SUPPORTING REPORT B

INVESTIGATION ON WATER RESOURCES

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1. METEOROLOGY AND HYDROLOGY

1.1 Annual Rainfall

To help understanding of the features of rainfall in the studied region, long term records of monthly rainfall at representative sites nearby are figured in Fig. B.1.1 together with monthly rainfall in 1990.

Fig. B.1.2 shows monthly rainfall records of the related Kabpatens in the studied region.

Fig. B.1.3 and B.1.4 show isohyets of the Central and East Java and the Bali island, together with studied 121 IKK sites in Phase I study.

1.2 Flow Rate of Spring Water

Table B.1.1 shows the flow rate of proposed springs. Availability for the proposed IKK water supply was confirmed through officials of related Kecamatan and BAPPEDA or PDAM.

Table B.1.1 Flow Rate of Proposed Springs

Name of Spring	Name of served IKK (Desa)	Kecamatan	Kabpaten	Proposed Demand of Water	Measured Flow Rate	Remarks
Mudal Spring	Madukara	Madukara	Banjar Negara	9.0 l/s	30 l/s	with other water supply Available
Trabawulan Spring	Punggelan	Punggelan	Banjar Negara	7.7 l/s	40 l/s	Available
Tlogomili Spring	Sukorejo	Sukorejo	Kendal	18.2 l/s	800 l/s +	with irrigation Available
Kakap Spring	Giriwoyo	Giriwoyo	Wonogiri	7.0 l/s	52 l/s	with irrigation Available
Umbul Spring	Bawen	Harjosari	Semarang	19.7 l/s	130 l/s	with other water supply Available
Umbulsari I Spring	Tempursari	Tempursari	Lumajang	14.5 l/s	600 l/s	with irrigation Available
Titra Emple Spring	Tampak Siring	Tampak Siring	Gianyar	8.4 l/s	400 l/s	with other water supply Available
Gerbug Spring	Menanga	Rendang	Karangarem	6.4 l/s	280 l/s	with irrigation Available
Dukuh Muding Spring	Sibetan	Bebandem	Karangarem	10.8 l/s	27 l/s	Available

Fig. B 1. 1

Mean Annual Rainfall (Laporan: Departmen Perhubungan Badan Meteorologi dan Geofisika 1990)

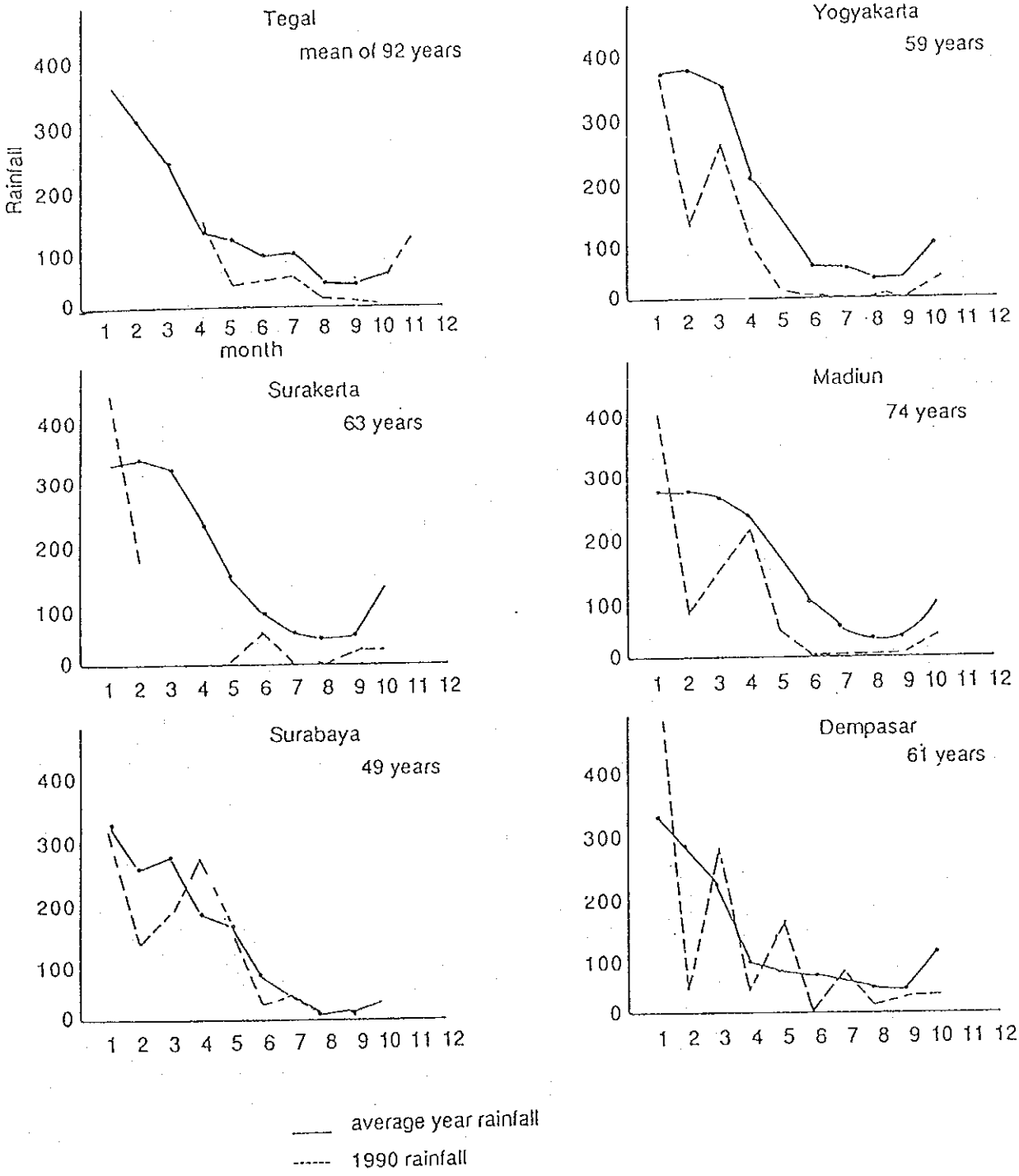
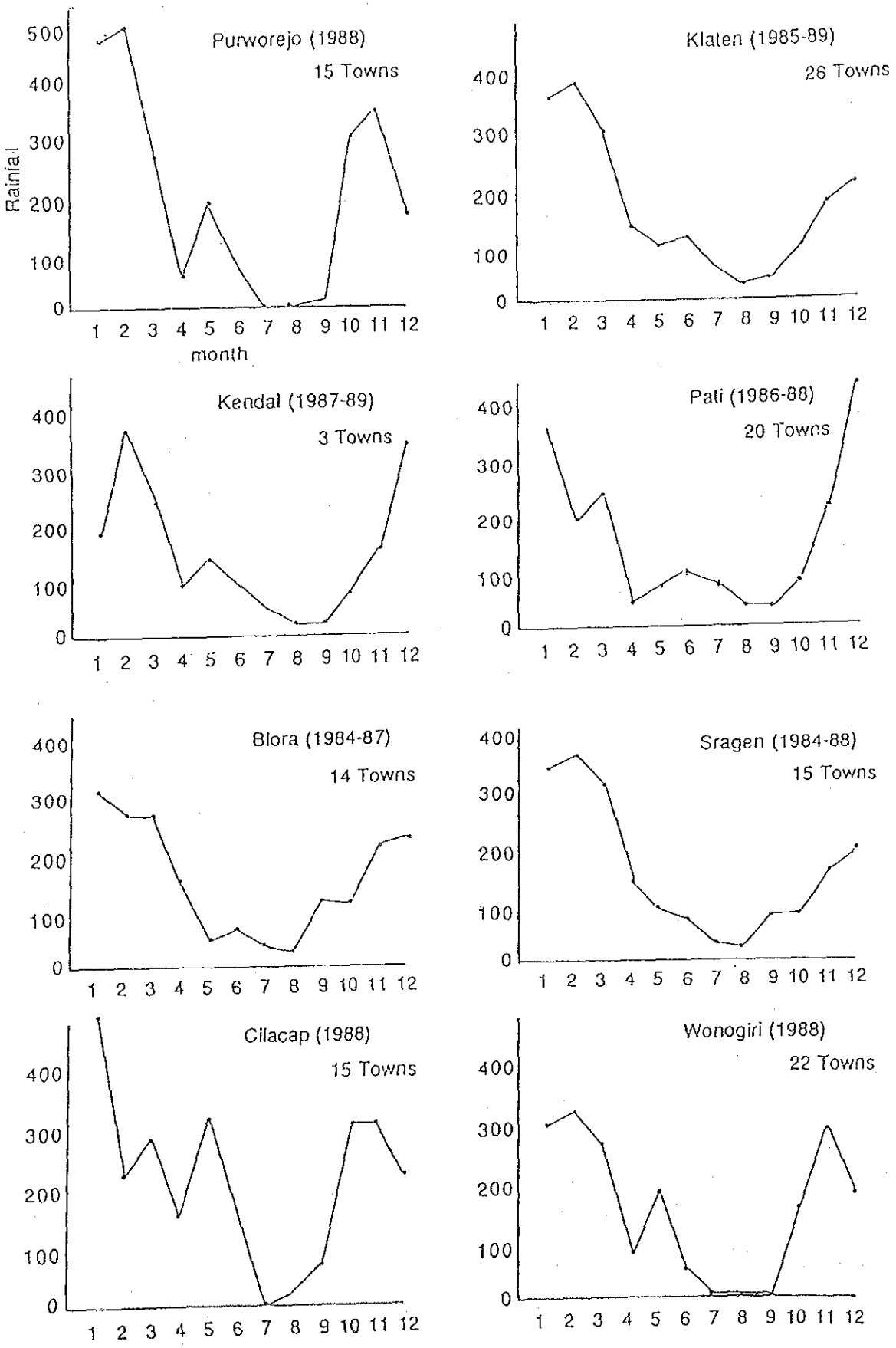
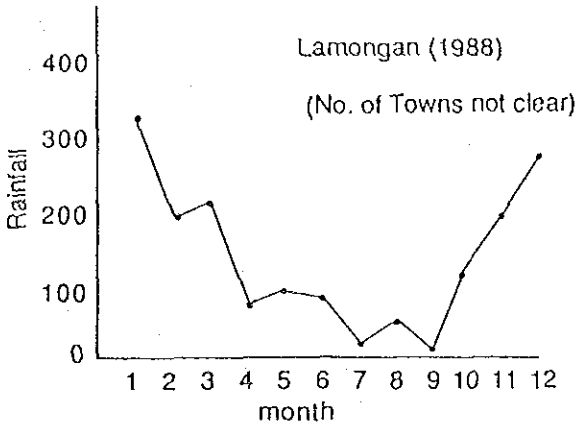
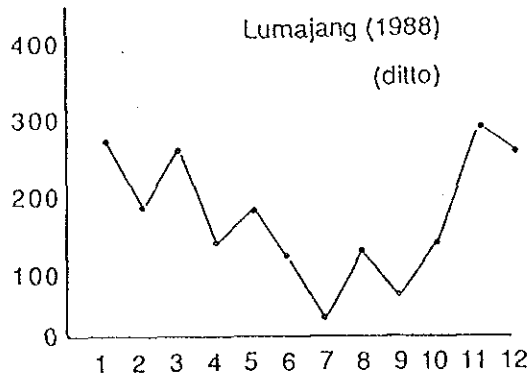


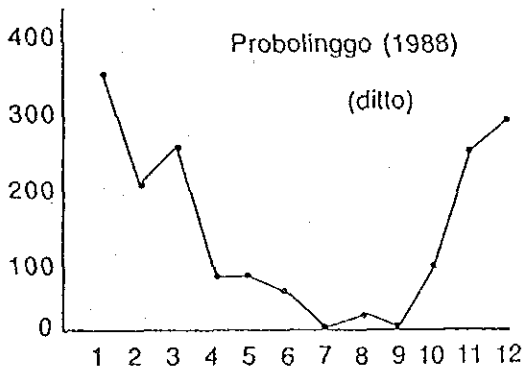
Fig. B 1. 2

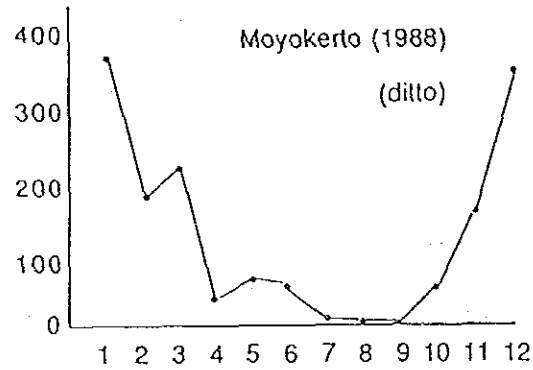
Annual Rainfall (Central Java) 1/3

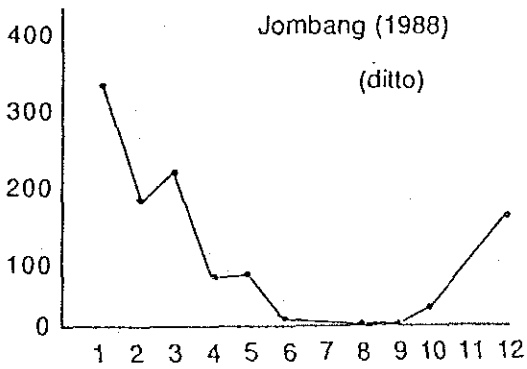


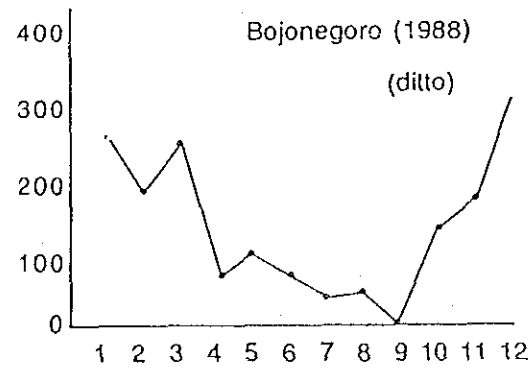

Lamongan (1988)
(No. of Towns not clear)
Rainfall
400
300
200
100
0
1 2 3 4 5 6 7 8 9 10 11 12
month

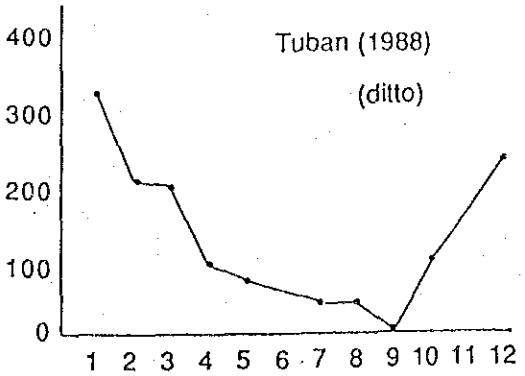

Lumajang (1988)
(ditto)
400
300
200
100
0
1 2 3 4 5 6 7 8 9 10 11 12

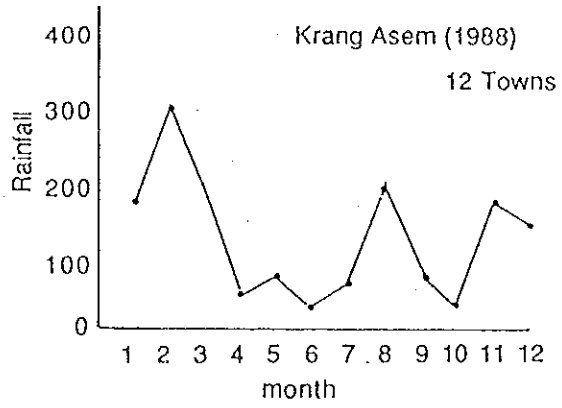

Probolinggo (1988)
(ditto)
400
300
200
100
0
1 2 3 4 5 6 7 8 9 10 11 12

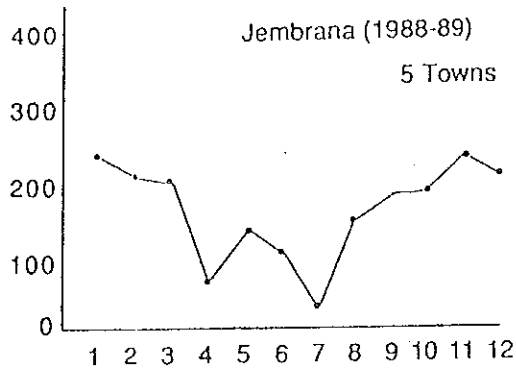

Moyokerto (1988)
(ditto)
400
300
200
100
0
1 2 3 4 5 6 7 8 9 10 11 12

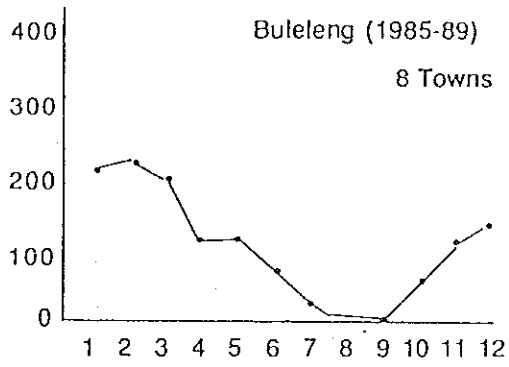

Jombang (1988)
(ditto)
400
300
200
100
0
1 2 3 4 5 6 7 8 9 10 11 12


Bojonegoro (1988)
(ditto)
400
300
200
100
0
1 2 3 4 5 6 7 8 9 10 11 12


Tuban (1988)
(ditto)
400
300
200
100
0
1 2 3 4 5 6 7 8 9 10 11 12


Krang Asem (1988)
12 Towns
Rainfall
400
300
200
100
0
1 2 3 4 5 6 7 8 9 10 11 12
month


Jembrana (1988-89)
5 Towns
400
300
200
100
0
1 2 3 4 5 6 7 8 9 10 11 12


Buleleng (1985-89)
8 Towns
400
300
200
100
0
1 2 3 4 5 6 7 8 9 10 11 12

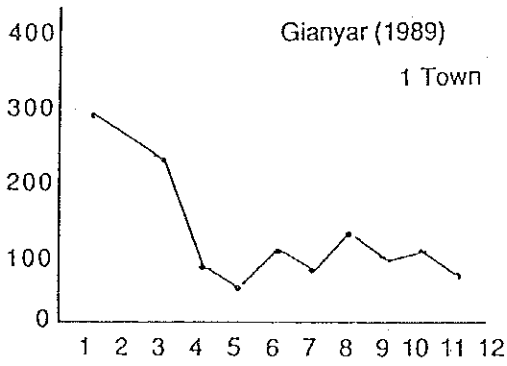
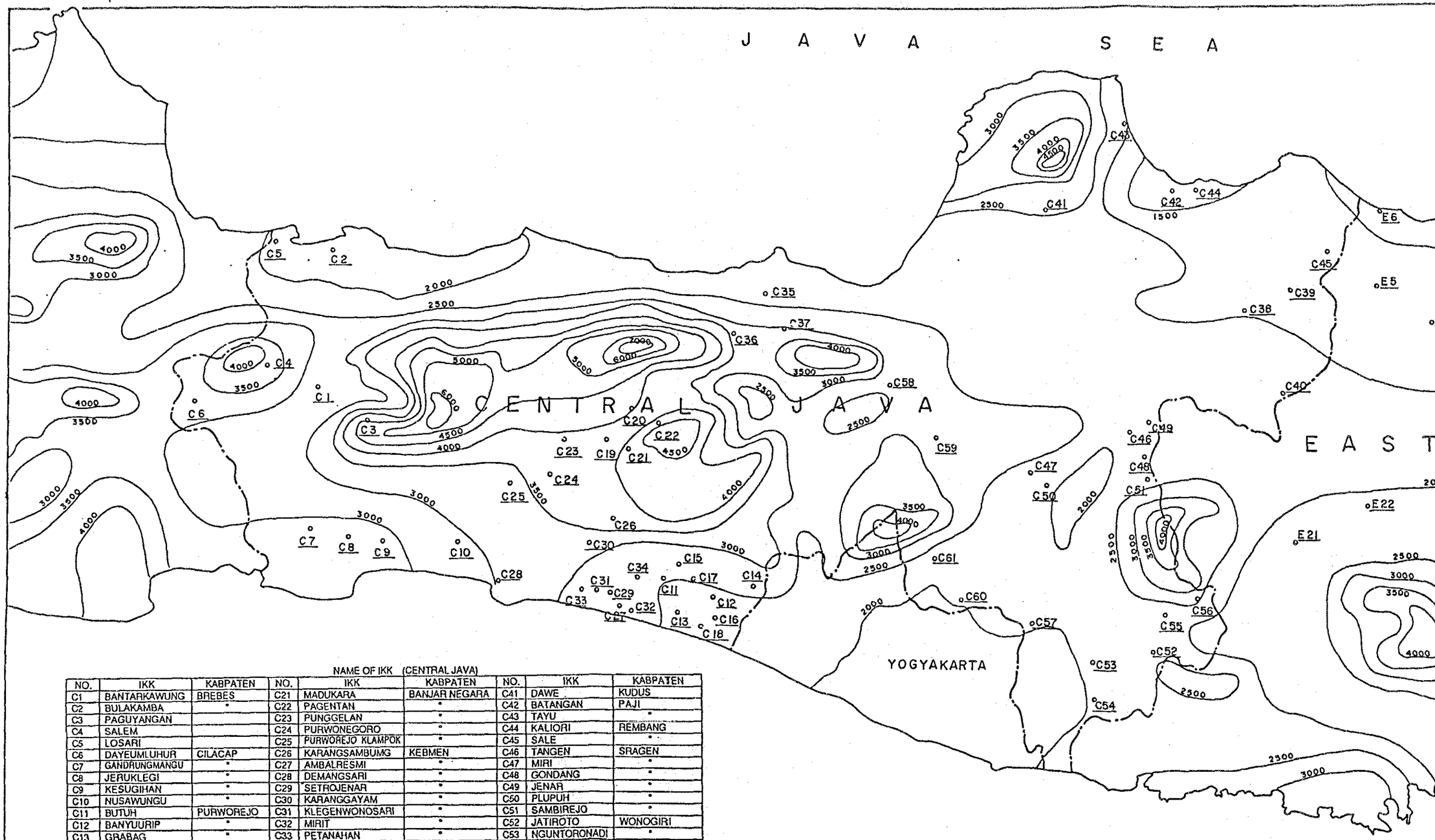

Gianyar (1989)
1 Town
400
300
200
100
0
1 2 3 4 5 6 7 8 9 10 11 12

Fig. B.1.3 ISOHYETS OF MEAN ANNUAL RAINFALL (CENTRAL AND EAST JAVA)
(DIRECTORATE ENVIRONMENTAL GEOLOGY 1973)



NAME OF IKK (CENTRAL JAVA)

NO.	IKK	KABPATEN
C1	BANTARKAWUNG	BREBES
C2	BULAKAMBA	"
C3	PAGUYANGAN	"
C4	SALEM	"
C5	LOSARI	"
C6	DAYEUMLUHUR	CILACAP
C7	GANDRUNGMANGU	"
C8	JERUKLEGI	"
C9	KESUGIHAN	"
C10	NUSAWUNGU	"
C11	BUTUH	PURWOREJO
C12	BANYUURIP	"
C13	GRABAG	"
C14	KALIGESING	"
C15	KEMIRI	"
C16	PURWODADI	"
C17	BAYAN	"
C18	NGOMBOL	"
C19	BANJARMANGU	BANJAR NEGARA
C20	KARANG KOBAR	"
C21	MADUKARA	BANJAR NEGARA
C22	PAGENTAN	"
C23	PUNGGELAN	"
C24	PURWONEGORO	"
C25	PURWOREJO KLAMPOK	"
C26	KARANGSAMBUMG	KEBMEN
C27	AMBALRESMI	"
C28	DEMANGSARI	"
C29	SETROJENAR	"
C30	KARANGGAYAM	"
C31	KLEGENWONOSARI	"
C32	MIRIT	"
C33	PETANAHAN	"
C34	PREMBUN	"
C35	GEMUH	KENDAL
C36	SUKOREJO	"
C37	SINGOROJO	"
C38	BANJARREJO	BLORA
C39	JEPON	"
C40	MENDENREJO	"
C41	DAWE	KUDUS
C42	BATANGAN	PATI
C43	TAYU	"
C44	KALIORI	REMBANG
C45	SALE	"
C46	TANGEN	SRAGEN
C47	MIRI	"
C48	GONDANG	"
C49	JENAR	"
C50	PLUPUH	"
C51	SAMBIREJO	"
C52	JATIROTO	WONOGIRI
C53	NGUNTORONADI	"
C54	GIRIWOYO	"
C55	JATIPURNO	"
C56	BULUKERTO	"
C57	MANYARAN	"
C58	BAWEN	SEMARANG
C59	SURUH	"
C60	BAYAT	KLATEN
C61	KARANGNONGKO	"

NAME OF IKK (EAST JAVA)

NO.	IKK	KABPATEN	NO.	IKK	KABPATEN
E1	BALEN	BOJONEGORO	E21	JIWAN	MADIUN
E2	BAURENO	"	E22	MEJAYAN	"
E3	KAPAS	"	E23	PLANGGU	MOJOKERTO
E4	SUMBERREJO	"	E24	GEDEG	"
E5	BANGILAN	TUBAN	E25	JATIREJO	"
E6	BULU	"	E26	KUTOREJO	"
E7	PARENGAN	"	E27	PACET	"
E8	JENU	"	E28	CANDIPURO	LUMAJANG
E9	KEREK	"	E29	GUCIALIT	"
E10	KARANGGENENG	LAMONGAN	E30	TEMPEH	"
E11	KEMBANGBAHU	"	E31	KUNIR	"
E12	TIKUNG	"	E32	RANDUAGUNG	"
E13	NGIMBANG	"	E33	RANUYOSO	"
E14	BRONDONG	"	E34	SENDURO	"
E15	DIWEK	JOMBANG	E35	TEMPURSARI	"
E16	GUDO	"	E36	BANYUANYAR	PROBOLINGGO
E17	KUDU	"	E37	BESUK	"
E18	MEGALUH	"	E38	GENDING	"
E19	MOJOWARNO	"	E39	MARON	"
E20	NGORO	"	E40	SUMBERASIH	"

S E A

E A S T J A V A

M A D U R A

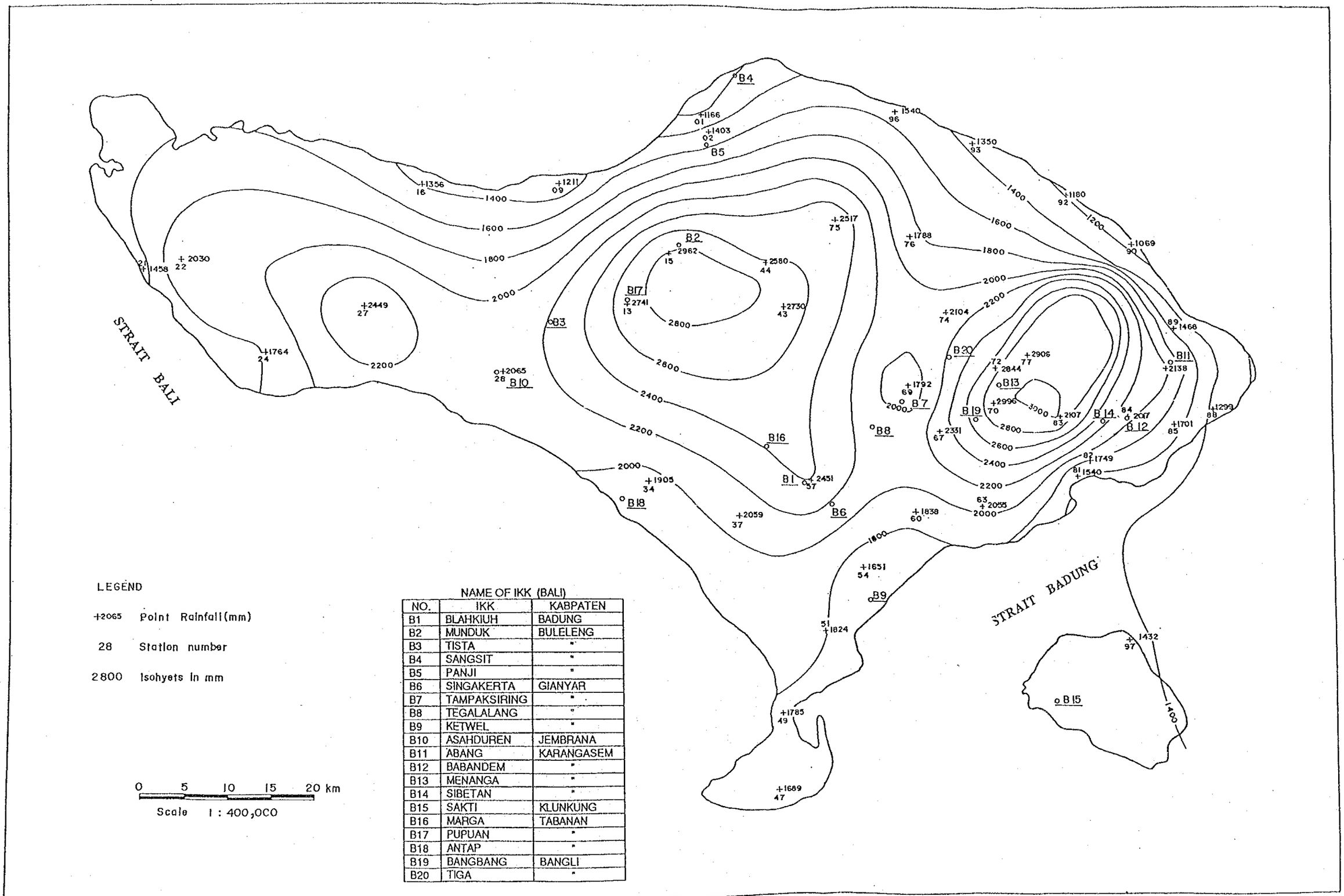
P. BALI

STRAIT BALI

I N D I A N O C E A N

B - 7

Fig. B 1. 4 ISOHYETS OF MEAN ANNUAL RAINFALL EQUALLED OR EXCEEDED IN 80% OF YEARS
(IUIDP BALI PROVINCE HYDROLOGY 1988)



LEGEND

+2065 Point Rainfall(mm)

28 Station number

2800 Isohyets in mm

0 5 10 15 20 km

Scale 1 : 400,000

NAME OF IKK (BALI)

NO.	IKK	KABPATEN
B1	BLAHKIUH	BADUNG
B2	MUNDUK	BULELENG
B3	TISTA	"
B4	SANGSIT	"
B5	PANJI	"
B6	SINGAKERTA	GIANYAR
B7	TAMPAKSIRING	"
B8	TEGALALANG	"
B9	KETWEL	"
B10	ASAHDUREN	JEMBRANA
B11	ABANG	KARANGASEM
B12	BABANDEM	"
B13	MENANGA	"
B14	SIBETAN	"
B15	SAKTI	KLUNKUNG
B16	MARGA	TABANAN
B17	PUPUAN	"
B18	ANTAP	"
B19	BANGBANG	BANGLI
B20	TIGA	"

2. Physiography and Hydrogeology

2.1 Summary of Hydrogeological Conditions at 121 IKK Sites

The following tables that were prepared for the Basic Plan in the end part of the Phase I are provided herein.

Table B-2.1 A Brief Summary of Geological Features and Hydrogeological Conditions, Central Java, which consists of 6 tables.

Table B-2.2 A Brief Summary of Geological Features and Hydrogeological Conditions, East Java, which consists of 4 tables.

Table B-2.3 A Brief Summary of Geological Features and Hydrogeological Conditions, Bali, which consists of 2 tables.

Table B-2.4 A Brief Summary of Water Resources and Their Potentiality, Central Java, which consists of 7 tables.

Table B-2.5 A Brief Summary of Water Resources and Their Potentiality, East Java, which consists of 4 tables.

Table B-2.6 A Brief Summary of Water Resources and Their Potentiality, Bali, which consists of 2 tables.

Notes : If the implementation is performed, in-depth field survey and review shall be run on the proposed water source and its capacity provided in Tables B-2.4 through B-2.6. Change of water source or modification of the capacity will be required in the implementation. In case of 30 high priority IKKs, refer to Section 2.2. of this report and Section 6.1.2 of Main Report about these issues.

Table B-2.1 (a) A Brief Summary of Geographical Features and Hydrogeological Conditions for IKKs in the Province of Central Java

Kabupaten	IKK	Annual Rainfall (mm)	Topographical Features	Geological Features	Hydrogeological Conditions
Brebes	Bantarkawung	2,537 (1988) 1,894 (1989)	El. +75 to +100m. A valley in the upstream section of Pemali River in the foot of hills.	Miocene sedimentary rocks overlain by Pliocene and Holocene volcanic facies.	Potential of groundwater productivity is low. Ciheurup Sping (19 l/s) in the IKK area is available.
	Bulakamba	Klampok 2,075 (1988)	El. +2 to +5m. Coastal lowland of Alluvial plain contacted with Java Sea on the north.	Alluvial swamp and lake deposits composed mainly of clays more than 80m thick.	No spring. Groundwater between 10m and 80m in depth is saline. Several artesian wells (90 - 150m deep) exist in the vicinity.
	Paguyangan	200 - 300mm per month	El. +250 to +350m. Intermontane col between Mt. Slamet (+3432m) and hill range on the west.	Young quarternary volcanic products of breccia, lava, lapilli and tuff. Pliocene sedimentary rocks in the west hill.	Some dug wells become dry in the dry season. Hot spring (70°C) exists nearby. Bujung Gereng Spring (20-30 l/s) is available.
	Salem	No data	El. +400m. A depression (inter-montane basin) in the hill range, on which pine trees are planted.	Pleistocene to Holocene sediments underlain and surrounded by Pliocene volcanic products and sedimentary rocks.	Dug wells become dry in the dry season. Groundwater is locally productive. Cimangga Spr. (30 l/s) is available.
	Losari	Tonjong 2,214 (1988)	El +2 to +4m. coastal lowland (delta) of Alluvial plain contaced with Java Sea on the north.	Holocene deposits consisting mainly of clays.	Shallow groundwater is saline. There are about 20 borehole wells (40 - 60m deep) nearby, which produce fresh water.
Cilacap	Dayeuhluhur	3,682 (1988)	El. +225m. Submontane alluvial fan.	Pliocene volcanic products of andesitic breccia, lava flows and dikes, tuff and sandstone overlain by fan deposits	Generally groundwater is poorly productive, but there are many springs on the flanks of hills, some of them discharge plentiful water.
	Gandrungmangu		El. +15m. The northern part of swampy area, hill on the north	Alluvial swamp and lake deposits consisting mainly of clays, which is underlain by Miocene claystone.	Groundwater productivity is very low. No spring. Shallow dug wells become dry in the dry season.
	Jeruklegi	2,647 (1988)	El. +6 to 12.5m. A narrow valley in undulated hill area	Holocene deposits mainly of clays, which is underlain by Miocene sedimentary rocks.	No spring. No river. Dug wells become dry in the dry season. Groundwater productivity is low.
	Kesugihan	2,006 (1988)	El. +6m. Alluvial plain in the downstream part of Serayu River.	Holocene deposits (alluvial deposits) composed mainly of clays.	Dug wells do not become dry even in the dry season. Aquifers are moderately productive.
	Nusawungu		El. +6m. coastal lowland formed in the hinterland of sand dune.	Alluvial swamp and lake deposits (Holocene deposits) consisting mainly of clays.	No spring. No river. water in dug wells is brackish. Potential of groundwater productivity is low.

Table B-2.1 (b) A Brief Summary of Geographical Features and Hydrogeological Conditions for IKKs in the Province of Central Java

Kabupaten	IKK	Annual Rainfall (mm)	Topographical Features	Geological Features	Hydrogeological Conditions
Purworejo	Butuh	2,321 (1988)	El. +10m. Coastal lowland formed in the hinterland of sand dune.	Alluvial swamp and lake deposits consisting of clay, sandy clay and locally sand strata.	Groundwater table is present at a shallow depth. Water in dug wells shows yellowish grey. Aquifers are moderate to highly (locally) productive.
	Banyuurip	1,365 (1988)	El. +20m. A higher plane of coastal Alluvial plain, several incised dissections	Alluvial deposits probably less than 10m thick is underlain by Pleistocene fan deposits and Miocene sediments.	Dug wells locally become dry in the dry season. Condonsari Spr. (10 l/s±) is available.
	Grabag	1,970 (1988)	El. +6m. Coastal Alluvial plain, 5km to seashore.	Alluvial swamp and lake depsoits consisting mainly of sandy clays which transform to sand toward the Ocean.	No spring. Lereng River flows through the IKK area. Dug wells never become dry. Aquifers are moderately productive.
	Kaligesing	2,371 (1988)	El. +200m. The western part of Monoreh Hills, several valleys.	Miocene sedimentary rocks (mudstone and limestone), locally intrusive rocks and matamorphic rocks.	River become almost dry in the dry season. Many small springs, little dug wells. Caves that flow water (10 l/s+) exist.
	Kemiri	2,598 (1988)	El. +16m. A higher plane of Alluvial plain. Hills at 8km north.	Alluvial deposits are underlain by sedimentary rocks of mudstone and sandy clay stone in alternation.	No spring. Possibly there is sand layer in the Alluvium. Groundwater potential of sedimentary rocks is low.
	Purwodadi	3,097 (1988)	El. +12m. Coastal Alluvial plain. Menoreh Hills on the east.	Alluvial deposits alternated by silty clay layers and sandy clay layers. The east hill consists of calcareous mudstone.	Groundwater productivity is moderately high. Shallow groundwater shows yellowish grey because of solution.
	Bayan	2,386 (1988)	El. +20m. A higher plane of Alluvial plain.	Relatively stiff alluvial deposits mainly of brown silty clays, occasional sandy clay with some gravels.	2 rivers flow in the IKK area. No spring. Groundwater potential varies depending on location due to erratic stratification.
	Ngombol	1,433 (1988)	El. +12m. Coastal lowland. 5km to seashore with sand dune	Alluvial swamp and lake deposits of clays interbedded with sand layers	No spring. No river. Aquifers are moderately productive.
Banjar-negara	Banjar mangu	3,271 (1989)	El. +300m. The southside foot of Dieng Plateau, contacting with Serayu River terrace.	Terrace deposits consisting of andesitic breccia and brown clay. Hill consists of sedimentary rocks.	More than 10 small springs in the IKK area. Mudal Spr. (30 l/s) in the flank of mountain is available.
	Karang Kobar	4,700 (1989)	El. +1000m. A part of Dieng Plateau. Dissected area.	Late Pleistocene andesitic lava and pyroclastic rocks, and Miocene sedimentary mady rocks.	Groundwater exploitation is little. Many small springs in the IKK area. Aquifers are poorly productive.

Table B-2.1 (c) A Brief Summary of Geographical Features and Hydrogeological Conditions for IKKs in the Province of Central Java

Kabupaten	IKK	Annual Rainfall (mm)	Topographical Features	Geological Features	Hydrogeological Conditions
Banjar-negara	Madukara	2,407 (1987) 4,216 (1988) 3,940 (19089)	El. +350 to +450m. The south side foot of Dieng Plateau, contacting with Serayu River terrace.	Pleistocene terrace deposits in the Serayu valley. Young Quarternary andesitic breccia in the hill.	Aquifers are poorly productive. Dug wells sometimes become dry. Several small springs.
	Pagentan	2,549 (1987) 3,617 (1988) 2,270 (1989)	El. +900 to +1000m. A part of Dieng Plateau range with a gorge in the east side.	Andesitic breccia, tuffaceous sandstone, tuff, marl, conglomerate of Miocene deposits.	No dug well. Groundwater potential is low. Several small springs are present in/around the IKK area.
	Punggelan	2,727 (1987) 2,115 (1988) 2,807 (1989)	El. +325m. The submontane slope of Mt. Simenbut (+1306m).	Sedimentary rocks and volcanic andesitic breccia of Quarternary deposits.	Aquifers are poorly productive. Dug wells become dry in the dry season. Trabawulan Spr. (35 l/s) is available.
	Purwonegoro	2,782 (1987) 3,546 (1988) 3,389 (1989)	El. +145m. The Serayu River terrace.	Terrace deposits consisting of semi-consolidated sandstone, sands, tuffs and tuffaceous breccia.	There are many small springs in the IKK area. Aquifers are poorly productive. Kali Gowok springs are available.
	Purwarejo Klampok	2,620 (1987) 3,351 (1988) 2,891 (1988)	El. +50m. The Serayu River terrace	Terrace deposits same as above and Pliocene sedimentary rocks of sandstone, marl and shale.	More than 10 springs in/around the IKK area. Jayud Spr. (25 l/s) and Guyangan Spr. (15 l/s) are available.
Kebumen	Karamsambung	2,841 (1987) 2,516 (1988)	El. 160m. The Lukula River terrace and a talus of fault scrap in the eastside	Young terrace deposits and talus underlain by Miocene sedimentary rocks mainly of limestone.	Majority of dug wells become dry in the dry season. Groundwater potential is low. Several small springs.
	Ambalresmi	6,181 (1988)	El. +6m. Coastal lowland just behind sand dune of El. +9m to +15m	Alluvial swamp and lake depsoits mainly of clays, erratically interbedeed with sand layers.	Aquifers are moderately productive. Groundwater from dug wells (max. 20m deep) is not brackish.
	Demangsari	2,952 (1987) 2,949 (1988)	Coastal lowland (El. +4m) and rocky hills of Cape Karangbolong.	Swampy Holocene deposits in the lowland. Cavernous Miocene limestone in the hill.	There are several springs whose discharge rate is 10 l/s + in Desa Jatijajar. Some of them are available.
	Setrojenar	2,153 (1987) 3,014 (1988)	El. +4m. Coastal lowland just behind sand dune. Swampy river is near.	Alluvial swamp and lake deposits mainly of clays.	No spring. No irrigation channel. Groundwater productivity is poor. Deep groundwater is saline.
	Karanggayam	2,633 (1987) 2,551 (1988)	El. +100m plus. A valley in the Dieng Plateau.	Miocene sedimentary rocks consisting mainly of mudstone.	Groundwater potential is very low. Many small springs, but the majority become dry in the dry season.

Table B-2.1 (b) A Brief Summary of Geographical Features and Hydrogeological Conditions for IKKs in the Province of Central Java

Kabupaten	IKK	Annual Rainfall (mm)	Topographical Features	Geological Features	Hydrogeological Conditions
Purworejo	Butuh	2,321 (1988)	El. +10m. Coastal lowland formed in the hinterland of sand dune.	Alluvial swamp and lake deposits consisting of clay, sandy clay and locally sand strata.	Groundwater table is present at a shallow depth. Water in dug wells shows yellowish grey. Aquifers are moderate to highly (locally) productive.
	Banyuurip	1,365 (1988)	El. +20m. A higher plane of coastal Alluvial plain, several incised dissections	Alluvial deposits probably less than 10m thick is underlain by Pleistocene fan deposits and Miocene sediments.	Dug wells locally become dry in the dry season. Condonsari Spr. (10 l/s±) is available.
	Grabag	1,970 (1988)	El. +6m. Coastal Alluvial plain, 5km to seashore.	Alluvial swamp and lake depsoits consisting mainly of sandy clays which transform to sand toward the Ocean.	No spring. Lereng River flows through the IKK area. Dug wells never become dry. Aquifers are moderately productive.
	Kaligesing	2,371 (1988)	El. +200m. The western part of Monoreh Hills, several valleys.	Miocene sedimentary rocks (mudstone and limestone), locally intrusive rocks and matamorphic rocks.	River become almost dry in the dry season. Many small springs, little dug wells. Caves that flow water (10 l/s+) exist.
	Kemiri	2,598 (1988)	El. +16m. A higher plane of Alluvial plain. Hills at 8km north.	Alluvial deposits are underlain by sedimentary rocks of mudstone and sandy clay stone in alternation.	No spring. Possibly there is sand layer in the Alluvium. Groundwater potential of sedimentary rocks is low.
	Purwodadi	3,097 (1988)	El. +12m. Coastal Alluvial plain. Menoreh Hills on the east.	Alluvial deposits alternated by silty clay layers and sandy clay layers. The east hill consists of calcareous mudstone.	Groundwater productivity is moderately high. Shallow groundwater shows yellowish grey because of solution.
	Bayan	2,386 (1988)	El. +20m. A higher plane of Alluvial plain.	Relatively stiff alluvial deposits mainly of brown silty clays, occasional sandy clay with some gravels.	2 rivers flow in the IKK area. No spring. Groundwater potential varies depending on location due to erratic stratification.
	Ngombol	1,433 (1988)	El. +12m. Coastal lowland. 5km to seashore with sand dune	Alluvial swamp and lake deposits of clays interbedded with sand layers	No spring. No river. Aquifers are moderately productive.
Banjar-negara	Banjar mangu	3,271 (1989)	El. +300m. The southside foot of Dieng Plateau, contacting with Serayu River terrace.	Terrace deposits consisting of andesitic breccia and brown clay. Hill consists of sedimentary rocks.	More than 10 small springs in the IKK area. Mudal Spr. (30 l/s) in the flank of mountain is available.
	Karang Kobar	4,700 (1989)	El. +1000m. A part of Dieng Plateau. Dissected area.	Late Pleistocene andesitic lava and pyroclastic rocks, and Miocene sedimentary marly rocks.	Groundwater exploitation is little. Many small springs in the IKK area. Aquifers are poorly productive.

Table B-2.1 (e) A Brief Summary of Geographical Features and Hydrogeological Conditions for IKKs in the Province of Central Java

Kabupaten	IKK	Annual Rainfall (mm)	Topographical Features	Geological Features	Hydrogeological Conditions
Kudus	Dawe		El. +90m. The southside foot of Mt. Miria that is bounded by the Kudus alluvial plain.	Consists of volcanic products such as breccia, tuff, and leucite bearing rocks	Aquifers are moderate to highly productive. There are several large springs on the mountain flanks.
Pati	Batangan	1,717 (1986) 1,276 (1980) 1,289 (1988)	El. +2 to +6m. Coastal lowland plain bounded by Rembang Bay on the north.	Alluvium; Holocone deposits; mainly of marine clays	Potential of goundwater productivity is very low. Groundwater is saline (brackish).
	Tayu	1,986 (1986) 2,315 (1987) 1,778 (1988)	El. +2 to +6m. Coastal lowland strip extended in the eastside of Mt. Muria (+1602m)	Alluvial deposits are under lain by volcanic products that are consisted mainly of leucite bearing rocks.	Extensive and highly productive aquifers are present in the submontane belt area on the west.
Rembang	Kaliori	1,399 (1986) 1,221 (1987)	E. +2 to +4m. Coastal lowland bounded by Rembang Bay on north	Thick Holocene deposists; mainly of marine clays with shell frameents	Potential of groundwater productivity is very low. Groundwater is saline. Inhabitants get water from "Jomblang".
	Sale	2,262 (1986) 1,103 (1987)	El. +100m. A valley in the central part of Kapur Utara Hill range	Alluvial deposits are underlain by Miocene to Pliocene sedimentary rocks of calcareous sandstone and limestone.	Groundwater potential is generally low, but there are such big springs as "Semen spr. (800 l/s+)" and "Tahunen spr. (80 l/s)".
Sragen	Tangen		El. +75m. Fluvial plain along the middle-upper stream of Solo River	Miocene to Pliocene sedimentary rocks of calcareous facies are covered by alluvial deposits.	No spring. Groundwater productivity potential is low in a general sense.
	Miri		El. +100m. Fluvial plain in a undulated hill region	Miocene to Pliocene sedimentary rocks are overlain by volcanic products of Pleistocene epoch and Alluvium.	Small springs exist. Groundwater productivity potential is low in a general sense.
	Gondang	1,833 (1988)	El. +85m. The Solo River basin bounded by the foot of Mt. Lawu (+3265m) on the south	Mainly consists of Quarternary volcanic products of tuff, breccia and lava.	No spring. The region of highly productive aquifers.
	Jenar		El. +89m. Fluvial plain of the Solo River with undulated hills in the north side	Miocene to Pliocene sedimentary rocks of calcareous facies, which are covered by Alluvium in the lowland.	No spring. Grounding productivity potential is low in a general sense.
	Plupuh	1,399 (1988)	El. +84m. Fluvial plain along the middle-upper stream of Solo River	Quarternary volcanic facies and products. Swampy alluvial deposits mainly of clay in the east side.	Groundwater productivity is generally poor, but it is fairly good in the south section.
	Sambirejo	1,560 (1989)	El. +200m. The lower flank of Mt. Lawu (+3265m), dissected	Consists of Quarternary volcanic products of tuff, breccia and lava	Small springs exist. The region of highly productive aquifers.

Table B-2.1 (f) A Brief Summary of Geographical Features and Hydrogeological Conditions for IKKs in the Province of Central Java

Kabupaten	IKK	Annual Rainfall (mm)	Topographical Features	Geological Features	Hydrogeological Conditions
Wonogiri	Jitiroto	1,879 (1987) 2,051 (1988) 2,000 (1989)	El. + 245m. The valley between Mt. Kususan (+2298m) and the Southern Mountains	Miocene sedimentary rocks of marl, calcareous sandstone and limestone, locally old Quarternary volcanic products	Small springs exist. Low pontential in groundwater productivity
	Nguntoronadi	1,359 (1987) 1,712 (1988) 1,465 (1989)	El. + 200m. The depression in the Southern Mountains bounded by Gajahmungkur Reservoir lake	Miocene sedimentary rocks mainly of limestone facies	Small springs exist. Aquifers are moderately productive.
	Giriwoyo	1,991 (1988)	El. +200m. The eastern edge of karstified limestone peneplain	Miocene limestone facies; marl, limestone and shale, locally covered by alluvial deposits	Medium to large springs exist, one of which discharges 33 l/s and is usable. Aquifers are moderately productive.
	Jatipurno	2,133 (1987) 2,186 (1988) 2,782 (1989)	El. +500m. The southside flank of Mt. Kususan (+2298m)	Old Quarternary volcanic products consisting of tuff, breccia and lava of low to moderate permeability	Small to medium size springs exist, some of which discharge 15 - 20 l/s and are applicable.
	Bulukerto	2,302 (1988) 2,271 (1989)	Ditto	Ditto	Small to large springs exist, one of which discharges 42 l/s and is applicable.
	Manyaran		El. +300m. Sloped area of rocky hill	A series of Miocene sedimentary rocks of limestone facies, occasionally volcanic products	Small to medium size springs exist, one of which dischages 20 - 35 l/s and is applicable.
Semarang	Bawen	1,562 (1988)	El. +500m. Submontane slope formed by Mt. Ungaran (+2050m) and Mt. Merbabu (+3142m)	Volcanic products of breccia, lava, tuff and tuffaceous sandstone and claystone; covered by brown soil 5 - 10 m thick	Unbul spring (160 l/s in total discharge) locates at some 10km southward. This spring is available.
	Suruh	2,433 (1988)	El. +650m. The north-east side submountane slope of Mt. Merebabu (+3142m)	Mainly of lava flows; olivine basalt and augite andesite	Mudal spring (40 l/s) in IKK area is applicable. Aquifers are moderately productive.
Klaten	Bayat	1,752 (1989)	El. +118m. The narrow valley formed between hill and karstified peneplain	Holocene deposits about 20m thick is underlain by indistinctive rocks formation	Aquifers are moderately productive. Shallow artesian wells exist in the northern section of Desa Banyuripan.
	Karangnongko	1,904 (1989)	El. +400m. Mt. Merapi (+2911m) submontane slope with incised valleys	Young Quarternary volcanic products of ash, tuff, breccia and agglomerate, and their secondary deposits	Some springs exist by reverbed consisting of sand and gravel. Groundwater potential is high.

Table B-2.2 (a) A Brief Summary of Geographical Features and Hydrogeological Conditions for IKKs in the Province of East Java

Kabupaten	IKK	Annual Rainfall (mm)	Topographical Features	Geological Features	Hydrogeological Conditions
Bojonegoro	Balen		El. +16m. Alluvial plain along Solo River.	Alluvial river deposits. Pleistocene sedimentary rocks in the southern section.	Aquifers are poorly productive and are low to very low in transmissivity. No spring.
	Baureno		El. +25m. An elevated spot in the Solo river plain.	Alluvial deposits. Pleistocene to Pliocene sedimentary rocks in the southern section.	Dug well condition differs between north section and south section. A few small springs.
	Kapas	Bojonegoro 1,685 (1988)	El. +26m. Alluvial plain along Solo River.	Alluvial river deposits. Pliestocene sedimentary rocks in the southern section.	No spring. Some dug wells become dry in the dry season. Area of poorly productive aquifers.
	Sumberrejo		El. +40m. Alluvial plain along Solo River. Hills are near.	Ditto	Groundwater is brackish. dug wells in the south area become dry in the dry season. No spring.
Tuban	Bangilan	1,449 (1988)	El. +45m. A depression in the eastern part of Kapur Utara Hill	Pliocene sedimentary rocks. Folded and faulted Miocene sedimentary rocks in the north hill.	Dug wells never become dry. An artesian test well exists in Desa Sidodadi, which is usable.
	Bulu		El. +10m. Coastal Alluvial plain. Seaside.	Alluvial deposits consisting mainly of clays. Miocene to Pliocene sedimentary rocks in the southern hill.	A few small springs. Unsuitable area for groundwater exploitation, but locally exploitable.
	Parengan		A part of undulated hill area.	Pleistocene sedimentary facies, mainly of limestone.	Groundwater potential is very low. Hot spring in Desa Wukirharjo. Watuaggar Spr. (max. 30 l/s) is usable.
	Jenu	1,610 (1988)	El. +10m. Coastal Alluvial plain. Seaside. A small hill on the west.	Coastal Alluvium, mainly of clays. Pliocene limestone in the west hill.	No spring. Unsuitable area for groundwater exploitation. Production well (30 l/s+) is present.
	Kerek	1,784 (1988)	El. +75m. Flat high land extended in the northern part of Kapur Utara Hill.	Pleistocene basin deposits underlain by Pliocene limestone.	Groundwater potential is very low, but there is a big spring flowing water more than 60 l/s; Ngiptng Spr.

Table B-2.2 (b) A Brief Summary of Geographical Features and Hydrogeological Conditions for IKKs in the Province of East Java

Kabupaten	IKK	Annual Rainfall (mm)	Topographical Features	Geological Features	Hydrogeological Conditions
Lamongan	Karanggeneng		El +23m. Alluvial plain in the downstream area of Solo River.	River Alluvium; Flood plain deposits of Solo River. Pliocene limestone in the north hill.	Groundwater is brackish and its potential is very low. Dug wells become empty in the dry season.
	Kembangbahu		El. +28m. Alluvial plain.	Mainly of Pleistocene sedimentary facies; marly.	Groundwater potential is very low especially in the south district. Water is calcareous. No spring.
	Tikung	1,509 (1988)	El. +23m. Alluvial plain.	Ditto	Groundwater potential is very low. Water is calcareous. No spring.
	Ngimbang	1690 (1987)	El. +90m. Gently sloped area extended in the foot zone of an isolated hill.	Pliocene sedimentary rocks and limestone. Faulted.	Several small springs. Groundwater potential is low. No water has come out from 75m test well. Titing Spr. (6 l/s) is available.
	Brondong		El. +10m. A small estuary plain.	Alluvium is underlain by Pliocene limestone (dolomitic limestone) and dolomite.	Groundwater is brackish and unsuitable for drinking. Groundwater potential is very low. No sping.
Jombang	Diwek	Jombang 1,173 (1988)	El. +60m. A highland area of Alluvial plain.	Alluvial deposits consisting by the alternation of sand, gravel and clay layers.	Extensive and highly productive aquifer area. Locally several borehole wells.
	Gudo		El. +60m. A highland area of Alluvial plain.	Ditto Permeability of soil is high in the deep strata.	Extensive and highly productive aquifer area. Artesian well zone.
	Kudu		El. +23m. Fluvial plain of Brantas River.	Alluvial deposits consisting by the alternation of silt, sand, gravel, and clay layers.	Groundwater potential is moderately high. Shallow groundwater is brackish.
	Megaluh		El. +32m. Fluvial plain of Brantas River.	Ditto	Ditto
	Mojowarno		El. +55m. A highland of alluvial plain near a series of volcanos.	Quarternary volcanic products with moderate to high permeability.	Extensive and highly productive aquifer area, but locally very poor productivity.
	Ngoro	1,422 (1988) 1,933 (1989)	El. +92m. Gently sloped fan-like land in the west of Mt. Argowayang (+2198m)	Young Quarternary volcanic products of tuffs, lahar, breccias and lavas.	Esxtensive and highly producive aquifers in the submontane zone. There is a production deep well.

Table B-2.2 (c) A Brief Summary of Geographical Features and Hydrogeological Conditions for IKKs in the Province of East Java

Kabupaten	IKK	Annual Rainfall (mm)	Topographical Features	Geological Features	Hydrogeological Conditions
Madiun	Jiwan	Madiun 1,818 (1988)	El. +65m. Intermontane plain between Mt. Liman (+2563m) and Mt. Lawu (+3265m).	River and basin deposits of clay, sand and gravel from volcanos. Alluvium.	Extensive and highly productive aquifer area.
	Mejayan		El. +76m. Flat land formed on the northside of Mt. Liman (+2563m).	Ditto. Plus Pleistocene sedimentary facies including marl.	Extensive and highly productive aquifer area. Extensible water suypply system exists.
Mojokerto	Dianggu		El. +90m. Gently sloped land formed on the northside of Mt. Welirang (+3156m).	Quarternary volcanic products of breccia, lahar, lava and brown soil.	Groundwater productivity is fairly high. Jubel Spr. (70 l/s) is in Kec. Pacet.
	Gedeg	Mojokerto 1,533 (1988)	El. +21m. Fluvial plain formed by Brantas River.	Alluvial deposits consisting of silt, sand and gravel covered by black clay.	Highly productive aguifers in the lower part of Alluvium. An artesian well is present nearby.
	Jatirejo		El. +90m. Submontane flat land at the foot of Mr. Welirang (+3156m).	Quarternary volcanic products of low to moderate permeability.	Auifers are moderately productive. Groundwater level is deep. Ubalan Spr. (10 l/s+) is available.
	Kutorejo		El. +125m. Gently sloped land formed on the northside of Mt. Welirang (+3156m).	Quarternary and undifferential volcanic products of breccia, lahar and lava.	Extensive and highly productive aquifer area. Existing deep well yields 25 l/s. Jubel Spr. flows 70 l/s.
	Pacet		El. +600m. The lower flank of Mt. Welirang (+3156m).	Quarternary volcanic products of low to moderate permeability.	Aquifer producivity is low, but fairly big springs are present. Mojo Spr. (40 l/s). Ubalan Spr. (70 l/s).
Lumajang	Candipurno		El. +320m. The southeast foot of Mt. Semeru (+3670m).	Young quarternary volcanic products; tuff, lahar, breccia and andesitic to basaltic lavas.	Grounwater productivity is moderate. G.W.L. of aquifer is deep. Gedang Sutro Spr. (20 l/s) is available.
	Gacialit		El. +625m. The eastside lower flank of Mt. Bromo (+2329m).	Old Quarternary volcanic products undifferentiated.	Area of no groundwater exploitation. Several springs are present. One of them is useful.
	Tempeh	Lumajang 1,998 (1988)	El. +85m. The submontane slope on the east of Mt. Semeru and Mt. Kepalo.	Young Quarternary volcanic products; tuff, labar, breccia and andesitic to basaltic lavas.	Aquifers are largely varying in transmissivity. Tikir Spr. (100 l/s) is available.

Table B-2.2 (d) A Brief Summary of Geographical Features and Hydrogeological Conditions for IKKs in the Province of East Java

Kabupaten	IKK	Annual Rainfall (mm)	Topographical Features	Geological Features	Hydrogeological Conditions
Lumajang	Kunir		El. +35m. A gently sloped Alluvial plain.	Alluvial deposits of gravel and sand with clayey soil interlayers.	Extensive aquifers of moderate to high transmissivity. Springs around the site are too small to supply water.
	Randuagung		El. +100m. The northern edge of gently sloped Alluvial plain contacting with Mt. Tarub.	Young Quarternary volcanic products of tuff, lahar, breccia and lava.	Groundwater productivity is moderate. Several medium size springs are present at useful conditions.
	Ranuyoso		El. +240m. A col between Mt. Bromo (+2329m) and Mt. Tarub (+1671m); water divide.	Ditto	Moderately high productive aquifer area. Ranubedali Spr. (70 l/s) by a lake is available. No dug well.
	Senduro		El. +425m. The lower flank of Mt. Bromo (+2329m) and Mt. Kepolo (+3035m).	Old quarternary volcanic products of tuff, lahar, breccia and lava.	Moderately productive aquifers of largely varying transmissivity. Blinger Spr. (12 l/s) and Ciri Spr. (120 l/s).
	Tempursari		El. +50m. The lower flank of a hill near Indonesian Ocean.	Miocene sedimentary rocks mixed with volcanic products of generally low permeability.	A large spring is present in Desa Pundungsari (out of IKK) in the same Kecamatan.
Probolinggo	Banyuanyar		El. +98m. A gently sloped land formed on the northern submontane of Mt. Tarub.	Quarternary volcanic products. Relatively thin Alluvium in the northern part.	Extensive and highly productive aquifer area. Dug wells are 25 - 35m deep. A few small springs.
	Besuk	1,407 (1988)	El. +30m. The foot of mountain contacting with coastal plain.	Volcanic products; overlain by Alluvial deposits especially in the west section.	Extensive and moderately high productive aquifer area, but little springs. Dug wells are 25 - 30m deep.
	Gending	1,069 (1988)	El. +15m. Coastal plain; Submontane slope in the southern section.	Alluvial deposits consisting of sand and gravel with intercalated clay layers.	Moderately high productive aquifer area. Some artesian wells. There is an available spring.
	Maron		El. +94m. Gently sloped submontane plain with hilly land in the south.	Young Quarternary volcanic products, overlain by Alluvium in the northern part.	Moderately high productive aquifer area. A spring (30 l/s) in Desa Brabe is available.
	Sumberasih		El. +37m. Submontane slope area near Strait of Madura. Mt. Bromo on the south.	Ditto	Extensive and highly productive aquifer area. Several springs are in valleys, one of which is available.

Table B-2.3 (a) A Brief Summary of Geographical Features and Hydrogeological Conditions for IKKs in the Province of Bali

Kabupaten	IKK (Desa)	Annual Rainfall (mm)	Topographical Features	Geological Features	Hydrogeological Conditions
Badung	Blah Kiuh	1,917 (1988)	El. +200m. The submontane slope with dissected valleys. Rice field area	Covered by Quarternary volcanic products of tuff, breccia and lahar deposits	Groundwater producivity by borehole is high (30 l/s+). Available spring exists.
Buleleng	(Munduk)		El. +600m. The upper flank of a group of mountains, with gorges at both sides	Quarternary volcanic products of several valcanos, consisting of tuff, breccia and lava	Groundwater exploitation by borehole seems impractical. Many small springs exist, one of which (10 l/s) can be used.
	(Tista)		El. +750m. A ridge of dissected mountain's upper flank. Plantation area	Old quarternary volcanic products of several volcanos; lavas, tuffs and breccias	No spring. Groundwater table is deep at the ridge plane, so well should be drilled in a valley zone.
	Sangsit		El. +25m. The foot of mountains connected with the coast plain.	Pliocene deposits consisting of lavas, breccias, and pumiceous tuffs with calcareous crack fillings.	Groundwater potential is high (20 l/s+). Singaraja Water Supply system is extensible.
	(Panji)		El. +100m. The lower flanks of mountains	Quarternary volcanic products of Bujan-Braten and Batur volcanos; tuffs and lahar deposits	Puncak Manik Spring (30 l/s) at 7km south is available.
Gianyar	(Singakerta)		El. +180m. The submontane slope with dissected vally. Rice field area.	Ditto	Groundwater productivity by borehole is considerably high. Extensible system exists.
	Tampak Siring		El. +500m. The lower flank of valcano with incised gorges	Ditto	Large spring (300 l/s) exists. Groundwater productivity by borehole is moderate.
	Tagalalang		El. +350m. The lower flank of volcano with incised gorges	Ditto	Bunung Kawi spring (50 l/s) is available. Groundwater productivity by borehole is moderate.
	(Ketewel)		El. +25m. Coastal terrace	Ditto	Groundwater productivity by borehole is considerably high. Extensible system exists.
Jembrana	(Asahduren)		El. +350m. The lower ridge of dissected mountain flanks with gorges 300m deep	Old quarternary volcanic products of several volcanos; lavas, breccias, and tuffs	Groundwater abstraction by borehole is impractical. Nine springs exist along the gorge.

Table B-2.3 (b) A Brief Summary of Geographical Features and Hydrogeological Conditions for IKKs in the Province of Bali

Kabupaten	IKK (Desa)	Annual Rainfall (mm)	Topographical Features	Geological Features	Hydrogeological Conditions
Karang Assem	Abang	1,282 (1989)	El. +325m. The intermontane valley between Mt. Agung (+3142m) and Mt. Seraya (+1175m).	Quarternary volcanic products of Mt. Agung and of Mt. Seraya in the lower part	Groundwater preductivity by borehole is moderate. Canging spring discharges 15 l/s.
	Bebandem	958 (1989)	El. +330m. The foot of Mt. Agung, some valleys	Quarternary volcanic products of Bujan-Braten and Batur volcanos; tuffs and lahar deposits	Groundwater producivity by borehole is moderate. Springs occur at many places.
	Menanga		El. +600m. The middle flank of Mt. Abang (+2153m) near intermontane valley	Ditto	Groundwater potential is fairly high. Arca spring (500 l/s) is available.
	(Sibetan)		El. +400m. The foot of Mt. Agung (+3142m), undulated but no river valley	Ditto	Groundwater productivity by borehole is moderate. Dukuh Muding spring (12 l/s) is available.
Klungkung	(Sakti)	Nusa Penida 1,169 (1989)	El. +250m. Small island encircled with precipices	Miocene sedimentary rocks mainly of limestone, some caves at sea level, little top soil	No groundwater at a shallow depth. A big spring (120 l/s) exists at seaside, whose water should be used.
Tabanan	Marga		El. +275m. The submontane slope of volcanos. Rice field area.	Quarternary volcanic products of Bujan-Braten and Batur volcanos; tuffs and lahar deposits	Groundwater productivity by borehole is considerably high. Two available springs exist.
	Pupuan		El. +650m. The peak (divide) of mountains	Ditto	Groundwater abstraction by borehole is impractical. A large spring (50 l/s) is available.
	(Antap)		El. +50m. The dissected terrace near sea shore. Rice field area	Ditto	Well drilling seems not easy because of hard rock seating. A spring (20 l/s) at 10km north.
Bangli	(Bangbang)	Bangli 2,636 (1989)	El. +500m. The lower flank of volcanos, some valleys	Ditto	Two medium size springs (10 - 15 l/s) exist, either of which can be used.
	(tiga)		El. +775m. The flank of volcanos, some gorges 200m or more deep	Ditto	A spring (30 l/s) exists at the bottom of gorge. Groundwater table appears to be deep.

Table B-2.4 (a) A Brief Summary of the Water Resources and Their Potentiality

No.	Name of IKK	Water Demand A.D.2000 (l/s)	Present Condition of Water Acquirement in Daily Life	Existing Water Works in IKK or The Neighborhood	Fresh Water Springs	Deep Groundwater (Deep Aquifers)	Surface Water	Proposed Water Source and Remarks
1	Bantarkawung	18.26	Most households depend on dug wells about 6m deep, but in a dry period depend on pits dug in riverbed. Desa Jipang has a water works.	Desa Jipang's water works is used by 200-300 H.H., but it has no extensibility because the current water source is a small spring (0.3 l/s).	Ciheurup spring in IKK area has the flow rate of about 19 l/s.	No deep well. Water productivity of deep aquifers is low, since the materials are of clayey sedimentary rocks.	Tributaries of Pemali River run in the IKK area.	Ciheurup Spring (19 l/s). It is said that the new system for this IKK is under design by Dinas Cipta Karya.
2	Bulakamba	19.28	75% households depend on dug wells 4-10m deep. The rest 25% buy drinking and cooking water from vendors.	No existing water works.	No spring since coastal lowland.	Several artesian deep wells (90-150m) in the vicinity, which yield fresh water at a rate of 10-15 l/s.	There are two irrigation channels and their water is used by some people for bathing.	2 Borehole Wells (150m deep, 10 l/s yield, each). Groundwater between 10m and 80m in depth is saline.
3	Paguyangan	11.71	Majority of households depend on dug wells about 7m deep. People living near dam often use the released water. Some households use spring water.	No systematic water works.	Bujung Gereng spring at 3km from Kec. office discharges at a rate of 20 l/s even in the dry season. There are several other springs.	No deep well. Groundwater productivity may be fairly high in the lower flank of Mt. Slamet on the east.	Water storage dam for irrigation use is near.	Bujung Gereng Spring (20 l/s+). Take required quantity of flow in a new system.
4	Salem	12.66	Dug wells 8-10m deep and small springs, and in the dry season temporary pits dug by a river. Some households get water from Cimangga spring.	No existing water works.	Cimangga spring (30 l/s) is at 3km from Kec. office. Water from this spring has not been used except for drinking and bathing. Other springs are small.	No deep well.	Neither useful river nor lake.	Cimangga Spring (30 l/s). Take required quantity of flow in a new system.
5	Losari	11.81	Dug wells up to 15m depth and borehole well of 40-60m depth. Water in dug wells is brackish but that from bore hole is fresh.	No existing water works.	No spring since coastal lowland.	Aquifers are not extensive and the transmissivity varies much depending on location. Several deep wells.	The water depth of Cissanggarung river is 0.25m in the dry season and 6m during a flood.	2 Borehole Wells (50m deep, 7 l/s yield each). River water is much contaminated.
6	Dayeuhluhur	8.54	Depend on existing small water works, dug wells 15-20m deep, and small springs.	There is small system provided in 1974 by the finances of the Ministry of Health. Its water source is a spring of about 10 l/s capacity.	There are many springs in the IKK area. Most of them are small, but big springs (500 l/s+) are present at 2 locations in the mountain of Dusun Ciparahu.	No deep well.	No river. Spring water is used for irrigation.	Spring (10 l/s) now used for existing small system.
7	Gandrungmangu	46.40	Depend on dug wells about 4m deep in the rainy season and on rain water storage tanks in the dry season.	No existing water works.	No spring.	No deep well. There is little exploitable aquifers.	Cibeureum river flows nearby.	Flow water of Cibeureum River.
8	Jeruklegi	20.20	Depend on dug wells 10-25m deep. The wells are useful only in the rainy season. People must depend on water supplying cars provided by Kec. in the dries.	No existing system, but the reservoir and associated water main for Kota Cilacap are located within this IKK.	No spring.	No deep well. Groundwater potential is low.	No useful river.	Extend existing Cilacap water supply system.
9	Kesugihan	12.73	Depend on dug wells 6m deep in the average. These wells never become dry. Only 10 H.H. depend on P.T. specially provided from the Cilacap system.	Intake (from Serayu river), pump station, and water treatment plant of the Cilacap City system locate within this IKK area.	No spring. Coastal lowland.	No deep well. Productivity of deep aquifers may be moderately high.	Serayu river is the east boundary.	ditto.
10	Nusawungu	18.54	Dug wells are used only for washing and bathing because the water is saline. Drinking water is given from dug wells in other desas outside the IKK.	No existing water works.	No spring. Coastal lowland.	60m deep well is present at PUSKESMAS. Water of this well is saline.	No river.	ditto.

Table B-2.4 (b) A Brief Summary of the Water Resources and Their Potentiality

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No.	Name of IKK	Water Demand A.D.2000 (l/s)	Present Condition of Water Acquirement in Daily Life	Existing Water Works in IKK or The Neighborhood	Fresh Water Springs	Deep Groundwater (Deep Aquifers)	Surface Water	Proposed Water Source and Remarks
11	Butuh	11.68	All inhabitants use water of dug wells of 5m depth in average. Well water shows yellowish grey because of suspension of dissolved clay particles.	No existing water works. Neighgourhood IKK Kutoarjo has water supply system with W.T.P., but it has no surplus capacity to supply to others.	No spring.	No deep well information, but there will be some productive aquifers in both shallow and deep depth.	2 small rivers run in IKK area.	Borehole Well (150m deep, 12 l/s yield rate). G.W.L. is near ground surface. Its seasonal fluctuation is ±2m.
12	Banyuurip	6.39	All inhabitants depend on wells 10-17m deep (dug well+borehole type). In the dry season only the wells in Desa Malangrijo (20% of IKK) become dry.	No existing water works.	Condongsari spring at 4km from Kec. office discharges at a rate of about 10 l/s. The location of this spring is outside IKK.	No deep well.	No river.	Condongsari Spring (10 l/s).
13	Grabag	17.30	All inhabitants depend on dug wells 3-5m deep. These wells never become dry during dry season. Seasonal fluctuation of g.w.l. is about 2m.	No existing water works.	No spring.	No deep well. Deep groundwater may be saline because the sea is near.	Lereng river runs on the east.	4 Borehole Wells (50m deep, 5 l/s yield, each).
14	Kaligesing	5.40	99% of inhabitants get water from small springs. The rest depends on dug wells 10-15m deep.	No existing water works.	There are 2 springs in Desa Donorejo about 6km from Kec. office. They produce water at a rate of more than 10 l/s. The name of springs is Kidang Rasak.	No deep well. Groundwater potential in IKK area is very low.	There are small rivers, but they become almost dry in the dry season.	Kidang Rasak Spring (10 l/s).
15	Kemiri	14.99	Depend on dug wells 4-6m deep. Seasonal fluctuation of g.w.l. is about 2m. In the dry season pits dugs by a river are used for washing and bathing.	No existing water works.	No spring.	No deep well. Possibly there is a sand layer in a shallow depth.	There are 2 rivers; Kali Meneng and Kali Rebug. Irrigation is completed.	3 Borehole Wells (50m deep, 6 l/s yield, each).
16	Purwadadi	13.72	Depend on dug wells 8-12m deep. In the northeastern part the wells are sunk by irrigation channels. Water in these wells shows yellowish grey.	No existing water works.	No spring.	Available information indicates a 75m deep well yields water at a safe rate of 13 l/s.	Bogowanto river on the east boundary.	3 Borehole Wells (50m deep, 5 l/s yield, each).
17	Bayan	14.03	Most inhabitants depend on shallow wells (dug wells and borehole wells) 8-12m deep. 50 H.H. get water from existing supply system for Purworejo.	Water pipe (100mm ϕ) is already extended from the Purworejo city water system to IKK Bayan.	Several small springs outside IKK.	No deep well.	2 rivers run in IKK area.	Extend the existing Purworojo Water Supply System.
18	Ngombol	4.32	Most inhabitants depend on dug wells 4-6m deep. There are several borehole wells 20-30m deep.	No existing water works.	No spring.	No deep well. Aquifers are moderately productive.	No river.	A Borehole Well (50m deep, 5 l/s yield).
19	Banjarmangu	10.23	Dug wells 15-20m deep and small springs. Bathing and washing depend mainly on river and irrigation water.	No systematic water works to this IKK, but the transmission main and W.T.P. of Banjarnegara water system are in this IKK.	There are 12 small springs in the IKK area. The potential spring is Mudal spring in Desa Pekendangan (30 l/s in a dry period).	No deep well.	A tributary of Serayu River runs in the east boundary.	Mudal Spring (30 l/s). Take required quantity of flow in a new system.
20	Karang Kobar	9.50	15% inhabitants use a simple water works. The others depend on dug wells about 20m deep and small springs	Desa Karang Kobar has installed a small water works. Its water source is Kencen spring.	There are 15-20 small springs. Potential springs are : Kencen Spr. (4 l/s, 2km away) Jumpi Spr. (2 l/s, 2km away) Montong Spr. (4 l/s, 2.5km away)	Potentiality of aquifers is low.	A small river in the east side.	Use 3 springs: Kencen Spr. (4 l/s) Jumpi Spr. (2 l/S) Montong Spr. (4 l/s)

Table B-2.4 (c) A Brief Summary of the Water Resources and Their Potentiality

Central Java Sheet 3 of 7

No.	Name of IKK	Water Demand A.D.2000 (l/s)	Present Condition of Water Acquirement in Daily Life	Existing Water Works in IKK or The Neighborhood	Fresh Water Springs	Deep Groundwater (Deep Aquifers)	Surface Water	Proposed Water Source and Remarks
21	Madukara	8.71	Dug wells 6-12m deep and small springs. Bathing and washing are carried out in river.	No existing water works. Irrigation channels are provided.	There are several small springs. Potential spring is Jurang Jero (min. 10 l/s) at 3km from Kec. Office.	No deep well. Aquifers are poorly productive	There are 2 small rivers: Bereng River and Tagung River	Jurang Jero Spring (10 l/s)
22	Pagentan	8.82	Depend on existing small water works and on small springs.	There are 2 small water works: 1) Supply water to Dusun Pagentan from small spring. 2) Supply water to some parts of Dusuns Bulukuning & Metawara.	There are several springs. Potential springs are: Watu Kuwuk Spr. (10 l/s+, 1.8km away) Sitan Spring (20-30 l/s, 2km away)	No deep well. Groundwater table is deep, so there is no dug well.	No irrigation channel. River flows on the bottom of a deep valley.	Watu Kuwuk Spring (10 l/s).
23	Punggelan	7.69	Depend on 6 dug wells about 20m deep, 3 small springs, and natural streams. Water of wells and springs deplete in the dry season.	No existing water works.	Small springs within IKK area are useless. Potential spring is Trabawulan Spr. (35 l/s) in Desa Petuguran at 7.5km from Kec. office.	No deep well. Groundwater potential is low.	Legong river flows on a deep valley.	Trabawulan Spr. (35 l/s). Take required quantity of flow in a new system.
24	Purwonegoro	13.48	Depend on dug wells 14-15m deep and springs. In the dry season many people take water of Kali Gowok Springs.	No existing water works.	There are 17 springs in the IKK area. Potential spring is Kali Gowek springs (10 l/s & 5 l/s) at 2km from Kec. Office.	No deep well. Aquifers are poorly productive.	Serayu River is the north boundary.	Use 2 springs: Kali Gowek Spr.I (10 l/s) Kali Gowek Spr.II (5 l/s)
25	Purworejo Klampok	33.62	Depend on dug wells 13-14m deep and small springs. In the dry season some people dig pits along Serayu River.	No existing water works.	There are 12 potential springs in/around the IKK. Large springs are: Jayuda Spr. (25 l/s, 1km away) Guyangan Spr. (15 l/s, 4km away)	No deep well.	Serayu River is the north boundary and its tributary Sadi River is on the south.	2 Borehole Wells (50m deep, 6 l/s yield, each).
26	Karangsambung	11.61	Depend on dug wells 3-10m deep (106 wells in total), but in the dry season 80% of wells become dry so that people have to use river water.	No existing water works.	There are several small springs on a talus of fault debris.	No deep well. Groundwater potential is low, but terrace deposits along Lukula River will be highly productive.	Lukula River is the west boundary. Its bed consists of sand & gravel and water is clean.	2 Borehole Wells (50m deep, 6 l/s yield, each)
27	Ambalresmi	3.56	Depend on dug wells about 10m deep and some borehole wells max. 20m deep. G.W.L. is 4m below ground surface in October.	No existing water works.	No spring.	2 borehole wells near seashore (50m and 60m deep, respectively) produce saline water at a rate of 10-18 l/s.	No river.	A Borehole Well (50m deep, 5 l/s yield).
28	Demangsari	4.28	Depend on dug wells about 6m deep. In the dry season, the majority of wells become dry so that people go to hill to take water of springs.	No existing water works.	There are several large spring (10 l/s+) on the cavernous limestone hill in Desa Jatijajar at 4km from Kec. office. Jatijajar Cave is sightseeing spot.	No deep well.	No river.	Sirah Spring (15 l/s). Take required quantity of flow in a new system.
29	Setrojenar	4.91	Depend on dug wells about 10m deep. In the dry season inhabitants of Desa Ayamputih have to get water in pits dug by Lukula River.	No existing water works.	No spring.	No deep well. Groundwater in the deep is possibly saline.	Lukula River is the west boundary. No irrigation channel.	A Borehole Well (50m deep, 5 l/s yield).

No.	Name of IKK	Water Demand A.D.2000 (l/s)	Present Condition of Water Acquirement in Daily Life	Existing Water Works in IKK or The Neighborhood	Fresh Water Springs	Deep Groundwater (Deep Aquifers)	Surface Water	Proposed Water Source and Remarks
30	Karanggayam	11.41	Depend on dug wells 4-8m deep and small springs. In the dry season the majority have to get water from water supply cars provided by Kabupaten.	No existing water works.	There are many small springs but the majority of them deplete in the dry season.	No deep well. Groundwater potential is very low.	There are Karanggayar River and its tributaries. Their water deplete in the dry season.	Extend existing Kebuman water supply system.
31	Klegenwonosari	9.23	Inhabitants depend only on dug wells 6-15m deep. The depth of wells increases towards east. In the dry season about half of wells become depletion.	No existing water works.	No spring.	No deep well. Productivity of deep aquifers is poor. Possibly alluvium is interbedded with sand layers.	Lukula River is the east boundary.	2 Borehole Wells (50m deep, 6 l/s yield, each).
32	Mirit	7.74	Depend only on dug wells 6-7m deep. These wells never become dry. The water is fresh and clean. G.W.L. is present at almost constant level of 5m.	No existing water works.	No spring.	No deep well. Possibly there are sand layers in the upper part of Alluvium.	Irrigation channel from Wadaslintang Dam is provided.	2 Borehole Wells (50m deep, 5 l/s yield, each).
33	Petanahan	9.26	Depend on dug wells 4-8m deep. Pump and elevated small water storage are installed in many houses. 30% of wells become dry in the dry season.	No existing water works.	No spring.	Available data indicate that borehole wells 50-60m deep produce water at a rate of 10-15 l/s.	No river. No irrigation channel.	2 Borehole Wells (50m deep, 6 l/s yield, each).
34	Prembun	16.19	Depend on dug wells generally 3-4m deep. G.W.L. is present at a depth of 1-2m. In the dry season g.w.l. is somewhat lowered but the well is still useful.	No existing water works.	No spring.	No deep well in the IKK. There is an artesian well at the foot of Serayu Hills at 6km north of IKK. Its overflow rate is 5 l/s±.	No river.	3 Borehole Wells (50m deep, 7 l/s yield, each).
35	Gemuh	17.66	Depend on dug wells of varying depth; 5-20m. Shallow wells become useless in the dry season. Water in some wells contain calcium bicarbonate.	No existing water works.	No spring.	Sand beds in the lower part of alluvium is highly productive aquifers, but the transmissivity varies much depending on location.	A small river on the east boundary of IKK.	2 Borehole Wells (50m deep, 10 l/s yield, each).
36	Sukorejo	18.16	Depend on dug wells of 15-30m depth, some of which become depletion in the dry season.	No existing water works.	No potential spring in IKK area. A large spring (500 l/s) called Tlogomili Spr. is present on the hill at 10km south of the IKK. Only 10% is used for irrigation.	No deep well. There will be highly productive aquifers.	Tlogomili spring is the water-head of a river.	Tlogomili Spring (500 l/s). Take required quantity of flow in a new system.
37	Singorojo	17.20	Depend on dug wells 10-30m deep, rainwater storage tanks, and a small gully river. Some wells deplete in the dry season. Well water contains much calcium.	No existing water works for drinking purpose. Water works for clove plantation exists, of which the source is Gesing spring.	There are 3 small springs in Dusun Jomblang at 1.5km from the IKK. The largest one is Gesing spring (7 l/s). The other two discharge 1-2 l/s.	No deep well. Groundwater is poorly productive because of calcareous claystone hill area.	A small gully river is present in the IKK. Bodri River flows at 3km from Kec. office.	Bodri River Water. Gesing Spr. is available but its discharging capacity is insufficient.
38	Banjarrejo	9.05	Depend on dug wells less than 10m deep. In the dry season most wells become dry, so people have to get water from pits dug in riverbed and from pond.	No existing water works.	No spring.	No deep well.	A small river is running within the IKK area, but its water decreases much in the dries.	A Borehole Well (150m deep, 10 l/s yield).
39	Jepon	17.47	Depend on dug wells about 10m deep during the rainy season and on temporary pits dug in riverbed during the dry season.	No existing water works in the IKK area. In Desa Waru of Kec. Jepon, there is a small water supply system, of which the source is a small spring.	No spring in the IKK area. In Desa Waru at about 11km north of IKK, there are several small springs. The biggest intake is used for irrigation.	There are 2 test wells (150m each) in Desa Soko (outside IKK). One of them is an artesian well.	ditto.	2 Borehole Wells (150m deep, 12 l/s yield, each).

Table B-2.4 (e) A Brief Summary of the Water Resources and Their Potentiality

No.	Name of IKK	Water Demand A.D.2000 (l/s)	Present Condition of Water Acquirement in Daily Life	Existing Water Works in IKK or The Neighborhood	Fresh Water Springs	Deep Groundwater (Deep Aquifers)	Surface Water	Proposed Water Source and Remarks
40	Mendenrejo	9.42	Depend only on dug wells about 13m deep. G.W.L. descends much in the dry season but the wells never become at useless state.	No existing water works. Pump station for irrigation is provided by Solo River	No spring.	No deep well in the IKK area. The neighbour Desa Sumber has 2 deep wells (15 l/s each). One of them supplies water for home life.	Solo River is at 200m distance from Kec. office.	A Bore hole Well (150m deep, 10 l/s yield).
41	Dawe	23.74	Depend on dug wells about 10m deep. Desa Piji has a simple water works provided by the finances of Ministry of Health.	No systematic water works. Desa Piji has water works of 2 reservoirs with public taps. Its source is a spring of 2 l/s.	There are several springs on the mountain flanks including a big water fall called "Montel". the nearest one is Termadi Spr. afar of about 10km.	No deep well in the IKK area.	Rivers flow on the bottom of deep valleys.	Termadi Spring (30 l/s).
42	Batangan	11.12	Depend on 1) water vendors, 2) water supply cars (by BPAM), 3) Jomblangs (dug-out reservoir) and 4) rainwater storage tanks. No dug well.	No existing water works in the IKK area. The end tap of existing BPAM system for Pati and Juwara is 9.3km afar.	No spring because of coastal lowland.	No deep well. Groundwater is saline, so even a shallow well is not present.	Ephemeral river only.	Extend existing BPAM system.
43	Tayu	19.70	Depend on dug wells 5-20m deep. G.W.L. descends several meters in the dry season but the wells are still at a useful condition.	No existing water works.	No spring.	There is a test well 150m deep, 4"dia. installed by PPSAB in 1986 (Pundenrejo Well).	A small river is near, whose water is used for irrigation.	2 Borehole Wells (150m deep, 10 l/s yield, each).
44	Kaliori	14.08	Depend on Jomblangs (dug-out reservoir) and rainwater storage tanks, but they become dry in the dry season, so people dig pits in the Jomblang.	No existing water works.	No spring because of coastal lowland.	No deep well. Groundwater is saline, so deep well is not applicable.	No perennial river.	The 2nd Water Supply Project now under study by PDAM. Its source is Semen Spring (see below). No potential source near.
45	Sale	20.90	Depend on dug wells 5-7m deep. These wells are useful all the year round.	No existing water works.	Semen spring (1500-2000 l/s in the rains and 800-1000 l/s in the dries) is afar of about 10km. Its water is used for irrigation (40% for C.J. and 60% for E.J.). Jahunan spr. (80 l/s) is at 1.5km.	No deep well.	No river. Irrigation channel from Semen Spr. is provided in the higher land area.	Semen Spring (800 l/s+). Take required quantity of flow in a new system.
46	Tangen	9.38	Depend on dug wells 15-20m deep. Seasonal fluctuation of g.w.l. is about 5m. Some wells become dry in the dry season.	No existing water works.	No spring.	No deep well.	Small rivers only.	A Borehole Well (150m deep, 10 l/s yield).
47	Miri	13.72	Depend on small springs and dug wells. Several houses provide rainwater storage tanks.	No existing water works to supply drinking water.	Small springs are in each desa.	No deep well in the IKK area. Borehole wells in Sumberlawang and Gemolong produce water at a rate of 5-23 l/s.	Small river flows.	2 Borehole Wells (150m deep, 7 l/s yield, each).
48	Gondang	22.35	Depend on dug wells only. The well depth varies from 8m in the north area to 27m in the south area.	No existing water works to supply drinking water.	No spring.	No deep well. Aquifers are highly productive	Sawur River flows from Mt. Lawa.	2 Borehole Wells (150m deep, 12 l/s yield, each).
49	Jenar	7.99	Depend on dug wells only. The well depth is several meters in the alluvial plain and more than 15m in the hilly area.	No existing water works.	No spring.	No deep well.	Solo River runs along the south boundary.	A Borehole Well (150m deep, 10 l/s yield, each).

No.	Name of IKK	Water Demand A.D.2000 (l/s)	Present Condition of Water Acquirement in Daily Life	Existing Water Works in IKK or The Neighborhood	Fresh Water Springs	Deep Groundwater (Deep Aquifers)	Surface Water	Proposed Water Source and Remarks
50	Plupuh	22.39	Depend on dug wells only. The well depth is generally 15m. The wells are useful all the year round.	No existing water works.	No spring. Very small springs outside IKK.	A deep well has been installed but it is not used since 3 years ago (no data available).	Solo River runs along the east boundary.	2 Borehole Wells (150m deep, 12 l/s yield, each).
51	Sambirejo	15.86	Depend on dug wells and existing water works.	Desa Kadipiro and Desa Smbirejo have 6 P.T. in total, whose water is supplied from small springs (Kaligedo & Getas).	3 Small springs (1-2 l/s each) are in Desa Masuk, 2 of which are used for existing water works.	No deep well. Aquifers are highly productive.	Irrigation channel only.	A Borehole Well (150m deep, 16 l/s yield).
52	Jatiroto	8.18	Depend on dug wells about 20m deep and existing simple water works. The dug wells never become dry.	There are total 3 P.T. in Desa Jatiroto and Desa Jatirejo. Also there are several community system. These system use small springs as the water source.	There are many small springs. Many of them are used for existing community systems.	No deep well. No available data on aquifer properties.	No river.	A Borehole Well (150m deep, 10 l/s yield).
53	Nguntoronadi	5.50	Depend on dug wells 8-20m deep and small springs. Some wells become dry in the dry season.	No existing water works.	There are several small springs.	ditto.	The IKK is surrounded by the Gajahmungker Reservoirs lake.	A Borehole Well (150m deep, 10 l/s yield).
54	Giriwoyo	7.00	Depend on dug wells 8-17m deep, small springs and simple water works. In the dry season water of them often depletes.	Existing water works provides 15 P.T. in 2 desas, but some P.T.s become useless in the dry season because the source is very small spr. (1 l/s- in the dries).	Teleng spr. (5 l/s in late October) and Kakap spr. (33 l/s in late October) in the IKK area. Their flowing water is now used for irrigation.	ditto.	A small river is near.	Kakap Spring (33 l/s). Take required quantity of flow in a new system.
55	Jatipurno	4.45	Depend mainly on existing simple water works installed separately by several communities. Dug wells are a few because g.w.l. is deep.	There are more than 10 community systems. All of them use small springs with the capacity less than 1 l/s.	Small springs are many. Potential springs are: Supit Spr.; 20 l/s, 7.5km afar Dung Grunggung Spr.; 15 l/s, 10km afar	ditto.	2 small rivers flow in incised valleys.	Supit Spring (20 l/s). Take required quantity of flow in a new system.
56	Bulukerto	11.04	Depend on existing water works and small springs. No dug well because g.w.l. is deep.	Existing system was installed by the finances of Ministry of Health in 1975, which supplies to 258 H.C. & 3 P.T. in IKK area and 130 H.C & 1 p.T. outside IKK.	There are several small springs. Potential spring is Ringinputih spring (42 l/s) at 10km from Kec. office, whose water is now used mainly for irrigation of E.J.	ditto.	ditto.	Ringinputih Spring (42 l/s). Take required quantity of flow in a new system.
57	Manyaran	7.33	17% of inhabitants are benefited by existing BPAM system. The others depend on dug wells 7-10m deep and small springs.	The BPAM system takes in water from Umbul Nogo Spr. (35 l/s) in the IKK area, which supplies to 76 H.C. & 7 P.T.	There are several small springs. Potnetial spring is Umbul Nogo(see left column), whose water is now used mainly for irrigation.	ditto.	No river.	Umbul Nogo Spring (35 l/s). Take required quantity of flow in a new system.
58	Bawon	19.68	Depend on dug wells deeper than 15m. The well water is soiled.	No existing water works.	No spring in the IKK area. A large spring called Tuk Umbul (160 l/s) locates at some 10km south. PPSAB has just completed intake facility here for the future.	ditto.	No river. Bowapening Lake is about 5km south.	Umbul Spring (160 l/s). Take required quantity of flow in a new system.
59	Suruh	16.47	Depend on dug wells 20-30m deep, existing small water works, and small river.	Existing water works supplies to 32 H.C. and 2 P.T. Its source is Jowongso spring (2 l/s).	Potential spring is Mudal Spring (40 l/s) in the IKK area. There is abandoned intake facility here.	ditto.	Small river only.	Mudal spring (40 l/s). Take required quantity of flow in a new system.

Table B-2.4 (g) A Brief Summary of the Water Resources and Their Potentiality

No.	Name of IKK	Water Demand A.D.2000 (l/s)	Present Condition of Water Acquirement in Daily Life	Existing Water Works in IKK or The Neighborhood	Fresh Water Springs	Deep Groundwater (Deep Aquifers)	Surface Water	Proposed Water Source and Remarks
60	Bayat	11.52	Depend on dug wells 6-15m deep. In the northern area of Desa Banyuripan, there are 7 artesian wells about 18m deep.	No existing water works.	No spring in the IKK area.	No deep well. Existing shallow artesian wells are of a type of dug well plus borehole.	A small river and a marsh near IKK. No rigation channel.	2 Borehole Wells (50m deep, 6 l/s yield, each).
61	Karangnonko	5.40	Depend on dug wells and small springs. The depth of the wells is 2-10m in the south area and 10-15m in the north area.	No existing water works.	Potential springs are present along the bank of Logeda River: Cliling Spr.; 20 l/s, afar of 3km Jebol Spr.; 6 l/s, afar of 3km	No deep well, but aquifers are highly productive.	3 rivers flow. Their riverbeds are sand & gravel.	A Borehole Well (50m deep, 6 l/s yield). The springs are by riverbed with cliff bank.

Table B-2.5 (a) A Brief Summary of the Water Resources and Their Potentiality

East Java Sheet 1 of 4

No.	Name of IKK	Water Demand A.D.2000 (l/s)	Present Condition of Water Acquirement in Daily Life	Existing Water Works in IKK or The Neighborhood	Fresh Water Springs	Deep Groundwater (Deep Aquifers)	Surface Water	Proposed Water Source and Remarks
1	Balen	17.77	Depend on dug wells 11-12m deep. The wells in the south section often deplete in the dry season. The water contains calcium solution.	No existing water works.	No spring.	No deep Well. No available data on aquifer properties.	Irrigation channel only.	2 Borehole Wells (150m deep, 10 l/s yield, each).
2	Baureno	14.80	Depend on dug wells. The well depth is 4-8m in the north section and more than 12m in the south section. In the dries the majority people depend on a spring.	No existing water works.	Baureno spring near Kec. office is controlled by Desa Baureno. Its water is valuable in the dry season, but the discharge rate is very low.	No deep Well. A test well at Desa Bumiayu, but its data are not available.	A small river flows near IKK.	2 Borehole Wells (150m deep, 8 l/s yield, each).
3	Kapas	16.62	Depend on dug wells 6-12m deep. Some wells become dry in the dry season.	No existing water works.	No spring.	No deep Well. No available data on aquifer properties.	Irrigation channels only.	2 Borehole Wells (150m deep, 10 l/s yield, each).
4	Sumberrejo	34.48	Depend on dug wells 25-30m deep. The well water is brackish. The wells in the south section become dry in the dry season.	No existing water works.	No spring.	A test well is in the IKK area.	No river in the IKK area.	4 Borehole Wells (150m deep, 10 l/s yield, each).
5	Bangilan	16.59	Depend on dug wells about 8m deep. The wells are useful all the year round.	No usable water works in the IKK area. Formerly there was system to supply water to Desa Bangilan from Krawak Spr. in Desa Banjarwono.	Krawak spring (3-4 l/s) is used by Desa Banjarwono (outside IKK). No other spring.	An artesian well (10 l/s+ flow, 50 l/s yield cap.) is at 6km form Kec. office. The flowing water is not used for specific purpose.	No river.	A Borehole Well (150m deep, 20 l/s yield).
6	Bulu	17.63	3 desas depend on a BPAM system (200 H.C. & 1 P.T.). The others depend on dug wells about 5m deep.	The BPAM system uses a P2AT test well as the source (yield cap. 9 l/s, pump cap. 5 l/s). Distributed water contains much sands.	No potential spring.	The P2AT test well has a yield capacity of 9 l/s.	Several small rivers flow in the IKK area.	2 Borehole Wells (150m deep, 10 l/s yield, each).
7	Parengan	12.43	3 desas (mostly Desa Wukirharjo) depend on existing water works. The others depend on dug wells 12-15m deep.	Existing system supplies to 45 H.C. and 21 P.T. Its source is Watuaggar spring.	Watuaggar spring is in Desa Wakirharjo at 9.5km from Kec. office. Its discharge rate is 30 l/s in the rains and about 15 l/s in the dries.	No deep Well.	Rivers flow in the IKK area, but their flow rate decreases much in the dries.	Watuaggar Spring (15 l/s). Renewal of existing pipe lines is required.
8	Jenu	11.67	Depend on dug wells 4-5m deep, except for people in Desa Sekardadi who use river water.	No existing water works.	No spring.	A test well in Desa Beji and a production well in Desa Karang Asam (both by P2AT). The latter (25 l/s+) is used for irrigation.	Small rivers flow.	2 Borehole Wells (150m deep, 6 l/s yield, each).
9	Kerek	17.67	Depend on existing water works installed in 1960.	Existing system supplies water to 10 desas including 4 desas of IKK. Total 150 H.C. & 41 P.T. in the IKK. The water source is Ngipting spring.	Ngipting spring now used for existing water works discharges 80 l/s in the rains and 60 l/s in the dries. 75% of it is now used for the water supply system	No deep Well.	No river.	Extend and Improve existing water supply system.
10	Karanggenang	11.14	Depend on dug wells about 10m deep, but the wells deplete in the dry season so that people get water from Solo River and make it filter for drinking.	No usable water works.	No spring.	No deep Well. No available data on aquifer properties.	Solo River flows along the north boundary.	3 Borehole Wells (150m deep, 5 l/s yield, each).

Table B-2.5 (b) A Brief Summary of the Water Resources and Their Potentiality

No.	Name of IKK	Water Demand A.D.2000 (l/s)	Present Condition of Water Acquirement in Daily Life	Existing Water Works in IKK or The Neighborhood	Fresh Water Springs	Deep Groundwater (Deep Aquifers)	Surface Water	Proposed Water Source and Remarks
11	Kembangbahu	7.04	Depend on dug wells 7-10m deep in the northern section. No wells in the south section. The water contains calcium solution.	No existing water works.	No spring.	No deep Well. 2 trial wells (40m and 100m) in the south area have resulted in failure because of little water.	A small river flows.	2 Borehole Wells (50m deep, 5 l/s yield, each).
12	Tikung	7.62	2 desas depend on existing small water works. The other 2 desas depend on dug wells 6-10m deep. The water contains calcium solution.	Existing small system supplies to 60 H.C. in 2 desas. Its source is Mantup spring. Lamongan system (70 l/s cap.) is 8km from the IKK.	Mantup spring (3-8 l/s) is at 15km south of IKK. No spring in the IKK area.	No deep Well. No available data on aquifer properties.	No river.	Extend the Lamongan system.
13	Ngimbang	5.72	Depend on dug wells and small springs. Number of dug wells is only 5 in the IKK area.	No existing water works.	There are several small springs. Potential one is Titing spring (6 l/s) in Desa Sendangrejo.	No deep Well. A P2AT test well (75m) in Desa Ngimbang has resulted in failure because of little water.	No river.	Titing Spring (6 l/s).
14	Brondong	18.60	Most people get charged potable water supplied by public car or cart. Dug well water is used for bathing and washing, for it is saline.	No existing water works. The public water car takes water from a dug well 10m deep with centrifugal pump.	No spring.	No deep Well. Groundwater is saline even in a shallow depth.	A small river runs on the west boundary.	4 Borehole Wells (50m deep, 5 l/s yield, each.a
15	Diwek	16.15	Depend on dug wells only. The well water is not clean. The well depth is several meters.	No existing water works.	No spring.	There are several deep wells in the vicinity. They are highly productive.	No river.	A Borehole Well (150m deep, 15 l/s yield).
16	Gudo	8.27	Depend on dug wells only. The well depth is 5-6m . The wells are useful all the year round.	No existing water works.	No potential spring.	No deep Well. Hydrological map indicates that aquifers are highly productive.	A small river (Kali Konto) runs.	A Borehole Well (150m deep, 10 l/s yield).
17	Kudu	11.78	Depend on dug wells 7-10m deep. In the dry season g.w.l. descends about 4m and the wells become dry, so people depend on pits dug at riverside.	No existing water works. Pump station (1000 l/s) for irrigation water is provided at a riverside of Brantas river.	No spring.	No deep Well. Productivity of aquifers are considerably high.	Brantas River is the south boundary.	A Borehole Well (150m deep, 15 l/s yield).
18	Megaluh	6.34	Depend on dug well only. The well depth is 3-4m. The wells are useful all the year round.	No existing water works.	No spring.	ditto.	Brantas River is the north boundary.	A Borehole Well (150m deep, 10 l/s yield).
19	Mojowarno	7.16	Depend on dug wells only. The well depth is 10-20m. Seasonal fluctuation of g.w.l. is about 5m.	No existing water works.	No spring.	A P2AT test well (100m) in Desa Mojowangi has resulted in 0.5 l/s yield. A deep production well for irrigation is in the IKK.	A small river only.	A Borehole Well (150m deep, 10 l/s yield).
20	Nagoro	9.30	Depend on dug wells only. The well depth is about 15m. Seasonal fluctuation of g.w.l. is about 5m.	No existing water works.	No spring.	A deep production well for factory use (bottled tea) is near.	A small river only.	A Borehole Well (150m deep, 10 l/s yield).

Table B-2.5 (c) A Brief Summary of the Water Resources and Their Potentiality

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No.	Name of IKK	Water Demand A.D.2000 (l/s)	Present Condition of Water Acquirement in Daily Life	Existing Water Works in IKK or The Neighborhood	Fresh Water Springs	Deep Groundwater (Deep Aquifers)	Surface Water	Proposed Water Source and Remarks
21	Jiwan	22.24	Depend on dug wells about 12m deep. The wells rarely become dry.	No existing water works. The Madium city system is near and is controlled by PDAM.	A few small springs.	No deep well. Hydrogeological map indicate that aquifers are highly productive.	Madium River and its tributary are near.	A Borehole Well (150m deep, 25 l/s yield).
22	Mejayan	19.60	54% of households depend on existing water works (BNA system). The others depend on dug wells about 10m deep, of which water is calcic.	BNA system controlled by BPAM provides 1554 H.C. & 43 P.T. in the IKK area. The water source is 2 deep wells in the IKK.	No spring.	2 deep wells (100m each) for existing system have the yield capacity of 15 l/s each.	Mejayan River from Mt. Liman runs near.	Extend existing BNA system.
23	Dlanggu	8.11	4% of households take water from existing water works. The others depend on dug wells 5-6m deep. The wells never deplete.	Existing system is one of branch lines bifurcated from the main to Mojokerto City. 53 H.C. have been provided in 3 desas in IKK.	No spring in the IKK area. Jebel spring (70 l/s) in the flank of Mt. Welirang is used by 3 Kabupatens; Mojokerto, Jombang and Sidoarjo.	No deep Well.	A river from Mt. Welirang is near.	Extend existing system.
24	Gedeg	12.06	Depend on dug wells about 6m deep. The wells are useful even in the dries, but quality of the water near Brantas river is not good.	No existing water works.	No potential spring.	A deep production well is near at a sugar factory, but its data could not be obtained.	Brantas River is the south boundary. The river water is contaminated.	A Borehole Well (150m deep, 15 l/s yield).
25	Jatirejo	7.45	Most people depend on dug wells. Only 1% household take water from existing water works that is a part of the system from Jubel spring.	Existing system provides 32 H.C. Its water source is Jubel spring.	2 small springs in the IKK area. Potential spring is Ubalan spring in Desa Beleran at 7km north from the IKK. Its discharge rate is more than 20 l/s.	No deep Well.	A river from the southern mountains runs on the east.	Ubalan Spring (20 l/s+). Take required quantity of flow in a new system.
26	Kutorejo	17.08	Most people depend on dug wells about 20m deep. 84 households get water from existing water works.	Existing system supplies water to 84 households in 4 desas. It is a part of comprehensive system from Jubel spring.	No spring.	There is a production well for irrigation use in the IKK area: 125m deep, 12" dia., 45 l/s yield capacity (25 l/s in use).	A small river only.	A Borehole Well (150m deep, 20 l/s yield).
27	Pacet	10.20	The majority depend on existing water works provided from springs (327 H.C.& 7 P.T.). The rest depend on dug wells and small springs.	There are PDAM system and desa Padusan system. The former is based on Mojo spr. (40 l/s, 10 l/s in use) and Ubalan spr. (60 l/s, 4 l/s in use).	There are 2 large springs outside IKK. They are now used for irrigation and existing system (see left). Several small springs are near IKK.	No deep Well.	An incised river runs on the west.	Extend existing system.
28	Candipuro	19.12	Depend on dug wells as to drinking water. For bathing and washing, river water is used.	No existing water works.	Gedang Sutro spr. (50 l/s) is at 4km from Kec. office. The discharge rate decreases to 25-30 l/s in the dries.	No deep Well.	Rivers from Mt. Semeru run in and near IKK.	Gedang Sutro Spring (25 l/s).
29	Gucialit	10.22	Depend on P.T. of existing water works and small springs.	Existing system supplies water to 2 desas (16 H.C. for public facilities and 26 P.T.). Its source is Gunung Tugel spring.	Gunung Tugel spring discharges more than 20 l/s. Existing intake is provided at a location of 4km from Kec. office.	No deep Well.	There are several incised small valleys.	Gunung Tugel Spring (20 l/s). Take required quantity of flow in a new system.
30	Tempeh	14.92	Depend on dug wells only. The well depth is 10-12m.	No existing water works to houses. Irrigation channel is provided from Takir spring.	No spring in the IKK area. Potential spring is Takir spr. (80 l/s+) in Desa Djokart at about 6km from Kec. office.	No deep Well.	A small river runs near IKK.	Takir Spring (80 l/s+). Take required quantity of flow in a new system.

No.	Name of IKK	Water Demand A.D.2000 (l/s)	Present Condition of Water Acquirement in Daily Life	Existing Water Works in IKK or The Neighborhood	Fresh Water Springs	Deep Groundwater (Deep Aquifers)	Surface Water	Proposed Water Source and Remarks
31	Kunir	20.33	Drinking water is taken from dug wells 5-7m deep. Bathing and washing are carried out in irrigation channel.	No existing water works.	No spring in the IKK area. There is a spring in Desa Kedungmoro at 3km from Kec. office, but it is too small to use for the source (only 2 l/s).	No deep Well. According to hydrogeological map, aquifers are highly productive.	Irrigation channel from Takir spring is provided in Tempoh only.	A Borehole Well (150m deep, 22 l/s yield).
32	Randuagung	14.10	Depend on dug wells 10-17m deep, existing simple water works, and springs.	Existing system takes water from Gunung Kenek spring afar of 6km, and supplies water to 19 P.T. (10 P.T. in IKK).	There are 3 potential springs: 1) Gunung Kenek Spr. (15 l/s, 6km) 2) Umblang Spr. (20 l/s, 2km) 3) Ranuwung Spr. (2 x 10 l/s, 8km)	No deep Well.	There is incised valley on the west.	Umblang Spring (20 l/s) in Desa Tempuro. Take required quantity of flow in a new system.
33	Ranuyoso	13.88	Depend on existing water works controlled by PDAM Lumajang, which is called Klakah-Ranuyoso system.	The Klakah-Ranuyoso system supplies water to 655 H.C. & 55 P.T. (135 H.C., 15 P.T. in IKK). Its source is Ranubedali spring.	Ranubedali spring discharges at a rate of 70 l/s. Its location is 2km from Kec. office. 25 l/s of flow is used by existing water system.	Neither deep well nor shallow well.	No river in IKK. A small river on the south.	Ranubedali Spring (70 l/s) Take required quantity of flow in a new system.
34	Senduro	14.42	Depend on dug wells of max. depth 15m, small springs and rivers.	No existing water works.	There are 2 potential springs: 1) Blinger Spr. (15 l/s). 2) Ciri Spr. (120 l/s, now used for irrigation)	No deep Well.	Several rivers run in incised valleys.	Blinger Spring (15 l/s).
35	Tempursari	14.42	Depend on dug wells and streams. Well water is not a good condition.	No existing water works.	There is a large spring called Sidomukti spring (300 l/s) in Desa Pundungsari at 4km from Kec. office.	No deep Well.	Rawan River runs in the east side of IKK.	Sidomukti Spring (300 l/s). Take required quantity of flow in a new system.
36	Banyuanyar	15.54	Depend on 4 wells 25-35m deep and on irrigation streams. 2 wells out of 4 become dry in the dries.	No existing water works. Irrigation channels are provided.	Very small springs only.	No deep Well.	3 small rivers run.	Two Borehole Wells (150m deep, 10 l/s yield, each).
37	Besuk	4.55	Depend on dug wells 25-30m deep. Washing and bathing are carried out in irrigation channel.	No existing water works.	No appreciable spring.	No deep Well. Hydrogeological map indicates that the productivity of aquifers is fairly high.	Besuk River runs in the west side.	A Borehole Well (150m deep, 10 l/s yield).
38	Gending	10.47	Depend on dug wells. The well water is soiled and contaminated.	No existing water works.	There are 2 springs: A small Spr. at 2km from Kec. office and Banyuanyar Lor Spr. (15 l/s) at 5km from Kec. office.	A deep artesian well is present in Desa Pesisir, but the water is saline and the flow rate is low.	A small river runs near IKK.	Banyuanyar Lor Spring (15 l/s).
39	Maron	12.50	70% of households depend on dug wells about 12m deep. The rest depends on existing Maron Wetan system controlled by BPAM.	Existing Maron Wetan system takes water from a well 93m deep and has 250 H.C. and 5 P.T., but some facilities are out of order.	Brabe spring (30 l/s+) in Desa Brabe is at an available condition.	Pump capacity of existing BDAM is 5 l/s.	Pekulen River runs in the east side.	Brabe Spring (30 l/s+). Take required quantity of flow in a new system.
40	Sumberasih	9.38	Depend on dug wells about 15m deep for all purposes.	No existing water works. Irrigation channels take in water from springs.	There are 3 springs in Desa Sumberbondo at 3-4km west of Kec. office. One spring discharges at a rate of 15 l/s+. The other two are small.	There are 2 deep wells near IKK. One well 100m deep has a yield capacity of 32 l/s and is used for irrigation purpose.	Rivers from Mt. Bromo run near IKK.	Sumberbondo Spring (15 l/s+). Take required quantity of flow in a new system.

Table B-2.6 (a) A Brief Summary of the Water Resources and Their Potentiality

No.	Name of IKK	Water Demand A.D.2000 (l/s)	Present Condition of Water Acquirement in Daily Life	Existing Water Works in IKK or The Neighborhood	Fresh Water Springs	Deep Groundwater (Deep Aquifers)	Surface Water	Proposed Water Source and Remarks
1	Blah Kiuh	6.75	Depend on dug wells 12-15m deep.	There was a system to supply water from a spring, but it was out of use in August 1990 because main pipe near the spring had been destroyed.	A spring with discharging rate of about 12 l/s is present on a sloped river bank at 2.5km from Kec. office.	No deep well.	A river runs in incised valley. Irrigation channels are provided.	Spring (12 l/s). Take required quantity of flow in a new system.
2	Munduk	6.03	Inhabitants along a main road depend on existing water supply system and the others depend on small springs.	Existing system was completed in 1977 by the finances of M.O.H. This system takes water from Lebah Tapong spr. and supplies it to 200 H.C. & 22 P.T.	There are 13 springs around Desa Munduk. Lebah Tapong spr. (10 l/s-) is used for existing system. The other potential spr. is Tukad Yemua in Tamblingan.	No deep well. (Mountain area)	Small valleys and gorges.	Tukad Yemua spring (10 l/s) at 3km from Dusun Tamblingan office.
3	Tista	5.23	Depend on dug wells about 20m deep, rainwater storage reservoirs and tanks, and water vendors. Wells and reservoirs deplete often.	No existing water works.	No spring around the IKK. The nearest potential spring is Tibumantung spring in Pupuan at 26km away.	No deep well. (Mountain area)	100m deep gorges only.	A Borehole Well (150m deep, 10 l/s yield).
4	Sangsit	11.03	Depend mostly on existing water works. The rest depends on dug wells. Existing systems were completed in 1986 (west area) and in 1987 (east area).	There are 2 existing system: Singaraja system (west area) and Airsanih system (east area) with 150 H.C. in total. Their sources are springs.	No potential spring around the IKK.	No deep well.	Sangsit River on the east.	Extend existing Singaraja system.
5	Panji	8.02	Depend on existing water works installed in 1980 by the finances of M.O.H. The rest depends on river water. No dug well here.	Existing system takes water from Banjar Anyar spring (2 l/s in the dries, 5 l/s in the rains) in Desa Ambangan, 5km from Panji. 201 H.C. & 8 P.T. in 2 desas.	Banjar Anyar spring is not satisfactory in discharge capacity. Potential spring is Puncak Manik spring (30 l/s) at Tihing tali in Desa Manadul, 7km from Panji.	No deep well.	Several streams run in valleys. Irrigation channels are provided.	Puncak Manik spring (30 l/s). Take required quantity of flow in a new system.
6	Singakerta	8.00	Depend on existing water works from a deep well.	Existing system takes water from a borehole 150m deep and supplies water to house connection taps.	No spring.	Tebongkang borehole well (150m deep, 50 l/s capacity) takes out water at a rate of 10 l/s for existing water works.	Tukad Wos River runs in the east.	Extend existing system.
7	Tampak Siring	8.38	Depend on existing simple water works and springs.	Detailed data on existing system was not available.	A large spring (300 l/s) in the yard of Tirta temple is near.	No deep well.	Incised valleys are at both sides of east and west.	Tirta Temple Spring (300 l/s). Take required quantity of flow in a new system.
8	Tegalalang	8.03	Depend on existing simple water works and springs.	Existing system takes water from a spring and supplies water to 161 H.C. & 20 P.T. This system was installed in 1982 by M.O.H.	There are several springs. The highest potential spring is one in the yard of Gunung Kawi temple (50 l/s) in Desa Sebatu near IKK.	No deep well.	Several rivers run in incised valley near IKK.	Gunung Kawi Spring (50 l/s). Take required quantity of flow in a new system.
9	Ketewel	9.76	Depend on dug wells.	Transmission of Singakerta system has been installed to the boundary of Desa Ketewel.	No spring.	There is a production well (160m deep, 5 l/s pump up) and a test well (200m deep, 50 l/s capacity) in Desa Batubulan.	Small river only.	Extend existing Singakerta system.
10	Asehduren	3.76	Depend on existing water works. No dug well.	Existing water works was installed in 1983 by the desa finances. Its water source consist of 9 springs, including Pankung Tanges springs.	Potential spring is Pankung Tanges (10 l/s) in the bottom part of a gorge in Tutupa Forest area.	No deep well.	Gorges 300m deep.	Pankung Tanges Spring (10 l/s).

No.	Name of IKK	Water Demand A.D.2000 (l/s)	Present Condition of Water Acquirement in Daily Life	Existing Water Works in IKK or The Neighborhood	Fresh Water Springs	Deep Groundwater (Deep Aquifers)	Surface Water	Proposed Water Source and Remarks
11	Abang	3.30	Depend on dug wells 4-17m deep (total 15 wells), Tukad Tubuh spring and seepage from river banks.	No existing water works.	Tukad Tubuh spring is used for irrigation purpose and its flow rate is low. Potential spring is Canging spr. (15 l/s) in Desa Pid Pid, 1km from Desa Abang.	No deep well.	Streams run in incised valleys.	Changing Spring (15 l/s).
12	Bebandem	3.65	Depend on dug wells 2-15m deep, springs and seepages from river banks, rain water storage tanks, and existing water works.	Existing system takes water from 2 springs and supplies water to 205 H.C. & 2 public hydrants in 4 banjers out of 12.	There are 5 small springs of 2-6 l/s flows. 3 springs are now used for irrigation purpose.	No deep well. A test well 30m deep has been resulted in failure.	2 rivers run in IKK area.	Spring (4-5 l/s)
13	Manggis	6.40	Depend mainly on springs. Some households buy water from a water vendor truck.	No existing water works.	Arca spring (500 l/s) is at 1.2km from the Desa office. 10 l/s of the flow is supplied to the Besaki system by 5 stepped pumps.	No deep well.	Several rivers run in incised valleys.	Arca Spring (500 l/s) Take required quantity of flow in a new system.
14	Sibetan	10.80	Depend on existing water works, dug wells 6-30m deep, and springs.	Existing system was installed in 1986 by the finances of M.O.H. The source is Sog Sog spring in Banjar Telaga. This system supplies water to 15 P.T.	Sog Sog spring (5 l/s) is insufficient in capacity. Potential spring is Dukuh Muding spring (12 l/s) in Banjar Dukuh.	No deep well.	No river.	Dukuh Muding Spring (12 l/s).
15	Sakti	7.05	Depend on rain water receptables (underground), public rainwater reservoirs (ground) and dug wells 5-17m deep. They become dry in the dries.	No existing water works.	Penida spring (120 l/s) is present at seaside about 2km afar. This spring consists of several springs.	No deep well. (Limestone hill)	No river.	Penida Spring (120 l/s). Take required quantity of flow in a new system.
16	Marga	6.00	Depend on 2 types of existing water works; Marga system and PDAM system. These systems take in water from springs.	Marga system is controlled by Desa Marga; completed in 1980, provided with 65 H.C. & 60 P.T. PDAM system; completed in 1989, provided with 240 H.C.	Telebsan Slaka spr. (2.8 l/s) in Desa Petiga is used for the Marga system. Kuwan spr. (5 l/s) in the same desa is used for PDAM system. There is another spr. (6 l/s) nearby.	No deep well.	Several rivers run in incised valleys.	A new spring (6 l/s) at 300m downstream of Kuwan spring.
17	Pupuan	3.10	Depend on existing water works and small springs.	Existing system is controlled by Desa Pupuan; completed in 1975 by the finances of M.O.H., provided with 287 H.C. & 9 P.T. The source is Pangkung Wari spr.	The flow rate of Pangkung Wari spring is less than 2 l/s. A large spring (Pibuman Tung spr. 50 l/s) is at 3km upstream of said spring.	No deep well. (mountain pass)	No river.	Pibuman Tung Spring (50 l/s). Take required quantity of flow in a new system.
18	Antap	4.62	Depend on bare pits (3m deep, 60cm dia.) dug near irrigation channel. No well at other places.	No existing water works. Irrigation channels are provided.	No spring in the vicinity. Potential spring is Mukori spr. (20 l/s) in Desa Belimbing 10km northward.	No deep well.	Several rivers run in incised valleys.	Belimbing Spring (20 l/s). Take required quantity of flow in a new system.
19	Bangbang	4.18	Depend on existing water works and springs. Existing system takes water from 2 springs; Pantunan spr. and Bangkiang Sidem spr.	Existing systems supplies water to 54 H.C. &27 P.T. Total length of transmission pipe is 7.6km.	Pantunan spr. (15 l/s). Bangkiang Sidem spr. (10 l/s). Existing system takes in 2-3 l/s from these springs.	No deep well.	Several rivers run in incised valleys.	Bankiang Sidem Spring (10 l/s).
20	Tiga	5.73	Depend on existing water works and springs. No dug well here because groundwater table is deep.	Existing system takes water from Ketupat spring. The water is served to 8 public hydrants with 4" pipe 3.7km long.	Discharge rate of Ketupat spring varies from 2.5 l/s (in the rains) to 0.5 l/s (in the dries). Nagasatru spring (30 l/s) is at the bottom of a gorge.	No deep well. Gorges of more than 150m depth are incised at both sides.	Gorges.	Nagasatru Spring (30 l/s). Take required quantity of flow in a new system.

2.2 Hydrogeological Description of 30 IKK Sites

2.2.1 Summary of Water Resources Conditions

A review was made on results of field survey and investigation on water resources to determine the most suitable water source of each IKK. Table B-2.7 consisting of 30 tables summarizes its result at every IKK, in which conditions of various types of water resources, useful test well data if any, and a proposed water source are provided in the same format. Recommendation on water collecting and development facilities is also provided.

In the determination of water source, a long-time water supply capability and a construction cost were taken into consideration as important factors.
In the determination of well size and capacity, not only the results of the field survey in Phase II including test well drilling and pumping tests, but also the following existing data of exploratory/test wells were used as reference for making decision, as well as hydrogeological maps and groundwater potential maps.

1. Daftar Sumur Explorasi/Sumur Uji, P2AT Jawa Tengah (122 wells in total)

2. Laporan Pengebolan, IKK di Bulakamba

3. Borehole Completion Report:
   1) EJWR-1; Bangilan-Tuban Kabupaten
   2) EJWR-2; Padangan-Bojonegoro Kabupaten
   3) EJWR-3; Kalitudu-Bojonegoro Kabupaten
   4) EJWR-4; Sumberrejo-Bojonegoro Kabupaten
   5) EJWR-5; Baureno-Bojonegoro Kabupaten
   6) EJWR-6; Nginbang-Lamongan Kabupaten

4. Test Well Data, East Java Groundwater Development Plan
   1) Test Well No. 104EJ; Merakura, Tuban Kabupaten
   2) Test Well No. 105EJ; Karangasem, Tuban Kabupaten
   3) Test Well No. 215EJ; Mojowarno, Jombang Kabupaten
   4) Test Well No. 95EJ; Sumberashih, Probolingo Kabupaten
   5) Test Well No. 97EJ; Kutorejo, Mojokerto Kabupaten
   6) Test Well No. 99EJ; Mojowarno, Jombang Kabupaten

5. Test Well Completion Report; Maron, Probolinggo Kabupaten

Table B-2.7(1)

Summary of Water Resources Investigation Results - IKK Bulakamba C.J.

Item		Description	
Water Supply Demand		22.8 l/s for the scheme year of 2000AD	
Topographical Conditions		Coastal lowland of El. +2 to +5m in the north side of Central Java, 4km to Java Sea	
Geological Conditions		Alluvial deposits consisted mainly of clays, which are underlain by Tertiary sedimentary rocks with some artesian aquifers	
Conditions of Water Resources	Spring	No spring in/around the IKK area	
	Shallow Groundwater	Groundwater within a depth of 10m is fresh and is abstracted by means of dug wells 4-10m deep but the productivity is low	
	Deep Groundwater	Groundwater below a depth of 10m is saline, especially in the town area. In the south area of the Kecamatan it is locally not saline	
	Surface Water	Kali Bebakan runs at 3km west of IKK but its water is saline	
	Existing Waterworks System	No existing system in the IKK area	
Test Well Data	Location	Desa Tegal Glagah	Desa Jubang
	Well Specifications	P2AT TW67: D=180m; Screens; 6"dia., 12-27 m & 57-69m	Bulakamba II: D=51m; Screens; 4"dia., 31-34 m, 39-41m & 43-45m
	Pumping Test	S.C.=1.17 l/s/m for Q=13.84 l/s	T=190-357m²/d, k=27-51 m/d for Q=3-7 l/s
	Water Quality	E.C.=810	Within norm
Selected Water Source and Recommendations	Source	Groundwater in Desa Jubang, 5km south of IKK	
	Development Facilities	2 drilled wells 300m apart in Desa Jubang; 75m depth and 12 l/s yield each, pump stations w/ generators, reservoirs, and elevated tanks	
	Treatment	Chlorination only	

Table B-2.7(2)
Summary of Water Resources Investigation Results - IKK Jeruklegi C.J.

Item		Description
Water Supply Demand		20.2 l/s for the scheme year of 2000AD
Topographical Conditions		A drawned valley of El. +6 to +12.5m and undulated hills. Marsh extends on the south
Geological Conditions		Alluvial deposits mainly of clays in the low land and Miocene sedimentary rocks in the hill area; no appreciable aquifer within them
Conditions of Water Resources	Spring	No spring in/around the IKK area
	Shallow Groundwater	Dug wells are relatively deep(10-25m) because there is no appreciable aquifer. The dry season depletes the dug wells & makes water salty
	Deep Groundwater	No deep well in/around the IKK. This area has been classified as a region without exploitable groundwater
	Surface Water	No perennial river in Kecamatan Jeruklegi. Stream water on the south is saline
	Existing Waterworks System	No waterworks for the IKK Jeruklegi, but a big reservoir and associated feeder lines of Cilacap water supply system are located in the IKK
Test Well Data	Location	No available data
	Well Specifications	
	Pumping Test	
	Water Quality	
Selected Water Source and Recommendations	Source	Existing water supply system for Kota Cilacap
	Development Facilities	Tapping to existing pipe line for Cilacap at the south area of the IKK, pump station, and reservoir
	Treatment	Not necessary

Table B-2.7(3)

Summary of Water Resources Investigation Results - IKK Kemiri C.J.

Item		Description	
Water Supply Demand		17.7 l/s for the scheme year of 2000AD	
Topographical Conditions		A high alluvial plane of El. +16m in the north part of a south coastal plain of C.J.	
Geological Conditions		Alluvial deposits consisting of sand and clay strata are underlain by Miocene sedimentary rocks mainly of mudstone with low permeability	
Conditions of Water Resources	Spring	No spring in/around the IKK area	
	Shallow Groundwater	A new shallow well test infers that alluvial sand stratum near the west boundary of the IKK is usable as an aquifer for production wells	
	Deep Groundwater	No deep well in/near the IKK area. A result of a new test well indicates that there is no potentially productive aquifer in the deep	
	Surface Water	Kali Meneng runs in the IKK and Kali Rebug runs outside IKK on the east	
	Existing Waterworks System	No waterworks exists in the IKK area	
Test Well Data	Location	Desa Kerep, about 1km west of the Kec. office	
	Well Specifications	TW-1(new): D=60m; Screens; 4"dia., 35-47 m & 50-56m	TW-2(new): D=24m; Screens; 6" PVC pipe with 4.2% opening, 10-20m
	Pumping Test	S.C.=0.048-0.063 l/s/m for Q=0.50-1.50 l/s	5-10 l/s yield for a screen opening of 25%
	Water Quality	E.C.=350, within norm	E.C.=334, Fe=3.5 mg/l
Selected Water Source and Recommendations	Source	Unconfined groundwater in Desa Kroyolor	
	Development Facilities	3 drilled wells 200m apart; 40m depth and 6 l/s yield each, pump stations, reservoirs, and elevated water tanks	
	Treatment	Iron (Fe) treatment and Chlorination	

Table B-2.7(4)
Summary of Water Resources Investigation Results - IKK Madukara C.J.

Item		Description
Water Supply Demand		8.1 l/s for the scheme year of 2000AD
Topographical Conditions		The southern edge of Dieng plateau range and Serayu river terraces
Geological Conditions		Tertiary series of mixed volcanic products and marine sedimentary rocks, terrace deposits and overlying brown soil stratum
Conditions of Water Resources	Spring	Several small springs in the hill. The biggest one is Jurong Jero in Dusun Pungangan, but its discharge is instable as it flows out of talus
	Shallow Groundwater	No appreciable aquifer in a shallow depth. The dries often depletes dug wells 6-12m deep
	Deep Groundwater	No deep well in/near the IKK area. There are 4 deep wells (150m) in Banjarnegara; one is dry and the others yield only 3-4 l/s
	Surface Water	Kali Bereng runs in the south part of the IKK but its flow rate in the dry season is small
	Existing Waterworks System	No system for the IKK. The Banjarnegara system line locates at about 6km west from the IKK
Test Well Data	Location	See above for the production wells of Banjarnegara system
	Well Specifications	
	Pumping Test	
	Water Quality	
Selected Water Source and Recommendations	Source	Mudal spring (30 l/s), Kecamatan Banjarmanggu
	Development Facilities	Spring-fed reservoir, 4.5km long supply line to existing reservoir, tapping to Banjarnegara pipe line with 6km long feeder line to the IKK
	Treatment	Lead (Pb) treatment and Chlorination

Table B-2.7(5)

Summary of Water Resources Investigation Results - IKK Punggelan C.J.

Item		Description
Water Supply Demand		7.1 l/s for the scheme year of 2000AD
Topographical Conditions		Undulated hills (El. +325m in IKK) in a south submontane flank of Mt. Simenbut(+1306m)
Geological Conditions		Tertiary sedimentary rocks of sandstones, conglomerates and tuff breccias in the north area and Quaternary volcanic products in the south
Conditions of Water Resources	Spring	Trabawulan spring at 7.5km north of the Kec. office discharges 40 l/s in total
	Shallow Groundwater	No appreciable aquifer in a shallow depth. Dug wells (20m± in depth) are habitually depleted in the dry season
	Deep Groundwater	No deep well in/around the IKK area. Available information implies that deep aquifers in this area are poorly productive
	Surface Water	Kali Ligung runs meandering in the IKK area. A little flow in the dry season
	Existing Waterworks System	No supply system in the IKK area
Test Well Data	Location	No available data
	Well Specifications	
	Pumping Test	
	Water Quality	
Selected Water Source and Recommendations	Source	Trabawulan spring-creek in Desa Petugulan
	Development Facilities	Creek-fed reservoir with protection cover against falling stones, pressure reducers, and a reservoir
	Treatment	Chlorination only

Table B-2.7(6)

Summary of Water Resources Investigation Results - IKK Karanggayam C.J.

Item		Description
Water Supply Demand		5.4 l/s for the scheme year of 2000AD
Topographical Conditions		The IKK is sited on mainly along a valley zone in Serayu mountains
Geological Conditions		Tertiary sedimentary deposits of marls with thin layers of sandy tuffs, sandy limestones and clays, locally tuffacious sandstones
Conditions of Water Resources	Spring	There are many small springs, but there is no such big one as to be used for supply source
	Shallow Groundwater	No appreciable aquifer in a shallow depth. The majority of dug wells (4-8m depth) are habitually dried up in the dry season
	Deep Groundwater	No deep well in/near the IKK area. This area has been classified as a region without exploitable groundwater
	Surface Water	Kali Karanganyar and its tributaries run in IKK but they flow little in the dry season
	Existing Waterworks System	No system for the IKK. The Kebumen supply line has been provided up to a site near the southern boundary of Kecamatan Karanggayam
Test Well Data	Location	No available data
	Well Specifications	
	Pumping Test	
	Water Quality	
Selected Water Source and Recommendations	Source	Existing Kebumen water supply system
	Development Facilities	Tapping to existing pipeline in the southern district, pump stations, and reservoirs.
	Treatment	Not necessary

Table B-2.7(7)
Summary of Water Resources Investigation Results - IKK Petanahan C.J.

Item		Description	
Water Supply Demand		9.3 l/s for the scheme year of 2000AD	
Topographical Conditions		Coastal lowland of El. +5m, 5km to Indonesian Ocean, sand dune about 1km wide along seashore	
Geological Conditions		Alluvial swamp and lake deposits consisted of sand strata and clay strata in alternation, locally old sand beach layers	
Conditions of Water Resources	Spring	No spring in/around the IKK area	
	Shallow Groundwater	30% of dug wells (4-8m in depth) are dried up during the dry season. The other wells are useful all the year round	
	Deep Groundwater	No deep production well, but P2AT exploration wells within IKK indicate that there are exploitable aquifers between depths of 10m & 50m	
	Surface Water	No flowing river within IKK. Marshy water belt is at the back of sand dune on the south.	
	Existing Waterworks System	No existing system in this IKK	
Test Well Data	Location	Desa Manggu at south	Desa Petanahan
	Well Specifications	P2AT EW98: D=60m; Screens; 6", 14-42m,	P2AT EW99: D=50m; Screens; 6", 12-30m & 36-42m
	Pumping Test	S.W.L.=1.3m; S.C.=5.8 l/s/m for Q=18 l/s	S.W.L.=1.2m; S.C.=1.7 l/s/m for Q=10 l/s
	Water Quality	E.C.= 5806; brackish	E.C.=1694; fresh
Selected Water Source and Recommendations	Source	Unconfined groundwater in Desa Karangduwur	
	Development Facilities	One drilled well of 60m depth and 10 l/s at a northern edge of IKK, pump station, reservoir; and elevated water tank	
	Treatment	Chlorination only	

Table B-2.7(8)
Summary of Water Resources Investigation Results - IKK Sukorejo C.J.

Item		Description
Water Supply Demand		16.5 l/s for the scheme year of 2000AD
Topographical Conditions		The northside submontane zone (El. +510m at IKK) of Mt. Perahu(+2565m)
Geological Conditions		Old volcanic deposits composed of basic and andesitic lava flows and breccias, which are overlain by a thick brown soil stratum
Conditions of Water Resources	Spring	No useful spring in/near the IKK. A big spring called Tlogo Mili (800 l/s) is at 15km west
	Shallow Groundwater	Most dug wells (5-30m in depth) are dried up during the dry season every year. No appreciable aquifer in a shallow depth
	Deep Groundwater	No deep well in/near the IKK. The productivity of deep aquifers varies much depending on location because of poor uniformity of deposits
	Surface Water	No flowing river within IKK
	Existing Waterworks System	No existing system in the IKK area
Test Well Data	Location	No available data
	Well Specifications	
	Pumping Test	
	Water Quality	
Selected Water Source and Recommendations	Source	Tlogo Mili spr. in a riverhead pond, 15km west
	Development Facilities	Collector caisson or embedded perforated conduits on/under one of springs, pressure reducers, and a reservoir
	Treatment	Chlorination only

Table B-2.7(9)
Summary of Water Resources Investigation Results - IKK Jepon C.J.

Item		Description	
Water Supply Demand		17.5 l/s for the scheme year of 2000AD	
Topographical Conditions		The eastern part of Blora basin. El. +120m in the IKK. Kapur Utara hill extends on the north	
Geological Conditions		The site is underlain by Pliocene to Pleistocene sedimentary rocks mainly of marls and clay stones. Faulted limestones in north hill	
Conditions of Water Resources	Spring	No spring in the IKK area. There are several springs in the north hill outside IKK but they have already been used for local water systems	
	Shallow Groundwater	No appreciable aquifer. Dug wells about 10m deep are habitually depleted in the dry season	
	Deep Groundwater	No deep production well. The new test well in IKK indicates that there is no productive aquifer nor groundwater in the deep	
	Surface Water	A river runs in the IKK area, but it becomes almost dry in the dry season	
	Existing Waterworks System	No existing system in the IKK area	
Test Well Data	Location	Desa Tempel Lemabang	Desa Soko, 9km north
	Well Specifications	New test well: D=127m; Screens: 4", 78-84m, 100-109m & 122-125m	P2AT TW77 & TW81: D=150m each; Screens: 6", at variable depths
	Pumping Test	Unable because of the lack of groundwater	TW77 is 2 l/s capacity TW81 is 5 l/s plus
	Water Quality		
Selected Water Source and Recommendations	Source	Fissure water in Limestones, Desa Soko, 9km N.	
	Development Facilities	4 drilled wells; 150m depth and 5 l/s yield each, pump stations, reservoir, and presuure reducers	
	Treatment	Iron (Fe) treatment and Chlorination	

Table B-2.7(10)
Summary of Water Resources Investigation Results - IKK Batangan C.J.

Item		Description
Water Supply Demand		12.1 l/s for the scheme year of 2000AD
Topographical Conditions		Coastal lowland of El. +2 to +6m, 2km to the Rembang bay of Java Sea
Geological Conditions		The IKK is underlain by a thick alluvium composed mainly of marine clays with saline groundwater
Conditions of Water Resources	Spring	No spring. Some town people get seepage water by means of large open pits called jomblang
	Shallow Groundwater	No dug well in the IKK area because water is saline. In desa Gunungsari outside IKK at 3km south, there are 19 dug wells of perennial use
	Deep Groundwater	No deep well in/around the IKK area because groundwater is saline
	Surface Water	Ephemeral flow river only
	Existing Waterworks System	No supply system in IKK. The Juwana system waterline is 8km west at the nearest. The max. capacity of the Juwana system is 40 l/s
Test Well Data	Location	Desa Gunungsari, 3km south of IKK, El. +25m
	Well Specifications	New test well: Well depth=27m; Screens; 4", slotted pipe at 14-18m & 20-22m, w.w. screen at 22-25m
	Pumping Test	S.W.L.=4.4m; S.C.=0.10-0.13 l/s/m for Q=1.0 l/s; max. well capacity is 1.5 l/s
	Water Quality	E.C.=7000-8800, unsuitable for water supply
Selected Water Source and Recommendations	Source	Sani river in Desa Karangdowo, Kec. Pati
	Development Facilities	Upgrade the pump capacity of existing intake for Juwana system, extend existing Juwana pipe line 8km to the IKK
	Treatment	A new water treatment plant

Table B-2.7(11)
Summary of Water Resources Investigation Results - IKK Gondang C.J.

Item		Description
Water Supply Demand		22.4 l/s for the scheme year of 2000AD
Topographical Conditions		Hills and terrace planes extended on the north side of Mt. Lawu (+3265m). El.+85m to +120m
Geological Conditions		Quaternary volcanic products of tuffs, tuffacious sandstones and breccias, which are overlain by terrace deposits in the terrace planes
Conditions of Water Resources	Spring	No spring in/around the IKK area
	Shallow Groundwater	Groundwater table becomes deeper as the ground level becomes higher. The depth of dug wells are 8m in Desa Gondang and 27m in Desa Tunggul
	Deep Groundwater	No deep well in the IKK area, but several deep wells around the IKK implies that the southern area is underlain by highly productive aquifer
	Surface Water	Kali Sawur runs on the east boundary of IKK
	Existing Waterworks System	No waterworks exists in the IKK area
Test Well Data	Location	No detailed data was obtained about the deep wells around the Gondang town; but the hydrogeological map shows the southern-most part of the IKK belongs to an extensive and highly productive aquifer zone. Pumping test data of P2AT deep wells in the same hydro-geological zone indicate that their well capacity is generally more than 15 l/s and specific yield is 2-4 l/s/m, and E.C.=310-740
	Well Specifications	
	Pumping Test	
	Water Quality	
Selected Water Source and Recommendations	Source	Groundwater in Desa Tunggul, southernmost IKK
	Development Facilities	2 drilled wells 300m apart; 150m depth and 12 l/s yield each, pump stations and a reservoir
	Treatment	Chlorination only

Table B-2.7(12)
Summary of Water Resources Investigation Results - IKK Jenar C.J.

Item		Description	
Water Supply Demand		8.7 l/s for the scheme year of 2000AD	
Topographical Conditions		Undulated hills in the north area and alluvial plain in the south area along the Solo river	
Geological Conditions		Tertiary sedimentary rocks mainly of marls, which are overlain by alluvial deposits, locally with much sands, in the alluvial plane	
Conditions of Water Resources	Spring	No appreciable spring in/around the IKK area. Only one spring that is present at a riverbank of Solo river discharges less than 1 l/s.	
	Shallow Groundwater	Dug wells are generally deep (15-20m) and are often dried up in the dries, but dug wells in Dusun Prayunan are shallow (8m-) and are never	
	Deep Groundwater	A new test well near Kec. office indicates there is no productive aquifer in the deep	
	Surface Water	Meandering Solo river flows along the south boundary of the Kecamatan	
	Existing Waterworks System	No existing system in the IKK area	
Test Well Data	Location	Near Kecamatan office	Dusun Prayunan
	Well Specifications	New test well: D=107m; Screens; 4", 76-82m, 86-92m & 92-102m	Existing dug well of D =6m and r_w=0.85m; and bored well of D=12m
	Pumping Test	S.C.=0.07-0.08 l/s/m for Q=1-2 l/s	k=0.01cm/s from d.w. & S.C.=1 l/s/m from b.w.
	Water Quality	Within norm	Within norm
Selected Water Source and Recommendations	Source	Unconfined groundwater in Dusun Prayunan	
	Development Facilities	2 drilled wells; 30m depth and 5 l/s yield each; pump stations and a reservoir	
	Treatment	Chlorination only	

Table B-2.7(13)
Summary of Water Resources Investigation Results - IKK Giriwoyo C.J.

Item		Description
Water Supply Demand		7.2 l/s for the scheme year of 2000AD
Topographical Conditions		The northern edge of karstified peneplain hill (El.+200 to +300m) and alluvial plain (+160m)
Geological Conditions		Miocene limestone facies of marls, limestones and shales, which are covered by alluvial deposits in the alluvial plane
Conditions of Water Resources	Spring	A large spring called Tuk Kakap in Desa Giriwoyo flows from a underground stream (33 l/s in the late dries and 250 l/s after the rains)
	Shallow Groundwater	Water level in dug wells (8-17m depth) falls down much in the dries. No dug well in Desa Guwotirto as there is no shallow aquifer
	Deep Groundwater	No available information about deep aquifer as there is no deep well in/around the IKK area
	Surface Water	A upper tributary of Bengawan Solo is running outside IKK from east towards north
	Existing Waterworks System	A simple waterworks has been provided in Desa Guwotirto by a finacial aid of the Christian Fund. Its supply source is small spring 1 l/s-
Test Well Data	Location	No available data
	Well Specifications	
	Pumping Test	
	Water Quality	
Selected Water Source and Recommendations	Source	Kakap spring in Desa Giriwoyo, within IKK
	Development Facilities	Spring-fed reservoir or intake weir; pump station, and reservoir
	Treatment	Chlorination only

Table B-2.7(14)
Summary of Water Resources Investigation Results - IKK Bawen C.J.

Item		Description		
Water Supply Demand		21.3 l/s for the scheme year of 2000AD		
Topographical Conditions		Submontane slopes and hills formed by Mt. Ungaran(+2050m) and Mt. Merbabu(+3142m)		
Geological Conditions		Volcanic products of breccias, lavas, tuffs, and tuffacious sandstones and claystones; covered by a brown soil stratum 5-10m thick		
Conditions of Water Resources	Spring	No spring in the IKK area. A large spring(130 l/s) called Tuk Umbul is at 15km south along the road. Intake has already been constructed		
	Shallow Groundwater	Dug wells are deeper than 15m and water from them is not clean.		
	Deep Groundwater	Recently several deep wells were drilled in the IKK area for a factory use. They indicates that deep well productivity is not high		
	Surface Water	Several small rivers run in the IKK area but their flow is very little in the dries		
	Existing Waterworks System	No system in the IKK area. Desa Kadangan, outside IKK, has a waterworks provided by a finance of MOH, whose water source is a spring		
Test Well Data	Location	Kanindotex	Coca Cola	Hartimarto
	Well Specifications	2 wells; 6" & 4"dia., 100m & 80m depth	4 wells; 8"dia 100-115m dept	6"dia., 60m depth
	Pumping Test	In operation, 2-3 l/s/well	In operation, 4 l/s/well	In operation, 0.22 l/s
	Water Quality	——	——	——
Selected Water Source and Recommendations	Source	Umbul spring in Dusun Kalibening, Kec. Jambu		
	Development Facilities	Tapping to a outlet of existing spring intake, pressure reducers, and a reservoir		
	Treatment	Chlorination only		

Table B-2.7(15)

Summary of Water Resources Investigation Results - IKK Balen E.J.

Item		Description	
Water Supply Demand		16.4 l/s for the scheme year of 2000AD	
Topographical Conditions		Alluvial plain of El.+17m. The Solo river at 7km north and low hills on the south	
Geological Conditions		Alluvium composed mainly of clays, but in the vicinity of the Solo river it is interbedded with sand layers of medium permeability	
Conditions of Water Resources	Spring	No spring in/around the IKK area	
	Shallow Groundwater	Dug wells (11-12m depth) in the northside of the main road are usable all the year round, but those in the southside usually become dry in the dry season	
	Deep Groundwater	3 test wells in Desa Kedungdowo at 4km north. Groundwater Potential map implies that there are 10-20 l/s potential aquifers in the north.	
	Surface Water	A meandering small river runs along the west boundary of Kecamatan	
	Existing Waterworks System	No waterworks for domestic use in/around the IKK. Irrigation channels are provided.	
Test Well Data	Location	Desa Kedungdowo, 4km N	Sumberrejo, 6km east
	Well Specifications	3 test wells of Solo River Authority: 4"ϕ - 80m & 100m, 8"ϕ -60m	EJWR-4: D=79m, 4"ϕ, Screens; 9-12m, 47-49m and 75-79m
	Pumping Test	No detailed data could be obtained	T=12.3 & 44.5 m²/d for Q=3.1 l/s
	Water Quality	Saline below 80m	TDS=6742, saline
Selected Water Source and Recommendations	Source	Confined aquifers of sands, Desa Kedungdowo	
	Development Facilities	2 drilled wells; 70m depth and 10 l/s yield each, pump stations, reservoirs, and elevated water tanks with inundation preventers	
	Treatment	Chlorination only	

Table B-2.7(16)
Summary of Water Resources Investigation Results - IKK Baureno E.J.

Item		Description	
Water Supply Demand		14.8 l/s for the scheme year of 2000AD	
Topographical Conditions		Undulated low hill region with dissected valleys of El.+11m to +20m. Solo river on the NW	
Geological Conditions		Pliocene sedimentary rocks (mainly of marls) in the hills and alluvium in the lowlands. Potential aquifers are restricted to alluvium	
Conditions of Water Resources	Spring	No appreciable spring. Seepage water from sedimentary rocks smells bad and is not clean	
	Shallow Groundwater	The depth of dug wells is 4-8m in the lowlands and more than 12m in the hill area. The dries depletes about 60% of wells	
	Deep Groundwater	Test wells in the north and on the west imply that there are exploitable aquifers in the N-W area. Groundwater of the S-E area is saline	
	Surface Water	Small rivers run near IKK. The Solo river is flowing at 3-4km north	
	Existing Waterworks System	No waterworks for domestic use in the IKK area	
Test Well Data	Location	Desa Tambakrame	6km west, Kec. Kanor
	Well Specifications	EJWR-5: D=24m, 4"ϕ, slotted pipes between 11m & 120m	Test well by Bungawan Solo Project Authority No detailed data was obtained, but based on test data this area is classified as zone of 10-20 l/s potential
	Pumping Test	T=158-598 m^2/d for Q=3.4 l/s. SWL=2.5m	
	Water Quality	Within norm	
Selected Water Source and Recommendations	Source	Confined aquifers, Desa Sunbung Lor, 5km west	
	Development Facilities	2 drilled wells; 70m depth and 10 l/s yield each, pump stations, and a reservoir	
	Treatment	Chlorination only	

Table B-2.7(17)
Summary of Water Resources Investigation Results - IKK Jenu E.J.

Item		Description	
Water Supply Demand		11.8 l/s for the scheme year of 2000AD	
Topographical Conditions		Coastal lowlands along the Java Sea shoreline in the east and hills in the west of IKK	
Geological Conditions		Beach sands and marine clays in the coastal lowlands. Pleistocene volcanic products and Pliocene limestones with fissures in the hills	
Conditions of Water Resources	Spring	No spring in/around the IKK area	
	Shallow Groundwater	Dug wells 4-5m deep are generally usable all the year round	
	Deep Groundwater	Groundwater under coastal lowlands is saline. Highly productive aquifer area extends 5-10km west, where many deep wells are in operation for irrigation purpose; Groundwater Potential map shows well yield capacity here is 40 l/s+	
	Surface Water	The Merangan river is flowing in the IKK area.	
	Existing Waterworks System	No waterworks for domestic use in this IKK	
Test Well Data	Location	Desa Suwalan	Desa Telogowaru
	Well Specifications	P2AT SP-67: Production well but not in operation as of surveys in Oct. '90 and June '91. No detailed data could be obtained, but it is said that the maximum capacity is 80 l/s	TW104EJ: D=101m, 8"ϕ, open hole below 64m. Limestones below 49m
	Pumping Test		T=13.775 m²/d for Q= 30.44 l/s. SWL=33.27m
	Water Quality		Within norm
Selected Water Source and Recommendations	Source	Fissure water in limestone, Desa Suwalan	
	Development Facilities	One drilled well; 100m depth and 20 l/s yield, pump station with generator and a reservoir	
	Treatment	Chlorination only	

Table B-2.7(18)
Summary of Water Resources Investigation Results - IKK Jiwan E.J.

Item		Description
Water Supply Demand		22.8 l/s for the scheme year of 2000AD
Topographical Conditions		Intermontane alluvial plain (El.+65m) between Mt. Lawu and Mt. Liwan
Geological Conditions		Fluvial deposits composed of clays, sands and gravels of volcanic origin, which include highly productive aquifers
Conditions of Water Resources	Spring	A small spring (Moro spring) is in Desa Jiwan, whose discharge capacity is less than 3 l/s
	Shallow Groundwater	Dug wells about 12m deep are generally usable all the year round
	Deep Groundwater	No deep well in this Kecamatan, but there are several deep wells at 5km SE in Madiun city of the same topography/geology, which indicate that the aquifers have high yielding potential
	Surface Water	A small tributary of the Madiun river flows near IKK
	Existing Waterworks System	No waterworks for domestic use in this IKK. The Madiun city waterworks is near this IKK. Irrigation channels are provided
Test Well Data	Location	No data could be obtained about deep wells in Madiun city, but a groundwater potential map infers that this IKK belongs to part of extensive and highly productive aquifer tract with potential for deep wells of more than 40 l/s
	Well Specifications	
	Pumping Test	
	Water Quality	
Selected Water Source and Recommendations	Source	Groundwater in Desa Jiwan, eastern part of IKK
	Development Facilities	One drilled well; 100m depth and 25 l/s yield, pump station, reservoir, and elevated water tank
	Treatment	Chlorination only

Table B-2.7(19)

Summary of Water Resources Investigation Results - IKK Kembangbahu E.J.

Item		Description	
Water Supply Demand		7.1 l/s for the scheme year of 2000AD	
Topographical Conditions		Part of Lamongan alluvial plain of El.+28m. Hills extend on the south from point 6km afar	
Geological Conditions		Pleistocene to Holocene deposits composed mainly of clays. Locally they are interbedded with sand layers and sandstones	
Conditions of Water Resources	Spring	No spring in/around the IKK area	
	Shallow Groundwater	Dug wells 7-10m deep exist only in the north-side of main road. Little potential of shallow groundwater productivity in the south area	
	Deep Groundwater	It is said that 2 exploratory holes (40m & 100 m) were drilled in the past in the south area but they were dry. Moderately productive aqui-fers are presumed to be in the north area	
	Surface Water	A small river runs in the IKK area, but its flow is little in the dry season.	
	Existing Waterworks System	No waterworks for domestic use in/around the the IKK area	
Test Well Data	Location	Desa Mangku Jajar	Desa Germah, 5km west
	Well Specifi-cations	New Test Well: D=102m, screens; 25-31m, 51-70 m and 90-98m	EJWR-7 Sugio: D=64.5m, screens; 22-23m $ 46-61m
	Pumping Test	S.C.=0.15 l/s/m for Q= 2.53 l/s. Qmax=4.5 l/s	T=50-60 m^2/d for Q=3.6 l/s. Qmax=10 l/s
	Water Quality	TDS=1634	Within norm
Selected Water Source and Recommen-dations	Source	Groundwater in Desas Mangkujajar and Kedung-megarih	
	Development Facilities	2 drilled wells of 100-125m depth and 4.0 l/s yield each, pump stations, reservoir, and ele-vated tank. Use the new test well as 1 of them	
	Treatment	Chlorination only	

Table B-2.7(20)
Summary of Water Resources Investigation Results - IKK Diwek E.J.

Item		Description
Water Supply Demand		17.1 l/s for the scheme year of 2000AD
Topographical Conditions		High flat lands (El.+60m) in the Brantas river alluvial plain
Geological Conditions		This area is underlain by alluvial deposits consisting of sands, gravels, and clays in alternation
Conditions of Water Resources	Spring	No spring in/around the IKK area
	Shallow Groundwater	Dug wells are several meters deep. Water bailed out of them shows cloudy at many places
	Deep Groundwater	No deep well within this IKK, but there are several deep wells in this Kecamatan including P2AT well in operation, which infers that this area is underlain by highly productive aquifer
	Surface Water	No river in/near this IKK
	Existing Waterworks System	No waterworks for domestic use in/around the the IKK area
Test Well Data	Location	No detailed data could be obtained about deep wells existing in the vicinity, but according to groundwater potential map this area belongs to an extensive and highly productive aquifer zone having the well yield potential of more than 40 l/s
	Well Specifications	
	Pumping Test	
	Water Quality	
Selected Water Source and Recommendations	Source	Groundwater in Desa Cukir in the south of IKK
	Development Facilities	One drilled well of 100m depth and 20-25 l/s yield, pump station, reservoir, and elevated water tank
	Treatment	Chlorination only

Table B-2.7(21)
Summary of Water Resources Investigation Results - IKK Kutorejo E.J.

Item		Description
Water Supply Demand		17.8 l/s for the scheme year of 2000AD
Topographical Conditions		Gently sloped alluvial tract(El.+125m) developed on the north of Mt. Welirang; nearly flat
Geological Conditions		Fluvial deposits of young volcanic products composed of rolling stones, boulders, gravels, and sands with clay binders; flow breccias
Conditions of Water Resources	Spring	No spring within the IKK. Some seeps in the southern part of Kecamatan outside IKK
	Shallow Groundwater	The depth of dug wells is more than 20m. The dries is liable to deplete them
	Deep Groundwater	Several drilled wells exist around the IKK. A groundwater potential map shows that the most highly productive aquifer area extends north from the northern part of this IKK
	Surface Water	Two small and shallow rivers flow within the IKK area
	Existing Waterworks System	The Dilanggu waterworks is partly extended to this IKK; 84 house connections in total have been provided in 4 desas
Test Well Data	Location	Desa Karangdieng, a northern corner of IKK
	Well Specifications	P2AT TW097: Depth=125m, 12"ϕ Maximum yield capacity = 45 l/s Current yield in operation = 25 l/s No other data could be obtained
	Pumping Test	
	Water Quality	
Selected Water Source and Recommendations	Source	Groundwater under Desa Karangdieng, within IKK
	Development Facilities	One drilled well of 100m depth and 20-25 l/s yield, pump station, reservoir, and elevated water tank
	Treatment	Chlorination only

Table B-2.7(22)

Summary of Water Resources Investigation Results - IKK Tempeh E.J.

Item		Description
Water Supply Demand		15.6 l/s for the scheme year of 2000AD
Topographical Conditions		Gently sloped land (El.+85m) developed on the east of Mt. Semeru; nearly flat
Geological Conditions		Pyroclastics of young Quarternary volcanics; such as volcanic ash, volcanic sand, breccia, and flow breccia
Conditions of Water Resources	Spring	No spring in/near IKK. Takir spring(80 l/s) at 6km+ NW of IKK is being used for irrigation
	Shallow Groundwater	70% households depend on dug wells of 10-12m depth for their domestic life
	Deep Groundwater	No operating drilled well in/around the IKK. A groundwater potential map shows that the IKK area is underlain by highly productive aquifer zone with well yield potential of 20-40 l/s
	Surface Water	A medium size river (Kali Mudjur) with boulder riverbed flows near IKK on the west
	Existing Waterworks System	No existing waterworks for domestic use
Test Well Data	Location	No available data about drilled well
	Well Specifications	
	Pumping Test	
	Water Quality	
Selected Water Source and Recommendations	Source	Groundwater under Desa Tempeh Lor, within IKK
	Development Facilities	One drilled well; 80m depth and 20 l/s yield, pump station, reservoir, and elevated water tank
	Treatment	Chlorination only

Table B-2.7(23)
Summary of Water Resources Investigation Results - IKK Kunir E.J.

Item		Description
Water Supply Demand		21.2 l/s for the scheme year of 2000AD
Topographical Conditions		Aluuvial flat plain of El.+35m. Indian(Indonesian) Ocean is 7km south
Geological Conditions		Alluvial deposits of gravels and sands with clayey soil interlayers, which are probably underlain by Tertiary series with pyroclastics
Conditions of Water Resources	Spring	No appreciable spring in/around the IKK area
	Shallow Groundwater	Dug wells 5-7m deep are used only for drinking and cooking purpose because of low yield
	Deep Groundwater	No drilled well in/around this IKK. A groundwater potential map shows that this area belongs to an extensive and highly productive aquifer zone of 20-40 l/s yield potential
	Surface Water	A small stream only. Irrigation channel water is used for bathing and washing
	Existing Waterworks System	No existing waterworks for domestic use in the IKK area
Test Well Data	Location	No available drilled well data here
	Well Specifications	Geoelectric survey carried out last year in this IKK implies that the subsite materials are composed of the following two formations. Upper formation: About 50m thick alluvial deposits of gravel and sand, good aquifer Lower formation: Tertiary series of volcanic products - sedimentary rocks mixtures, potential aquifer
	Pumping Test	
	Water Quality	
Selected Water Source and Recommendations	Source	Groundwater under Desa Kunir Lor, within IKK
	Development Facilities	One drilled well; 100m depth and 25 l/s yield, pump station, reservoir, and elevated water tank
	Treatment	Chlorination only

Table B-2.7(24)

Summary of Water Resources Investigation Results - IKK Tempursari E.J.

Item		Description
Water Supply Demand		13.7 l/s for the scheme year of 2000AD
Topographical Conditions		A coastal draw between hills. Indian(Indonesian) Ocean is 4km south
Geological Conditions		Miocene sedimentary rocks mixed with volcanic products are overlain by alluvial deposits
Conditions of Water Resources	Spring	2 big springs within 4km from the IKK; Sidomukti spring(300 l/s) and Umbulsari 1(600 l/s)
	Shallow Groundwater	About 50 dug wells in the IKK area. Their water generally shows cloudy
	Deep Groundwater	No drilled well in/around this IKK. Groundwater potential in the draw seems to be fairly high, but there is no positive proof to verify this
	Surface Water	Two rivers flows in this IKK area. Their water is often used by the town people for lives
	Existing Waterworks System	No existing waterworks for domestic use in the IKK area
Test Well Data	Location	No available drilled well data here
	Well Specifications	
	Pumping Test	
	Water Quality	
Selected Water Source and Recommendations	Source	Umbulsari I spring (600 l/s), 3km from IKK
	Development Facilities	Spring-fed reservoir or intake tower, pump station with generator, and a reservoir
	Treatment	Chlorination only

Table B-2.7(25)

Summary of Water Resources Investigation Results - IKK Banyuanyar E.J.

Item		Description	
Water Supply Demand		19.5 l/s for the scheme year of 2000AD	
Topographical Conditions		Sloped land (El.+50m to +100m) developed on the north of Mt. Tarub	
Geological Conditions		Young Quaternary volcanic products are overlain by alluvial deposits. The basaltic lava mass lies below 40m depth in the south section	
Conditions of Water Resources	Spring	No appreciable spring in/around the IKK area	
	Shallow Groundwater	There are a few dug wells 18-35m deep, which indicates that GWL in the dries is considerably deep, but good aquifers exist above lava	
	Deep Groundwater	The new test well indicated that there is no potential aquifer in the basaltic lava mass below 40m. However, the overburden soils have medium permeability and are useful as aquifers	
	Surface Water	Three gullies run in the IKK area. They become dry in the dry season	
	Existing Waterworks System	No existing waterworks for domestic use in the IKK. Irrigation channel is provided. Its flow water is widely used for bathing and washing	
Test Well Data	Location	Desa Liprak Kidul, near the Kecamatan office	
	Well Specifications	New Test Well: D=84m, 8"ϕ open hole below 42m	Existing 3 dug wells were put to the pumping test
	Pumping Test	The hole became dry by pumping	k=0.01-0.02 cm/s from the recovery data
	Water Quality	Unsuitable	Within norm
Selected Water Source and Recommendations	Source	Groundwater in Desa Liprak Lulon, within IKK	
	Development Facilities	3 drilled wells of 50m depth and 8 l/s yield each, pump stations, and a reservoir	
	Treatment	Chlorination only	

Table B-2.7(26)
Summary of Water Resources Investigation Results - IKK Sumberasih E.J.

Item		Description
Water Supply Demand		11.8 l/s for the scheme year of 2000AD
Topographical Conditions		Flat land (El.+40m to +50m) between coastal lowlands and Mt. Bromo submontane. 5km to sea
Geological Conditions		Young Quaternary volcanic products and overlying alluvial deposits. No rock outcrop in the vicinity
Conditions of Water Resources	Spring	No spring in the IKK area. 3 springs in Desa Sumberbendo (4km NW) of another kecamatan
	Shallow Groundwater	Dug wells about 15m deep produce enough water required for all kinds of domestic life of the town people
	Deep Groundwater	Several drilled wells existing around the IKK indicate that this area belongs to one of most highly productive (40 l/s+) aquifer zone
	Surface Water	A gully with a little flow in the dries run in in the IKK area from south to north
	Existing Waterworks System	No existing waterworks for domestic use in the IKK area
Test Well Data	Location	Northern part of Desa Muneng, near IKK border
	Well Specifications	P2AT TW012: Operating well; Depth=102m No other data could be obtained
	Pumping Test	SWL = GL-2.5m, SC = 3.8 l/s/m Pump capacity = 32 l/s Yield in operation = 24 l/s
	Water Quality	No data could be obtained
Selected Water Source and Recommendations	Source	Groundwater in Desa Muneng Kidul, within IKK
	Development Facilities	One drilled wells of 80m depth and 15 l/s yield, reservoir, and elevated water tank
	Treatment	Chlorination only

Table B-2.7(27)

Summary of Water Resources Investigation Results - IKK Tampak Siring, Bali

Item		Description
Water Supply Demand		9.7 l/s for the scheme year of 2000AD
Topographical Conditions		The southern lower flank (El.+500m) of Mt. Batur incised by gorges more than 100m deep
Geological Conditions		Quaternary volcanic products; tuffs and lahar deposits including breccias overlain by brown volcanic ash stratum
Conditions of Water Resources	Spring	Tirta Empul(temple) spring (400 l/s) is in the northern IKK. Several small springs also exist
	Shallow Groundwater	No dug well nor drilled well in this IKK. Groundwater development by means of wells in this area appears not easy and not effective, because the land is incised deep at both sides of east and west and moreover groundwater is discharged locally by springs near the bottom of valleys; not by diffusive flow by seepages
	Deep Groundwater	
	Surface Water	Water is flowing on the bottom of valleys
	Existing Waterworks System	Simple waterworks was constructed in some part of IKK by the Provincial Government after Aug. 1990
Test Well Data	Location	No related data here
	Well Specifications	
	Pumping Test	
	Water Quality	
Selected Water Source and Recommendations	Source	Tirta Empul spring at the northern part of IKK
	Development Facilities	New spring-fed reservoir, booster pump station and reservoir
	Treatment	Chlorination only

Table B-2.7(28)
Summary of Water Resources Investigation Results - IKK Ketewel, Bali

Item		Description
Water Supply Demand		11.1 l/s for the scheme year of 2000AD
Topographical Conditions		Coastal terrace (El.+25m). The Badung strait is 1 km south of the town center
Geological Conditions		Quaternary volcanic products; tuffs and lahar deposits including breccias. Locally they are overlain by alluvium
Conditions of Water Resources	Spring	No appreciable spring in/around the IKK area
	Shallow Groundwater	Dug wells are the primary means of residents to obtain water for their everyday life
	Deep Groundwater	A test well(TPW2; 200m depth, 50 l/s capacity) and a operation well (160m depth, 5 l/s yield in operation) are in Desa Batubulan, 3km west
	Surface Water	Small streams run in/around the IKK area
	Existing Waterworks System	No waterworks for domestic use in this IKK. 3"ϕ pipe-line of Singakerta waterworks is installed to nearby the boundary of IKK Ketewel
Test Well Data	Location	Desa Batubulan, 3km west of Ketewel
	Well Specifications	Test Well TPW2: Depth=200m, constructed in '88 by the G.I. finance
	Pumping Test	Maximum yield capacity = 60 l/s Normal yield capacity = 50 l/s
	Water Quality	Within norm
Selected Water Source and Recommendations	Source	Groundwater, use existing test well-TPW2
	Development Facilities	Submersible pump of 20 l/s capacity, pump station with generator, and reservoir
	Treatment	Chlorination only

Table B-2.7(29)
Summary of Water Resources Investigation Results - IKK Menanga, Bali

Item		Description
Water Supply Demand		6.9 l/s for the scheme year of 2000AD
Topographical Conditions		Intermontane valley (El.+600m to +700m) between Mt. Batur and Mt. Agung; the Unda valley
Geological Conditions		Quaternary volcanic products; tuffs and lahar deposits including breccias
Conditions of Water Resources	Spring	There are 2 big springs (Arca and Gerubug) and several small springs in the IKK area
	Shallow Groundwater	No dug well nor drilled well in this IKK. Most homes depend on springs and seepages to get water for domestic use. Some homes in the highlands buy water from a water vendor
	Deep Groundwater	
	Surface Water	Several rivers flow on the bottom of gullies and ravines
	Existing Waterworks System	Simple waterworks was constructed in some part of IKK by the Provincial Government after Aug. 1990
Test Well Data	Location	No related data here
	Well Specifications	
	Pumping Test	
	Water Quality	
Selected Water Source and Recommendations	Source	Gerubug spring (280 l/s) on a precipice
	Development Facilities	New spring-fed reservoir or tapping to existing spring intake, booster pump stations with generators, and reservoir
	Treatment	Chlorination only

Table B-2.7(30)

Summary of Water Resources Investigation Results - IKK Sibetan, Bali

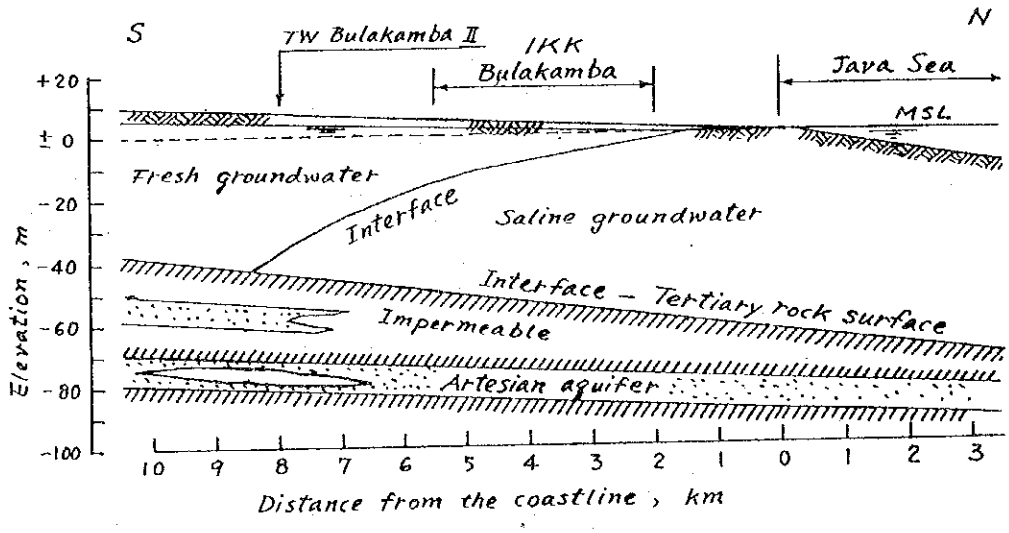
Item		Description
Water Supply Demand		11.6 l/s for the scheme year of 2000AD
Topographical Conditions		Undulated hilly lands (El.+350m to +450m) in the south-east foot of Mt. Agung
Geological Conditions		Quaternary volcanic products; tuffs and lahar deposits including breccias overlain by brown volcanic ash stratum
Conditions of Water Resources	Spring	Sog-Sog spring(5 l/s) in Bajar Telega and Dukuh Muding spring(27 l/s) in Banjar Dukuh
	Shallow Groundwater	Dug wells 6-30m deep, 75 in total, are present outside IKK. No dug well within the IKK
	Deep Groundwater	No drilled well in/around the IKK area. There might be potential aquifers in the sag of north-eastern part, but no positive proof
	Surface Water	Small streams run in the north-eastern part of IKK
	Existing Waterworks System	Simple waterworks with 15 public taps in total is provided in the IKK area. Its water source is Sog-Sog spring
Test Well Data	Location	No related data here
	Well Specifications	
	Pumping Test	
	Water Quality	
Selected Water Source and Recommendations	Source	Dukuh Muding spring in Banjar Dukuh near IKK
	Development Facilities	New spring-fed reservoir, booster pump station with generator, and reservoir
	Treatment	Chlorination only

2.2.2 Hydrogeological Description of Each IKK Site

(1) Bulakamba, Brebes Kab., C.J.

This IKK is located on the coastal lowland of El.+2 to +5 m near Java Sea and is underlain by alluvial deposits which in turn is underlain by Tertiary deposits. There is no rock outcrop in the vicinity. River water is saline under the influence of the sea-water intrusion. As for the thickness and stratification of alluvium, no detailed data could be obtained. Probably, it is composed of alternation of sand and clay layers in some locations and mainly of clays in the other locations. Total thickness of alluvium is presumed to be about 60 m in the IKK area.

Available information indicates that there is an extensive artesian aquifer zone along the coast. It is said that there are about 300 artesian deep wells in three kecamatans of Bulakamba, Tanjung and Losari. The well depth is generally in the range of 90-150 m. Most of them are privately owned and are used for irrigation, but their productivity varies much depending on wells and is not so high as to use for water supply source in general. Moreover, water from deep well is saline in some parts, and groundwater between depths of 10 m and about 50 m is commonly saline in the IKK area. According to test well data (P2AT-TW67 & TW-Bulakamba II), there are potential and productive aquifers in relatively shallow depth in an area about 5-6 km south of IKK. A sketch below shows a presumed profile of aquifers of this IKK district.



A Presumptive Hydrogeological Profile in Bulakamba

(2) Jeruklegi, Cilacap Kab., C.J.

This IKK area is located on dissected hills consisting of Miocene sedimentary rocks. The Miocene rocks outcrop at several locations along a road within IKK and in a borrow pit of Nusantra Cement on the south of IKK. These outcrops indicate that the rock mass is composed of light bluish grey calcareous mudstone of practically impermeable. Sandstone bed was not observed at any outcrop. The strike and dip of the bedding planes is N 0-20° E/ 7-10° SE. A photograph showing a outcrop attached below.

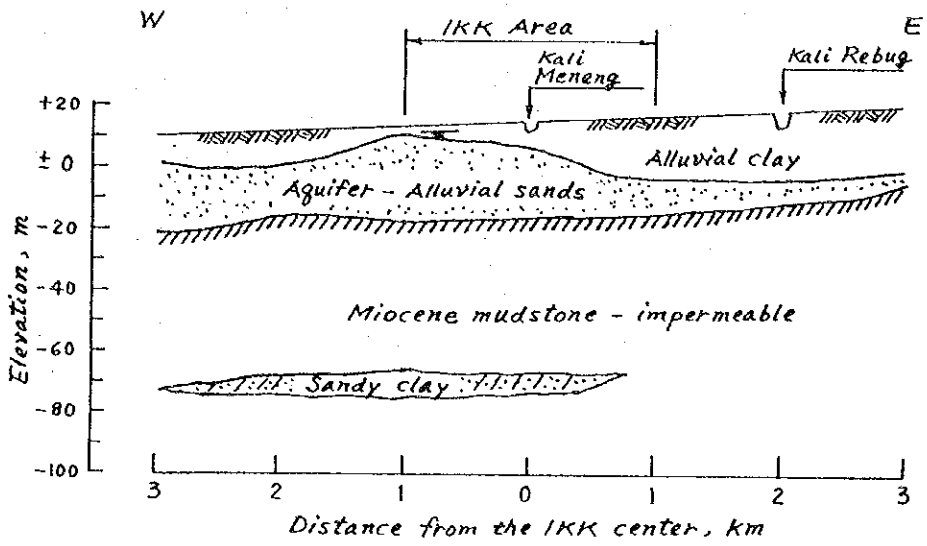
An Outcrop of Miocene Sedimentary Rock in Jeruklegi

There is neither perennial river nor spring in the IKK area, and the dry season depletes existing dug wells and makes its water salty. From such a geological condition, it may be concluded that groundwater exploitation in this area is impractical.

(3) Kemiri, Purworejo Kab., C.J.

This IKK is located on an alluvial plain of El. ±16 m contacting with the Serayu mountains at 2 km north of IKK. Kali Meneng runs in the IKK area but its suface water becomes stagnant in the dry season. In the upper stream of the river, there is a water intake for irrigation, where an outcrop of Miocene sedimentary rocks consisting of the alternation of sandstone and mudstone can be seen on the river banks.

Dug wells are 4-6 m deep and are generally useful even in the dry season. In another adjacent kecamatan on the east, on the other hand, the people depends on bored wells of 20-30 m depth. Results of test wells performed in Phase II inferred that there is a useful aquifer in the western IKK area, i.e. and alluvium sand stratum about 25 m thick. There isn't any productive aquifer below it. From such information, it appears that a hydrogeological profile of the IKK area is as shown below.

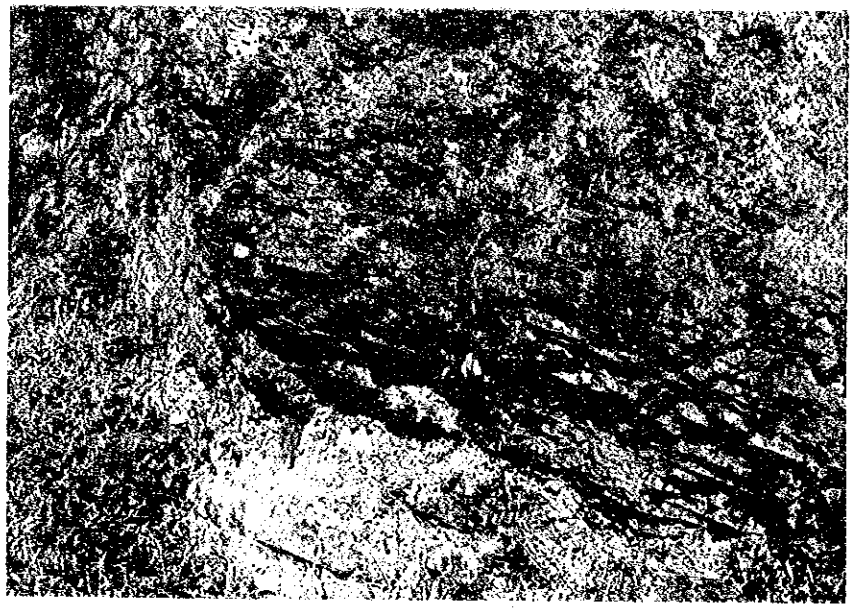


A Presumptive Hydrogeological Profile in Kemiri

(4) Madukara and Puggelan, Banjarnegara Kab., C.J.

IKKs Madukara and Punggelan are located on a boundary zone between the Dieng plateau and the river terrace. The subsurface materials consist of; mixtures of folded Tertiary sedimentary rocks (sandstone, conglomerate and shale) and volcanic products mainly of breccias in the mountain area; and a brown soil (volcanic ash) formation - about 20 m thick brown soil stratum is underlain by a mixture of brown soil, gravels and cobbles - in the terrace area. There are several springs in the mountain area, but most of them are too small to utilize for water supply. Usable spring is only the Trabawulan spring (35 l/s capacity) in kecamatan Punggelan. Groundwater productivity of both shallow and deep aquifers is low {see Tables B-2.7(4) and B-2.7(5)}. The Serayu river with gravels and cobbles in the riverbed flows near IKK Madukara on the south.

Two photographs are attached on the following page.



An Outcrop of Sedimentary Rock Surrounded by Young Quaternary Breccias, Northern Part of Kec. Madukara

Trabawulan Spring at The Northern Part of Desa Petuguran, IKK Punggelan

(5) Karanggayam, Kebumen Kab., C.J.

This IKK is located on a valley in the Serayu mountains. There are springs in the mountain area, but the discharge rate of them is less than 2 l/s. The dry season depletes the majority of springs, dug wells, and rivers as well. There is no deep well in the IKK area. Such information implies that the groundwater potential of this area is very low. The IKK and surrounding mountains are underlain by Miocene sedimentary rocks mainly of mudstones. The rock is exposed on the riverbed. In the southern IKK area, rock outcrops can be seen at a borrow pit and on the Karanggayam river banks, where calcareous siltstones are intercalated by calcareous silty sandstones with the strike and dip of N 60-80° W/10-15° S. A photograph below shows one of rock outcrops.

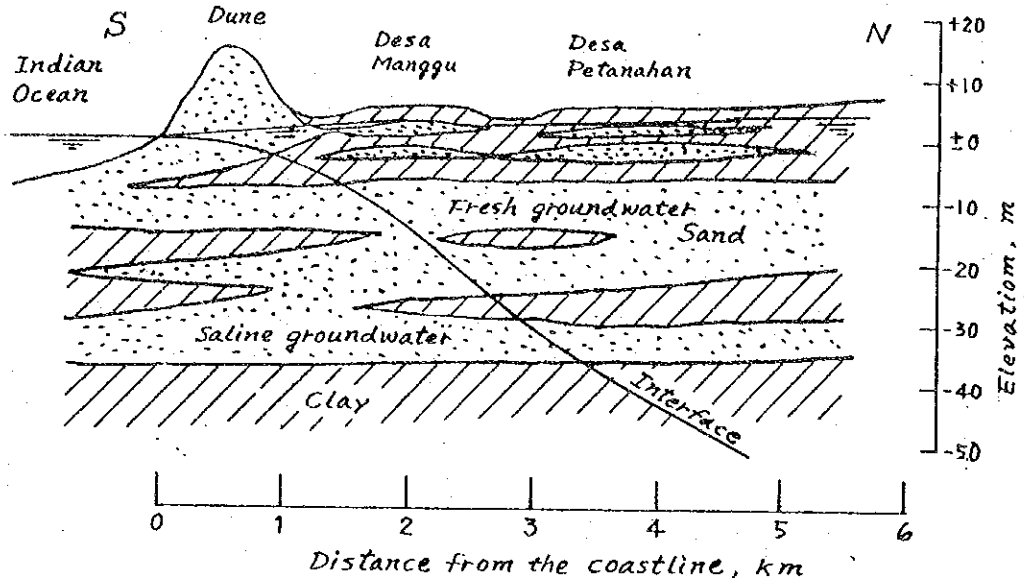
A Rock Outcrop by the road at 2.45 km south of Kec. Office

Dark zone on the photograph represent platy sandstones at wet condition; however, water oozing from them could not be seen.

(6) Petanahan, Kebumen Kab., C.J.

This IKK is located on a coastal lowland near Indian Ocean. The subsurface materials are composed of sand and clay strata of alluvium. According to P2AT test wells conducted at Desa Manggu and Desa Petanahan, groundwater was brackish at Desa Manggu and fresh at Desa Petanahan. Water in dug wells 4-8 m deep is fresh.

From such information, hydrogeological condition of IKK Petanahan is conjectured as a sketch shown below.



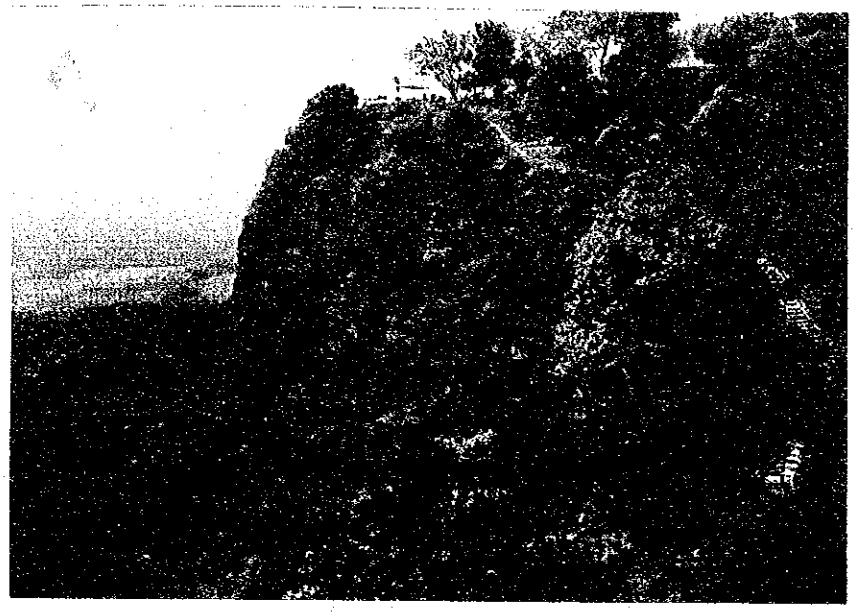
A Presumptive Hydrogeological Profile in Petanahan

(7) Sukorejo, Kendal Kab., C.J.

This IKK is located on an undulated submontane slope like basin. The land is covered with a brown soil stratum about 15 m thick in the mountain area, which is underlain by Pleistocene volcanic products mainly of flow breccias. In kecamatan Patean on the east, there is a big precipice formed by fault and a large water fall called "Curug Sewu", where breccia-outcrops can be seen. A photograph showing the precipice is attached on the following page.

The depth of dug wells is relatively deep here (15-30 m), because the surgical stratum of brown soil has a thickness of 15 m or more. Some of them become dry in the dry season. Although groundwater potential in the deep appears to be high in this IKK area, there isn't any data of positive proof.

There isn't any useful spring in the IKK area. A large spring called "Tlogomili" is present in Desa Tlogo Payung, Kecamatan Plantungan at 15 km south-west. This spring consists of several springs and is located at a riverhead. Its water is used for irrigation, but there is no problem to take its water in a new water supply system. A picture of this spring is attached on the following page.



A Precipice at Curug Sewu in Kecamatan Patean

Tlogomili Spring at Desa Tlogo Payung in Kec. Plantungan

(8) Jepon, Blora Kab., C.J.

This IKK is located on the eastern edge of the Blora depression. The site is underlain by Pliocene to Pleistocene sedimentary rocks of low permeability, which are overlain by comparatively thin stratum of alluvial clays. The initial test well drilled this time at the east part of IKK has indicated that the subsurface materials are composed of marl and clay stone and there is no potential aquifer. Dug wells and rivers within the IKK are habitually subjected to depletion in the dry season, and there is no spring in and near this IKK.

Potential water sources are small springs in Desa Waru on the Kapur Utara Hill on the north of Desa Soko and groundwater in Desa Soko at 9 km north of IKK. However, water from the springs in Desa Waru has already been used for waterworks and irrigation by local communities and a military complex in Kota Blara; consequently, these springs have no surplus capacity for a new demand. Two P2AT test wells exist in Desa Soko on the south slope of the Kapur Utara Hill consisting of faulted limestones. The yield capacity of these wells was confirmed by pumping tests including a test of this time; it is 2 l/s for one well and 5 l/s for the other one of flowing well. Since the groundwater is borne in fissures, its productivity is comparatively low.

A Flowing P2AT Well That Exists in Desa Soko

One subject deserves to be studied in the future would be horizontal wells to tap water in vertical faults in Desa Waru.

(9) Batangan, Pati Kab., C.J.

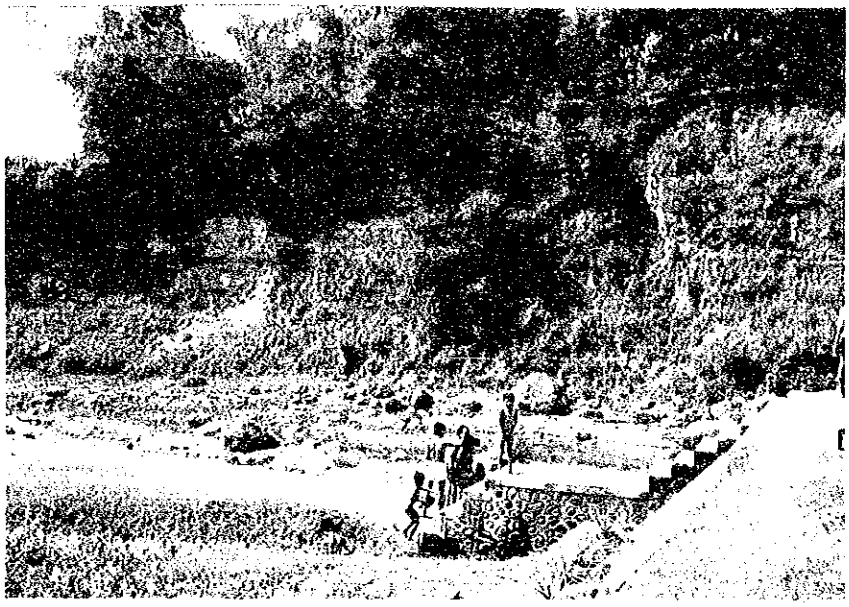
Batangan town is located on one of typical coastal lowlands encroached by sea water. Rembang Bay of Java Sea is 2 km from the IKK center, which is underlain by Holocene marine clays. From such an environment, there is neither dug well nor spring in and around the IKK, and salt farming and shrimp farming are the main industry of the town. Water for domestic use has been acquired by means of rainfall storage tanks, dug-out reservoirs to store rain water which are locally called "Jomblang", and through the water supply car provided by PDAM and a private water vendor. The water source of the water vendor is a dug well in Desa Gunungsari at 3 km south of the IKK. There are 19 dug wells in Gunungsari. They are useful even in the dry season. Accordingly, a 27 m deep well was drilled and tested this time at Desa Gunungsari to ascertain the makings of shallow aquifers. The test well result indicated that not only the aquifer potential is insufficient for the need but also water quality is unsuitable for the supply, regretfully.

Available water source is only the Juwana waterworks existing in the neighboring town on the west. Otherwise, a detailed investigation should be made on water resources of the Kapur Utara hill on the south at a good distance.

(10) Gondang, Sragen Kab., C.J.

This IKK extends on a terrain of hills and terraces developed on north of Mt. Lawu. The southernmost part of IKK belongs to the foot of Mt. Lawu and the subsurface materials are composed of Quaternary volcanic products of tuffaceous sandstones and breccias. According to a hydrogeological map, the southern IKK area belongs to a highly productive aquifer zone with capacity of more than 15 l/s. Outcrops of volcanic products can be seen on river banks at an intake dam for irrigation located near the southern boundary. A river valley in the same area consists of alluvial gravels and boulders. Pictures showing these surfaces are attached on the following page.

Terrace gravel layers can also be observed in Desa Tegalrejo in the southern Kecamatan. In the northern part of IKK or near Desa Glonggong, however, taffacious sandstone is exposed on riverbed.

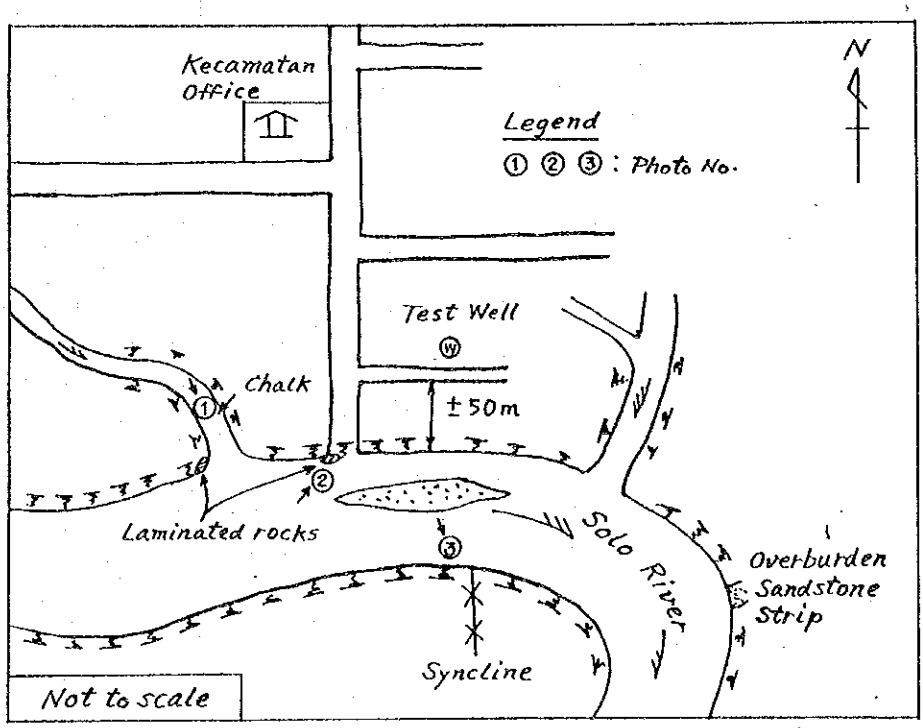


Outcrop of Quaternary Volcanic Products on The East Bank
of Sawur River, at The Irrigation Water Intake Dam Site
near the southern boundary of IKK Gondang

Alluvial Gravels in The Sawur River Valley
near the southern boundary of IKK Gondang

(11) Jenar, Sragen Kab., C.J.

Topographically, this IKK belongs to hill region in the northern part and to small alluvial plains along the Solo river in the southern part. The subsurface materials are composed of Miocene to Pliocene sedimentary rocks of calcareous facies, which are overlain by a relatively thin alluvium in the alluvial plains. Outcrops of sedimentary rocks can be seen on the surfaces of draws (tributaries to the Solo river) and on river banks of the Solo. They indicate that white calcareous clay-stone (chalk) is predominant in this area. It is occasionally intercalated with sandstone layers and locally overlain by a sandstone strip. Photographs showing typical rock outcrops are provided on the following page. Their locations are shown on a sketch below.



A Sketch showing photograph locations

Results of the deep well test at location shown above indicated that the aquifer potential is low although sandstone layers are interbedded. Probably, the sandstones are cemented. According to geoelectric survey carried out in 1990, alluvial sand stratum 20-30 m thick was presumed to be present in alluvial plain at Dukuh Prayunan at a west side of the IKK. Its aquifer potential and hydraulic property were verified to be sufficient for water supply by additional pumping tests of existing shallow wells.

Photo ①
Chalk Outcrop
on Draw Suface

Photo ②
Rocks Laminated
with Limestones
and Sandstones,
N 70°E/15°N

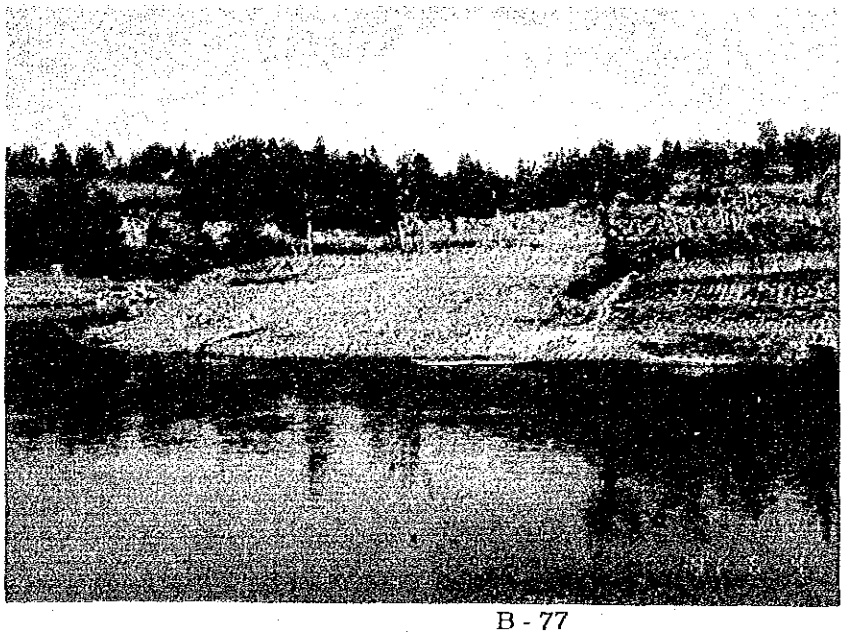


Photo ③
Thin Layers of
Laminated Rocks
imply the presence
of Syncline

(12) Giriwoyo, Wonogiri Kab., C.J.

This IKK is located mainly on the north-eastern edge of a vast karstified peneplain consisting of Miocene limestone facies and partly on alluvial plain in the northern IKK. Since there are several springs in the hill area, most town people depend on springs for their daily life water. In Desa Guwotirto, a simple waterworks has been provided by taking in water from a small spring. The biggest spring is Kakap spring in Desa Giriwoyo, which comes out of underground stream. Although its water has been used for irrigation, bathing and washing, there is no problem to take water in a new supply system. A picture of Kakap spring is attached on the following page.

Concerning aquifer potential of deposits below alluvial plain, there is no available data.

(13) Bawen, Semarang Kab., C.J.

This IKK is located on a mixed terrain consisting of hills and alluvial valleys developed near the foots of volcanos. The sub-surface materials are composed mainly of volcanic products and locally of sedimentary rocks. In Desa Kandangan on the east of IKK, there is a quarry site of andesite and basalt, and a quarry site of black sulfate claystone that is used for home industry. Recently, this IKK area especially along the inter-urban main road between Semarang City and Yogyakarta and Surakarta City has been developed as an industrialized zone, and several factories of such as Coca Cola, Kanindotex etc. have been built. These factories have installed deep wells in the sites for their business; e.g. the Coca Cola has 4 drilled wells and the Kanindotex has 2 drilled wells in their factory sites. The yield capacity of these wells is not high, regretfully; 2-3 l/s per well in the Kanindotex and less than 4 l/s per well in the Coca Cola even though their well depth is generally more than 100 m. Besides, the local government has a scheme to restrict the groundwater exploitation by means of deep wells in this region. Because the land is covered by brown soil stratum more than 15 m thick, there is no appreciable spring in and near the IKK, and existing dug wells are deeper than 15 m. Large springs exist in mountain area afar, among which Tuk Umbul in Kec. Jambu deserves to be used.

Kakap Spring in Desa Giriwoyo

Umbul Spring at Dusun Kalibening, Kec. Jambu,
Proposed for IKK Bawen. This Facility was
Constructed by DINAS Cipta Karya in 1990

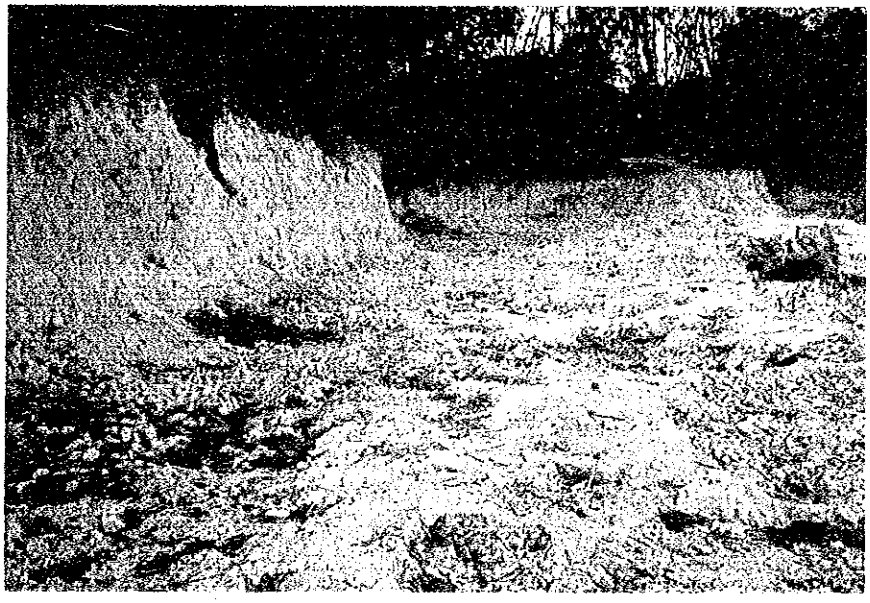
(14) Balen and Baureno, Bojonegoro Kab., E.J.

These two IKKs are located on an area where low hills and alluvial plain are jointed each other. The Solo river is not far on the north. The hill is composed of Pleistocene sedimentary rocks mainly of grey calcareous clay stones, whose outcrop can be seen at a borrow pit in Desa Gunungsari in the eastern section of Baureno Kecamatan. Alluvial plain is underlain by clays with occasional sand layers of medium permeability.

Balen: This IKK area mostly belong to alluvial plain; therefore, there is no spring in and around the IKK. Availability of dug wells indicates that there is a good shallow aquifers in the northside of the IKK but there isn't such a good aquifer in the southside of the IKK.
There are 3 test wells in Desa Kedungdowo at about 4 km north of IKK, which were installed by the Bungawan Solo Project Authority (see a picture of them on the following page). Although detailed data of them was unable to gain, it is said that water from wells deeper than 80 m was saline. In addition, according to a groundwater potential map, the aquifers of this area has a well yield capacity of 10-20 l/s. It is noted that houses in Desa Kadungdowo are built along ex-stream depression that is habitually inundated with 2 m depth water after heavy rain; thus the houses are built on mound to protect them from flooding.

Baureno: This IKK area mostly belongs to undulated low hill zone consisting of Pleistocene sedimentary rocks. A picture showing its outcrop is attached on the following page. There are three seepage water storage pits in this kecamatan, but the seepage amount is small and water is no clean. According to a groundwater potential map, groundwater is unsuitable for water supply in an extensive south area of IKK.
Alluvial plain extends on the north and the west parts of this kecamatan. There is one test well in this kecamatan; EJWR-5 at Desa Tambakrame. Here, sand stratum between 10 m and 20 m in depth consist of aquifer. Its well yield potential is estimated to be 7.5 l/s and water quality is good. Another test well is present in Kecamatan Kanor near Desa Sunbung Lor. It is said that the yield capacity of aquifer is more than 10 l/s around this well.

Remains of 3 Test Wells for Bungawan Solo Project
in Rice Field in Desa Kedungdowo, Kec. Balen



Outcrop of Pleistocene Sedimentary Rock;
A Borrow Pit in Desa Gunungsari, Kec. Baureno

(15) Jenu, Tuban Kab., E.J.

This town is developed on seaside lowlands along beautiful beach of Tuban Bay. The IKK area extends to the west where limestone hills stretch in a row. In Desa Suwalan, near the west boundary of IKK, there is P2AT well SP-67(64). Unfortunately, this well was not in operation during our surveys in 1990 and 1991, but it is said that the maximum well capacity is 80 l/s. A pump station picture of this well is shown below.

Pump Station of P2AT SP-67 Well in Desa Suwalan

Since groundwater of coastal lowlands is saline, it would be the best way to take up water by means of drilled well installed in Desa Suwalan. The limestones are locally brecciated and bear much fresh water. According to a groundwater potential map, well yield capacity is more than 40 l/s in this limestone zone.

(16) Jiwan, Madium Kab., E.J.

This IKK is located on a vast intermontane alluvial plain between Mt. Lawu and Mt. Liwan. Madium city adjoins in the east. The subsurface materials are composed of fluvial deposits of clays, sands, and gravels in alternation. There are several deep wells in Madium city of the same geological zone. Based on these information, a groundwater potential map infers that the intermontane basin to which this IKK belongs is extensive and highly productive aquifer tract with well capacity of more than 40 l/s.

(17) Kembangbahu, Lamongan Kab., E.J.

This IKK is located on the southern part of Lamongan alluvial plain. Low hills extend on the south. There is neither rock outcrop nor spring in and around the IKK area. Lowlands in the northern part of IKK are habitually subject to inundation during the rains.

According to a groundwater potential map, moderately productive aquifer belt runs from west to east through the northern IKK, which encompasses an exploratory well of EJWR-7-Sugio (Qmax=10 l/s) at about 5 km west of the IKK. It is said that 2 exploratory holes were drilled in the past in the southern IKK area but they were dry. Based on these information, a test well drilling and pumping test was carried out at Desa Mangku Jajar in the north area of IKK. The result indicates that there isn't any highly productive aquifer but the test well can be used as a production well. Its maximum yield capacity is estimated to be 4.5 l/s. A vast saline groundwater zone extends on the north starting from a point of about 2 km north of IKK and most parts of IKK are underlain by Tertiary sedimentary rocks of low permeability; so, exploitable groundwater area is limited to a narrow strip being underlain by Pleistocene volcanic products. Although groundwater potential of this strip is not high, there is no other water source but this groundwater strip in this IKK area.

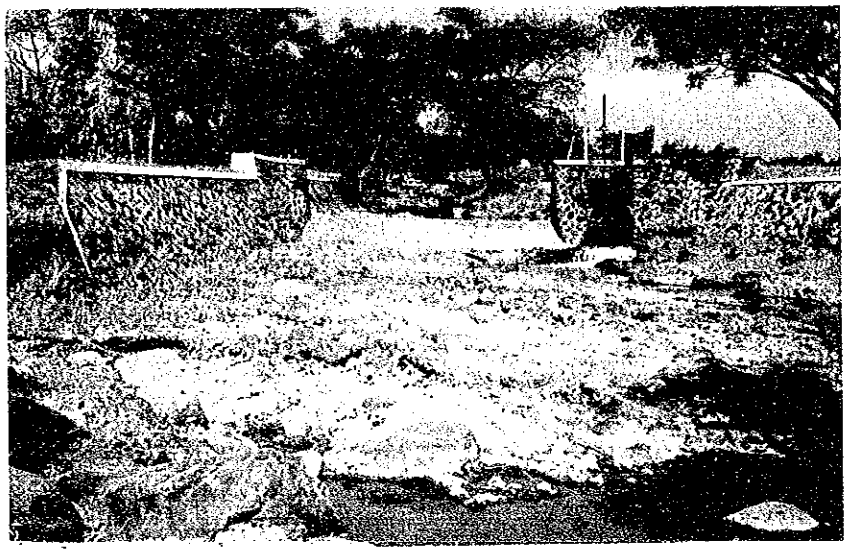
(18) Diwek, Jombang Kab., E.J.

This IKK is located on part of high flat lands of Brantas alluvial plain. There is neither rock outcrop nor river nor spring in and around IKK. Also, there is no existing deep well within the IKK. But, several deep wells including P2AT well in operation are present around the IKK. From these well data, it has been disclosed that the IKK area is underlain by alluvial deposits consisting of sands, gravels, and clays in alternation which have a well yield capacity of more than 40 l/s.

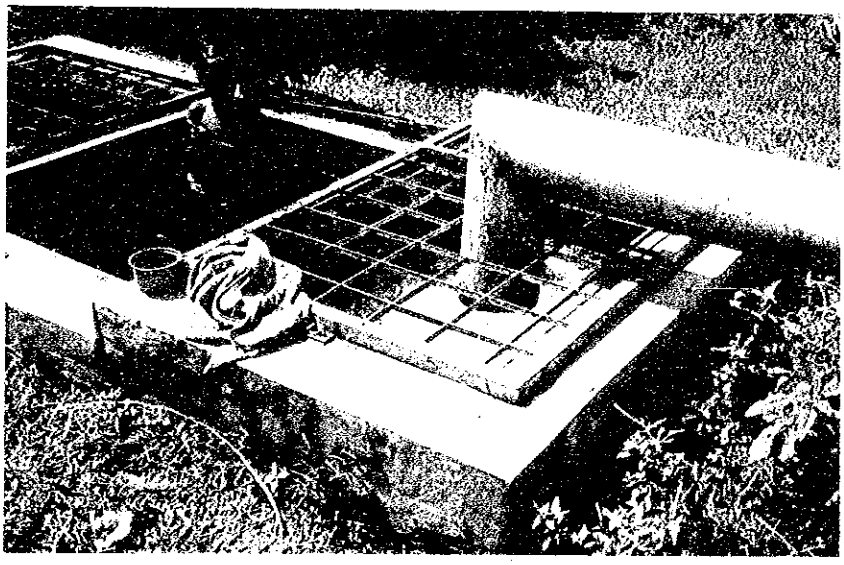
(19) Kutorejo, Mojokerto Kab., E.J.

This IKK is located on part of gently sloped lands developed on the north of Mt. Welirang. The land declines toward north and is underlain by young Quaternary volcanic products. Outcrop of flow breccia can be seen on a riverbed in the IKK area (see a picture below). The breccia mass is locally overlain by thin alluvial gravel layer.

At the north-western corner of the IKK, there is a P2AT well (TW097) in operation. Another P2AT well also exists in Desa Kepupandak at 2 km north of TW097. The maximum capacity of TW097 is 45 l/s (25 l/s in use now; see a picture below). From these well information, it is inferred that the north area of IKK is underlain by highly productive aquifers. In the south area of IKK, groundwater potential is not so high.



Exposed Flow Breccia w/Boulders on Riverbed in Kutorejo

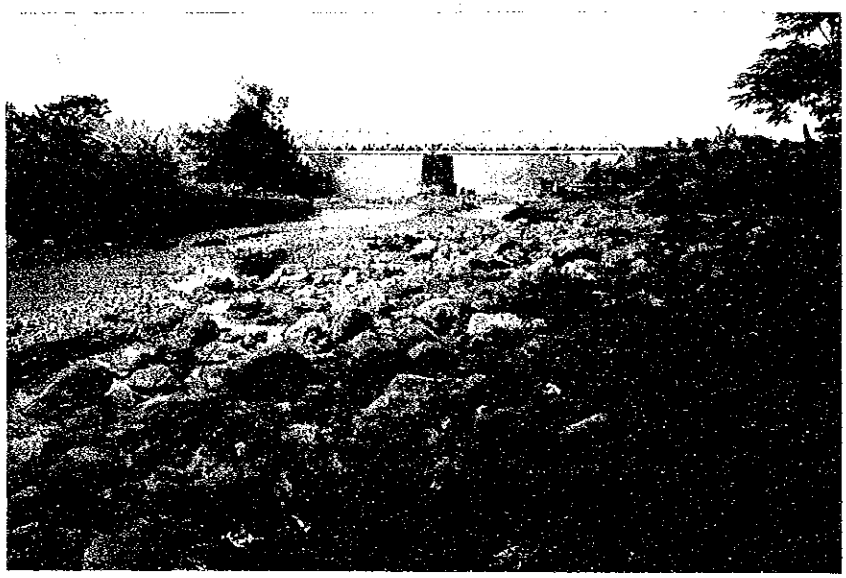


Outlet Pipe From Pump Station of P2AT TW097 in Desa Kr. Dieng

(20) Tempeh and Kunir, Lumajang Kab., E.J.

These IKKs are located on an alluvial plain in the Indian Ocean side.

Tempeh: Along the west boundary of Kecamatan Tempeh, Besuktunggeng (Mudjur) river flows. To the west of this river, active volcano called Mt. Semeru (El. +3676 m) rises. It is said that a former road bridge that had been built across the river was washed away by a recent pyroclastic flow generated by Mt. Semeru. Existing bridge was originally built for the railroad. There are many rolling stones and gravels on the riverbed (see a picture shown below). The river water is one of water resources hereabouts.



Kali Mudjur on The West Boundary of kecamatan Tempeh

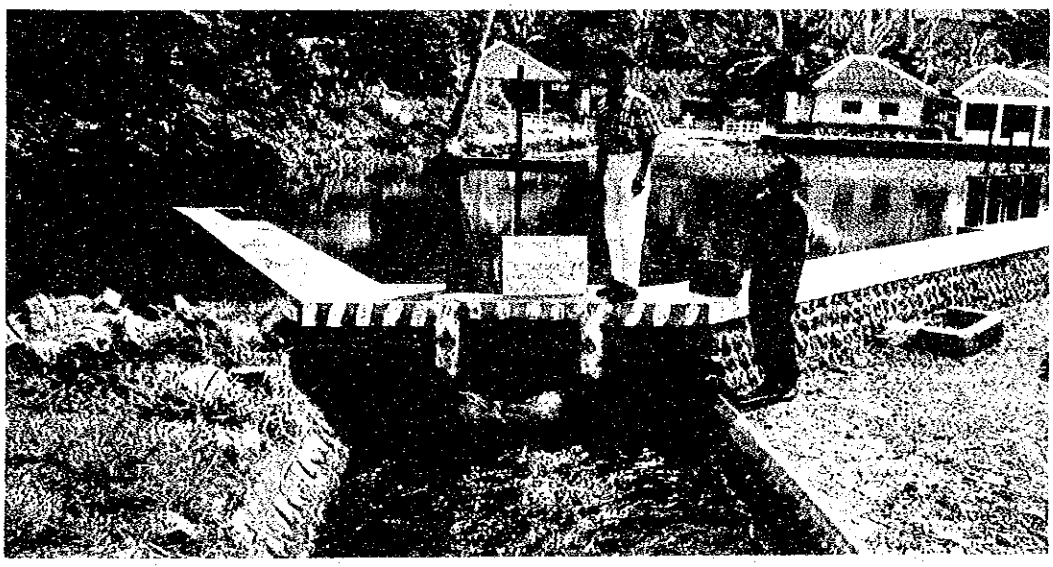
The river banks are composed of breccias, pyroclastics and terrace gravels, which implies that the IKK area is underlain mainly by volcanic products that include satisfactory aquifers.

Kunir: Geoelectric survey was carried out in the northside of IKK in 1990. The result indicates that the site is underlain by materials having comparatively high resistivity and they are subdivided into two major formations; i.e. the upper formation of ρ a > 35 Ω m about 50 m thick and the lower formation with ρ a = 10-30 Ω m. Although there is neither deep well nor rock outcrop around the IKK, it is conjecture from available documents that the upper formation is an alluvium consisting mainly of sands and gravels and the lower formation is Tertiary series consisting of mixtures of volcanic products and sedimentary rocks. The well yield capacity of the IKK area is estimated to be 20-40 l/s.

(21) Tempursari, Lumajang Kab., E.J.

This IKK is located on a coastal draw surrounded its three sides by hills consisting of sedimentary rocks mixed with volcanic products. Indian Ocean is 4 km south. The groundwater potential of the IKK area seems high, but there is no positive proof to verify this because there is no borehole data hereabouts.

In the hill zone there are big springs, i.e. Sidomukti spring (300 l/s) at 4 km north of IKK and Umbulsari I spring (600 l/s) at 3 km west of IKK etc. Although water discharged from these springs is used for irrigation, Umbulsari I spring has enough and to spare capacity to be used for proposed water supply. A picture of Umbulsari I spring is shown below.

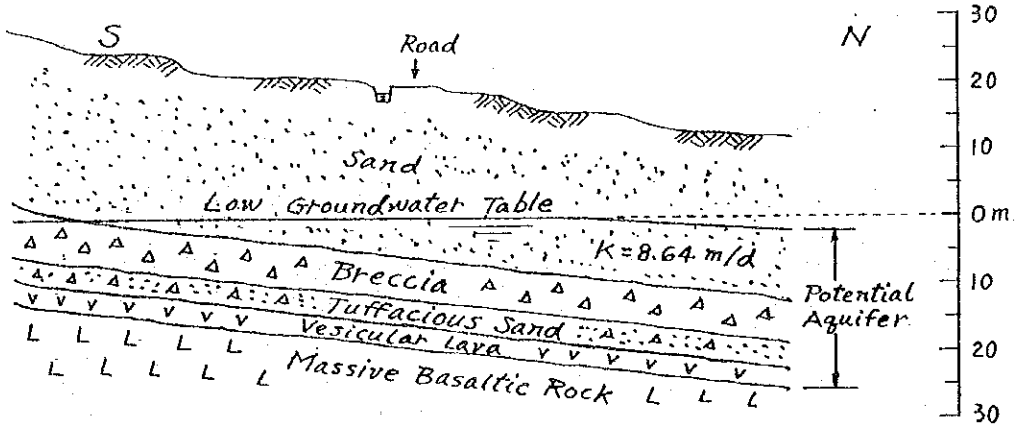


A Reservoir of Umbulsari I Spring in Kecamatan Tempursari

(22) Banyuanyar, Probolinggo Kab., E.J.

This IKK area is located on sloped lands developed on the north of Mt. Tarub. The land declines toward north. Test hole drilling and pumping tests of dug wells were carried out in the southern IKK area. The results indicate that the site is underlain by young Quaternary volcanic products consisting mainly of sands and basaltic lava. At test well location, a massive basaltic rock lies below a depth of 37 m and it is overlain mainly by sand stratum. The basaltic lava mass has no groundwater potential despite it includes fracture zone. According to dug well pumping tests, groundwater level was present at a depth of more than 20 m at a state of nearly flat in the kecamatan office area along

the main road, and the coefficient of permeability of subsoil was estimated to be 0.01-0.02 cm/s. It can be inferred from a result of dug well investigations that materials overlying basaltic lava mass is potential aquifer. The following sketch illustrates the subsurface conditions at the southern IKK area. It is noted that the potential aquifer increases its thickness toward north; therefor, it is better to drill wells in the north side.



A Presumptive Hydrogeological Profile in The South Banyuanyar

Along the west boundary of Kecamatan Banyuanyar, a valley runs from south to north. It is dry in the dry season as is shown by the following photograph. Brown tuffs and sands including black basaltic sands are exposed on the side cliffs.

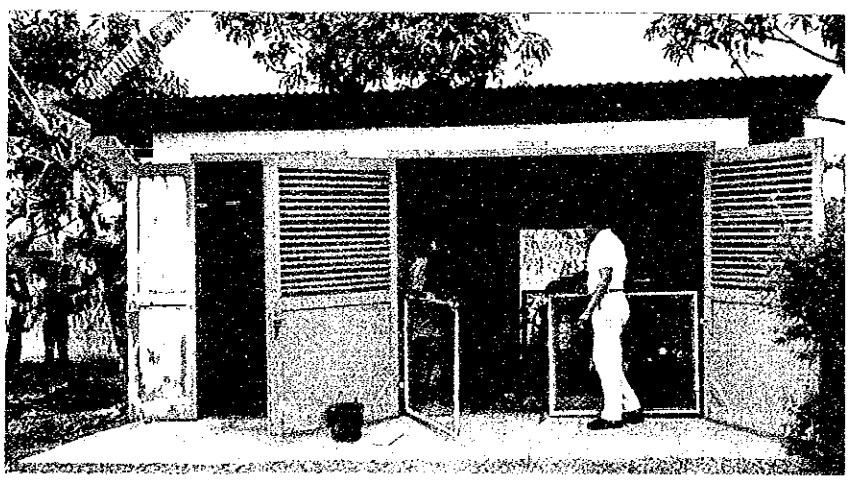
Valley at Dry State, West Boundary of Kec. Banyuanyar, June '91

(23) Sumberashih, Probolinggo Kab., E.J.

This IKK is located on part of flat lands near Strait of Madura. Although the sea is 5 km north, the IKK area is underlain by young Quaternary volcanic products erupted by Mt. Bromo on the south. There is no spring in the IKK area. The land is generally covered by brown soil stratum 10-15 m thick. Dug wells about 15 m deep are useful all the year round. A gully with stream on the lower riverbed runs in the IKK area from south to north. After flooding, gravels are sedimented on the lower riverbed and silty sands on the higher riverbed (see the picture below).

Kali Paser (kelar) Running in IKK Sumberasih

Near the northwest corner of IKK, there is P2AT well TW012 in operation at yield rate of 24 l/s (see the picture below).

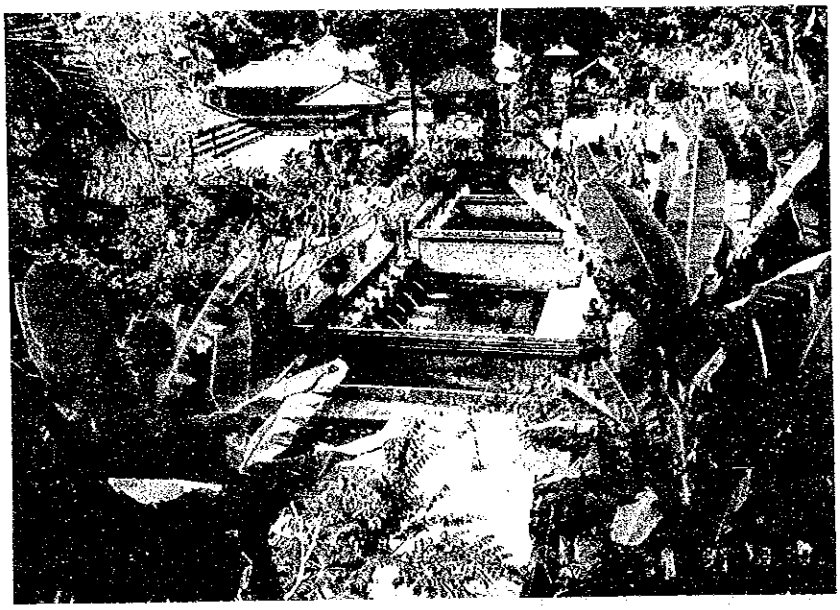


A Pump Station of P2AT TW012 in Desa Menung Kidul

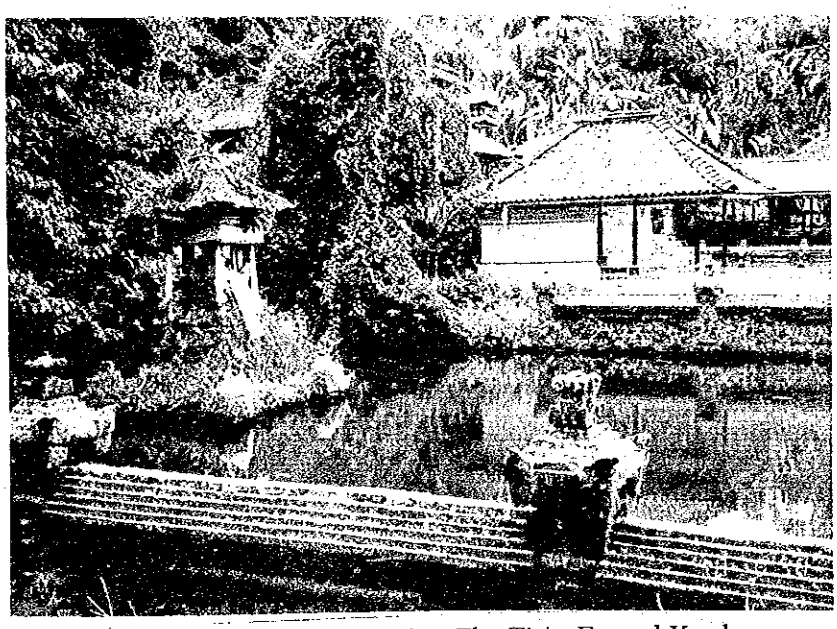
Not only said well but also several drilled wells exist around this IKK. From these well data, it is estimated that the well yield potential of this IKK area is more than 40 l/s.

(24) Tampak Siring, Gianyar Kab., Bali

This IKK is located on part of the southern lower flanks of Mt. Batur, and the land is incised by gorges more than 100 m deep at both sides of east and west. The subsite materials are composed of Quaternary volcanic products such as tuffs, sands and lahar deposits including breccias. There are several small springs in the IKK area. A large spring (400 l/s capacity) is present at a northern edge of IKK in the Tirta Empul (Water Temple) yard. The pictures below show its scenes.



A Panoramic View of Tirta Empul Spring Facilities



Part of Springhead Pond in The Tirta Empul Yard

Water from Tirta Empul spring can be taken into the proposed waterworks provided that the intake is built without any change and damage on existing facilities.

Groundwater exploitation by means of a drilled well appears not easy in this area, because the land is incised by deep gorges and groundwater is moving through specific passages.

(25) Ketewel, Gianyar Kab., Bali

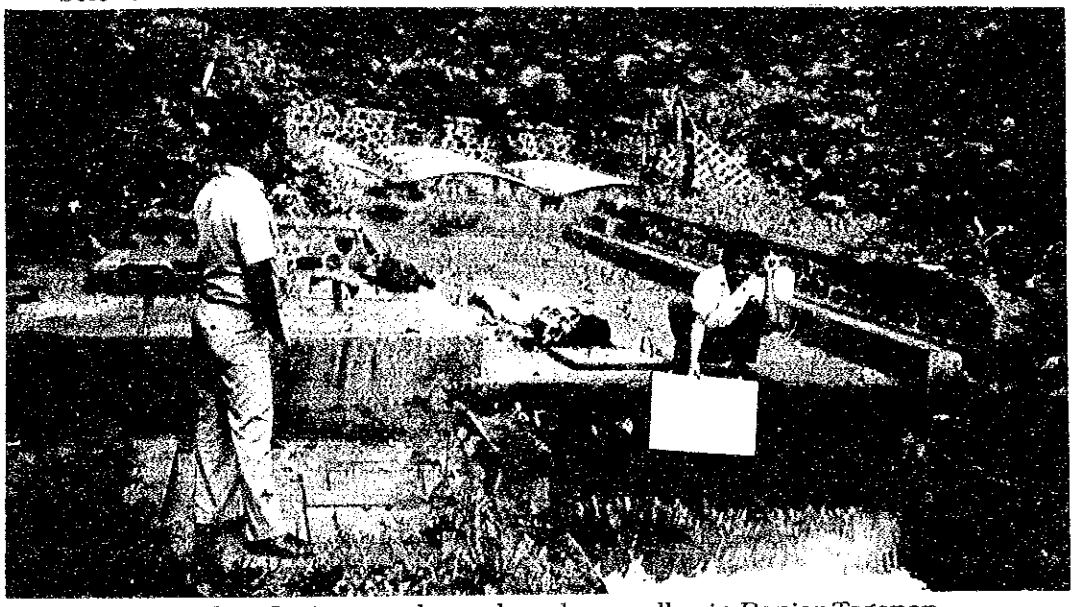
This Desa is located on coastal terrace and is underlain by Quaternary volcanic products, locally overlain by alluvium. There is no appreciable spring in and around the Desa . In Desa Batubulan at 3 km west of the Desa, there are one deep well in operation and one test well being not in use. The operational well (160 m depth, 6" dia., 5 l/s pump capacity) is worked only 3 hours a day. The test well (TPW2; 200 m depth, 8" dia., 50 l/s normal capacity) was completed in October 1988 with intention to supply water to Denpasar City, but up to the present day its embodiment has not been materialized and the well is in a position to be used for an area other than Denpasar. A picture of TPW2 is shown below.

Test Well TPW2 in Desa Batubulan at 3 km West of Ketewel

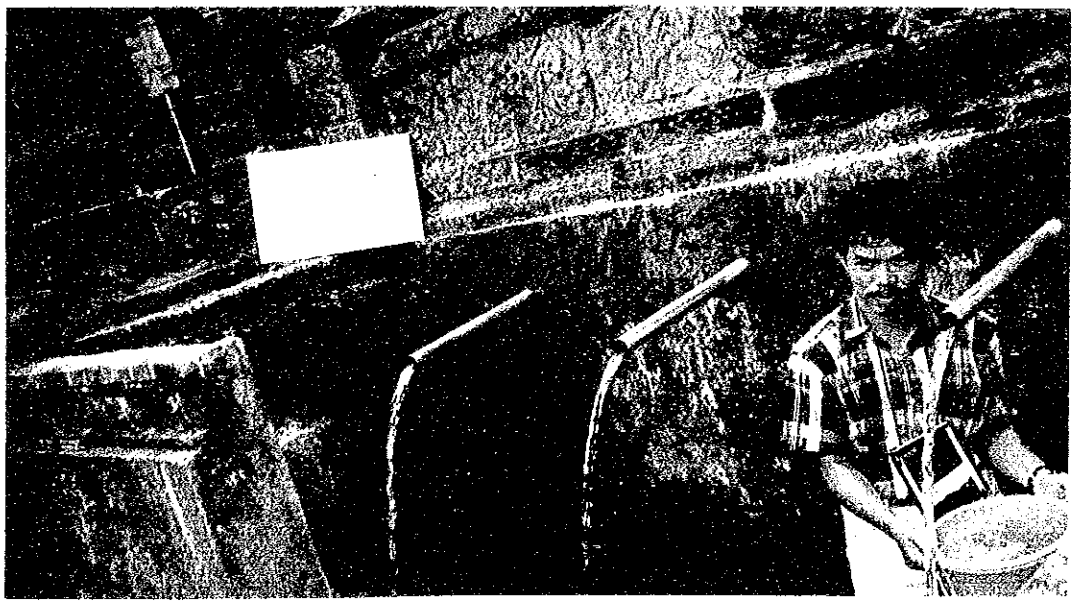
A pipeline of Singakerta waterworks has been installed to the boundary of Desa Ketewel, but Singakerta waterworks has no longer expansibility, for recently its extension has been decided to other area than Ketewel.

(26) Menanga and Sibetan, Karang Asem Kab., Bali

They are located on part of the southern foot of Mt. Agung and the land is underlain by Quaternary volcanic products such as tuffs and lahar deposits including breccias. There is neither dug well nor drilled well in these Desa areas. Most homes get water from springlets and seepages being thereabouts. Available springs are Gerubug spring (280 l/s) for IKK Menanga and Dukuh Muding spring (27 l/s) for Desa Sibetan. Their photographs are attached below.



Gerubug Spring on a horseshoe shape valley in Banjar Tegenan



Dukuh Muding Spring on a horseshoe shape valley in Banjar Dukuh