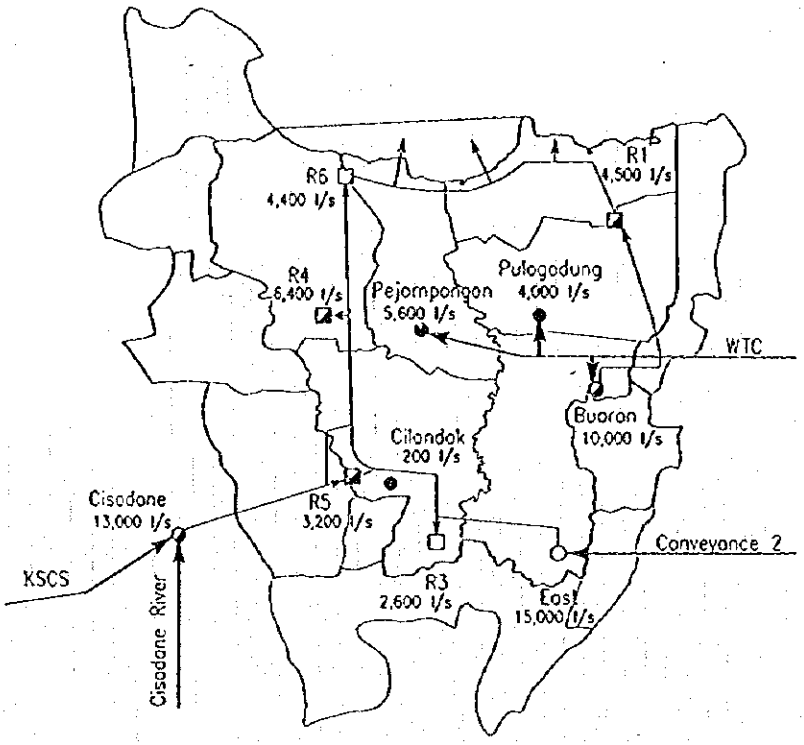
Figure-372.5 also shows a relation between Day-Maximum Water Demand and Treatment Capacity with timing of construction of proposed treatment plants.

Table-372.8 ORIGINALLY PROPOSED FACILITIES

Proposed Facilities	Capacity (l/sec)
Buaran III Treatment Plant	5,000
East I Treatment Plant	5,000
East II Treatment Plant	10,000
Cisadane II Treatment Plant	5,000
Cisadane III Treatment Plant	5,000
R1 II Distribution Center	1500
R3 I Distribution Center	1,300
R3 II Distribution Center	1,300
R4 II Distribution Center	2,600
R4 III Distribution Center	2,600
R5 II Distribution Center	1,600
R6 I Distribution Center	2,000
R6 II Distribution Center	2,400

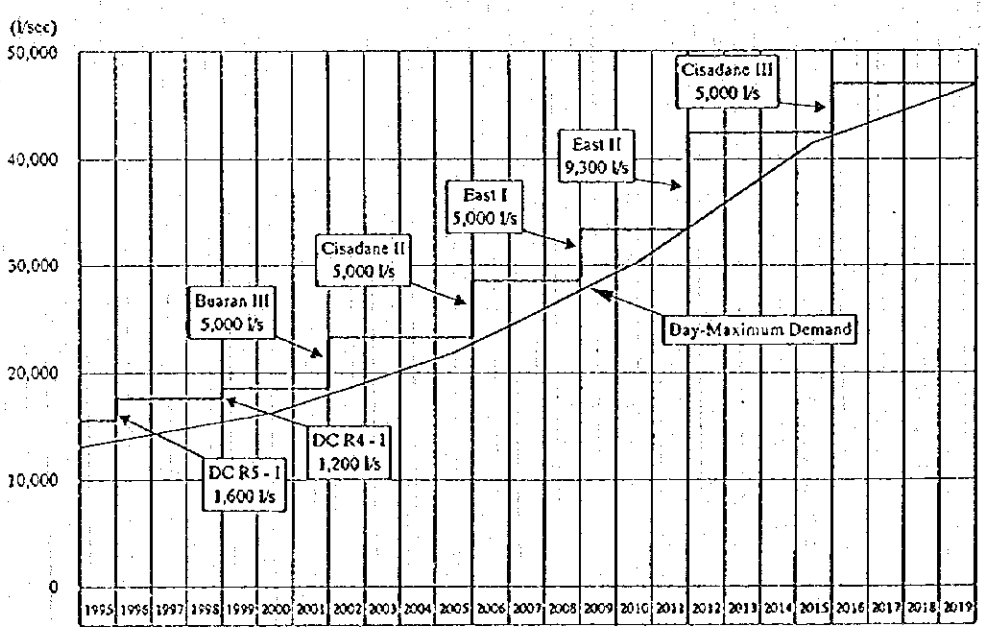
Details of the Original Alternative Study is shown in Annex-37.

Figure-372.5 RESULTS OF ORIGINAL ALTERNATIVE STUDY AND ORIGINAL IMPLEMENTATION SCHEDULE



LEGEND :

- Expansion of Treatment Plant
- Proposed Treatment Plant
- Existing Treatment Plant
- Expansion of Distribution Center
- Proposed Distribution Center
- Raw Water
- Treated Water Transmission



4) Revised Alternative Studies on Water Supply Facilities

i) Given Conditions and Methodology of the Revised Alternative Studies

Basic policies and methodologies for the revised alternative studies are same as the ones which were employed for the original alternative study.

Location of the treatment plants which will receive raw water from the Conveyance 2 and KSCS are considered as already fixed at south-east of Jakarta, namely New East (Cipayung) Treatment Plant, and Cisadane Treatment Plant, respectively.

Location of the above treatment plants were already carefully studied during the original alternative studies, therefore, in the revised alternative studies, location of these treatment plants were treated as fixed. Therefore, in this revised alternative study, alternatives are prepared considering location of treatment plant which will receive raw water from WTC, 2 times of 5 m^3/sec.

The revised alternative study has been conducted focusing on system planning for treated water transmission from Eastern Part to Western Part of the city. Consideration of the treated water transmission system and its route between two parts will not be concluded without careful mulling over the location of treatment plants. Therefore, treated water transmission system and location of treatment plants are studied in detail taking due consideration on the condition of alternative location for the treatment plants and routes for water transmission as well.

ii) Preparation of Alternatives

As the first step of the alternative study, several possible location of treatment plants which will receive raw water from the WTC were considered.

According to the revised scheme of water resources development, Scenario II, which are described in the previous section, the 1st 5 m3/sec will be available from Year 2002 and the 2nd 5 m3/sec will be available from Year 2006 from the WTC.

Possible location of treatment plans for 1st and 2nd 5 m3/sec are considered respectively as shown on the matrix, Table-372.9.

Table-372.9 POSSIBLE LOCATION OF TREATMENT PLANTS WHICH WILL RECEIVE RAW WATER FROM WTC

		2nd 5 m^3/sec		
		Buaran	Bekasi	New East
1st 5m^3/sec	Buaran	O	O	O
	Bekasi	X	O	X
	New East	X	X	X

O : Combination of location considered as an alternative
X : Combination omitted from alternative study

Buaran : Within the premises of existing Buaran I & II or expansion of the existing premises of Buaran I & II.
Bekasi : In Bekasi area near from confluence of WTC and Bekasi river
New East : South east of Jakarta, at Cipayung

Reason of omission

Combination (1st - 2nd)	Reason
Bekasi + Buaran	The 1st 5 m3/sec will be transmitted to the Distribution Center R6 to distribute water to the north-west area of Jakarta. Treated water transmission from Buaran treatment plant was already constructed with capacity for future expansion. Therefore, for Part One project, Buaran Treatment plant will be more suitable than Bekasi. In Bekasi area, at Jakasampurna, land space for treatment plant of which capacity is 10 m3/sec will be available. Therefore, it is not necessary to consider other location, such as Buaran, for the second 5 m3/sec.
Bekasi + New West	In Bekasi area, at Jakasampurna, land space for treatment plant of which capacity is 10 m3/sec will be available. Therefore, it is not necessary to consider other location, such as New West, for the second 5 m3/sec.
New East + Buaran	The 1st 5 m3/sec will be transmitted to the Distribution Center R6 to distribute water to the north-west area of Jakarta. New East is father than Buaran to the R6.
New East + Bekasi	Same reason as "New East + Buaran".
New East + New East	Same reason as "New East + Buaran".

Based on the reasons above, further revised alternative study will be conducted on the combinations as follows:

Alternative R1 : Buaran + Bekasi

Alternative R2 : Bekasi + Bekasi

Alternative R3 : Buaran + Buaran

Alternative R4 : Buaran + New East

Currently, the existing Buaran plant directly distributes 2.0 m3/sec water out of the total production of 5.0 m3/sec to Zone 2, and transmits the remaining 3.0m3/sec to the Distribution Center R1. After system expansion by implementation of the priority project which will receive raw water, 5 + 5 = 10 m^3/sec, from WTC, water treated at the existing Buaran I & II plants, 5 m^3/sec, will be distributed around the plants directly in Zone 2 and Zone 3. For the alteration of the distribution system, the existing pumps for water transmission will be necessary to be replaced by pumps for distribution.

After implementation of the priority project, amount of water required to be transmitted to Western Part will be 6.9 m^3/sec, while the remaining 2.3 and 0.8 m^3/sec to North and South areas of Eastern Part respectively.

For the water transmission, the following three alternative routes are considered.

1. Transmit water to Western Part through the existing transmission mains and R1 distribution center (North route).

2. Transmit water to Western Part through the new transmission mains via East pumping station, of which location will be at Cipayung, to be constructed (South route).

3. Transmit water to Western Part through the central Jakarta by installing a new pipeline along the raw water transmission main to Pejompongan plant which is now under construction (Central route).

As to Central route, it is considered difficult to install additional large diameter pipelines through the congested central area of Jakarta city, and North and South routes are employed for the alternative study. In the following section, four different combinations of treatment plant location and transmission route mentioned above are considered as alternatives and they are compared in detail.

Outline of four alternatives are described as follows.

Alternative R1

Part 1: Buaran plant expansion and treated water transmission through North route.

Part 2: Bekasi plant construction and treated water transmission through South route.

Alternative R2

Part 1: Bekasi plant construction and treated water transmission through North route.

Part 2: Bekasi plant expansion and treated water transmission through South route.

Alternative R3

Part 1: Buaran plant expansion and treated water transmission through North route.

Part 2: Buaran plant expansion and treated water transmission through South route.

Alternative R4

Part 1: Buaran plant expansion and treated water transmission through North route.

Part 2: New East, Cipayung, plant construction, raw water transmission through South route and treated water transmission to West form East plant.

iii) Comparative Studies on Selected Alternatives

For each alternative, future water supply system in year 2019 was prepared and shown on **Figures-372.6, 372.7, 372.8, 372.9** and **372.10**. Major features of alternatives are shown in **Annex-37.**

Required treated water transmission for each alternative system was obtained by hydraulic analysis for cost comparison. Construction cost for the treatment plant was calculated using same unit cost as the original alternative study.

Figure-372.6 FUTURE WATER SUPPLY SYSTEM IN 2019
ALTERNATIVE R1 : BUARAN + BEKASI

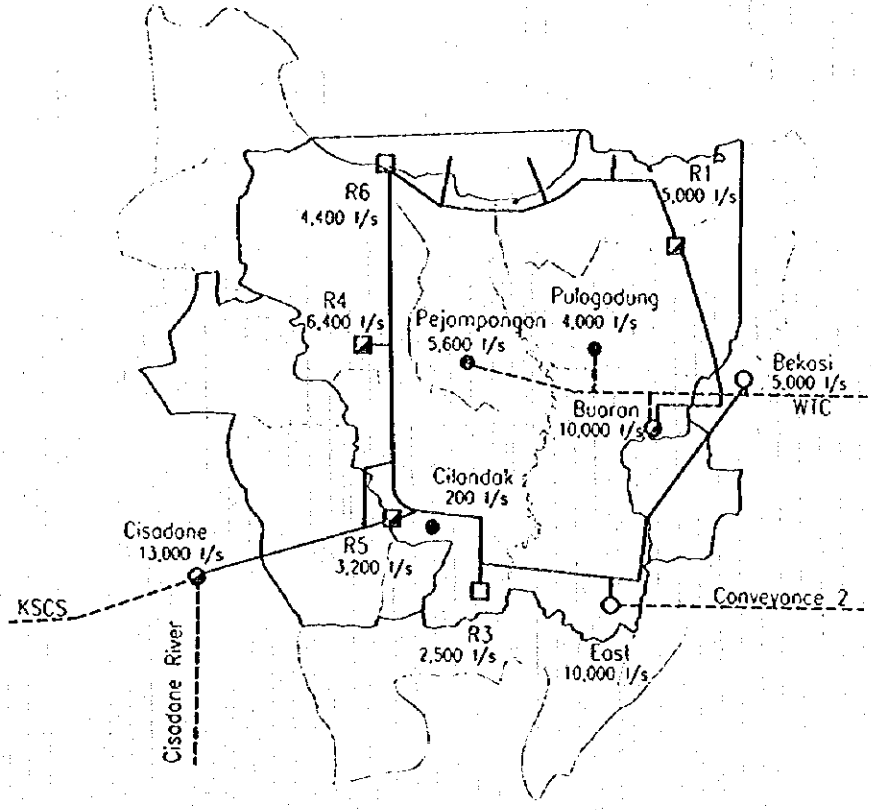
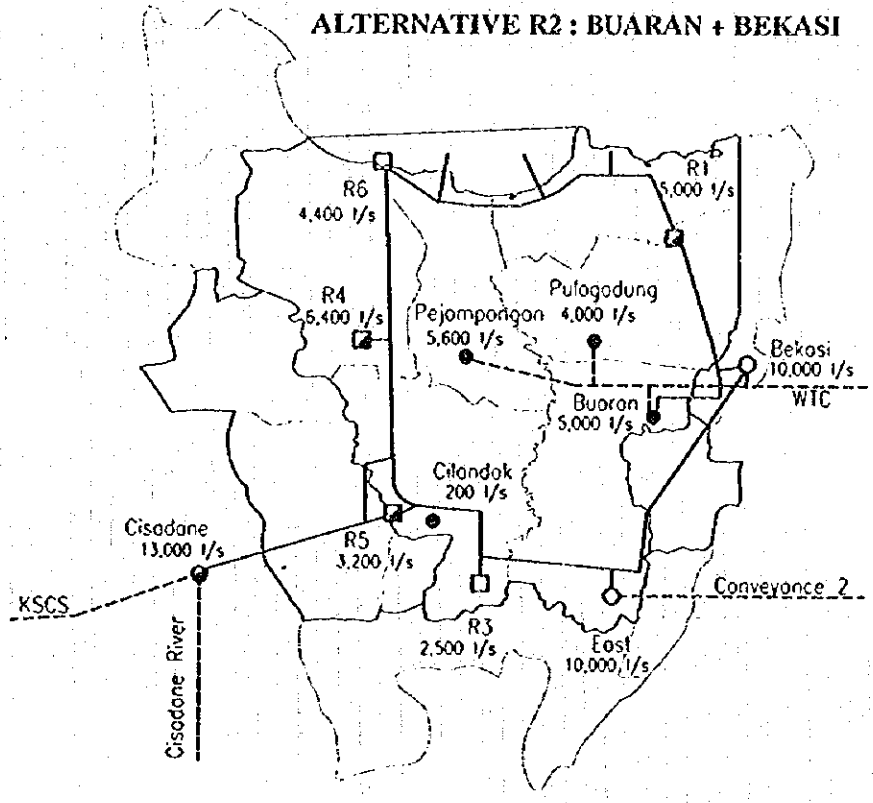


Figure-372.7 FUTURE WATER SUPPLY SYSTEM IN 2019
ALTERNATIVE R2 : BUARAN + BEKASI



LEGEND :

- Expansion of Treatment Plant
- Proposed Treatment Plant
- Existing Treatment Plant
- Expansion of Distribution Center
- Proposed Distribution Center
- Raw Water
- Treated Water Transmission

Figure-372.8 FUTURE WATER SUPPLY SYSTEM IN 2019
ALTERNATIVE R3 : BUARAN + BEKASI

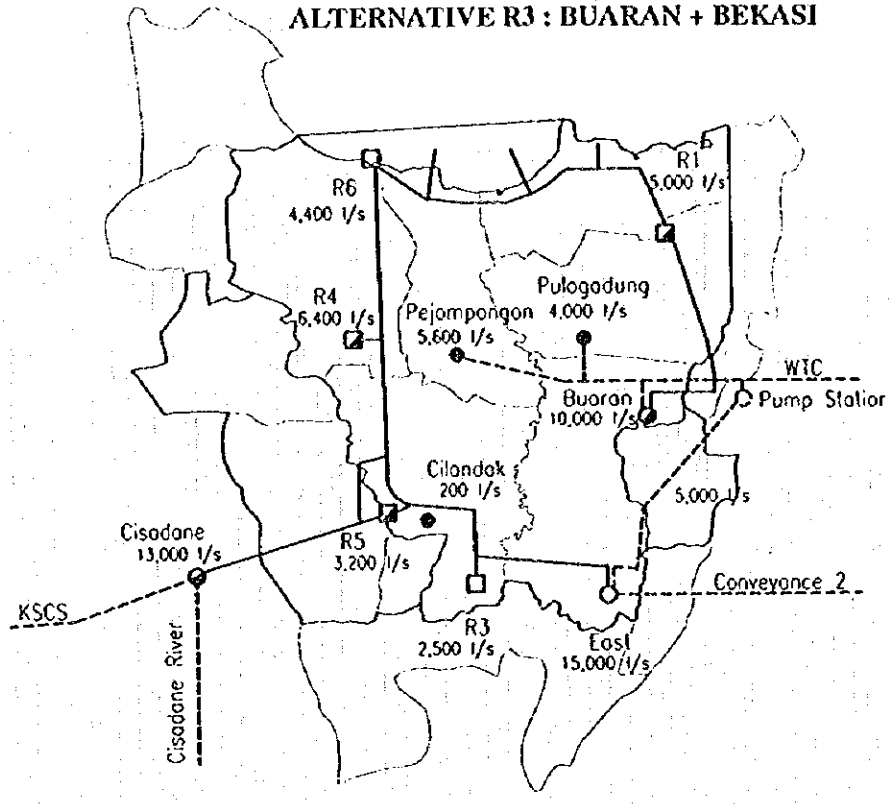
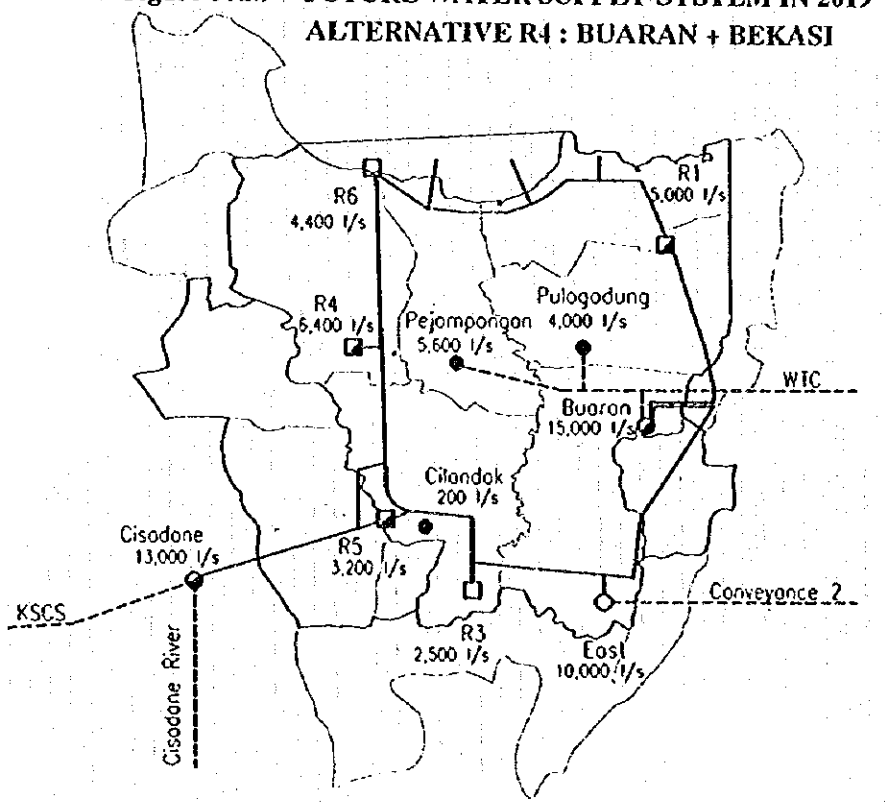


Figure-372.9 FUTURE WATER SUPPLY SYSTEM IN 2019
ALTERNATIVE R4 : BUARAN + BEKASI

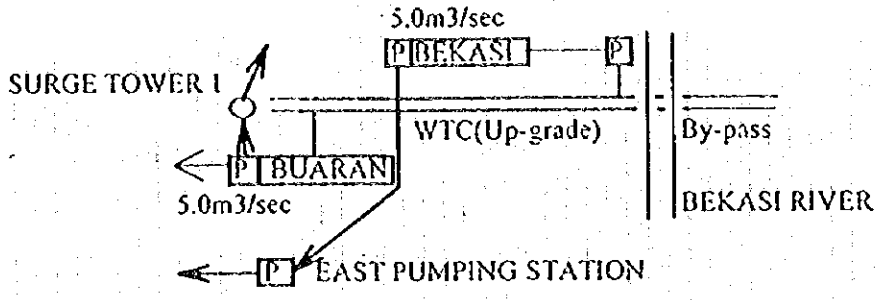


LEGEND :

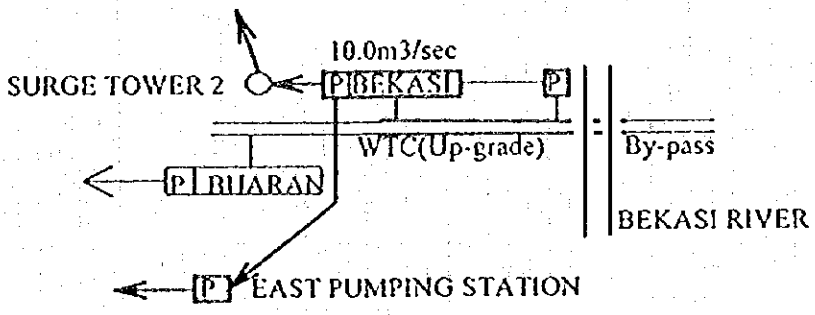
- Expansion of Treatment Plant
- Proposed Treatment Plant
- Existing Treatment Plant
- Expansion of Distribution Center
- Proposed Distribution Center
- Raw Water
- Treated Water Transmission

Figure-372.10 OUTLINE OF ALTERNATIVES

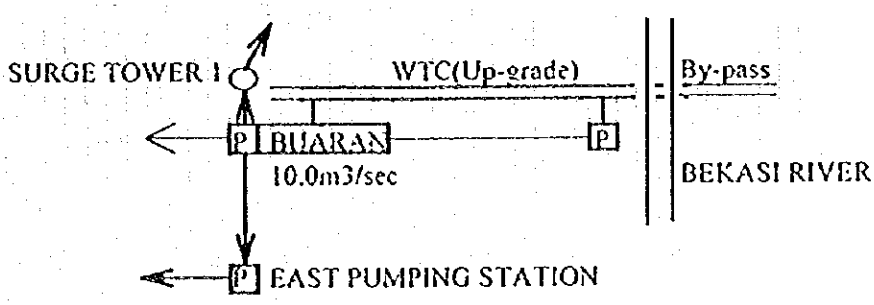
ALTERNATIVE 1: BUARAN - BEKASI



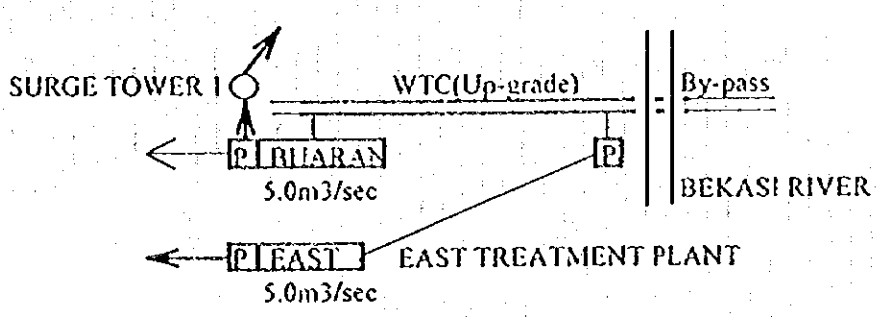
ALTERNATIVE 2: BEKASI - BEKASI



ALTERNATIVE 3: BUARAN - BUARAN



ALTERNATIVE 4: BUARAN - EAST



Regend: Clear Water Tansmission ← Raw Water Main — Distribution Main ←

Present value of the construction cost for each alternative is shown on **Table-372.10**, and details are shown in **Annex-37**. Costs shown on the **Table-372.10** include;

1. Construction cost of Treatment plant
   Distribution Center
   Treated water transmission
2. Land acquisition cost for Treatment plant
3. Cost for resettlement

Note : Costs for distribution pipes are not included.

Table-372.10 CONSTRUCTION COST COMPARISON BASE COST VS. PRESENT VALUE FOR EACH ALTERNATIVE

Unit : Million

unit		Alternative			
		R1	R2	R3	R4
BASE COST					
Foreign Cost	Yen	72,912	73,195	73,619	65,162
Local Cost	Rp.	1,627,977	1,622,559	1,680,182	1,524,758
	Eq. Yen	77,523	77,265	80,009	72,608
Total	Yen	150,435	150,460	153,628	137,770
PRESENT VALUE					
Foreign Cost	Yen	59,556	59,817	60,163	52,926
Local Cost	Rp.	760,334	756,337	788,415	705,150
	Eq. Yen	36,206	36,016	37,544	33,579
Total	**Yen**	**95,762**	**95,833**	**97,707**	**86,505**
RANK		**2**	**3**	**4**	**1**

Exchange Rate : 1Yen = Rp.21.0

The results of the comparison of the costs for construction, land acquisition, and resettlement, as shown on the Table above, show that the Alternative R4 is the most economical plan.

In addition to the construction cost comparison, costs required for the raw water conveyance were also compared. For the estimation of the costs required for the raw water conveyance, following condition was pre-assumed.

- The first 5 m3/sec from the WTC will be conveyed through existing WTC with some capacity upgrading works.
- The second 5 m3/sec from the WTC will be conveyed through raw water transmission

pipeline to each treatment plant.

Based on the conditions stated above, base cost and present value for the raw water conveyance are shown on the **Table-372.11**.

Table-372.11 RAW WATER CONVEYANCE COST COMPARISON BASE COST VS. PRESENT VALUE FOR EACH ALTERNATIVE

Unit : Million

unit		Alternative			
		R1	R2	R3	R4
BASE COST					
Foreign Cost	Yen	1,490	1,255	2,060	8,374
Local Cost	Rp.	17,390	14,880	24,360	83,893
	Eq. Yen	828	709	1,160	3,995
Total	Yen	2,318	1,964	3,220	12,369
PRESENT VALUE					
Foreign Cost	Yen	1,334	1,117	1,819	7,185
Local Cost	Rp.	11,352	9,500	15,093	47,045
	Eq. Yen	541	452	719	2,240
Total	**Yen**	**1,875**	**1,569**	**2,538**	**9,452**

Exchange Rate : 1Yen = Rp.21.0

As shown on the Table above, costs required for the raw water conveyance for the Alternative R4 is the most expensive although the construction cost is the smallest as shown on the **Table-372.10**.

As the next step, construction cost, shown on the **Table-372.10**, and costs for raw water conveyance, shown on the **Table-372.11**, are combined and the results are shown on the **Table-372.12**.

The results of the total cost comparison shown on the Table above, show that the Alternative R4 is the most economical system.

In addition to the cost comparison, other aspects of each alternative are also compared. The results of the comparison are shown on the **Table-372.13**.

Table-372.12 TOTAL COST COMPARISON FOR EACH ALTERNATIVE

Unit : Million

unit		Alternative			
		R1	R2	R3	R4
PRESENT VALUE					
Construction Cost	Eq. Yen	95,762	95,833	97,707	86,505
Costs for Raw Water Conveyance	Eq. Yen	1,875	1,569	2,538	9,452
Total	Eq. Yen	97,637	97,402	100,245	95,957
RANK		3	2	4	1

Comparison are made on items related to land acquisition, construction, operation and maintenance, the existing facilities, preparatory works, sludge treatment as well as cost items.

For selection of the best alternatives, scoring method is employed as follows.

1. For each component item 5 points are given to the best one and 1 point is given to the worst one.

2. For the important comparative item which is shaded in the Table, 10 points are given to the best one and 2 point is given to the worst one.

Thus, scores given to each alternative are shown in the **Table-372.13**. From the table, the best alternative, that is Alternative R4 with the highest score of 52 points, is selected for the locations of treatment plant construction for the priority project.

Alternative R4 is to expand the existing Buaran treatment plant as Part 1 for the additional capacity of 5.0m3/sec, and succeedingly to construct a new treatment plant with capacity of $5m^3$/sec at Cipayung as Part 2 of the priority project.

Advantages of the Alternative R4 is summarized as follows:

1. The existing facilities of Buaran treatment plants I and II such as administration building, power sub-station and laboratory will also be utilized for the expanded system with necessary modification leading to decreasing plant construction cost.

2. Necessary period for detailed design of Buaran plant expansion, though partly, will be shortened by utilizing a part of the existing tender documents and as-built drawings. Using open space of the existing Buaran plant premises in addition to the above, earlier commencement of the plant expansion works as well as earlier commencement of its service will be expected.

3. Treated water of either one of the existing and new Buaran plants will be commonly used to secure more stable water supply, especially in an emergency case.

4. A new treatment plant which will receive raw water from Jatiluhur dam through Conveyance 2 will be constructed at the fourth step of the whole development program in the eastern part of the City. Vast land area which may be available at Cipayung for Part 2 of the priority project will allow accommodation of the above future plant.

5. Construction of treatment plants within administrative area of Jakarta city will be easier in obtaining necessary permission for the construction and it will not be necessary to coordinate with other neighboring local PDAMs on the management of the plant.

6. Operation of the whole Jakarta water supply system will be easier and O/M costs will be smaller than the other alternatives, since number of treatment plants for final stage of the Master plan is smaller than the others.

Land area for the treatment plant at Cipayung is a property of DKI Jakarta municipal government. On the other hand, land area in Buaran and Bekasi are owned by private. In case of delay of implementation, escalation of the land cost will be higher in the case of Buaran and Bekasi than the case of Cipayung. Therefore, in addition to the advantages listed above, the case of Cipayung, Alternative R4, has advantage in terms of sensitivity of land price escalation.

Table-372.13 COMPARISON OF ALTERNATIVES

No.	ITEMS	DESCRIPTION	Alt.1	Alt.2	Alt.3	Alt.4
1	Project Cost including plant construction	Not only construction cost of treatment plants, but also cost of the whole water supply system until year 2019 described in the M/P report are compared. According to the cost estimates in the report, order of project costs is, from cheaper, alternatives 4,2,1 and 3.	8	8	5	10
2	Availability of land area for Plant Construction	Vast lands may be available both at Jakasanpurna for Bekasi and Cipayung for East plant including necessary space for their future expansion. Comparing Jakasanpurna with Cipayung, land acquisition at Jakasapurna may be easier because of the land is owned by private. For Part 2, Buaran expansion for further 5.0m^3/sec, existence of a lot of dwellers required for resettlement may increase difficulty in acquiring land for the plant premises.	8	10	2	7
3	Necessity of Land Acquisition	Considering being difficult of vast land acquisition in and around Jakarta city year by year, preparation for acquiring land for future plant premises in early time is important. In case of Alternative 4, advanced acquisition of the land in Cipayung will allow accommodation of future plant facilities not only for the Priority project but also for the future project which will receive raw water of planned Conveyance 2 from Jatiluhur dam.	2	2	2	5
4	Cost for Land Acquisition etc,	Costs of land acquisition and of resettlement for new plant or plant expansion are compared. Buaran expansion requires smaller additional area among others by utilization of the existing open area, but because of higher land cost and large number of resettlement, cost for land acquisition will be the highest.	5	2	4	5
5	Resettlement for Plant Construction	In addition to the above items 2 and 3, implementation of large scale resettlement will cause delay of commissioning of the plant in service.	3	5	1	3
6	Implementation with in JKT City Area	Considering from past experience on Cisadane plant, construction of treatment plants of Jakarta water supply system within Jakarta city will lesson problems on their implementation.	3	3	5	5
7	Utilization of The Existing Facilities	For Buaran plant expansion, the existing facilities such as administration building and power sub-station will be used with slight modification leading to decreasing plant construction cost. Alternative 2 will abandon the newly constructed surge tower 1, because its water transmission is made directly to the surge tower 2 locating downstream of the tower 1.	5	2	5	5
8	Land Development for Plant Construction	Large portion of premises for Buaran plant expansion is composed of rocky hilly area 5 to 10m higher than the existing level. Land development for plant construction is needed. Its development cost and period must be considered for selection of alternatives.	4	5	1	4
9	Sludge Treatment	Although the lagoon system for sludge treatment will require vast land space, the system may be cheaper than mechanical sludge treatment system. Alternative which affords to acquire vast land space will be appropriate in terms of sludge treatment.	3	5	1	3
10	Final Plant Numbers	For easy operation and maintenance and for saving O/M costs, numbers of treatment plants shall be small.	2	2	5	5
	TOTAL SCORE		43	44	31	52

iv) Results of the Revised Alternative Studies - Proposed Water Supply System

Based on the results of comparative study not only from the aspect of cost required but also from the other aspects, it is concluded that the Alternative R4 is the most recommendable system. Proposed system, Alternative R4 is shown on the **Figure-372.11**. List of proposed facilities are shown on **Table-372.14**.

Table-372.14 LIST OF PROPOSED FACILITIES

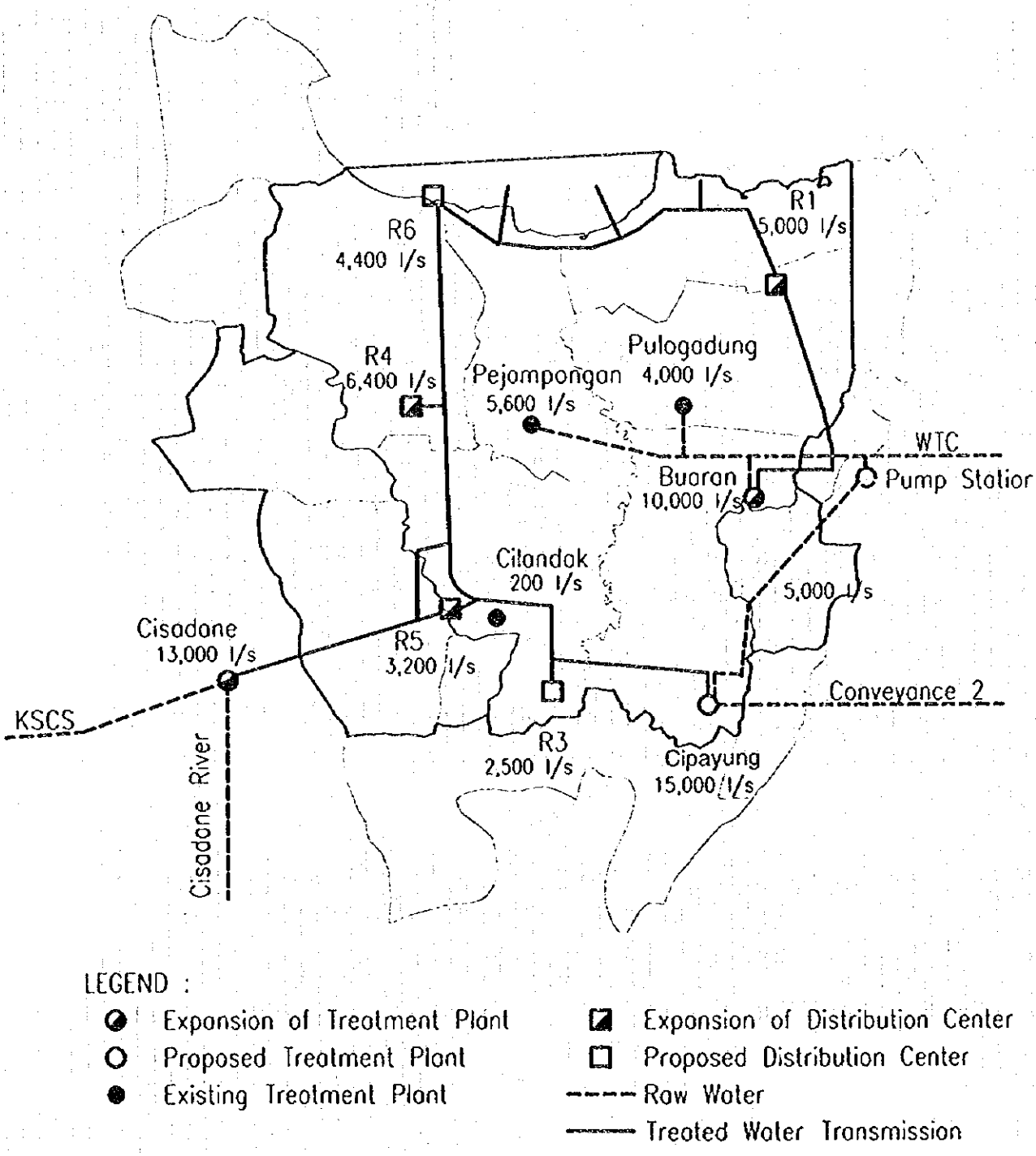
Proposed Facilities	Capacity (l/sec)	Volume (m3)
Buaran III Treatment Plant	5,000	-
New East I Treatment Plant	5,000	-
New East II Treatment Plant	10,000	-
Cisadane II Treatment Plant	5,000	-
Cisadane III Treatment Plant	5,000	-
R1 II Distribution Center	2,000	19,800
R1 III Distribution Center *	0	19,800
R3 I Distribution Center	1,250	22,500
R3 II Distribution Center	1,250	22,500
R4 II Distribution Center	2,600	46,400
R4 III Distribution Center	1,300	23,200
R4 IV Distribution Center	1,300	23,100
R5 II Distribution Center	1,600	35,100
R6 I Distribution Center	4,400	50,400

* : Construction of additional distribution basin

Although the best alternative is concluded as the Alternative R4 and location of future treatment plants are fixed at Buaran (Buaran III) and at Cipayung, the Indonesian side pointed out other possible location of new treatment plant as the alternative location of Buaran III in Bekasi. According to the explanation by the Indonesian side, in the event of the Indonesian side encountering difficulties on additional land acquisition around existing Buaran Treatment Plant premises, there will be a possibility to shift the location of the treatment plant from Buaran to Bekasi.

Proposed location in Bekasi by the Indonesian side is different from the location discussed in the alternative study stated above which is in Bekasi area near from confluence of WTC and Bekasi River. Proposed location by the Indonesian side is in several kilometers upstream from the Bekasi Weir and the exact location has not been fixed yet.

Figure-372.11 PROPOSED WATER SUPPLY SYSTEM IN 2019
ALTERNATIVE R4 : BUARAN + NEW EAST



3.7.3 Distribution Facilities

(1) Zoning Implementation

1) Treated Water Transmission Between East and West Concession Area

Before discussing zoning, treated water transmission between East and West Concession Areas, which is a fundamental information for zoning implementation, is summarized in **Table-373.1**. The Table shows treated water transmission in each year just before the increase of respective treatment plant capacity.

Treated bulk water should be transmitted from Buaran III to DC-R6 through DC-R1 after completion of Buaran III Treatment Plant in 2002. As recommended by JWSSP Reports, construction and usage of DC-R6 will be a solution to the supply problem in the north-west area of DKI Jakarta during this period. The subject treated water transmission pipe, between DC-R1 and DC-R6 will also be used as a transmission pipe for bulk water supply to the Water Front City later on.

2) Musts for zoning Implementation

As discussed in the previous section, it is necessary to establish hydraulically independent zoning system for controlling and monitoring water flow, pressure and quality properly in such a large distribution system. Based on the concept of zoning system, future distribution facilities are considered.

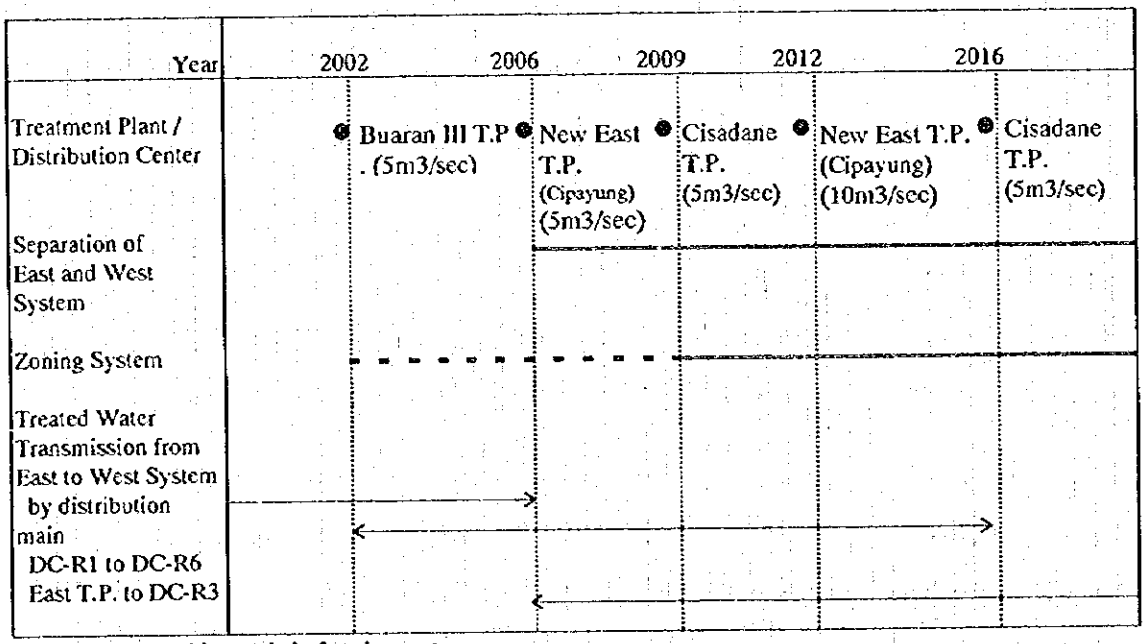
For zoning implementation, a treatment plant or a distribution center, as core facility of water distribution, should be constructed in each zone with enough capacity to meet water demand in the respective zone. To secure continuous water supply to the distribution center, treated water transmission facilities connecting treatment plants and distribution centers should also be constructed. Timing and location of treatment plant construction will affect the construction schedule of transmission facilities.

Besides the above, other zoning preparation works such as installation of distribution pipes together with necessary valves and meters should also be installed in order to create independent distribution zones according to the implementation schedule.

3) Zoning Implementation Schedule

Considering timing of commencement and location of each treatment plant, zoning implementation schedule is prepared as shown in **Figure-373.1**.

Figure-373.1 ZONING IMPLEMENTATION SCHEDULE



Note : -----: Transition period of zoning system

a) Before Completion of New East (Cipayung) T.P. in 2006

Before completion of New East (Cipayung) Treatment Plant, water should be transferred from east to west across the Cilliwung River which is the boundary between East and West private sector concessional areas through not only treated water transmission pipe but also distribution pipes. This is because required distribution centers will not be constructed in each zone during this period. In other words, each zone will not be isolated and zones will be interconnected by distribution pipes. Distribution zoning system can not be implemented during this period.

Table - 373.1(1) Treated Water Transmission Between East and West Concessional Area

Before Commencement of Buaran III T.P. (5m3/sec) in Year 2002 (m3/sec)

		WEST	East
Water Demand	a	9.5	8.5
Production Capacity	b	8.9	9.3
Treated Water Transmission	c	0.6 ← by interconnected distribution main	
Quantity of Distribution	d=b+(-)c	9.5	8.7

Note : Production capacity includes mini plant productions.

Before Commencement of New East (Cipayung) T.P.(5m3/s) in Year 2006 (m3/sec)

		WEST	East
Water Demand	a	12.1	10.0
Production Capacity	b	8.6	14.0
Treated Water Transmission	c	3.5 ← DC-R6 ← DC-R1 by interconnected distribution main	
Quantity of Distribution	d=b+(-)c	12.1	10.5

Before Commencement of Cisadane T.P.(5m3/s) in Year 2009 (m3/sec)

		WEST	East
Water Demand	a	15.5	12.0
Production Capacity	b	8.6	19.0
Treated Water Transmission	c	6.9 ← DC-R5 ← East TP; DC-R6 ← DC-R6	
Quantity of Distribution	d=b+(-)c	15.5	12.1

Note : Figures shown above are Day-Maximum basis

Table - 373.1(2) Treated Water Transmission Between East and West Concessional Area

Before Commencement of New East (Cipayung) T.P.(10m3/s) in Year 2012 (m3/sec)

		WEST	East
Water Demand	a	18.9	13.7
Production Capacity	b	13.6	19.0
Treated Water Transmission	c	5.3 ← DC-R3 ← East T.P.; DC-R6 ← DC-R1	
Quantity of Distribution	d=b+(-)c	18.9	13.7

Before Commencement of Cisadane T.P.(5m3/s) in Year 2016 (m3/sec)

		WEST	East
Water Demand	a	25.0	16.9
Production Capacity	b	13.6	29.0
Treated Water Transmission	c	11.4 ← DC-R6 ← DC-R1; DC-R3 ← East TP	
Quantity of Distribution	d=b+(-)c	25.0	17.6

Year 2019, Target year of the Master Plan (m3/sec)

		WEST	East
Water Demand	a	28.8	18.0
Production Capacity	b	18.6	29.0
Treated Water Transmission	c	10.2 ← DC-R3 ← East T.P.	
Quantity of Distribution	d=b+(-)c	28.8	18.8

Note : Figures shown above are Day-Maximum basis

However, during this transition period, four zone system will be able to be implemented instead of seven zone system, as follows;

1. Zone 1
2. One combined zone, Zone 2 and Zone 3
3. Zone 4
4. One combined zone, Zone 5 and Zone 6

b) After Completion of Treatment Plant at New East (Cipayung) in 2006

After completion of Treatment Plant at New East (Cipayung) with capacity of 5.0 m^3/sec, in 2006 and before commencement of Cisadane Treatment Plant with capacity of 5m^3/sec in 2009, enough capacity of distribution center and related treated water transmission facilities will not have been completely constructed.

However, East and West water supply system can be separated and five (5) zone system will be introduced. Each concessional area will be consist of ;

East : 1. One combined zone, Zone 2 and Zone 3
2. Zone 6

West : 3. Zone 1
4. One combined zone, Zone 4 and Zone 7
5. Zone 5

c) After completion of Cisadane Treatment Plant in 2009

After completion of Cisadane Treatment Plant with additional treatment capacity of 5.0 m3/sec at south-west of DKI Jakarta in 2009, service area can be divided into 7 (seven) zone, since each zone can have enough distribution facilities and distribution pipelines required for isolation of Zones will be installed.

(2) Preliminary Primary Pipe Network Analysis

Preliminary Primary Pipe Network (ø300mm and larger) analysis is conducted in order to create appropriate distribution network which support zoning system mentioned above and to decide most effective way of achieving suitable pressure level in the year 2019.

1) Condition

The conditions of net work analysis are as follows:

a) The service area is divided into seven zones as described in **Section 3.7.1**, and pipe network analysis is conducted for each zone separately for the year of 2019. For hydraulic analysis, Zone 5, Zone 6 and Zone 7 are divided into high and low sub-zones since the topography of southern part of the service area is not flat. Cilandak sub-zone is also isolated hydraulically with the rest of the system in zone 5.

b) The model prepared by JWSSP is adopted for the schematic diagram of existing pipe network. The new pipes are designed to be installed along existing and planning roads. This model includes most of trunk mains of diameter 300 mm and above.

c) For Kecamatans in the service area, the maximum daily demand has been allocated to individual nodes and then converted into a peak hour demand. The demand has been equally divided between nodes located within that Kecamatan. Kecamatan Kemayoran and Kecamatan Pademangan are exceptions to this demand allocation method because 500 l/sec of water transmission to Kemayoran Development area was considered separately.

d) Hourly Maximum Water Demand (Peak hour demand) is designed as 130 % of Day Maximum water demand. This figure of peak hour factor is same as the one adopted by JWSSP.
Full detail of the nodal demand allocation can be found in **Annex-37.**

e) Hazen-Williams formula is used for water head loss calculation. C-value adopted were 90 for 1920's to 1950's mains and 110 for 1970's and 1980's.

f) Pressure level of service is defined as same as JWSSP. That is 17 m (1.7 kg/cm^2) minimum and 50 m (5.0 kg/cm^2) maximum pressure head at the nodes of the primary network during peak hour demand .

2) Results

Several pipeworks are necessary for reinforcement and modification to meet the forecasted demand in the year of 2019. **Table-373.2** provides lists of summary of the pipe length to be installed by diameter until the year 2009 and 2019, respectively.

Required pump capacity in each zone is listed in **Table-373.3.** Although replacement of pumps for DC-R4 in zone 4 will be required because of low existing pump head, no booster pump will be required in future distribution system.

Future model of pipe networks is shown in **Figure-373.2.** This figure shows whole system of distribution primary mains in 2019 including existing and proposed pipelines.

The results of network analysis are contained in **Annex-37.**

3) Service Mains and House Connection

Number of house connection in future is estimated from the future served population and number of person per connection (5.8 person per connection) as discussed in **Section 3.5** and shown on **Table-373.4.**

Table-373.4 NUMBER OF HOUSE CONNECTION

Unit : 1,000 connection

YEAR	1995	2000	2005	2010	2015	2019
DKI Jakarta	298	539	802	1,112	1,478	1,540
Fringe Area *	0	0	0	50	180	310
Total	298	539	802	1,162	1,658	1,850

* : Connections in Kecamatans which are included in the PAM JAYA service area

Length of the service mains, secondary and tertiary mains, are estimated based on the unit pipe length per connection.

Total length of the existing service mains, according to the data of PAM JAYA in September, 1995, is as follows.

Table-373.2 BREAKDOWN OF PRIMARY MAINS PIPE LENGTH

Diameter (mm)	Existing Length * (m)	Before 2009		Up to 2019	
		Newly reqired Length(m)	Accumulated Length(m)	Newly reqired Length(m)	Accumulated Length(m)
300	117,789	125,380	243,169	150,256	393,425
350	27,217	190	27,407	2,380	29,787
400	123,718	35,144	158,862	42,820	201,682
450	4,650	0	4,650	0	4,650
500	55,423	19,602	75,025	22,060	97,085
550	2,504	0	2,504	0	2,504
600	123,898	96,757	220,655	56,980	277,635
700	0	12,900	12,900	0	12,900
800	61,422	84,170	145,592	24,082	169,674
900	17,977	10,040	28,017	100	28,117
1000	27,126	31,254	58,380	25,163	83,543
1100	6,442	0	6,442	1,370	7,812
1200	5,590	16,930	22,520	15,340	37,860
1350	1,912	9,100	11,012	1,230	12,242
1500	640	16,392	17,032	0	17,032
1600	2,619	3,960	6,579	0	6,579
1800	2,962	8,214	11,176	7,910	19,086
2200	0	0	0	8,820	8,820
Total	581,889	470,033	1,051,922	358,511	1,410,433

Note :

* Figures of existing pipe length are referred to JWSSP Distribution System Report in 1995. The length includes pipes to be installed by PJSIP Phase 1 and Phase 2

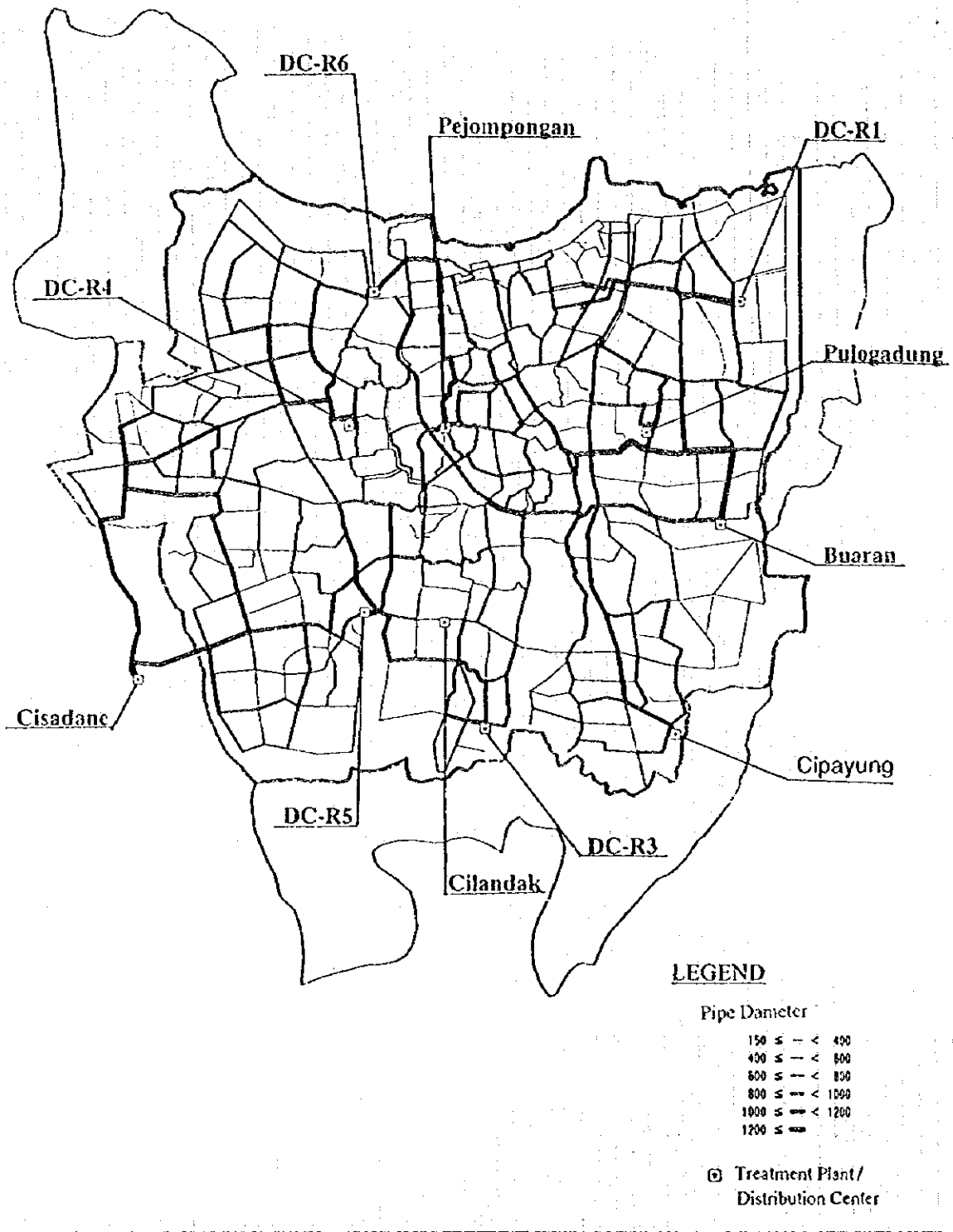
Table-373.3 REQUIRED DISTRIBUTION PUMPS IN EACH ZONE (2019)

Source of Treated Water Supply	Required Pump Head m	Pump Capacity			Water Demand (day max) l/sec	Remarks
		Required l/sec	Existing l/sec	Newly Required l/sec		
ZONE 1						
Pejompongan I	34	3,700	4,000	0	1,850	
	38	300	300	0	150	
Pejompongan II	50	7,200	9,000	0	3,600	
DC-R6	45	4,800		4,800	2,400	
ZONE 2						
Pulogadung	54	8,000	8,000	0	4,000	
Buaran III	54	6,400		6,400	3,200	
ZONE 3						
DC-R1	44	7,000	6,000	1,000	3,500	Expansion
ZONE 4						
DC-R4	57	12,800		12,800	6,400	Required Pump head<Existing
ZONE 5						
DC-R3	43	5,000		5,000	2,500	
DC-R5	45	6,400	2,730	3,670	3,200	Expansion
Cilandak	45	400	620	0	200	
ZONE 6						
N.East	41	8,200		8,200	4,100	
Buaran I	54	4,600	4,000	600	2,300	Expansion
ZONE 7						
Cisadane (Low)	35	7,400		7,400	3,700	
(High)	68	5,600		5,600	2,800	

NOTE : Pump capacity includes the capacity of Standby pumps
The figures might be subject to change by further detailed study

Scale : 1/300,000

Figure - 373.2 PROPOSED PRIMARY DISTRIBUTION SYSTEM (YEAR 2019) (EXISTING AND PROPOSED PIPELINES)



Secondary Main (150 - 250 mm) :	878 km
Tertiary Main (50 - 100 mm) :	2,966 km
Total of Service Main :	3,844 km

Total number of house connection in 1995 is 297,590. Therefore, unit pipe length per house connection is derived as 12.9 m/connection.

In future, density of house connection will become higher than the existing density. In other words, unit pipe length will become shorter than the existing length. Therefore, current unit length in Jakarta 12.9 m/connection will become shorter but difference with current length might be small. Based on these consideration, it is estimated that future unit pipe length per connection will become 90 % of current length. Calculated length of service mains is shown on **Table-373.5.**

Table-373.5 LENGTH OF SERVICE MAIN IN FUTURE

YEAR		1995	2000	2005	2010	2015	2019
Number of Connection	x 1,000	298	539	802	1,162	1,658	1,850
Unit Pipe Length	m/conc.	12.9	12.6	12.4	12.1	11.8	11.6
Total Length of Service Mains	km	3,844	6,808	9,926	14,081	19,630	21,522

(4) Water Supply to Kecamatan Kepulauan Seribu (1,000 Islands)

Existing water supply condition in Kecamatan Kepulauan Seribu (1,000 Islands) is described in **Section 2.3** and **Annex-23.** People live in the 1,000 Islands depend their water source on shallow wells of which water quality is not suitable for drinking. There are some famous resort islands in 1,000 Island and accommodation facilities have been constructed on the island. But these accommodation facilities are operated by the private companies and their water demands have been satisfied by their own water supply system. Some hotels have mini treatment plant in their premises and some hotels have been depend on mineral water delivered from main Java Island by their own boat. Under the circumstances, water demand only for inhabitants are considered in this study.

As mentioned in the previous **Section 3.5**, installation of under-sea pipeline to the islands is not feasible. However, minimum water required for drinking and cooking should be conveyed from the main Java Island.

It is recommended to construct water terminals at main islands and PAM JAYA supply water to the water terminals periodically by boat. Candidate islands for construction of the water terminals are,

Pulau Tidung Besar
Pulau Untung Java
Pulau Panggang
Pulau Pramuka
Pulau Kelapa

From the water terminals constructed in islands shown above, water will be served to inhabitants in the island by public hydrants and also distributed to the neighboring islands by small boat.

Facility of water terminal will be consist of,

Piping from harbor to the reservoir,
Reservoir
Small pumps,
Public Hydrant, and
Outlet piping to harbor for neighboring islands

3.7.4 Water Quality

(1) Target Quality and its Realization

Quality of tap water shall be potable. However, tap water nor finished water of treatment plants of Jakarta water supply system is not always drinkable. Considering variety of the problems on water quality as listed in the **Table-374.1**, it is difficult and unrealistic to obtain potable tap water within a short period.

Of course, the target on quality is placed on realization of potable water throughout the City for public health and welfare as well as for recover reliability of water supply operation of PAM JAYA. For realization of the target, a concept of stepwise improvement of water quality is employed in the Master Plan.

As shown in the table 6.2, Three steps of quality improvement from upstream to down stream of the water supply facilities, namely,

Step 1: Potable finished water at all treatment plant and distribution center,

Step 2: Potable water at the and of distribution mains, and,

Step 3: Potable tap water in the City,

are planned. As to implementation of the steps, it is also planned that Step 1 shall be realized urgently, Step 2 shall be under middle term project and Step 3 shall be until the target year of the Master Plan.

Major improvement works for realization of the target quality of each step are planned as below, and all the necessary work items are thought out and summarized in the following section.

Step 1: Improvement of raw water conveyance and strengthening of chlorine control at each treatment plant and distribution center,

Step 2: Improvement of distribution mains and equipment of quality monitoring system, and,

Step 3: Quality Improvement of water source and improvement of service connection including proper maintenance of receiving tanks of each consumer.

Table-374.1 STEPWISE QUALITY IMPROVEMENT AND FACILITIES FOR IMPROVEMENT

ITEMS		WATER SOURCE	RAW WATER COVEYANCE	TREATMENT PLANT	DISTRIBU-TION MAINS	SERVICE CONNECTION	REMARKS
PRESENT QUALITY				Δ	×	×	Not potable
TARGET QUALITY	STEP 1			O	×	×	Drinkable at plant
	STEP 2			O	O	×	Drinkable at pipes
	STEP 3			O	O	O	Potable tap water
FACILITIES FOR IMPROVEMENT	STEP 1						Urgently realized
	STEP 2						For middle term
	STEP 3						For target year

NOTE: O GOOD, Δ NOT ALWAYS GOOD, × POOR

(2) Quality Standard

Water quality standard should lead in realization of potable water supply which is a goal of water supply business for every consumer. Therefore, the existing quality standard for clean water shall be omitted and the standard for water supply shall be united to the quality standard for potable water in the future, when the above Steps 1 and 2 have been completed.

As described in the **Section 2.1.7**, values of arsenic and lead among inorganic parameters should be improved as described in the followings.

Ministry's standard value of arsenic (As) is 0.05 mg/l which is five times higher than that of WHO guideline because IARC (International Agency for Research on Cancer) put standard of arsenic into high rank of importance defining arsenic as "carcinogenic to human being". The standard value of lead (Pb) is 0.05 mg/l which is five times that of WHO guideline. Lead is harmful substance known to cause lead poisoning and its standard value recommended to be revised to 0.01 mg/l.

As also described in the **Section 2.1.7**, Ministry of health is going to revise the existing quality standard along with WHO guideline, and improvement of the above two parameters should be included in the revision.

It is considered important to grade up the standard, but more important item is strengthening of quality monitoring performance/system which will be discussed in the latter paragraph.

(3) Raw Water Quality and Water Treatment Method

1) Future Raw Water Quality

Considering that treatment of raw water with present quality by conventional rapid sand filtration is almost reaching performance limit, it is necessary to maintain the present level of raw water quality or to improve it in the future. It is feared, however, from the past trend that quality of raw water might be more deteriorated in the future.

Thus, the present quality of raw water of West Tarum canal at the upstream of confluence of Bekasi river is set up as the future quality for planning of water treatment method. To secure the raw water quality such measures including separation of WTC and Bekasi river by bypass channel construction or by other means, preparation of proper fencing or covering of WTC for prevention of further contamination of the raw water and promotion of PROKASIH should be taken.

2) Water Treatment Method

By implementation of the above measures, conventional method with rapid sand filtration can be applied for water treatment of future water in the future. However, the following three provisions are considered necessary.

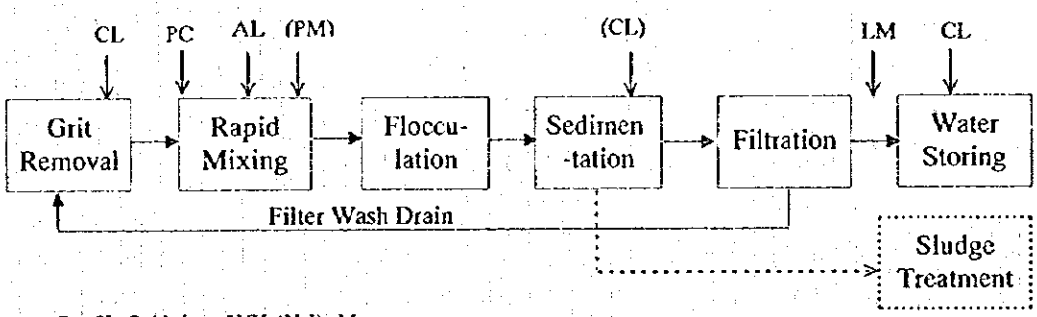
i) Pre, Post and intermediate (if necessary) chlorination shall be equipped and its operation shall be properly made introducing breakpoint chlorination methodology so as to oxidize NH4-N, Organic substance, Fe and Mn and to disinfect filtered water.
ii) For supporting coagulation and flocculation in case poor performance of alum, possibility of Polymer dosage shall be considered.
iii) Powdered carbon shall be equipped against sudden problems of raw water quality.

Discharging waste water into public watershed is controlled by issued by Ministry of Environment and Human Welfare in 1990. Although categories to be applied is not fixed yet, waste water from treatment plants of Jakarta water supply system is also controlled by the regulation.

As for waste water treatment, wash drain of filters is planned to pump back to the treatment process, and not to discharge out of the plant, for saving raw water quantity as experienced at Cisadane plant. Sludge from sedimentation basins is planned to be treated.

Thus, water treatment method for the future is planned as shown on the **Figure-374.1.**

Figure-374.1 FUTURE WATER TREATMENT METHOD



Note : Pre-CL: Oxidation of NH-4N, Fe, Mn
Int.-CL: Oxidation of Mn
Post-CL: Disinfection
PC : Sudden problem of raw water quality
AL : Coagulant
LM: pH control

(4) Monitoring of Water Quality

1) Monitoring of Distributed Water

In order to evaluate deterioration of treated water quality in the distribution system, samples of treated water quality shall be taken not only from treatment plants and distribution centers, but also from distribution pipelines.

Basic parameters for monitoring water quality in the distribution pipelines are residual chlorine and E. Coli group. Their sampling will be from fire hydrants located on the small pipes, where retention time of water from a treatment plant or distribution center is longest. Numbers and frequency of sampling will be a few for each zone and 4 to 6 per year respectively.

2) Monitoring of Tap Water

To have responsibility on quality of water supply, PAM JAYA shall prepare a complete quality monitoring/examination system. For the purpose, apparatus and qualified personnel to analyze entire parameters in the quality standard shall be prepared at least at the existing central laboratory by some improving modification or at the newly established central laboratory.

Parameters for daily and monthly analysis shall be analyzed regularly and commonly at each of the four large scale plants except for such parameters as TDS, CL and Detergent.

(5) Summary of Necessary Measures for Quality Improvement

Necessary measures for improvement quality of water supply including tentative costs for the improvements are summarized as described in the **Table-374.2.** In the table, priority for implementing the measures are also marked aiming at acquiring potable tap water at the target year of the Master Plan.

Table-374.2 NECESSARY MEASURES FOR WATER QUALITY IMPROVEMENT OF JAKARTA WATER SUPPLY SYSTEM

ITEMS RELATED	EXISTING CONDITIONS ON WATER QUALITY	NECESSARY MEASURES FOR WATER QUALITY IMPROVEMENT	PRIORITY		
			Step1	Step2	Step3
QUALITY STANDARD	Potable and clean water standard.	Standard of clean water be abandoned in future.		○	
	Pb & As values shall be smaller.	Revision of the standard for Pb&As in the future.		○	
WATER SOURCES					
JATILUHUR DAM	Eutrophication and deoxidization.	Construction of sewerage system in upper cities			○
		Equipment of artificial aeration system in Jatilufur.			○
CISADANE RIVER	Quality data are not enough.	Accumulation of quality data of raw water.	○	○	
		Study & implement quality preservation & improvement.		○	○
		Promotion of PROKASIH.	○	○	
RIVERS IN DKI	More downstream poorer quality.	Shift of raw water intake to WTC.	○		
GROUNDWATER	Groundwater quality deteriorated.	Restriction of excessive groundwater abstraction.		○	○
		Shifting promotion from groundwater to PAM JAYA water.		○	○
RAW WATER CONVEYANCE					
WEST TARUM CANAL	Quality becomes poor after Bekasi.	Bypass channel construction of WTC.	○		
		Preventive measure dumping pollutant into WTC.	○		
CANALS IN DKI	Very poor quality(BOD=20mg/l).	Shift of raw water intake to WTC.			
WATER SUPPLY FACILITIES					
TREATMENT PLANT	Detergent and Mn over limit.	Improvement of water quality of WTC.	○		
	+ E.Coli in treated water seldom.	Strengthening chemical control incl. Cl2 and carbon.	○		
MINI PLANT	Plants in north poor finished water.	Mini plants in northern Jakarta abandoned in future.		○	○
DISTRIBUTION PIPES	Deteriorated pipelines much exist.	Implementation of PJSIP throughout service area.	○	○	
	Poor quality near zone boundary.	PJSIP and Zoning of distribution network.		○	○
SERVICE CONNECTION	Cross connection still exists.	Implementation of PJSIP throughout service area.			
	Direct pumpage still exists.	Implementation of PJSIP throughout service area.			
	Many service pipes deteriorated.	Implementation of PJSIP throughout service area.			
	Receiving tanks are popular in City.	Proper maintenance of receiving tanks.		○	○
		Direct connection to house taps in the future.			○
OPERATION & MAINTENANCE					
WEST TARUM CANAL	Bekasi silt-trap causes turbidity.	Bypass channel construction of WTC.			
TREATMENT PLANT	Chlorine control is not adequate.	Application of break-point chlorination.	○		
SERVICE CONNECTION	Poor maintenance receiving tanks.	Proper maintenance of receiving tanks.			
		Direct connection to house taps in the future.			
ANALYSIS AND MONITORING					
CENTRAL LABORATORY	Central labo tests half parameters.	Preparation of space and equipment for Central labo.	○	○	
REPORTING	Reporting procedures not followed.	Curry out proper reporting and checking.	○	○	
DISTRIBUTION PIPES	Quality in pipe not monitored.	Application of quality monitoring on pipelines.		○	

3.8 REDUCTION OF UNACCOUNTED - FOR WATER

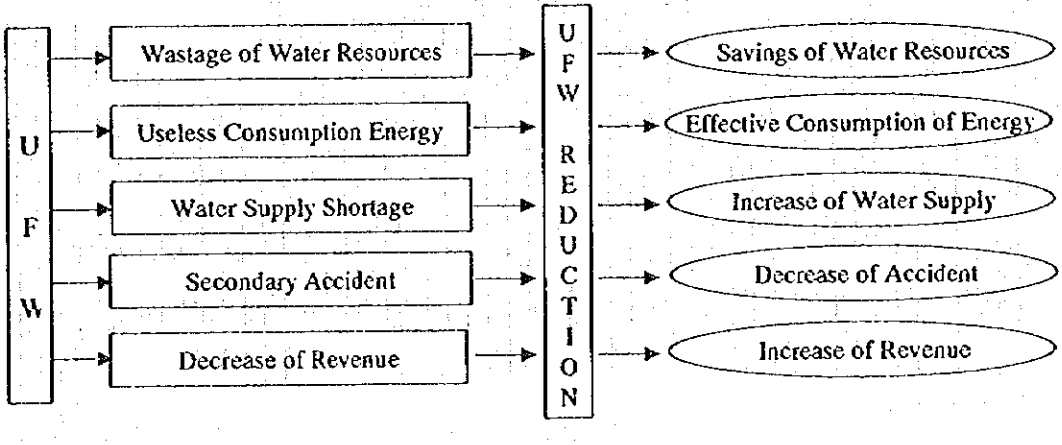
3.8.1 Necessity of UFW Reduction

The Unaccounted-For Water (UFW) defined at successive paragraph should be reduced as much as possible because UFW causes the following serious ill effects in water supply system.

- UFW is a wastage of precious water resources because the water produced at the water treatment plant does not be used effectively.
- UFW is a useless consumption of electricity and chemicals at the water treatment plant because these energy and chemicals are consumed for production of useless water.
- UFW causes water supply shortage and pollution of piped water.
- UFW sometimes causes such secondary accident as traffic accident.
- Thus UFW touch off the economical loss due to decrease of revenue.

Figure-381.1 shows the concept of Necessity of UFW Reduction

Figure-381.1 NECESSITY OF UFW REDUCTION



3.8.2 Definition and Component of UFW

1) Definition of the Unaccounted For Water (UFW)

UFW is defined as :

The difference between "Net Production" (the volume of water delivered into a network) and "consumption" (the volume of water that can be accounted for by legitimate consumption, whether metered or not)

UFW = Delivered Water - Accounted Water

2) Definition of UFW Component

UFW calculated from the difference between production and consumption falls into two categories :

- Water consumed but not recorded by consumer's meters or otherwise accounted for by government or other public use. This is referred to as a "non-physical" loss (NPL) and is reflected in lost revenue. It includes water consumed through illegal connections.

- Water lost through leakage, also referred to as "physical" loss (PL). This is a resource loss and is reflected in the cost of production.

3.8.3 On-Going UFW Reduction Project

(1) Brief Explanation of the Project

The PAM JAYA System Improvement Project (PJSIP) is under implementation in order to a) to improve service conditions by reducing by unaccounted-for water (UFW), and replacing obsolete secondary and tertiary mains, and b) to extend distribution networks to meet the water demand of the rapidly expanding urban population of DKI Jakarta and to secure the supply of additional water production at Buaran Water Treatment Plant.

There are two(2) PJSIPs which are financed by IBRD and OECF, PJSIP(IBRD) covers Zone 1,2,4,5 and PJSIP(OECF) covers Zone 3,6,and scope of works of each PJSIP are listed in **Table-383.1**.

Table-383.1 SCOPE OF WORK OF PJSIP

PJSIP(IBRD)	PJSIP(OECF)
Component A: Rehabilitation and Replacement Program	a. Extension and Rehabilitation of Primary Network b. Infill/Ext. of Service Network c. Rehabilitation of Service Network
Component B: Service Network Extension	d. Extension of Service Network
Component C: Institutional Development	e. Technical Assistance on Institutional Development

General Program of Wastage Control Program(IBRD) and General Sequence of Pipe Network Rehabilitation and Meter & Fitting Rehabilitation (OECF) are included in **Annex-38.**

(2) Target of the Project

Within the framework of the Second Stage expansion program of Jakarta Water Supply System, the entire scheme for improvement and extension of PAM JAYA is staged into two phases. The scheduled implementation is that Phase-1 is envisaged to start in 1990 and to be completed in 1995/96 subject to the commencement time, and Phase-2 to start in 1994 and to be completed in 1999.

A target level of 30 % UFW or less has been set for each elementary zone(EZ) under PJSIP I . Upon achievement of this target, the EZ is handed over to PAM JAYA rayon staff for routine operation and maintenance, including further UFW reduction and its maintenance at the lowest economically justifiable level. The target level of 30 % UFW was determined from UFW reduction achievements in the three pilot zones of Pluit, Tanjung Duren and Gelora Senayan. Further detailed explanation of on-going PJSIP is attached on **Annex-21**.

3.8.4 UFW Reduction Program

(1) Target

The target of UFW level is established as shown in **Table-384.1** on the condition that such factors as described in the following paragraph are executed. Also the following estimates and present status of other cities were taken into consideration.

This target should be achieved through implementation of items described in **Section 3.8.5**, Methodology to Achieve The Target.

Table-384.1 TARGET OF UFW LEVEL

YEAR	2005	2010	2019
UFW (%)	30	28	25

At the completion of PJSIP, UFW is reduce to 30% in distribution system zoned into six(6) supply area.

After the completion of PJSIP and hand over to Rayon PAM JAYA continues following up to keep UFW at 30% level even when the distribution pressure greatly improve due to the Buaran and Cisadane Treatment Plants operation considering the leakage increase when distribution pressure rise.

The UFW in transmission/distribution trunk main should be kept at a low level because almost all of these pipeline were newly laid during the past several years.

The JWSSP presented UFW levels in the Water Demand Update Report as listed in Table-384.2.

Table-384.2 UFW LOSSES ASSUMED FOR JWSSP DEMAND UPDATE

YEAR	1994/5	2000	2005	2010
UFW OVERALL	54%	40%	30%	28%

3.8.5 Methodology to Achieve The Target

The target described above can only be achieved through implementation of the following major items:

- to continue steady implementation of on-going PJSIP
- to secure efficient follow up maintenance of elementary zone after completion of PJSIP by expected PSP.
- to expedite the planned zoning of distribution area by implementation of PJSIP
- to strengthen the flow / pressure monitoring at distribution system

These major items are essential for UFW reduction and another important items are mentioned below:

(1) Methodology

In order to reduce the UFW, the following are important

a) Analysis of Distributed Water

The accurate analysis of total amount of distributed water is indispensable to improve water supply efficiency.

The accurate measurement of flow rate at outlet of treatment plant, strategic point of distribution main, and house connection (customer meter) is necessary to accurately analyze total amount of distributed water.

Therefore the following are important:

- Installation of flow/pressure meter at strategic points of whole water supply system,
- To maintain these meters so as to accurately measure flow rate/pressure continuously including customer meter.

b) Maintenance of Pipeline

In order to reduce UFW, the maintenance of transmission/distribution pipeline is essential. The maintenance of pipeline includes monthly, yearly, and periodical inspection.

The detailed inspection items and period are recommended in **Section 3.9** Operation and Maintenance of the Facilities. PAM JAYA is suggested to implement these inspection based on the recommended inspection items and period.

c) Present Status of Improvement of Distribution Pipeline

The on-going PJSIP are implementing improvement work of distribution pipeline and house connection including customer meter through the following:

<u>Pipeline Network</u>

i) field survey

ii) rehabilitation, replacement, and extension of pipeline

iii) metering by District Meter (DM) and Waste Meter (WM)

iv) rehabilitation and replacement of pipeline metering by DM and WM

Customer Meter

i) field customer survey

ii) replacement of customer meter

Figure-385.1 shows procedure of UFW reduction in distribution system.

The PJSIPs ate handing over the maintenance of distribution main and house connection to PAM JAYA after UFW improved to 30 % through above works.

d) PAM JAYA's Duty for UFW Reduction

At present PAM JAYA should implement the following:

Distribution System

i) Metering by DM and WM at handed over elementary zones

ii) To calculate UFW ratio based on the above metering

iii) If the UFW ratio exceeds 30 % necessary rehabilitation/replacement of pipeline should be executed

Other Pipeline

i) To prepare installation of flow/pressure meter at strategic points based on a) of this section

Figure-385.2 shows methodology of UFW reduction, and **Figure-385.3** shows countermeasure for UFW reduction.

(2) Physical Loss (PL) Reduction

In order to reduce the UFW, it is essential to quantify the physical loss(PL) of UFW firstly, covering comprehensive water supply system ranging from water treatment plant, transmission/distribution mains, primary/secondary/tertiary distribution system and house connection.

Furthermore, flow/pressure measurement at proper point of whole pipeline network is indispensable to quantify the physical loss. These meters should be installed at treatment plant, transmission/distribution trunk main, and strategic point of distribution system.

The district meter (DM) and waste meter (WM) in an elementary zone(EZ) are being installed under the on-going PJSIP, therefore, the Project recommends the concept of installation points except distribution system as follows:

- Inlet and outlet of water treatment plant
- Inlet and outlet of booster station and distribution center
- Branch point of transmission/distribution trunk main

On the other hand, the value of flow/pressure measurement at the strategic points should be continuously monitored for optimum water supply operation of whole water supply system. However, data accumulation, network analysis , and methodology of water supply operation strategy should have been developed before the commencement of continuous monitoring.

Consequently, the installation of flow/pressure meters should be taken UFW reduction and water supply operation strategy into account. **Figure-385.4** shows the concept of metering.

The procedure of meter installation and monitoring is as follows:

i) Selection of meter installation point and type of meter
ii) Detailed design of meter installation
iii) Meter installation work
iv) Data collection for considerable period
v) Water supply network analysis
vi) Preparation of strategic water supply operation methodology
vii) Detailed design of Supervisory Control and Data Acquisition (SCADA) system with computerized real-time, on-line data collection
viii) Installation of SCADA System
ix) Daily Monitoring and Control (Central Supervisory System)
x) Modification of software

3) Non-Physical Loss (NPL) Reduction

The Non-Physical Loss (NPL) may represent the important part of the UFW and it is essential to monitor and to reduce them as far as possible.

The reduction of NPL should allow to:

- have a correct evaluation of PL which could be approximately represent by the amount of remaining UFW, and
- the amount of PL being determined, decide if a leak detection program must be conducted.

Under the on-going PJSIP quantification of NPL is being undertaken through the following activities:

- Field consumer survey
- Meter replacement program
- Crash program
- Routine program (improvement of consumers management)

At the consumer survey, illegal connection will be clarified.

Figure-385.1 PROCEDURE OF UFW REDUCTION IN DISTRIBUTION SYSTEM BY SETTING ELEMENTARY ZONE (EZ)

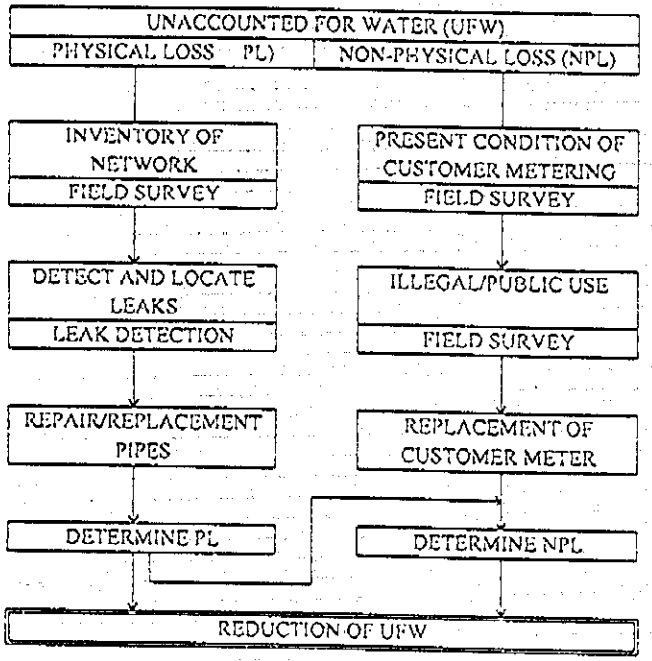


Figure-385.2 METHODOLOGY OF UFW REDUCTION

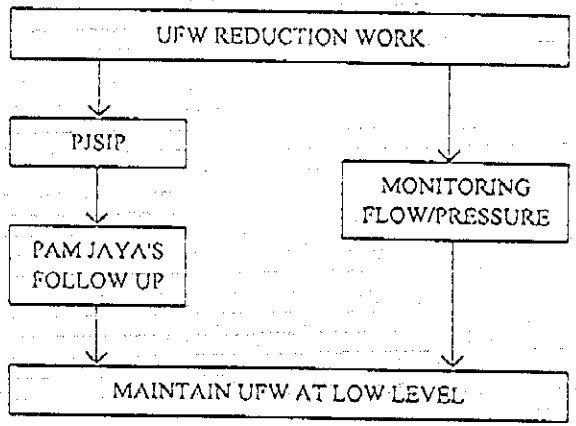
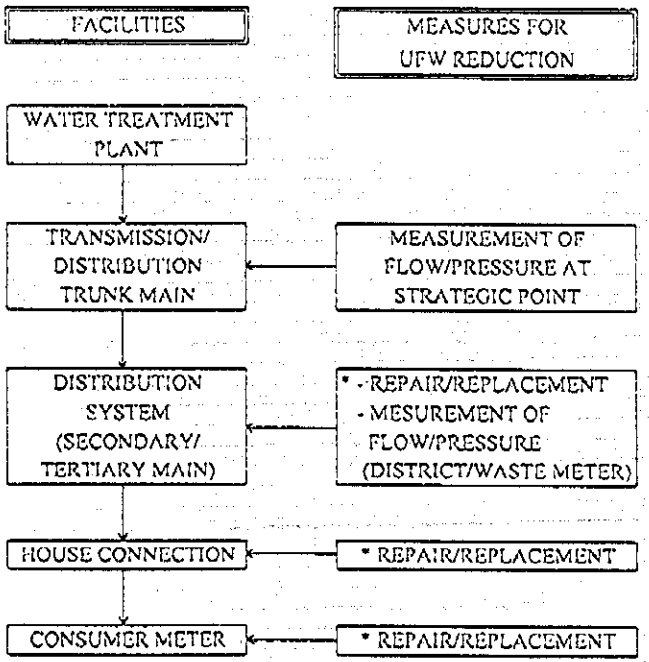
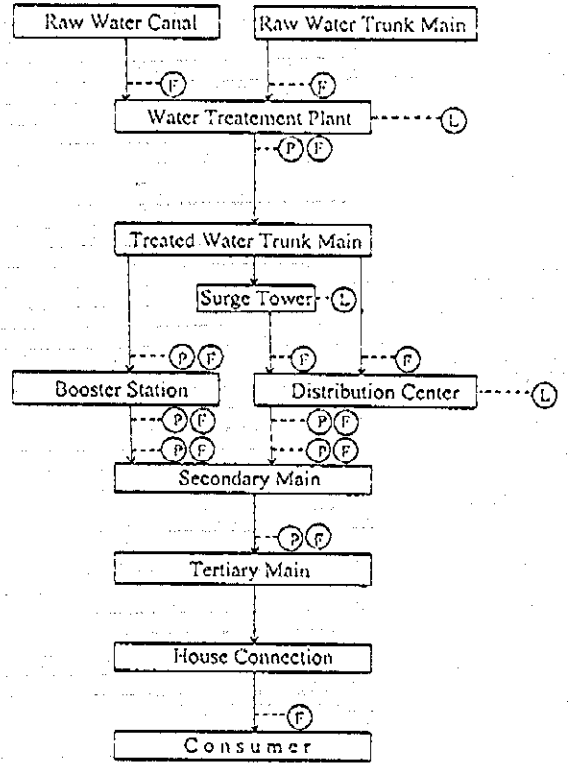


Figure-385.3 COUNTERMEASURE FOR UFW REDUCTION



NOTE : * UNDER IMPLEMENTATION BY PJSIP

Figure-385.4 CONCEPT OF METERING JAKARTA WATER SUPPLY SYSTE,



Note : F.: Flow Meter P : Pressure Meter L : Level Meter

3.8.6 Organization for UFW Reduction

The water supply pipeline is laid underground and there are many chances of leakage from pipe due to the following reasons:

- The pipe is filled up with high pressure water continuously.
- The pipe is always receiving weight from road load.
- The pipe is easily affected by ground fluctuation and earthquake.
- The pipe corrodes.

Therefore leakage should be detected as early as possible after leaks from pipe, repaired as soon as possible, and be protected preventively.

The leakage protection work should be implemented continuously as a routine daily work, otherwise leakage or UFW cannot be maintained at low level.

The counter-measures for leakage protection are as follows:

1) Basic Counter-measure

a) Preparation for leakage protection

- Preparation of budget and organization
- Preparation of accurate drawings.
- Setting up of working zone.
- Arrangement of measurement instruments.

b) Field Survey

- Analysis of distributed amount of water
- Measurement of water pressure.
- Clarification of leakage cause

c) Technical Development

- Measurement of leakage
- Detection of leakage
- Locating of underground pipe
- Repairing method

2) Water Leakage Protection Work

a) Mobile Work

- Detection of surface leakage
- Repairing

b) Scheduled Work

- Detecting of underground leakage
- Repairing

3) Preventive Work

a) Planning of Water Supply Enterprise

- Planning in consideration of leakage protection

b) Design of Water Supply Facilities

- Earthquake-proof
- Durability
- Corrosion-proof
- Watertight

c) Replacement of Long Period Laid Pipe

- Distribution pipe
- House connection

d) Improvement of House Connection

- Crossing road with collective pipe

e) Pipe Protection

- Location of meter installation
- Corrosion protection

f) Management of Un-used Pipe

- Management of un-used pipe at branch
- Management of service installation

g) Patrol Inspection

- Pipe protection from other construction work

h) Adjustment of Water Supply Pressure

- Zoning of distribution area
- Installation of pressure reducing valve

The organization for UFW reduction should include above mentioned functions, and posts of organization should be assigned clearly the above. Therefore the present organization of PAM JAYA is recommended to improve in consideration of above mentioned each function. The style of organization of leakage protection crew varies from utility to utility; an instance is shown in Annex-38.

3.8.7 Training

The staff training is essential to perform the methodology to achieve the target of UFW reduction , the Project basically agrees the Proposed Training Component proposed by the PJSIP(IBRD) including training organization and method, types of training and training implementation program.

Furthermore it is most important to implement such program as soon as possible for effective performance of UFW reduction work.

The Proposed Short Term Training Program by PJSIP(IBRD) and further detailed description is attached in Annex-38.

3.9 OPERATION / MAINTENANCE AND MONITORING SYSTEM

3.9.1 Concept of Operation and Maintenance

The primary purpose of a water supply enterprise is to continuously furnish a potable water, that is, a water that may be ingested without menace to health and that is satisfactory for drinking in its physical, chemical, and biological characteristics. For this purpose, a water supply system is constructed and its management is executed.

The responsibility of management as to the safety of water supply can be resolved in the statement that management is expected to take every precaution that would be exercised by a normal, individual who has familiarity with the management of water supply system.

Obviously, these would include such steps as: a sanitary monitoring and records of the source of supply; proper supervision, including records and checks, of the operation of treatment plant; a continuing determination of the quantities of water required to meet the demands for water consumption; and continuing monitoring of residual pressures throughout the water supply system.

A supply of potable water involves not only the source, but the collection, the treatment, the transmission, the storage, and the distribution works of the water supply system.

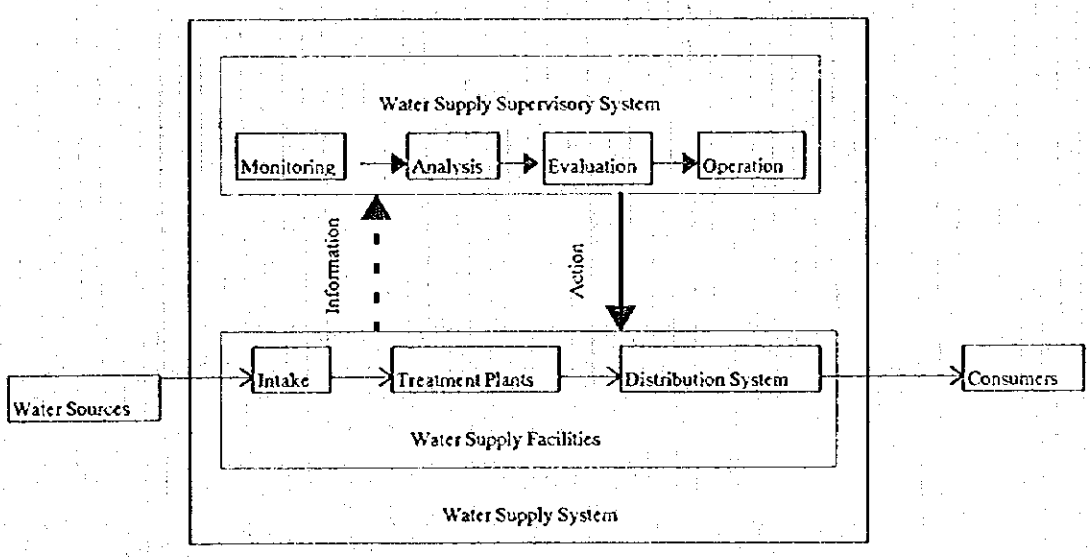
The responsibility for a supply of safe water rests with the water supply enterprise and its management even if the private sector operates.

The operating duties are divided into four main categories: structures, pumping facilities, treatment plant works and distribution system with its appurtenances. These facilities should be maintained so that they are kept in reliable and satisfactory condition.

Figure-391.1 shows the above mentioned concept of management of water supply facilities operation including management cycle of information collection, analysis, evaluation and feed back activity.

Figure -391.2 shows the concept of management including operation, maintenance, and rehabilitation together with time order.

Figure-391.1 CONCEPT OF MANAGEMENT OF WATER SUPPLY FACILITIES OPERATION



Note: Operation includes operation, maintenance and rehabilitation

Figure-391.2 CONCEPT OF MANAGEMENT WITH TIME ORDER