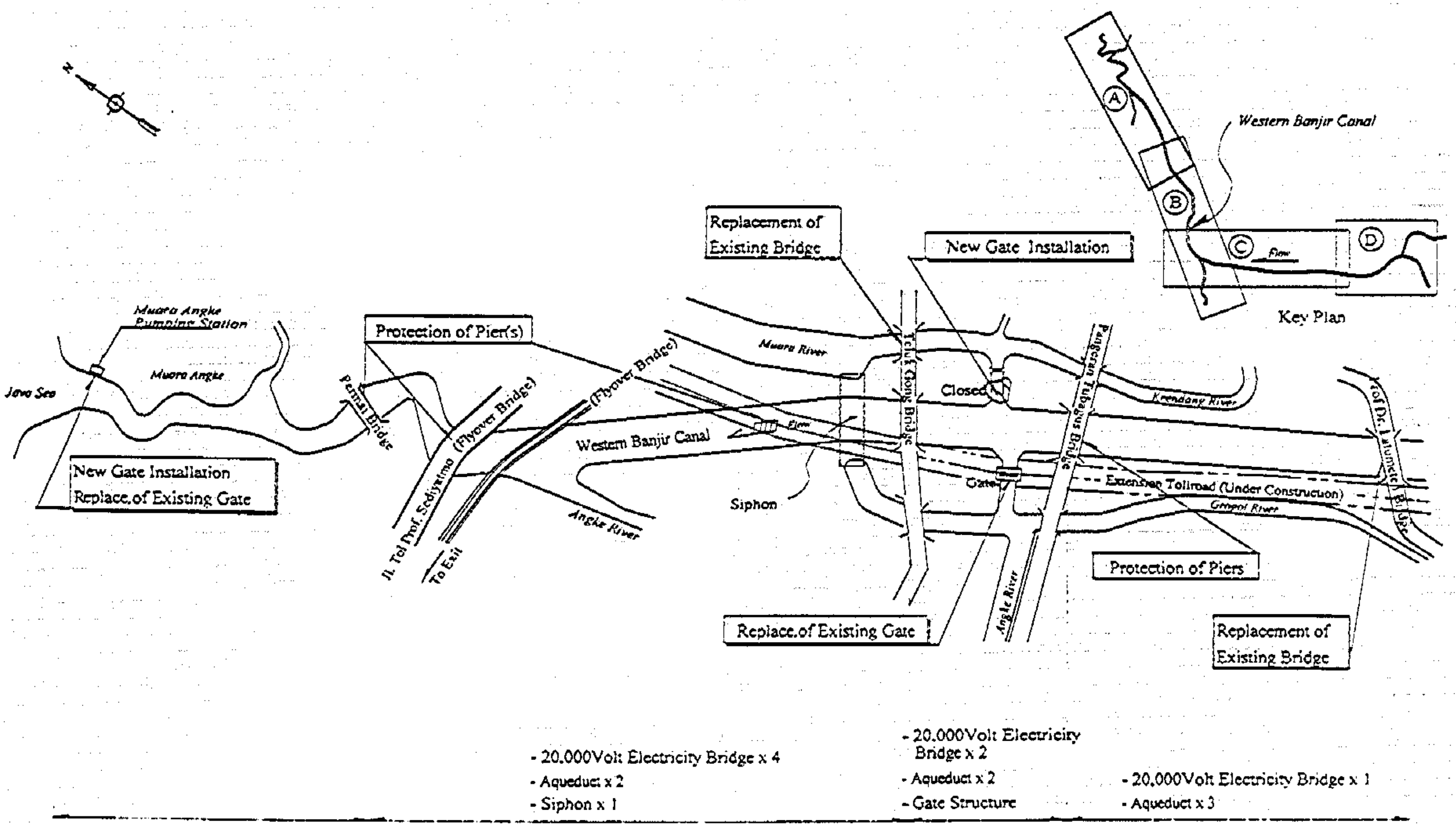
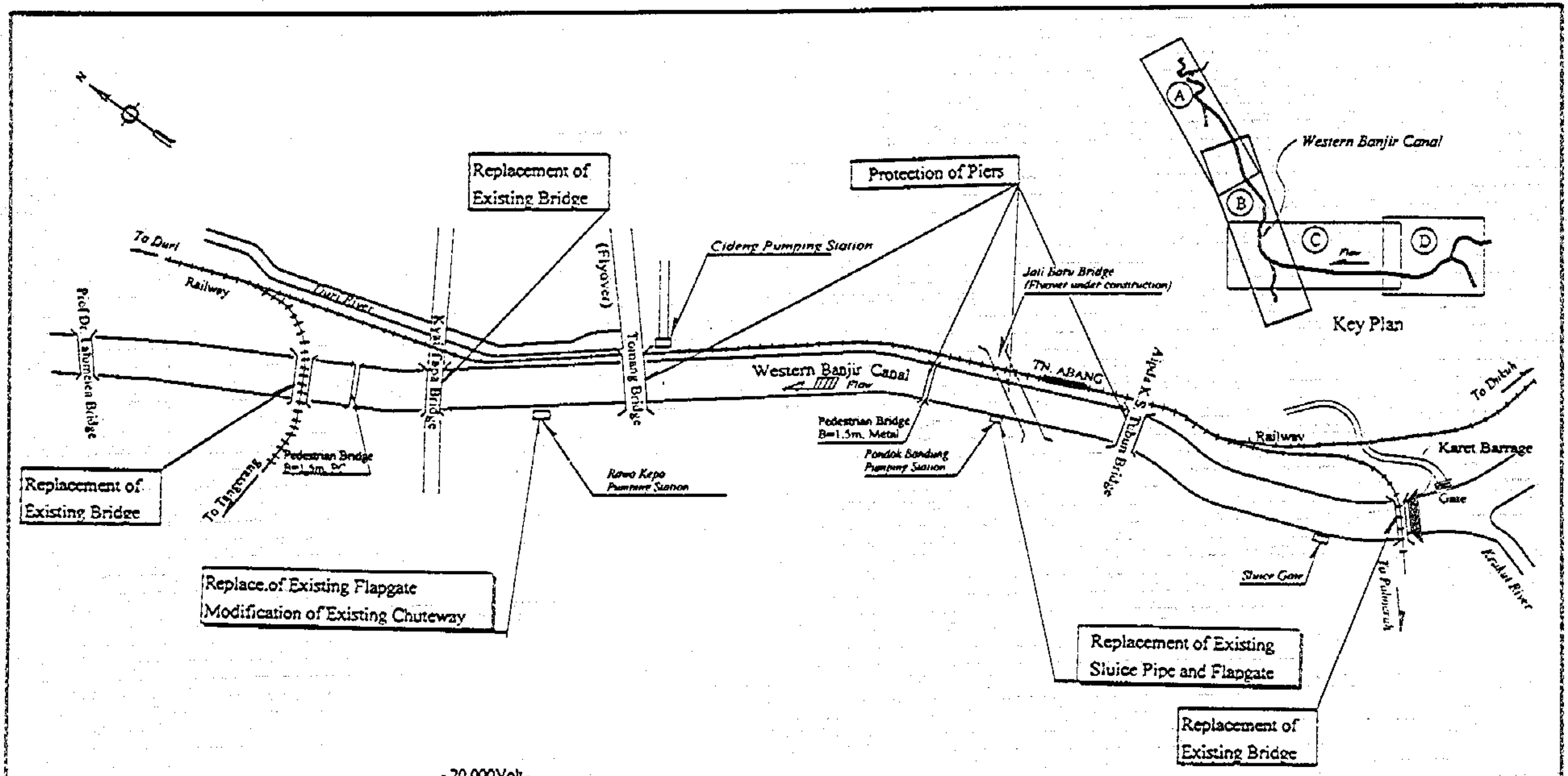


Figure 13 EXISTING RELATED STRUCTURES AND PROPOSED WORKS IN WESTERN BANJIR CANAL (1/4)

(1/4 : SHEET Ⓐ)



- 20,000Volt Electricity Bridge x 1

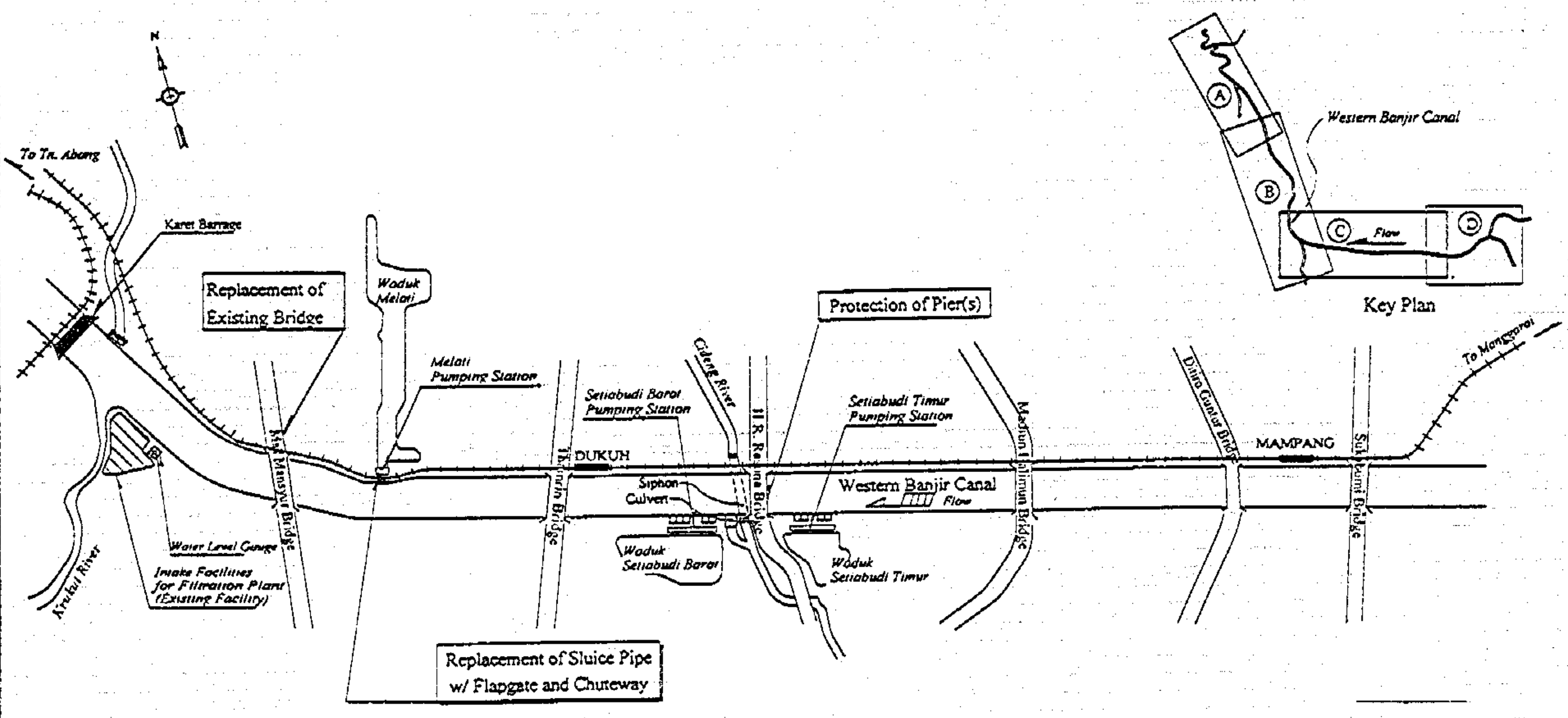
- 20,000Volt Electricity Bridge x 1

- 20,000Volt Electricity Bridge x 1
- Aqueduct x 1
- Gas Supply Bridge x 1

- Aqueduct x 1

- Drainage Gate x 1

Figure 13 EXISTING RELATED STRUCTURES AND PROPOSED WORKS IN WESTERN BANJIR CANAL (2/4) (2/4 : SHEET B)



-Filtration Plant Gate x 2 - 20,000Volt Electricity Bridge x 6 -150 kVA Transmit Bridge x 1	- Aqueduct x 2 - Drainage Culvert Single Pipe x 2 Double Pipe x 1 Rectangular x 4	- Commercial Panel Tower x 1 - Siphon x 1 - Triple Drainage Pipe Culvert x 1 - Electricity Bridge x 1 - Gas Supply Bridge x 1	- Commercial Panel Tower x 1 - Single Drainage Conduit x 1 - Aqueduct x 1	- Small Chuteway for Drainage x 1 -Drainage Single Pipe x 1	- Drainage Single Pipe with Structure x 1 - Aqueduct x 1 - Gas Supply Bridge x 1 - Electricity Bridge x 1

Figure 13 EXISTING RELATED STRUCTURES AND PROPOSED WORKS IN WESTERN BANJIR CANAL (3/4)

(3/4 : SHEET©)

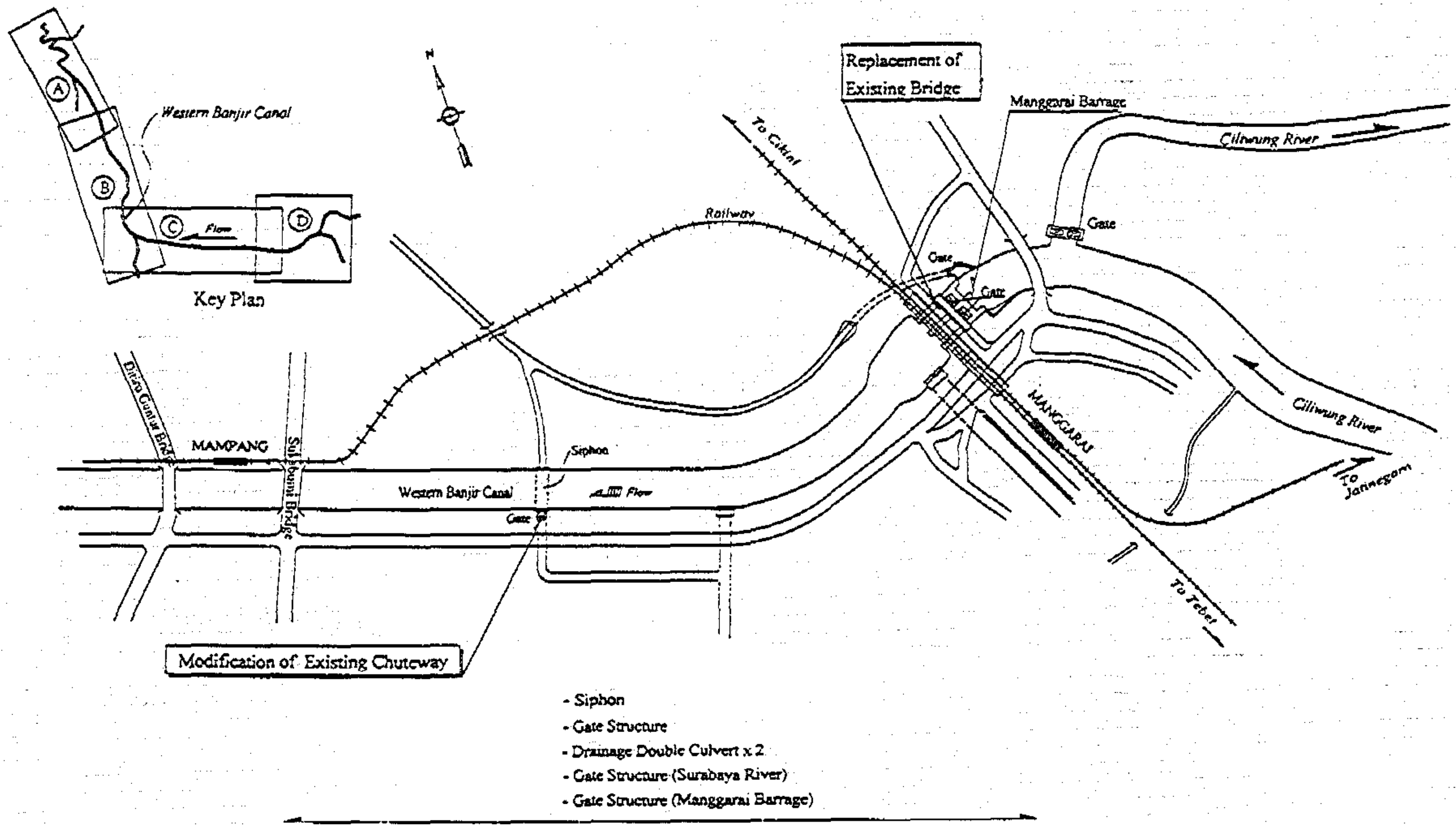


Figure 13 EXISTING RELATED STRUCTURES AND PROPOSED WORKS IN WESTERN BANJIR CANAL (4/4)

(4/4 : SHEET D)

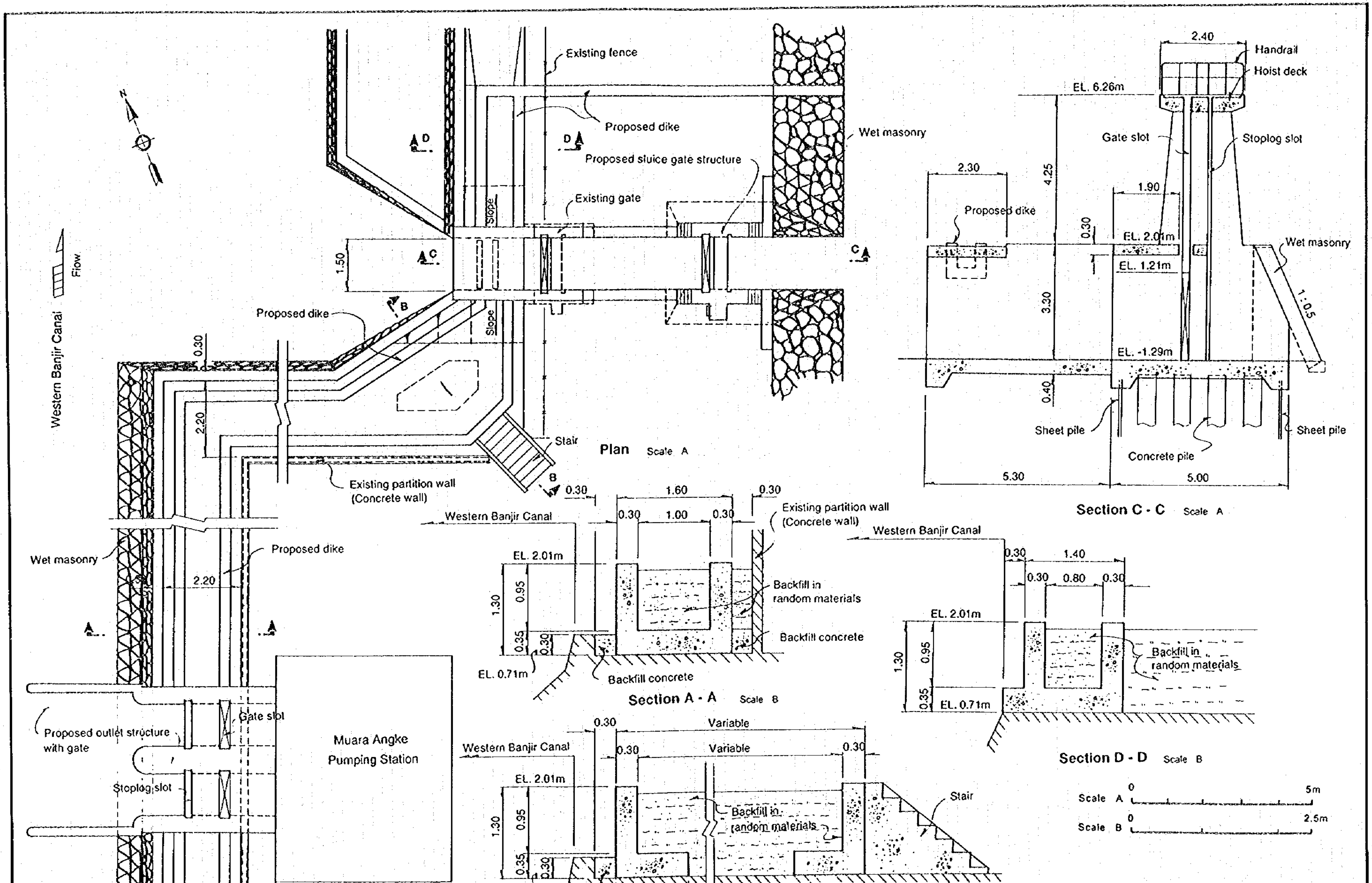


Figure 14 PLAN AND PROFILE OF THE PROPOSED GATED SLUICEWAY IN THE MUARA ANGKE PUMPING STATION

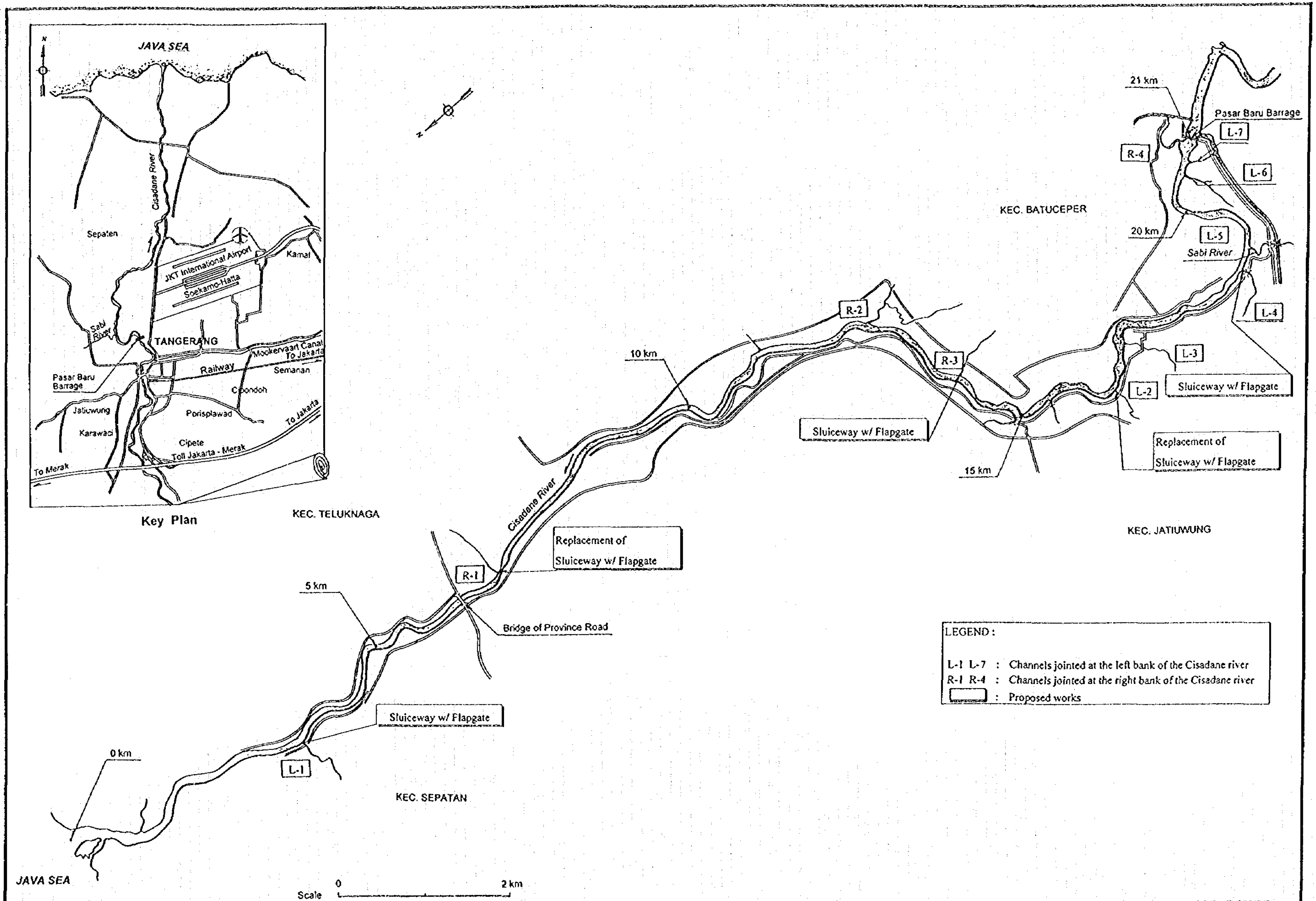
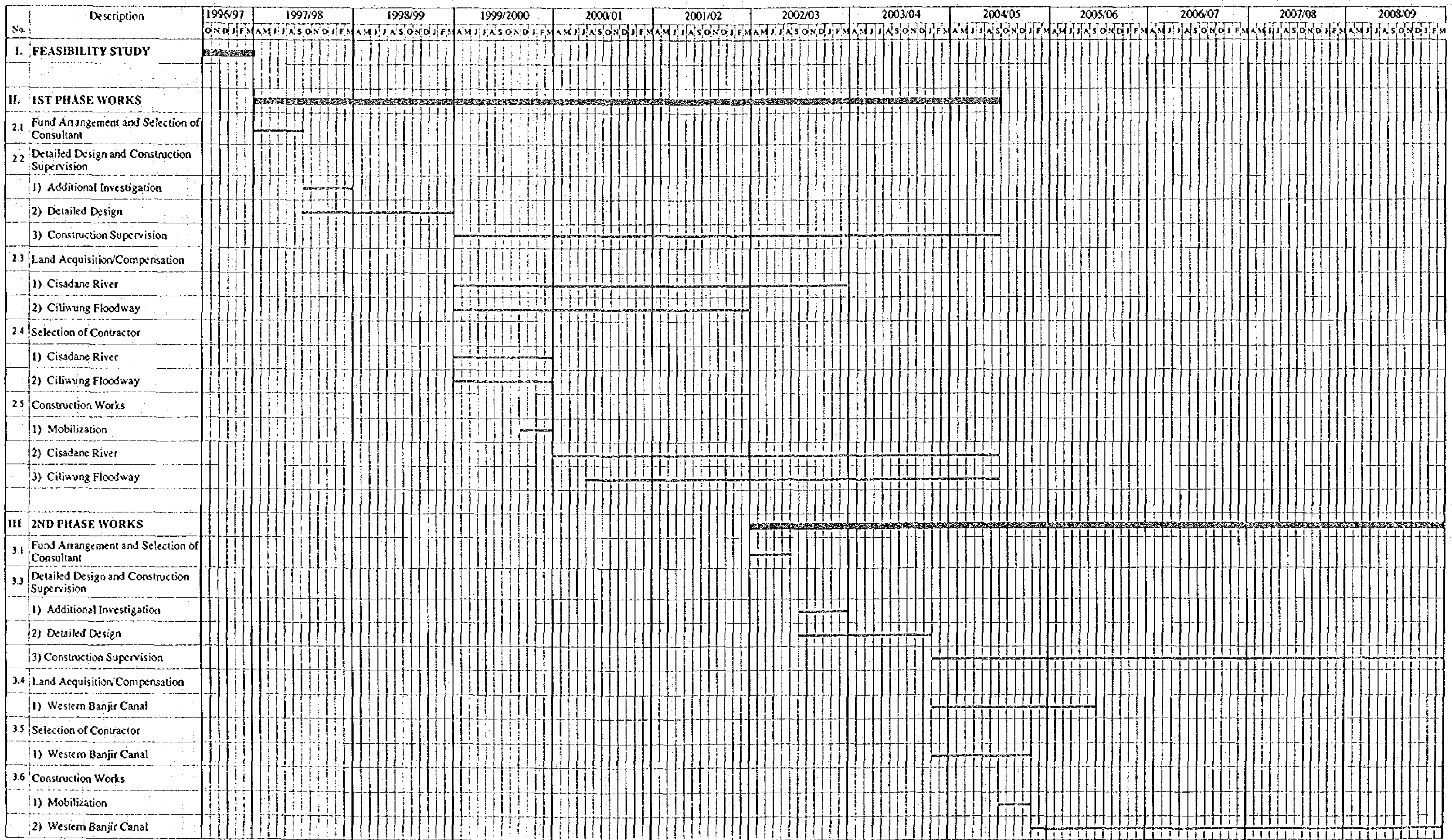


Figure 15 EXISTING DRAINAGE CHANNELS AND PROPOSED WORKS IN CISADANE RIVER

Figure 16 IMPLEMENTATION SCHEDULE OF THE PROJECT



ANNEX 9

WATER RESOURCES AND RIVER WATER QUALITY

THE STUDY
ON
COMPREHENSIVE RIVER WATER MANAGEMENT PLAN
IN
JABOTABEK

Annex 9 : Water Resources and River Water Quality

Table of Contents

List of Tables

List of Figures

List of Figures

List of Attachment

1. GENERAL

The study on water resources and water quality management was carried out to make recommendations for water resources and river water quality management from flood control and drainage aspects through identification of current problems on the surface and ground water uses and river water quality in the Jabotabek area, and review of results of previous studies.

To achieve the above objectives, the study undertook the following investigations and studies:

(1) collection of data and information related to the study, specially reports of previous studies,

(2) field reconnaissance including interviews to inhabitants and discussions with officials concerned with the study,

(3) water sampling at about forty (40) sites in eight (8) river systems and water quality analysis for samples taken,

(4) review of previous studies based on results of the mentioned works,

(5) recommendation for managing water resources and water quality in Jabotabek area from flood control and drainage aspects

2.1 Present Situation of Water Use and River Water Quality

2.1 Water Use Condition

2.1.1 Surface Water Use

(1) Water Use Facilities Including Existing Reservoirs and Water Conveyance System

The water supply to municipal and industrial, irrigation and fishery water sectors in Jabotabek area has been carried out by developing the surface water resources in the Citarum river, which is one of the main water sources for the eastern part of Jabotabek area, and the objective rivers for the Study, and by providing shallow and deep groundwater wells.

Presently, dam and reservoir for regulating river water flow and for stabilizing water supply are provided only in the Citarum river basin in and around Jabotabek area as shown in Figure 1; namely, the Jatiluhur, Cirata and Saguling dams with a total gross storage volume of 5,354 million m^3, which were constructed in 1969, 1985 and 1988 respectively.

Among these dams, the Jatiluhur dam have multi-functions; 1) municipal and industrial water supply to DKI Jakarta and its surrounding areas through the Curug intake weir and the West Tarum Canal (WTC); 2) irrigation water supply to the Prosijat area; 3) hydropower generation with an installed capacity of 183 MW; 4) flood control in the downstream; and 5) flushing water supply to DKI Jakarta. The later two (2) dams were developed mainly for hydropower generation with a total installed capacity of 1,200 MW. The main features of these dams are as follows:

Main Features	Juanda	Cirata	Saguling
(1) Catchment area (km^2)	4,500	4,119	2,100
(2) Gross storage volume (million m^3)	3,000	1,900	888
(3) Effective storage volume (million m^3)	2,100	900	640
(4) Dam height (m)	105	125	99

These dams, however, have been operated for optimal use of water resources in the Citarum river basin for the aforesaid purposes based on the yearly basic program issued by the Jatiluhur Authority. In case of severe drought year, this program might be adjusted through coordination meeting among such agencies concerned as West Java Irrigation Committee, State Electric Corporation, Jakarta Municipality Administration and Jatiluhur Authority.

The natural ponds called as "situ-situ" are located along the objective rivers and have contributed to agricultural development, M&I water supply, and flood retention around the natural ponds. In the Jabotabek area, the natural ponds of 191 locations with an area of 2,228 ha in total, presently, are functioning as follows:

	River System	DKI Jakarta		Bogor		Tangerang		Bekasi		Total	
		No.	Area (ha)	No.	Area (ha)	No.	Area (ha)	No.	Area (ha)	No.	Area (ha)
1.	Cidurian	-	-	10	25	6	586	-	-	16	611
2.	Cimanceuri	-	-	11	25	4	106	-	-	15	130
3.	Cisadane	-	-	26	59	9	142	-	-	35	201
4.	Angke	-	-	17	107	9	274	-	-	26	381
5.	Pesanggrahan	1	10	11	93	5	32	-	-	17	135
6.	Ciliwung	1	16	15	121	-	-	-	-	16	137
7.	Sunter	2	20	-	-	-	-	-	-	2	20
8.	Cakung	2	70	-	-	-	-	-	-	2	70
9.	Bekasi	-	-	25	120	-	-	2	44	27	164
10.	Cikarang	-	-	5	68	-	-	7	41	12	109
11.	Cibeet	-	-	-	-	-	-	4	36	4	36
12.	Others	3	52	-	-	12	166	4	15	19	233
	Total	9	168	120	618	45	1,306	17	136	191	2,228

However, the pond areas are gradually decreasing by housing development and industrialization, and therefore, the DGWRD intends to rehabilitate these natural ponds in order to maintain their functions important from the aspects of water resources conservation, water use, flood control and environmental conservation.

Many water conveyance systems have been constructed in order to supply raw water mainly to irrigation sector in Jabotabek area as indicated in the aforesaid Figure 1. The main features of the existing water conveyance systems are given in Table 1 and summarized as follows:

Conveyance System	Intake Weir/ River System	Service Area	Length (km)	Design Capacity (m^3/sec)
1) West Tarum Canal (WTC)	Curug/Citarum Cibeet/Cibeet Cikarang/Cikarang Bekasi/Bekasi	Prosijat irrigation area and DKI Jakarta/other areas along the WTC	69.5	11 to 85
2) Cisadane Main Canals	Pasar Baru/ Cisadane	Prosida irrigation area	98.4	0.7 to 30
3) Selokan Barat Main Canal (Empang)	Empang/Cisadane	Empang irrigation area	22.0	1.4 to 6.9
4) Katulampa Main Canal	Katulampa/ Ciliwung	Katulampa irrigation area	42.7	4.5
5) Cidurian Main Canal	Rancasumur/ Cidurian	Rancasumur irrigation area	24.8	0.4 to 14.7
6) Cicinta Main Canal	Cicinta/Cicinta	Cicinta irrigation area	12.0	1.8

The aforesaid canals and intake structures have been constructed since the beginning of the 20th century and contributed to economic development in the areas. Recently, since reduction of their capacities due to sedimentation in the canals and slope failure along the canals had been remarkable, the improvement and rehabilitation works were done for some of the canals. In addition, the study team identified through the investigation for the existing weirs that the gate structures at the Pasar Baru weir in the Cisadane river and the CBL weir in the Cikarang river needs the rehabilitation for effective and timely operation for water uses and flood control.

(2) Municipal and Industrial Water Use

Figures 2 and 3 give the water amount taken in from the existing rivers and water conveyance systems for the municipal and industrial water supply in the Jabotabek area as well as irrigation water supply, which are based on the data provided by the Dinas PU at Bekasi, Tangerang, Bogor and Serang as well as the data obtained by the previous studies. The surface water amount taken in for M&I water use from the major rivers are as follows:

(unit : l/s)

	Rivers/Conveyance System	DKI Jakarta	Bogor	Tangerang	Bekasi	Total
(1)	Citarum/WTC	15,100	-	-	875	15,975
(2)	Cibeet	-	-	-	1	1
(3)	Cikarang	-	20	-	229	249
(4)	Bekasi		682	-	490	1,172
(5)	Sunter	50	1	-	-	51
(6)	Ciliwung		2,104	-	-	2,104
(7)	Angke	5	32			37
(8)	Cisadane	2,800	2,163	3,794		8,757
(9)	Cimanceuri		10			10
(10)	Cidurian			8		8
	Total	17,955	5,012	3,802	1,595	28,364

Municipal water in DKI Jakarta has been supplied by the PAM Jaya system, mainly using the surface water in the Citarum river basin through the WTC, and groundwater exploitation by providing shallow and deep wells. The existing water treatment plants of the PAM Jaya system are listed in Table 2. In addition to the mentioned existing treatment plants with the total capacity of about 16 m^3/sec, Buaran II and Serpong water treatment plants both with a capacity of 3 m^3/s are under construction. These treatment plants are planned to take water in from the WTC and the Cisadane river.

According to the PAM Jaya System Improvement Project (PJSIP), the PAM system covers an area of 300 km^2 and serves drinking water for population of two (2) million corresponding to 30 % of a total population in the service area. Unit water consumption in DKI Jakarta is estimated at 200 l/d/capita based on the daily average consumption of 400,000 m^3/d and the aforesaid served population by the PJSIP. Also, the PJSIP identified through the project survey that rate of distribution loss is presently about 50 % for the whole service area and that it is 60 % to 80 % in Pulogadung pilot area. However, these distribution loss is planned to be reduced to 30 % by implementation of the PJSIP.

Municipal water supply in Botabek area are undertaken by the PDAM independently organized in each Kabupaten. These water supply systems have mainly been provided by the IKK and BNA projects, using shallow and deep groundwater, spring water and/or surface water such as river water and the water in the existing irrigation canals. But, their service factor is still within 10 % and population served by piped water supply system is rather low. Unit water consumption in the Kabupaten systems ranges between 100 to 125 litter per capita per day. Most of population in Botabek area, presently, takes a drinking water mainly through shallow or deep wells provided by the respective water user.

According to the result of investigation data on industrial water use, especially by the

JWRMS, the total water demands as of 1990 in the Jabotabek area were estimated at 9.61 m^3/s. The main water source for the above water demands is presently groundwater which covers about 50 % to 80 % of demands in the Kabupatens and other demands are fulfilled by the surface water, which is directly taken in by the industrial companies, or piped water system of the PAM Jaya or PDAM.

As for commercial use, there are no sufficient data in order to analyze and grasp present commercial use condition even in Jabotabek area. JWRMS roughly estimated on the basis of production data provided by the water supply companies in Jabotabek area that total water demands in commercial and service sectors corresponded to about 20 % to 40 % of the municipal water demands.

(3) Irrigation Water Use

The major existing irrigation systems in Jabotabek area are as follows:

	Irrigation System	Water Source	Irrigation Area (ha) as of 1990
a)	Prosijat area	Citarum, Cibeet, Cikarang and Bekasi	65,845
b)	Prosida-Cisadane	Cisadane	31,156
c)	Empang	Cisadane	5,791
d)	Cidurian-Rancasumur	Cidurian	10,805
e)	Cicinta	Cicinta	1,371
g)	Katulampa	Ciliwung	3,853
	Total		118,821

These irrigation systems have been operated mainly by the West Java Provincial Government. The average intake discharges are given as follows:

(unit : m^3/sec)

Irrigation System	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Mean
Prosijat at Curug	16.5	15.7	15.9	16.1	18.2	21.7	27.4	30.6	24.5	20.4	20.4	20.6	20.7
Cisadane	18.0	20.2	21.9	22.1	23.5	23.6	22.2	18.9	17.6	14.2	22.1	23.3	20.6
Empang	11.7	12.0	12.7	12.8	12.5	11.8	11.0	10.2	10.7	10.1	11.2	11.8	11.5
Rancasumur	8.1	7.5	7.5	7.3	7.2	8.0	7.1	6.5	5.7	3.3	4.0	4.0	6.3
Katulampa	7.7	8.1	8.8	8.6	8.1	5.6	4.8	5.5	5.7	2.7	6.6	6.0	6.5
Total	62.0	63.5	66.8	66.9	69.5	70.7	72.5	71.7	64.2	50.7	64.3	65.7	65.6

The Prosijat area has been irrigated by taking water in from the Citarum regulated by the Juanda dam, the Bekasi, Cikarang and Cibeet rivers through the intakes along the WTC, and stable water supply for the area through a year has been made even in severe drought year in 1982. As for the other areas where the dam/reservoir has not been provided, the water requirements for dry season cropping have not been satisfied by the natural flow. This becomes more severe in the drought year.

The average cropping patterns in the technical irrigation areas in 1990 are summarized as follows:

Irrigation System	Irrigation Area (ha)	Cropping Pattern (%)				Cropping Intensity (%)
		Paddy-Paddy	Paddy-Palawija	Paddy	Palawija	
Prosijat	65,845	58.0	-	33.0	-	149.0
Cisadane	31,156	78.0	-	22.0	-	178.0
Empang	5,791	30.0	20.0	10.0	10.0	120.0
Rancasumur	10,805	30.0	20.0	10.0	10.0	120.0
Cicinta	1,371	30.0	20.0	10.0	10.0	120.0
Katulampa	3,853	30.0	20.0	10.0	10.0	120.0

Source : JWRMS, Draft Final Report, Annex 2, August 1993

Presently, large scale irrigation areas such as Prosijat and Cisadane areas have higher intensities than those in other areas where the water availability in both the dry and wet seasons is rather limited comparing with their irrigation areas.

(4) Fishery

Two (2) types of inland fishery, namely fresh water fishery in paddy field and river course and brackish water fishery along the coastal areas facing the Java Sea, have been carried out in the study area. Water requirement of fresh water fishery is negligibly small comparing with irrigation and municipal and industrial water demands according to BTA-155 study. On the other hand, intensive fishery developments have been initiated since 1985 for shrimp production by using the return flow of the existing irrigation areas or river flow, but traditional tambak areas still occupies the major part of the sector as given in the following table showing areas of brackish water fishery in 1988:

Description	Serang	Tangerang	Bekasi	Total
Private firms (PT) in 1985	269	797	11	1,077
Semi-intensive development since 1985	250	379	150	779
Traditional tambaks	5,018	3,478	6,266	14,762
Traditional tumpang sari	-	-	800	800
Total	5,537	4,654	7,227	17,418

Source : Cisadane-Cimanuk Integrated Water Resources development (BTA-155), 1989

2.1.2 Groundwater Use for Municipal and Industrial Water Supply

The shallow and deep groundwater in Jabotabek area is intensively utilized as the main water source for M&I water supply. Currently, deep groundwater wells of 2,681 in total are registered to the Directorate of Environment and Geology (DEG) and PAM Jaya but there are no data on shallow wells in Jabotabek area.

Therefore, the JWRMS estimated the amount of groundwater abstraction for M&I water use in Jabotabek area as of 1992 based on the survey as follows:

(unit : m^3/s)

Groundwater Use	Shallow Groundwater		Deep Groundwater		Total	
	DKI Jakarta	Botabek	DKI Jakarta	Botabek	DKI Jakarta	Botabek
Domestic	8.8	10.6	0.1	0.1	8.9	10.7
Commercial and Services	2.0	1.9	1.6	0.5	3.6	2.4
Industry	0.5	0.4	2.5	1.8	3.0	2.2
Total	11.3	12.9	4.1	2.4	15.4	15.3

In estimating the above water abstraction amount utilized, the JWRMS assumed the number of real abstraction wells at three (3) to four (4) times of the registered wells to the DEG and PAM Jaya in DKI Jakarta.

As seen in the above table, the water amount of 15.4 m^3/s is estimated to be abstracted in DKI Jakarta in 1992 while the safe yields in DKI Jakarta was preliminarily estimated to be 3.6 m^3/s by the feasibility study on Cisadane River Basin Development Project. With respect to Botabek area, the current abstraction amount of 15.3 m^3/s, also, exceeds the safe yields of about 11 m^3/s estimated by the mentioned feasibility study. The impacts due to the mentioned over-abstraction of the shallow and deep groundwater are delineated by the JWRMS as listed in Table 3.

Among the impacts, the JWRMS reported that increase of flooding and drainage congestion to be induced by the land subsidence is one of the most significant issues and that it may need further improvement of the existing and/or planned flood control and drainage systems.

2.2 Land Subsidence

The possibility of land subsidence in the northern part of DKI Jakarta has been reported by the previous studies and therefore the DGWRD, DKI Jakarta and the related agencies have provided monitoring wells, and leveling survey on elevation of the existing bench marks in DKI Jakarta has been carried out periodically since 1989.

The Dinas PU DKI Jakarta investigated the elevation of the existing bench marks in Jakarta in the fiscal years of 1989/1990, 1991/1992 and 1993/1994 and worked out by elevation at these bench marks with those in 1974/1978. As a result, it is identified that the northern part of Jakarta has subsided, and that the current land subsidence is mainly caused by the intensive groundwater abstraction through observation of the remarkable decline of the piezometric levels in deeper aquifer along the coastal areas.

Figure 4 shows the lowered depth between 1974/1978 to 1993/1994. The lowered areas with a significant degraded depth of about more than 60 cm are as follows:

Location	Difference between Elevation from 1974/1978 to 1993/1994	Drainage System
Jl. Daan Mogot in Kec. Jakarta Barat	0.6 m to 1.0 m	Mookervaart canal
Jl. Pangeran Jayakarta in Kec. Jakarta Pusat	0.6 m to 0.9 m	Ciliwung river
Jl. Perintis Kemerdekaan in Kec. Jakarta Timur	0.6 m to 0.7 m	Sunter river

Comparing survey result in 1989, 1991 and 1993, the land in DKI Jakarta is being subsided with the annual lowering rate of 1 cm/year to 5 cm/year. The mentioned locations are already facing drainage problems due to insufficiency or deterioration of the existing drainage system and in case that the land subsidence is further progressed, the drainage problems will become serious.

The JWRMS preliminarily simulated the future extent of land subsidence under combination of groundwater management strategy with the water demand scenarios as shown in Figure 5. According to the result of the simulation, land subsidence was predicted to further be progressed till 2025 even if the groundwater abstraction is stopped in 1995, and lowered depth, currently 50 cm to 100 cm, will become about 200 cm in 2025. Also, If there will be no restriction, lowered depth will exceed 400 cm.

Presently, the Government of Indonesia is managing the groundwater use by specifying the conservation zones of I to IV in DKI Jakarta as shown in Figure 6, which was set up mainly taking into account the salinization and decline of piezometric groundwater levels at the existing monitoring wells:

(1) Zone I : no restrictions on groundwater pumping

(2) Zone II : groundwater abstraction only permitted below 40 m of depth

(3) Zone III : groundwater abstraction only permitted below 140 m of depth

(4) Zone IV : no groundwater abstraction permitted, except for local fresh water occurrences deeper than 250 m

Although the above-mentioned regulation is issued, it is necessary to analyze and clarify the relationship between the extent of land subsidence and the mentioned regulation through more detailed simulation study based on detailed geotechnical and geological investigations and groundwater records to be monitored.

2.3 River Water Quality

It has been reported that the water quality of rivers has been deteriorated year by year due to influx of domestic and industrial waste water into the rivers in Jabotabek area, especially in Bogor and Jakarta with high population density and industrial activities.

Under the mentioned situation, an intensive water sampling and analysis were carried out by the JUDP-II at the locations shown in Figure 7 for seven (7) months during the dry season in 1992. According to the result of the mentioned investigation, biological oxygen demand (BOD), chemical oxygen demand (COD), dissolved oxygen (DO) and ammonium (NH_4), which are usually utilized as key indicators showing degree of water pollution due to influx of domestic waste water into rivers, are illustrated in Figures 8 to 11 and summarized as follows:

(unit : mg/l)

Rivers	BOD	COD	DO	NH_4
1. Cidurian	0.5 to 4.5	5.0 to 30.0	5.0 to 8.5	0.0 to 0.4
2. Cimanceuri	1.0 to 4.0	10.0 to 30.0	3.0 to 6.5	0.0 to 0.6
3. Cirarab	1.0 to 5.0	7.0 to 26.0	2.0 to 8.0	0.0 to 0.9
4. Cisadane	1.0 to 6.0	1.0 to 35.0	4.0 to 9.0	0.0 to 0.6
5. Angke	2.0 to 32.0	5.0 to 60.0	0.1 to 7.0	0.0 to 4.6
6. Pesanggrahan	1.0 to 6.0	5.0 to 50.0	1.5 to 8.5	0.1 to 1.4
7. Grogol	10.0 to 70.0	45.0 to 90.0	0.1 to 1.2	5.0 to 15.0
8. Krukut	10.0 to 35.0	20.0 to 55.0	0.2 to 1.4	1.5 to 13.0
9. West Banjir Canal	3.0 to 8.0	10.0 to 30.0	0.2 to 2.5	0.2 to 3.7
10. Cipinang	15.0 to 30.0	20.0 to 90.0	0.0 to 1.0	1.0 to 5.0
11. Ciliwung	1.5 to 8.0	1.0 to 50.0	2.5 to 7.5	0.1 to 0.8
12. Sunter	5.0 to 20.0	10.0 to 60.0	0.5 to 3.0	0.4 to 1.9
13. Bekasi	2.0 to 30.0	1.0 to 110.0	1.0 to 7.0	0.1 to 2.2
14. Cikarang	1.5 to 6.0	10.0 to 95.0	2.5 to 7.0	0.1 to 0.8
Standard in West Java Province and DKI Jakarta	no standard	no standard	more than 3.0	less than 0.5
Standard in Bekasi and Tangerang	20 to 300	40 to 600	no standard	0.02 to 20

All the indicators obviously describe that high values have been observed through the dry season in the downstream of the Angke, Grogol, Krukut, Cipinang and Bekasi rivers, and the middle reaches of the Sunter river, comparing with the standards in Jabotabek area. These rivers are running through Jakarta and/or Bogor with high population density, and therefore, most of them are judged to be affected mainly by domestic and commercial waste water in urbanized area.

In addition to the mentioned survey result, the JICA Study Team undertook river water quality investigation at 41 locations for 19 rivers between the Cidurian and Cikarang rivers in Jabotabek area in October 1995. The water sampling locations are shown in Figure 12. The investigated water quality items are; 1) water temperature, 2) turbidity, 3) pH, 4) chemical oxygen demand (COD), 5) dissolved oxygen (DO), 6) chloride (Cl^-), 7) phosphate, 8) ammonium (NH_4), 9) nitrite (NO_2), 10) nitrate (NO_3), and 11) total hardness. The water quality tests for the water samples were carried out by using Thermometer, Toa Instrument Co., Ltd. for water temperature, Comparator Model: CP4, Advantec for pH, and Water Analyzer completed with Photometer - High precision and speedy resulting model, Kyoritsu Chemical-Check Lab., Corp. for other test items.

The result of water quality test is shown in Table 4 and summarized as follows:

(unit : mg/l)

Rivers	COD	DO	NH_4
1. Cidurian	3.9 to 27.0	3.7 to 7.4	not detected
2. Cimanceuri	8.7	4.7	not detected
3. Cirarab	56.0	not detected	2.60
4. Cisadane	4.6 to 7.5	4.0 to 6.1	not detected
5. Mookervaat Canal	6.3 to 32.0	not detected	1.48
6. Angke	8.2 to 22.0	2.0 to 3.3	0.0 to 0.24
7. Cengkareng Floodway	23.0	not detected	0.65
8. Pesanggrahan	3.8 to 4.8	1.2 to 2.4	0.28 to 0.33
9. Grogol	6.6	not detected	0.78
10. West Banjir Canal	5.0 to 8.8	0.0 to 2.8	0.22 to 0.28
11. Krukut	6.2	1.4	2.00
12. Ciliwung	3.5 to 7.8	2.2 to 8.7	0.0 to 0.88
13. Cipinang	24.0	not detected	1.02
14. Buaran	43.0	8.0	10.60
15. Sunter	3.3 to 22.0	1.4 to 6.0	0.0 to 1.02
16. Bekasi	3.6 to 44.0	4.0 to 10.0	0.0 to 0.24
17. West Tarum Canal	4.5 to 6.8	4.0 to 7.0	0.0 to 0.20
18. CBL Floodway	5.6 to 30.0	2.3 to 8.0	0.0 to 4.40
19. Cikarang	4.2	8.2	not detected
Standard in Java Province and DKI Jakarta	no standard	more than 3.0	less than 0.5
Standard in Bekasi and Tangerang	40 to 600	no standard	0.02 to 20

It may be concluded on the basis of the water quality analysis carried out by the JUDP-II and JICA study team that the water quality in the downstream of the rivers flowing down in Jakarta and Bogor has been deteriorated by intrusion of domestic and industrial waste water, as reported by the previous investigations.

Water quality standards issued by the governments of West Java province, DKI Jakarta, Kabupatens Bekasi and Tangerang are given in Tables 5 to 7. The water quality classes have been determined by the Government regulation, number 20/1990 on water pollution control as follows:

Class A : Water that can be used directly as drinking water without any treatment,

Class B : Water that can be used as raw water for drinking water,

Class C : Water that can be used for fisheries and livestock, and

Class D : Water that can be used for agricultural, commercial, and industrial uses and hydropower generation.

With respect to the current standards in DKI Jakarta and West Java Province, BOD and COD, which are key indicators for evaluating the water pollution situation by domestic and industrial waste water, are not stipulated in these standards. Also, in those of Kabupatens Bekasi and Tangerang, rather high allowable BOD and COD are applied in ranging 20 to 300 for BOD and 40 to 600 for COD, considering that DKI Jakarta adopted 10 to 30 for BOD and 20 to 50 for COD in the previous standard during 1980's.

3. PREVIOUS STUDIES AND PLANS

3.1 Water Resources Management

3.1.1 Major Studies Related to Water Resources Management

The studies on water resources management including its development in the Jabotabek area have been carried out by the DGWRD in order to meet the water demands in the various water sectors in Jabotabek area. The recent studies covering management and development of the surface and/or subsurface water resources are; the feasibility study on Cisadane River Basin Development Project in 1987, financed by the IBRD; Cisadane-Cimanuk Integrated Water Resource Development in 1990 by the Dutch Government, and the Jabotabek Water Resources Management Study in 1994 by the IBRD.

Cisadane River Basin Development Project

The Cisadane river basin development project undertook the pre-feasibility study for water resources development in Jabotabek area and the feasibility study on the Parungbadak and Tanjung dam schemes selected by the pre-feasibility study. However, since the former scheme requires the relocation of about 60,000 persons, the DGWRD has not proceeded with this dam scheme. While, the Tanjung dam scheme was planned in order to develop Tanjung irrigation scheme with an irrigation area of 5,400 ha but not recommended by the study because of its low economic viability. Also, the study prepared the groundwater management plan, taking into account land subsidence and decline of the piezometric deep groundwater pressure.

Cisadane-Cimanuk Integrated Water Resources Development

In 1990, the study on the Cisadane-Cimanuk integrated water resources development formulated the water supply plan in the Jabotabek area and Kabs. Karawang and Purwakarta, in which the existing three (3) dams in the Citarum river basin and the Karian dam in the Ciujung river basin and Tanjung dam in the Cidurian river basin were planned as the water sources for water supply to related water sectors, taking into account rapidly increasing water demands in the areas. In the plan, "Balanced Water Supply" comprising the aforesaid dams and water conveyance systems connecting the Jakarta area and the mentioned water resources was concluded to be the optimum water resources development plan during the time horizon until 2015. The plan recommended to; 1) supply 17.8 m^3/s to DKI Jakarta and 2.0 m^3/s to Cilegon for municipal and industrial uses from the Karian and Tanjung dams; 2) develop local source such as groundwater for water supply to other areas; 3) supply irrigation water to the proposed scheme in Kopo-Carenang-Cikande (KCC) area and the existing Rancasumur area and the western part (5,400 ha) of the Cisadane area.

Jabotabek Water Resources Management Study (JWRMS)

The Jabotabek Water Resources Management Study (JWRMS) was carried out in 1994 and aimed to formulate a global plan for raw water supply by developing surface water and groundwater and to establish a water resources management plan during a time horizon till 2025 in Jabotabek area, updating the previous water resources development plans and incorporating the rapid industrialization and urbanization due to high economic development in 1990's. The JWRMS also covered the north Banten and Karawang/Purwakarta areas as the study area since such the main surface water resources for Jabotabek area as the Ciujung/Cidurian and the Citarum rivers are located in these areas. The water resources management plan for both surface water and groundwater resources is currently under examination by the steering committee provided by the DGWRD to proceed with the proposed projects and actions by the JWRMS. The outline of the proposed water resources management plan is described in the following sub-section.

3.1.2 Jabotabek Water Resources Management Study (JWRMS)

(1) Scenarios for Water Resources Management Including Development

The JWRMS applied the scenarios for managing both the surface and ground water resources during the period until 2025. The JWRMS set out the conceptual three (3) scenarios for the management as given in Table 8; scenario A with high economic growth; scenario B with low economic growth; and scenario C with high economic and managed growth.

With respect to water resources management, the scenarios A and B assumed that the main water source for municipal and industrial (M&I) water supply would be still groundwater, and that development of surface water is delayed due to the low investment of the Government. While, the scenario C would divert the main water source for the M&I water supply from the ground water to the surface water in order to cope with such problems related to the over-abstraction of ground water as land subsidence and lowering of ground water table.

(2) Water Demand Projection

Under the mentioned scenarios, the JWRMS projected the future water demand in the M&I and irrigation sectors during the time horizon till 2025. The M&I water demands for the surface and ground water resources in the objective areas were estimated based on the data and methodology as shown in Figure 13. As indicated in the figure, the M&I water demands were estimated based on the population projection and spatial distribution plan in the Jabotabek area which was worked out by the Jabotabek Metropolitan Development Plan and Review (JMDPR), under many assumptions on parameters for estimation.

The result of water demand projection is given as follows:

Areas	Scenario	M&I Water Demands (m^3/s)							
		1990	1995	2000	2005	2010	2015	2020	2025
Jakarta	A	24.1	26.5	29.0	33.1	35.8	38.2	40.3	43.7
	B	24.1	26.9	29.6	33.2	35.6	37.8	39.7	42.7
	C	24.1	28.9	33.7	41.3	47.1	48.2	48.9	52.2
Tangerang	A	6.7	8.6	10.8	13.1	15.8	18.3	21.1	23.4
	B	6.7	8.2	9.8	11.6	13.4	15.0	16.7	18.2
	C	6.7	9.0	11.5	14.9	19.0	23.2	27.3	30.7
Bekasi	A	5.0	6.4	8.0	9.8	11.8	13.7	16.0	17.8
	B	5.0	6.1	7.2	8.5	9.9	11.2	12.6	13.7
	C	5.0	6.7	8.6	10.7	14.2	17.3	20.8	23.5
Bogor	A	7.5	10.1	13.4	17.0	20.6	24.5	28.4	32.2
	B	7.5	9.4	12.0	14.8	17.5	20.1	22.9	25.2
	C	7.5	9.7	12.6	15.8	19.9	24.0	27.7	31.0
Serang	A	4.8	6.4	8.3	10.9	13.1	15.5	17.7	20.0
	B	4.8	5.9	7.1	8.8	10.2	11.7	12.7	13.9
	C	4.8	6.5	8.4	11.5	14.1	17.3	19.5	22.6
Purwakarta/Karawang	A	4.5	5.5	7.5	9.8	12.3	14.9	17.4	20.2
	B	4.5	5.1	6.7	8.2	9.8	11.5	12.9	14.4
	C	4.5	5.5	7.6	10.3	13.4	17.1	20.2	23.7
Grand Total	A	52.6	63.5	77.0	93.7	109.4	125.1	140.9	157.3
	B	52.6	61.6	72.4	85.1	96.4	107.3	117.5	128.1
	C	52.6	66.3	82.4	104.5	127.7	147.1	164.4	183.7

The irrigation water requirement in the existing irrigation areas was estimated, using the meteorological and hydrological data from 1950 to 1979 and the typical cropping patterns in these areas under the following conditions:

a) The existing irrigation area will be gradually decreased due to expansion of the residential area to support rapidly increasing population.

b) Agricultural diversification from paddy to vegetable is expected in order to meet the requirement of vegetables in the surrounding urban areas and to effectively use the available water in and around Jabotabek area.

The estimated irrigation water requirement in 1990 and 2025 is given as follows:

Large Irrigation Schemes	Water Requirement for Scenarios (m^3/s)			
	1990	A	B	C
Ciujung	14.0	10.5	11.3	11.1
Cidurian	4.2	3.7	3.7	3.7
Cisadane	18.9	16.9	17.2	17.2
Empang	1.4	0.7	0.7	0.8
Katulampa	1.5	0.9	0.9	1.0
West Tarum Canal	33.6	28.2	28.7	28.6
North Tarum Canal	57.5	48.2	50.1	48.4
Other large schemes	131.1	109.1	112.7	110.8
Total	212.9	186.5	190.9	189.3

With respect to flushing water demands, the JWRMS concluded that provision of new works would not be viable and that surplus water available in the Cisadane and Citarum rivers would be possible to be utilized as flushing water in Jakarta in the normal hydrological year, conveying the water through the existing water course system in Jakarta.

The JWRMS defined the water sources for water sectors to meet the projected water demands during the period till 2025 as follows:

Water Sectors	Water Sources
a) Municipal and industrial water supply	1) Groundwater 2) Surface water • Piped water supply to municipal and industrial sectors • Raw water supply to industrial sector
b) Irrigation water supply	Surface water
c) Flushing water	Surface water

(3) Groundwater Management Strategy

The JWRMS identified that the significant problems related to the groundwater use are; 1) land subsidence induced by over-abstraction of deep groundwater in the northern part of DKI Jakarta, 2) pollution of shallow groundwater due to intrusion of waste water, and 3) lowering of groundwater table predicted to be caused by the intensive and concentrating abstraction. To improve the mentioned situations, the JWRMS recommended the following measures:

Management Issues	Improvement Measures
1) Reducing or controlling the abstraction of medium to deep ground water in the northern part of DKI Jakarta	a) licensing to water users b) provision of high groundwater tariff c) provision of alternative water source (piped water supply system) d) subsidizing piped water supply system
2) Reducing or controlling the abstraction of shallow ground water	a) licensing to water users b) provision of high groundwater tariff c) provision of alternative water source (piped water supply system) d) subsidizing piped water supply system
3) Promoting and extending groundwater abstraction in selected zones	a) licensing to water users b) provision of low groundwater tariff c) provision of alternative water source (piped water supply system) d) subsidizing piped water supply system
4) Groundwater recharge enhancement	a) provision of roof catchment recharge system b) open pavement
5) Groundwater pollution control	a) relocating risky industries b) regulations on production and uses of pollutants c) pollution tax d) obligatory waste water treatment e) provision of sewerage systems f) reclaiming polluted sites

The JWRMS also concluded through comparative study on the alternative strategies titled as; 1) "present groundwater management (GWM)", 2) "improved GWM", and 3) "strongly improved GWM", that it was required to monitor and strictly manage the groundwater use by applying the mentioned measures in order to realize sustainable use of groundwater resources, to reduce public health risk and to reduce land subsidence in Jabotabek area. The general key issues of the proposed strategies, "strongly improved GWM : A2 and C3", are described as follows:

Description	Unit	A2	C3
1. Total Groundwater Abstraction	billion m^3	44.9	35.4
a) Deep groundwater abstraction from 1995 to 2025	billion m^3	9.3	5.7
b) Shallow groundwater abstraction from 1995 to 2025	billion m^3	35.6	29.7
2. Economic cost			
a) Total incremental investment	trillion Rp.	1.71	1.01
b) Total incremental expenditure	trillion Rp.	4.09	2.55
c) Incremental cost for shallow groundwater	Rp./ m^3	380	489
d) Incremental cost for deep groundwater	Rp./ m^3	210	225
e) Total incremental cost	Rp./ m^3	334	441
3. Environmental impact			
a) Land subsidence volume	million m^3	466	270
b) Average depth of land subsidence	m	1.17	0.68
c) Shallow groundwater shortage risk	million people equiv.	1.8	0.2
4. Health risks			
a) Total people relying on shallow groundwater	million people	22.8	15.1
b) Health risk score	million people equiv.	4.1	2.4

Based on the groundwater management strategies, the JWRMS estimated the water amount to be supplied by the groundwater source as given in Table 9.

(4) Surface Water Resources Management Strategy

The JWRMS set up priority ranking for water allocation to various water users; 1) the existing irrigation and M&I water demand, 2) additional M&I water demand, 3) new irrigation development, 4) aqua-culture, 5) flushing water, and 6) hydropower generation. Also, in order to evaluate the potential water resources, the JWRMS established the following supply criteria describing severity of design drought:

1) Municipal and industrial water supply : failure 1 day in 10 years

2) Irrigation water supply : failure 1 half month in 5 years

3) Flushing water : use of residual water

Under the mentioned criteria, the strategy for surface water resources development during time horizon till 2025 were formulated for both the scenarios of A and C as given in Figure 14. The proposed strategy is called as "strategy 5" and has multi-objectives to; 1) balanced water supply to DKI Jakarta, which provides the water supply sources both in the west (the Ciujung and Cidurian) and the east (the Citarum) to DKI Jakarta; 2) safe drinking water sources, which could prevent water pollution along water conveyance system and minimize the use of polluted water in the Cisadane and Bekasi rivers passing through Bogor city area; and 3) maximum gravity supply to Bogor.

Also, the proposed plan includes sub-options; 1) upgrading of the existing West Tarum Canal

(WTC) to improve water quality in the WTC, polluted by the joining rivers of the Bekasi and Cikarang passing through Bogor city area; 2) Canal 2 or Tarum Jaya Canal (TJC), out of which the detailed design was carried out for the later scheme but presently, it has become more difficult to acquire the necessary land along the TJC due to urbanization and industrialization in Bekasi while the Canal 2 could be a possible option instead of the TJC since its alignment is designed to pass an area with the low population density; and 3) the Genteng reservoir, which has possibility to supply water by gravity system and if no compensation cost is required for the existing railway which is not used presently, it would be more preferable.

As indicated in the mentioned figure, the combination of the strategy 5 with the scenarios of A and C are proposed for the surface water resources management strategy, assuming that the increasing water demands will trend between those of the scenarios of A and C, taking into account the currently high economic growth in Jabotabek area.

The action program for surface water resources development strategies was prepared by the JWRMS as shown in Table 10, which includes; 1) the Karian, Pasir Kopo, Bojongmanik reservoirs in the Ciujung river; 2) the Cilawang reservoir in the Cidurian river; 3) the Genteng reservoir in the Cisadane river; 4) heightening of the existing Cirata reservoir; 5) operational management of the Citarum river basin including prediction of runoff in the unregulated rivers joining the WTC, drought management in the irrigation areas and on-demand irrigation for efficient use of water; 6) upgrading of the WTC, 7) Salak contour canal; 8) water conveyance system of the Canal 2 supplying raw water in the Jatiluhur reservoir to the demand areas; and 9) Karian-Serpong conveyance system connecting the Karian and Cilawang reservoirs to the on-going Serpong water treatment plant. Since the Tanjung dam scheme was identified to be necessary to meet the water demands till 2025 but to need high project cost and resettlement of about 3,000 households, this scheme was not incorporated into the action program in Table 10.

Even though the proposed works will be completed during the period till 2025, in severe drought year with a probability of once in 5 years, irrigation water requirement is required to be restricted to fulfill the M&I water demands with the top priority in water allocation in the Jabotabek area. Therefore, drought management including the proposed operational management of the Citarum river basin such as prediction of runoff in the unregulated rivers joining the WTC, drought management in the irrigation areas and on-demand irrigation for efficient use of water is important in order to meet the water demands in Jabotabek area and not to induce the conflict between water users.

While, in order to realize the proposed works, it is necessary to relocate the inhabitants of about 50,000 in total from their current residential area to other places till 2025. The study on the Ciujung-Cidurian integrated water resources, which was carried out by technical cooperation of JICA and was coupled with the JWRMS, proposed the provision of an environmental monitoring and management unit (EMMU) at PU for; 1) monitoring and management of all the environmental aspects related to the proposed schemes, 2) coordination of institutional matters related to environmental monitoring and management, 3) supervision of the actual resettlement and land compensation, 4) evaluation of the actual performance of resettlement and land compensation, 5) monitoring any changes in the requirements of the resettlers, and 6) establishment of an appropriate concept and manner for resettlement, in order to smoothly undertake the resettlement operation.

3.2 Water Quality Management

In Jabotabek area, the Government of Indonesia has carried out the studies and programs for managing river water quality. In these years, the major ones are; a) Proyek Kali Bersih (PROKASIH: clean river program); b) Jabotabek Water Resources Management Study, and c) Water Quality Control Management in Jabotabek.

Outline of the mentioned studies and program is described in the following sub-sections:

3.2.1 PROKASIH

The PROKASIH is going on by the local governments under the BAPPEDAL for specified twenty two (22) river systems in eleven (11) provinces, focusing on industrial sewage. The Provincial Government of West Java and DKI Jakarta are implementing the program for the Ciliwung, Cisadane, Bekasi, and Cipinang rivers and Mookervaat canal among the aforesaid rivers. The program includes monitoring of waste water quality from the industrial factories and provides instruction to the factory owners to give appropriate measures for improving the waste water quality, when the quality exceeds the national standard for industrial sewage.

As a result of the implementation of the PROKASIH, the toxic effluent has been decreased in Jakarta through monitoring of river water quality. While, in Botabek, it, currently, is judged that monitored data are insufficient for evaluation of the program and that further continuous monitoring is necessary.

3.2.2 Jabotabek Water Resources Management Study (JWRMS)

The JWRMS was carried out by the DGWRD under JUDP-II Project between June, 1991 and February, 1994 as described in the aforesaid section 3.4. The study concluded on the water quality as summarized as follows:

(1) West Tarum Canal

It is identified that there are no significant problems on river water quality of the WTC, which are currently utilized as one of the main water sources for domestic water supply in DKI Jakarta and Bekasi. But, during the period till 2025, it is predicted that river water quality in the WTC will be deteriorated by high concentration of organic material and influx of municipal and industrial waste water in the rivers running through Bogor. From this prediction, it is recommended to upgrade the WTC by provision of syphon structure at the existing Cikarang and Cibeet weirs and pipelines to the water treatment plants for preventing the intrusion of polluted water in the related rivers into the WTC.

(2) Cisadane River

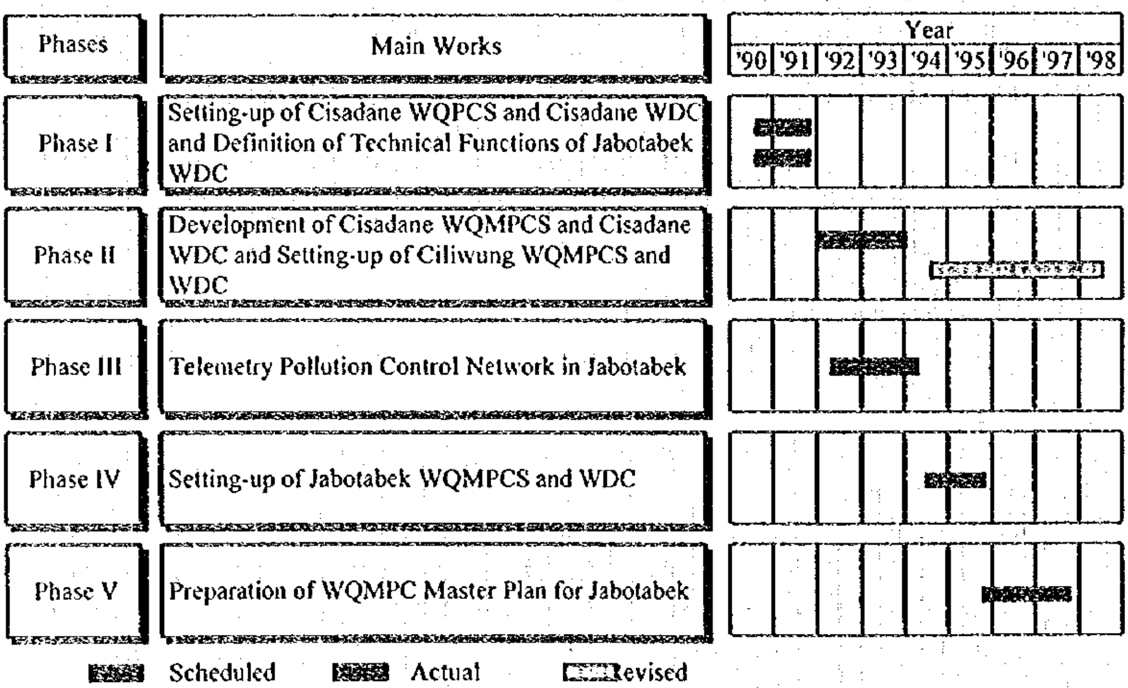
The JUDP-II is constructing a water treatment plant at Serpong, which will take water amount of 3 m^3/s for municipal and industrial water supply to Jakarta. The JWRMS identified that values of dissolved oxygen and BOD in 1990 fully meet the drinking water criteria, but since it is predicted that the significant water pollution is predicted by intrusion of untreated waste water from municipal and industrial water uses, high concentration of organic material and potential problems and risks in the upstream activities such as efflux of heavy metals from the gold mining and waste water from nuclear research station at Serpong, it is strongly recommended to concentrate all pollution control efforts for maintaining the water quality of the Cisadane at acceptable levels.

(3) Flushing Water Supply to DKI Jakarta

Taking into consideration of the large amount of flushing water required to maintain the river water quality to the acceptable level, it is concluded that construction of dams/reservoirs and conveyance canals are unrealistically expensive, and therefore, no water resources development for flushing water is proposed in the JWRMS.

3.2.3 Water Quality Management Study in Jabotabek (WQMJ)

The study on Water Quality Management in Jabotabek (WQMJ) is being undertaken under financial assistance of the World Bank and the French Government in order to; 1) set up the Cisadane Water Data Center (WDC) and finally develop Jabotabek WDC, and 2) formulate an integrated and comprehensive master plan for water quality management and pollution control in Jabotabek area including short term (2005), medium term (2015) and long term (2025) plans. The WQMJ is being undertaken by dividing into the five (5) phases since 1990 as scheduled as follows:



Note:
WQMPCS : Water Quality Management and Pollution Control System
WDC : Water Data Center

The result of the phase I, progress of phase II and outline of phases of III to V are described as follows:

(1) Phase I

The Phase I study was carried out for a period from July 1990 until September 1991 and as a result, a technical and administrative structure for Cisadane river basin, namely Cisadane Water Data Center (Cisadane WDC), was established at Cawang office of the DGWRD in Jakarta and was a pilot case for future development of a Jabotabek Water Data Center.

The Cisadane WDC has a field data acquisition network consisting of 11 hydrological gauging stations and 17 water quality sampling stations, data base and cartography software facilities including menu driven and relational data base on topography, hydrology, hydraulics population, domestic pollution sources, industrial pollution sources, land use, water intakes, water quality standards, water quality objectives, administrative and socio-economical data. Also, a water quality simulation model, which comprises 80 elementary sub-catchment areas and 24 river sections for the Cisadane river and its main tributaries, the Cikaniki and Cihiris rivers, has been constructed in computer system.

Through the initial operation of the Cisadane WDC from February to August in 1991, the WQMJ identified the following :

a) Tangerang and Bogor areas, both which are rapidly industrialized, urbanized and densely populated, are the main water pollution sources for the Cisadane river basin as evaluated in Table 11. Therefore, it should be considered that these areas have priority for implementation of sanitation and sewerage system development.

b) Bacteriological pollution is critical in the area of Serpong and Tangerang and represents a serious health hazard to basin populations due to insufficient sanitation.

c) Toxicity unacceptable levels were identified in the Tangerang area.

d) No real nuclear pollution (still in acceptable ranges) has been identified at the downstream of the research center of Puspitek (nuclear research station).

e) There are several water standards issued for the area in the Cisadane river basin. However, the present standards are incomplete and inadequate for the purpose of river water quality monitoring and evaluation of them. Therefore, during the Phase I, the temporary standard indicated in Table 12 was prepared for the project use on the basis of the existing regulations, and this is required to be updated through the next phases.

The WQMJ, also, defined the Jabotabek WDC as outlined in Figure 15. In the definition, the territory of the Jabotabek WDC is basically the Cidurian-Ciberueum, Cimanceuri, Cisadane, Ciliwung including other minor basins, Sunter, Bekasi and Cikarang, and its required functions are suggested as follows :

a) Monitoring, analyzing and publishing of water quality and quantity data in cooperation with other relating agencies such as BAPPEDAL (Environmental Impact Management Agency), KPPL of DKI Jakarta (Urban and Environmental Study Office, Jakarta City Government),

b) Technical recommendation to local government (DKI Jakarta and West Java Province) with respect to the water quality and effluent standard,

c) Monitoring of pollution sources,

d) Protection program for the raw water supply (emergency pollution alert system),

e) Evaluation of the pollution on the water quality,

f) Recommendation of the establishment of water users and polluter fee structures,

g) Coordination among the relating agencies to water data as given in Figure 16,

h) Providing short term and long term plans and investment programs for management and improvement of water quality,

(2) Phase II

The Phase II was started in August 1994, and is going on as of November 1995. The scope of works for the Phase II has been expanded by including parts of the scheduled Phases III and IV, though the scale is more limited than that originally planned. The main objectives of the Phase II are to; 1) establish "Alert" system for maintaining safety of water supply from the water pollution, 2) planning and monitoring systems of water quality, pollution levels and pollution control, 3) effluent discharge policy, and 4) river basin water resources management.

The Phase II is scheduled to be completed in July 1998.

(3) Phases III to V

The phase III will aim at finalizing the automatic water quality monitoring networks for the Cisadane and the part of Jabotabek area as a pilot system for the whole of Jabotabek including installation of equipment, development of data and information processing programs. The Phase IV will establish Jabotabek Water Data Center including water quality monitoring network, staff training and preparation of information campaigns and data dissemination procedures. Also, the Phase IV will evaluate water pollution sources in the whole Jabotabek area.

The Phase V will formulate a integrated and comprehensive master plan for water quality management and pollution control in Jabotabek WDC area including technical and financial evaluation of short, medium and long term actions through evaluation of pollution loads and characteristics from industrial, agricultural and domestic sources, simulation of "water uses - water polluters " fee system for financing the WDC operation costs and pollution control and water resources management measures, and launching of information campaigns.

4. RECOMMENDATIONS FOR WATER RESOURCES AND QUALITY MANAGEMENT

In Jabotabek area, the urbanization and industrialization are being rapidly progressed due to economic growth with a high rate. Also, the currently high economic growth brings the significant change in life style of inhabitants and land use in Jabotabek area.

As a result, problems and issues related to river water management including water resources, flood control and water quality have become serious in Jabotabek area. Figure 17 indicates the problems and issues related to river water management.

Among these, the following are recommended to be urgently managed by the Government of Indonesia for improvement of the present situation in river water in Jabotabek area:

(1) Preservation of Natural Pond, "Situ-Situ"

There are many natural ponds with a total area of about 2,200 ha which have a multiple functions for water use, groundwater recharge, flood retention, recreation, stabilization of flow situation, and so on. In these years, the ponds have been decreased for industrialization and housing development and its total volume have been reduced by sedimentation. Besides, water quality in natural ponds have been deteriorated due to intrusion of waste water.

Furthermore, the river water quality in Jakarta and Bogor areas is being significantly deteriorated but it becomes difficult to provide flushing water for improving worsened situation since construction of dam and reservoir for providing it is rather hard and expensive job as stated by the JWRMS. Taking into account these situation, preservation of the natural ponds "Situ-Situ" contributing to stabilization of river water during the drought season is one of urgent works in managing river water in Jabotabek area.

From the aspects of river water management, it is recommended to provide rehabilitation works for the existing "Situ-Situ" area for preservation of important functions of them.

(2) Strict Management of Groundwater Use and Provision of Piped Water Supply System and Water Resources Development

It has been identified by the previous studies that the northern part of DKI Jakarta is subsided due to intensive groundwater uses for municipal and industrial water supply. The Government of Indonesia has made efforts to manage the groundwater uses. However, the land subsidence is still progressed and several areas are facing drainage problems which will become more serious if the land subsidence situation is further worsened.

Strict management of the groundwater uses is indispensable to mitigate the land subsidence in the northern part of DKI Jakarta, including clarification of safe yield of groundwater based on detailed data on the existing wells and geographical information, and improvement of licensing and registration of water users.

As a countermeasure for land subsidence, provision of piped water supply system in Jabotabek area is recommended to be urgently undertaken by the PAM Jaya in order to replace the water amount taken from ground water source thereby and to develop the surface water resources as soon as possible, as proposed by the JWRMS. Also, other possible measures for groundwater recharge enhancement and groundwater tariff are proposed to be implemented together with the mentioned works.

(3) Separation of Polluted Rivers from West Tarum Canal (WTC)

The West Tarum Canal currently conveys the river water in the Bekasi, Cikarang and Cibeet rivers for drinking water supply in Kabupaten Bekasi and Jakarta. However, the river water quality in these rivers are being worsened by the intrusion of polluted water in the upstream areas. In order to reduce the health risks and operation and maintenance cost in the water treatment plants, especially purification cost, it is recommended to separate these rivers by provision of syphon structure or pipeline conveyance at joining points with these rivers.

While, the intake weirs along the WTC are currently operated mainly for conveying water to DKI Jakarta. Therefore, the gates of these weirs are not effectively operated for smoothly passing flood water in these rivers in order to keep water level at the weir sites and to take water in, and this is one of causes for flooding in the upstream of weir sites.

From the above, the proposed improvement works will be effective not only for water uses management but also flood control.

(4) Establishment of Solid Waste Collection System

Solid waste is deposited at many places or trapped by the river structures along the river course and drainage canal, and it worsens river water quality and river view. Besides, the waste causes reduction of flow capacity of river channels and drainage canals.

To mitigate the mentioned situation, appropriate solid waste collection system is required to be established by DKI Jakarta.

(5) Water Data Center for Managing Water Resources

The Cisadane Water Data Center was established as a part of the Water Quality Management and Pollution Control Project and is scheduled to be upgraded to the Jobotabek Water Data Center by the project.

As indicated in Figure 16, the related data to water quantity and quality are currently managed by the many agencies. However, in order to timely and effectively manage the water resources and its quality, data observation network, collection and analysis system are strongly required under close relation and coordination between these agencies concerned.

To earlier realization of the Jabotabek Water Data Center, the phases III and IV, scheduled to be carried out in 1992 to 1995, are expected to be proceeded in the current phase of the Water Quality Management and Pollution Control Project.

Table 1 EXISTING WATER CONVEYANCE SYSTEM IN JABOTABEK AREA

Conveyance System	Intake Weir/ River System	Service Area	Length (km)	Design Capacity (m^3/sec)
1) West Tarum Canal	Curug/Citarum Cikarang/Cikarang Bekasi/Bekasi Cibeet/Cibeet	Prosijat irrigation area (65,845 ha) M&I water supply to Jakarta Flushing water supply to Jakarta	69.5	Curug-Cibeet : 77 to 85 Cibeet-Cikarang : 48 to 90 Cikarang-Bekasi : 21 to 45 Downstream of Bekasi : 11 to 21
2) Cisadane Irrigation Canals	Pasar Baru/Cisadane	Prosida-Cisadane irrigation area (31,156 ha)	Barat : 39.5 Barat Laut : 13.3 Timur : 14.6 Utara : 15.1 Tana Tingi : 15.9 Total : 98.4	Barat : 0.7 to 30 Barat Laut : 11.5 Timur : 14.6 Utara : 15.1 Tana Tingi : 15.9
3) Solokan Barat Main Canal (Empang)	Empang/Cisadane	Cisadane-Empang irrigation area (5,791 ha)	22.0	1.4 to 6.9
4) Katulampa Main Canal	Katlumpa/ Ciliwung	Ciliwung-Katulampa irrigation area (3,853 ha)	42.7	4.5
5) Cidurian Main Canal	Rancasumur/ Cidurian	Cidurian-Rancasumur irrigation area (10,805 ha)	Intake to Cimanceuri : 14.0 Cimanceuri to E.P. : 10.8 Total : 24.8	Intake to Cimanceuri : 4.6 to 14.7 Cimanceuri to E.P. : 0.4 to 4.4
6) Cicinta irrigation canal	Cicinta/Cicinta	Cicinta irrigation area (1,371 ha)	12.0	1.8

Note : Parenthesis indicates irrigation area as of 1990

Table 2 EXISTING WATER TREATMENT PLANT IN PAM SYSTEM

Treatment Plant	Capacity (lit./sec)	Water Source	Commissioned Year	Remarks
(1) Pejompongan I	2,000	Banjir Canal	1957	
(2) Pejompongan II	3,000	Banjir Canal	1970	
Pejompongan II	4,000	Banjir Canal	1986	Addition of 4 units
(3) Pulogadung	4,000	Sunter River/ WTC	1982	
(4) Buaran I	2,000	WTC	1992	
(5) Ciburial	300	Spring water in Bogor	1922	
(6) Muara Karang	100	Banjir Canal	1982	
(7) Taman Kota	50		1982	
	200		1992	Upgraded
(8) Cilandak	100	Krukut River	1977	
	200	Krukut River	1979	Upgraded
(9) Condet	50	Ciliwung River	1983	
(10) Cakung	25	WTC	1982	
(11) Pesing	5	Angke River	1980	
(12) Pejaten	5	Ciliwung	1982	
(13) Sunter	50	Sunter River	1982	
Total	15,935			

Table 3 PREDICTED IMPACT OF GROUNDWATER ABSTRACTION

Direct Impacts	Environmental Impact	Environmental and other damages	Significance
Shallow Groundwater Abstraction			
1. Lowering groundwater table	a) Declining water levels	• Possibility of drying-up of wells in long dry season • Higher pumping cost including investment and replacement cost	• Serious problem in areas with over-abstraction of shallow groundwater • Significant cost for damages for abstractors themselves
	b) Increased chemical groundwater pollution due to increase of infiltration of sewage	• Lowering suitability of water for drinking and cooking	• Significant
	c) Land subsidence	• Increased flooding and drainage congestion	• Limited impacts
	d) Decreased bacteriological pollution due to thicker unsaturated zone	• Less risk for public health (un-intention of consumption of unboiled groundwater)	• Varying significance depending on sanitation condition
2. Increased vertical groundwater flow towards well	a) Increased pollution of shallow groundwater due to shorter travel times of polluted groundwater	• Lowering suitability of water for drinking and cooking	• Varying significance
3. Increased horizontal groundwater flow towards well	a) Reduction of base flow due to decreasing flow towards streams	• Surface water shortages and deterioration of river water quality in dry season	• Significant in areas with intensive shallow groundwater abstraction
	b) Increased pollution of shallow groundwater due to shorter travel times of polluted groundwater	• Lowering suitability of water for drinking and cooking	• Varying significance
	c) Salinization due to inland transport of fossil brackish water	• Unsuitable water for purposes requiring low salinity	• No significance
Deep Groundwater Abstraction			
4. Lowering groundwater pressure in aquifer	a) Declining piezometric levels	• Higher pumping cost including investment and replacement cost	• Significant cost for damages for abstractors themselves
	b) Land subsidence	• Increased flooding and drainage congestion	• Significant and critical problem, specially in northern part of DKI Jakarta
	c) Salinization caused by squeezing out fossil brackish water from clay layers	• Unsuitable water for purposes requiring low salinity	• Significant but slow process mainly in areas with very high rates of deep groundwater abstraction
	d) Increased salinity caused by higher contribution deeper screen	• Unsuitable water for purposes requiring low salinity	• Not very significant
5. Increased vertical groundwater flow towards well	a) Salinization caused by downward transport of shallow saline groundwater	• Unsuitable water for purposes requiring low salinity	• Significant in small part of northern part of DKI Jakarta
	b) Lowering of shallow groundwater table	(refer to Item 2.)	• Significant in parts of north Jakarta and locally in southern Jakarta
	c) Increased pollution of shallow groundwater due to induced vertical transport	• Lowering suitability of water for drinking and cooking	• Varying significance
	d) Reduction of base flow due to decreasing seepage towards streams	• Surface water shortages and deterioration of river water quality in dry season	• Limited significance
	e) Pollution of deep groundwater	• Unsuitable water for several purposes or needs extra treatment	• Not significant due to long travel times and adsorption processes
6. Increased horizontal groundwater flow towards well	a) Salinization due to inland transport of fossil brackish water	• Unsuitable water for purposes requiring low salinity	• Limited significance

Table 4 RESULT OF WATER QUALITY TESTS CARRIED OUT BY JICA STUDY TEAM

Location	Test Items	Date		Climate	Physical Items		Chemical Items								
		Day	Time		Water Temp. ℃	Turbid-ity °	pH -	COD mg/l	DO mg/l	Chlo-ride mg/l	Phos-phate mg/l	Ammo-nium mg/l	Nitrite mg/l	Nitrate mg/l	Hard-ness mg/l
Cidurian	CID-1	9-Oct	12:38	fair	33.0	180	6.8	27.0	3.7	18.0	ND<0.05	ND<0.2	0.045	1.28	85
	CID-2	9-Oct	11:00	fair	31.5	100	6.8	4.3	7.0	0.7	ND<0.05	ND<0.2	0.015	1.16	33
	CID-3	9-Oct	9:45	fair	31.0	40	7.1	3.9	7.4	0.5	ND<0.05	ND<0.2	ND<0.01	0.52	43
Cimanceuri	CIM-1	9-Oct	13:00	fair	32.0	90	7.0	8.7	4.7	18.0	0.06	ND<0.2	0.18	1.42	89
Cirarab	CIR-1	9-Oct	13:30	fair	31.0	170	7.0	56.0	ND<1.0	5.0	1.45	2.60	0.033	0.12	53
Cisadane	CIS-1	12-Oct	10:15	cloudy	27.5	160	7.0	7.1	4.0	1.6	ND<0.05	ND<0.2	0.045	2.77	31
	CIS-2	12-Oct	8:55	cloudy	27.5	160	6.9	4.8	5.0	1.8	0.06	ND<0.2	0.04	2.91	28
	CIS-3	12-Oct	12:05	cloudy	28.0	190	7.0	6.2	4.7	2.4	ND<0.05	ND<0.2	0.034	2.06	27
	CIS-4	13-Oct	11:30	fair	27.0	110	7.3	4.6	6.1	1.3	0.15	ND<0.2	0.075	3.25	44
	CIS-5	13-Oct	10:05	fair	26.0	125	7.4	7.5	6.0	1.2	0.11	ND<0.2	0.013	3.43	57
Mookervaat Canal	MOO-1	12-Oct	9:25	cloudy	28.5	140	6.9	6.3	3.8	2.3	0.28	0.65	0.035	2.35	40
	MOO-2	18-Oct	11:45	fair	28.5	125	6.6	32.0	ND<1.0	12.5	0.7	1.48	0.51	4.2	90
Angke	A-1	19-Oct	11:25	fair	29.5	330	6.7	22.0	2.0	1.8	0.29	0.24	0.27	5.6	43
	A-2	19-Oct	13:18	fair	29.5	550	6.7	8.2	3.3	5.9	0.08	ND<0.2	0.035	8.66	30
Cengkareng	CF-1	19-Oct	12:45	fair	30.0	220	6.6	23.0	ND<1.0	5.0	0.38	0.65	0.25	2.2	5
Pesanggrahan	PE-1	18-Oct	10:00	fair	27.5	800	6.6	4.6	1.2	1.7	0.07	0.28	0.112	8.2	27
	PE-2	18-Oct	9:10	fair	27.5	750	6.6	3.8	2.4	2.0	ND<0.05	0.33	0.022	7.02	30
Grogol	GRO-1	18-Oct	8:35	fair	27.0	450	6.6	6.6	ND<1.0	2.4	0.17	0.78	0.128	5.95	40
West Banjir Canal	WB-1	17-Oct	8:50	fair	27.5	170	6.9	5.0	2.8	1.8	0.4	1.96	0.22	2.8	58
	WB-2	18-Oct	12:45	fair	28.5	330	6.8	8.8	ND<1.0	2.0	ND<0.05	0.50	0.28	6.6	49
Krukut	KRU-1	19-Oct	9:55	fair	29.0	165	6.9	6.2	1.4	2.7	0.86	2.00	0.52	3.8	62
Ciliwung	CIL-1	17-Oct	9:37	fair	28.5	225	6.8	7.8	2.2	2.0	0.25	0.88	0.26	2.8	49
	CIL-2	17-Oct	10:47	fair	27.5	125	6.9	3.8	4.8	1.8	0.16	0.03	0.18	3.78	38
	CIL-3	17-Oct	11:47	fair	27.0	160	7.1	3.7	5.8	1.6	0.05	ND<0.2	0.12	4.2	34
	CIL-4	13-Oct	12:12	fair	29.0	48	7.1	6.0	6.5	2.9	0.17	0.26	0.52	6.1	51
	CIL-5	13-Oct	9:30	fair	24.5	34	7.5	3.5	8.7	2.3	0.07	ND<0.2	ND<0.01	2.88	50
Cipinang	CIP-1	20-Oct	9.05	fair	28.0	220	7.0	24.0	ND<1.0	2.3	3.2	1.02	0.22	ND	58
Buaran	BUA-1	20-Oct	11:26	fair	30.5	70	7.6	43.0	8.0	7.3	6.2	10.60	0.027	ND	100
Sunter	SU-1	20-Oct	12:07	fair	29.5	75	6.9	22.0	1.4	1.5	0.29	1.02	0.15	ND	53
	SU-2	20-Oct	10:17	fair	28.5	70	7.0	3.3	6.0	1.5	ND<0.05	ND<0.2	0.03	1.38	40
Bekasi	BEK-1	5-Oct	11:30	fair	29.0	480	7.0	40.0	4.0	6.0	ND<0.05	ND<0.2	ND<0.01	7.5	70
	BEK-2	6-Oct	10:00	fair	29.0	230	7.0	44.0	5.2	0.6	ND<0.05	0.24	0.045	2.98	65
	BEK-3	6-Oct	11:15	fair	29.5	80	7.0	3.6	6.3	1.2	ND<0.05	ND<0.2	0.02	5.58	32
	BEK-4	6-Oct	11:55	fair	30.0	ND<20	6.6	4.5	10.0	2.3	ND<0.05	0.24	0.058	4.57	98
WTC	TAR-1	5-Oct	14:00	fair	31.0	65	7.2	5.6	7.0	2.3	0.09	ND<0.2	0.039	1.28	80
	TAR-2	7-Oct	11:00	fair	29.0	39	7.1	4.6	4.8	1.5	0.11	ND<0.2	0.082	2.09	74
	TAR-3	7-Oct	9:40	fair	29.5	32	7.1	4.5	4.3	2.3	0.15	0.20	0.073	1.85	70
	TAR-4	6-Oct	10:30	fair	29.0	200	7.1	6.8	4.0	1.7	ND<0.05	ND<0.2	0.032	2.13	70
CBL	CBL-1	5-Oct	10:45	fair	30.0	330	7.0	30.0	2.3	1.7	ND<0.05	4.40	0.03	1.8	65
	CBL-2	7-Oct	10:30	fair	29.5	32	7.2	5.6	8.0	1.5	ND<0.05	ND<0.2	0.085	1.77	80
Cikarang	CIK-1	7-Oct	11:45	fair	31.7	23	7.5	4.2	8.2	1.5	ND<0.05	ND<0.2	ND<0.01	2.63	120

Note : Samples were analyzed by the water analyzer completed with photometer - high precision and speedy resilting method.

Table 5 WATER QUALITY STANDARD IN WEST JAVA PROVINCE

Parameter	Unit	Rank					
		A	B	C	D	B,C,D	C,D
Physical							
Odour	-	-		-	-	-	-
Total Dissolved Solid Substances	mg/l	1000	1000	1000	1000	1000	1000
Turbidity	NTU	5	-	-	-	-	-
Temperature	℃	Air Temp ± 3	Normal	Normal ± 3	Normal	-	-
Colur	TCU	15	-	-	-	-	-
Taste	-	Tasteless	-	-	-	-	-
Electrical Conductivity	umho/cm(25℃)	-	-	-	2250	2250	2250
Chemical							
Inorganic Chemical							
Mercury(Hg)	mg/l	0.001	0.001	0.002	0.005	0.001	0.002
Aluminium(Al)	mg/l	0.2	-	-	-	-	-
Arsenic(As)	mg/l	0.05	0.05	1.00	1.00	0.05	1.00
Boron(B)	mg/l	-	-	-	1.0	1.0	1.0
Barium(Ba)	mg/l	1.0	1.0	-	-	1.0	-
Iron(Fe)	mg/l	0.3	5.0	-	-	5.0	-
Fluoride(F)	mg/l	0.5	1.5	1.5	-	1.5	1.5
Cadmium(Cd)	mg/l	0.005	0.01	0.01	0.01	0.01	0.01
Cobalt(Co)	mg/l	-	-	-	0.2	0.2	0.2
CaCO3 Hardness	mg/l	500	-	-	-	-	-
Chloride(Cl)	mg/l	250	600	-	-	600	-
Free Chlorine	mg/l	-	-	0.003	-	0.003	0.003
Hexavalent Chromium (Cr+6)	mg/l	0.05	0.05	0.05	1.00	0.05	0.05
Manganese(Mn)	mg/l	0.1	0.5	-	2.0	0.5	2.0
Na(alkari salt)	%	-	-	-	60	60	60
Sodium(Na)	mg/l	200	-	-	-	-	-
Nickel (ni)	mg/l	-	-	-	0.5	0.5	0.5
NH4	mg/l	-	0.5	0.02	-	0.02	0.02
Nitrate-N	mg/l	10.0	10.0	-	-	10.0	-
Nitrite-N	mg/l	1.0	1.0	0.06	-	0.06	0.06
DO	mg/l	-	≥6.0	>3.0	-	>3.0	>3.0
Silver (Ag)	mg/l	0.05	-	-	-	-	-
pH		6.5-8.5	5.0-9.0	6.0-9.0	5.0-9.0	6.0-9.0	6.0-9.0
Selenium(Se)	mg/l	0.01	0.01	0.05	0.05	0.01	0.05
Zinc(Zn)	mg/l	5.0	58.0	0.02	2.0	0.02	0.02
Cyanide(Cn)	mg/l	0.1	0.1	0.02	-	0.02	0.02
Sulphate(SO4)	mg/l	400	400	-	-	400	-
Sulphide H2S	mg/l	0.05	0.1	0.002	-	0.002	0.002
Copper(Cu)	mg/l	1.0	1	0.02	0.2	0.02	0.02
Lead(Pb)	mg/l	0.05	0.10	0.03	1.00	0.03	0.03
Sodium Absorption Ratio(SAR)	mg/l	-	-	-	18	18	18
Residual Sodium Carbonate(RSC)	mg/l	-	-	-	1.25-2.50	1.25-2.50	1.25-2.50
Organic Chemical							
Aldrin and Dieldrin	mg/l	0.0007	0.017	-	-	0.017	-
BHC	mg/l	-	-	0.21	-	0.21	0.21
Benzene	mg/l	0.01	-	-	-	-	-
Benzo (a) pyrene	mg/l	0.00001	-	-	-	-	-
Chlodane (total-isomer)	mg/l	0.0003	0.003	-	-	0.003	-
Chloroform	mg/l	0.03	-	-	-	-	-
2,4 - D	mg/l	0.1	-	-	-	-	-
DDT	mg/l	0.03	0.042	0.002	-	0.002	0.002
Endrine	mg/l	-	0.001	0.004	-	0.001	0.004
Phenol	mg/l	-	0.002	0.001	-	0.001	0.001
Detergent	mg/l	0.5	-	-	-	-	-
1,2 - Dichloroethane	mg/l	0.01	-	-	-	-	-
1,1 - Dichloroethane	mg/l	0.0003	-	-	-	-	-
Heptachlor and Heptachlor	mg/l	0.003	0.018	-	-	0.018	-
Carbon Chloroform extract	mg/l	-	0.5	-	-	0.5	-
Hexachlorobenzene	mg/l	0.00001	-	-	-	-	-
Lindane	mg/l	0.004	-	-	-	-	-
Methoxychlor	mg/l	0.03	0.035	-	-	0.035	-
Oil and Grease	mg/l	-	none	1.0	-	none	1.0
Pentachlorophenol	mg/l	0.01	-	-	-	-	-
Organophosphie & Carbamate	mg/l	-	0.1	0.1	-	0.1	0.1
PCB	mg/l	-	none	-	-	none	-
Methylene Blue Active Sustance	mg/l	-	0.5	0.2	-	0.2	0.2
Toxaphene	mg/l	-	0.005	-	-	0.005	-
Total pesticide	mg/l	0.1	-	-	-	-	-
2,4,6-Trichlorophenol	mg/l	0.01	-	-	-	-	-
Organic Substances(KMnO4)	mg/l	10.0	-	-	-	-	-
Microbiologycal							
Faecal coliform bacteria	MPN/100ml	0	2000	-	-	2000	-
Total coliform bacteria	MPN/100ml	3	10,000	-	-	10,000	-
Radioactivity							
Gross Alpha Activity	Bq/l	0.1	0.1	0.1	0.1	0.1	0.1
Gross Beta Activity	Bq/l	1.0	1.0	1.0	1.0	1.0	1.0

Table 6 WATER QUALITY STANDARD IN JAKART CITY

Parameter	Unit	Rank			
		A	B	C	D
Physical					
Odour	-	Odourless	-	-	-
Total Dissolved Solid Substances	mg/l	1000	500	-	1000
Turbidity	NTU	5	-	-	-
Temperature	℃	Air Temp ± 3	Normal	Normal ± 3	Normal
Colur	TCU	15	-	-	-
Taste	-	Tasteless	-	-	-
Electrical Conductivity	umho/cm(25℃)	-	-	-	1000
Chemical					
Inorganic Chemical					
Mercury(Hg)	mg/l	0.001	0.0005	0.002	0.0005
Aluminium(Al)	mg/l	0.2	-	-	-
Arsenic(As)	mg/l	0.05	0.05	0.5	0.05
Boron(B)	mg/l	-	-	-	1.0
Barium(Ba)	mg/l	1.0	1.00	-	-
Iron(Fe)	mg/l	0.3	2.0	-	-
Fluoride(F)	mg/l	0.5	1.5	1.5	-
Cadmium(Cd)	mg/l	0.005	none	0.01	0.01
Cobalt(Co)	mg/l	-	-	-	0.2
Hardness (CaCO3)	mg/l	500	-	-	-
Chloride(Cl)	mg/l	250	250	-	-
Free Chlorine	mg/l	-	-	0.003	-
Hexavalent Chromium (Cr+6)	mg/l	0.05	none	none	0.05
Manganese(Mn)	mg/l	0.1	0.5	-	1.0
Na(alkari salt)	%	-	-	-	40
Sodium(Na)	mg/l	200	-	-	-
Nickel (Ni)	mg/l	-	-	-	0.05
NH4	mg/l	-	0.5	0.02	-
Nitrate-N	mg/l	10.0	5.0	-	-
Nitrite-N	mg/l	1.0	1.0	0.06	-
DO	mg/l	-	≧6.0	>3.0	-
pH		6.5~8.5	6.0~8.5	6.0~8.5	6.0~8.5
Selenium(Se)	mg/l	0.01	0.01	0.05	0.05
Zinc(Zn)	mg/l	5.0	1.0	0.02	1.0
Cyanide(Cn)	mg/l	0.1	0.05	0.01	-
Sulphate(SO4)	mg/l	400	50	-	-
Sulphide H2S	mg/l	0.05	0.1	0.002	-
Copper(Cu)	mg/l	1.0	0.05	0.02	0.1
Lead(Pb)	mg/l	0.05	0.05	0.03	0.05
Sodium Absorption Ratio(SAR)	mg/l	-	-	-	10.0
Residual Sodium Carbonate(RSC)	mg/l	-	-	-	1.25~2.50
Organic Chemical					
Aldrin and Dieldrin	mg/l	0.0007	0.017	-	-
BHC	mg/l	-	-	0.21	-
Benzene	mg/l	0.01	-	-	-
Benzo (a) pyrene	mg/l	0.00001	-	-	-
Chlodane (total-isomer)	mg/l	0.0003	0.003	-	-
Chloroform	mg/l	0.03	-	-	-
2,4 - D	mg/l	0.1	-	-	-
DDT	mg/l	0.03	0.042	0.002	-
Endrine	mg/l	-	0.001	0.004	-
Phenol	mg/l	-	0.002	0.001	-
Detergent	mg/l	0.5	-	-	-
1,2 - Dichloroethane	mg/l	0.01	-	-	-
1,1 - Dichloroethane	mg/l	0.0003	-	-	-
Heptachlor and Heptachlor epoxide	mg/l	0.003	0.018	-	-
Carbon Chloroform extract	mg/l	-	0.5	-	-
Hexachlorobenzene	mg/l	0.00001	-	-	-
Lindane	mg/l	0.004	0.056	-	-
Methoxychlor	mg/l	0.03	0.035	-	-
Oil and Grease	mg/l	-	none	0.5	-
Pentachlorophenol	mg/l	0.01	-	-	-
Organophosphte & Carbamate	mg/l	-	0.1	0.1	-
PCB	mg/l	-	none	-	-
Methylene Blue Active Sustance(surfactant)	mg/l	-	0.5	0.2	-
Toxaphene	mg/l	-	0.005	-	-
Total pesticide	mg/l	0.1	-	-	-
2,4,6-Trichlorophenol	mg/l	0.01	-	-	-
Organic Substances(KMnO4)	mg/l	10.0	-	-	-
Microbiologycal					
Faecal coliform bacteria	MPN/100ml	0	2000	-	-
Total coliform bacteria	MPN/100ml	3.0	10,000	-	-
Radioactivity					
Gross Alpha Activity	Bq/l	0.1	0.1	0.1	0.1
Gross Beta Activity	Bq/l	1.0	1.0	1.0	1.0

Table 7 WATER QUALITY STANDARD IN KABUPATEN BEKASI AND TANGERANG

(1) Kabupaten Bekasi (Number 13, 1995)

Parameter	Unit	Class I	Class II	Class III	Class IV
Phsical					
Temparature		35	38	40	45
Total Dissolved Solid Substances	mg/l	1500	2000	4000	5000
Total Dissolved Solid Suspend	mg/l	100	200	400	500
Chemical					
pH		6.0-9.0	6.0-9.0	6.0-9.0	5.0-9.0
Iron (Fe)	mg/l	1.0	5.0	10.0	20.0
Manganese(Mn)	mg/l	0.5	2.0	5.0	10.0
Barium(Ba)	mg/l	1.0	2.0	3.0	5.0
Copper(Cu)	mg/l	1.0	2.0	3.0	5.0
Zinc(Zn)	mg/l	2.0	5.0	10.0	15.0
Hexavalent Chromium(Cr6+)	mg/l	0.05	0.10	0.50	1.00
Total Chromium(Cr)	mg/l	0.1	0.5	1.0	2.0
Cadmium(Cd)	mg/l	0.01	0.05	0.1	0.5
Mercury(Hg)	mg/l	0.001	0.002	0.005	0.01
Lead(Pb)	mg/l	0.03	0.10	1.00	2.00
Stannum(Sn)	mg/l	1.0	2.0	3.0	5.0
Arsenic(As)	mg/l	0.05	0.1	0.5	1.0
Selenium(Se)	mg/l	0.01	0.05	0.5	1.0
Nickel(Ni)	mg/l	0.1	0.2	0.5	1.0
Cobalt(Co)	mg/l	0.2	0.4	0.6	1.0
Cyanide(Cn)	mg/l	0.02	0.05	0.50	1.00
Sulphide(H2S)	mg/l	0.01	0.05	0.10	1.00
Fluoride(F)	mg/l	1.5	2.0	3.0	5.0
Free Chlorine	mg/l	0.5	1.0	2.0	5.0
NH4-N	mg/l	0.02	1.00	5.00	20.00
NO2-N	mg/l	10.0	20.0	30.0	50.0
NO3-N	mg/l	0.06	1.00	3.00	5.00
BOD5	mg/l	20.0	50.0	150.0	300.0
COD	mg/l	40.0	100.0	300.0	600.0
Methylene Blue Active Substance	mg/l	0.5	5.0	10.0	15.0
Phenol	mg/l	0.01	0.50	1.00	2.00
Grease Oil	mg/l	1.0	5.0	10.0	20.0
Mineral Oil	mg/l	1.0	10.0	50.0	100.0

(2) Kabupaten Tangerang (Number 545/SK 03.a-Perek, 1993)

Parameter	Unit	Class I	Class II	Class III	Class IV
Phsical					
Temparature		35	38	40	45
Total Dissolved Solid Substances	mg/l	1500	2000	4000	5000
Total Dissolved Solid Suspend	mg/l	100	200	400	500
Chemical					
pH		6.0-9.0	6.0-9.0	6.0-9.0	5.0-9.0
Iron (Fe)	mg/l	1.0	5.0	10.0	20.0
Manganese(Mn)	mg/l	0.5	2.0	5.0	10.0
Barium(Ba)	mg/l	1.0	2.0	3.0	5.0
Copper(Cu)	mg/l	1.0	2.0	3.0	5.0
Zinc(Zn)	mg/l	2.0	5.0	10.0	15.0
Hexavalent Chromium(Cr6+)	mg/l	0.05	0.10	0.50	1.00
Total Chromium(Cr)	mg/l	0.1	0.5	1.0	2.0
Cadmium(Cd)	mg/l	0.01	0.05	0.1	0.5
Mercury(Hg)	mg/l	0.001	0.002	0.005	0.01
Lead(Pb)	mg/l	0.03	0.10	1.00	2.00
Stannum(Sn)	mg/l	1.0	2.0	3.0	5.0
Arsenic(As)	mg/l	0.05	0.1	0.5	1.0
Selenium(Se)	mg/l	0.01	0.05	0.5	1.0
Nickel(Ni)	mg/l	0.1	0.2	0.5	1.0
Cobalt(Co)	mg/l	0.2	0.4	0.6	1.0
Cyanide(Cn)	mg/l	0.02	0.05	0.50	1.00
Sulphide(H2S)	mg/l	0.01	0.05	0.10	1.00
Fluoride(F)	mg/l	1.5	2.0	3.0	5.0
Free Chlorine	mg/l	0.5	1.0	2.0	5.0
NH4-N	mg/l	0.02	1.00	5.00	20.00
NO2-N	mg/l	10.0	20.0	30.0	50.0
NO3-N	mg/l	0.06	1.00	3.00	5.00
BOD5	mg/l	20.0	50.0	150.0	300.0
COD	mg/l	40.0	100.0	300.0	600.0
Methylene Blue Active Substance	mg/l	0.5	5.0	10.0	15.0
Phenol	mg/l	0.01	0.50	1.00	2.00
Grease Oil	mg/l	1.0	5.0	10.0	20.0
Mineral Oil	mg/l	1.0	10.0	50.0	100.0

Note : Application of classes I to IV is decided in accordance with the water use conditions defined by class A to D.

Table 8 OVERVIEW OF CHARACTERISTICS OF BASIC SCENARIOS

Item/Variable	Scenario A (high growth)	Scenario B (low growth)	Scenario C (managed growth)
I. General Conditions			
a) Economic growth rate	high (>6.5%)	low (<6.5%)	high (≈6.5%)
b) Unemployment	low	high	low or medium
c) Focus of government policy	high economic growth	high economic growth	equity and environment
d) Government budget	medium	low	high
e) Attitude to subsidies	no	no (can not)	yes
f) Government investments	medium	low	high
g) Income distribution	skewed	skewed	more equal
II. Population			
a) Effect of urban planning	no	no	yes
b) General trend *)	JMDPR - 2nd	JMDPR - 2nd	JMDPR - 3rd
c) Growth of DKI	low	high	medium
d) Growth Botabek	around DKI Jakarta	low	west-east corridor
e) Outside Jabotabek	high	low	high
III. Domestic Water Demands			
a) Cost recovery of PWS	full	full	subsidized
b) Price development	high	high	low
c) Willingness to connect	medium	low	high
IV. Industry			
a) Industry development	high	low	medium or high
b) Per unit water demand	as present	as present	increase of 25 %
c) Industrial pollution loads	high	medium	low
V. Agriculture			
a) Area	<< present	≈ present	<< present
b) Consumption pattern	other / paddy	present	change
c) Government policy	present	present	diversified
d) Production	paddy and vegetables	paddy	intensified and vegetables
e) Water demand	< present	present	<< present
VI. Water Quality			
a) Government policy	present	present	intensified
b) Sewerage / treatment	no	no	yes
c) Discharges	high	medium	low

Note : *) Trend of spatial development according to analyses of Jabotabek Metropolitan Development Plan and Review, Second and Third Planning Report

Source : Jabotabek Water Resources Management Study in 1994

Table 9 FUTURE MUNICIPAL AND INDUSTRIAL WATER DEMAND PROJECTED BY JWRMS

(unit : cu.m/s)

Areas		Scenario	Surface Water Source								Groundwater Source							
			Year								Year							
			1990	1995	2000	2005	2010	2015	2020	2025	1990	1995	2000	2005	2010	2015	2020	2025
Jakarta	North	A	6.6	7.6	8.4	10.8	12.3	13.9	15.3	18.1	7.2	7.5	7.8	7.8	7.7	7.5	7.2	6.6
		B	6.6	7.6	8.4	10.4	11.5	12.8	14.1	16.2	7.2	7.7	8.1	8.3	8.4	8.3	8.1	7.9
		C	6.6	9.1	11.9	18.5	23.9	24.3	24.6	26.2	7.2	7.1	6.7	5.2	3.3	3.0	2.7	2.5
	South	A	2.4	3.0	3.8	5.0	5.9	6.5	7.2	7.9	7.9	8.4	9.0	9.5	9.9	10.3	10.6	11.1
		B	2.4	3.1	4.0	4.8	5.6	6.2	6.7	7.4	7.9	8.5	9.1	9.7	10.1	10.5	10.8	11.2
		C	2.4	4.6	7.0	9.4	12.1	13.2	13.9	15.9	7.9	8.1	8.1	8.2	7.8	7.7	7.7	7.6
	Total	A	9.0	10.6	12.2	15.8	18.2	20.4	22.5	26.0	15.1	15.9	16.8	17.3	17.6	17.8	17.8	17.7
		B	9.0	10.7	12.4	15.2	17.1	19.0	20.8	23.6	15.1	16.2	17.2	18.0	18.5	18.8	18.9	19.1
		C	9.0	13.7	18.9	27.9	36.0	37.5	38.5	42.1	15.1	15.2	14.8	13.4	11.1	10.7	10.4	10.1
Tangerang		A	2.3	3.2	4.4	5.7	7.3	9.0	11.0	12.5	4.4	5.4	6.4	7.4	8.5	9.3	10.1	10.9
		B	2.3	3.0	3.9	4.9	6.0	7.0	8.1	9.0	4.4	5.2	5.9	6.7	7.4	8.0	8.6	9.2
		C	2.3	3.4	4.8	7.3	11.1	15.1	19.1	22.3	4.4	5.6	6.7	7.6	7.9	8.1	8.2	8.4
Bekasi		A	1.6	2.1	2.8	3.7	4.8	5.9	7.4	8.6	3.4	4.3	5.2	6.1	7.0	7.8	8.6	9.2
		B	1.6	2.0	2.5	3.1	3.9	4.6	5.4	6.0	3.4	4.1	4.7	5.4	6.0	6.6	7.2	7.7
		C	1.6	2.2	3.1	4.2	7.4	10.2	13.6	16.2	3.4	4.5	5.5	6.5	6.8	7.1	7.2	7.3
Bogor	North	A	0.4	0.6	1.2	1.7	2.4	3.1	3.7	4.6	1.6	2.1	2.6	3.2	3.7	4.2	4.7	5.0
		B	0.4	0.5	1.0	1.5	1.9	2.4	2.8	3.2	1.6	2.0	2.4	2.8	3.1	3.5	3.8	4.1
		C	0.4	0.7	1.2	1.9	2.7	3.7	4.4	5.3	1.6	1.8	2.1	2.3	2.4	2.4	2.4	2.4
	South	A	0.7	1.2	1.9	2.6	3.5	4.4	5.5	6.5	2.0	2.7	3.5	4.4	5.2	5.9	6.6	7.2
		B	0.7	1.1	1.6	2.3	3.1	3.8	4.7	5.3	2.0	2.6	3.2	3.8	4.4	4.8	5.3	5.6
		C	0.7	1.2	2.0	3.2	5.5	7.5	9.5	10.9	2.0	2.6	3.3	3.7	3.8	3.9	4.0	4.0
	South-west	A	0.3	0.5	0.7	1.0	1.2	1.7	2.0	2.4	1.3	1.6	1.9	2.2	2.5	2.7	3.1	3.3
		B	0.3	0.4	0.6	0.8	1.0	1.2	1.5	1.7	1.3	1.5	1.7	1.9	2.1	2.3	2.5	2.7
		C	0.3	0.5	0.6	0.8	1.4	2.0	2.6	3.3	1.3	1.5	1.8	2.1	2.1	2.2	2.2	2.2
	West	A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.7	0.8	0.9	1.0	1.2	1.3	1.5
		B	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.6	0.7	0.8	0.9	1.0	1.1	1.2
		C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.4
	East	A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.7	0.8	1.0	1.1	1.3	1.5	1.7
		B	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.4
		C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.7	0.8	0.9	1.0	1.2	1.4	1.5
	Total	A	1.4	2.3	3.8	5.3	7.1	9.2	11.2	13.5	6.1	7.8	9.6	11.7	13.5	15.3	17.2	18.7
		B	1.4	2.0	3.2	4.6	6.0	7.4	9.0	10.2	6.1	7.4	8.8	10.2	11.5	12.7	13.9	15.0
		C	1.4	2.4	3.8	5.9	9.6	13.2	16.5	19.5	6.1	7.3	8.8	9.9	10.3	10.8	11.2	11.5
Outside Jabotabek	Serang	A	2.2	3.2	4.3	5.8	7.1	8.7	10.2	11.8	2.6	3.2	4.0	5.1	6.0	6.8	7.5	8.2
		B	2.2	2.9	3.6	4.6	5.4	6.4	7.0	7.7	2.6	3.0	3.5	4.2	4.8	5.3	5.7	6.2
		C	2.2	3.3	4.4	6.9	9.1	12.2	14.3	17.3	2.6	3.2	4.0	4.6	5.0	5.1	5.2	5.3
	Purwakarta/ Karawang	A	1.0	1.5	2.8	4.1	5.5	7.2	8.9	11.0	3.5	4.0	4.7	5.7	6.8	7.7	8.5	9.2
		B	1.0	1.3	2.4	3.3	4.3	5.4	6.3	7.3	3.5	3.8	4.3	4.9	5.5	6.1	6.6	7.1
		C	1.0	1.5	2.9	4.9	7.7	11.4	14.6	18.1	3.5	4.0	4.7	5.4	5.7	5.7	5.6	5.6
Grand Total		A	17.5	22.9	30.3	40.4	50.0	60.4	71.2	83.4	35.1	40.6	46.7	53.3	59.4	64.7	69.7	73.9
		B	17.5	21.9	28.0	35.7	42.7	49.8	56.6	63.8	35.1	39.7	44.4	49.4	53.7	57.5	60.9	64.3
		C	17.5	26.5	37.9	57.1	80.9	99.6	116.6	135.5	35.1	39.8	44.5	47.4	46.8	47.5	47.8	48.2

Table 10 ACTION PROGRAM PROPOSED BY JWRMS

	Scenario C	Scenario A
1994 - 19..	- Feasibility study Western Supply (detailed design) - Feasibility study WTC Upgrading (detailed design) - Feasibility study Canal -2 (detailed design) - Feasibility study Salak countour canal (detailed design) - Feasibility study Genteng - Start conservation program Cisadane : feasibility study - Feasibility studies on better management of Citarum basin	
1995	- Start preparation of construction of Karian and pipe lines to Tangerang - Start upgrading WTC - Start preparation of construction of Canal - 2	- Start upgrading WTC
1997	- Start preparation of construction of salak countour canal	- Start preparation of construction of Salak countour canal - Start preparation of construction of Karian and pipe lines to Tangerang
1999	- Completion of WTC upgrading	- Completion of WTC upgrading
2001	- Completion of Karian and first set of pipelines - Completion of Canal-2 - Start preparation of construction of Genteng reservoir	- Start preparation of construction of Canal-2
2002	- Completion of Salak Countour Canal	- Completion of Salak Countour Canal
2003		- Completion of Karian and first set of pipelines - Start preparation of construction of Genteng reservoir
2005		- Start preparation of construction of Genteng Reservoir
2007	- Completion of Genteng - Start Subsitution DKI - Bekasi	- Completion of Canal-2 - Completion connection Babakan - DKI - Completion connection Babakan - Bogor North
2009	- Start preparation of construction of Cilawang (after feasibility study)	
2011	- Start suplly to Serang from Karian (after feasibility study)	- Completion of Genteng - Start subsitution DKI - Bekasi
2013	- Start preparation of construction of Pasirkopo (after feasibility study)	
2014	- Completion of Cilawang	
ca.2015	- Start preparation of raising Cirata (after feasibility study)	
2016		- Start supply to Serang from Karian
2019	- Completion of Pasirkopo	
ca.2020	- Completion of Raising Cirata	

Source: Final Report, JWRMS, February 1994

Table 11 PRESENT WATER QUALITY CLASSES OF MAIN RIVER SECTIONS

Location	Objectives	Present Situation	Declassifying Group of Parameters
1. Cisadane River			
• Upstream to Confluence with Cianten River	Class B	Out of Class	suspended solid, nutrients, organic matters
• Confluence with Cianten River to Serpong Water Treatment Plant	Class B	Class D	suspended solid, nutrients, organic matters
• Serpong Water Treatment Plant to Pasar Baru	Class B	Out of Class	suspended solid, toxics, bacteriology
• Pasar Baru Weir to Kali Baru	Class C	Out of Class	toxics, bacteriology
• Kali Baru to Java Sea	Class C	Class D	all groups
2. Cikaniki River			
• Upstream	Class B	Class B	all parameters except toxics
• Cikaniki Bridge to Confluence with Cianten River	Class B	Class C	all parameters except toxics
3. Cianten River			
• Leuwiliang to Confluence with Cisadane River	Class B	Class C	organic matters, suspended solids, bacteriology

Source : Inception Report, Jabotabek Water Quality Management Plan - II, October 1994

Note : Class A : Water that may be used directly as drinking water without any treatment
Class B : Water that may be used as raw water for drinking water
Class C : Water that may be used as raw water for fisheries and livestock
Class D : Water that may be used as raw water for agricultural purposes and small business in cities, industries and hydroelectric power generation

Table 12 TEMPORARY WATER QUALITY STANDARD PREPARED BY WQMJ

Group	Parameters	Unit	Clsss (Worst Value Allowed)				
			A	B	C	D	Out
Group 1	Water Temperature	•C					
	Dissolved Oxygen (DO)	mg/l	7	6	3	< 3	< 3
	pH	-	-	-	-	-	-
	BOD	mg/l	3	5	10	25	> 25
	Total Nitrogen	mg/l	1	2	3	> 3	> 3
	Permanganate Values	-	-	-	-	-	-
	COD	mg/l	10	25	40	80	> 80
	NH4	mg/l	0.1	0.16	0.33	1.63	1.63
	N-NO3	mg/l	10	10	10 to 20	20 to 30	30
	N-NO2	mg/l	1	1	1.2	2	> 2
	Soluble Phosphorus	mg/l	-	-	-	-	-
	Total Phosphorus	mg/l	0.1	0.25	0.5	2.5	> 2.5
	Total Suspended Solid	mg/l	25	25	25.7	70.150	>150
	Detergent	mg/l	0.15	0.15	0.2	5	> 5
	Conductivity	NTU	-	-	-	-	-
Group 2	Fluoride (F)	mg/l	0.5	1.5	1.5	-	-
	Cadmium (Cd)	mg/l	0.005	0.001	0.001	0.001	> 0.025
	Copper (Cu)	mg/l	1	1	0.02	0.2	-
	Lead (Pb)	mg/l	0.05	0.05	0.08	1	-
	Chromium (Cr)	mg/l	0.05	0.05	0.05	-	-
	Cyanide (CN)	mg/l	0.1	0.1	0.02	-	-
	Mercury (Hg)	mg/l	0.001	0.001	0.002	0.005	-
	Boron	mg/l	-	-	-	-	-
	Sulfide (H2S)	mg/l	-	-	-	-	-
	Zinc (Zn)	mg/l	-	-	-	-	-
Group 3	Chloride (Cl-)	mg/l	250	600	600	1000	1000
	Iron (Fe)	mg/l	0.3	5	5	-	-
	Fluoride (F)	mg/l	0.5	1.5	1.5	-	-
	Manganese (Mn)	mg/l	0.1	0.5	2	-	-
	Phenol	mg/l	0.001	0.002	0.05	0.5	> 0.5
	Sulfate (SO4)	mg/l					
	Surfactant	mg/l					
Group 4	CO2	mg/l	-	-	-	-	-
	Oxydability (KMnO4)	mg/l	10	20	40	100	100
	Nitrite (NO2-N)	mg/l					
	Total Hardness	mg/l	< 15	15 to 30	30 to 50	50 to 100	> 100
	Color	-	10	50	100	200	-
	Chloride (Cl-)	mg/l	250	600	600	1000	1000
	Iron (Fe)	mg/l	-	-			
	Manganese (Mn2+)	mg/l	-	-			
	Detergent	mg/l	0.15	0.15	0.2	5	> 5
	Fluoride (F)	mg/l	0.5	1.5	1.5	-	-
	Sulfate (SO4)	mg/l	400	400	400	-	-
	Conductivity						
Group 5	Faecal Coliform	MPN/100 ml	0	2000	20000	> 20000	> 20000
	Total Coliform	MPN/100 ml	3	10000	50000	> 50000	> 50000
	Steptococcus	MPN/100 ml	20	1000	1000	10000	> 10000

Note :

Group 1 : Routine monitoring for organic pollution detection

Group 2 : Industrial area monitoring

Group 3 : Raw water source monitoring for drinking water supply

Group 4 : Groundwater quality monitoring

Group 5 : Microbiological parameters monitoring

Source : Final Report, The study on Water Quality Management in Jabiotabek - Phase I, November 1991

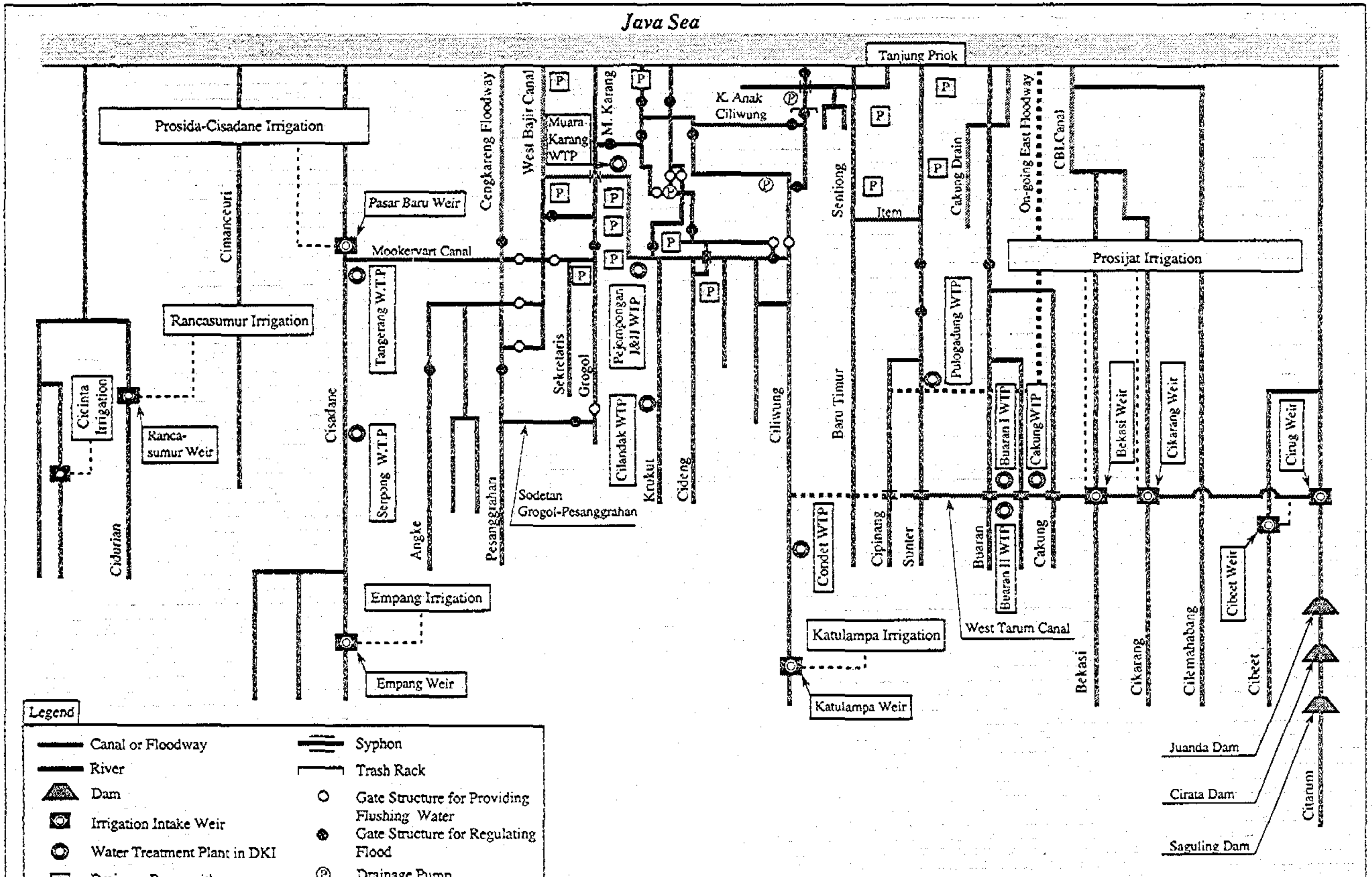
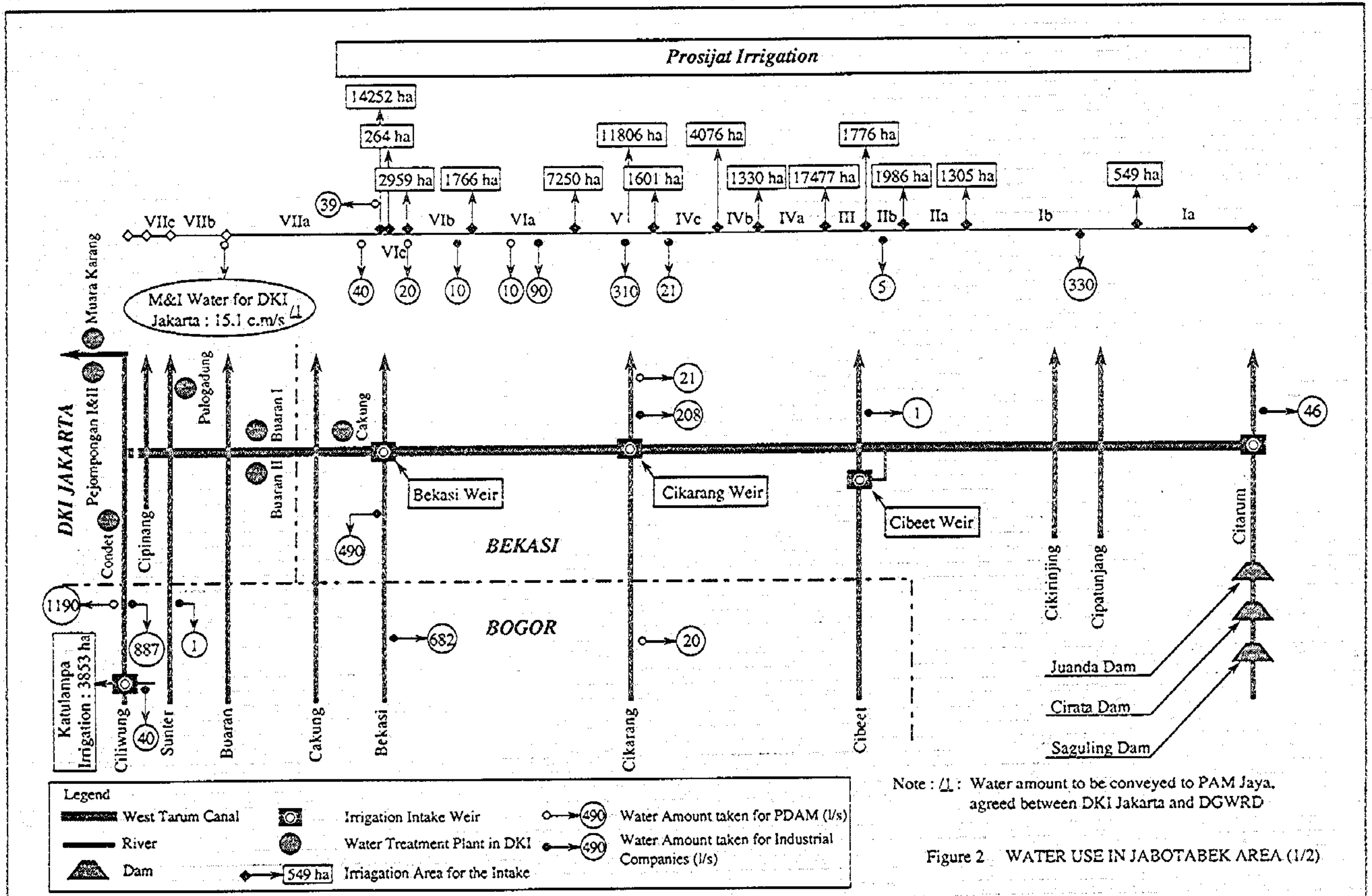


Figure 1 EXISTING FLOOD CONTROL AND WATER USE FACILITIES IN JABOTABEK AREA



Note : /1 : Water amount to be conveyed to PAM Jaya, agreed between DKI Jakarta and DGWRD

Figure 2 WATER USE IN JABOTABEK AREA (1/2)

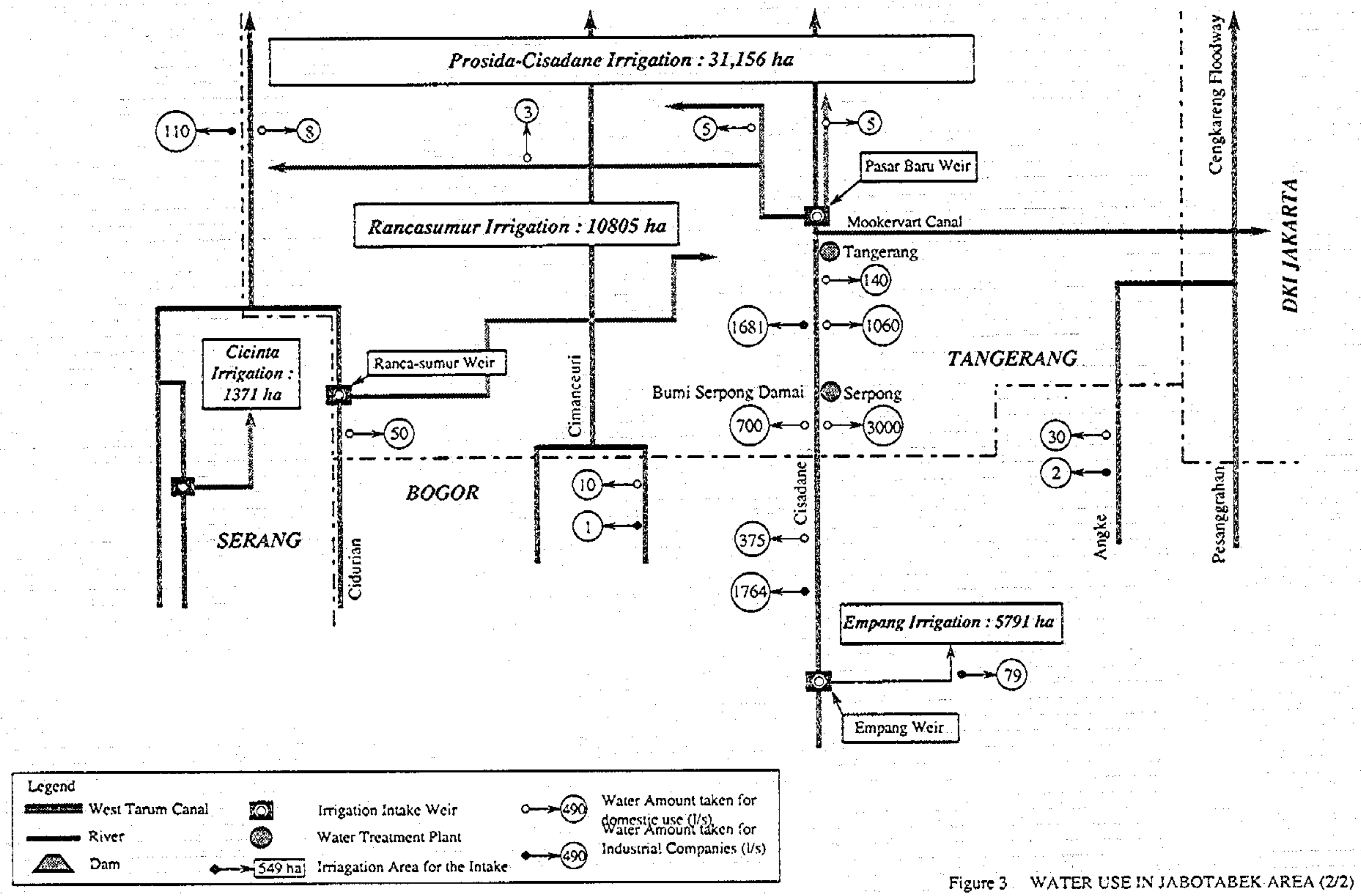


Figure 3 WATER USE IN JABOTABEK AREA (2/2)

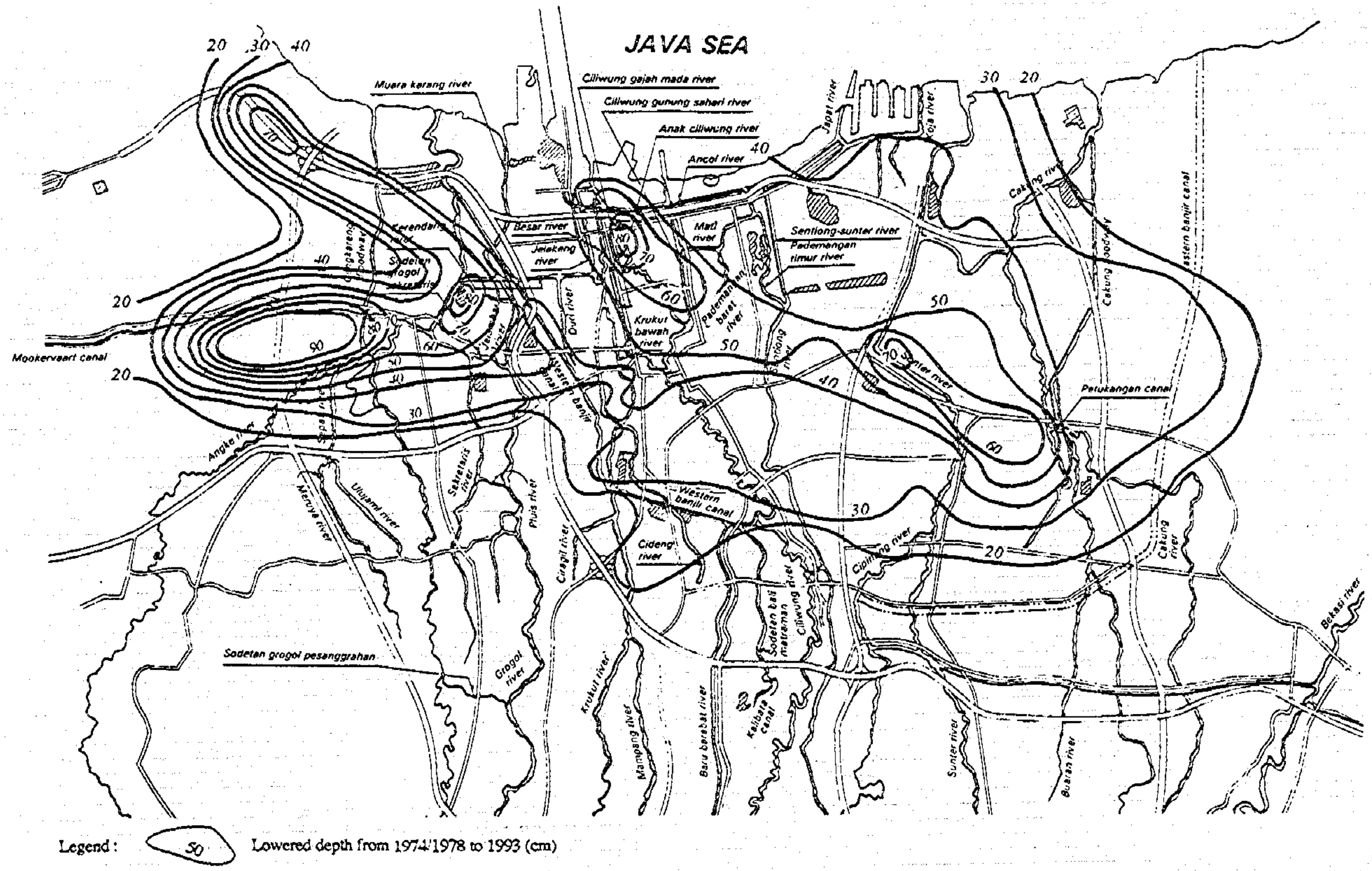
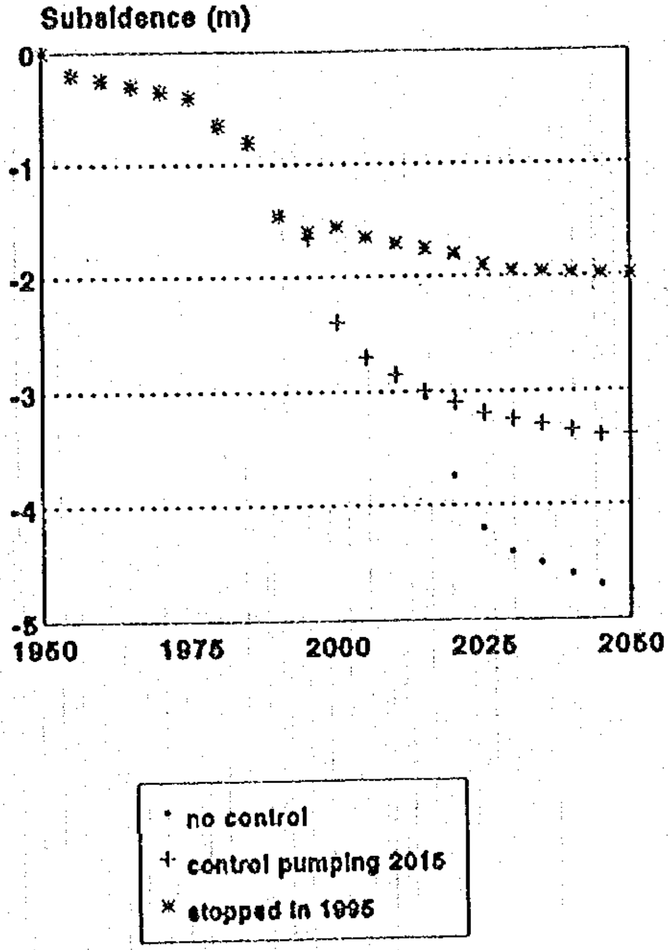
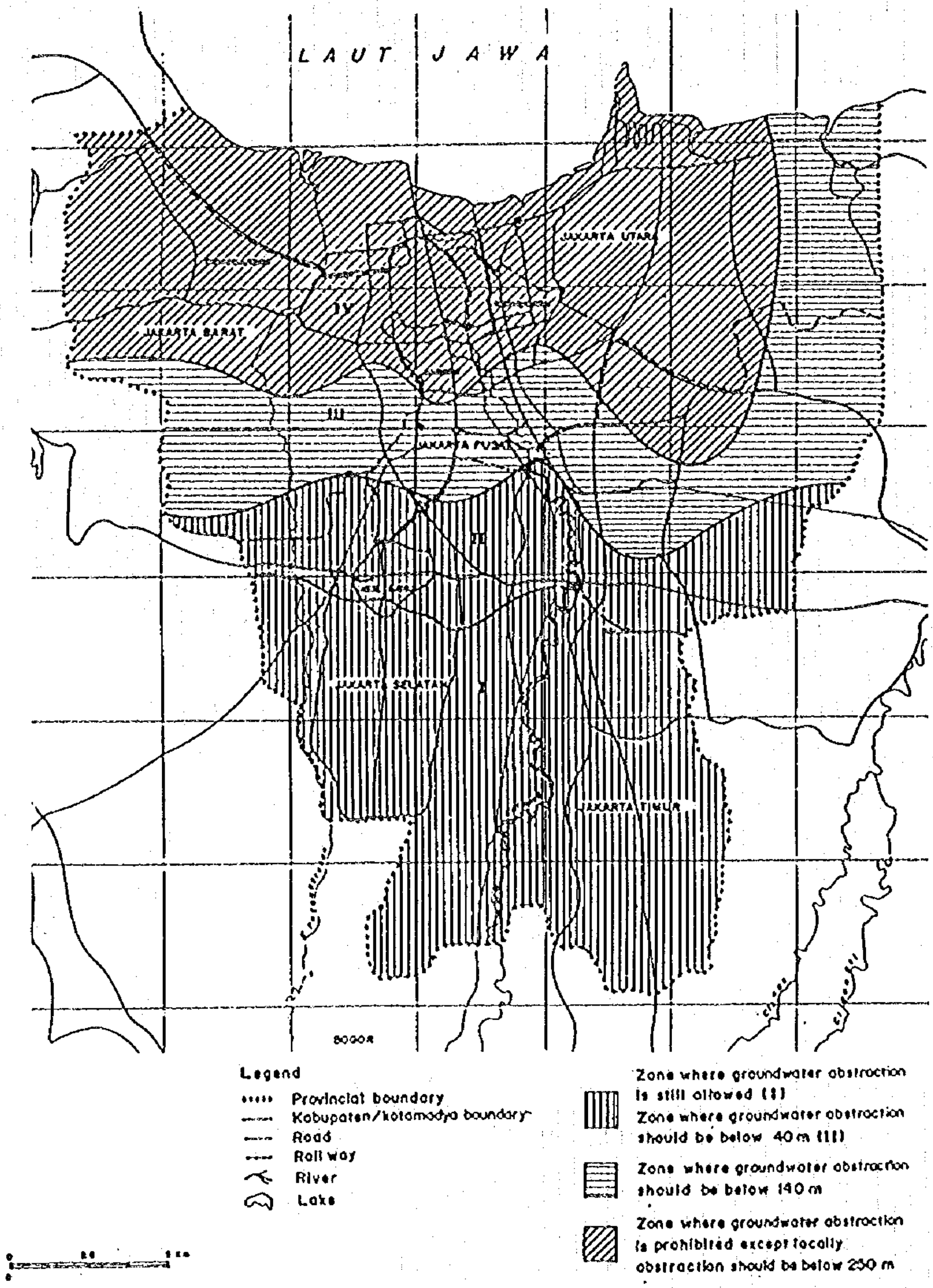


Figure 4 LAND SUBSIDENCE IN NORTHERN PART OF DKI JAKARTA



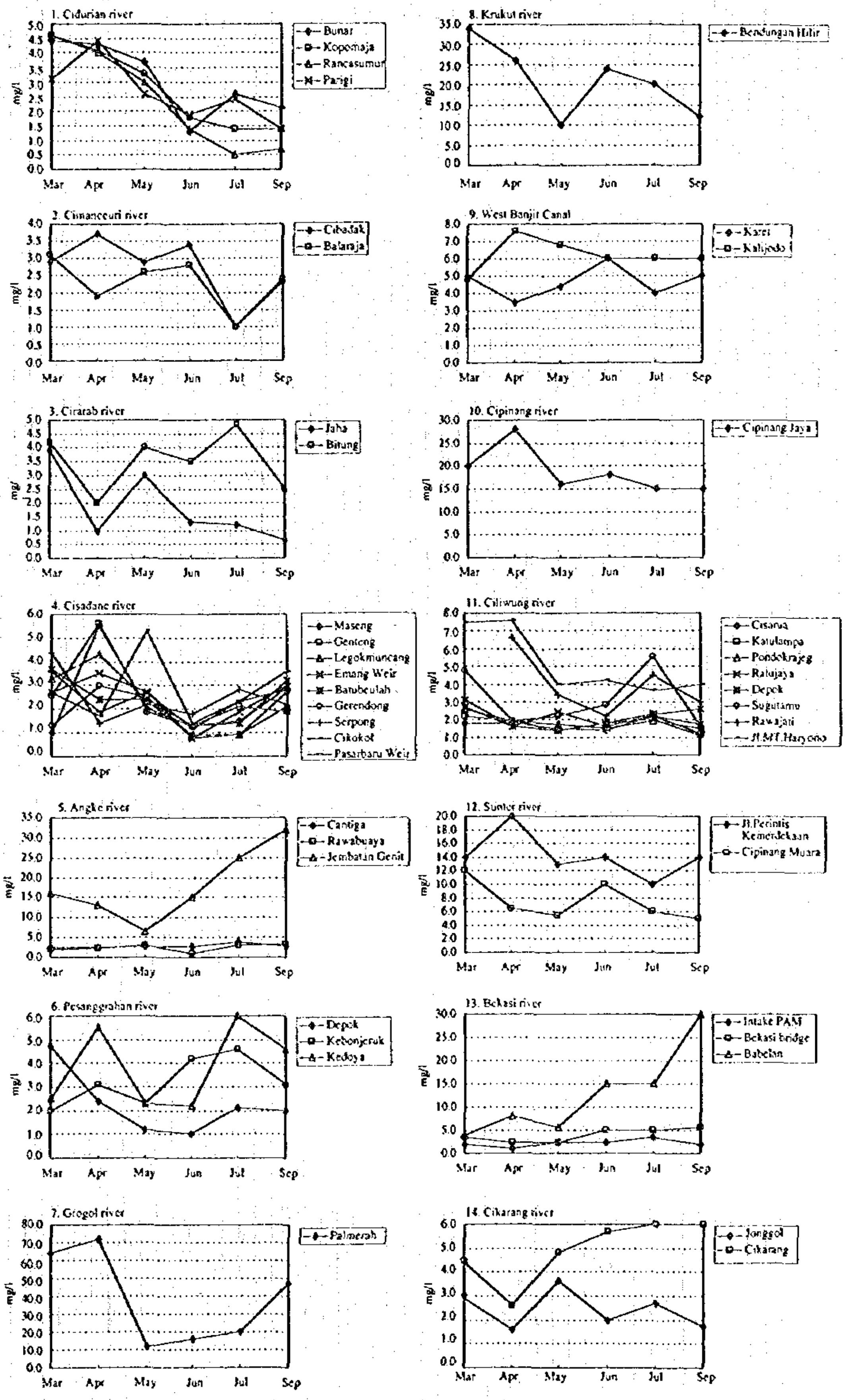
Source : Final Report, JWRMS, February 1994

Figure 5 PREDICTED LAND SUBSIDENCE IN THE MOST VULNERABLE ZONES IN NORTHERN DKI JAKARTA



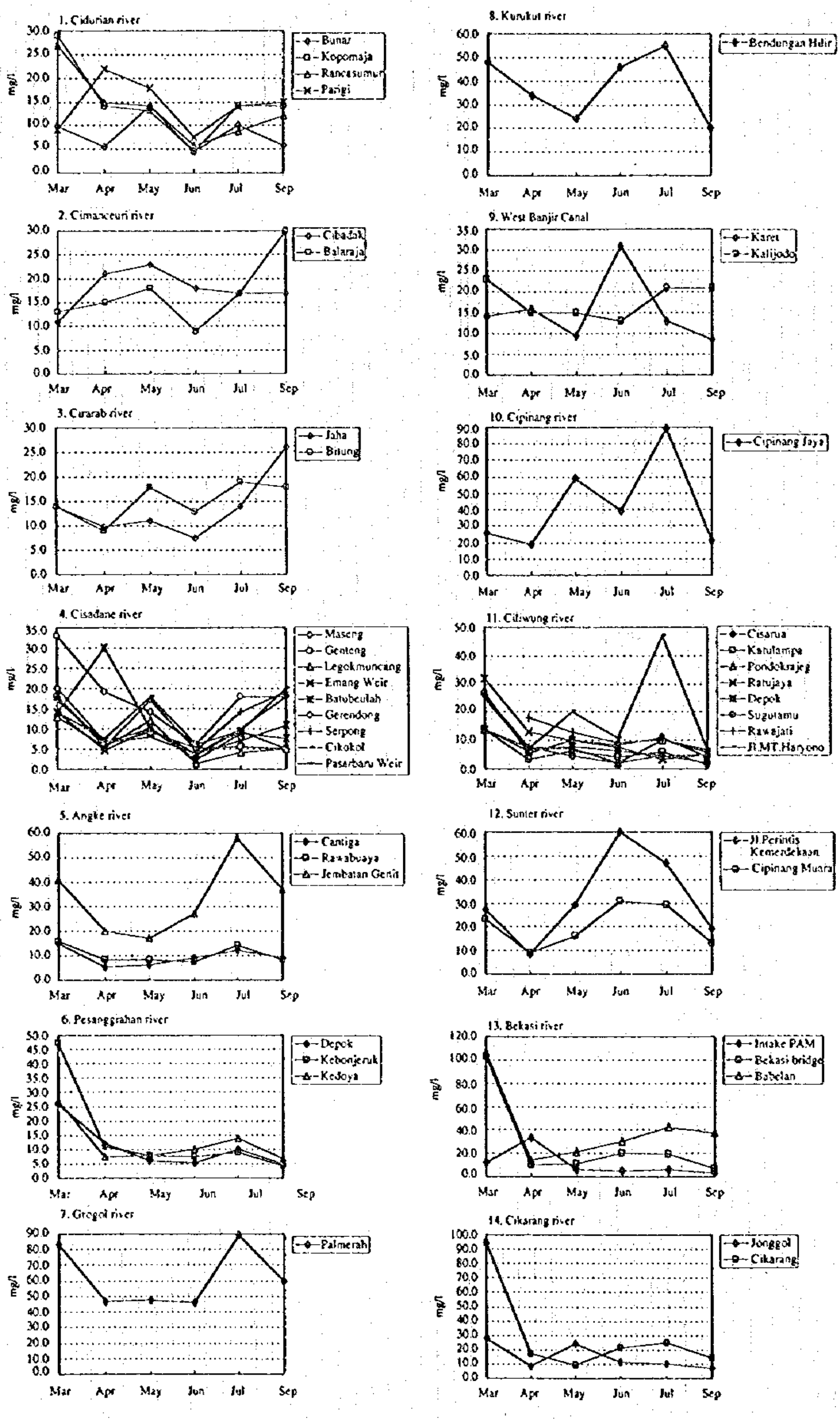
Source : Final Report, JWRMS, February 1994

Figure 6 GROUNDWATER CONSERVATION ZONES ACCORDING TO DEG 1991



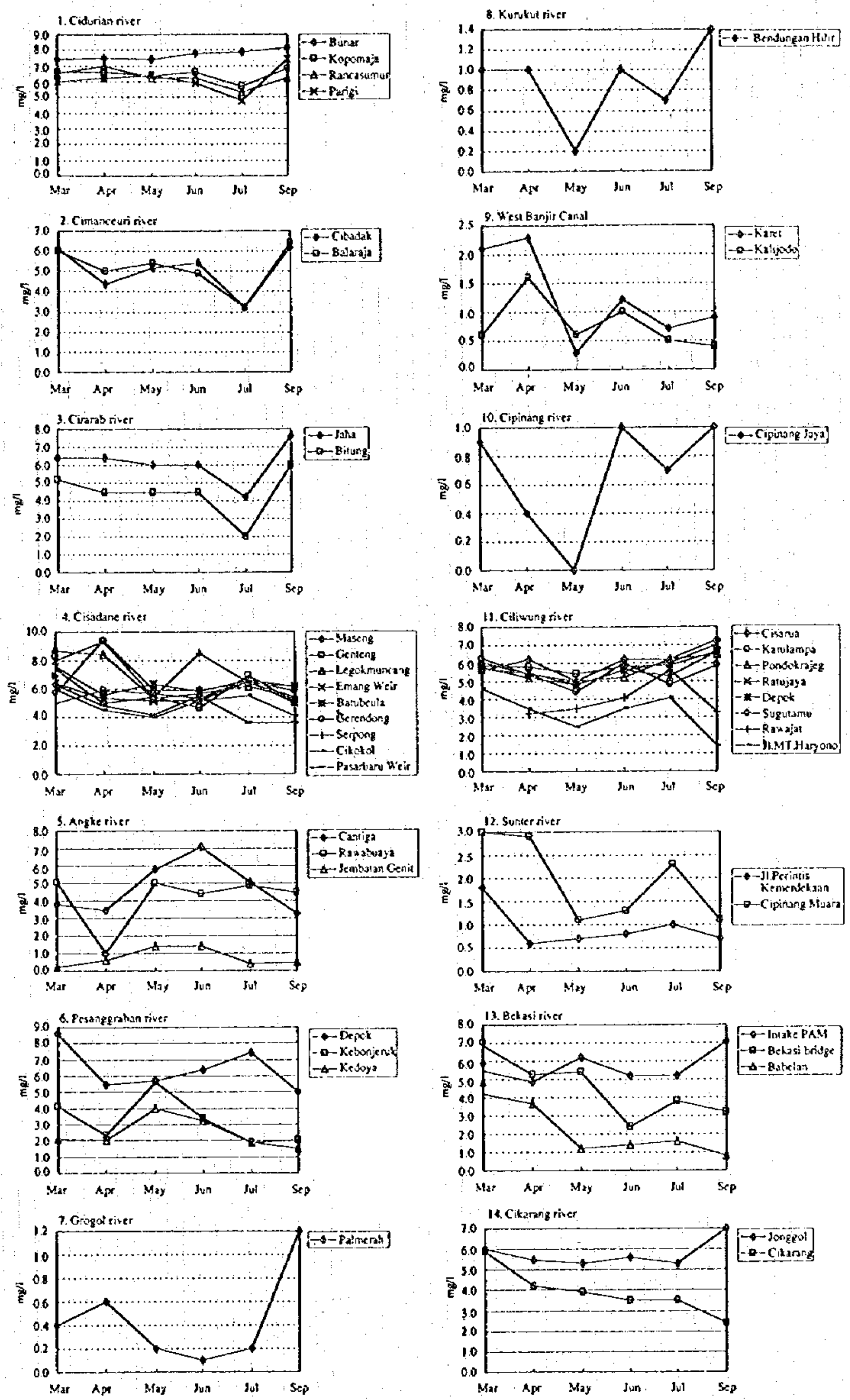
Source: WATER QUANTITY AND WATER QUALITY INVESTIGATION

Figure 8 BIOLOGICAL OXYGEN DEMAND (BOD) OF RIVER WATER IN JABOTABEK AREA



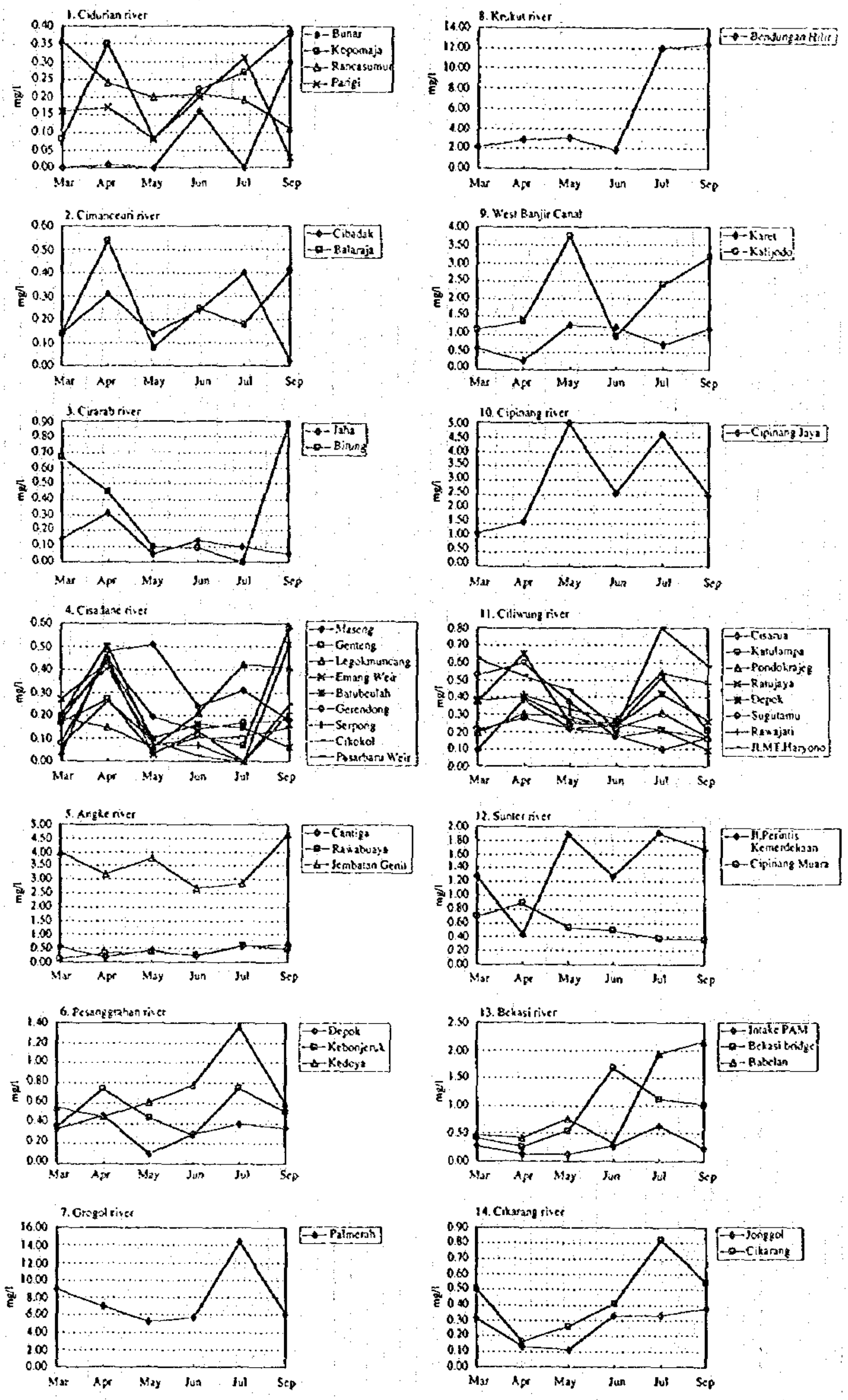
Source: WATER QUANTITY AND WATER QUALITY INVESTIGATION

Figure 9 CHEMICAL OXYGEN DEMAND (COD) OF RIVER WATER IN JABOTABEK AREA



Source. WATER QUANTITY AND WATER QUALITY INVESTIGATION

Figure 10 DISSOLVED OXYGEN (DO) OF RIVER WATER IN JABOTABEK AREA



Source: WATER QUANTITY AND WATER QUALITY INVESTIGATION

Figure 11 AMMONIUM (NH 4) OF RIVER WATER IN JABOTABEK AREA

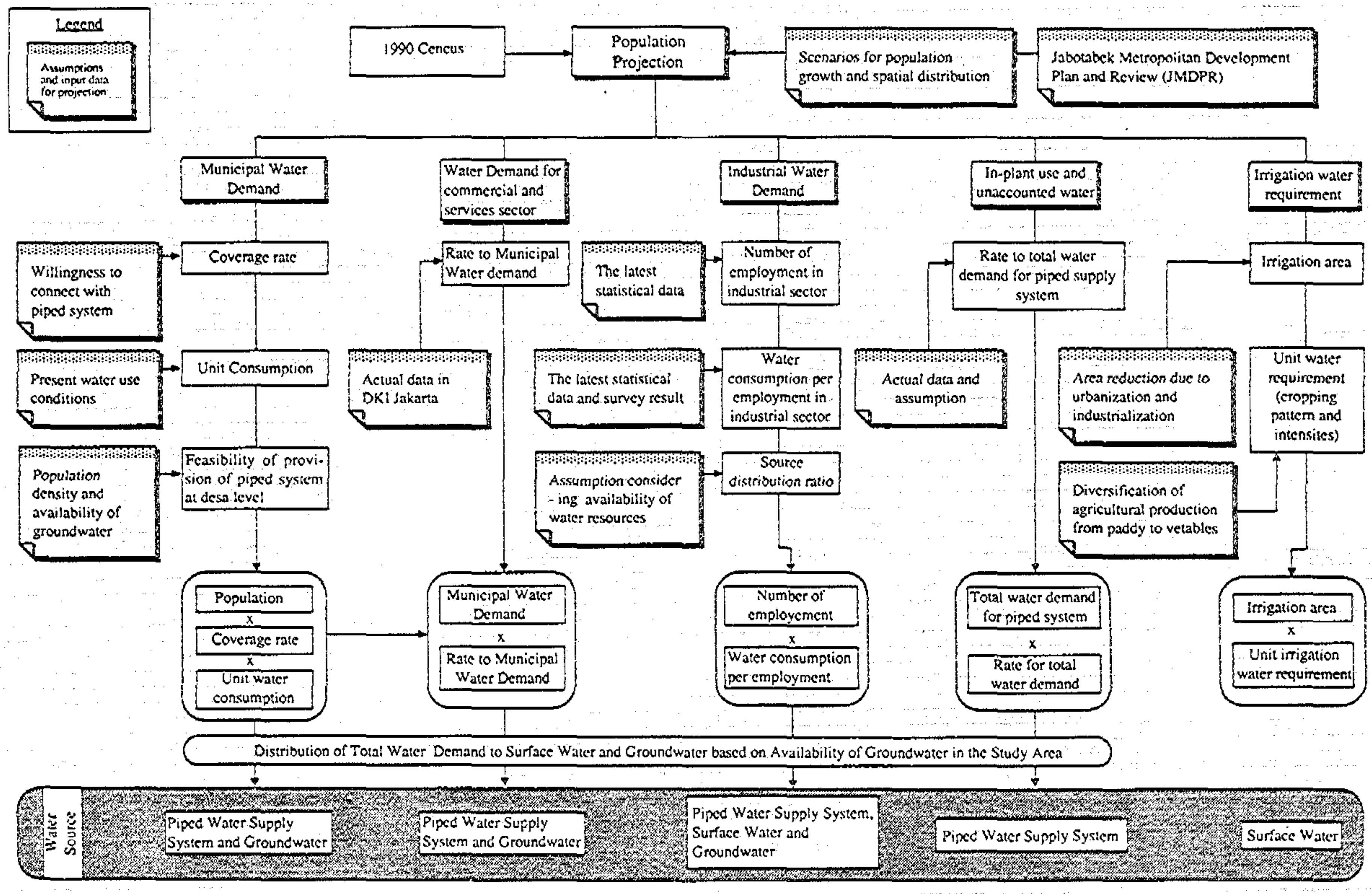
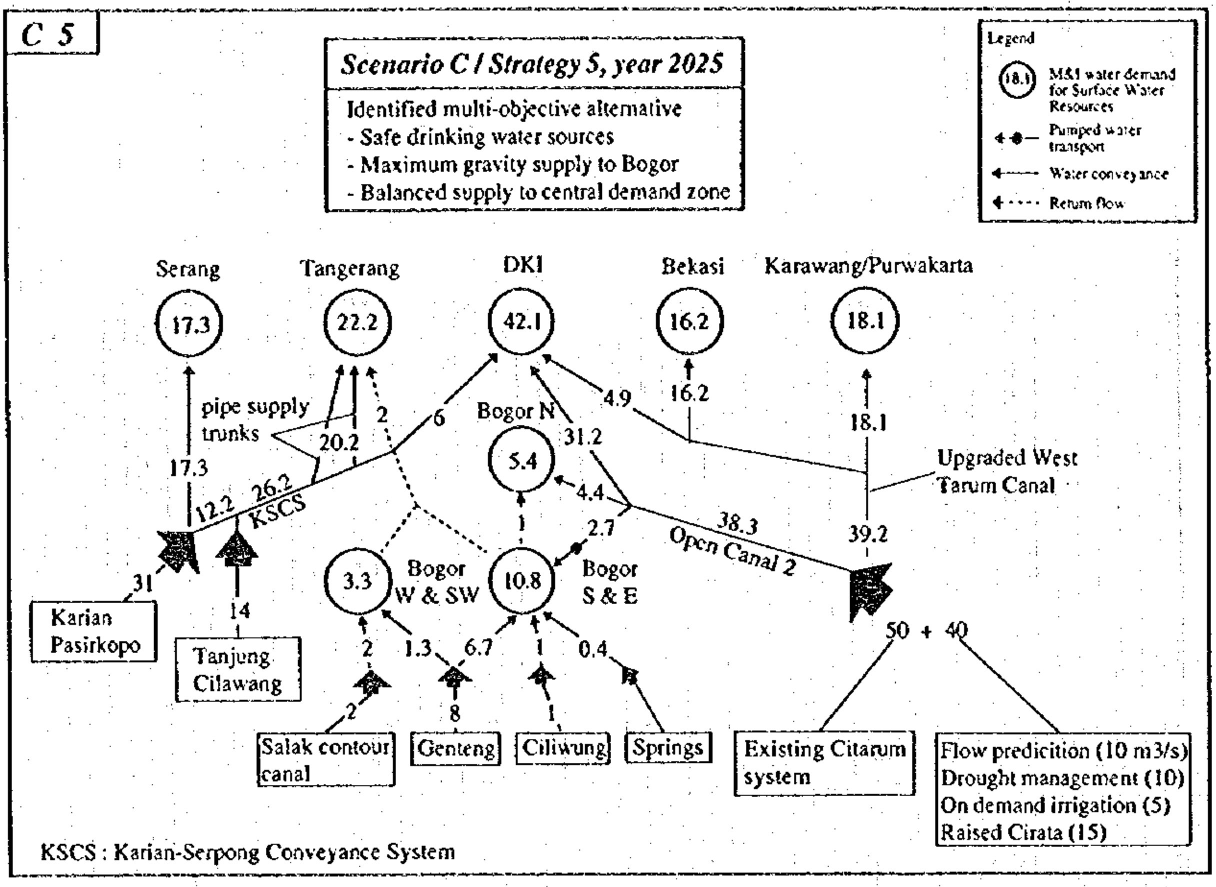


Figure 13 DATA AND METHOD OF WATER DEMAND PROJECTION BY JWRMS



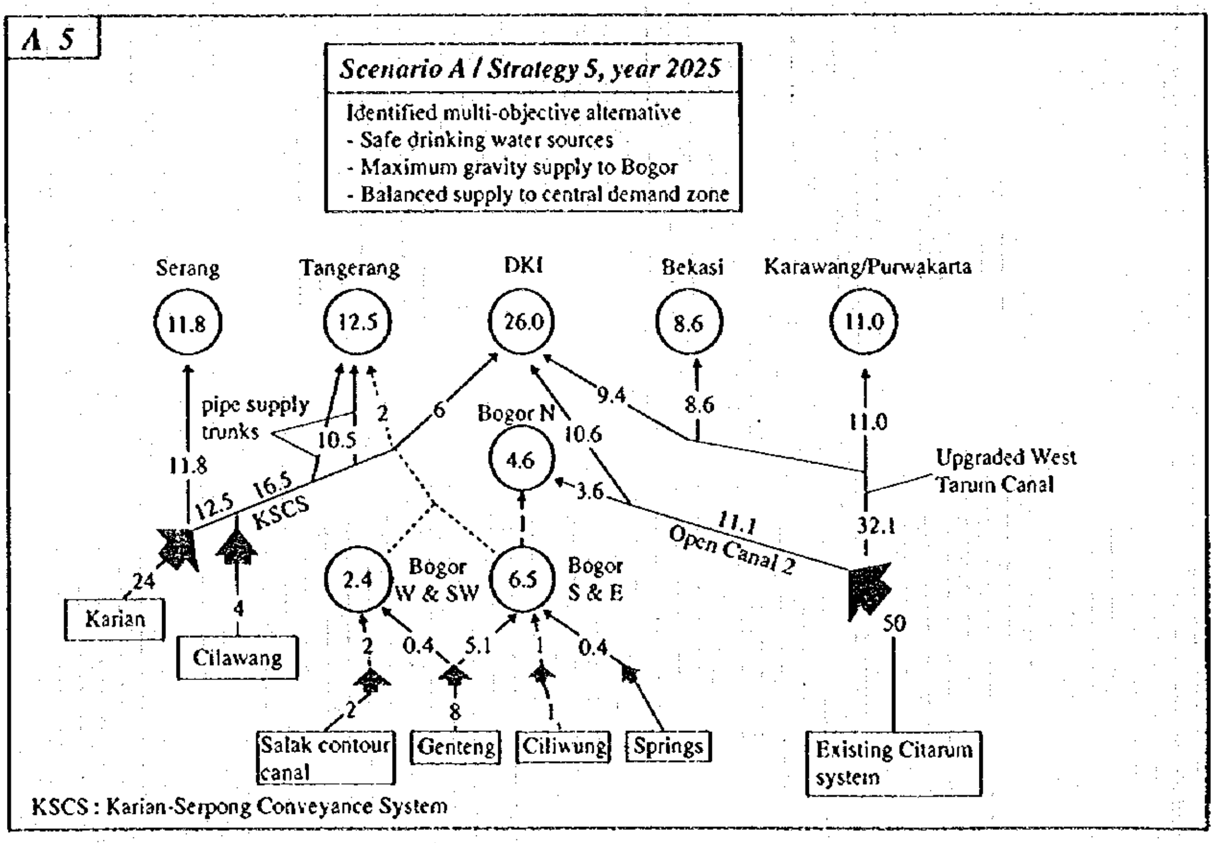
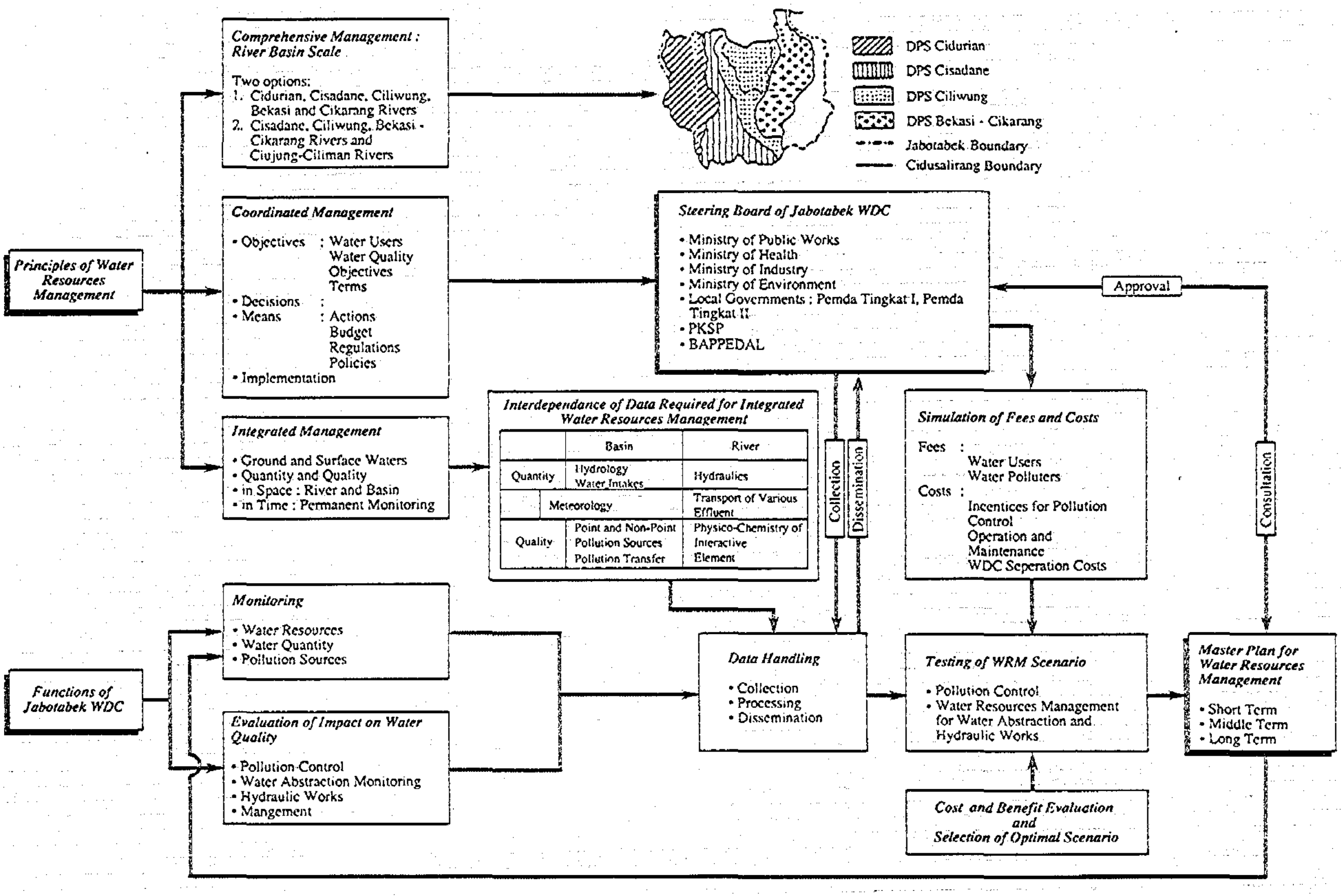
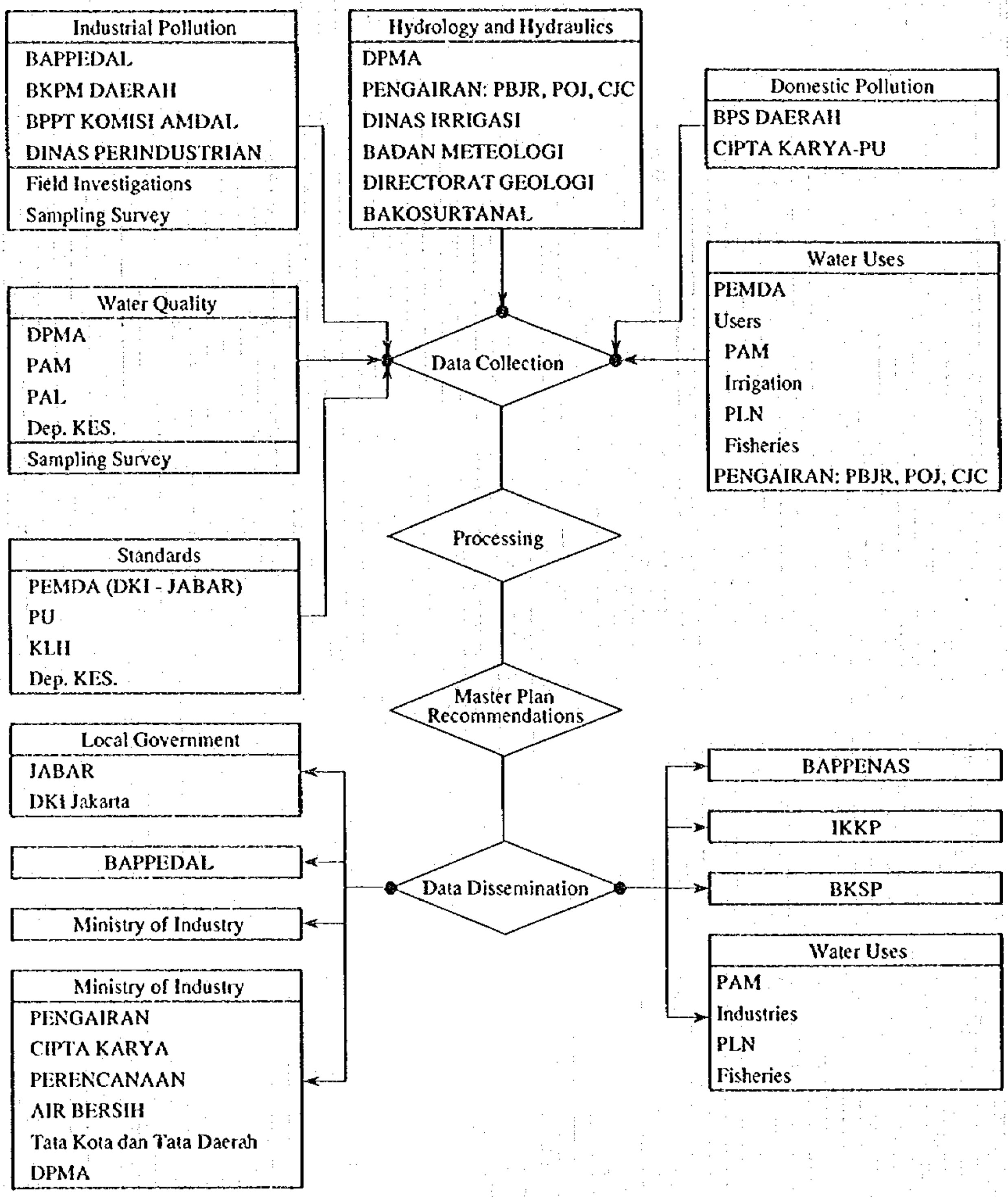


Figure 14 SURFACE WATER RESOURCES DEVELOPMENT STRATEGY PROPOSED BY JWRMS



Source : Inception Report, Jabotabek Water Quality Management Plan-II, October 1994

Figure 15 PRINCIPLES AND FUNCTIONS OF JABOTABEK WATER DATA CENTER



Source : Inception Report, Jabotabek Water Quality Management Plan-II, October 1994

Figure 16 AGENCIES CONCERNED WITH WATER DATA

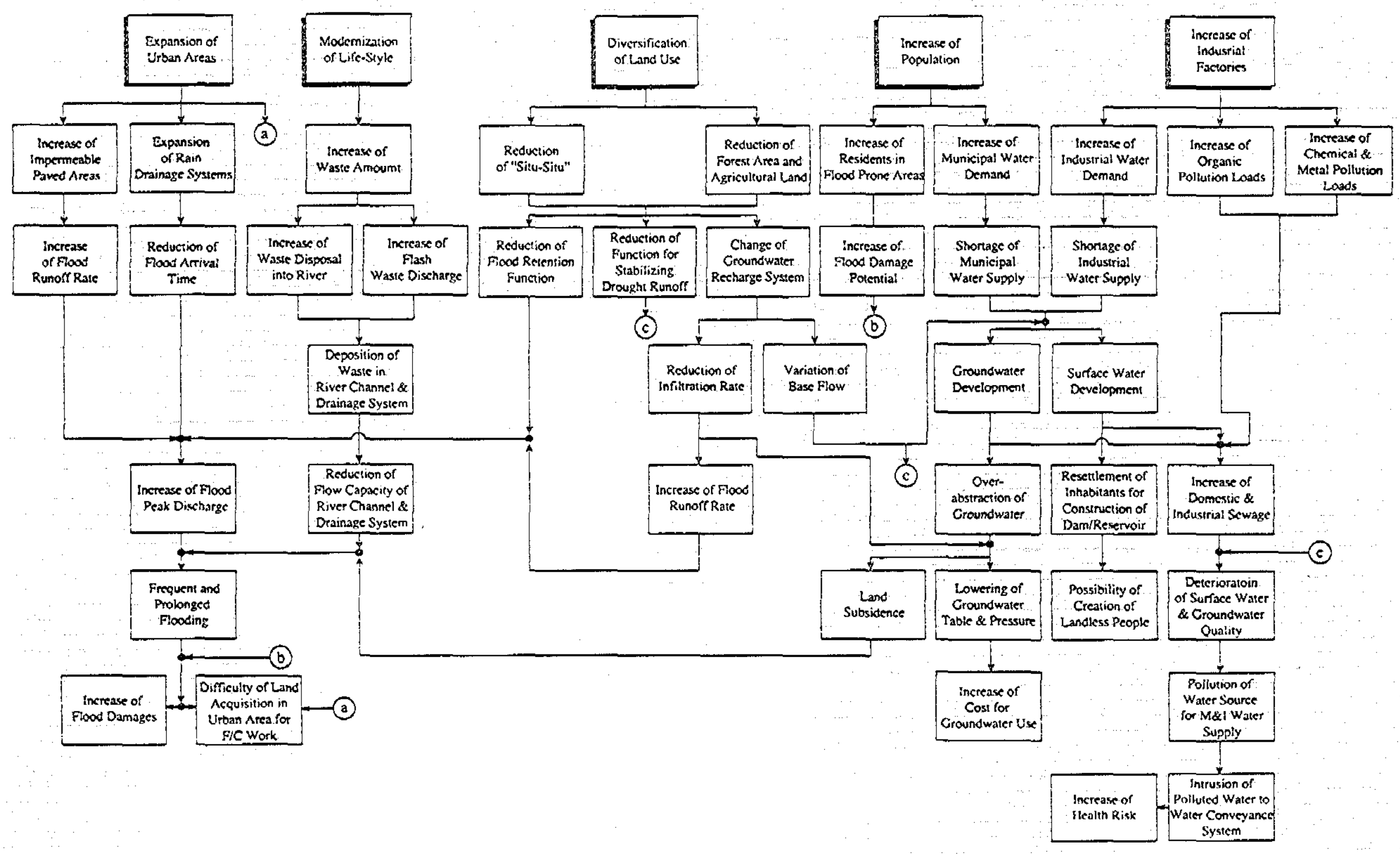


Figure 17 SIGNIFICANT PROBLEMS IN MANAGEMENT OF RIVER WATER

Attachment

Result of Leveling Survey for Bench Marks by DINAS DPU DKI Jakarta

Bench Marks	Elevation (m) 74/78 (1)	89/90 (2)	91/92 (3)	93/94 (4)	Difference (m) between (2) - (1)	(3) - (1)	(4) - (1)	(3) - (2)	(4) - (3)
PP. 001	1.813				-	-	-	-	-
PP. 001.A		1.863	1.855		-	-	-	-0.008	-
PP. 002	2.071	1.854	1.845		-0.217	-0.225	-	-0.008	-
PP. 008	2.337	2.201	2.191		-0.135	-0.146	-	-0.010	-
PP. 011	2.383	2.238	2.228		-0.145	-0.155	-	-0.010	-
PP. 012	2.442	2.339	2.329		-0.103	-0.113	-	-0.010	-
PP. 013	2.498				-	-	-	-	-
PP. 013.A		1.858	1.849		-	-	-	-0.009	-
PP. 014	3.359	2.943	2.935		-0.415	-0.424	-	-0.009	-
PP. 015	1.655	1.323	1.315		-0.332	-0.340	-	-0.008	-
PP. 016	1.513				-	-	-	-	-
PP. 016.A		2.003	1.995		-	-	-	-0.007	-
PP. 017	2.240	2.037	2.030		-0.203	-0.211	-	-0.007	-
PP. 025	1.716	1.386	1.377		-0.330	-0.340	-	-0.009	-
PP. 027	2.738	2.580	2.569		-0.158	-0.169	-	-0.011	-
PP. 028	2.020			1.876	-	-	-0.144	-	-
PP. 030	2.061	1.923	1.913		-0.138	-0.148	-	-0.010	-
PP. 031	2.262	2.115	2.104		-0.148	-0.158	-	-0.010	-
PP. 033	3.299	3.192	3.182		-0.107	-0.118	-	-0.011	-
PP. 036	3.733				-	-	-	-	-
PP. 036.A		3.338	3.327		-	-	-	-0.011	-
PP. 037	3.489			3.245	-	-	-0.244	-	-
PP. 038	2.390				-	-	-	-	-
PP. 038.A		2.431	2.419		-	-	-	-0.012	-
PP. 039	2.158	1.792	1.781		-0.366	-0.377	-	-0.011	-
PP. 040	1.847	1.388	1.378		-0.459	-0.469	-	-0.010	-
PP. 042	2.577			2.174	-	-	-0.403	-	-
PP. 045	3.816				-	-	-	-	-
PP. 045.A		3.377	3.364		-	-	-	-0.013	-
PP. 046	3.772			3.462	-	-	-0.310	-	-
PP. 049	3.643				-	-	-	-	-
PP. 049.A		3.165	3.154		-	-	-	-0.011	-
PP. 050	3.052				-	-	-	-	-
PP. 050.A		3.205	3.193		-	-	-	-0.012	-
PP. 053	3.103				-	-	-	-	-
PP. 053.A		3.112	3.101		-	-	-	-0.012	-
PP. 054	2.601	2.499	2.488		-0.102	-0.113	-	-0.011	-
PP. 055	2.384	2.291	2.280		-0.093	-0.104	-	-0.011	-
PP. 056	1.941	1.839	1.828		-0.102	-0.113	-	-0.011	-
PP. 057	2.231	2.149	2.137		-0.083	-0.094	-	-0.011	-
PP. 058	2.176	2.085	2.074		-0.092	-0.103	-	-0.011	-
PP. 059	2.449	2.343	2.332		-0.106	-0.117	-	-0.011	-
PP. 060	2.722	2.606	2.594		-0.117	-0.128	-	-0.011	-
PP. 061	2.965	2.822	2.811		-0.143	-0.155	-	-0.011	-
PP. 064	5.879			5.740	-	-	-0.139	-	-
PP. 065	5.091				-	-	-	-	-
PP. 065.A		4.882	4.870		-	-	-	-0.012	-
PP. 066	4.577	4.411	4.399		-0.166	-0.178	-	-0.012	-
PP. 067	3.543	3.412	3.400		-0.131	-0.143	-	-0.012	-
PP. 068	3.461				-	-	-	-	-
PP. 068.A		3.096	3.048		-	-	-	-0.048	-
PP. 070	4.367			3.970	-	-	-0.397	-	-
PP. 070.A		3.953	3.939		-	-	-	-0.014	-
PP. 071	2.688				-	-	-	-	-
PP. 071.A		3.770	3.754		-	-	-	-0.015	-
PP. 080	4.808	4.273	4.257		-0.534	-0.551	-	-0.016	-
PP. 081	4.113				-	-	-	-	-

Result of Leveling Survey for Bench Marks by DINAS DPU DKI Jakarta

Bench Marks	Elevation (m) 74/78 (1)	89/90 (2)	91/92 (3)	93/94 (4)	Difference (m) between (2) - (1)	(3) - (1)	(4) - (1)	(3) - (2)	(4) - (3)
PP. 081.A		4.916	4.898		-	-	-	-0.018	-
PP. 085	4.535				-	-	-	-	-
PP. 085.A		3.124	3.112		-	-	-	-0.012	-
PP. 086	5.320				-	-	-	-	-
PP. 086.A		4.799	4.788		-	-	-	-0.012	-
PP. 087	5.806				-	-	-	-	-
PP. 087.A		4.703	4.691		-	-	-	-0.012	-
PP. 088	4.909	4.708	4.696		-0.201	-0.214	-	-0.012	-
PP. 089	4.874	4.538	4.526		-0.336	-0.348	-	-0.012	-
PP. 090	6.152				-	-	-	-	-
PP. 090.A		5.821	5.808		-	-	-	-0.013	-
PP. 095	4.309				-	-	-	-	-
PP. 095.A		4.723	4.704		-	-	-	-0.019	-
PP. 119	4.304			3.045	-	-	-1.259	-	-
PP. 126	1.678				-	-	-	-	-
PP. 126.A		1.125	1.111		-	-	-	-0.013	-
PP. 127	0.806				-	-	-	-	-
PP. 127.A		1.384	1.371		-	-	-	-0.013	-
PP. 128	1.251				-	-	-	-	-
PP. 128.A		1.140	1.127		-	-	-	-0.013	-
PP. 129	1.222				-	-	-	-	-
PP. 129.A		0.542	0.528		-	-	-	-0.013	-
PP. 130	2.811	2.276	2.262		-0.535	-0.549	-	-0.014	-
PP. 131	2.906				-	-	-	-	-
PP. 131.A		2.412	2.399		-	-	-	-0.013	-
PP. 135	2.054				-	-	-	-	-
PP. 135.A		1.228	1.216		-	-	-	-0.013	-
PP. 137	1.603				-	-	-	-	-
PP. 137.A		2.228	2.216		-	-	-	-0.012	-
PP. 142	1.848	1.451	1.441		-0.397	-0.407	-	-0.009	-
PP. 143	2.876				-	-	-	-	-
PP. 143.A		2.786	2.779		-	-	-	-0.008	-
PP. 144	2.142	1.725	1.720		-0.417	-0.422	-	-0.006	-
PP. 145	3.052	2.681	2.677		-0.371	-0.374	-	-0.004	-
PP. 146	1.234				-	-	-	-	-
PP. 146.A		1.874	1.872		-	-	-	-0.002	-
PP. 147	1.366				-	-	-	-	-
PP. 147.A		2.674	2.666		-	-	-	-0.008	-
PP. 201	3.986	3.380	3.363		-0.606	-0.622	-	-0.017	-
PP. 202	5.417				-	-	-	-	-
PP. 202.A		3.477	3.460		-	-	-	-0.017	-
PP. 208	4.014	3.482	3.465		-0.532	-0.549	-	-0.017	-
PP. 209	5.741				-	-	-	-	-
PP. 209.A		5.833	5.816		-	-	-	-0.017	-
PP. 210	4.925	4.308	4.291		-0.617	-0.634	-	-0.017	-
PP. 211	7.956	7.334	7.316		-0.623	-0.640	-	-0.017	-
PP. 212	5.417	4.807	4.788		-0.610	-0.630	-	-0.020	-
PP. 213	5.761	5.131	5.112		-0.631	-0.649	-	-0.018	-
PP. 214	6.309				-	-	-	-	-
PP. 214.A		6.314	6.297		-	-	-	-0.017	-
PP. 215	6.938				-	-	-	-	-
PP. 215.A		7.628	7.615		-	-	-	-0.013	-
PP. 216	6.670				-	-	-	-	-
PP. 216.A		6.840	6.827		-	-	-	-0.013	-
PP. 217	6.851				-	-	-	-	-
PP. 217.A		7.100	7.087		-	-	-	-0.013	-
PP. 220	8.977				-	-	-	-	-

Result of Leveling Survey for Bench Marks by DINAS DPU DKI Jakarta

Bench Marks	Elevation (m)				Difference (m) between				
	74/78 (1)	89/90 (2)	91/92 (3)	93/94 (4)	(2) - (1)	(3) - (1)	(4) - (1)	(3) - (2)	(4) - (3)
PP. 220.A		8.622	8.609		-	-	-	-0.012	-
PP. 221	8.529				-	-	-	-	-
PP. 221.A		10.361	10.350		-	-	-	-0.012	-
PP. 223	3.224				-	-	-	-	-
PP. 223.A		3.101	3.090		-	-	-	-0.011	-
PP. 224	3.471				-	-	-	-	-
PP. 224.A		3.351	3.340		-	-	-	-0.011	-
PP. 225	3.839				-	-	-	-	-
PP. 225.A		3.667	3.656		-	-	-	-0.011	-
PP. 226	5.374				-	-	-	-	-
PP. 226.A		5.219	5.207		-	-	-	-0.011	-
PP. 227	7.809	7.542	7.530		-0.268	-0.279	-	-0.011	-
PP. 228	10.052	9.578	9.566		-0.475	-0.486	-	-0.011	-
PP. 229	12.177	11.631	11.620		-0.546	-0.557	-	-0.011	-
PP. 230	7.745	7.450	7.440		-0.295	-0.305	-	-0.010	-
PP. 231	8.585	8.390	8.380		-0.195	-0.205	-	-0.010	-
PP. 232	11.895	11.735	11.725		-0.161	-0.170	-	-0.009	-
PP. 234	9.124	9.031	9.022		-0.093	-0.102	-	-0.009	-
PP. 236	9.327	9.212	9.203		-0.114	-0.123	-	-0.009	-
PP. 237	11.713	11.631	11.622		-0.083	-0.091	-	-0.009	-
PP. 238	14.765			14.619	-	-	-0.146	-	-
PP. 243	9.346			9.250	-	-	-0.096	-	-
PP. 246	9.598			9.498	-	-	-0.100	-	-
PP. 248	12.922	12.838	12.828		-0.083	-0.093	-	-0.010	-
PP. 249	11.858	11.879	11.867		0.021	0.010	-	-0.012	-
PP. 250	9.611				-	-	-	-	-
PP. 250.A		9.369	9.356		-	-	-	-0.014	-
PP. 251	6.108				-	-	-	-	-
PP. 251.A		6.609	6.590		-	-	-	-0.019	-
PP. 252	6.801	6.634	6.622		-0.166	-0.179	-	-0.013	-
PP. 254	9.723			9.613	-	-	-0.110	-	-
PP. 255	11.766				-	-	-	-	-
PP. 255.A		8.933	8.924		-	-	-	-0.009	-
PP. 256	9.846	9.711	9.701		-0.136	-0.145	-	-0.009	-
PP. 257	10.196	10.029	10.021		-0.167	-0.175	-	-0.008	-
PP. 262	6.173			5.615	-	-	-0.558	-	-
PP. 263	6.216			5.660	-	-	-0.556	-	-
PP. 266	6.575			6.108	-	-	-0.467	-	-
PP. 268	10.148	9.957	9.949		-0.191	-0.199	-	-0.008	-
PP. 270	11.983				-	-	-	-	-
PP. 270.A		11.813	11.804		-	-	-	-0.009	-
PP. 271	9.475	9.108	9.097		-0.367	-0.378	-	-0.011	-
PP. 272	7.111	6.567	6.551		-0.545	-0.561	-	-0.016	-
PP. 273	6.205				-	-	-	-	-
PP. 273.A		7.498	7.483		-	-	-	-0.016	-
PP. 274	6.728			6.352	-	-	-0.376	-	-
PP. 275	8.694			8.117	-	-	-0.577	-	-
PP. 278	10.209			9.985	-	-	-0.224	-	-
PP. 279	9.707			9.400	-	-	-0.307	-	-
PP. 280	8.393			8.119	-	-	-0.274	-	-
PP. 284	9.158			8.890	-	-	-0.268	-	-
PP. 286	10.997			10.720	-	-	-0.277	-	-
PP. 287	11.285			11.022	-	-	-0.263	-	-
PP. 288	12.963			12.753	-	-	-0.210	-	-
PP. 296	12.134			12.011	-	-	-0.123	-	-
PP. 298	14.358			14.253	-	-	-0.105	-	-
PP. 299	15.514			15.379	-	-	-0.135	-	-

Result of Leveling Survey for Bench Marks by DINAS DPU DKI Jakarta

Bench Marks		Elevation (m)				Difference (m) between				
		74/78 (1)	89/90 (2)	91/92 (3)	93/94 (4)	(2) - (1)	(3) - (1)	(4) - (1)	(3) - (2)	(4) - (3)
PP.	301	15.948			15.764	-	-	-0.184	-	-
PP.	304	11.237	11.001	10.994		-0.235	-0.243	-	-0.007	-
PP.	305	19.360			19.321	-	-	-0.039	-	-
PP.	308	14.329	14.694	14.688		0.364	0.358	-	-0.006	-
PP.	312	13.816	13.736	13.731		-0.080	-0.084	-	-0.004	-
PP.	315	15.943				-	-	-	-	-
PP.	315.A		16.859	16.858		-	-	-	-0.001	-
PP.	316	18.635	18.163	18.162		-0.472	-0.473	-	-0.001	-
PP.	316A		17.184	17.183		-	-	-	-0.001	-
PP.	318	14.329				-	-	-	-	-
PP.	318.A		15.014	15.010		-	-	-	-0.003	-
PP.	319	5.390	5.096	5.084		-0.294	-0.306	-	-0.012	-
PP.	320	12.365			12.172	-	-	-0.193	-	-
PP.	321	14.721			14.604	-	-	-0.117	-	-
PP.	323	18.088	18.017	18.010		-0.071	-0.079	-	-0.008	-
PP.	324	14.072			13.983	-	-	-0.089	-	-
PP.	327	18.671			18.599	-	-	-0.072	-	-
PP.	328	20.166	20.101	20.095		-0.065	-0.071	-	-0.006	-
PP.	329	13.965			13.911	-	-	-0.054	-	-
PP.	331	18.646	18.589	18.588		-0.057	-0.058	-	-0.001	-
PP.	332	19.572	19.526	19.526		-0.046	-0.047	-	-0.001	-
PP.	333	18.694				-	-	-	-	-
PP.	333.A		19.654	19.652		-	-	-	-0.002	-
PP.	334	18.719				-	-	-	-	-
PP.	334.A		18.424	18.421		-	-	-	-0.004	-
PP.	335	22.594	22.916	22.912		0.322	0.318	-	-0.004	-
PP.	336	20.767	20.702	20.696		-0.065	-0.071	-	-0.005	-
PP.	337	33.996				-	-	-	-	-
PP.	337.A		34.048	34.048		-	-	-	0.000	-
PP.	339	24.417				-	-	-	-	-
PP.	339.A		24.531	24.530		-	-	-	-0.001	-
PP.	340	17.156				-	-	-	-	-
PP.	340.A		17.949	17.948		-	-	-	-0.001	-
PP.	346	21.345	21.278	21.279		-0.067	-0.066	-	0.001	-
PP.	347	20.957				-	-	-	-	-
PP.	347.A		26.935	26.935		-	-	-	0.001	-
PP.	348	29.312	29.256	29.255		-0.057	-0.057	-	-0.001	-
PP.	349	22.611			22.525	-	-	-0.086	-	-
PP.	350	22.940			22.857	-	-	-0.083	-	-
PP.	351	23.175			23.057	-	-	-0.118	-	-
PP.	352	21.251	21.182	21.182		-0.069	-0.069	-	0.000	-
PP.	353	27.731	27.691	27.691		-0.040	-0.039	-	0.001	-
PP.	355	31.941				-	-	-	-	-
PP.	355.A		31.026	31.025		-	-	-	-0.001	-
PP.	356	27.255			27.191	-	-	-0.064	-	-
	357	27.375			27.318	-	-	-0.057	-	-
PP.	358	31.542	31.502	31.503		-0.039	-0.039	-	0.000	-
PP.	359	28.922	28.884	28.884		-0.038	-0.037	-	0.000	-
PP.	360	28.138				-	-	-	-	-
PP.	360.A		29.836	29.837		-	-	-	0.001	-
PP.	365	32.986	32.941	32.941		-0.045	-0.045	-	0.000	-
PP.	366	26.844	28.801	28.801		1.957	1.957	-	0.000	-
PP.	367	31.492	31.470	31.470		-0.021	-0.021	-	0.000	-
PP.	369	23.705	23.681	23.681		-0.024	-0.024	-	0.001	-
PP.	372	39.346	39.315	39.315		-0.031	-0.031	-	0.000	-
PP.	373	32.460	32.441	32.441		-0.019	-0.019	-	0.000	-
PP.	376	34.538	34.506	34.506		-0.032	-0.032	-	0.001	-

Result of Leveling Survey for Bench Marks by DINAS DPU DKI Jakarta

Bench Marks	Elevation (m)				Difference (m) between				
	74/78 (1)	89/90 (2)	91/92 (3)	93/94 (4)	(2) - (1)	(3) - (1)	(4) - (1)	(3) - (2)	(4) - (3)
PP. 378	43.633	43.607	43.607		-0.025	-0.025	-	0.000	-
PP. 380	42.470				-	-	-	-	-
PP. 380.A		41.107	41.107		-	-	-	0.000	-
PP. 382	35.821	35.810	35.810		-0.011	-0.010	-	0.001	-
PP. 383	45.284	45.245	45.245		-0.038	-0.038	-	0.000	-
PP. 385	44.187				-	-	-	-	-
PP. 385.A		39.097	39.098		-	-	-	0.000	-
PP. 386	45.645	45.608	45.608		-0.038	-0.038	-	0.000	-
PP. 390	39.198				-	-	-	-	-
PP. 390.A		40.118	40.118		-	-	-	0.001	-
PP. 391	38.931	38.928	38.928		-0.003	-0.003	-	0.000	-
PP. 392	48.130	48.093	48.093		-0.037	-0.037	-	0.000	-
PP. 394	49.519	49.481	49.482		-0.038	-0.038	-	0.000	-
PP. 396	45.380	45.373	45.373		-0.007	-0.006	-	0.001	-
PP. 397	45.306	45.305	45.306		-0.001	-0.001	-	0.000	-
PP. 399	52.983				-	-	-	-	-
PP. 399.A		52.954	52.955		-	-	-	0.000	-
PP. 401	51.857	51.832	51.832		-0.025	-0.025	-	0.000	-
PP. 405	50.967	50.970	50.971		0.003	0.004	-	0.001	-
PP. 406	47.890	47.901	47.901		0.011	0.011	-	0.000	-
PP. 407	59.428	59.428	59.428		0.000	0.000	-	0.000	-
PP. 409	58.483				-	-	-	-	-
PP. 409.A		58.390	58.390		-	-	-	0.000	-
PP. 410	56.652	56.647	56.648		-0.005	-0.004	-	0.000	-
PP. 411	55.803				-	-	-	-	-
PP. 411.A		56.580	56.580		-	-	-	0.000	-
PP. 413	63.633				-	-	-	-	-
PP. 413.A		63.227	63.227		-	-	-	0.000	-
PP. 416	63.810	63.785	63.786		-0.024	-0.024	-	0.000	-
PP. 420	58.969	58.983	58.983		0.013	0.014	-	0.001	-
PP. 422	63.623	63.603	63.604		-0.020	-0.019	-	0.001	-
PP. 427	66.555	66.568	66.568		0.013	0.013	-	0.001	-
PP. 428	65.594	65.610	65.610		0.016	0.016	-	0.000	-
PP. 429	66.769				-	-	-	-	-
PP. 429.A		64.953	64.953		-	-	-	0.000	-
PP. 430	67.936	67.933	67.933		-0.003	-0.003	-	0.000	-
PP. 431	70.755	70.750	70.751		-0.005	-0.004	-	0.001	-
PP. 433	69.926	69.936	69.937		0.010	0.010	-	0.001	-
PP. 434	70.746				-	-	-	-	-
PP. 434.A		70.980	70.980		-	-	-	0.001	-
PP. 435	69.033	69.035	69.035		0.002	0.002	-	0.001	-
PP. 436	74.281	74.275	74.276		-0.006	-0.006	-	0.001	-
PP. 438	71.479	71.475	71.476		-0.004	-0.003	-	0.001	-
PP. 439	58.412	58.434	58.434		0.022	0.022	-	0.001	-
PP. 440	69.065	69.081	69.082		0.017	0.017	-	0.001	-
PP. 450	3.749	3.052	3.035		-0.697	-0.714	-	-0.016	-
PP. 501	14.901			14.523	-	-	-0.378	-	-
PP. 502	14.548			14.508	-	-	-0.040	-	-
PP. 503	17.422			17.369	-	-	-0.053	-	-
PP. 504	23.858				-	-	-	-	-
PP. 504.A		22.669	22.663		-	-	-	-0.006	-
PP. 505	17.765				-	-	-	-	-
PP. 505.A		17.654	17.646		-	-	-	-0.008	-
PP. 506	16.607				-	-	-	-	-
PP. 506.A		16.365	16.556		-	-	-	0.192	-
PP. 507	16.086				-	-	-	-	-
PP. 507.A		17.365	17.356		-	-	-	-0.009	-

Result of Leveling Survey for Bench Marks by DINAS DPU DKI Jakarta

Bench Marks		Elevation (m)				Difference (m) between				
		74/78 (1)	89/90 (2)	91/92 (3)	93/94 (4)	(2) - (1)	(3) - (1)	(4) - (1)	(3) - (2)	(4) - (3)
PP.	508	12.306	12.225	12.215		-0.081	-0.091	-	-0.010	-
PP.	508.A			12.803		-	-	-	-	-
PP.	509	18.164				-	-	-	-	-
PP.	509.A		18.341	18.331		-	-	-	-0.010	-
PP.	510	20.934				-	-	-	-	-
PP.	510.A			17.604		-	-	-	-	-
PP.	517	24.138		24.035		-	-0.103	-	-	-
PP.	518	27.539		27.430		-	-0.110	-	-	-
PP.	522	21.617		21.554		-	-0.063	-	-	-
PP.	523	20.512			20.427	-	-	-0.085	-	-
PP.	524	20.248			20.193	-	-	-0.055	-	-
PP.	525	26.352		26.324		-	-0.028	-	-	-
PP.	526	25.519		25.496		-	-0.023	-	-	-
PP.	527	29.715		29.708		-	-0.008	-	-	-
	530	22.332			22.311	-	-	-0.021	-	-
PP.	534	28.847		28.755		-	-0.091	-	-	-
PP.	535	31.830				-	-	-	-	-
PP.	535.A			31.872		-	-	-	-	-
PP.	541	33.783		34.052		-	0.268	-	-	-
PP.	545	31.387		31.350		-	-0.037	-	-	-
PP.	546	28.163		28.135		-	-0.027	-	-	-
PP.	549	35.478				-	-	-	-	-
PP.	549.A			35.414		-	-	-	-	-
PP.	550	36.468				-	-	-	-	-
PP.	550.A			37.435		-	-	-	-	-
PP.	553	35.009		34.970		-	-0.039	-	-	-
PP.	556	36.263		36.271		-	0.008	-	-	-
PP.	557	37.475				-	-	-	-	-
PP.	557.A			39.225		-	-	-	-	-
PP.	558	39.639				-	-	-	-	-
PP.	558.A			35.504		-	-	-	-	-
PP.	560	42.850		42.855		-	0.004	-	-	-
PP.	561	43.742		43.771		-	0.029	-	-	-
PP.	562	47.780		48.015		-	0.235	-	-	-
PP.	563	48.670		48.689		-	0.020	-	-	-
PP.	564	32.099		32.110		-	0.011	-	-	-
PP.	565	48.155		48.141		-	-0.015	-	-	-
PP.	566	13.165				-	-	-	-	-
PP.	566.A		13.045	13.043		-	-	-	-0.003	-
PP.	568	15.560				-	-	-	-	-
PP.	568.A		16.703	16.699		-	-	-	-0.004	-
PP.	570	13.165				-	-	-	-	-
PP.	570.A		18.652	18.648		-	-	-	-0.004	-
PP.	571	20.224				-	-	-	-	-
PP.	571.A		20.151	20.147		-	-	-	-0.004	-
PP.	573	15.880	15.797	15.795		-0.083	-0.086	-	-0.003	-
PP.	574	20.256	20.156	20.150		-0.100	-0.105	-	-0.005	-
PP.	575	15.887				-	-	-	-	-
PP.	575.A		18.850	18.847		-	-	-	-0.003	-
PP.	576	21.256	20.277	20.275		-0.979	-0.980	-	-0.001	-
PP.	576.A					-	-	-	-	-
PP.	578	23.516	23.453	23.452		-0.062	-0.064	-	-0.001	-
PP.	579	27.573	27.492	27.491		-0.031	-0.082	-	-0.001	-
PP.	586	37.058				-	-	-	-	-
PP.	586.A			35.858		-	-	-	-	-
PP.	590	43.646				-	-	-	-	-
PP.	590.A			43.141		-	-	-	-	-

Result of Leveling Survey for Bench Marks by DINAS DPU DKI Jakarta

Bench Marks	Elevation (m)				Difference (m) between				
	74/78 (1)	89/90 (2)	91/92 (3)	93/94 (4)	(2) - (1)	(3) - (1)	(4) - (1)	(3) - (2)	(4) - (3)
PP. 594	49.972				-	-	-	-	-
PP. 594.A			49.992		-	-	-	-	-
PP. 597	47.606		47.634		-	0.028	-	-	-
PP. 601	52.732		52.775		-	0.043	-	-	-
PP. 604	54.207				-	-	-	-	-
PP. 604.A			53.821		-	-	-	-	-
PP. 606	56.746				-	-	-	-	-
PP. 606.A			56.083		-	-	-	-	-
PP. 608	60.485		60.075		-	-0.410	-	-	-
PP. 610	56.493				-	-	-	-	-
PP. 610.A			56.704		-	-	-	-	-
PP. 611	62.725		62.764		-	0.039	-	-	-
PP. 613	66.492		66.532		-	0.040	-	-	-
PP. 615	60.025		60.158		-	0.134	-	-	-
PP. 616	58.030				-	-	-	-	-
PP. 616.A			50.683		-	-	-	-	-
PP. 617	69.983		70.005		-	0.022	-	-	-
PP. 618	63.234				-	-	-	-	-
PP. 618.A			53.583		-	-	-	-	-
PP. 619	69.741		69.977		-	0.236	-	-	-
PP. 620	71.345		71.372		-	0.026	-	-	-
PP. 622	68.745				-	-	-	-	-
PP. 622.A			60.726		-	-	-	-	-
PP. 627	10.168				-	-	-	-	-
PP. 627.A		10.799	10.795		-	-	-	-0.004	-
PP. 629	10.616				-	-	-	-	-
PP. 628.A		9.890	9.889		-	-	-	-0.001	-
PP. 630	10.556				-	-	-	-	-
PP. 630.A		11.620	11.614		-	-	-	-0.006	-
PP. 631	10.468				-	-	-	-	-
PP. 631.A		11.871	11.861		-	-	-	-0.009	-
PP. 634	11.174	11.066	11.064		-0.108	-0.110	-	-0.002	-
PP. 636	10.437				-	-	-	-	-
PP. 636.A		12.400	12.396		-	-	-	-0.005	-
PP. 637	8.830	8.595	8.585		-0.235	-0.245	-	-0.010	-
PP. 639	17.931			17.666	-	-	-0.265	-	-
PP. 642	11.227				-	-	-	-	-
PP. 642.A		11.405	11.396		-	-	-	-0.009	-
PP. 645	17.279	17.143	17.134		-0.136	-0.144	-	-0.009	-
PP. 646	13.069				-	-	-	-	-
PP. 646.A		12.614	12.602		-	-	-	-0.012	-
PP. 647	8.225				-	-	-	-	-
PP. 647.A		8.792	8.780		-	-	-	-0.012	-
PP. 648	11.351	11.207	11.194		-0.144	-0.156	-	-0.012	-
PP. 649	14.146				-	-	-	-	-
PP. 649.A		16.850	16.841		-	-	-	-0.009	-
PP. 650	13.360				-	-	-	-	-
PP. 650.A		16.073	16.063		-	-	-	-0.010	-
PP. 658	12.476			12.330	-	-	-0.146	-	-
PP. 665	14.452	14.342	14.333		-0.109	-0.119	-	-0.009	-
PP. 666	20.517				-	-	-	-	-
PP. 666.A		22.816	22.805		-	-	-	-0.010	-
PP. 667	15.895				-	-	-	-	-
PP. 667.A		14.755	14.745		-	-	-	-0.010	-
PP. 668	18.099				-	-	-	-	-
PP. 668.A		18.606	18.597		-	-	-	-0.010	-
PP. 669	22.663				-	-	-	-	-

Result of Leveling Survey for Bench Marks by DINAS DPU DKI Jakarta

Bench Marks	Elevation (m) 74/78 (1)	89/90 (2)	91/92 (3)	93/94 (4)	Difference (m) between (2) - (1)	(3) - (1)	(4) - (1)	(3) - (2)	(4) - (3)
PP. 669.A		24.547	24.538		-	-	-	-0.009	-
PP. 671	17.969				-	-	-	-	-
PP. 671.A		19.023	19.014		-	-	-	-0.008	-
PP. 672	23.216				-	-	-	-	-
PP. 672.A			22.321		-	-	-	-	-
PP. 673	21.997				-	-	-	-	-
PP. 673.A			24.425		-	-	-	-	-
PP. 677	22.069				-	-	-	-	-
PP. 677.A			21.847		-	-	-	-	-
PP. 681	26.725			26.666	-	-	-0.059	-	-
PP. 682	24.515				-	-	-	-	-
PP. 682.A			23.239		-	-	-	-	-
PP. 683	24.618				-	-	-	-	-
PP. 683.A			21.705		-	-	-	-	-
PP. 684	24.525				-	-	-	-	-
PP. 684.A			16.645		-	-	-	-	-
PP. 685	25.126		25.123		-	-0.003	-	-	-
PP. 686	30.205				-	-	-	-	-
PP. 686.A			30.466		-	-	-	-	-
PP. 688	30.226			29.994	-	-	-0.232	-	-
PP. 690	29.556				-	-	-	-	-
PP. 690.A			30.602		-	-	-	-	-
PP. 692	32.956		32.957		-	0.001	-	-	-
PP. 695	38.066				-	-	-	-	-
PP. 695.A			38.743		-	-	-	-	-
PP. 698	39.497				-	-	-	-	-
PP. 698.A			38.623		-	-	-	-	-
PP. 699	42.720				-	-	-	-	-
PP. 699.A			42.313		-	-	-	-	-
PP. 700	31.448		31.479		-	0.031	-	-	-
PP. 701	3.528	3.306	3.295		-0.221	-0.233	-	-0.012	-
PP. 702	3.191				-	-	-	-	-
PP. 702.A		3.203	3.191		-	-	-	-0.012	-
PP. 703	2.359				-	-	-	-	-
PP. 703.A		2.277	2.266		-	-	-	-0.012	-
PP. 704	3.906				-	-	-	-	-
PP. 704.A		4.275	4.263		-	-	-	-0.011	-
PP. 705	4.509	4.386	4.374		-0.123	-0.135	-	-0.011	-
PP. 707	4.043	3.734	3.722		-0.309	-0.321	-	-0.012	-
PP. 708	2.603	1.845	1.834		-0.757	-0.769	-	-0.012	-
PP. 709	4.459				-	-	-	-	-
PP. 709.A		5.182	5.171		-	-	-	-0.011	-
PP. 710	4.318				-	-	-	-	-
PP. 710.A		4.608	4.597		-	-	-	-0.011	-
PP. 712	3.512	3.138	3.127		-0.374	-0.385	-	-0.012	-
PP. 713	1.922	1.177	1.165		-0.745	-0.756	-	-0.012	-
PP. 716	5.196	4.806	4.795		-0.389	-0.401	-	-0.011	-
PP. 717	4.206	3.712	3.700		-0.494	-0.506	-	-0.012	-
PP. 718	6.096	6.029	6.018		-0.067	-0.078	-	-0.011	-
PP. 721	4.526	4.225	4.213		-0.301	-0.313	-	-0.011	-
PP. 722	4.374	4.017	4.006		-0.356	-0.368	-	-0.012	-
PP. 723	5.282	5.195	5.183		-0.087	-0.099	-	-0.011	-
PP. 724	6.054				-	-	-	-	-
PP. 724.A		6.940	6.928		-	-	-	-0.011	-
PP. 725	6.070	5.984	5.972		-0.086	-0.097	-	-0.011	-
PP. 726	6.847				-	-	-	-	-
PP. 726.A		6.678	6.667		-	-	-	-0.011	-

Result of Leveling Survey for Bench Marks by DINAS DPU DKI Jakarta

Bench Marks	Elevation (m)				Difference (m) between				
	74/78 (1)	89/90 (2)	91/92 (3)	93/94 (4)	(2) - (1)	(3) - (1)	(4) - (1)	(3) - (2)	(4) - (3)
PP. 727	5.803	5.662	5.651		-0.140	-0.152	-	-0.011	-
PP. 728	6.199	6.000	5.988		-0.199	-0.210	-	-0.011	-
PP. 729	5.999	5.716	5.705		-0.283	-0.294	-	-0.011	-
PP. 730	5.914				-	-	-	-	-
PP. 730.A		5.137	5.126		-	-	-	-0.011	-
PP. 731	7.118	6.992	6.981		-0.126	-0.137	-	-0.011	-
PP. 738	7.411	7.021	7.010		-0.390	-0.401	-	-0.011	-
PP. 740	7.439				-	-	-	-	-
PP. 740.A		7.103	7.092		-	-	-	-0.011	-
PP. 741	7.347				-	-	-	-	-
PP. 741.A		6.549	6.538		-	-	-	-0.011	-
PP. 742	6.506			5.824	-	-	-0.682	-	-
PP. 742.A		5.900	5.889		-	-	-	-0.011	-
PP. 743	5.660	4.987	4.976		-0.674	-0.685	-	-0.011	-
PP. 744	4.172				-	-	-	-	-
PP. 744.A		4.339	4.328		-	-	-	-0.011	-
PP. 745	4.746				-	-	-	-	-
PP. 745.A		5.750	5.738		-	-	-	-0.011	-
PP. 746	7.647			7.211	-	-	-0.436	-	-
PP. 747	6.171			5.205	-	-	-0.966	-	-
PP. 749	5.726				-	-	-	-	-
PP. 749.A		5.611	5.600		-	-	-	-0.010	-
PP. 750	3.582	2.585	2.574		-0.997	-1.008	-	-0.011	-
PP. 753	2.904	2.328	2.316		-0.576	-0.588	-	-0.012	-
PP. 754	2.732				-	-	-	-	-
PP. 754.A		5.038	5.026		-	-	-	-0.012	-
755	5.144			5.066	-	-	-0.078	-	-
PP. 758	2.679				-	-	-	-	-
PP. 758.A		2.530	2.518		-	-	-	-0.012	-
PP. 759	1.991				-	-	-	-	-
PP. 759.A		2.069	2.056		-	-	-	-0.012	-
PP. 764	4.815	4.044	4.032	3.924	-0.771	-0.784	-0.891	-0.012	-0.108
PP. 765	5.235	4.294	4.283		-0.941	-0.953	-	-0.011	-
PP. 766	3.679				-	-	-	-	-
PP. 766.A		3.788	3.776		-	-	-	-0.012	-
PP. 767	5.078	4.389	4.377		-0.689	-0.701	-	-0.012	-
PP. 768	4.026	3.402	3.389		-0.624	-0.636	-	-0.012	-
PP. 769	5.868	5.274	5.262		-0.594	-0.606	-	-0.012	-
PP. 772	2.076				-	-	-	-	-
PP. 772.A		4.619	4.609		-	-	-	-0.010	-
PP. 775	3.702				-	-	-	-	-
PP. 775.A		4.584	4.571		-	-	-	-0.012	-
PP. 776	4.217				-	-	-	-	-
PP. 776.A		3.579	3.566		-	-	-	-0.013	-
PP. 777	4.411				-	-	-	-	-
PP. 777.A		2.898	2.885		-	-	-	-0.013	-
PP. 778	2.452				-	-	-	-	-
PP. 778.A		1.385	1.369		-	-	-	-0.016	-
PP. 780	1.789			1.753	-	-	-0.036	-	-
PP. 784	2.848				-	-	-	-	-
PP. 784.A		2.243	2.230		-	-	-	-0.014	-
PP. 787	2.945	2.076	2.061		-0.869	-0.884	-	-0.016	-
PP. 793	3.361				-	-	-	-	-
PP. 793.A		3.486	3.470		-	-	-	-0.016	-
PP. 796	5.375	5.025	5.011		-0.350	-0.364	-	-0.014	-
PP. 800	3.351	2.956	2.942		-0.395	-0.409	-	-0.014	-
PP. 802	2.614				-	-	-	-	-

Result of Leveling Survey for Bench Marks by DINAS DPU DKI Jakarta

Bench Marks	Elevation (m) 74/78 (1)	89/90 (2)	91/92 (3)	93/94 (4)	Difference (m) between (2) - (1)	(3) - (1)	(4) - (1)	(3) - (2)	(4) - (3)
PP. 802.A		4.410	4.397		-	-	-	-0.013	-
PP. 803	2.566				-	-	-	-	-
PP. 803.A		2.444	2.430		-	-	-	-0.014	-
PP. 804	2.789				-	-	-	-	-
PP. 804.A		3.251	3.236		-	-	-	-0.015	-
PP. 805	2.983	2.555	2.540		-0.427	-0.442	-	-0.015	-
PP. 806	5.309				-	-	-	-	-
PP. 806.A		4.884	4.872		-	-	-	-0.012	-
PP. 809	4.185				-	-	-	-	-
PP. 809.A		3.832	3.818		-	-	-	-0.014	-
PP. 812	6.944	6.783	6.774		-0.161	-0.171	-	-0.009	-
PP. 819	7.267				-	-	-	-	-
PP. 819.A		7.382	7.367		-	-	-	-0.015	-
PP. 821	7.668				-	-	-	-	-
PP. 821.A		7.966	7.957		-	-	-	-0.009	-
PP. 825	5.077				-	-	-	-	-
PP. 825.A		7.266	7.255		-	-	-	-0.011	-
PP. 831	8.064	7.963	7.954		-0.101	-0.109	-	-0.009	-
PP. 832	10.226				-	-	-	-	-
PP. 832.A		10.833	10.825		-	-	-	-0.008	-
PP. 835	8.669				-	-	-	-	-
PP. 835.A		6.560	6.550		-	-	-	-0.011	-
PP. 839	8.077				-	-	-	-	-
PP. 839.A		8.382	8.368		-	-	-	-0.014	-
PP. 840	6.999				-	-	-	-	-
PP. 840.A		7.417	7.403		-	-	-	-0.014	-
PP. 842	12.410	12.336	12.328		-0.074	-0.082	-	-0.008	-
PP. 843	9.233				-	-	-	-	-
PP. 843.A		7.489	7.481		-	-	-	-0.008	-
PP. 844	6.501				-	-	-	-	-
PP. 844.A		8.664	8.656		-	-	-	-0.009	-
PP. 845	6.558				-	-	-	-	-
PP. 845.A		7.497	7.488		-	-	-	-0.009	-
PP. 846	9.446				-	-	-	-	-
PP. 846.A		8.911	8.900		-	-	-	-0.010	-
PP. 847	10.616				-	-	-	-	-
PP. 847.A		10.239	10.228		-	-	-	-0.011	-
PP. 848	13.348				-	-	-	-	-
PP. 848.A		11.331	11.320		-	-	-	-0.011	-
PP. 849	13.196				-	-	-	-	-
PP. 849.A		12.683	12.672		-	-	-	-0.011	-
PP. 850	14.319	14.104	14.093		-0.215	-0.227	-	-0.011	-
PP. 852	9.357				-	-	-	-	-
PP. 852.A		11.704	11.691		-	-	-	-0.013	-
PP. 853	11.977	11.780	11.767		-0.197	-0.210	-	-0.013	-
PP. 855	13.927	13.903	13.896		-0.024	-0.031	-	-0.007	-
PP. 863	17.133	17.156	17.152		0.023	0.018	-	-0.004	-
PP. 872	16.186				-	-	-	-	-
PP. 872.A		16.936	16.931		-	-	-	-0.004	-
PP. 873	15.896				-	-	-	-	-
PP. 873.A		17.119	17.116		-	-	-	-0.003	-
PP. 874	16.301				-	-	-	-	-
PP. 874.A		15.763	15.762		-	-	-	-0.001	-
PP. 875	13.755	13.753	13.753		-0.001	-0.001	-	0.000	-
PP. 876	9.730				-	-	-	-	-
PP. 876.A		10.688	10.686		-	-	-	-0.002	-
PP. 878	11.521	11.493	11.487		-0.028	-0.034	-	-0.006	-

Result of Leveling Survey for Bench Marks by DINAS DPU DKI Jakarta

Bench Marks	Elevation (m)				Difference (m) between				
	74/78 (1)	89/90 (2)	91/92 (3)	93/94 (4)	(2) - (1)	(3) - (1)	(4) - (1)	(3) - (2)	(4) - (3)
PP. 879	18.720				-	-	-	-	-
PP. 879.A		19.515	19.508		-	-	-	-0.007	-
PP. 883	16.300				-	-	-	-	-
PP. 883.A		16.067	16.061		-	-	-	-0.006	-
PP. 884	15.102				-	-	-	-	-
PP. 884.A		15.732	15.726		-	-	-	-0.006	-
PP. 885	23.075				-	-	-	-	-
PP. 885.A		22.625	22.618		-	-	-	-0.007	-
PP. 886	20.897				-	-	-	-	-
PP. 886.A		23.440	23.432		-	-	-	-0.008	-
PP. 887	18.216	18.209	18.200		-0.007	-0.015	-	-0.009	-
PP. 888	8.334				-	-	-	-	-
PP. 888.A		7.344	7.333		-	-	-	-0.011	-
PP. 903	2.784	2.346	2.334		-0.438	-0.451	-	-0.012	-
PP. 905	3.085	2.566	2.552		-0.520	-0.533	-	-0.013	-
PP. 909	3.518				-	-	-	-	-
PP. 909.A		3.302	3.284		-	-	-	-0.018	-
PP. 911	3.441	2.795	2.781		-0.645	-0.660	-	-0.015	-
PP. 912	5.849				-	-	-	-	-
PP. 912.A		5.347	5.331		-	-	-	-0.016	-
PP. 913	3.402	2.961	2.944		-0.441	-0.458	-	-0.017	-
PP. 914	3.507	3.026	3.008		-0.481	-0.499	-	-0.018	-
PP. 915	4.275	3.902	3.888		-0.373	-0.387	-	-0.014	-
PP. 916	5.297	4.831	4.813		-0.467	-0.484	-	-0.017	-
PP. 918	3.882				-	-	-	-	-
PP. 918.A		3.888	3.872		-	-	-	-0.015	-
PP. 919	8.798	8.378	8.363		-0.420	-0.436	-	-0.016	-
PP. 920	4.054	3.719	3.703		-0.335	-0.352	-	-0.016	-
PP. 921	4.350				-	-	-	-	-
PP. 921.A		3.942	3.925		-	-	-	-0.017	-
PP. 922	3.829	3.426	3.409		-0.402	-0.419	-	-0.017	-
PP. 925	3.979	3.550	3.534		-0.429	-0.445	-	-0.016	-
PP. 927	3.570	4.156	4.141		0.586	0.571	-	-0.015	-
PP. 928	3.320	3.045	3.030		-0.275	-0.290	-	-0.015	-
PP. 930	7.158	6.837	6.824		-0.321	-0.334	-	-0.013	-
PP. 932	4.498				-	-	-	-	-
PP. 932.A		10.751	10.738		-	-	-	-0.014	-
PP. 933	4.409	4.052	4.039		-0.358	-0.370	-	-0.012	-
PP. 935	7.786	7.487	7.475		-0.299	-0.311	-	-0.012	-
PP. 937	9.238				-	-	-	-	-
PP. 937.A		8.411	8.399		-	-	-	-0.011	-
PP. 944	5.723				-	-	-	-	-
PP. 944.A		5.502	5.491		-	-	-	-0.011	-
PP. 946	10.490	10.273	10.263		-0.217	-0.227	-	-0.010	-
PP. 948	9.446				-	-	-	-	-
PP. 948.A		10.178	10.171		-	-	-	-0.008	-
PP. 950	5.687				-	-	-	-	-
PP. 950.A		5.123	5.115		-	-	-	-0.008	-
PP. 951	12.839				-	-	-	-	-
PP. 951.A		12.678	12.675		-	-	-	-0.003	-
PP. 952	9.664				-	-	-	-	-
PP. 952.A		11.310	11.297		-	-	-	-0.013	-
PP. 954	8.860			8.684	-	-	-0.176	-	-
PP. 956	12.030				-	-	-	-	-
PP. 956.A		12.053	12.041		-	-	-	-0.012	-
PP. 959	11.013				-	-	-	-	-
PP. 959.A		11.545	11.534		-	-	-	-0.011	-

Result of Leveling Survey for Bench Marks by DINAS DPU DKI Jakarta

Bench Marks	Elevation (m)				Difference (m) between				
	74/78 (1)	89/90 (2)	91/92 (3)	93/94 (4)	(2) - (1)	(3) - (1)	(4) - (1)	(3) - (2)	(4) - (3)
PP. 961	17.198				-	-	-	-	-
PP. 961.A		11.804	11.794		-	-	-	-0.010	-
PP. 964	8.167			8.064	-	-	-0.103	-	-
PP. 965	5.139				-	-	-	-	-
PP. 965.A		4.867	4.859		-	-	-	-0.009	-
PP. 969	3.700				-	-	-	-	-
PP. 969.A		3.900	3.884		-	-	-	-0.016	-
PP. 970	3.408	2.938	2.923		-0.470	-0.485	-	-0.015	-
PP. 971	4.721				-	-	-	-	-
PP. 971.A		3.976	3.960		-	-	-	-0.016	-
PP. 972	2.119				-	-	-	-	-
PP. 972.A		2.885	2.869		-	-	-	-0.016	-
PP. 973	3.926	3.436	3.420		-0.490	-0.506	-	-0.016	-
PP. 974	4.448				-	-	-	-	-
PP. 974.A		5.035	5.019		-	-	-	-0.016	-
PP. 978	2.582				-	-	-	-	-
PP. 978.A		3.185	3.169		-	-	-	-0.016	-
PP. 983	4.374			3.806	-	-	-0.568	-	-
PP.B. 135		8.200	8.190		-	-	-	-0.010	-
PBJRMIC.01		10.840	10.827		-	-	-	-0.012	-
PBJRCKL.03		5.121	5.105		-	-	-	-0.016	-
PBJRSRB. 03	12.527	12.390	12.386		-0.137	-0.141	-	-0.004	-
PBJRBUA. 05	9.707	11.120	11.111		1.413	1.404	-	-0.009	-
PBJRRRA.03		18.846	18.843		-	-	-	-0.004	-
PBJR. 420	16.315	17.522	17.515		1.207	1.200	-	-0.007	-
PB. JR		5.370	5.358		-	-	-	-0.012	-
NWP. 006		3.989	3.990		-	-	-	0.001	-
NWP. 007	4.229	3.978	3.978		-0.251	-0.251	-	0.000	-
NWP. 013	2.747	2.081	2.069		-0.666	-0.678	-	-0.011	-
NWP. 017		1.406	1.392		-	-	-	-0.015	-
NWP. 021	5.204	4.544	4.525		-0.660	-0.679	-	-0.018	-
NWP. 023	5.765	5.205	5.189		-0.560	-0.576	-	-0.016	-
NWP. 056.A		33.094	33.094		-	-	-	0.000	-
NWP. 060	41.161	41.141	41.141		-0.020	-0.020	-	0.000	-
NWP. 066	55.747	55.753	55.753		0.006	0.006	-	0.000	-
NWP. 487	9.530	9.342	9.335		-0.188	-0.195	-	-0.007	-
NWP. 488	10.263	9.993	9.984		-0.270	-0.279	-	-0.009	-
TTG. 257		2.766	2.752		-	-	-	-0.014	-
TTG. X		2.194	2.194		-	-	-	0.000	-
GEB. 016		2.673	2.661		-	-	-	-0.012	-
GEB. 039		3.353	3.339		-	-	-	-0.014	-
DKI. 3074		20.558	20.557		-	-	-	-0.001	-
TBM. DKI		19.286	19.277		-	-	-	-0.009	-
TBM.B 5025		17.324	17.319		-	-	-	-0.005	-
TBM. 001		10.802	10.792		-	-	-	-0.009	-
TBM. 197		6.518	6.505		-	-	-	-0.013	-
TBM. 318		21.677	21.676		-	-	-	-0.002	-
TBM. 339		21.985	21.964		-	-	-	-0.021	-
TBM. 348		26.208	26.187		-	-	-	-0.021	-
TBM. 352		27.758	27.738		-	-	-	-0.020	-
TBM. 355		32.207	32.187		-	-	-	-0.021	-
TBM. 365		30.232	30.212		-	-	-	-0.020	-
TBM. 401		49.605	49.585		-	-	-	-0.020	-
TBM. 411		55.279	55.259		-	-	-	-0.020	-
TBM. 422		54.261	54.241		-	-	-	-0.020	-
TBM. 428		61.679	61.659		-	-	-	-0.020	-
TBM. 429		67.232	67.212		-	-	-	-0.020	-

Result of Leveling Survey for Bench Marks by DINAS DPU DKI Jakarta

Bench Marks	Elevation (m)				Difference (m) between				
	74/78 (1)	89/90 (2)	91/92 (3)	93/94 (4)	(2) - (1)	(3) - (1)	(4) - (1)	(3) - (2)	(4) - (3)
TBM. 576		22.367	22.365		-	-	-	-0.001	-
TBM. 832		11.151	11.143		-	-	-	-0.008	-
TBM. 855		13.124	13.118		-	-	-	-0.006	-
TBM. 942		4.485	4.473		-	-	-	-0.011	-