3.2 Physiography and Hydrogeology

3.2.1 Topographical Features of The Study Region

(1) General

Topographic features of 121 IKK areas were investigated by means of topographic map and site reconnaissance. Geographical maps were also used for this purpose.

Investigated IKK areas stand on various topographic planes, i.e. the flank of strato-volcanos, submontane slope, hill area, intermontane basin, river terrace and valley, high alluvial plain along the middle-upper stream basin of a long river, and alluvial low lands such as coastal plain, estuary plain and delta. Therefore, the land height of IKK areas ranges from 2 m to 1000 m above sea level.

Fig. 3.2.1 and Fig. 3.2.2 - Geographical Maps of Java and Bali - will help us understand the topographic features of the islands.

It is not too much to say that the existing topography of Java and Bali islands have been built up by quaternary volcanos. By the same token there are many volcanos on the islands, of which most are konide type strato-volcanos with the top height of more than 1500 m. Number of volcanos whose height are higher than 2000 m is 5 in Bali, 20 in East Java and 10 in Central Java.

Hills that consist mainly of Tertiary sedimentary rocks extend in places along the coast and/or vast plain areas. Their height above the sea level is in a range between 100 m and 1000 m in general.

Ground heights of alluvial plains are :

For coastal plains ;

Flat lowlands	2 m to 10 m
Inland-side plains	15 m to 25 m

For Inland plains ;

Fluvial plains	25 m to 90 m
Intermontane basins	not specifiable

(2) Topographic Features of Each IKK Site

Table 3.2.1 shows a topographic classification of each IKK of 121. It is remarked that the following topography is relatively predominent:

In Central Java	;	Coastal plains, inland plains, and river terrace.
In East Java	;	Inland plains and submontane slopes.
In Bali	;	Submontane slopes and the flanks of volcanos.

Typical coastal plains are those distributed in the southernmost district of Central Java from Cilacap to Purworejo via Kebumen and those distributed in the northernmost regions of Central Java and East Java; such as Brebes-Tegal, Kendal-Semarang, and Rembang and Tuban coasts. In the south coastal lowlands of Central Java, sanddune about 1 km wide is piled up along the shore.

Typical river valley (terrace) is the Serayu River valley of Central Java that runs from Banjarnegara to Banyumas.

In East Java, most IKKs are located on vast inland plains developed along rivers of Solo and Brantas and some are on the submontane slope areas and intermontane plains.

In Bali, since the island itself consists of several volcanos, most IKKs are located on the flanks of volcanos and on the submontane slope zones.

Ground elevation and topographic features of each IKK site are briefly summarized in Table B-2.1 through B-2.3 of Supporting Report B.

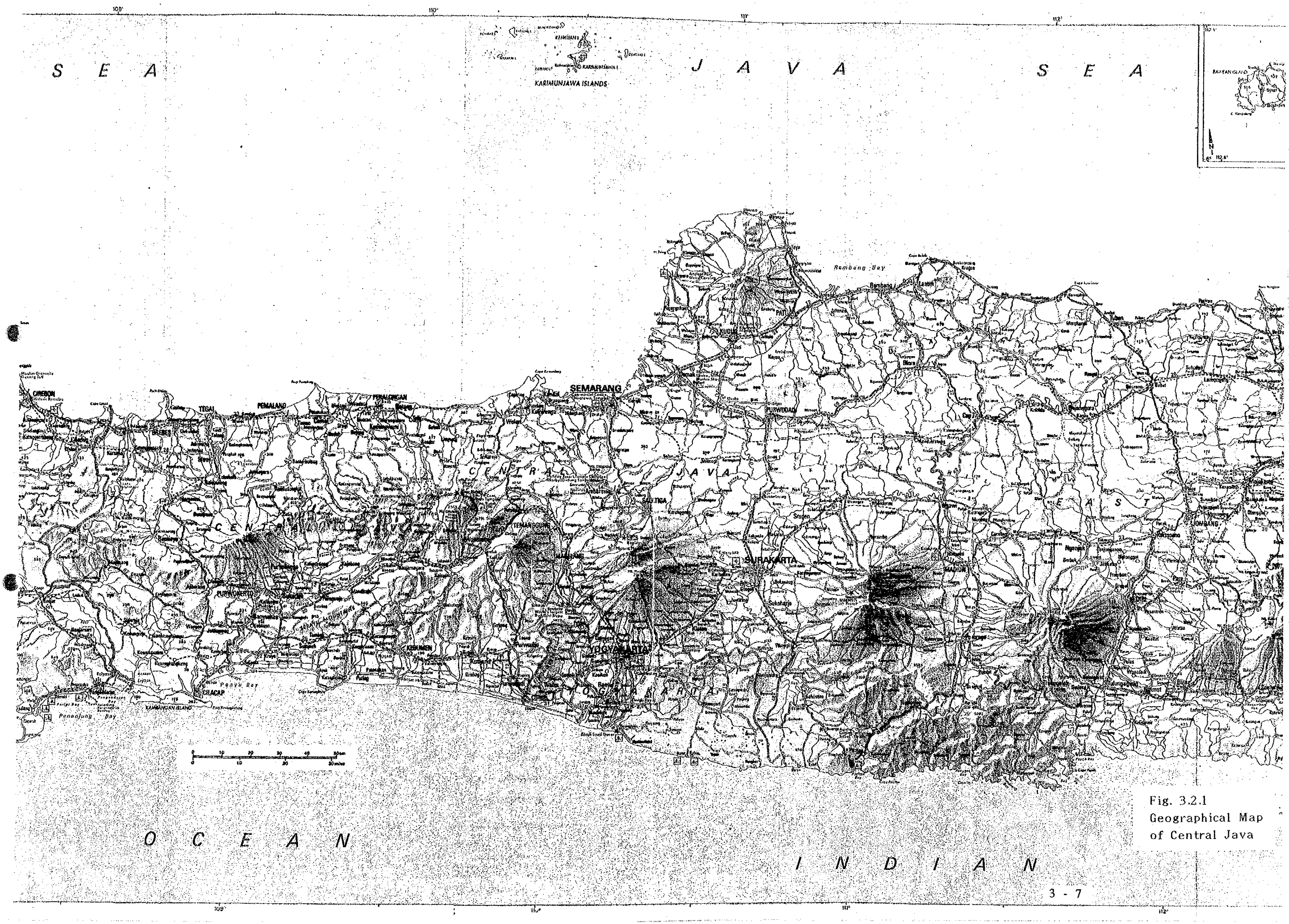


Fig. 3.2.1
Geographical Map
of Central Java

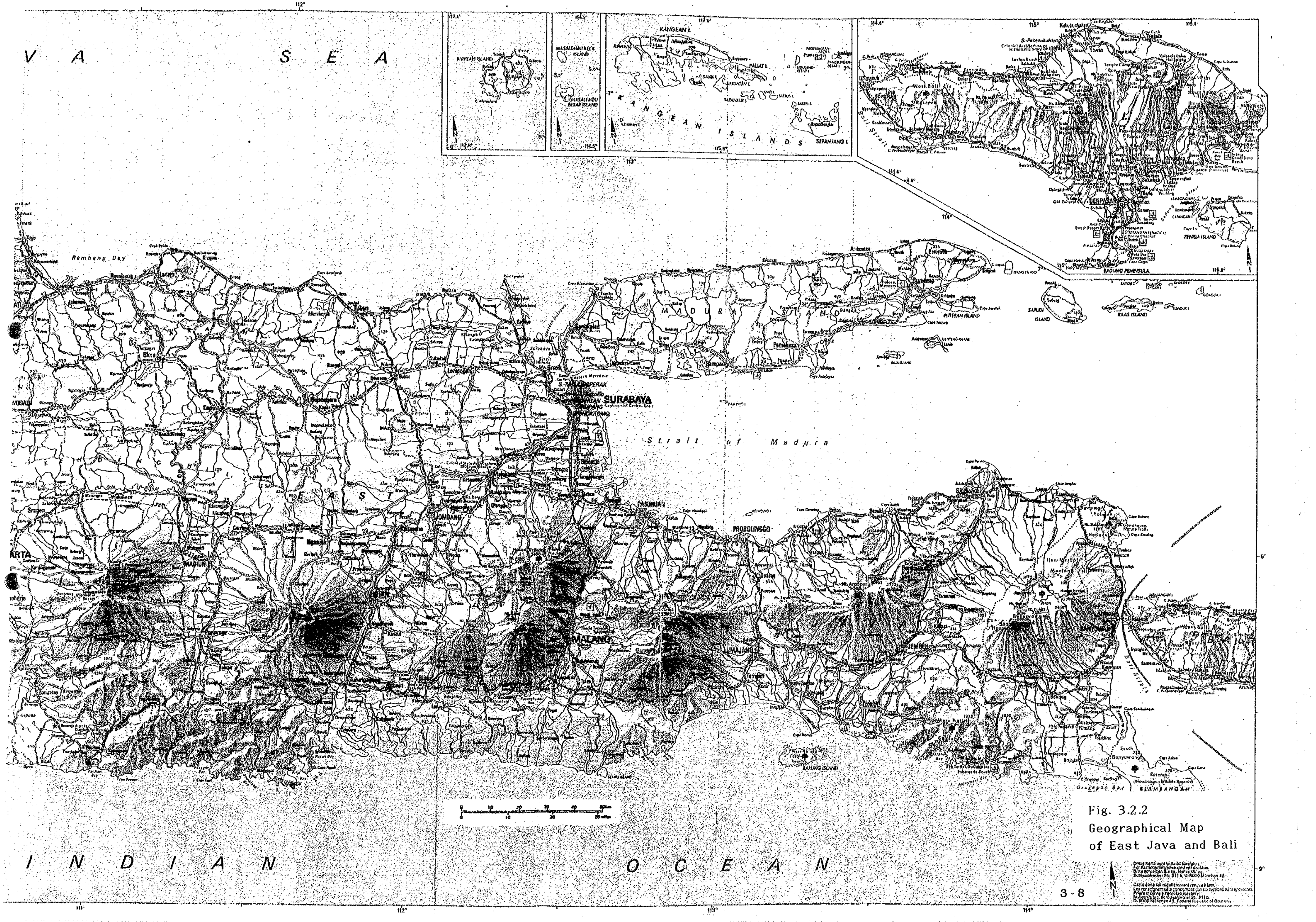


Fig. 3.2.2
Geographical Map
of East Java and Bali

Table 3.2.1 Topographic Classification of 121 IKKs

Major Division	Subdivision	IKK Belonged to	Province
Coastal Plains	Coastal Lowland	Bulakamba, Losari, Kesugihan, Nusawungu, Grabag, Purwodadi, Ngombol, Ambalresmi, Demangsari, Setrojenar, Klegenwonosari, Mirit, Petanahan, Gemuh, Batangan, Tayu, Kaliori	Central Java
		Bulu, Jenu, Brondong, Gending	East Java
	Inland-side Plain & Coastal Terrace	Gandrungmangu, Jeruklegi, Butuh, Banyuurip, Kemiri, Bayan, Prembun	Central Java
		Tikung, Kunir, Besuk, Sumberasih	East Java
		Sangsit, Ketewel	Bali
Inland Plains	Fluvial Plain & Intermontane Basin	Bantarkawung, Salem, Bajarrejo, Jepon, Mendenrejo, Tangen, Miri, Gondang, Jenar, Plupuh	Central Java
		Balen, Baureno, Kapas, Sumberrejo, Bangilan, Kerek, Karanggeneng, Kembangbahu, Diwek, Gudo, Kudu, Megaluh, Mojowarno, Jiwan, Mejayan, Gedeg	East Java
River Terraces & Intermontane Valleys	River Terrace & Intermontane Valley	Paguyangan, Karamsambung, Karanggayam, Sale, Jatiroto, Nguntoronadi, Giriwoyo, Bayat, Purwonegoro, Purworejo Klampok	Central Java
		Ranuyoso	East Java
		Antap, Abang	Bali
Hills	Hilly Terrain & Islet	Kaligesing, Banjarmangu, Madukara, Singorojo, Manyaran	Central Java
		Parengan, Ngimbang, Tempursari	East Java
		Sakti	Bali
Volcanos (Mountains)	Mountain Foot & Submontane Slope	Dayeuhluhur, Punggelan, Sukorejo, Dawe, Sambirejo, Bawen, Suruh, Karangnongko	Central Java
		Ngoro, Dlanggu, Jatirejo, Kutorejo, Candipurno, Tempeh, Randuagung, Banyuanyar, Maron	East Java
		Blah Kiuh, Panji, Singakerta, Bebandem, Sibetan, Marga	Bali
	Flank or Ridge of Mountain	Karang Kobar, Pagentan, Jatipurno, Bulukerto	Central Java
		Pacet, Gucialit, Senduro	East Java
		Munduk, Tista, Tampak Siring, Tagalalang, Asahduren, Menanga, Pupuan, Bangbang, Tiga	Bali

(3) Ground Height vs Valley Depth Relation in Bali

In the strato-volcanos, the depth of valley increases as the ground height becomes higher. Fig. 3.2.3 below shows an approximate relation between ground height and incised depth of valley for the flanks and submontane slopes of strato-volcanos in Bali.

The figure indicates that the depth of valley is one-fourth of the ground height of the vicinity and that the depth of a riverbed at the river mouth is about 0.6 m below mean sea level (M.S.L.).

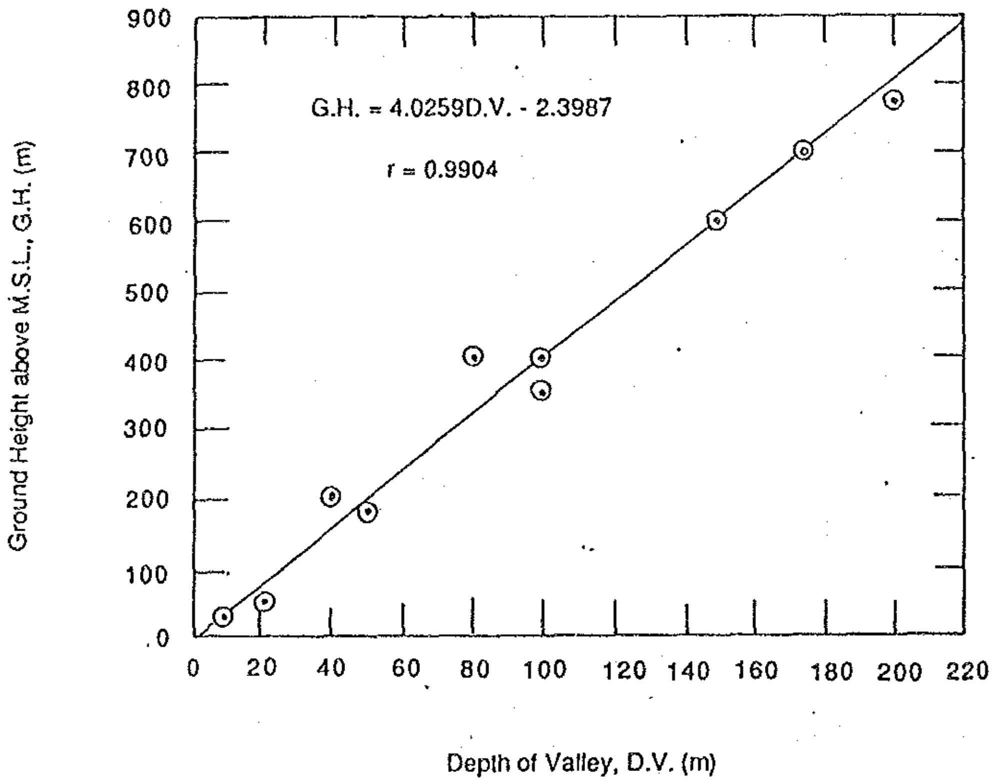


Fig. 3.2.3 A Relationship between Ground Height and Valley Depth for Strato-Volcanos in Bali

The said relation infers that higher the land elevation deeper the groundwater table.

3.2.2 Geological Features of The Study Region

(1) General

Geological conditions of 121 IKKs areas were inspected during the site reconnaisance through the help of geological maps.

Java and Bali islands are, in a geohistorical sense, made up of relatively young deposits. Except for a north-eastern part of Serayu Mountains and small hills near Bayat in Central Java, where faulted Pretertiary and Palaeogene sediments extend along with intrusive rocks and metamorphic rocks, the oldest formation outcropping in the investigated region is of early Tertiary age (Oligocene to Miocene, mainly of Miocene).

The hills consist mainly of sedimentary rocks of Tertiary age. The Miocene sedimentary rocks consisting of consolidated claystone, siltstone, marl, sandstone, conglomerate, and compact limestone are widely distributed in the hilly region. The limestone especially of Miocene is locally cavernous. The Pliocene to Pleistocene sedimentary rocks are also widely distributed in the hill region. The Kapur Utara hill that extends over Central Java and East Java in their northern parts is generally folded with anticlinical axis of east-west direction.

The volcanos and their flanks and submontane slopes including those of Bali are built up of Quaternary volcanic products ; tuff, lahar, breccia, agglomerate, and andesitic to basaltic lavas. Rolling stones of andesitic and basaltic rocks are being crushed by hand by people living thereabouts to produce coarse aggregates that are used for concrete works in the construction project. Vescicular volcanic rocks are used for masonry sculptures.

Such metamorphic rocks as marble and crystalline schists are being excavated in quarries in the northeastern part of Serayu Mountains, near which IKK Karangsambung locates, to produce materials used for the decoration of building and furniture.

Coastal lowlands are underlain by soft Holocene deposits being composed mainly of clay strata, in which layers of sand, occasionally gravel, are intercalated.

Inland fluvial plains and intermontane basins consist of alluvial deposits of clay, sand and gravel, but their thickness and proportion vary depending on river size, geology of upstream are and topographic conditions. In a narrow valley such as the middle stream basin of Serayu river, terrace deposits consisting of sand and gravel of Pleistocene epoch are predominant. In a gorge that dissects higher flank of mountain at elevation of more than +500 m, there is little alluvial deposits.

The clay portion in alluvial deposits increases as going downstream, and the sand and gravel portion becomes relatively high as going upstream. Large intermontane basins developed in the upper stream region are likely to be underlain by a thick sand and gravel stratum.

(2) Geological features of Each IKK Site

Geology of each IKK of 121 is briefly described in Tables B-2.1 - B-2.3 provided in Section 2.1 of Supporting Report B. As for 30 high priority IKKs, further description is provided in Section 2.2 of Supporting Report B.

(3) Remarks

In addition to said statement, the following can also be given to the geology of the investigated regions (Java and Bali).

There is no top soil layer or A-Horizon consisting of organic soils in Indonesia. In a temperate zone having four seasons a year, it is common that the terrain is overlain by the top soil of black to dark brown organic soils about 1 m thick, but in the typical tropical zone of Indonesia such a superficial soil layer does not extends despite the land is covered with plant and vegetation. The reason of this difference may be explained as follows:

In the temperate zone with four seasons including snowy winter, leaves of most trees and grasses die and fall on land in every autumn. Fallen leaves are stockpiled and gradually decayed, and are transformed into organic soils. In the tropic zone, on the other hand, there is no such a specific season as autumn and snowy winter so that fallen leaves are washed away during the rainy season and consequently organic top soil layer can not be formed. Instead of it a surficial stratum consisting of brown soils (volcanic ash and laterite) distributes over the lands of Java and Bali.

The brown soil is practically impervious; therefore the overland runoff ratio of rainfall is high or the infiltration ratio is low. Infiltration of surface water would occurs mainly through the riverbed of sands and gravels of specific river or specific area.

3.2.3 Hydrogeological Features of The Study Region

(1) Preface

Hydrogeological conditions, in other words the conditions of underground water and aquifer, were investigated by the field survey and reconnaissance and by means of hydrogeological maps.

The groundwater conditions are the reflection of topographic conditions, geologic conditions and rainfall characteristics of the area. Accordingly, a general feature of hydrogeology may briefly be described by dividing the land into the following five zones for convenience sake.

1) Coastal lowland plains
2) Inland flat plains and intermontane basins
3) Quarternary strato-volcanos
4) Limestone terrains
5) Sedimentary rock hills

Water level in dug wells is generally at a depth of 3 m to 5 m below ground surface, but in a hill ridge like IKK Singorojo in Central Java it locates at a depth of 10 m or more. These levels are fell down in the dry season and depletion of wells often occurs at places.

(2) Hydrogeology of Coastal Lowland Plains

In the coastal strip of alluvial plains, the terrestrial deposits of late Pleistocene to early Holocene epochs consisting of sand and gravel layers, being overlain by Holocene marine deposits, are the most important aquifers, because there is little fresh and clean water source on the ground surface neverthless many people are living thereon. The regression of sea during the ice-age lowered the sea level more than 100 m (about 140 m at most). Most parts of present offshore are were land and streams were rapid at that time, so that coarse-grained materials derived from nearby volcanos had begun to deposit first over the depression just before the aggression of sea started. The bed-soil-stratum thus formed was later overlain by a thick alluvium mainly composed of clays, and consequently groundwater in the bed-stratum became to be a confined state. These processes imply that the presence of artesian aquifer in the coastal plain, but it should be noted that the distribution of highly productive aquifers is not so extensive but local because it was controlled by the topography and flooding range as of late Pleistocene and early Holocene epoch.

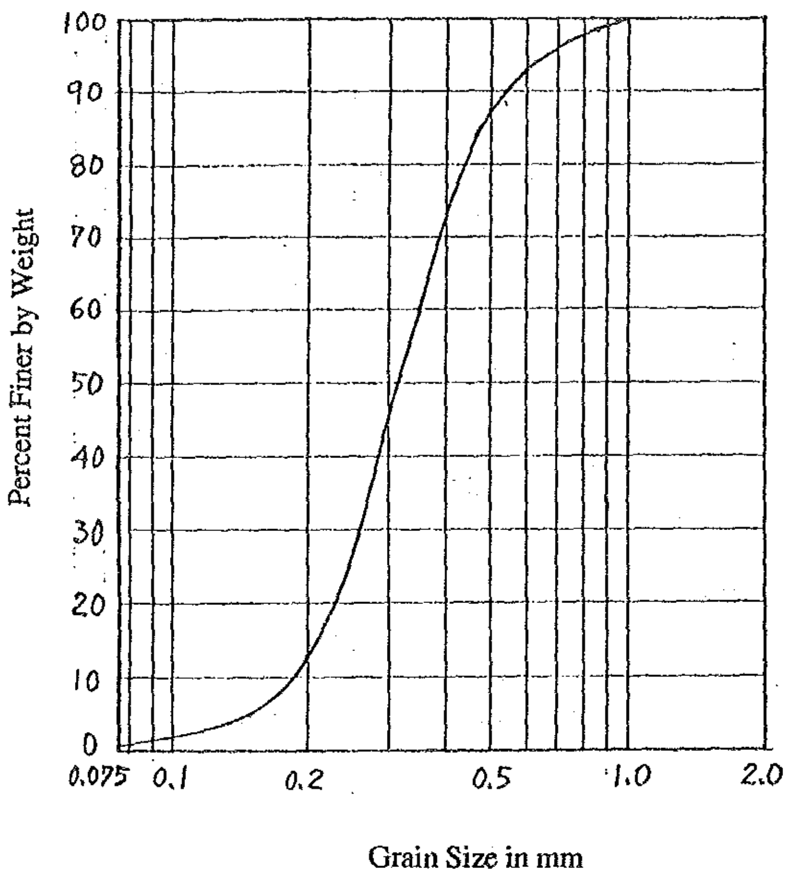
Groundwater abstraction from confined aquifers in the deep probably in tertiary formation has been operated by many deep wells in the northside coastal plains of Central Java, e.g., the coastal plain between Semarang and Kudus, and the coastal plain in Kabupaten Brebes. Most productive aquifers locate at a depth of more than 50 m below the ground surface. The majority of these aquifers are in Artois conditions although the potentiometric head has been gradually decreased year by year.

Due to the interaction of surface water infiltration, seawater encroachment and upward pressure of confined groundwater, the groundwater between depths of 10 m and 50 m is saline. Shallow groundwater withdrawn from dug wells contains calsium bicarbonate at some places.

Another northside coastal lowlands developed in the eastern part of the Java island, such as the Rembang-Juwana plain, the Tuban plain and the Lamongan plain, have low potentiality in groundwater productivity, because in these areas the hinterlands consist of Tertiary hill ranges of sedimentary rocks and limestone, and had no chance of volcanoclastic material redeposition. Groundwater is saline in the Rembang plain.

The lowland also extends along the southside coast of Central Java, i.e., the coastal plains from Cilacap to Cape Karangbolong and from Cape Karangbolong to Menoreh Hills. The seashore of these lowlands consists of sand-dunes about 1 km wide and +9 m to +15 m high. People living on these plains are getting fresh water for their domestic use from dug wells and shallow berehole wells. Because several rivers transverse these plains, among which Serayu River and Lukula River are main sources of coarse-grained materials, it seems that there is much variation in the longitudinal soil profiles although aquifers of shallow wells are presumed to be black sand layers in general. Groundwater developments in these plains are not active, but it appears that the groundwater potential and productivity of these coastal plains are substantially high, especially for shallow aquifers. The geophysical survey made in IKK Purwodadi, Purworejo kabupaten, inferred that there is a highly potential aquifer between 10 m and 30 m in depth. The test well made in IKK Kemiri, Kebumen Kabupaten, also indicated that there is alluvial sand stratum of medium permeability or medium productivity between 5 m and 25 m in depth.

Fig. 3.2.4 below shows a result of sieve analysis carried out on a sand sample taken at the beach of dune in Petanahan. The result demonstrates that the sample is composed of uniformly distributed fine-grained sands with little fines. Its coefficient of permeability was estimated to be $k=3.4 \times 10^{-2}$ cm/s from the Hazen equation for poorly graded sands. According to the results of pumping tests of shallow wells at Kemiri and Jenar, the peameability of alluvial sands is almost the same as said value.



Fraction :

Sand 99%

Fines 1%

Grain Size in mm :

Maximum	2.00
D_{60}	0.35
D_{30}	0.26
D_{10}	0.185

$Cu = D_{60}/D_{30} = 1.9$

Permeability:

Hazen's formula;

$k = 100\,(D_{10})^2$

in which D_{10} in cm and K in cm/s

$\therefore$

$K = 100 \times 0.0185^2$

$= 0.034$ cm/s

Fig. 3.2.4 Grain Size Distribution Curve of Dune Sand in Petanahan, Kebumen Kabupaten

One thing of concern in the south coast is, as similar to the north coast, seawater encroachment. Available information indicates that groundwater abstructed from wells 50 - 60 m deep at Ambal was highly saline and that from a 60 m deep P2AT well drilled at the southern part of IKK Petanahan was brackish.

(3) Hydrogeology of Inland Flat Plains and Intermontane Basins

The Banjarnegara Valley is built up of the Serayu River terrace that is composed of semi-cemented gravel (breccia) and brown soil. Since this terrace is bounded by the Serayu Mountains (Hills) on the south and by the Dieng Plateau range on the north, it is blessed with a number of springs.

As for the inland river plains, confined aquifers are present in the middle to upper stream region of Solo River in the vicinity of provincial boundary between East Java and Central Java, but in the downstream estuary region; such as Lamongan, Mojokerto and Jombang, groundwater is generally saline, and productive aquifers are rare except the Mojokerto plain.

Fig. 3.2.5 is a rough sketch of hydrogeological profile along the Solo river in the region of Bojonegoro and Lamongan. This sketch is based on test well results at only six locations, so it is really rough. The purpose of this sketch is to aid in perceiving the hydrogeological characteristics of the region. It may be understood from Fig. 3.2.5 that a formation that bears saline groundwater (probably connate water) distributes over the area. Fresh groundwater is estimated to be present in the Holocene formation along the Solo river and the Tertiary formation, and saline groundwater is in the Pleistocene formation. However, a correlationship between geological formation and groundwater quality is not yet verified as well as their interfaces. Aquifer potential of this area is not high but moderate anyway. In the estuary plain area the groundwater in quaternary sediments is thoroughly saline.

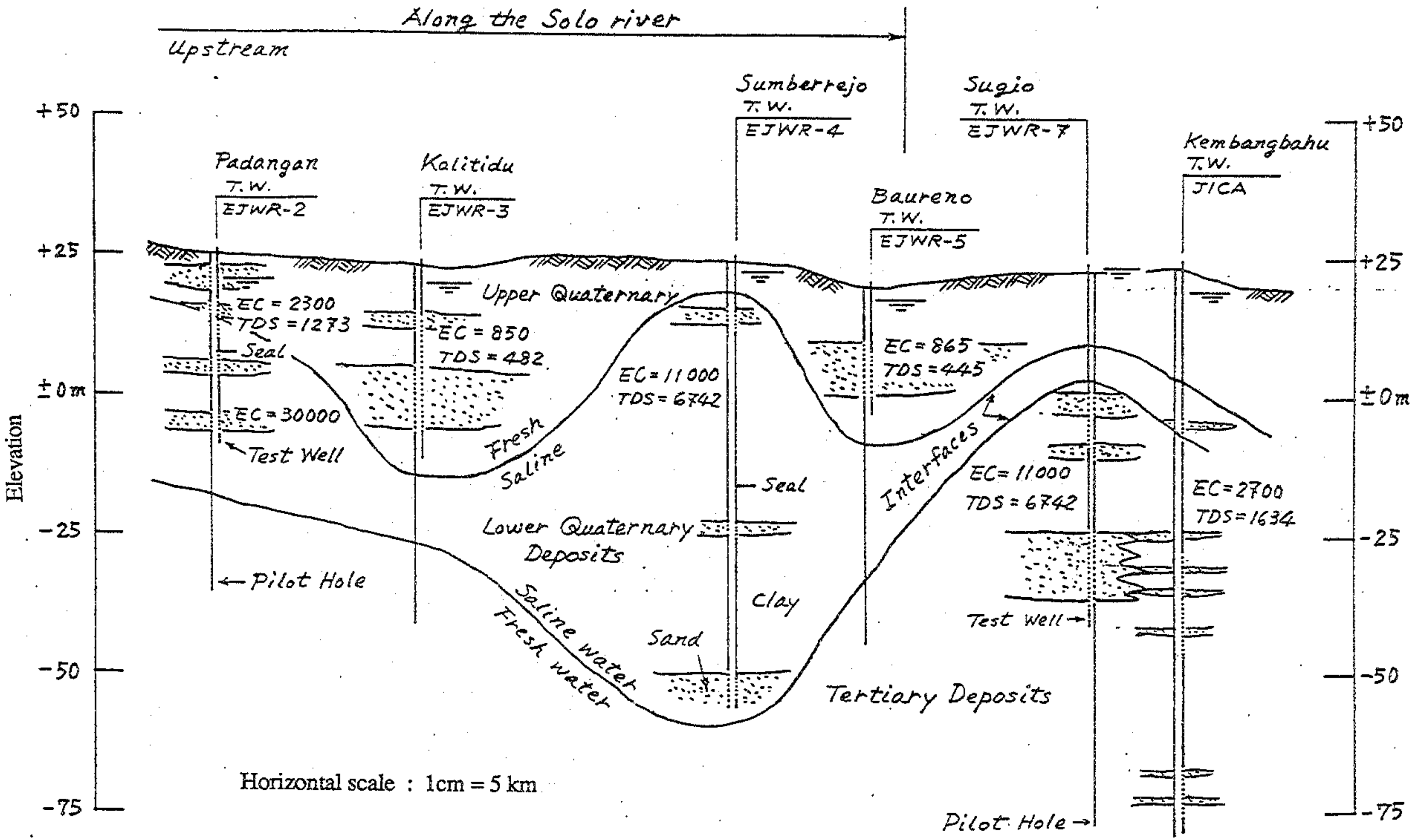


Fig. 3.2.5 Presumed Hydrogeological Profile along Solo River in East Java

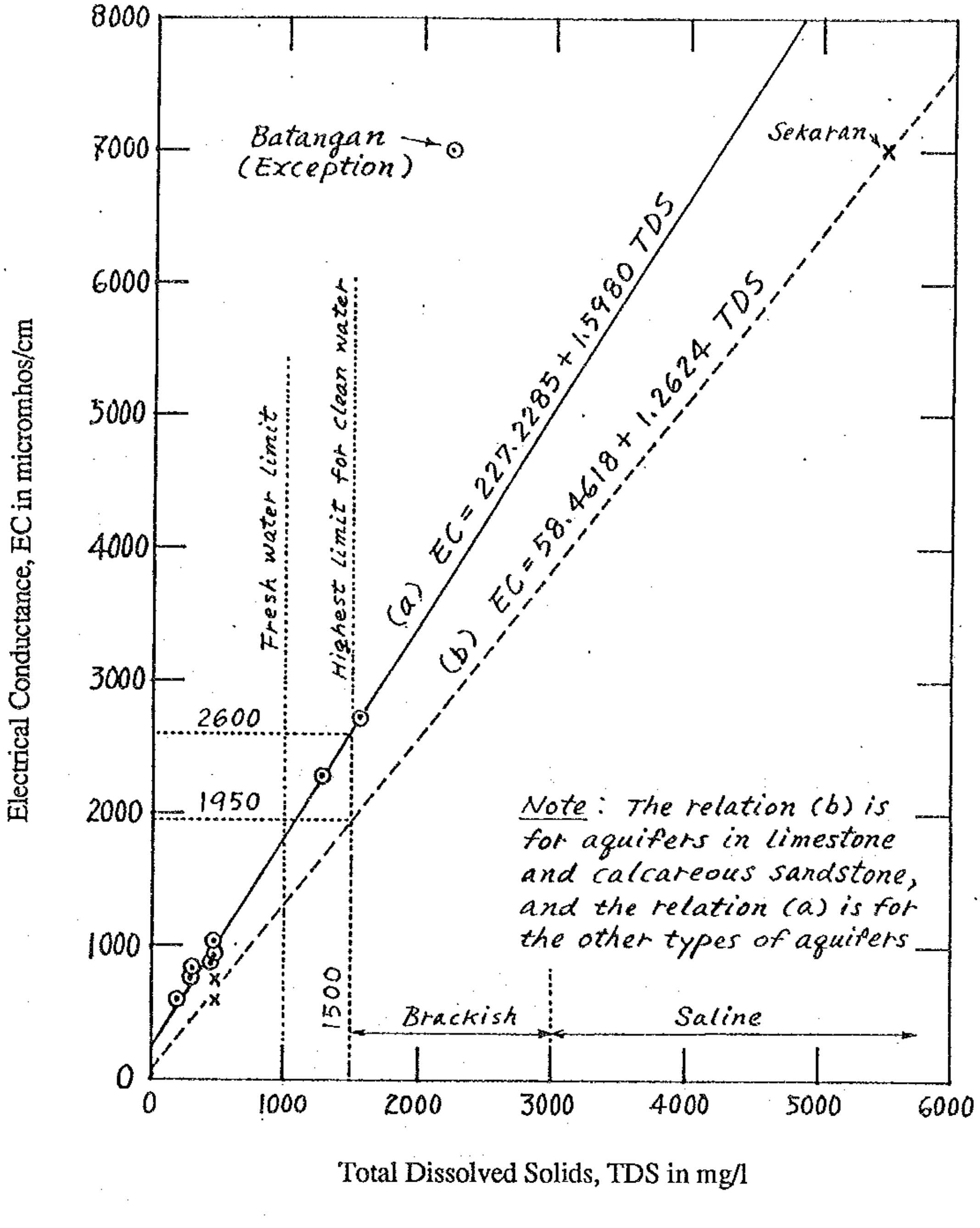


Fig. 3.2.6 Empirical Relations between EC and TDS of Groundwater Mostly in East Java

Fig. 3.2.6, in passing, shows a correlationship between electrical conductance (EC) in micromhos/cm and total dissolved solids (TDS) in mg/l of groundwater. The data are based on results of test wells mostly in East Java. TDS and EC reflect the salt concentration in water, so tests on these items are widely used in the test well works to judge groundwater quality. The relation expressed by equation (b) is for aquifers in limestone and calcareous sandstone strata in Tuban kabupaten and northern Lamongan kabupaten, and equation (a) is for the other types of aquifers such as alluvium sand, sandstone, and pyroclastics including tuff breccia. It is said by Salinity Laboratory (1954) that 1000 micromhos/cm customarily corresponds to 640 mg/l of TDS content, but in case of Java the corresponding EC value is somewhat higher than the value proposed by Salinity Laboratory. In the field classification, EC = 2600 may generally be used as the threshold index to decide groundwater usability. The relation (b) should be re-confirmed by using more data.

In topographic depressions and intermontane basins contacted with the foot of volcanos, Quaternary deposits consisting of fairly permeable sands, gravels and volcanoclastics are sedimented and overlain by less permeable materials, as a general rule. The recharge of water into the permeable stratum is accomplished from rivers flowing water on incised valleys in the flanks of volcanos, which resulted in the presence of high potential confined aquifer in the downstream areas. Typical areas classified in this group of background are, among investigated areas :

Central Java	;	The Sragen basin
		The Klaten basin
		The Kudus - Pati depression
East Java	;	The Madiun basin
		The Probolinggo-Lumajang depression

In case of intermontane basin surrounded by Tertiary hills, e.g., the Blora basin, the groundwater potential is low.

3.2.4 Water Resources at Each IKK Site

(1) Water Resources at Each IKK of 121

In Phase I (1990), water resources investigations were carried out to decide the water source for the basic plan of water supply system of each IKK, and their results were summarized in tables. Tables B-2.4 through B-2.6 provided in Supporting Report B show them, in which current methods of water acquisition by IKK people, conditions of various water resources and related information, and proposed water source are briefly described and summarized for every IKK of 121. Information on water resources provided in Tables B-2.4, B-2.5 and B-2.6 is still valid, and essentially there is no significant change in the type of water supply source proposed therein. However, as to sizing the design capacity of springs and drilled wells for implementation, re-study should be made by performing in-depth field survey. In fact, in the feasibility study of 30 high priority IKKs, modification was made to decide the design condition on water supply source of every IKK after in-depth field survey (see the following Paragraph (2) of this sub-section).

The process to determine the water supply source of each IKK was as follows:

From the water supply system's point of view, the water resources may be divided into the following four sources.

1) Surface water
2) Spring water
3) Groundwater
4) Existing water supply system

In order to determine an economical and adequate water source, the field survey and reconnaissance was energetically strived at each IKK area to search after useful springs and existing water supply system being nearby. When there is no useful spring but some kind of water supply system exists, then the extensibility of existing system was investigated.

If there was neither useful spring nor extensible water supply system, abstraction of groundwater by means of drilled well was studied.

The use of river water was proposed at the last resort for IKK where the use of other types of water sources had been judged ineffective or inapplicable from hydrogeological conditions thereof.

The final decision on water source to be used for the basic plan was made taking the design condition and the hydrogeological conditions into consideration. Total number of IKKs included in each type of water sources selected for the basic plan of 121 IKKs is summarized below.

Type of Source	Number of IKKs
Spring water	53
Existing system	14
Groundwater	52
(Deep well 150m deep)	(36)
(Shallow well 50m deep)	(16)
River water	2

(2) Water Resources at Each High Priority IKK of 30

In Phase II (1991), after in-depth field surveys including questionnaire survey, site reconnaissance, and test well drilling, a careful review was made on IKK area (served area), population and water demand, and conditions of proposed water source and other water resources. As a result of the review, inevitable modification occurred on water supply quantity and size of water collecting facilities as well.

Table B-2.7, consisting of 30 tables, being attached to Supporting Report B summarizes the conditions of water resources and a selected water source for the feasibility study of each IKK. Test well data are also provided in the table if they were available.

Water sources were changed at some IKKs from those proposed for Basic Plan to another sources. Their reasons are explained in Section 6.1.2 of Chapter 6.

Total number of IKKs included in each type of water sources selected for the feasibility study of 30 IKKs is summarized below

Type of Source	Number of IKKs
Spring water	9
Existing system	3
Groundwater	18

3.3 Geophysical Survey

3.3.1 Geophysical Survey Sites

Geophysical survey consisting of an electrical survey by the Schlumberger method and an electromagnetic survey by the loop-loop method was carried out at 10 IKK sites during a period from November 15 to December 15, 1990. Associated data analysis was completed on January 15, 1991. In other words, the geophysical survey was performed in the latter to end part of Phase I.

The purpose of the geophysical survey was to grasp the geological structure and aquifer condition of subsite materials at IKKs where groundwater should be used as the water supply source but hydrogeological condition has not been clarified.

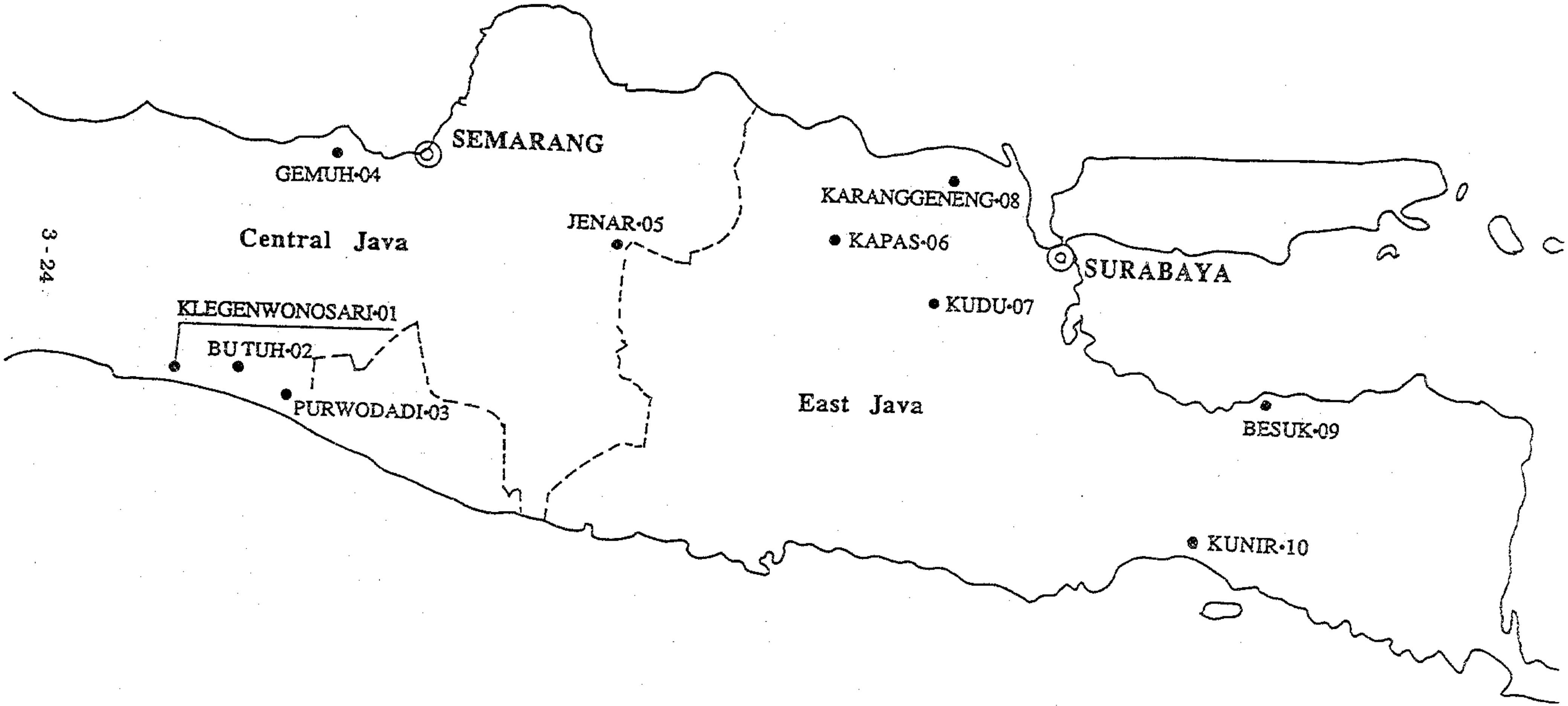
In the determination of geophysical survey sites, the following factors were taken into consideration.

a) Availability of existing test well data
b) Availability of existing hydrogeological information
c) Groundwater potential of the area
d) Geological and topographical conditions of the area

Based on available information acquired by the field survey and site reconnaissance at 121 IKKs, IKKs were classified into 3 groups, i.e. 1) IKKs where deep well data are available, 2) IKKs in which geophysical survey can be omitted, and 3) IKKs in which geophysical survey should be conducted. Then, a meeting was held between Cipta Karya and JICA study team on November 14, 1990 to finalize the IKK sites where geophysical survey shall be carried out.

A flow chart and related tables used in the determination of geophysical survey sites are provided in Section B-3.1 of Supporting Report B.

Fig. 3.3.1 LOCATION MAP OF GEOPHYSICAL SURVEY
(• IKK Name, Location No.)



In conclusion, the following 10 IKKs were selected as geophysical survey sites.

Name of IKK	Kabupaten	Province
Klegenwonosari	Kebumen	Central Java
Butuh	Purworejo	Central Java
Purwodadi	Purworejo	Central Java
Gemuh	Kendal	Central Java
Jenar	Sragen	Central Java
Kapas	Bojonegoro	East Java
Kudu	Jombang	East Java
Karanggeneng	Lamongan	East Java
Besuk	Probolinggo	East Java
Kunir	Lumajang	East Java

The locations of these IKKs are marked with solid spots on Fig. 3.3.1.

Actual survey sites were decided by conducting site reconnaissance again and by consulting with the kecamatan official. Since the geophysical survey requires a considerable tract of land being outside the artificial electromagnetic field, the survey points were arranged on a large rice field or a dry farm land. Detailed locations of the survey points at each IKK are shown on Fig. B-3.2 attached in Supporting Report B.

3.3.2 The Method of Geophysical Survey

The method of geophysical surveys performed is described in Section 3.2 of Supporting Report B.

3.3.3 Results and Interpretation of Geophysical Survey

(1) Results of Geophysical Survey

Based on the results of field measurements, a cross-sectional resistivity profile was constructed at every site in the last analysis. All profiles thus developed are attached to Supporting Report B (Fig. B-3.3 consisting of 10 drawings).

Generally speaking, the subsurface materials can be divided into two major zones in resistivity, i.e., the upper shallow zone of relatively high resistivity and the lower deep zone of lower resistivity, but the resistivity itself was commonly low except for Besuk and Kunir; therefore it was practically impossible to subdivide the lower deep zone by computer analysis.

(2) Interpretation on Subsurface Condition at each IKK

Main points of interpretation developed from the results of the geophysical survey are described hereinafter.

1) Klegenwonosari

According to the resistivity-depth relation, the subsurface materials of this site can be divided into two major zones; the shallow zone of the resistivity between 20Ω•m and 40Ω•m and the deep zone of the resistivity less than 5Ω•m. The boundary of these two zones is at a depth of 12 - 15 m below the ground surface.

The shallow zone seems to be a fine-sand stratum of Alluvium, and the deep zone seems to be composed mainly of clays. At present inhabitants get water from the sand stratum by means of dug wells. The deep zone may be interbedded with sand layers and may be composed both of Alluvial clays and Tertiary sedimentary rocks, but it is practically impossible to subdivide it in more detail.

The sand stratum of the shallow zone is evaluated to be a productive aquifer.

2) Butuh

The subsurface conditions of this site are similar to those of Klegenwonosari. The subsurface materials can be divided into the following two major zones.

Shallow zone	;	$\rho a = 10 - 20 \Omega \cdot m$
Deep zone	;	$\rho a \leq 5 \Omega \cdot m$

The boundary depth of these zones is 15 - 16 m from the ground surface. The resistivity of the shallow zone is relatively low compared with that of Klegenwonosari, so it appears that the materials of the shallow zone consist of sand-clay mixtures or alternation of sand layers and clay layers. Probably, the deep zone consists mainly of Tertiary mudstones.

The shallow zone can be considered to be a productive aquifer but its groundwater productivity will be lower than that of Klegenwonosari. In so far as the geoelectric survey is concerned, it is difficult to locate a specific aquifer within a depth of 100 m of the deep zone.

3) Purwodadi

The subsurface conditions of this site are almost the same as those of Butuh, except the boundary depth between the shallow zone (upper zone) and the deep zone (lower zone). The boundary depth is about 30 m below the ground surface.

The resistivity values are:

Shallow zone	;	$\rho a = 20\Omega \cdot m$
Deep zone	;	$\rho a \leq 5\Omega \cdot m$

The shallow zone is thought to be composed of sand-clay mixtures, which is overlain by a clay stratum about 12 m thick in the west part. It seems that the deep zone consists mainly of tertiary mudstone.

As for the groundwater potentiality, refer to the comment given to Butuh.

4) Gemuh

The subsurface materials consist of the following two resistivity zones.

Shallow zone	;	$\rho a = 10 - 15\Omega \cdot m$
Deep zone	;	$\rho a \leq 4 - 5\Omega \cdot m$

The boundary of these zones is at a depth of 15 - 18 m from the ground surface.

It appears that the shallow zone consists of sand-clay mixtures with occasional limestone fragments and the deep zone consists of sandy clays or a mud formation with frequent sand seams. We had expected that a sand-gravel bed might be deposited at a depth below 50 m, but it was unable for us to locate such a layer by computer analysis.

Both the shallow zone and the deep zone may be considered as productive aquifers although their productivity will not be high.

5) Jenar

In this IKK, geoelectrical surveys were conducted at two sites of different topography; one at a river terrace along the Solo river and the other one at a small valley in a hill region.

- River terrace

The subsurface materials can be divided into four resistivity zones, namely:

1st zone	;	$\rho a = 11 - 12\Omega \cdot m$
2nd zone	;	$\rho a = 29 - 41\Omega \cdot m$
3rd zone	;	$\rho a = 6 - 9\Omega \cdot m$
4th zone	;	$\rho a \leq 5\Omega \cdot m$

Boundary depths of these zones are undulated. The 4th zone develops below a depth of 20 - 25 m. This zone is conjectured to be sedimentary facies of Tertiary age. Although we could not locate a productive aquifer in 4th zone by computer analysis, the presence of fracture zones is expected in Tertiary formation of this area. The fracture zone would be moderate to high productive aquifer.

The 2nd zone is a good aquifer for dug wells.

- Valley in hill

The subsurface materials are divided into two zones even though their resistivities are low.

Upper zone ; $\rho a = 9\Omega \cdot m$

Lower zone ; $\rho a = 2 - 3\Omega \cdot m$

The boundary depth of these zones is much undulated varying from 15 m to 40 m. It is not clear why such a result has been taken place, because it is conjectured here that a relatively thin layer of Alluvial clay is underlain by marly sedimentary rocks of Tertiary age. Probably, it has some relation with a fault action.
Only the fracture zone would be the productive aquifer.

6) Kapas

This site is underlain by thick low resistivity materials of $\rho a < 7\Omega \cdot m$. Although a shallow section shows $\rho a < 2.5\Omega \cdot m$, its boundary is not clear.

From such a result, it is conjectured that the subsurface materials consist mainly of clays; Holocene clay deposits in the upper part and Pleistocene mudstone in the lower part. Regarding the intercalation of sand layers, the detail is not clear; consequently, it would be recommended that in practice a deep well be drilled at a northern location nearby the Solo river.

7) Kudu

Geoelectric survey was carried out in the direction of N-S. The results indicate that the subsurface materials can be divided into 2 or 3 zones and a zone whose resistivity is 10 - $15\Omega \cdot m$ extends in the south area near the Brantas river increasing its thickness toward the south. According to the electromagnetic survey, the thickness of this relatively high resistivity zone is locally more than 100 m. This zone may be composed mainly of sands. The resistivity of the other zones is less than $5\Omega \cdot m$.

It would be concluded that here a productive aquifer is present near the Brantas river.

8) Karanggeneng

The results of geoelectric surveys indicate that this area is underlain by thick alluvial deposits of low resistivity. The resistivity of materials below a depth of about 15 m was less than 1.0Ω•m, which implies that the materials are possibly affected with salinization.

From such a result of investigation, it would be remarked for the practice of well drilling that it is better to sink a well at north side of the Solo river in order to avoid the salinization effect on groundwater.

9) Besuk

The subsurface materials of this area can be divided into the following two zones.

Upper zone ; $\rho a = 20 - 400\Omega \cdot m$
Lower zone ; $\rho a < 10\Omega \cdot m$

The boundary depth of these zones varies from 25 m to 45 m. Geologically speaking, the upper zone consists of Quaternary volcanic products of andesitic breccia and tuff breccia, and the lower zone would be composed of Tertiary sedimentary deposits.

It is inferred from said results that this area is blessed with productive aquifers.

10) Kunir

Geoelectric surveys were conducted at three locations around the IKK area. Their results indicate that this area is underlain by materials of substantially high resistivity.

The upper section of 50 m thickness consists of materials having $\rho a = 35 - 150\Omega \cdot m$ and the lower section below a depth of 50 m consists of materials having $\rho a = 10 - 30\Omega \cdot m$. The upper section is possibly composed of secondary deposits of volcanic products mainly of sand and gravel, and perhaps the lower section is composed of Tertiary series of mixed volcanic products and sedimentary facies.

It would be concluded that this area is one of highly productive aquifer areas.

3.4 Test Well Drilling and Pumping Test

3.4.1 Test Well Sites

In order to grasp the aquifer potential and its hydraulic properties of subsurface materials at IKKs where groundwater was decided to be developed as the water supply source, test well drilling and associated in-situ/laboratory tests were performed at selected sites. At first, test well plans were made. A shallow aquifer was considered to be a secondary resource in this stage because of its instability of water level and quality, and of its little information. Sub-sequently, test wells (100m±) were drilled, constructed and tested at the following five (5) IKK sites which had been decided previously by the meetings between JICA study team and Indonesian Government.

- 3 IKKs of Kemiri, Jenar, and Jepon in Central Java
- 2 IKKs of Kembangbahu and Banyuanyar in East Java

After the completion of said works, additional test well drillings and pumping tests were planned and carried our for the following IKKs.

- 4 IKKs of Kemiri, Jenar, Jepon, and Batangan in Central Java
- 1 IKK of Banyuanyar in East Java

3.4.2 The Process of Conducting Works

The work process of initial test wells and additional well testings is described in Sections 4.1 and 4.2 of Supporting Report B.

3.4.3 Test Results

Results of test well drilling and pumping tests are described herein along with recommendations on well design for the feasibility study.

Test well completion reports and analyses of dug well pumping tests are provided in Section 4.3 of Supporting Report B.

(1) Kemiri, Central Java

Two test wells were drilled here. They were 5m apart each other.

1) Initial test well (TW-1)

Pilot hole was drilled to a depth of 125 m expecting the occurrence of some potential aquifers such as sandstones and conglomerates that are interbedded in the sedimentary rocks under the alluvium of this region, but regrettably such a potential aquifer was not identified in the lower section up 125m. Therefore, the well was constructed to a depth of 60m with screens at 35-47m and 50-56m. The pumping test resulted in that the specific capacity is 0.048-0.063 l/s/m for Q=0.50-1.50 l/s. This result infers that this test well cannot be used as a production well.

2) Additional test well (TW-2)

Drilling was made to a 30m depth and a 24m deep well was constructed using 6" PVC pipe with slotted section between 10m and 20m. Unfortunately, the opening ratio of the slotted section was only 4.2%.

Pumping tests were carried out for Q=1.8 l/s, Q=2.8 l/s, and k=7m/d was estimated, but if common screens of 25% opening is used then a higher value of k will be obtained, and yield capacity of Q=5-10 l/s is estimated for a well with screens of 25% opening.

Water quality analysis shows that only Fe content is somewhat higher than the standardized upper limit.

3) Recommendation

Provide 3 wells of 40m depth and 6 l/s capacity each. Water quality analysis should also be conducted before implementation.

(2) Jenar, Central Java

1) Initial test well

Drilling was made to a depth of 125m, and the well was constructed to a depth of 107m with screens at 76-82m, 86-92m and 92-102m. Although sand strata were presumed to be at screen portions, pumping test results indicate that aquifer potential of these sand strata is low; the specific yield capacity was 0.07-0.08 l/s/m for Q=1-2 l/s. This means that the test well cannot be used as a production well. If discharge of Q=5 l/s is continued, drawdown of about 60m will happen.

2) Additional well test

Pumping test of a dug well 6m deep in Dukuh Prayunan obtained k=0.01 cm/s for alluvial sands. And the test on a bored well 12m deep, at 105m distance from the dug well, inferred that specific capacity of aquifer is about 1.0 l/s/m. From these results, a yield capacity of 20m deep well was theoretically estimated, and Q=6-7 l/s was obtained as a normal value on the safe side (refer to Section 4.4 of Supporting Report B). Water quality within the norm.

3) Recommendation

Provide 2 drilled wells of 20-30m depth and 5 l/s yield capacity in Dukuh Prayunan.

(3) Jepon, Central Java

1) Initial test well

The test well was drilled to a depth of 127m and the well was constructed in its full depth. Here, pumping test could not be carried out because of poor groundwater productivity; subsurface materials were composed of marls with occasional clayey sand layers at practically impervious.

2) Additional well test

Pumping test was performed using an existing P2AT test well in Desa Soko in November-December 1991. The result indicates that its yield capacity is more than 5 l/s; the draw-down of water level was 20.16m in continuous pumping at a discharge rate of 5 l/s. Water quality was within the norm, except for iron content.

3) Recommendation

Provide 4 drilled wells of 150m depth and 5 l/s yield capacity each in Desa Soko.

(4) Kembangbahu, East Java

1) Test well

Drilling was made to a depth of 103m, and a 102m deep test well was constructed with screens of 27m in total length. The specific yield capacity was 0.18 l/s/m for Q=4.1 l/s, from which a nominal maximum well capacity is estimated to be 4.5 l/s. Although specific sand stratum was not identified in the drill hole, this well has moderate well capacity so that it can be used as a production well. Water was brackish, and TDS and Cl^- were somewhat higher than the standardized upper limits.

2) Recommendation

Use the test well as one of production wells. Construct one more drilled well of similar size. Well capacity for design use should be 4-4.5 l/s. Water quality should be re-examined.

(5) Banyuanyar, East Java

1) Initial test well

A hard basaltic lava mass was present below a depth of 37m. The drilling of this rock took much time, so it was stopped at 84m. The well was constructed with no casing below a depth of 42m. After well development, the water level fell down much, and the well became dry by pumping. It was estimated that there is a breccia zone between 53m and 62m in depth, but the trial test inferred that there is compressed groundwater in this breccia zone.

2) Additional well test

Pumping tests were carried out using 3 dug wells 21.76m-27,14 m deep which are present near the initial test well. The results show that the permeability of subsoils is 0.012-0.2 cm/s. A theoretical analysis was made for a 40m deep well using this data, and Q=7-9 l/s was estimated was a practical well capacity (refer to Section 4.4 of Supporting Report B).

3) Recommendation

Provide 3 drilled wells of 40-50m depth on the north side of the main road. Yield capacity of 7-8 l/s should be used for design purpose.

(6) Batangan, Central Java

1) Additional test well

A 27m deep test well was drilled and constructed in Desa Gunungsari at 3km south of IKK. The result of pumping test indicates that aquifer potential for water production is very low (1.0 l/s), and water is unsuitable in quality for water supply use.

2) Recommendation

A scheme to take water from shallow aquifers by means of new wells in Desa Gunungsari should be renounced.

3.5 Water Quality Analysis

3.5.1 Items of the Analysis

(1) In field survey of Phase II, water quality analyses were conducted on samples collected from springs and a river which are proposed as water sources for the High Priority IKKs and on groundwater samples from the test wells.

The numbers of samples are 9 (nine) spring water, 1 (one) river water and 5 (five) groundwater as shown in Table B.5.2 in SUPPORTING REPORT B.

(2) Items of analysis

Items of water quality analysis were decided in accordance with the Indonesian Standard for Clean Water. They are shown in Table B.5.1 in SUPPORTING REPORT B.

(3) Analysis at Site

On some specific items (refer to Table B.5.1), analyses were conducted at site on samples collected from spring sources, using the portable test kit.

(4) Analysis at Laboratories

All samples collected from springs, test wells and a river were analyzed at the authorized local laboratories.

(5) Bacterial Test

Bacterial test were conducted to detect the number of coliform group and the number of bacteria on samples collected from spring water, using two kinds of simplified detection papers.

3.5.2 Result of Water Quality Analysis

Results of water quality analysis are summarized in Table B.5.2 in SUPPORTING REPORT B.

As shown in Table B.5.2, chemical properties of analyzed samples are acceptable with some exceptions explained below.

Lead content in samples collected from Mudal spring and Sani river exceed the threshold of the Standard. Samples collected from test will at Kemiri and at Jepon show somewhat higher content of iron and that from test well at Kembangbahu shows somewhat higher values of TDS and Chloride.

By the way, actual conditions of these water sources are as follows.

Water from Mudal spring has been used by the nearby people for their domestic purpose and is proposed as the source for Banjarmangu town by another project. Sani river water has been used for Juwana water supply system after treated by the existing treatment plant in Pati. IKK Batangan is proposed to take in water from existing waterpipe of the Juwana system partially improved. Water of dug wells ant Kemiri has been used by inhabitants nearby. As for IKKs Kemiri, Jepon and Kembangbahu, plural wells are proposed for the feasibility study, but analysis of water quality were conducted only once and on one sample at these locations.

Judging from these situations, rechecking of water quality of these water sources in both dry and rain seasons is anyway recommended before implementation.

However, based on the discussion with Cipta Karya on January 30 and February 3, 1992, JICA Team studied the treatment facilities regarding Lead (Pb) and Iron (Fe) content.

As a result of the study, the following treatment facilities were proposed additionally.

Name of IKK	Water Source	Items to be treated
Madukara	Mudal Spring	Lead (Pb)
Kemiri	Shallow Well	Iron (Fe)
Jepon	Deep Well	Iron (Fe)

In Batangan, treatment facilities for Lead will not be required, because for Batangan the water is proposed to be taken from Juwana system which has the existing treatment facilities for Sani river water and is proposed to be improved by this project.

As for bacterial test, except Umbulsari I spring, existence of coliform group more than the threshold of the Standard was detected at all spring sources. Therefore, $Ca(OCl)_2$ injection facilities to all water sources are proposed in this study. Although the Indonesian Standard has no threshold about bacteria content, detected number of bacteria are also shown in Table B.5.2.

CHAPTER 4 BASIC PLAN OF WATER SUPPLY FACILITIES FOR 121 IKKs

CHAPTER 4 BASIC PLAN OF WATER SUPPLY FACILITIES FOR 121 IKKS

4.1 Design Conditions

4.1.1 Design Criteria

Based on the site survey for 121 IKKs and survey results for the existing IKK system water supply facilities, the following design criteria have been adopted for the Basic Plan in Phase 1.

(1) Population served is 100% of the total population in each IKK served area.

(2) Supply level of public tap is 30 l/c/d.

(3) Supply level of house connection is 90 l/c/d.

(4) Ratio of Population Served by Public Taps and House Connection

From the result of site survey (Answer to Questionnaire), 121 IKKs have been classified into 3 (three) groups according to the income level of each IKK.

Ratio of population served by public taps and house connections was defined into 3 (three) groups according to the classification of income level shown below.

Class	Monthly Income Household (Rp/Month)	Ratio of Population Served by Public Taps	Ratio of Population served by House Connection
High	More than 135,000	20%	80%
Medium	75,000 - 135,000	30%	70%
Low	Less than 75,000	40%	60%

(5) Water allocation for non-domestic demand is 5%.

(6) Water allocation for leakage in the system and losses is 15%.

(7) Factor for maximum day is 1.1

(8) Factor for peak hour is 1.5.

(9) Population served by one public tap is 100.

(10) Population served by one house connection is 5.

(11) Target year is 10 years future.

4.1.2 Design Data

(1) Design data for the Basic Plan such as population, income level, water supply conditions, etc., were collected during site survey for 121 IKKS by the Study Team.

(2) Population Projection

According to the Design Criteria, target year is 10 years future.
Therefore population for this Project should be the population in the Year 2,000.
Population projection in year 2,000 was defined based on the historical population growth rate, computed from population data collected during the site survey through Answers to the Questionnaires.

4.1.3 Cost Estimation

(1) As a result of data collection and site survey for the existing IKK system water supply facilities, the following cost estimation basis have been used for this Basic Plan.

1) Basic Price from Pusat Informasi Teknik Bangunan Jawa Tengah. (Central Jawa)
2) Basic Price from Pusat Informasi Teknik Bangunan Jawa Timur. (East Jawa)

3) Basic Price from Pusat Informasi Teknik Bangnan Bali. (Bali)

4) Quotation from Suppliers

(2) Purpose of the Cost Estimation

The purpose of this cost estimation is to compare the installation cost of 121 IKKs relatively based on the Basic Plan.
Therefore this estimated costs would be rough and different from those in Phase 2 which will be estimated after more detailed survey such as topographical the surveys and test well drilling, etc.

(3) Items of this Cost Estimation

1) The installation cost (material cost and labour fee) for the following facilities will be included in this cost estimation.

(i) Intake facilities for spring
(ii) Water treatment facilities for river water
(iii) Wells (Shallow Well/Deep Well)
(iv) Pumps (+ generator if necessary)
(v) Chlorination unit
(vi) Reservoir/Elevated tank
(vii) Piping
(viii) Public taps
(ix) House connections
(x) Others if any

2) The following costs will be excluded in this cost estimation.

(i) Land acquisition
(ii) Spare parts
(iii) Contingency
(iv) Design
(v) Supervision for construction
(vi) Transportation of imported materials
(vii) Escalation

4.2 Summary of Basic Plan

4.2.1 Types of Water Supply Systems

The types of water supply systems are shown in Fig. 4.1

4.2.2 Summary of Basic Plan

Summary of Basic Plan is shown in the Table 4.1, 4.2 and 4.3.

4.2.3 System plans for 121 IKKs are shown in Supporting Report C.

(1)

Fig. 4.1 Types of Water Supply System

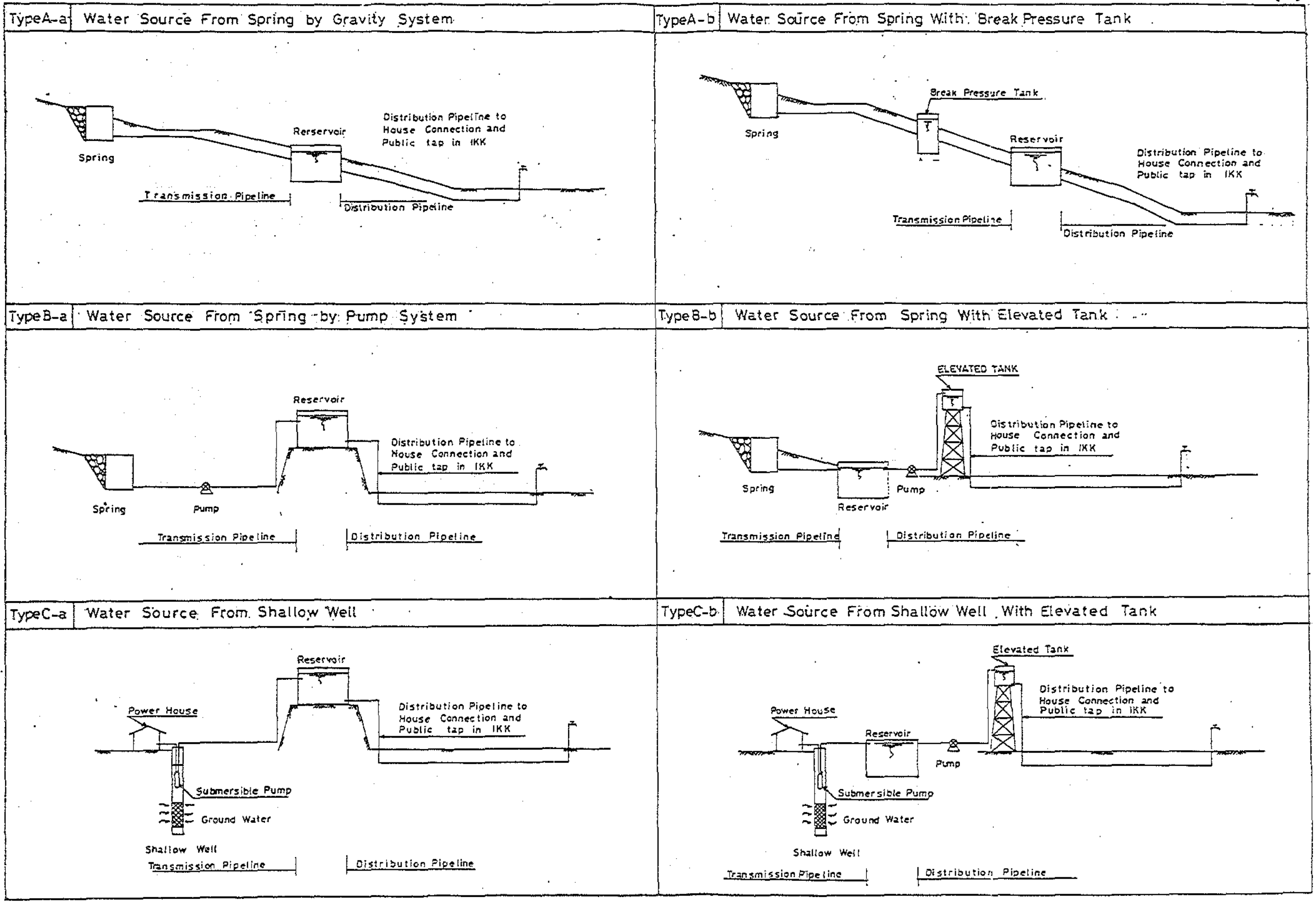


Fig. 4.1 Types of Water Supply Systems (2)

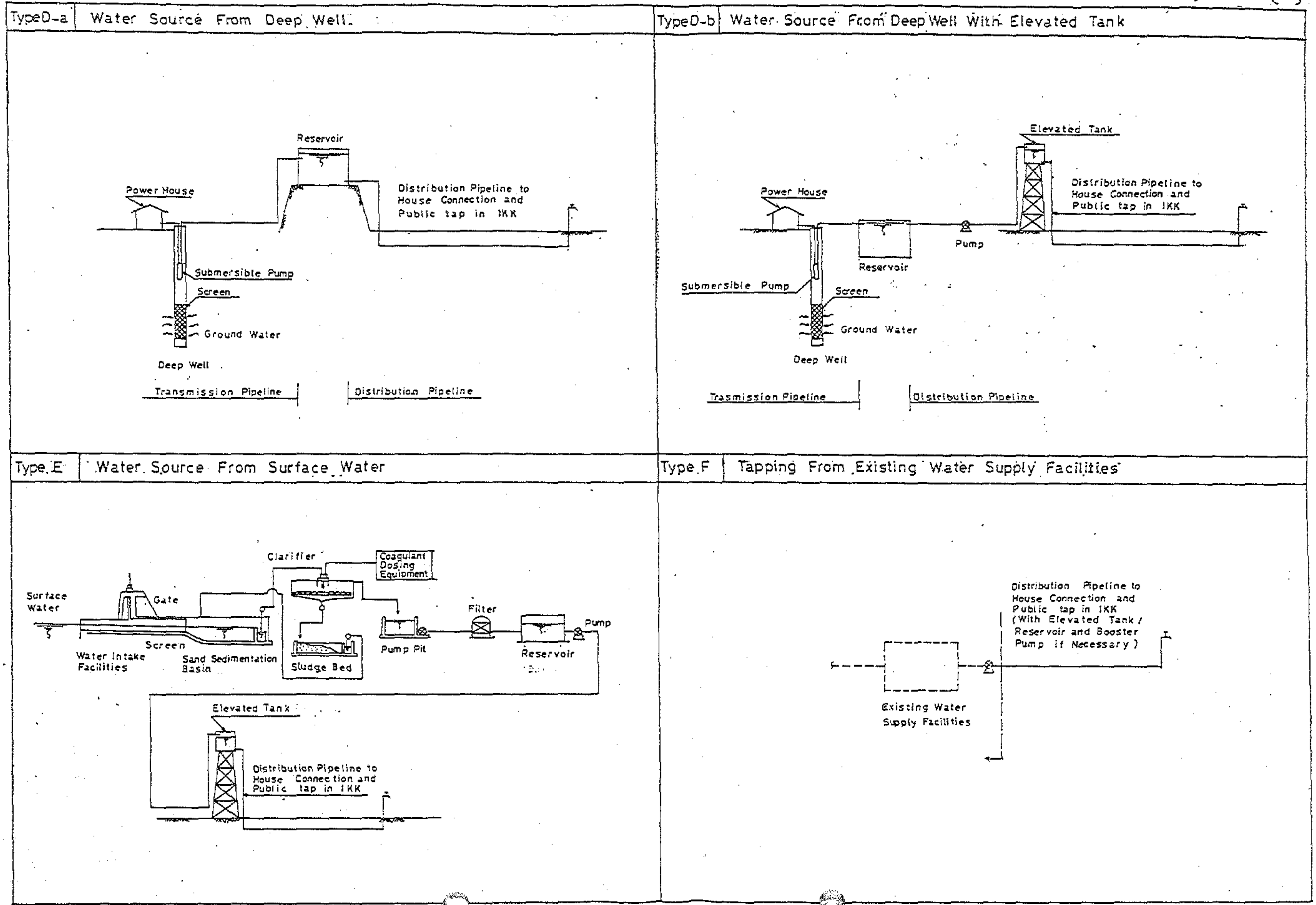


Table 4.1 Summary List for Basic Plan for IKKs in Central Jawa

No.	Item															
1	Province	C - 1	C - 2	C - 3	C - 4	C - 5	C - 6	C - 7	C - 8	C - 9	C - 10	C - 11	C - 12	C - 13	C - 14	C - 15
2	Kabupaten	BREBES	BREBES	BREBES	BREBES	BREBES	CILACAP	CILACAP	CILACAP	CILACAP	CILACAP	PURWOREJO	PURWOERJO	PURWOREJO	PURWOREJO	PURWOREJO
3	Kecamatan	BANTARKAWUNG	BULAKAMBA	PAGUYANGAN	SALEM	LOSARI	DAYEUHLUHUR	GANDRUNGMANGU	JERUKLEGI	KESUGIHAN	NUSAWUNGU	BUTUH	BANYUURIP	GRABAG	KALIGESING	KEMIRI
4	I K K	BANTARKAWUNG	BULAKAMBA	PAGUYANGAN	SALEM	LOSARI	DAYEUHLUHUR	GANDRUNGMANGU	JERUKLEGI	KESUGIHAN	NUSAWUNGU	BUTUH	BANYUURIP	GRABAG	KALIGESING	KEMIRI
5	Total Population in the year 2000	15329	19123	11619	12560	11713	7771	33464	18365	11576	16854	10627	5810	17157	4530	14871
6	Served Population	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %
7	%-tage of Population served by House Conection (H.C.)	80	60	60	60	60	70	60	70	70	70	70	70	60	80	60
8	Water demand for H.C. (0 = 90 1/cap/day)(1/day)	1103688	1032642	627426	678240	632502	489573	1807056	1155995	729288	1061802	669501	366030	926478	326160	803034
9	%-tage of population served by Public Tap (P.T.)	20	40	40	40	40	30	40	30	40	30	30	30	40	20	40
10	Water demand for P.T. (0 = 30 1/cap/day)(1/day)	91974	229476	139428	150720	140556	69939	401568	165285	104184	151686	95643	52290	205884	27180	178452
11	Sub-total water demand (1/day)	1195662	1262118	766854	828960	773058	559512	2208624	1322280	833472	1213488	765144	418320	1132362	353340	981486
12	Water demand for non domestic (5 % X (11)(1/day))	59783	63105	38342	41448	38652	27975	1104312	66114	41674	60674	38257	20916	56618	17667	49074
13	Water demand for leakage and losses 15 % (11)(1/day)	179349	189317	115028	124344	115958	83927	331293	198342	125021	182023	114772	62748	169854	53001	147223
14	Total average demand (l/day)	1434794	15145416	920224	994752	927669	671414	3644230	1586736	1000167	1456185	918173	501984	1358834	424008	1177783
15	Total Average demand (l/sec)	16.60	17.52	10.65	11.51	10.74	7.77	42.17	18.36	11.58	16.85	10.62	5.81	15.73	4.91	13.63
16	Max day : 1.1 X (15)(1/sec)	18.26	19.28	11.71	12.66	11.81	8.54	46.40	20.20	12.73	18.54	11.68	6.39	17.30	5.40	14.99
17	Peak hour demand : 1.5 X (15)(1/s)	24.91	26.29	19.58	17.26	16.11	11.65	63.27	27.55	17.36	25.28	15.93	8.72	23.59	7.37	20.45
18	Source capacity required at 24 hours operation/day (l/sec)	18.26	19.28	11.71	12.66	11.91	8.54	46.40	20.20	12.73	18.54	11.68	6.39	17.30	5.40	14.99
19	Potential source available	SPR.	D.W.	SPR.	SPR.	S.W.	SPR.	R.	EXT.	EXT.	EXT.	D.W.	SPR.	S.W.	SPR.	S.W.
20	Water source capacity available	19	10*2	20	15	7*2	9					12	10	5*4	10	6*3
21	S y s t e m	B-b	D-b	A-a	B-b	C-b	A-a	E	F	F	F	D-b	B-b	C-b	B-a	C-b
22	Submersible pump A. Number of pump B. Capacity (1/min) C. Head (m)	- - -	3 585 70	- - -	- - -	3 350 24	- - -	- - -	- - -	- - -	- - -	2 702 70	- - -	5 270 24	- - -	4 305 24
23	Centrifugal pump : A. Number of pump B. Capacity (1/min) C. Head (m)	2 1097 22	2 1170 32	- - -	2 762 29	2 700 25	- - -	2 2760 25	- - -	- - -	2 1118 32	2 702 33	2 384 30	2 1039 28	2 324 22	2 917 20
24	Break Pressure Tank (m3)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25	Service Reservoir (m3)	495	520	320	345	320	230	1255	-	-	500	315	175	470	150	405
26	Elevated tank A. Capacity (m3) B. Height (m)	33 20	35 30	- -	22.8 29	21 23	- -	60.4 2	- -	- -	34 30	21 33	12 27	31.39 26	- -	27.5 18
27	Chlorination Capacity (l/hr)	6.27	6.62	4	4.35	4.05	2.9	15.92	-	-	6.4	4	2.2	5.9	1.85	5.14
28	Number of house connections	2453	2295	1394	1507	1406	1088	4016	2204	1621	2360	1488	813	2059	725	1785
29	Number of Public Taps	31	78	46	50	47	23	134	55	35	51	32	17	69	9	59
30	Estimation Cost (1.000*)	981.350	1.467.104	596.421	743.756	806.252	504.936	2.232.179	962.273	485.628	2.812.455	911.159	470.427	1.521.170	435.060	1.488.794

Note :
No:19 (Abreviation list): Spring = SPR.
Deep Well = D.W.
River = R.
Extention = EXT.
Shallow well = S.W.

No.20 : 10 *2 ; 10 = Capacity (1/sec)
2 = Number of well
No.21 : D - b etc = type of water Supply System
No.30 : Estimation Cost * Rp.1000.-

Table 4.1 Summary List for Basic Plan for IKKs in Central Jawa

No.	Item	C - 16	C - 17	C - 18	C - 19	C - 20	C - 21	C - 22	C - 23	C - 24	C - 25	C - 26	C - 27	C - 28	C - 29
1	Province														
2	Kabupaten	PURWOREJO	PURWOREJO	PURWOREJO	BANJARNEGARA	BANJARNEGARA	BANJARNEGARA	BANJARNEGARA	BANJARNEGARA	BANJARNEGARA	BANJARNEGARA	KEBUMEN	KEBUMEN	KEBUMEN	KEBUMEN
3	Kecamatan	PURWODADI	BAYAN	NGOMBOL	BANJARMANGU	KARANGKOBAR	MADUKARA	PAGETAN	PUNGGELAN	PURWONEGORO	PUR. KLAMPOK	SADANG	AMBALRESMI	AYAH	BULUSPESANTREN
4	I K K	PURWODADI	BAYAN	NGOMBOL	BANJARMANGU	KARANG KOBAR	MADUKARA	PAGETAN	PUNGGELAN	PURWONEGORO	PUR. KLAMPOK	KARANGSAMBUNG	AMBALRESMI	DEMANGSARI	SETROJENAR
5	Total Population in the year 2000	13609	12745	4942	8583	7971	7314	8021	6448	11310	28207	10552	3531	3892	6279
6	Served Population	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %
7	%-tage of Population served by House Conection (H.C.)	60	70	60	80	80	80	70	80	80	80	70	60	70	70
8	Water demand for H.C. (D = 90 1/cap/day)(1/day)	714866	802935	231768	617976	573912	526608	505323	464256	814320	2030904	664776	190674	245196	395577
9	%-tage of population served by Public Tap (P.T.)	40	30	40	20	20	20	30	20	20	20	30	40	30	30
10	Water demand for P.T. (D = 30 1/cap/day)(1/day)	163308	114705	51504	51498	47826	43884	72189	38688	67860	169242	94968	42372	35028	56511
11	Sub-total water demand (1/day)	898194	917640	283272	669474	621738	570492	577512	502944	882180	2200146	759744	233046	280224	452088
12	Water demand for non domestic (5 % X (11)(1/day))	44910	45882	14164	33434	31087	28525	28876	25147	44109	110007	37987	11652	14011	22604
13	Water demand for leakage and losses 15 % (11)(1/day)	134729	137646	42491	100421	93261	85574	86627	75442	132327	330022	113962	34957	42034	67813
14	Total average demand (l/day)	1077833	1101168	339927	803329	746086	684591	693015	603533	1058616	2640175	911693	279655	336259	542505
15	Total Average demand (l/sec)	14.27	12.75	3.93	9.30	8.64	7.92	8.02	6.99	12.25	30.56	10.55	3.24	3.89	6.28
16	Max day : 1.1 X (15)(1/sec)	13.72	14.03	4.32	10.23	9.50	8.71	8.82	7.69	13.48	33.62	11.61	3.56	4.28	6.91
17	Peak hour demand : 1.5 X (15)(1/s)	18.71	19.13	5.90	13.95	12.96	11.88	12.03	10.49	18.38	45.84	15.93	4.86	5.84	9.42
18	Source capacity required at 24 hours operation/day (l/sec)	13.72	14.03	4.32	10.23	9.50	9.71	8.82	7.69	13.48	33.62	11.61	3.56	4.28	4.91
19	Potential source available	S.W.	EXT.	S.W.	SPR.	SPR.	SPR.	SPR.	SPR.	SPR.	SPR.	S.W.	S.W.	SPR.	S.W.
20	Water source capacity available	5*3		5	30	4+4+2	10	10	35	10+5	15+25	6*2	5	15	5
21	S y s t e m	C-b	F	C-b	A-a	A-a	B-b	A-a	B-a	B-b	B-a	C-b	C-b	B-b	C-b
22	Submersible pump														
	A. Number of pump	4	-	2	-	-	-	-	-	-	-	2	2		3
	B. Capacity (1/min)	275	-	256	-	-	-	-	-	-	-	360	238		208
	C. Head (m)	24	-	22	-	-	-	-	-	-	-	22	22		24
23	Centrifugal pump :														
	A. Number of pump	2	-	2	-	-	2	-	2	2	2	2	2	2	2
	B. Capacity (1/min)	824	-	265	-	-	325	-	465	814	2027	720	228	258	415
	C. Head (m)	20	-	22	-	-	32	-	70	40	53	20	20	18	19
24	Break Pressure Tank (m3)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25	Service Reservoir (m3)	370	-	120	280	280	235	240	200	365	910	315	100	115	190
26	Elevated tank														
	A. Capacity (m3)	25	-	8	-	-	16	-	-	24	-	22	10	7.7	12.5
	B. Height (m)	18	-	20	-	-	30	-	-	38	-	18	18	16	17
27	Chlorination Capacity (l/hr)	4.7	-	1.5	3.5	3.3	3	3.0	2.6	4.6	11.5	4.0	1.2	1.5	1.7
28	Number of house connections	1633	1784	515	1373	1275	1170	1123	1032	1810	4513	1477	424	545	879
29	Number of Public Taps	54	38	17	17	16	15	24	13	23	56	32	14	12	19
30	Estimation Cost (1,000**)	1,165,353	573,152	377,103	656,192	682,441	575,772	511,647	452,347	1,051,579	1,679,776	771,637	313,117	369,222	701,205

Note :

No:19 (Abreviation list): Spring = SPR.
Deep well = D.W.
River = R.
Extention = EXT.
Shallow well = S.W.

No.20 : 10 *2 ; 10 = Capacity (1/sec)
2 = Number of well

No.21 : 0 - b etc = type of water Supply System

No.30 : Estimation Cost * Rp. 1000,-

Table 4.1 Summary List for Basic Plan for IKKs in Central Jawa

No.	Item	C - 30	C - 31	C - 32	C - 33	C - 34	C - 35	C - 36	C - 37
1	Province								
2	Kabupaten	KEBUMEN	KEBUMEN	KEBUMEN	KEBUMEN	KEBUMEN	KENDAL	KENDAL	KENDAL
3	Kecamatan	KARANGGAYAM	KLIRONG	MIRIT	PETANAHAN	PREMBUN	GEMUH	SUKOREJO	SINGOROJO
4	I K K	KARANGGAYAM	K.WONOSARI	MIRIT	PETANAHAN	PREMBUN	GEMUH	SUKOREJO	SINGOROJO
5	Total Population in the year 2000	10400	9157	7041	8421	14723	16049	16514	15639
6	Served Population	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %
7	%-tage of Population served by House Conection (H.C.)	70	60	70	70	70	70	70	70
8	Water demand for H.C. (D = 90 l/cap/day)(l/day)	655200	494478	443583	530523	927549	1011087	1040382	985527
9	%-tage of population served by Public Tap (P.T.)	30	40	30	30	30	30	30	30
10	Water demand for P.T. (D = 30 l/cap/day)(l/day)	93600	103884	63359	75789	132507	144441	148626	140751
11	Sub-total water demand (l/day)	748800	604362	506952	606312	1060056	1155528	1189008	1126008
12	Water demand for non domestic (5 % X (11)(l/day))	37440	30218	25348	30316	53003	57776	59450	56300
13	Water demand for leakage and losses 15 % (11)(l/day)	112320	90654	76043	90947	159008	173329	178351	168901
14	Total average demand (l/day)	898560	725234	608343	727575	1272067	1386633	1426809	1351209
15	Total Average demand (l/sec)	10.40	8.39	7.04	8.42	14.72	16.05	16.51	15.64
16	Max day : 1.1 X (15)(l/sec)	11.44	9.23	7.74	9.26	16.19	17.66	18.16	17.20
17	Peak hour demand : 1.5 X (15)(l/s)	15.60	12.59	10.56	12.63	22.08	24.08	24.77	23.46
18	Source capacity required at 24 hours operation/day (l/sec)	11.44	9.23	7.74	9.26	16.19	17.66	18.16	17.20
19	Potential source available	EXT.	S.W.	S.W.	S.W.	S.W.	D.W.	SPR.	R.
20	Water source capacity available		6*2	5*2	6*2	7*3	10*2	100	
21	S y s t e m	F	C-b	C-b	C-b	C-b	B-b	A-a	E
22	Submersible pump								
	A. Number of pump	-	2	3	3	6	3	-	-
	B. Capacity (l/min)	-	610	295	232	314	665	-	-
	C. Head (m)	-	22	24	24	24	70	-	-
23	Centrifugal pump :								
	A. Number of pump	-	2	2	2	2	2	-	2
	B. Capacity (l/min)	-	610	585	695	1886	1328	-	1330
	C. Head (m)	-	25	33	21	32	27	-	42
24	Break Pressure Tank (m3)	-	-	-	-	-	-	-	-
25	Service Reservoir (m3)	-	250	210	250	350	480	490	465
26	Elevated tank								
	A. Capacity (m3)	-	18.2	17.5	90	56	40	-	40
	B. Height (m)	-	23	31	19	30	25	-	40
27	Chlorination Capacity (l/hr)	-	3.2	2.7	3.2	5.6	6.1	6.2	5.9
28	Number of house connections	1456	1039	986	1180	2061	2247	2312	2190
29	Number of Public Taps	31	37	21	20	44	48	50	47
30	Estimation Cost (1,000*)	785,022	701,236	710,954	688,472	1,769,707	1,411,301	931,872	1,527,018

No.	Item	C - 38	C - 39	C - 40	C - 41	C - 42	C - 43	C - 44	C - 45
1	Province								
2	Kabupaten	BLORA	BLORA	BLORA	KUDUS	PATI	PATI	REMBANG	REMBANG
3	Kecamatan	BANJARREJO	JEPON	KRADENAN	DAWE	BATURSARI	TAYU	KALIORI	SALE
4	I K K	BANJARREJO	JEPON	MENDENREJO	DAWE	BATANGAN	TAYU	KALIORI	SALE
5	Total Population in the year 2000	8226	14654	8559	19917	10109	17909	12804	20729
6	Served Population	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %
7	%-tage of Population served by House Conection (H.C.)	70	80	70	80	70	70	70	60
8	Water demand for H.C. (D = 90 l/cap/day)(l/day)	518238	1055088	539217	1434024	636867	1128267	806652	1119366
9	%-tage of population served by Public Tap (P.T.)	30	20	30	20	30	30	30	40
10	Water demand for P.T. (D = 30 l/cap/day)(l/day)	74034	87924	77031	119502	90981	161181	115236	248748
11	Sub-total water demand (l/day)	592272	1143012	616248	1553526	727848	1289448	921888	1368114
12	Water demand for non domestic (5 % X (11)(l/day))	29614	57151	30812	77676	36392	64472	46094	68406
13	Water demand for leakage and losses 15 % (11)(l/day)	88841	171452	92437	233029	109177	193417	138283	205217
14	Total average demand (l/day)	710727	1371615	739497	1864231	873417	1547337	1106265	1641737
15	Total Average demand (l/sec)	8.23	15.88	8.56	21.58	10.11	17.91	12.80	19.00
16	Max day : 1.1 X (15)(l/sec)	9.05	17.47	9.42	23.74	11.12	19.70	14.08	20.90
17	Peak hour demand : 1.5 X (15)(l/s)	12.35	23.82	12.84	32.37	15.16	26.87	19.20	28.50
18	Source capacity required at 24 hours operation/day (l/sec)	9.05	17.47	9.42	23.74	11.12	19.70	14.08	20.90
19	Potential source available	D.W.	D.W.	D.W.	SPR.	EXT.	D.W.	SPR.	SPR.
20	Water source capacity available	10*1	12*2	10	30		10*2	60	40
21	S y s t e m	D-b	D-a	D-b	B-a	F	D-b	B-b	B-b
22	Submersible pump								
	A. Number of pump	4	3	3	-	-	4	1	2
	B. Capacity (l/min)	533	609	515	-	-	500	1608	1720
	C. Head (m)	70	70	70	-	-	70	-	-
23	Centrifugal pump :								
	A. Number of pump	2	2	2	2	-	2	2	2
	B. Capacity (l/min)	1600	1218	1030	1655	-	1494	1068	1720
	C. Head (m)	33	20	65	45	-	30	50	52
24	Break Pressure Tank (m3)	-	-	-	-	-	-	-	-
25	Service Reservoir (m3)	245	475	255	640	-	535	380	380
26	Elevated tank								
	A. Capacity (m3)	48	35	30	50	-	40.7	32	51.6
	B. Height (m)	31	18	60	42	-	27	48	50
27	Chlorination Capacity (l/hr)	3.1	6	3.2	8.1	-	6.8	4.8	7.2
28	Number of house connections	1152	2345	1198	3187	1415	2507	1793	2487
29	Number of Public Taps	25	30	26	40	30	54	39	83
30	Estimation Cost (1,000*)	1,076,858	1,167,559	808,312	1,341,251	501,257	1,341,549	1,716,724	1,650,868

Note :
No:19 (Abreviation list): Spring = SPR.
Deep Well = D.W.
River = R.
Extention = EXT.
Shallow Well = S.W.

No.20 : 10 * 2 ; 10 = Capacity (l/sec)
2 = Number of well
No.21 : D - b etc = type of water Supply System
No.30 : Estimation Cost * Rp.1000.-

Table 4.1 Summary List for Basic Plan for IKKs in Central Jawa

No.	Item	C - 46	C - 47	C - 48	C - 49	C - 50	C - 51	C - 52	C - 53
1 2 3	Province Kabupaten Kecamatan	SRAGEN TANGEN	SRAGEN MIRI	SRAGEN GONDANG	SRAGEN JENAR	SRAGEN PLUPUH	SRAGEN SAMBIREJO	WONOGIRI JATIROTO	WONOGIRI NGUNTORONADI
4	I K K	TANGEN	MIRI	GONDANG	JENAR	PLUPUH	SAMBIREJO	JATORPTO	NGUNTORONADI
5	Total Population in the year 2000	7876	12470	20327	7904	20347	14372	6418	4807
6	Served Population	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %
7	%-tage of Population served by House Conection (H.C.)	80	70	70	60	70	70	60	70
8	Water demand for H.C. (0 = 90 l/cap/day)(l/day)	567072	785510	1280601	426816	1281861	905436	346572	302841
9	%-tage of population served by Public Tap (P.T.)	20	30	30	40	30	30	30	40
10	Water demand for P.T. (0 = 30 l/cap/day)(l/day)	47256	112230	182943	94848	183123	129348	57762	57684
11	Sub-total water demand (l/day)	614328	897940	1463544	521664	1464984	1034784	404334	360525
12	Water demand for non domestic (5 % X (11)(l/day))	30716	44892	73177	26083	73249	51739	20217	18026
13	Water demand for leakage and losses 15 % (11)(l/day)	92149	134676	219532	78250	219748	155218	60650	54079
14	Total average demand (l/day)	737193	1077408	1756253	625997	1757981	1241741	485201	432630
15	Total Average demand (l/sec)	8.53	12.47	20.32	7.25	20.35	14.37	5.62	5.00
16	Max day : 1.1 X (15)(l/sec)	9.38	13.72	22.35	7.99	22.39	15.81	8.18	5.50
17	Peak hour demand : 1.5 X (15)(l/s)	12.80	18.71	30.48	10.88	30.35	21.56	8.43	7.50
18	Source capacity required at 24 hours operation/day (l/sec)	9.38	13.72	22.35	7.99	22.39	15.81	8.18	5.50
19	Potential source available	O.W.	O.W.	O.W.	O.W.	O.W.	O.W.	O.W.	O.W.
20	Water source capacity available	10	7*2	12*2	10	12*2	16	10	10
21	S y s t e m	O-b	O-a	O-b	O-b	O-b	O-b	O-b	O-b
22	Submersible pump A. Number of pump B. Capacity (l/min) C. Head (m)	 2 652 62	 3 393 70	 3 675 70	 2 480 62	 2 954 62	 2 885 62	 2 395 62	 2 290 62
23	Centrifugal pump : A. Number of pump B. Capacity (l/min) C. Head (m)	 2 652 26	 - - -	 2 1350 29	 2 480 17	 2 954 21	 2 885 52	 2 395 23	 2 290 25
24	Break Pressure Tank (m3)	-	-	-	-	-	-	-	-
25	Service Reservoir (m3)	255	375	610	216	605	430	170	140
26	Elevated tank A. Capacity (m3) B. Height (m)	 19.5 24	 - -	 41 27	 14.4 15	 28 19	 3.85 17	 12 21	 8.7 32
27	Chlorination Capacity (l/hr)	3.22	4.7	7.8	2.7	7.7	5.5	2.8	1.9
28	Number of house connections	1260	1748	2846	949	2849	2012	893	673
29	Number of Public Taps	16	32	61	32	61	43	20	15
30	Estimation Cost (1,000*)	720,433	775,455	1,598,028	551,102	1,378,296	1,222,664	626,432	426,526

No.	Item	C - 54	C - 55	C - 56	C - 57	C - 58	C - 59	C - 60	C - 61
1 2 3	Province Kabupaten Kecamatan	WONOGIRI GIRIWOYO	WONOGIRI JATIPURON	WONOGIRI BULUKERTO	WONOGIRI MANYARAN	SEMARANG HARJOSARI	SEMARANG SURUH	KLATEN BAYAT	KLATEN KARANGNONGKO
4	I K K	GIRIWOYO	JATIPURNO	BULUKERTO	MANYARAN	BAWEN	SURUH	BAYAT	KARANGNONGKO
5	Total Population in the year 2000	6350	4427	10039	6663	17886	14965	10468	4910
6	Served Population	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %
7	%-tage of Population served by House Conection (H.C.)	70	70	70	70	70	70	70	70
8	Water demand for H.C. (0 = 90 l/cap/day)(l/day)	400680	278901	632457	419769	1126818	942795	659484	309330
9	%-tage of population served by Public Tap (P.T.)	30	30	30	30	30	30	30	30
10	Water demand for P.T. (0 = 30 l/cap/day)(l/day)	57240	39843	90351	59967	160974	124685	94212	44190
11	Sub-total water demand (l/day)	457920	318744	722808	479736	1287792	1077480	753696	353520
12	Water demand for non domestic (5 % X (11)(l/day))	22896	15937	36140	23987	64390	53874	37685	17679
13	Water demand for leakage and losses 15 % (11)(l/day)	68688	47811	108421	71960	193169	161622	113054	53028
14	Total average demand (l/day)	549504	382492	867369	575683	1545351	1292976	904435	424224
15	Total Average demand (l/sec)	6.36	4.43	10.04	6.66	17.89	14.97	10.47	4.91
16	Max day : 1.1 X (15)(l/sec)	7.00	4.45	11.04	7.33	19.68	16.47	11.52	5.40
17	Peak hour demand : 1.5 X (15)(l/s)	9.54	6.05	15.06	9.99	26.84	22.46	15.71	7.37
18	Source capacity required at 24 hours operation/day (l/sec)	7.00	4.45	11.04	7.33	19.68	16.47	11.52	5.40
19	Potential source available	SPR.	SPR.	SPR.	SPR.	SPR.	SPR.	S.W.	S.W.
20	Water source capacity available	15	20	15	8	30	30	6*2	6
21	S y s t e m	B-b	B-b	A-a	B-b	B-b	B-b	C-b	C-b
22	Submersible pump A. Number of pump B. Capacity (l/min) C. Head (m)	 - - -	 - - -	 - - -	 - - -	 - - -	 - - -	 3 235 22	 2 326 22
23	Centrifugal pump : A. Number of pump B. Capacity (l/min) C. Head (m)	 2 335 21	 2 440 16	 - - -	 2 440 14	 2 1191 27	 2 990 33	 2 696 24	 2 326 21
24	Break Pressure Tank (m3)	-	-	-	-	-	-	-	-
25	Service Reservoir (m3)	190	120	300	200	536	445	313	147
26	Elevated tank A. Capacity (m3) B. Height (m)	 11.5 19	 13.3 14	 - -	 15 12	 36 25	 30 31	 21 19	 19 17
27	Chlorination Capacity (l/hr)	2.4	1.5	3.9	2.5	6.8	6.3	4.0	1.9
28	Number of house connections	890	520	1406	933	2054	2095	1466	687
29	Number of Public Taps	19	14	30	20	54	45	32	15
30	Estimation Cost (1,000*)	445,717	424,743	597,844	448,714	1,391,863	1,141,120	792,085	450,677

Note :
No:19 (Abreviation list): Spring = SPR.
Deep Well = O.W.
River = R.
Extention = EXT.
Shallow Well = S.W.

No.20 : 10 *2 : 10 = Capacity (l/sec)
2 = Number of well
No.21 : O - b etc = type of water Supply System
No.30 : Estimation Cost * Rp.1000.-

Table 4.2 Summary List for Basic Plan for IKKs in East Jawa

No.	Item								
1	Province	E - 1	E - 2	E - 3	E - 4	E - 5	E - 6	E - 7	E - 8
2	Kabupaten	BOJONEGORO	BOJONEGORO	BOJONEGORO	BOJONEGORO	TUBAN	TUBAN	TUBAN	TUBAN
3	Kecamatan	BALEN	BAUREXO	KAPAS	SUMBERREJO	BANGILAN	BANCAR	PARENGAN	JENU
4	I K K	BALEN	BAUREXO	KAPAS	SUMBERREJO	BANGILAN	BULU	PARENGAN	JENU
5	Total Population in the year 2000	14905	12411	13951	21377	13923	16034	11296	10606
6	Served Population	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %
7	%-tage of Population served by House Conection (H.C.)	80	80	80	80	80	70	70	70
8	Water demand for H.C. (0 = 90 1/cap/day)(1/day)	1073160	893592	1004472	1539144	1002456	1010142	711648	668178
9	%-tage of population served by Public Tap (P.T.)	20	20	20	20	20	30	30	30
10	Water demand for P.T. (0 = 30 1/cap/day)(1/day)	89430	74466	83706	128262	83538	144306	101664	95454
11	Sub-total water demand (1/day)	1162590	968058	1088178	1667406	1085994	1154448	813312	763632
12	Water demand for non domestic (5 % X (11)(1/day))	58130	48403	54409	83370	54300	57722	40666	38182
13	Water demand for leakage and losses 15 % (11)(1/day)	174389	145209	163227	250111	162899	173167	121997	114545
14	Total average demand (l/day)	1395109	1161670	1305814	2000287	1303193	1385337	975975	916359
15	Total Average demand (l/sec)	16.15	13.54	15.11	23.16	15.08	16.03	11.30	10.61
16	Max day : 1.1 X (15)(1/sec)	17.77	14.80	16.62	25.48	16.59	17.63	12.43	11.67
17	Peak hour demand : 1.5 X (15)(1/s)	24.23	20.18	22.67	34.74	22.62	24.05	16.95	15.92
18	Source capacity required at 24 hours operation/day (1/sec)	17.77	14.80	16.62	34.48	16.59	17.63	12.43	11.67
19	Potential source available	D.W.	D.W.	D.W.	D.W.	D.W.	D.W.	SPR.	S.W.
20	Water source capacity available	10*2	10*2	10*2	10*4	20	10*2	15	6*2
21	S y s t e m	D-b	D-b	D-b	D-b	D-b	D-b	S-b	C-b
22	Submersible pump A. Number of pump B. Capacity (1/min) C. Head (m)	3 680 70	3 425 70	5 540 70	5 540 70	2 915 62	3 550 70	- - -	3 360 22
23	Centrifugal pump : A. Number of pump B. Capacity (1/min) C. Head (m)	2 1355 31	2 850 31	2 2150 23	2 2160 44	2 915 35	2 1120 39	2 790 53	2 715 30
24	Break Pressure Tank (m3)	-	-	-	-	-	-	-	-
25	Service Reservoir (m3)	480	400	450	690	450	480	340	320
26	Elevated tank A. Capacity (m3) B. Height (m)	41 26	28 29	65 18	65 39	27 30	34 34	24 37	22 25
27	Chlorination Capacity (l/hr)	6.1	6.1	6.7	11.8	5.7	6.1	4.3	4.0
28	Number of house connections	2385	1989	2332	3420	2228	2245	1591	1485
29	Number of Public Taps	30	25	28	43	28	48	39	32
30	Estimation Cost (1.000*)	1.337.317	1.088.122	1.537.465	2.163.301	1.130.541	1.352.088	1.126.298	788.453

No.	Item							
1	Province	E - 9	E - 10	E - 11	E - 12	E - 13	E - 14	E - 15
2	Kabupaten	TUBAN	LAMONGAN	LAMONGAN	LAMONGAN	LAMONGAN	LAMONGAN	JOMBANG
3	Kecamatan	KEREK	KARANGGENENG	KEMBANGBAHU	BAKALANPULE	NGIMBANG	BRONDONG	DIWEK
4	I K K	KEREK	KARANGGENENG	KEMBANGBAHU	TIKUNG	NGIMBANG	BRONDONG	DIWEK
5	Total Population in the year 2000	16061	10128	6404	6400	5199	16912	14028
6	Served Population	100 %	100 %	100 %	100 %	100 %	100 %	100 %
7	%-tage of Population served by House Conection (H.C.)	70	80	70	80	70	80	60
8	Water demand for H.C. (0 = 90 1/cap/day)(1/day)	1011843	638064	403452	460800	327537	1065456	757512
9	%-tage of population served by Public Tap (P.T.)	30	20	30	20	30	20	40
10	Water demand for P.T. (0 = 30 1/cap/day)(1/day)	144549	91152	57636	38400	46791	152208	168336
11	Sub-total water demand (1/day)	1156392	729216	461088	499200	374328	1217664	925848
12	Water demand for non domestic (5 % X (11)(1/day))	57820	36461	23054	24960	18716	60883	46292
13	Water demand for leakage and losses 15 % (11)(1/day)	173459	109382	69163	74880	56149	182650	138877
14	Total average demand (l/day)	1387671	875059	553305	599040	449193	1461197	1111017
15	Total Average demand (l/sec)	16.06	10.13	6.40	6.93	5.20	16.91	12.86
16	Max day : 1.1 X (15)(1/sec)	17.67	11.14	7.04	7.62	5.72	18.60	14.15
17	Peak hour demand : 1.5 X (15)(1/s)	24.09	15.20	9.60	10.40	7.80	25.37	19.29
18	Source capacity required at 24 hours operation/day (1/sec)	17.67	11.14	7.04	7.62	5.72	18.60	14.15
19	Potential source available	EXT.	D.W.	D.W.	EXT.	SPR.	S.W.	D.W.
20	Water source capacity available	-	5*3	5*2	-	6	5*4	15
21	S y s t e m	F	D-b	D-b	F	S-b	C-b	D-b
22	Submersible pump A. Number of pump B. Capacity (1/min) C. Head (m)	- - -	4 290 70	2 345 70	- - -	- - -	5 300 22	2 775 62
23	Centrifugal pump : A. Number of pump B. Capacity (1/min) C. Head (m)	2 1000 31	2 865 31	2 685 27	2 455 35	2 325 39	2 1195 44	2 775 34
24	Break Pressure Tank (m3)	-	-	-	-	-	-	-
25	Service Reservoir (m3)	-	300	190	-	155	500	385
26	Elevated tank A. Capacity (m3) B. Height (m)	30 26	26 26	20 22	14 30	10 25	36 39	23 23
27	Chlorination Capacity (l/hr)	-	3.8	2.4	-	2.0	5.4	4.9
28	Number of house connections	2249	1418	897	1024	728	2368	1683
29	Number of Public Taps	48	30	20	13	16	17	55
30	Estimation Cost (1.000*)	1.062.115	991.132	688.873	478.001	701.616	1.223.891	1.099.808

Note :

No:19 (Abreviation list): Spring = SPR.
Deep Well = D.W.
River = R.
Extention = EXT.
Shallow Well = S.W.

No.20 : 10 *2 : 10 = Capacity (1/sec)
2 = Number of well

No.21 : D - b etc = type of water Supply System

No.30 : Estimation Cost * Rp.1000,-

Table 4.2 Summary List for Basic Plan for IKKs in East Jawa

No.	Item															
1	Province	E - 16	E - 17	E - 18	E - 19	E - 20	E - 21	E - 22	E - 23	E - 24	E - 25	E - 26	E - 27	E - 28	E - 29	E - 30
2	Kabupaten	JOMBANG	JOMBANG	JOMBANG	JOMBANG	JOMBANG	MADIUN	MADIUN	MOJOKERTO	MOJOKERTO	MOJOKERTO	MOJOKERTO	MOJOKERTO	LUMAJANG	LUMAJANG	LUMAJANG
3	Kecamatan	GUDO	KUDU	MEGALUH	MOJOWARNO	NGORO	JIWAN	MEJAYAN	DLANGGU	GEDEG	JATIREJO	KUTOREJO	PACET	CANDIPURO	GUCIALIT	TEMPEH
4	IKK	GUDO	KUDU	MEGALUH	MOJOWARNO	NGORO	JIWAN	MEJAYAN	DLANGGU	GEDEG	JATIREJO	KUTOREJO	PACET	CANDIPURO	GUCIALTT	TEMPEH
5	Total Population in the year 2000	6226	11688	6285	7104	8453	18650	16448	7372	10964	7382	15532	9269	17383	9294	13557
6	Served Population	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %
7	%-tage of Population served by House Conection (H.C.)	60	60	60	80	70	80	80	70	70	60	70	70	70	70	70
8	Water demand for H.C. (0 = 90 l/cap/day)(l/day)	336150	631044	339390	511488	532539	1343520	1184256	464436	690732	398628	978516	583947	1095129	585522	854091
9	%-tage of population served by Public Tap (P.T.)	40	40	40	20	30	20	20	30	30	40	30	30	30	30	30
10	Water demand for P.T. (0 = 30 l/cap/day)(l/day)	74700	140232	75420	42624	76077	111960	98688	66348	98676	88584	139788	83421	156447	83646	122013
11	Sub-total water demand (l/day)	410850	771276	414810	554112	608616	1455480	1282944	530784	789408	487212	1118304	667368	1251576	669168	976104
12	Water demand for non domestic (5 % X (11)(l/day))	20542	38564	20741	2131	30431	72774	64147	26539	39470	24361	55915	33368	62579	33458	48805
13	Water demand for leakage and losses 15 % (11)(l/day)	81628	115691	62222	6394	91292	218322	192442	79618	118411	73082	167746	100105	187736	100375	146416
14	Total average demand (l/day)	493020	925531	497773	562637	730339	1746576	1539533	636941	947289	584655	1341965	800841	1501891	803001	1171325
15	Total Average demand (l/sec)	5.70	10.71	5.76	6.51	8.45	20.22	17.82	7.37	10.96	6.77	15.53	9.27	17.38	9.29	13.56
16	Max day : 1.1 X (15)(l/sec)	6.27	11.78	6.34	7.16	9.30	22.24	19.60	8.11	12.06	7.45	17.08	10.20	19.12	10.22	14.92
17	Peak hour demand : 1.5 X (15)(l/s)	8.55	16.07	8.64	9.77	12.68	30.33	26.73	11.06	16.44	10.16	23.30	13.91	26.07	13.94	20.34
18	Source capacity required at 24 hours operation/day (l/sec)	6.27	11.78	6.34	7.16	9.30	22.24	19.60	8.11	12.06	7.45	17.08	10.20	19.12	10.22	14.92
19	Potential source available	O.W.	O.W.	O.W.	O.W.	O.W.	O.W.	EXT.	EXT.	O.W.	SPR.	O.W.	EXT.	SPR.	SPR.	SPR.
20	Water source capacity available	10	15	10	10	10	25	-	-	15	12	20		22	15	80
21	System	O-b	O-b	O-b	O-b	O-b	O-b	F	F	O-b	B-a	O-b	F	A-a	A-a	A-a
22	Submersible pump															
	A. Number of pump	2	2	2	2	2	2	-	-	2	-	2	-	-	-	-
	B. Capacity (l/min)	380	995	495	495	320	1585	-	-	915	-	1250	-	-	-	-
	C. Head (m)	62	62	62	62	62	62	-	-	62	-	62	-	-	-	-
23	Centrifugal pump :															
	A. Number of pump	2	2	2	2	2	2	2	-	2	2	2	-	-	-	-
	B. Capacity (l/min)	380	995	495	495	320	1585	1250	-	915	610	1250	-	-	-	-
	C. Head (m)	34	33	43	32	24	30	47	-	39	24	30	-	-	-	-
24	Break Pressure Tank (m3)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25	Service Reservoir (m3)	170	318	171	195	250	600	-	-	330	200	465	-	520	280	400
26	Elevated tank															
	A. Capacity (m3)	11	30	15	15	13	49	40	-	27	-	39	-	-	-	-
	B. Height (m)	29	28	38	27	119	25	37	-	34	-	25	-	-	-	-
27	Chlorination Capacity (l/hr)	2.2	4.0	2.2	2.5	3.2	7.6	-	-	4.1	2.6	5.9	-	6.6	3.5	5.1
28	Number of house connections	747	1402	754	1137	1183	2986	2632	10272	1535	886	2174	1298	2434	1301	1898
29	Number of Public Taps	25	47	25	14	25	37	33	22	33	30	47	28	52	28	41
30	Estimation Cost (1,000**)	531.475	1.150.570	588.313	642.111	560.854	1.580.836	923.322	2.821.518	1.091.820	811.474	1.397.149	638.373	1.053.737	618.858	1.103.315

Note :
No:19 (Abreviation list): Spring = SPR.
Deep Well = O.W.
River = R.
Extention = EXT.
Shallow well = S.W.

No.20 : 10 *2 ; 10 = Capacity (l/sec)
2 = Number of well
No.21 : O - b etc = type of water Supply System
No.30 : Estimation Cost * Rp.1000,-

Table 4.: Summary List for Basic Plan for IKKs in East Jawa

No.	Item										
1	Province	E - 31	E - 32	E - 33	E - 34	E - 35	E - 36	E - 37	E - 38	E - 39	E - 40
2	Kabupaten	LUMAJANG	LUMAJANG	LUMAJANG	LUMAJANG	LUMAJANG	PROBOLINGGO	PROBOLINGGO	PROBOLINGGO	PROBOLINGGO	PROBOLINGGO
3	Kecamatan	KUNIR	RANDUAGUNG	RANUYOSO	SENDURO	TEMPURSARI	BANYUANYAR	BESUK	GENDING	MARON	SUMBERASIH
4	I K K	KUNIR	RANDUAGUNG	RANUYOSO	SENDURO	TEMPURSARI	BANYUANYAR	BESUK	GENDING	MARON	SUMBERASIH
5	Total Population in the year 2000	18480	13982	13771	13107	11931	14129	4515	9516	11355	8536
6	Served Population	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %
7	%-tage of Population served by House Conection (H.C.)	70	60	60	70	80	70	60	70	70	70
8	Water demand for H.C. (D = 90 l/cap/day)(l/day)	1164240	755028	743634	825741	859032	890127	243810	599508	715365	537768
9	%-tage of population served by Public Tap (P.T.)	30	40	40	30	20	30	40	30	30	30
10	Water demand for P.T. (D = 30 l/cap/day)(l/day)	166320	167784	165252	117963	71586	127161	54180	85644	102195	76824
11	Sub-total water demand (l/day)	1330560	922812	908886	943704	930618	1017288	297990	685152	817560	614592
12	Water demand for non domestic (5 % X (11)(l/day))	66528	46140	45444	47185	46531	50864	14900	34258	40878	30730
13	Water demand for leakage and losses 15 % (11)(l/day)	199584	138422	136333	141556	139593	152593	44699	102773	122634	92189
14	Total average demand (l/day)	1596672	1107374	1090663	1132445	1116742	1220745	357589	822183	981072	737511
15	Total Average demand (l/sec)	18.48	12.82	12.62	13.11	12.93	14.13	4.14	9.52	11.36	8.54
16	Max day : 1.1 X (15)(l/sec)	20.33	14.10	13.88	14.42	14.22	15.54	4.55	10.47	12.50	9.39
17	Peak hour demand : 1.5 X (15)(l/s)	27.72	19.23	18.93	19.67	19.40	21.20	6.21	14.28	17.04	12.81
18	Source capacity required at 24 hours operation/day (l/sec)	20.33	14.10	13.88	14.42	14.22	15.54	4.55	10.47	12.50	9.39
19	Potential source available	D.W.	SPR.	SPR.	SPR.	SPR.	D.W.	D.W.	SPR.	SPR.	SPR.
20	Water source capacity available	22	20	50	15	30	10*2	15	15	25	15
21	S y s t e m	D-b	B-b	B-b	B-a	B-b	D-b	D-b	B-b	A-a	B-b
22	Submersible pump										
	A. Number of pump	2	-	-	-	-	2	2	-	-	-
	B. Capacity (l/min)	1250	-	-	-	-	1020	300	-	-	-
	C. Head (m)	62	-	-	-	-	82	82	-	-	-
23	Centrifugal pump :										
	A. Number of pump	2	2	2	2	2	2	2	2	-	2
	B. Capacity (l/min)	1250	750	725	770	760	1020	300	670	-	615
	C. Head (m)	38	25	56	33	48	24	35	98	-	24
24	Break Pressure Tank (m3)	-	-	-	-	-	-	-	-	-	-
25	Service Reservoir (m3)	550	380	375	390	385	420	125	285	340	255
26	Elevated tank										
	A. Capacity (m3)	38	23	22	-	25	31	9	21	-	18
	B. Height (m)	31	20	33	-	30	19	20	42	-	19
27	Chlorination Capacity (l/hr)	7.0	4.8	4.8	4.9	4.9	5.3	1.8	3.6	4.3	3.2
28	Number of house connections	2587	1678	1653	1835	1909	1978	542	1332	1590	1195
29	Number of Public Taps	55	58	55	40	24	42	18	29	34	26
30	Estimation Cost (1,000Rp)	1,498,320	1,128,135	1,213,289	1,242,194	1,005,319	1,277,084	479,645	1,508,387	1,238,956	647,927

Note :
No:19 (Abreviation list): Spring = SPR.
Deep Well = D.W.
River = R.
Extention = EXT.
Shallow Well = S.W.

No.20 : 10 *2 : 10 = Capacity (l/sec)
2 = Number of well
No.21 : D - b etc = type of water Supply System
No.30 : Estimation Cost = Rp. 1000,-

Table 4.3 Summary List for Basic Plan for IKKs in Bali

No.	Item										
1 2 3	Province Kabupaten Kecamatan	B - 41 BADUNG ABIANSEMAL	B - 42 BULELENG BANJAR	B - 43 BULELENG BUSUNGBIU	B - 44 BULELENG SAWAN	B - 45 BULELENG SUKASADA	B - 46 GIANYAR UBUD	B - 47 GIANYAR TAMPAKSIRING	B - 48 GIANYAR TEGALALANG	B - 49 GIANYAR SUKAWATI	B - 50 JEMBRANA PEKUTATAN
4	I K K	BLAN KIUH	MUNDUK	TISTA	SANGSIT	PANJI	SINGAKERTA	TAMPAKSIRING	TEGALALANG	KETEWEL	ASAHOUREN
5	Total Population in the year 2000	6139	5483	4384	10029	6728	7274	8337	6742	8869	3134
6	Served Population	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %
7	%-tage of Population served by House Conection (H.C.)	70	70	80	70	80	70	60	80	70	80
8	Water demand for H.C. (Q = 90 l/cap/day)(l/day)	386757	345429	315648	631827	484416	458262	450198	485424	558747	225648
9	%-tage of population served by Public Tap (P.T.)	30	30	20	30	20	30	40	20	30	20
10	Water demand for P.T. (Q = 30 l/cap/day)(l/day)	55251	49349	26304	90261	40368	65466	100044	40452	79821	18804
11	Sub-total water demand (l/day)	442008	394776	341952	722088	524784	523728	550242	525876	638568	244452
12	Water demand for non domestic (5 % X (11)(l/day))	22100	19739	17097	36104	26239	26186	27512	26294	31928	12223
13	Water demand for leakage and losses 15 % (11)(l/day)	66301	59216	51293	108313	78718	78559	82536	78882	95784	36669
14	Total average demand (l/day)	530409	473731	410342	866505	629741	628473	658290	631052	766280	293344
15	Total Average demand (l/sec)	6.14	5.48	4.75	10.03	7.29	7.27	7.62	7.30	8.87	3.40
16	Max day : 1.1 X (15)(l/sec)	6.75	6.03	5.23	11.03	8.02	8.00	8.38	8.03	9.76	3.74
17	Peak hour demand : 1.5 X (15)(l/s)	9.21	8.22	7.13	15.05	10.94	10.91	11.43	10.95	13.31	5.10
18	Source capacity required at 24 hours operation/day (l/sec)	6.75	6.03	5.23	11.03	8.02	8.00	8.38	8.03	9.76	3.74
19	Potential source available	SPR.	SPR.	D.W.	EXT.	SPR.	EXT.	SPR.	SPR.	EXT.	SPR.
20	Water source capacity available	12	10	10		30		300	50		10
21	S y s t e m	A-a	B-b	D-b	F	A-a	F	B-b	A-a	F	B-b
22	Submersible pump A. Number of pump B. Capacity (l/min) C. Head (m)	- - -	- - -	1 346: 62	- - -	- - -	- - -	- - -	- - -	- - -	- - -
23	Centrifugal pump : A. Number of pump B. Capacity (l/min) C. Head (m)	- - -	2 364 36	2 346 50	- - -	- - -	2 509 37	2 540 28	- - -	- - -	2 227 40
24	Break Pressure Tank (m3)	-	-	-	-	-	-	-	-	-	-
25	Service Reservoir (m3)	185	165	145	300	220	220	230	220	265	100
26	Elevated tank A. Capacity (m3) B. Height (m)	- -	11 13	10 -	- -	- -	16 32	16 27	- -	- -	7 3.8
27	Chlorination Capacity (l/hr)	2.3	2.1	1.8	-	2.8	-	2.9	2.8	-	1.3
28	Number of house connections	859	768	701	1404	1076	1018	1000	1079	1242	501
29	Number of Public Taps	18	16	9	30	13	22	33	14	27	6
30	Estimation Cost (1,000**)	708,745	688,533	486,953	1,028,282	942,155	545,973	604,977	1,156,604	693,008	583,290

Note :
No:19 (Abreviation list): Spring = SPR.
Deep Well = D.W.
River = R.
Extention = EXT.
Shallow Well = S.W.

No.20 : 10 * 2 : 10 = Capacity (l/sec)
2 = Number of well
No.21 : D - b etc = type of water Supply System
No.30 : Estimation Cost * Rp.1000,-

Table 4.3 Summary List for Basic Plan for IKKs in Bali

No.	Item										
1	Province	8 - 51	3 - 52	8 - 53	9 - 54	9 - 55	8 - 56	3 - 57	8 - 58	8 - 59	3 - 60
2	Kabupaten	KARANGASEM	KARANGASEM	KARANGASEM	KARANGASEM	KLUNGKUNG	TABANAN	TABANAN	TABANAN	BANGLI	BANGLI
3	Kecamatan	ABANG	BEBANDEM	RENDANG	BEBANDEM	NUSAPENIDA	MARGA	PUPUAN	SELEMADEG	TEMBUKU	SUSUT
4	I K K	ABANG	BEBANDEM	MENANGA	SIBETAN	SAKTI	MARGA	PUPUAN	ANTAP	BANGBANG	TIGA
5	Total Population in the year 2000	3275	3316	5821	9821	6411	5954	2824	4584	4108	5213
6	Served Population	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %
7	%-tage of Population served by House Conection (H.C.)	60	70	70	70	70	60	70	60	60	70
8	Water demand for H.C. (0 = 90 l/cap/day)(l/day)	176350	208908	366723	618723	403893	321516	177912	247536	221832	328419
9	%-tage of population served by Public Tap (P.T.)	40	30	30	30	30	40	30	40	40	30
10	Water demand for P.T. (0 = 30 l/cap/day)(l/day)	39300	29844	52389	88389	57699	71448	25416	55008	49296	46917
11	Sub-total water demand (l/day)	216190	238752	419112	707112	461592	392964	203328	302604	271128	375336
12	Water demand for non domestic (5 % X (11)(l/day))	10810	11938	20956	35356	23080	19648	10166	15130	13556	18767
13	Water demand for leakage and losses 15 % (11)(l/day)	32430	35814	62868	106068	69240	58944	30498	45390	40668	56301
14	Total average demand (l/day)	259430	286504	502936	848536	553912	471556	243992	363124	325352	450404
15	Total Average demand (l/sec)	3.00	3.32	5.82	9.82	6.41	5.45	2.82	4.20	3.77	5.21
16	Max day : 1.1 X (15)(l/sec)	3.30	3.65	6.40	10.80	7.05	6.00	3.10	4.62	4.18	5.73
17	Peak hour demand : 1.5 X (15)(l/s)	4.50	4.98	8.73	14.73	9.61	8.18	4.23	6.30	5.66	7.82
18	Source capacity required at 24 hours operation/day (l/sec)	3.30	3.65	6.40	10.80	7.05	6.00	3.10	4.62	4.18	5.73
19	Potential source available	SPR.	SPR.	SPR.	SPR.	SPR.	SPR.	SPR.	SPR.	SPR.	SPR.
20	Water source capacity available	15	5	500	12	15	7	50	5	15	20
21	S y s t e m	A-a	B-b	A-a	A-a	B-b	A-a	A-a	B-b	A-a	B-b
22	Submersible pump										
	A. Number of pump	-	-	-	-	-	-	-	-	-	-
	B. Capacity (l/min)	-	-	-	-	-	-	-	-	-	-
	C. Head (m)	-	-	-	-	-	-	-	-	-	-
23	Centrifugal pump :										
	A. Number of pump	-	1	-	-	2	-	-	2	-	2
	B. Capacity (l/min)	-	298	-	-	456	-	-	297	-	365
	C. Head (m)	-	35	-	-	40	-	-	40	-	30
24	Break Pressure Tank (m3)	-	-	-	-	-	-	-	-	-	-
25	Service Reservoir (m3)	90	100	175	295	190	165	85	125	115	155
26	Elevated tank										
	A. Capacity (m3)	-	9	-	-	14	-	-	9.0	-	10
	B. Height (m)	-	30	-	-	38	-	-	39	-	29
27	Chlorination Capacity (l/hr)	1.1	1.3	2.2	3.7	2.4	2.7	1.0	1.8	1.4	2.0
28	Number of house connections	393	464	815	1375	898	714	395	500	493	730
29	Number of Public Taps	13	10	17	30	19	24	9	18	17	16
30	Estimation Cost (1,000*)	308,344	313,729	544,944	780,863	608,168	492,111	292,850	540,157	409,402	573,407

Note :

No:19 (Abreviation list): Spring = SPR.
Deep Well = D.W.
River = R.
Extention = EXT.
Shallow well = S.W.

No.20 : 10 *2 ; 10 = Capacity (l/sec)
2 = Number of well

No.21 : B - b etc = type of water Supply System

No.30 : Estimation Cost * Rp.1000,-

CHAPTER 5 SELECTION OF HIGH PRIORITY IKKs

Chapter 5 Selection of High Priority IKKs

5.1 Procedure of Selection of High Priority IKKs

Among 121 IKKs, for which the Basic Plan has been made in Phase 1, High Priority IKKs (Max. 30) have been selected by the procedure shown in Fig. 5.1.

5.2 Identification of High Priority IKKs

5.2.1 Enumeration and Prioritization of Factors

Factors for selection of High Priority IKKs were proposed as shown in Table 5.1. In this table, priority of each factor is also indicated.

5.2.2 Identification

Identification of High Priority IKKs was conducted, by making the comparison list, in accordance with the steps shown in Fig. 5.2 and JICA Team proposed 30 IKKs as High Priority IKKs.

Fig. 5.1 Procedure of Selection of High Priority IKKs

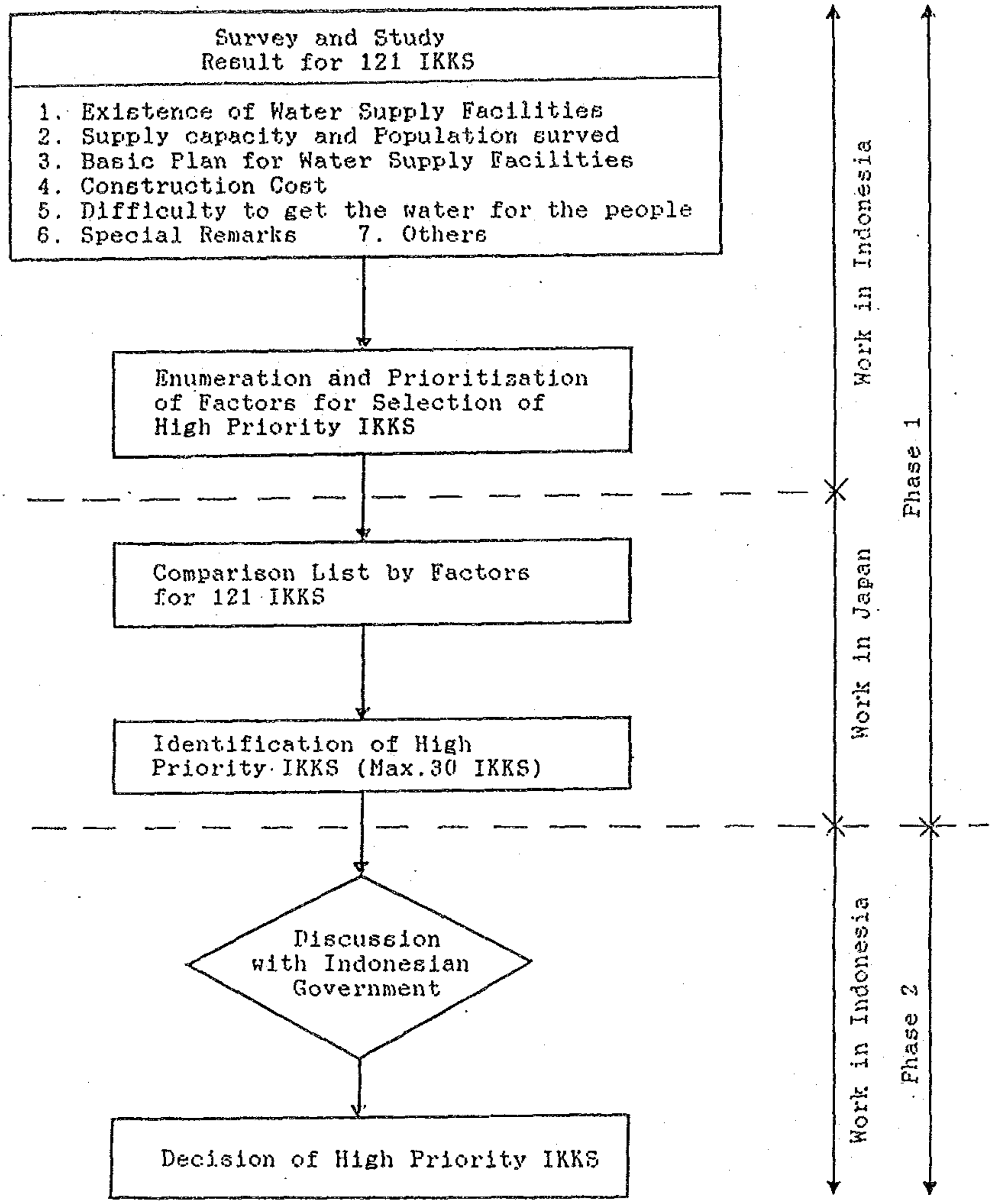


Table 5.1 Factors for Prioritization

Priority of Factors	No.	Factor for Prioritization	Classification	Description
A	①	Installation cost per person served (Rp/person)	a b	To be classified into 2 (two) classes (a --- Lower class) (b --- Higher class)
A	②	Difficulty to get the water for the people	a -- b --	Difficult to get the water because of lack of water sources Not so difficult because there are water sources such as shallow wells, etc.
A	③	Existence of Water Supply Facilities	a -- b --	No existing system at all There is some existing system even through superannuated and worn out
A	④	Income level of house hold	a b c	To be classified into 3 (three) classes (a --- High class) (b --- Medium class) (c --- Low class)
B	⑤	Sanitary reason		Water born disease/ morbidity
A	⑥	Local condition		Balance of numbers of IKKs in each Province
A	⑦	Policy/Intention of central/local Government		Development possibility of IKKs, etc.

Note : A -------- High priority
B -------- Important but difficult to make priority based on survey results

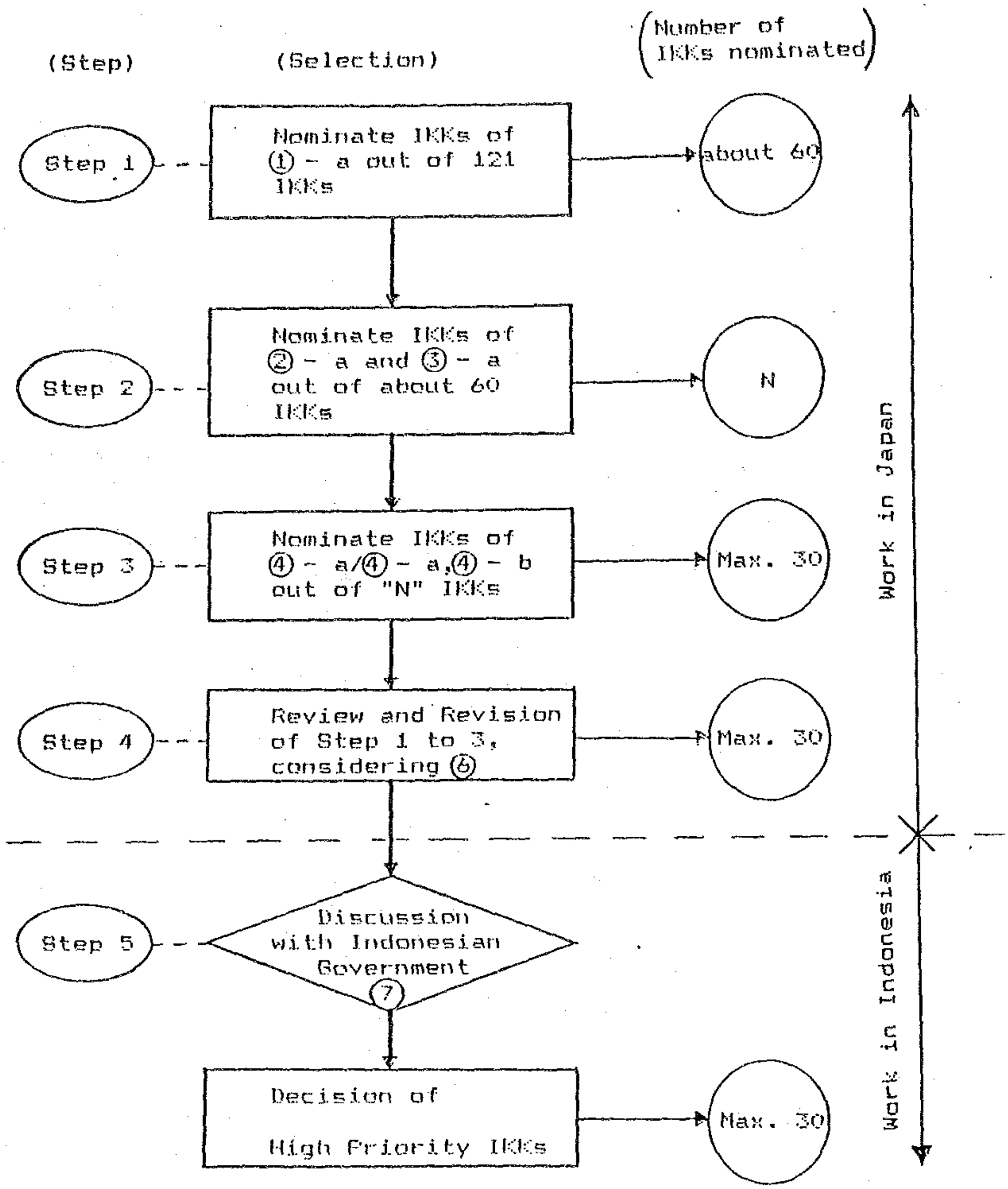


Fig. 5.2 Identification of High Priority IKKs