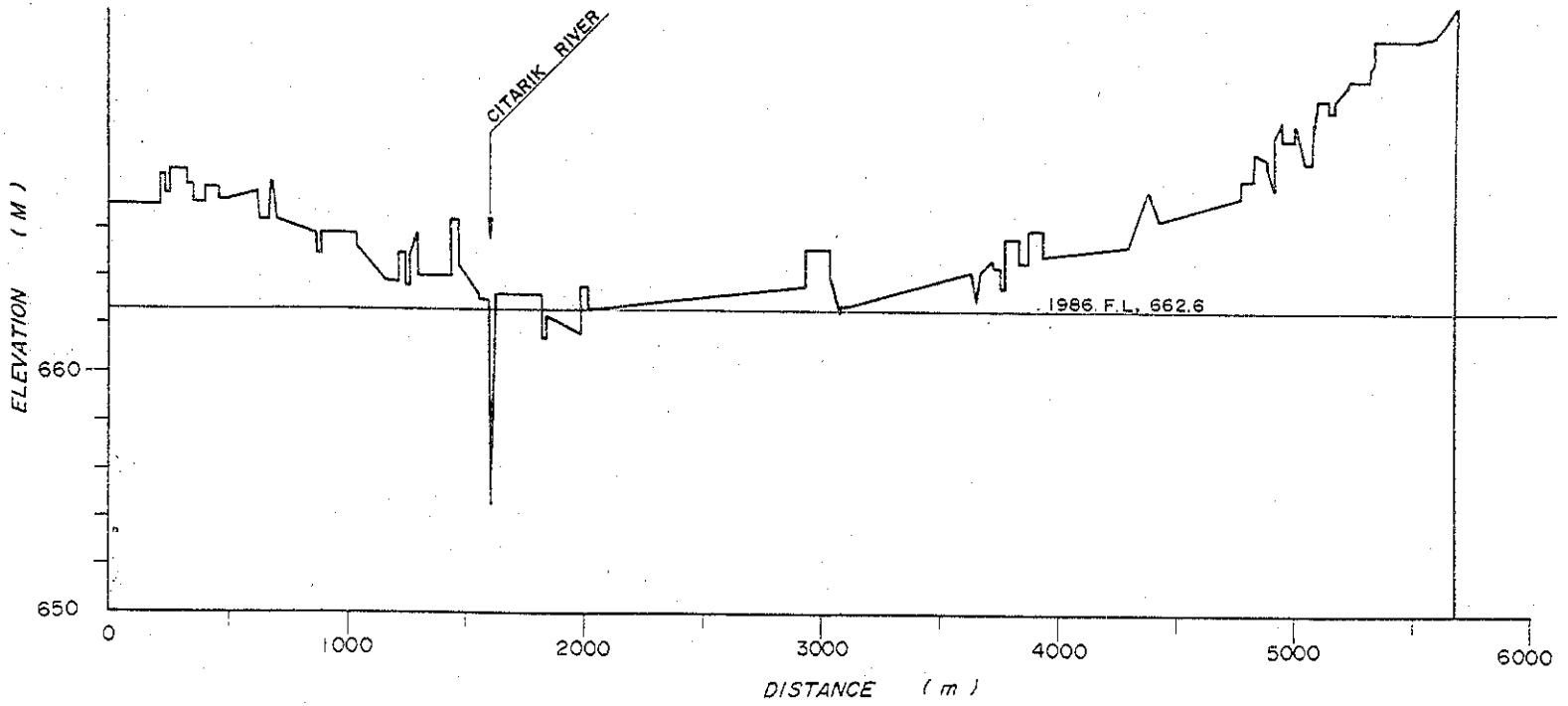

CITARIK (ALONG MAJALAYA-RANCAEKEK ROAD)

FIG. D.7 TYPICAL CROSS SECTIONS OF FLOOD AREA (2)

STUDY ON THE FLOOD CONTROL PLAN OF THE UPPER CITARUM BASIN

JICA

SUPPORTING REPORT E

FLOOD DAMAGE

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SUPPORTING REPORT E
FLOOD DAMAGE

1. Flood Record

The flood in March 1986 left a huge damage in the flood area, as shown in Table E.1. The table shows not only the flood damage but also the expense for supporting activity to both victims and facilities affected by the flood in March 1986. This record was presented to the President by the Governor of Jawa Barat Province. According to this table, damages on agricultural production, buildings such as houses and industrial facilities, and infrastructure are Rp. 2,045 million, Rp. 239 million, Rp. 651 million, respectively. On the other hand, agencies in charge of supporting activities incurred following expenses: (a) Rp. 64 million for emergency support such as rescue and medical support for victims; (b) Rp. 4,264 million for rehabilitation for affected facilities; and (c) Rp. 553 million for temporary facilities for victims until recovery from the flood disaster. Incidentally, Table E.2 shows damage on fishpond production during the same flood. Affected area where the fishponds are located seems to be different from the flood area because Kecamatan Banjaran is included in the flood area. At any rate, 65% of existing fish in the fishponds is lost due to the 1986 flood.

The total inundation area of the March 1986 flood was 7,249 ha with 66 million m^3 of water volume. The inundation depth and area are summarized as follows:

Depth (m)	Area (ha)	Percentage (%)
Less than 0.5m	1,894	26.1
0.5 ~ 1.0m	2,484	34.3
1.0 ~ 1.5m	1,854	25.6
More than 1.5m	1,017	14.0
Total	7,249	100.0

The inundated area by depth and by zone of this 1986 floods are summarized in Table E.3, which is classified according to land-use category. Among various inundated areas, paddy field is the worst affected. Estimated flood damage for each asset in the flooded area is discussed in Section 4.1.

2. Socio-Economic Condition in the Flood Area

2.1 Administration

The flood area, a demarcation line delineating the damaged area by the March 1986 floods, spreads over rural areas along the Citarum River and its tributaries in Kabupaten Bandung. The flood area extends over nine Kecamatans as follows: Dayeuh Kolot, Pameungpeuk, Buah Batu, Ciparay, Ujung-Berung, Rancaekek, Majalaya, Paseh and Cikancung. However, there is no Kecamatan where its whole territory is included by the flood area. Fig. E.1 shows the location of the flood area within the study area. In order to identify characteristics of the flood area, the area is divided into five zones on the basis of both the administrative divisions and flood conditions. The delineation of five zones is shown in Fig. E.2. Within the flood area, 50 Desas are included, although most of them are only covered partially by the flood area. In fact, only three Desas are entirely included in the flood area, which are Dayeuh Kolot in Kecamatan Dayeuh Kolot, Bojong Sari in Kecamatan Buah Batu and Sukamahan in Kecamatan Ranca Ekek. Fig. E.2 illustrates the relationship among these flood affected Desas.

2.2 Present Land-use

The flood area is predominantly covered by lowland paddy fields which account for 6,363 ha or 87.8% of the total flood area, as shown in Table E.4. The second most flood area is the built-up area such as Kampung and industrial area, which accounts for 452 ha or 6.2%. Plantation such as bamboo and banana cultivation accounts for 298 ha or 4.1%. Other land use categories of flood area are as follows: fishpond with an area of 77 ha or 1.1%; upland crop fields, 40 ha or 0.5%; grass land, 19 ha or 0.3%. Fig. E.3 illustrates the present land use condition of the flood area.

2.3 Population

Table E.5 provides population in the years 1975, 1980 and 1985, of those Desas that are related to the flood area. The total population in these Desas is estimated at 344,582 in 1985. The total area of the Desas is about 20,400 ha, so its average population density is 16.9 persons/ha. Since the flood area covers around 7,249 ha, the population in the flood area could be estimated at 122,000 in 1985, assuming a uniform population distribution in the whole area. A sample survey done in June 1987 reports a population of 54,766 in 67 Kampungs (living quarters) within 50 Desas related to the flood area. Incidentally, a damage record reports around 75,000 affected victims by the 1986 flood.

According to Potensi Desa (Desa data), that provides the population data of each Desa, population in the flood area is estimated at 112,252 in total, as shown in Table E.6. Population density in the flood area was 15.5 persons per ha, as an average in 1986. Each of the five zones has a population and population density as follows: zone A with a population of 41,429 and a population density of 68.4 per ha; zone B, 25,970 and 17.9 per ha; zone C, 20,683 and 9.0 per ha; zone D, 10,859 and 9.8 per ha; and zone E, 13,301 and 7.4 per ha.

According to the regional development policy, the flood area is restricted to no further development and is to be kept as a green belt in the region, because of habitual flood disasters. Therefore, a future population in the flood area will grow at a lower rate than other areas in Bandung region. The population in Desas related to the flood area grew at a quite high rate of 6.0% per annum during the second half of 70's, but has decreased to 1.45% in the first half of 80's, as shown in Table E.7. On the other hands, population in the study area is estimated to grow at 1.67% per annum, as shown in Table B.4 of Supporting Report B. Thus, the population in the flood area is assumed to grow at 1.45% per annum, which is lower than that of the study area and is the same rate of the first half of 80's in the flood area. Accordingly, the population in the flood area is estimated at 149,700 in the year 2005.

2.4 Housing Condition

According to population census of 1985, both the population and the number of household in nine (9) Kecamatans related to the flood area are 881,691 and 193,366 respectively, as shown in Table E.8. In 1975, the corresponding figures were 613,697 and 132,724, hence the average annual growth rates are 3.3% and 3.5%, respectively. Since the growth rate of population is slightly lower than that of household, an average family size has decreased from 4.62 persons/ family to 4.56 for those ten years. Its reduction, however, is not very significant and the family size is expected to remain constant.

The average family size in the flood area could not be estimated, because the data on the number of household is not presented in the Potensi Desa. However, since the number of residential building is estimated at 27,310, as given in the next paragraph, the average family size in the flood area is estimated to be 4.1 persons/family in 1986, if the number of residential building in assumed to be equal to the number of household. This figure is lower than the average figure in nine Kecamatans related to the flood area of 4.56 persons/family in 1985, so the number of residential building might include vacant units and/or some families might have multiple residential buildings.

The number of residential building in the flood area is basically estimated using the data of Potensi Desa. For such an estimation, a desa is devided into two portions, the flood area and non flood area, and the number of residential buildings in each portion is assumed to be proportional to the respective area of each portion. According to DPU, the residential building is classified into following three types on the basis of structural material of the building: permanent type, in which the main structural components are of permanent materials such as concrete and steel; semi-permanent type, that are of semi-permanent materials such as brick; and non-permanent type, that are of non-permanent materials such as wood and bamboo. Each building type is distributed in the flood area as follows, (a) permanent type of 14,133 numbers or 51.7% of the total number of houses; (b) semi-permanent,

3,759 or 13.8%; and (c) non-permanent, 9,418 or 34.5%. The details concerning these distribution is given in Table E.9.

The unit cost of each type of building is presented by DPU as follows: (a) permanent type, ranges from Rp. 55,000/m^2 to Rp. 90,000/m^2, with a mean value of Rp. 63,000/m^2; (b) semi-permanent, ranges from Rp. 34,000/m^2 to Rp. 37,000/m^2, with a mean of Rp. 36,000/m^2; and (c) non-permanent, ranges from Rp. 25,000 /m^2 to Rp. 30,000/m^2, with a mean of Rp. 28,000/m^2.

The average floor area of each building type is given in Table E.10, as presented by the tax office of the Province. Since buildings registered in this office are limited to a property having a value more than Rp. 2 million, majority of residential buildings are not registered. A cursory of housing situation, however, is given by the data of this table. Also, some of industrial buildings as well are included in the same table, which are mostly classified into luxurious class, i.e., A to C. In terms of the price value of buildings, type-D corresponds to permanent type and type-E corresponds to semi-permanent type. An average area of each type could be assumed as follows: (a) permanent type with an average area of 70 m^2/unit; (b) semi-permanent and non-permanent type with an area of 40 m^2/unit.

Total value of residential building in the flood area is calculated as the sum of total values of three types. Each total value is calculated as follows:

$$\text{Total value} = (\text{number of unit}) \times (\text{average floor area}) \times (\text{average unit cost})$$

Accordingly the total value of all three residential types is of Rp. 78,288 million at 1987 prices. Then the average value of one unit becomes to Rp. 2.87 million. This value, however, is the price of a new building, hence it should be depreciated in order to convert it into the present condition. Supposing that the present value is 50% of that of a new building, the present value of an average house unit would be Rp. 1.43 million.

A direct survey/interview was conducted in most (about 75%) of Kampung captains in the flood area in July 1987 in order to identify housing conditions, assets holdings and damage on assets. An effective feed back from 66 Kampung captains was obtained by this survey. According to an analysis of the survey results, the relation between housing unit and household effects are identified as follows: The average cost of a housing unit, in case of it is rebuilt at present price under the same specification, is Rp. 6.45 million; household effects, assuming the same condition as per a housing units, is Rp. 2.94 million. Accordingly, an average value of household effects in an average house is about 45% of the value of the housing unit. These samples, however, come from all Kampung captains. Therefore, an average price of general housing units in Kampungs would be comparatively lower than the aforesaid average. Nevertheless, by applying the ratio between a housing unit and its household effects mentioned above, the value of household effects is estimated at Rp. 1.29 million. In the same manner, the depreciated present value of an average house unit would be Rp. 645,000.

2.5 Agricultural Production

The main industry in the flood area is agriculture, i.e., crop production, and the main crop is paddy. About 88% of the flood area is covered by lowland paddy fields. Besides paddy, upland crops and secondary crops such as cassava, tomato, maize and peanuts are cultivated in the flood area, as well in the whole Kabupaten, as shown in Table E.11.

In 76% of lowland paddy field, crop cultivation is done twice an year. Most of lowland paddy fields in the flood area are provided with irrigation facilities. Then, an average unit yield of lowland paddy attains 5.4 t/ha, as given in Table E.11. Table E.12 provides the production cost per ha of irrigated paddy in 1986, adopted from Dinas Pertanian Tanaman Pangan in Kabupaten Bandung (municipal agency of crop production). According to the table, an average production cost of lowland paddy is Rp. 457,000/ha. On the other hand, a farm gate price of paddy is estimated to be Rp. 180,000/t, hence gross income from lowland paddy production is Rp. 972,000/ha. Accordingly, an expected net income amounts to Rp. 515,000/ha in 1986.

Dairy farming is also popular in the flood area. As shown in Table E.13, the number of chicken and duck is also prominent in the Kabupaten. Buffalo is bred not only for livestock but also for ploughing of paddy fields.

Inland fishery is also practised in the flood area. As shown in Table E.14, the potential fishery production is accrued not only from fishpond but also from paddy fields, because the environment in lowland paddy fields is well maintained to facilitate fresh water fish growth as well. Table E.15 provides an average production cost of ikan mas (golden fish: a kind of popular fresh-water fish in Indonesia) in a fishpond in Kabupaten Bandung. In general, it takes seven months for a fish to become fully grown, through five intermediate stages. A rearing pond, which is the final stage of raising and is generally called a "fishpond", rears the fish for three months. An average production cost per unit area of fishpond by taking into consideration the each raising stage amounts to Rp. 1.682 million/ha/annum. On the other hand, since a farm gate price of ikan mas is Rp. 1,500/kg, gross income from fish production is estimated as Rp. 3.656 million/ha/annum. Accordingly, an estimated net income amounts to Rp. 1.974 million/ha/annum.

2.6 Industrial and Services' Production

In the flood area, manufacturing industry is not much established as in Kotamadya Bandung and its surroundings because of frequent inundation, except some large and medium scale textile industry. According to Table E.16, more than half of the industries are established in Kecamatans related to the flood area. The reason seems to be that those Kecamatans are at convenient distance to the center of Bandung. Textile industry is the most prominent one in the nine Kecamatans. Most of this industry belongs to the large and medium scale and employs more than 70% of the whole industrial workers in the nine Kecamatans, as given in Table E.17. Most of the large scale industries are located outside the flood area. Only 32 textile industries of large scale are located inside the flood area, especially in Kecamatans Dayeuh Kolot and Pameungpeuk. According to financial data of 1985 on 15 of the 32 industries, following average production characteristics are recognized

per establishment. (a) An annual production of Rp. 3,632 million; (b) An accumulated value of buildings and factories of Rp. 293 million; (c) An accumulated value of production equipment of Rp. 2,095 million; (d) A working capital for inventory stock of Rp. 1,138 million; and (e) Number of workers including managerial staff are 433.

Besides textile, there are also other industries such as ceramics, bricks and concrete in the flood area. Most of these establishments are small scale industries or home industries. According to the research report of 1986 on brick industries in Kabupaten Bandung (Ref. 023), this industrial type shows the following average production characteristics, based on data of 60 brick factories: (a) An annual production of Rp. 6.7 million; (b) An accumulated value for building and equipment of Rp. 4.0 million; and (c) A working capital for inventory and stock of Rp. 1.1 million.

Table E.18 provides number of service establishment and workers in Kabupaten Bandung and nine Kecamatans related to the flood area. More than 80% of both the establishments and workers belong to retail stores. An average number of workers in a store is 1.1, as shown in the table. No supermarket exists in the flood area.

Table E.19 shows estimated number of industrial and commercial establishments in the flood area in 1986. The estimation is done based on the following assumptions: (a) the number of establishments are devided as per the area ratio between flood and non flood area in a Desa; (b) The number of large and medium scale industry is estimated based on the following, (i) use a topographical map of scale 1:2,000 and (ii) use statistical data of industrial production in Potensi Desa, using an average production of brick industry of Rp. 6.7 million/establishment; (c) home industry is estimated on the basis of workers in a Desa, using a unit of 2.6 persons/establishment (refer to Table E.17); (d) marketing facilities such as public market, co-operation, bank and rice warehouse are estimated using the data of Potensi Desa; and (e) service' establishments such as retail store and refreshment are estimated on the basis of number of workers in a Desa, using a 1.1 persons/establishment of trade industry. As a result, 78 manufacturing establishments and 388 services' establishments are estimated to be in the flood area.

2.7 Infrastructure

2.7.1 Physical Infrastructure

(1) Transportation

In the flood area, an arterial road traverses from north to south demarcating the boundary between Kecamatan Dayeuh Kolot and Buah Batu, and between Pameungpeuk and Ciparay. There are some other by-roads as well in these areas. An inventory of roads in each of the five (5) zones of the flood area is given in Table E.20, according to the type of paving and adminstrative agency. Accordingly Zone A has the highest density of roads. More than 30% of the roads are paved with asphalt, while the rest are unpaved and are gravel and earth roads.

(2) Other Physical Infrastructure

Electricity facilities is already made available in the flood areas, including the rural areas. Also electrical appliances are seemed to be used by most residents. Potable water is obtained from wells all over rural areas. However, there is no piped water supply system even in urbanized areas such as Dayeuh Kolot in the flood area. The telephone services are rather under developed in the flood area.

2.7.2 Social Infrastructure

The Potensi Desa presents an inventory of social infrastructure such as medical institutions, educational institutions, religious facilities and public facilities. The number of each social infrastructure is given in Table E.21. Accordingly the available social infrastructures in the flood area are as follows: (a) 34 number of medical facilities such as clinics, medical centers and drug stores; (b) 120 number of educational facilities such as schools and colleges; (c) 286 number of religious facilities such as mosques and churches; and (d) 28 number of public building such as village halls and conference halls.

3. Flood Damage Potential

3.1 Inventory of Existing Assets

Existing assets in the flood area as of 1986 are estimated as follows. Table E.22 provides the inventory of these existing assets, and is summarized below.

(a)	Agricultural land	6,796 ha
	- Paddy field	6,363 ha
	- Upland field	40 ha
	- Plantation	298 ha
	- Grass land	19 ha
	- Fishpond	77 ha
(b)	Housing Unit	27,310
	- Permanent type	14,133
	- Semi-permanent type	3,759
	- Non-permanent type	9,418
(c)	Industrial and commercial facility	477
	- Large, medium and small scale industry	45
	- Home industry	33
	- Marketing facility	20
	- Retail store and refreshment shop	368
(d)	Road	124.2 km
	- Provincial road	6.9 km
	- Kabupatan road	75.6 km
	- Desa road	41.7 km
(e)	Social infrastructure	468
	- Medical facility	34
	- Educational facility	120
	- Religious facility	286
	- Public facility	28

3.2 Flood Damage Potential

Flood damage potential of the above mentioned existing assets are summarized in monetary terms as follows. These values are estimated as of 1986 at 1987 prices. The estimated values of existing assets are given in Table E.23, and are summarized below.

(a)	Agricultural production	
	- Paddy field	Rp. 5.46 billion
	- Fishpond	Rp. 0.07 billion
(b)	Housing unit	
	- Permanent type	Rp. 45.18 billion
	- Semi-permanent type	Rp. 3.92 billion
	- Non-permanent type	Rp. 7.65 billion
(c)	Industrial and commercial facility	
	- Large-scale industry	Rp. 90.18 billion
	- Small-scale industry	Rp. 3.66 billion
	- Home industry	Rp. 0.12 billion
	- Marketing facility	Rp. 0.28 billion
	- Retail store and refreshment shop	Rp. 0.36 billion
(d)	Road	
	- Provincial road	Rp. 0.22 billion
	- Kabupaten road	Rp. 0.88 billion
	- Desa road	Rp. 0.25 billion
(e)	Social infrastructure	
	- Medical facility	Rp. 0.51 billion
	- Educational facility	Rp. 1.80 billion
	- Religious facility	Rp. 1.72 billion
	- Public facility	Rp. 0.32 billion

4. Flood Damage

4.1 Estimated Damage by Frequent Flood

The frequent flood is described in Chapter 2 of Supporting Report D. In this section, damage on assets in areas inundated by frequent flood will be estimated and be transferred into monetary term. The results of the damage estimation is shown below.

Item	Zone					Total	Damage Amount (Rp. 10^6)
	A	B	C	D	E		
Victim	20,607	7,535	10,506	1,740	0	40,387	-
Residential Building	3,912	1,686	4,202	369	0	10,169	1,475
Industrial Facilities	103	28	30	2	0	163	504
Paddy Field (ha)	239	221	1,132	202	0	1,794	748
Fishpond	0	0	0	0	0	0	0
Infrastructure	-	-	-	-	-	-	396
Indirect Damage	-	-	-	-	-	-	156
Total							3,278

According to the table, inventory of affected assets and their amounts at 1987 prices are summed up as follows:

- Victims : 40,387
- Affected residential buildings : 10,169
- Affected industrial facilities : 163
- Affected paddy fields : 1,794 ha
- Damage Amount per one time : Rp.3.28 billion
- Expected damage amount per annual : Rp.8.20 billion

Incidentally, the procedure of damage estimation is based on the methodology explained in Supporting Report K, so refer to it for detail.

4.2 Estimated Damage by 1986 Flood

The area inundated by the 1986 flood is explained in Chapter 1. In this section, damage on assets in the flood area will be estimated in monetary term. Inventory of assets as of March 1986 in the flood area and their values are estimated in the previous sections.

Table E.24 provides the number of victims affected by the 1986 flood in the five (5) zones and the inundation depth. Total number of victims is 112,252. Zone B is the worst affected area in terms of inundation depth, with some residents suffering from more than 3.0m depth of inundation. About 60% of the total victims live in zone A and zone B.

Table E.25 shows the number of residential buildings damaged by the flood in the five zones and the inundation depths. The tendency of damage on houses is similar to that of victims. Of the total affected houses of 27,310 numbers, 19,056 or 70% is inundated by less than 1.0m depth. Applying the damage estimation methodology mentioned in Supporting Report K, the flood damage on housing units including household effects is estimated at Rp. 7.00 billion. This damage amount is quite different from the official record of flood damage given in Table E.1. This record shows the damage on residential buildings as Rp. 127.68 million, which is only 1.8% of the estimated damage. This may be due to that most of the damages on residential buildings are not accounted for in monetary terms, as most damages are recoverable. Since the inundation affects to reduce the house durable periods in a long run, the damage due to this effect should be accounted for. In fact, the record reports 18,516 affected housing units by the flood.

Table E.26 provides the affected area of paddy field according to inundation depth and inundation duration for each zone. Total inundation area is 6,362.8 ha. Of these 2,443.3 ha or 38% was inundated by a depth more than 1.5 m. Furthermore, 5,235.9 ha or 82% is inundated for more than seven days after initial flooding. By applying the damage estimation methodology of Supporting Report K, the flood damage on paddy cultivation is estimated at Rp. 3.36 billion, which includes a production cost of Rp. 344,000/ha, invested until flooding by March (75% of the total production cost of Rp. 457,000/ha), and an

expected net income of Rp. 515,000/ha. This damage amount is larger than the official record of Rp. 1.698 billion given in Table E.1. The recorded amount might be estimated only on the basis of production cost and not including the expected net income. In such as case, the damage amount decreases to Rp. 1.29 billion. Though this value is still different from the record, the discrepancy might have caused due to difference in basic data for estimation.

4.3 Annual Flood Damage Potential

Flood Damage losses due to the flood are classified into three categories as shown in Fig. K.1 in Supporting Report K: (a) damage on accumulated capital such as structures and productive facilities; (b) damage on economic activities during suspension period, i.e., both accumulated production activities until a flood occurred, and opportunity losses of production; (c) emergency activities such as rescue and medical facilities. These losses are reorganized into the following four items from the point of view of damage estimation procedure: (1) building damage; (2) agricultural damage; (3) infrastructure damage; and (4) indirect damage. In this section, only the results of average annual flood damage potential are given, while the details on the procedure of estimation in illustrated in Supporting Report K. Incidentally, damage amounts are estimated at 1986 financial prices in order to compare easily with the damage of 1986 flood.

Table E.27 provides estimated damage amounts to each asset caused by various recurrent frequency of floods, and an average annual damage potential in the flood area. Accordingly, the average annual damage potential is estimated at Rp. 17.51 billion under the present conditions without any improvement in the flood area.

The break-down in damage potential for each zone is as follows: Zone A, Rp. 4.22 billion or 24.1% of the total; Zone B, Rp. 4.39 billion or 25.1%; Zone C, Rp. 5.79 billion or 33.1%; Zone D, Rp. 1.23 billion or 7.0%; and Zone E, Rp. 1.89 billion or 10.7%. Table E.28 provides the detail of this damage potential in all five (5) zones.

No.	Title	Issued on	Issued by
001	STATISTIK INDONESIA 1985	Nov.1986	BPS
002	PENDUDUK JAWA-BARAT HASIL REGISTRASI PENDUDUK AKHIR TAHUN 1985	Oct.1986	BPS Kantor Statistik Propinsi Jawa Barat
003	PENDUDUK JAWA BARAT, SERI SUPAS NO.15 HASIL SURVEI PENDUDUK ANTAR SENSUS 1985	Jan.1986	BPS
004	PENDUDUK KABUPATEN DT.II BAUDUNG PER DESA HASIL REGISTARASI PENDUDUK TAHUN 1986	Aug.1987	Kantor Statistik Kab. Bandung
005	PENDUDUK KABUPATEN DT.II BAUDUNG PER DESA HASIL REGISTARASI PENDUDUK TAHUN 1985	May 1986	Kantor Statistik Kab. Bandung
006	PENDUDUK KABUPATEN DT.II BAUDUNG PER DESA HASIL REGISTARASI PENDUDUK TAHUN 1974-1981	Apr.1983	Kantor Statistik Kab. Bandung
007	STATISTIK KABUPATEN DT.II BANDUNG TAHUN 1978-1981	Jan.1983	Kantor Statistik Kab. Bandung BAPPEDA Kab. Bandung
008	KABUPATEN BANDUNG DALAM ANGKA 1984	Mar.1987	Kantor Statistik Kab. Bandung
009	STATISTIK DOTAMADYA DAERAH TK.II BANDUNG 1985	Sep.1986	BAPPEDA Kot. Bandung Kantor Statistik Kot. Bandung
010	SENSUS EKONOMI 1986 KECAMATAN DI KABUPATEN BAUNDUNG	Aug.1987	Kantor Statistik Kab. Bandung
011	PENDUDUK PROPINSI JAWA BARAT 1980 HASIL PENCACAHAN LENGKAP	Mar.1981	BPS Kantor Statistik Propinsi Jawa Barat
012	INDONESIA, SENSUS PENDUDUK 1971 PENDUDUK DIPERINTJI MEMURUT KETJAMATAN DI DJAWA-MADURA	May 1972	BPS

No.	Title	Issued on	Issued by
013	LAPORAN TAHUNAN 1986	Mar.1986	Pemerintah Kab. Bandung Dinas Pertanian Tanaman Pangan
014	LAPARAN TAHUNAN, DINAS PERERNAKAN KABUPATEN BANDUNG TAHUN 1985-1986	Apr.1986	Pemerintah Kab. Bandung
015	LAPORAN TAHUNAN KANTOR DEPARTEMEN / CABANG DINAS PERINDUSTRIAN KABUPATEN DAERAH TINGKAT II BANDUNG TAHUN 1986	Jan.1987	Kantor Wilayah Dinas Perindustrian
016	STATISTIK JAWA BARAT TAHUN 1980	Dec.1981	Kantor Statistik Propinsi Jawa Barat
017	STATISTIK JAWA BARAT TAHUN 1982	Dec.1983	Kantor Statistik Propinsi Jawa Barat
018	STATISTIK JAWA BARAT TAHUN 1983	Dec.1984	Kantor Statistik Propinsi Jawa Barat
019	STATISTIK JAWA BARAT TAHUN 1984	Dec.1985	Kantor Statistik Propinsi Jawa Barat
020	STATISTIK JAWA BARAT TAHUN 1985	Dec.1986	Kantor Statistik Propinsi Jawa Barat
021	STATISTIK KABUPATEN BANDUNG TAHUN 1977	Sep.1978	Kantor Sensus & Statistik Kab. Bandung
022	STATISTIK KABUPATEN BANDUNG TAHUN 1976	Sep.1977	Kantor Sensus & Statistik Kab. Bandung
023	PENELITIAN TENTANG KEBUTUHAN TRAINING PENGUSAHA BATA METAH DAN BATAKO DI KABUPATEN BANDUNG	May 1986	Konrad Adenauer Stiftung & Lembaga Manajemen Fakultas Ekonomi Universitas Padjadjaran
024	PRODUK DOMESTIK REGIONAL BRUTO KABUPATEN BANDUNG 1975 - 1982		- Kantor Statistik Kab. Bandung - BAPPEDA Kab. Bandung

No.	Title	Issued on	Issued by
025	PRODUK DOMESTIK REGIONAL BRUTO KABUPATEN BANDUNG 1983 - 1986	1987	BAPPEDA Tk. II Kab. Bandung
026	PRODUK DOMESTIK REGIONAL BRUTO MENURUT WILAYAH PEMBANGUNAN PROPINSI DT.I. JAWA BARAT 1979-1983		- Kantor Statistik Propinsi Jawa Barat - Baden Prencanaan Pembangunan Daerah Propinsi Jawa Barat
027	PRODUK DOMESTIK REGIONAL BRUTO MENURUT WILAYAH PEMBANGUNAN PROPINSI DT.I. JAWA BARAT 1980-1984		- Kantor Statistik Propinsi Jawa Barat - Baden Prencanaan Pembangunan Daerah Propinsi Jawa Barat
028	PRODUK DOMESTIK REGIONAL BRUTO MENURUT WILAYAH PEMBANGUNAN PROPINSI DT.I. JAWA BARAT 1983-1985		- Kantor Statistik Propinsi Jawa Barat - Baden Prencanaan Pembangunan Daerah Propinsi Jawa Barat
029	STATISTIK INDONESIA 1986	Jan.1987	BPS
030	STATISTIK INDONESIA 1977-1978		BPS
031	STATISTIK JAWA BARAT TAHUN 1981		Kantor Statistik Propinsi Jawa Barat

Table E.1 RECORD OF FLOOD DAMAGE IN MARCH 1986

Item	Damage Level				Expenditure
	Inundation	Minor Damage	Heavy Damage	Destroyed	(Rp. 10^6)
I. DAMAGE					
1. Agriculture					2,044.69
1) Crop					1,774.90
a. Paddy	2,459 ha	89 ha	1,354 ha	425 ha	1,698.50
b. Upland Crop	37 ha	40 ha	199 ha	175 ha	69.55
c. Second Crop	79 ha	-	20 ha	10 ha	6.85
2) Livestock	-	-	-	-	15.28
3) Fishpond	69 ha	55 ha	91 ha	212 ha	224.61
4) Forestry	-	-	-	-	-
2. Building					239.08
1) Residential building					127.68
a. House	18,473	-	19	24	127.68
b. Household effects	-	-	-	-	-
2) Industrial & commercial building					
a. Brick factory	16	130	96	38	93.60
b. Rice hulling	13	17	-	-	2.10
c. Restaurant & store	29	55	9	-	8.70
d. Warehouse	120	70	-	-	7.00
3. Infrastructure					651.71
1) Sanitary					64.63
a. Dig well	1,976	217	1,223	1,006	33.74
b. Water pump	426	69	-	-	5.92
c. Electric pump	94	-	7	-	0.70
d. Clinic	1	-	-	-	-
e. Lavatory	319	88	150	285	24.27
2) Religious					83.63
a. Mosque	21	76	6	-	27.60
b. Small mosque	27	27	15	2	14.88
c. Religious school	4	15	6	-	41.15
3) Educational					68.23
a. Kindergarden	-	2	-	-	1.15
b. Elementary	16	67	6	-	50.93
c. Secondary	1	7	-	-	7.00
d. High School	-	8	-	-	7.15
e. College/University	-	2	-	-	2.00
4) Public					4.20
a. Village Office	1	5	-	-	1.90
b. Municipal Office	-	16	-	-	2.30
5) Transportation					406.67
a. Provincial road	-	5 km	1 km	-	13.50
b. Municipal road	-	40 km	4 km	-	240.00
c. Village road	10 km	47 km	26 km	-	116.44
d. Bridge	6	7	12	-	36.73
6) Irrigation					24.35
a. Embankment	1	1	2	-	13.60
b. Culvert	287	-	6	-	4.00
c. Irrigation	5	4	3	-	3.10
d. Tertiary canal	-	52 km	3 km	-	3.75
Total					2,935.48

(To be continued)

(Conclusion)

Item	Expenditure (Rp. 10^6)
II. EXPENSE FOR SUPPORTING ACTIVITY	
1. Emergency Support (Medicine, food for victims)	63.99
2. Rehabilitation	4,263.65
1) Social assistance (rehabilitation for affected houses)	107.63
2) Physical assistance for affected facilities	4,156.02
a. Sanitary	97.08
b. Religious facility	120.90
c. Educational facility	254.00
d. Public office	105.00
e. Transportation	2,850.10
f. Irrigation	86.00
g. Crop	106.97
h. Fishpond	419.79
i. Livestock	8.50
j. Industrial & commercial facility	31.18
3. Equipment for supporting (Temporary house, etc.)	553.00
Total	4,880.64
Grand Total	7,816.12

Source : Governor Report of Jawa Barat Province for the President.

Table E.2 FLOOD DAMAGE OF FISHPOND IN MARCH 1986

Kecamatan	Inundated Area (ha)	Volume (kg)	Amount (Rp.10^3)
Majalaya	6.66	6,126	6,738.6
Ranca Ekek	150.00	30,000	33,000.0
Ciparay	51.15	9,600	10,560.0
Banjaran	2.65	2,500	2,750.0
Buah Batu	810.50	149,860	164,846.0
Total	1,020.96	198,086	217,894.6
Estimated Total Volume in the same area at the Time of Flood		306,288 /1	
Estimated Loss Rate (%)		64.7	

Note : /1 Unit production is assumed at 300kg/ha.
Source : Dinas Perikanan, Kabupaten Bandung

Table E.3 PRESENT LAND-USE BY INUNDATION DEPTH IN THE FLOOD AREA DUE TO 1986 FLOOD

Land Use Category / Zone	Total Area (ha)	Inundation Depth (m) 0.0 -0.5	0.5 -1.0	1.0 -1.5	1.5 -2.0	2.0 -2.5	2.5 -3.0	3.0 -3.5
Paddy Field	6,362.8	1,757.2	2,162.3	1,675.9	809.8	112.0	7.8	37.8
Zone A	450.9	156.1	112.2	163.6	18.9	-	-	-
Zone B	1,112.5	169.3	437.5	284.9	107.8	67.6	7.8	37.8
Zone C	2,042.6	351.8	698.4	583.6	402.8	5.8	-	-
Zone D	1,022.1	476.7	428.8	100.7	15.9	-	-	-
Zone E	1,734.7	603.3	485.4	543.4	64.4	38.7	-	-
Upland Field	40.4	-	6.3	11.9	18.1	1.2	1.0	1.7
Zone A	2.6	-	-	2.3	0.3	-	-	-
Zone B	21.8	-	-	-	17.8	1.2	1.0	1.7
Zone C	16.0	-	6.3	9.7	-	-	-	-
Zone D	-	-	-	-	-	-	-	-
Zone E	-	-	-	-	-	-	-	-
Plantation	297.8	2.1	65.4	50.5	108.2	25.9	14.4	31.8
Zone A	0.5	0.5	-	-	-	-	-	-
Zone B	133.9	-	9.0	12.0	43.1	24.2	14.1	31.8
Zone C	130.0	1.7	28.3	37.0	61.6	1.7	-	-
Zone D	33.2	-	28.1	1.5	3.5	-	-	-
Zone E	-	-	-	-	-	-	-	-
Grass Land	18.6	0.2	9.1	9.3	-	-	-	-
Zone A	-	-	-	-	-	-	-	-
Zone B	2.5	0.2	0.4	1.9	-	-	-	-
Zone C	16.1	-	8.7	7.4	-	-	-	-
Zone D	-	-	-	-	-	-	-	-
Zone E	-	-	-	-	-	-	-	-
Fishpond	76.6	11.9	64.7	-	-	-	-	-
Zone A	1.4	1.4	-	-	-	-	-	-
Zone B	75.2	10.5	64.7	-	-	-	-	-
Zone C	-	-	-	-	-	-	-	-
Zone D	-	-	-	-	-	-	-	-
Zone E	-	-	-	-	-	-	-	-
Built-up Area	452.8	122.3	176.5	106.2	37.3	6.4	1.3	2.8
Zone A	150.4	54.2	49.6	33.1	13.5	-	-	-
Zone B	108.4	15.2	37.1	29.3	16.5	6.2	1.3	2.8
Zone C	89.7	5.0	45.0	34.8	4.7	0.2	-	-
Zone D	52.6	22.3	28.5	1.8	-	-	-	-
Zone E	51.7	25.6	16.3	7.2	2.6	-	-	-
Total	7,249.0	1,893.7	2,484.4	1,853.7	773.5	145.6	24.2	73.9
Zone A	605.7	212.2	161.8	199.0	32.7	-	-	-
Zone B	1,454.4	195.1	548.8	328.1	185.0	99.2	24.2	73.9
Zone C	2,294.5	358.4	786.7	672.5	469.2	7.7	-	-
Zone D	1,107.9	499.0	485.4	104.0	19.5	-	-	-
Zone E	1,786.5	628.9	501.7	550.1	67.1	38.7	-	-

Table E.4 PRESENT LAND-USE IN THE FLOOD AREA

Item	Area (ha)						Percentage Distribution (%)
	Zone A	Zone B	Zone C	Zone D	Zone E	Total	
Paddy field	451	1,112	2,043	1,022	1,735	6,363	87.8
Upland field	2	22	16	0	0	40	0.5
Plantation	1	134	130	33	0	298	4.1
Grass land	0	3	16	0	0	19	0.3
Fishpond	2	75	0	0	0	77	1.1
Built-up area	150	108	90	53	51	452	6.2
Total	606	1454	2,295	1,108	1,786	7,249	100.0

Table E.5 POPULATION DISTRIBUTION IN DESAS RELATED TO FLOOD AREA

Zone / Kecamatan / Desa	Population			Average Annual Growth Rate (%)		Area (ha)	Density in 1985 (Persons/ha)
	1975	1980	1985	'75-'85	'80-'85		
I. Zone A	53,939	78,280	79,884	7.7	0.4	2,012	39.7
A) K. Dayeuh Kolot	29,910	46,168	6,368	9.1	0.1	885	52.5
A1 Cangkuang Timur	3,989	6,174	6,368	9.1	0.6	215	29.6
A2 Pasawahan	8,910	13,393	12,485	8.5	-1.3	272	45.9
A3 Citeureup	8,459	13,227	13,751	9.4	0.8	300	45.8
A4 Dayeuh Kolot	8,522	13,374	13,903	9.4	0.8	98	141.9
B) K. Pameungpeuk	24,029	32,112	33,377	6.0	0.8	1,127	29.6
B1 Andir	10,684	11,867	11,723	2.1	-0.2	378	31.0
B2 Bojong Malaka	3,627	4,837	5,105	5.9	1.1	244	21.0
B3 Malakasari	3,709	4,945	5,219	5.9	1.1	174	30.1
B4 Sukasari	2,783	4,846	5,248	11.7	1.6	189	27.8
B5 Langonsari	3,226	5,617	6,082	11.7	1.6	142	42.8
II. Zone B	39,765	61,955	71,472	9.2	2.9	3,633	19.7
C) K. Buah Batu	26,472	40,477	44,212	8.9	1.8	2,509	17.6
C1 Bojong Soang	5,289	7,463	8,216	7.1	1.9	396	20.8
C2 Lengkong	3,045	4,485	4,416	8.1	-0.2	390	11.3
C3 Bojong Sari	4,488	6,333	6,360	7.1	0.1	503	12.6
C4 Buah Batu	7,862	12,784	14,677	10.2	2.8	483	30.4
C5 Margasari	5,788	9,412	10,543	10.2	2.3	737	14.3
E) K. Ciparay	13,293	21,478	27,260	10.1	4.9	1,124	22.3
E1 Bale Endah	8,297	13,405	18,001	10.1	6.1	654	27.5
E2 Mang Gahang	4,996	8,073	9,259	10.1	2.8	570	16.2
III. Zone C	48,610	62,357	66,748	5.1	1.4	5,994	11.1
C) K. Buah Batu	9,225	11,032	11,548	3.6	0.9	1,352	8.5
C6 Cipamakolan	4,645	5,449	5,584	3.2	0.5	692	8.1
C7 Tegar Luar	4,580	5,583	5,964	4.0	1.3	660	9.0
E) K. Ciparay	39,385	51,325	55,200	5.4	1.5	4,642	11.9
E3 Jelekong	10,611	14,216	15,745	6.0	2.1	1,898	8.3
E4 Sumber Sari	6,288	7,724	8,442	4.2	1.8	868	9.7
E5 Ciheulang	6,048	8,384	8,996	6.8	1.4	902	10.0
E6 Serang Mekar	3,954	5,377	5,760	6.3	1.4	203	28.4
E7 Sarimahi	3,803	4,672	4,746	4.2	0.3	312	15.2
E8 Ciparay	3,822	4,695	4,767	4.2	0.3	269	17.7
E9 Mekar Sari	4,859	6,257	6,744	5.2	1.5	190	35.5

(To be continued)

(Conclusion)

Zone / Kecamatan / Desa	Population			Average Annual Growth Rate (%)		Area (ha)	Density in 1985 (Persons/ha)
	1975	1980	1985	'75-'85	'80-'85		
IV. Zone D	29,460	36,227	39,290	4.2	1.6	3,118	12.6
D) K. Ujung Berung	4,554	5,902	7,786	5.3	5.7	700	11.1
D1 Cipadung	4,554	5,902	7,786	5.3	5.7	700	11.1
F) K. Ranca Ekek	10,104	12,494	12,629	4.3	0.2	1,280	9.9
F1 Tegal Sumedang	1,170	2,188	2,245	4.3	0.5	402	5.6
F2 Ranca Ekek Wetan	5,656	6,994	6,987	4.3	0.0	450	15.5
F3 Sukamanah	2,678	3,312	3,397	4.3	0.5	428	7.9
G) K. Majaraya	14,802	17,831	18,875	3.8	1.1	1,138	16.6
G1 Ranca Kasumba	4,856	5,879	6,396	3.9	1.7	360	17.8
G2 Bojong Emas	4,357	5,275	5,739	3.9	1.7	354	16.2
G3 Solokan Jeruk	5,589	6,677	6,740	3.6	0.2	424	15.9
V. Zone E	67,857	81,822	87,188	3.8	1.3	5,490	15.9
F) K. Ranca Ekek	33,243	39,954	42,209	3.7	1.1	2,757	15.3
F4 Ranca Eke Kulon	4,175	5,162	5,156	4.3	0.0	325	15.9
F5 Bojong Loa	6,537	8,113	8,177	4.4	0.2	430	19.0
F6 Jelekong	3,825	4,676	4,957	4.1	1.2	434	11.4
F7 Linggar	4,490	5,086	5,209	2.5	0.5	351	14.8
F8 Sukamulya	4,555	5,160	5,285	2.5	0.5	318	16.6
F9 Cangkuang	3,091	4,063	4,779	5.6	3.3	297	16.1
F10 Haur Pugur	3,780	4,283	4,881	2.5	2.6	385	12.7
F11 Sangiang	2,790	3,411	3,765	4.1	2.0	217	17.3
G) K. Majaraya	12,081	14,480	14,839	3.7	0.5	849	17.5
G4 Cibodas	4,209	5,075	5,147	3.8	0.3	316	16.3
G5 Langensari	4,228	5,099	5,171	3.8	0.3	270	19.1
G6 Padamukti	3,644	4,306	4,521	3.4	1.0	263	17.2
H) K. Paseh	11,654	15,248	16,144	5.5	1.1	848	19.0
H1 Mekar Pawitan	2,825	3,501	3,746	4.4	1.4	208	18.0
H2 Tangsi Mekar	2,806	3,862	4,082	6.6	1.1	162	25.2
H3 Cipedes	3,508	4,827	5,102	6.6	1.1	288	17.7
H4 Cigentur	2,515	3,058	3,214	4.0	1.0	190	16.9
I) K. Cikancung	10,879	12,140	13,996	2.2	2.9	1,036	13.5
I1 Tanjunglaya	4,301	4,592	5,253	1.3	2.7	474	11.1
I2 Ciluluk	3,508	4,025	4,662	2.8	3.0	292	16.0
I3 Srirahayu	3,070	3,523	4,081	2.8	3.0	270	15.1
Total	239,631	320,641	344,582	6.0	1.5	20,347	16.9

Note : Population of a Desa which became independent of other desas is estimated in proportion to population records after separation.
Sources : 002, 004 and Potensi Desa

Table E.6 POPULATION DISTRIBUTION BY SEX AND BY AGE IN THE FLOOD AREA : 1986

Zone	Sex		Age (Year)		Total		Zone Area (ha)	Density (p./ha)
	Male	Female	0 - 9	10 & Over	Number	Percent(%)		
Zone A	19,951	21,478	12,512	28,917	41,429	36.9	606	68.4
Zone B	13,742	12,228	7,397	18,573	25,970	23.1	1,454	17.9
Zone C	11,525	9,168	6,117	14,576	20,693	18.4	2,295	9.0
Zone D	5,399	5,460	2,951	7,908	10,859	9.7	1,108	9.8
Zone E	7,128	6,173	3,697	9,604	13,301	11.4	1,786	7.4
Total	56,683	55,559	32,674	79,578	112,252	100.0	7,249	15.5
Percentage Distribution(%)	50.5	49.5	29.1	70.9	100.0	-	-	-

Source : Potensi Desa

Table E.7 POPULATION GROWTH

Area	Average Annual Growth Rate (%)		Remarks
I. Achievement	1971 - 1980	1980 - 1985	
1. Indoneshia	2.32	2.15	Ref. 029
2. Jawa Barat Province	2.66	2.35	Ref. 029
3. Bandung Region	2.96	1.79	Table B.2 & B.4
4. Kabupaten Bandung	3.41	2.35	Table B.2 & B.4
5. Study Area	3.13	1.77	Table B.2 & B.3
6. Desas Related to the Flood Area	6.00 (1975 - 1980)	1.45	Table B.5
II. Projection	Growth Rate (%)	Period	
1. Indonesia	2.01	1980 - 2000	Ref. 029
2. Indonesia	1.90	1995 - 2000	Ref. 029
3. Kotamadya Bandung	0.71	1985 - 2005	Table B.4
4. Kabupaten Bandung	2.31	1985 - 2005	Table B.4
5. Study Area	1.67	1985 - 2005	Table B.4
6. Flood Area	1.45	1985 - 2005	Note

Note : Urban development policy restricts to develop the flood area and proposes to keep it as a green belt, because of habitual flood disasters. So, the population growth is kept to be the same rate as the present condition. Then, the population in the flood area is estimated at 149,700 in the year 2005.

Table E.8 FAMILY SIZE BY KECAMATAN RELATED TO THE FLOOD AREA

Kecamatan	1975			1985			Average Annual Growth Rate (%)		
	Population	Number of Household	Average Family Size	Population	Number of Household	Average Family size	Population	Number of Household	Average Family size
Dayeuh Kolot	82,754	15,690	5.27	137,974	26,017	5.30	4.8	4.7	0.1
Pameungpeuk	67,768	13,734	4.93	90,120	21,065	4.28	2.6	4.0	-1.2
Buahbatu	67,686	16,851	4.02	100,868	26,162	4.23	4.6	4.1	0.5
Ciparay	88,244	18,710	4.72	134,743	28,559	4.72	3.9	3.9	0.0
Ujung Berung	82,021	17,823	4.60	122,702	26,186	4.69	3.7	3.6	0.2
Rancaekek	52,548	10,683	4.92	61,899	13,180	4.70	1.6	1.9	-0.3
Majalaya	100,293	22,726	4.41	126,330	29,876	4.23	2.1	2.2	-0.3
Paseh	45,941	10,049	4.57	61,752	13,848	4.46	2.7	3.0	-0.1
Cikancung	26,442	6,458	4.09	35,303	8,473	4.17	2.7	2.5	0.2
Total	613,697	132,724	4.62	881,691	193,366	4.56	3.3	3.5	0.0

Note : The Kecamatan Boundary in 1975 is reorganized to be the same as the one in 1985
Sources : 005 and 006

Table E.9 NUMBER OF RESIDENTIAL BUILDINGS BY TYPE IN THE FLOOD AREA : 1986

Zone	Permanent Type	Semi-permanent Type	Non-permanent Type	Total	Percentage Distribution(%)
Zone A	4,691	1,862	1,404	7,947	29.1
Zone B	2,066	637	2,913	5,616	20.6
Zone C	5,334	483	2,493	8,310	30.4
Zone D	953	273	1,022	2,248	8.2
Zone E	1,089	514	1,586	3,189	11.7
Total	14,133	3,759	9,418	27,310	100.0
Percentage Distribution(%)	51.7	13.8	34.5	100.0	-

Source : Potensi Desa

Table E.10 DISTRIBUTION OF BUILDING SIZE BY CLASS

Kecamatan	Class A			Class B			Class C			Class D			Class E		
	No.	Total Floor Area (m^2)	Average Floor Area (m^2)	No.	Total Floor Area (m^2)	Average Floor Area (m^2)	No.	Total Floor Area (m^2)	Average Floor Area (m^2)	No.	Total Floor Area (m^2)	Average Floor Area (m^2)	No.	Total Floor Area (m^2)	Average Floor Area (m^2)
Dayeuh Kolot	-	-	-	70	168,251	2,404	514	239,770	466	8,372	616,504	74	5,000	204,035	41
Pameungpeuk	-	-	-	9	100,305	110,145	18	61,013	3,390	163	52,133	320	2	169	85
Buah Batu	-	-	-	23	43,045	1,872	284	106,671	375	10,675	662,624	62	37	2,409	65
Ujung Berung	-	-	-	27	82,492	3,055	136	192,045	1,412	6,681	430,921	64	4,014	123,847	31
Majalaya	1	698	698	61	74,266	1,217	3,381	312,910	93	1,581	152,875	97	1,545	65,893	43
Ciparay	-	-	-	3	1,282	427	11	7,793	708	1,168	59,506	51	1	72	72
Paseh	-	-	-	2	1,824	912	101	19,574	194	369	38,926	105	-	-	-
Total	1	698	698	195	471,465	2,417	4,445	939,776	211	29,009	2,013,489	69	10,599	396,425	37

Note : The number of buildings includes not only residential buildings but also industrial buildings, whose value is more than Rp. 2×10^6.

Source : Wilayah IV Directorat Jenderal, Pajak Jawa Barat.

Table E.11 HARVESTED AREA, UNIT YIELD AND PRODUCTION OF CROPS : 1986

Crop	Kabupaten Bandung			Nine Kecamatans Related to the Flood Area			
	Harvested Area (ha)	Unit Yield (t/ha)	Production (t)	Harvested Area (ha)	Unit Yield (t/ha)	Production (t)	Share to Kabupaten (%)
Lowland paddy	109,687	5.4	589,245	38,905	5.4	209,427	35.5
Upland paddy	10,344	2.5	26,010	2,738	2.9	7,884	30.3
Corn /1	8,219	2.5	20,548	859	2.3	1,932	9.4
Soybeans	8,895	1.1	9,830	634	0.9	590	6.0
Peanuts	5,369	1.3	7,027	1,410	1.3	1,774	25.2
Potatoes	5,460	15.6	85,091	153	9.1	1,396	1.6
Cabbage	5,443	23.8	129,722	89	7.8	693	0.5
Tomato	3,685	15.2	42,727	678	9.9	6,686	15.6
Red pepper	5,771	3.1	177,963	836	1.5	1,282	0.7
Garlic	503	6.1	3,084	9	5.8	520	16.8
Cassava /1	15,961	10.3	163,626	2,340	9.1	21,339	13.0

Note : /1 Data in 1985
Source : 013

Table E.12 PRODUCTION COST OF LOWLAND PADDY IN THE FLOOD AREA

Item	Unit	Amount	Unit Cost (Rp./Unit)	Total Cost (Rp./ha)
1. Materials				
- Seed	kg/ha	25	300	7,500
- Fertilizers	kg/ha	270/1	130	35,100
- Agro-chemicals	l/ha	3	2,700	8,100
- Others	nos.	-	-	25,300
Sub-total				76,000
2. Labour				
- Nursery work	persons/ha	8	1,500	12,000
- Land preparation	persons/ha	90	1,500	135,000
- Basic fertilizer	persons/ha	10	1,500	15,000
- Pulling & transplanting	persons/ha	24	1,500	36,000
- Weeding	persons/ha	40	1,500	60,000
- Spraying	persons/ha	6	1,500	9,000
- Harvesting & threshing	persons/ha	46	1,500	69,000
- Drying	persons/ha	30	1,500	45,000
Sub-total	persons/ha	225	1,500	381,000
3. Total				457,000

Note : /1 Including equivalent urea amount of other fertilizers.
Source : Dinas Pertanian Tanaman Pangan, Government of Kabupaten Bandung.

Table E.13 INVENTORY OF LIVESTOCK : 1986

Item	Unit	Kabupaten Bandung	Nine Kecamatans Related to the Flood Area	
			Number	Share to K.Bandung (%)
Buffalo	Head	11,404	3,234	28.4
Cattle (Meat)	Head	742	214	29.5
(Milk)	Head	30,600	1,767	5.8
Goat	Head	33,460	3,135	9.4
Sheep	Head	188,282	33,638	17.9
Horse	Head	3,482	1,197	34.4
Pig	Head	18,149	0	0.0
Chicken	Head	2,661,885	1,308,046	49.1
Duck	Head	162,459	111,054	68.4
Rabbit	Head	39,442	11,778	29.9
Others	Head	7,391	3,000	40.6

Source : 014

Table E.14 FISHERY PRODUCTION : 1986

Item	Kabupaten Bandung		Nine Kecamatans Related to the Flood Area			
	Production/1	Area	Production	Area	Share to K.Bandung(%)	
	(kg)	(ha)	(kg)	(ha)	Production	Area
Fishpond	3,240,585	365	1,306,336	144	40.3	39.5
Paddy Field	3,032,230	944	2,213,403	603	73.0	63.9
Extraction from River	62,937	1,095	-	-	-	-
Extraction from Lake	52,828	1,376/2	-	-	-	-
Total	6,388,580	3,780	(3,519,738)	(747)	-	-

Note : /1 Production in two months (March, April) is not included.
/2 Saguling reservoir is not included.
Source : Dinas Perkana, Government of Kabupaten Bandung.

Table E.15 PRODUCTION COST OF IKAN MAS (GOLDEN FISH) IN FISHPOND

Stage	Raising Period (Month)	Expense (Rp.10³/ha/1) Fry	Wage	Feed & Chemicals	Equipment	Total
I. Unit Cost of Each Transition Stage						
1. Nursery	1.0	200	50	155	30	435
2. Transition 1	1.0	-	50	155	10	215
3. Transition 2	1.0	-	50	155	10	215
4. Transition 3	1.0	-	50	155	10	215
5. Rearing	3.0	-	125	205	10	340

II. Production cost per Unit Area of Fishpond

	Composition of Each Stage (%)	Balanced Area Composition (ha/2)	Turnover (Times/year)	Unit Cost (Rp.10³/ha/1/Crop)	Unit Cost (Rp.10³/ha/2/year)
1. Nursery	0.7	0.004	12	435	21
2. Transition 1	2.3	0.012	12	215	31
3. Transition 2	9.5	0.048	12	215	124
4. Transition 3	37.9	0.191	12	215	493
5. Rearing	49.4	0.745	4	340	1,013
6. Total	100.0	1.000	-	-	1,682
				(Rp.421 x 10³/ha/2/crop)	

III. Expected Production per Unit Area of Fishpond

	Balanced Area Composition (ha/2)	Harvesting (Times/year)	Unit Production (kg/ha/1/crop)	(kg/ha/2/year)
1. Nursery	0.004	-	-	-
2. Transition 1	0.012	-	-	-
3. Transition 2	0.048	-	-	-
4. Transition 3	0.191	12	23	53
5. Rearing	0.745	4	800	2,384
6. Total	1.000	-	-	2,437
(Gross Income/3			Rp.3,656 x 10³/ha/2/year)	
(Gross Income/3			Rp.914 x 10³/ha/2/crop)	

Note : /1 Pond area of single stage
/2 Balanced compound area of each stage
/3 A farm gate price of Ikan Mas is Rp.1,500/kg.

Source : Dinas Perikanan, Kabupaten DT II Bandung

Table E.16 NUMBER OF MANUFACTURING ESTABLISHMENT BY INDUSTRIAL TYPE : 1986

Industrial Type	Kabupaten Bandung						Nine Kecamatans Related to the Flood Area						
	Large Scale	Medium Scale	Small Scale	Home Industry	Total	Percentage Distribution(%)	Large Scale	Medium Scale	Small Scale	Home Industry	Total	Percentage Distrib.(%)	Share to Kab.(%)
31 Food	19	54	646	3,670	4,389	23.6	1	15	234	1,023	1,273	19.3	29.0
32 Textile	155	375	1,038	2,029	7,597	19.4	116	304	273	1,157	1,850	28.1	51.4
33 Wooden Product	-	8	190	4,002	4,200	22.6	-	2	67	927	996	15.1	23.7
34 Paper	5	6	26	120	157	0.8	1	4	20	47	72	1.1	45.9
35 Chemicals	8	41	44	331	404	2.2	1	16	25	32	74	1.1	18.3
36 Ceramics	4	53	481	1,897	2,435	13.1	-	8	158	991	1,157	17.6	47.5
37 Metal	-	-	-	-	-	-	-	-	-	-	-	-	-
38 Machine	5	28	79	591	703	3.8	1	14	34	173	222	3.4	31.6
39 Others	-	5	34	2,641	2,680	14.4	-	2	18	924	944	14.3	35.2
Total	196	570	2,538	15,261	18,565	100.0	120	365	829	5,274	6,588	100.0	35.5
Percentage Distribution (%)	1.0	3.1	13.7	82.2	100.0	-	1.8	5.5	12.6	80.1	100.0	-	-

Source : 010

Table E.17 EMPLOYMENT OF MANUFACTURING ESTABLISHMENTS BY INDUSTRIAL TYPE : 1986

Industrial Type	Kabupaten Bandung						Nine Kecamatans Related to the Flood Area						
	Large Scale	Medium Scale	Small Scale	Home Industry	Total	Percentage Distribution(%)	Large Scale	Medium Scale	Small Scale	Home Industry	Total	Percentage Distrib.(%)	Share to Kab.(%)
31. Food	11,233	2,141	4,749	10,024	28,147	16.9	497	580	1,761	2,871	5,709	6.5	9.6
32. Textile	68,430	16,558	8,583	4,199	97,770	58.5	47,929	13,457	4,904	2,438	68,728	78.4	70.3
33. Wooden Product	-	224	1,447	9,041	10,712	6.4	-	43	484	1,962	2,489	2.8	23.2
34. Paper	1,334	320	239	235	2,128	1.3	140	205	168	95	608	0.7	28.6
35. Chemicals	2,632	1,672	421	656	5,381	3.2	343	697	239	59	1,338	1.5	24.9
36. Ceramics	1,259	1,683	3,283	6,960	13,185	7.9	-	401	994	3,873	5,268	6.0	40.0
37. Metals	-	-	-	-	-	-	-	-	-	-	-	-	-
38. Machines	807	1,083	586	1,689	4,165	2.5	240	543	247	493	1,523	1.7	36.6
39. Others	-	278	334	4,864	5,476	3.3	-	125	162	1,727	2,014	2.3	36.8
Total	85,695	23,959	19,642	37,668	166,964	100.0	49,149	16,051	8,959	13,518	87,677	100.0	52.5
Number of Workers per Establishment	437.2	42.0	7.7	2.5	9.0	-	409.6	44.0	10.8	2.6	13.3	-	-
Percentage Distribution (%)	51.3	14.3	11.8	22.6	100.0	-	56.1	18.3	10.2	15.4	100.0	-	-

Source : 010

Table E.18 NUMBER OF SERVICE ESTABLISHMENTS AND WORKERS BY INDUSTRIAL TYPE : 1986

Industrial Type	Kabupaten Bandung					Nine Kecamatans Related to the Flood Area				
	Establishment		Worker		Number of Worker per Establishment	Establishment		Worker		Number of Worker per Establishment
	Number	Percentage Distribution(%)	Number	Percentage Distribution(%)		Number	Percentage Distribution(%)	Number	Percentage Distribution(%)	
Wholesale	1,393	1.4	3,742	3.1	2.7	258	0.8	962	2.6	2.7
Supermarket	2	0.0	81	0.1	40.5	2	0.0	81	0.2	40.5
Retail Store	83,003	84.2	98,605	82.7	1.2	27,871	84.7	29,924	82.0	1.1
Restaurant & Refreshment	14,075	14.3	16,447	33.4	1.1	4,751	14.4	5,487	15.0	1.2
Hotel & Inn	77	0.1	401	0.3	5.2	37	0.1	37	0.1	1.0
Total	98,550	100.0	119,276	100.0	1.2	32,919	100.0	36,491	100.0	1.1

Source : 010

Table E.19 NUMBER OF INDUSTRIAL AND COMMERCIAL FACILITIES IN THE FLOOD AREA : 1986

Zone	*Manufacturing Industry* /1			*Service's Industry*		
	Large-Small Industries/2	Home Industry/3	Total	Marketing Facilities/4	Retail Store Refreshment/5	Total
Zone A	34	8	42	10	187	197
Zone B	0	12	12	6	52	58
Zone C	5	7	12	3	56	59
Zone D	1	0	1	0	13	13
Zone E	5	6	11	1	60	61
Total	45	33	78	20	368	388

Note /1 : Textile, Shoe, Brick, Roof tile, Lime, Sand-digging, Iron, etc.
/2 : 32 large scale manufacturers are picked up through a map. Other scale industries are estimated on the basis of both an interview survey and statistical industrial production in a Desa, using a average production of brick industry of Rp.6.7 x 10^6/establishment.
/3 : Estimated on the basis of number of workers in a Desa, using an unit of 2.6 persons/establishment of home industry (refer to Table E.17).
/4 : Public market, Co-operation, Bank, Rice warehouse, etc. Estimated by Potensi Desa.
/5 : Estimated on the basis of number of workers in a Desa, using an unit of 1.1 persons/establishment of trade industry (refer to Table E.18).

Sources : Potensi Desa and 023

Table E.20 INVENTORY OF ROAD IN THE FLOOD AREA

(Unit : km)

Zone	Provincial Road	Kabupaten Road	Desa Road	Total	Density /1 (Km / Km²)
Zone A	6.9	16.2	1.5	24.6	4.06
Asphalt Road	5.7	-	-	5.7	
Gravel Road	1.2	16.2	-	17.4	
Earth Road	-	-	1.5	1.5	
Zone B	-	22.6	9.6	32.2	2.21
Asphalt Road	-	15.7	-	15.7	
Gravel Road	-	6.9	-	6.9	
Earth Road	-	-	9.6	9.6	
Zone C	-	13.6	9.4	23.0	1.00
Asphalt Road	-	8.0	-	8.0	
Gravel Road	-	5.6	-	5.6	
Earth Road	-	-	9.4	9.4	
Zone D	-	7.4	6.3	13.7	1.24
Asphalt Road	-	4.4	-	4.4	
Gravel Road	-	3.0	-	3.0	
Earth Road	-	-	6.3	6.3	
Zone E	-	15.8	14.9	30.7	1.72
Asphalt Road	-	5.3	-	5.3	
Gravel Road	-	10.5	-	10.5	
Earth Road	-	-	14.9	14.9	
Total	6.9	75.6	41.7	124.2	1.71
Asphalt Road	5.7	33.4	-	39.1	
Gravel Road	1.2	42.2	-	43.4	
Earth Road	-	-	41.7	41.7	
Percentage Distribution	5.5%	60.9%	33.6%	100.0%	-

Note /1 : Total Length by Zone Area.
Source : Potensi Desa

Table E.21 INVENTORY OF SOCIAL INFRASTRUCTURE IN THE FLOOD AREA : 1986

Zone	Medical Facilities /1	Educational Facilities /2	Religious Facilities /3	Public Facilities /4
Zone A	17	31	91	5
Zone B	6	28	52	6
Zone C	5	25	42	9
Zone D	3	23	26	3
Zone E	3	13	75	5
Total	34	120	286	28

Note /1 : Clinic, Public medical center, Private medical center, Drug store, etc.
/2 : Junior school, Junior high school, high school, college, etc.
/3 : Mosque, Church, Chapel
/4 : Village hall, Conference, Safeguard building, etc.
Source : Potensi Desa

Table E.22 INVENTORY OF PRODUCTIVE AND SOCIAL ASSETS IN THE FLOOD AREA :1986

Item	Zone A	Zone B	Zone C	Zone D	Zone E	Total
Land Use (ha)						
- Paddy Field	450.9	1,112.5	2,042.6	1,022.1	1,734.7	6,362.8
- Upland Field	2.6	21.8	16.0	-	-	40.4
- Plantation	0.5	133.9	130.0	33.2	-	297.8
- Grass Land	-	2.5	16.1	-	-	18.6
- Fishpond	1.4	75.2	-	-	-	76.6
- Built-up Area	150.4	108.6	89.6	52.6	51.8	452.9
- Total Area	605.7	1,454.4	2,294.5	1,107.9	1,786.5	7,249.0
Residential Building						
- Permanent Type	4,691	2,066	5,344	953	1,089	14,133
- Semi-permanent Type	1,852	637	483	273	514	3,759
- Non-permanent Type	1,404	2,913	2,493	1,022	1,586	9,418
- Total	7,947	5,616	8,310	2,248	3,189	27,310
Productive Facility						
- Large-small Scale Industry	34	0	5	1	5	45
- Home industry	8	12	7	0	6	33
- Marketing Facility	10	6	3	0	1	20
- Retail Store & Refreshment	187	52	56	13	60	368
- Total	239	70	71	14	72	466
Road (km)						
- Asphalt Type	5.7	15.7	8.0	4.4	5.3	39.1
- Gravel Type	17.4	6.9	5.6	3.0	10.5	43.4
- Earth Type	1.5	9.6	9.4	6.3	14.9	41.7
- Total	24.7	32.2	23.0	13.7	30.6	124.2
Social Infrastructure						
- Medical Facility	17	6	5	3	3	34
- Educational Facility	31	28	25	23	13	120
- Religious Facility	91	52	42	26	75	286
- Public Facility	5	6	9	3	5	28
- Total	134	92	81	55	96	468

Table E.23 ESTIMATED VALUE OF EXISTING ASSETS IN THE FLOOD AREA : 1986

Item	Existing Number	Unit Value (Rp.1000)	Total Value (Rp.10^9)
Agricultural Production			5.53
- Paddy (ha)	6362.8	858/1	5.46
- Fishpond (ha)	76.6	914/2	0.07
Residential Building			56.75
- Permanent Type	14,133	3,197/3	45.18
- Semi-permanent Type	3,759	1,044/4	3.92
- Non-permanent Type	9,418	812/5	7.65
Productive Facility			94.60
- Large-scale Industry	32	2,818,000/6	90.18
- Small-scale Industry	13	281,800/7	3.66
- Home Industry	33	3,549/8	0.12
- Marketing Facility	20	13,843/10	0.28
- Retail Store and Refreshment Shop	368	974/9	0.36
Road			1.35
- Provincial Road (km)	6.9	32,500/11	0.22
- Kabupaten Road (km)	75.6	11,700/11	0.88
- Desa Road (km)	41.7	5,900/11	0.25
Social Infrastructure			4.20
- Medical Facility	34	15,000/12	0.51
- Educational Facility	120	15,000/13	1.80
- Religious Facility	286	5,500/14	1.57
- Administrative Facility	28	11,250/15	0.32

Note : /1 Production cost (Rp.457x10^3) x Accumulated cost rate till March 1986 (75%) + Expected net income (Rp.515x10^3).
/2 Production cost (Rp.421x10^3) + Expected net income (Rp.493x10^3).
/3 Building value (Rp.2,205x10^3) + Household Effects (Rp.992x10^3).
/4 Building value (Rp.720x10^3) + Household Effects (Rp.324x10^3).
/5 Building value (Rp.560x10^3) + Household Effects (Rp.252x10^3).
/6 Building value (Rp.293x10^6) + Equipment value (Rp.2,095x10^6) + Inventory stock (Rp.1,138x10^6) + Expected net income (Rp.486x10^6). Where: net income is assumed to be 30% of sale amount; and turnover ratio of inventories is assumed to be 3.2/year.
/7 10% of large-scale industry, which is almost equal to rate of average number of workers in each industry.
/8 Building and equipment value (Rp.2x10^6) + Inventory stock (Rp.1.1x10^6)+ Expected net income (Rp.0.45x10^6).
/9 Equipment value is assumed to be 10% of home industry. Inventory stock and expected net income are assumed to be 50% of home industry.
/10 Building value (Rp.5x10^6). Others are assumed to be equal to values of 10 retail stores.
/11 Half of new construction cost is applied. New construction costs are assumed as follows based on a survey of the team: Provincial road, Rp.65,000/m(8m width); Kabupaten road, Rp.23,400/m(6m width); and Desa road, Rp.11,700/m(4m width).
/12 Building value (Rp.10x10^6) + Equipment (50% of building value).
/13 Building value (Rp.10x10^6) + Equipment (50% of building value).
/14 Building value (Rp.5x10^6) + Equipment (10% of building value).
/15 Building value (Rp.7.5x10^6) + Equipment (50% of building value).

Table E.24 ESTIMATED NUMBER OF VICTIMS OF THE 1986 FLOOD IN THE FLOOD AREA

Zone	Inundation Depth (m)							Total	Percentage Distribution (%)
	0.0 -0.5	0.5 -1.0	1.0 -1.5	1.5 -2.0	2.0 -2.5	2.5 -3.0	3.0 -3.5		
Zone A	13,525	14,593	9,321	3,989	0	0	0	41,428	36.9
Zone B	3,842	8,488	6,104	3,909	2,712	340	574	25,969	23.1
Zone C	1,633	10,693	7,024	1,267	76	0	0	20,693	18.4
Zone D	4,562	5,696	601	0	0	0	0	10,859	9.7
Zone E	6,600	4,160	1,795	746	0	0	0	13,301	11.4
Total	30,162	43,630	24,846	9,912	2,788	340	574	112,252	100.0
Percentage Distribution(%)	26.9	38.9	22.1	8.8	2.5	0.3	0.5	100.0	-

Source : Potensi Desa in 1986

Table E.25 ESTIMATED NUMBER OF RESIDENTIAL BUILDINGS DAMAGED BY THE 1986 FLOOD IN THE FLOOD AREA

Zone	Inundation Below Floor Level	Inundation Above Floor Level (m)					Total	Percentage Distribution (%)
		0.0 -0.5	0.5 -1.0	1.0 -2.0	2.0 -3.0	More than 3		
Zone A	527	2,669	2,600	2,152	0	0	7,948	29.1
Zone B	176	1,055	1,664	1,983	641	98	5,617	20.6
Zone C	80	1,248	4,249	2,720	13	0	8,310	30.4
Zone D	184	976	983	104	0	0	2,247	8.2
Zone E	316	1,458	871	543	0	0	3188	11.7
Total	1,283	7,406	10,367	7,502	654	98	27,310	100.0
Percentage Distribution(%)	4.7	27.1	38.0	27.5	2.4	0.3	100.0	-

Source : Potensi Desa in 1986

Table E.26 ESTIMATED AREA OF PADDY FIELD DAMAGED BY THE 1986 FLOOD IN THE FLOOD AREA

(Unit : ha)

Zone	Inundation Depth (m)	Duration (days) 1 - 2	3 - 4	5 - 6	More than 7	Total	Zone Total	Percentage Distribution (%)
Zone A	<0.5/1	89.4	1.5	0.3	64.9	156.1	450.9	7.1
	0.5-1.5	11.1	45.5	2.7	3.3	52.9		
	>1.5/2	2.1	31.9	0.0	148.6	182.6		
Zone B	<0.5/1	0.0	0.0	0.0	169.3	169.3	1,112.5	17.5
	0.5-1.5	0.0	0.0	0.0	437.5	437.5		
	>1.5/2	0.0	0.0	0.0	505.7	505.7		
Zone C	<0.5/1	152.3	3.8	0.0	195.8	351.9	2,042.6	32.1
	0.5-1.5	20.0	16.4	0.0	662.0	698.4		
	>1.5/2	0.0	0.0	0.0	992.3	992.3		
Zone D	<0.5/1	182.4	17.5	15.2	261.6	476.7	1,022.1	16.1
	0.5-1.5	60.5	0.0	0.0	368.3	428.8		
	>1.5/2	8.6	0.0	0.0	108.0	116.6		
Zone E	<0.5/1	316.6	66.6	3.0	217.1	603.3	1,734.7	27.3
	0.5-1.5	63.0	12.5	4.0	405.8	485.3		
	>1.5/2	0.0	0.0	0.0	646.1	646.1		
Total	<0.5/1	740.7	89.4	18.5	908.7	1,757.3	6362.8	100.0
	0.5-1.5	154.6	74.4	6.7	1,926.5	2,162.2		
	>1.5/2	10.7	31.9	0.0	2,400.7	2,443.3		
Grand Total		906.0	195.7	25.2	5,235.9	6362.8	-	-
Percentage Distribution(%)		14.2	3.1	0.4	82.3	100.0	-	-

Note : /1 Less than 0.5m
/2 More then 1.5m

Table E.27 ESTIMATED FLOOD DAMAGE AND AVERAGE ANNUAL DAMAGE POTENTIAL BY ASSET AT 1987 FINANCIAL PRICES

(Unit : Million Rupiahs)

Asset Item	Recurrence Interval						
	1986 Flood	2-Years	5-Years	10-Years	20-Years	50-Years	100-Years
Houses	6,998.0	8,709.3	13,910.4	19,468.8	23,428.1	27,194.5	29,429.7
Industry	1,777.2	2,020.9	2,432.9	2,675.8	2,850.1	3,053.0	3,182.1
Paddy	3,358.0	3,476.2	3,653.2	3,702.8	3,719.4	3,738.9	3,746.8
Fishpond	45.5	45.5	45.5	45.5	45.5	45.5	45.5
Infrastructure	1,755.0	2,146.0	3,268.7	4428.9	5,255.6	6,049.5	6,522.4
Indirect Damage	696.7	819.9	1,165.5	1,516.1	1,764.9	2,004.1	2,146.3
Total	14,630.4	17,217.8	24,476.2	31,837.9	37,063.7	42,085.5	45,075.8
Average Annual Damage Potential							17,507.8

Table E.28 ESTIMATED FLOOD DAMAGE AND AVERAGE ANNUAL DAMAGE POTENTIAL BY ZONE AT 1987 FINANCIAL PRICES

(Unit : Million Rupiahs)

Zone	Recurrence Interval							Average Annual Damage Potential	Percentage Distribution (%)
	1986 Flood	2-Years	5-Years	10-Years	20-Years	50-Years	100-Years		
Zone A	3,467.1	4,244.8	5,905.1	7,331.4	8,810.7	10,770.5	12,195.6	4,216.9	24.1
Zone B	3,825.3	4,499.8	6,140.0	7,456.0	8,728.5	9,670.8	10,032.1	4,386.2	25.1
Zone C	4,318.3	5,124.0	8,337.3	12,294.4	13,773.3	14,836.7	15,219.1	5,788.5	33.1
Zone D	1,048.7	1,227.5	1,673.7	2,017.1	2,738.2	3,465.8	3,865.7	1,232.8	7.0
Zone E	1,971.0	2,121.5	2,420.3	2,738.7	3,013.0	3,341.6	3,760.4	1,883.4	10.7
Total	14,630.4	17,217.8	24,476.2	31,837.9	37,063.7	42,085.5	45,072.8	17,507.8	100.0

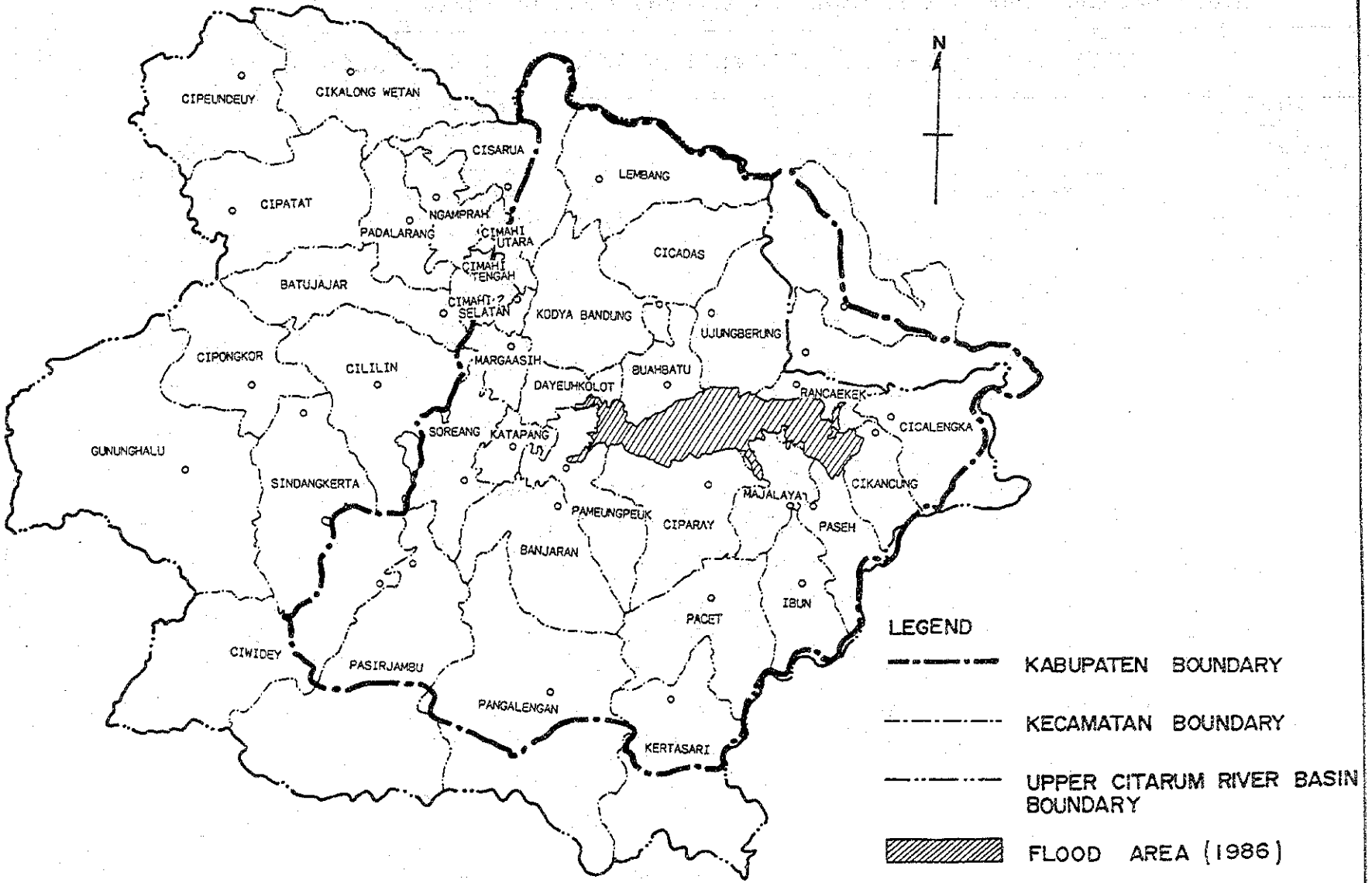
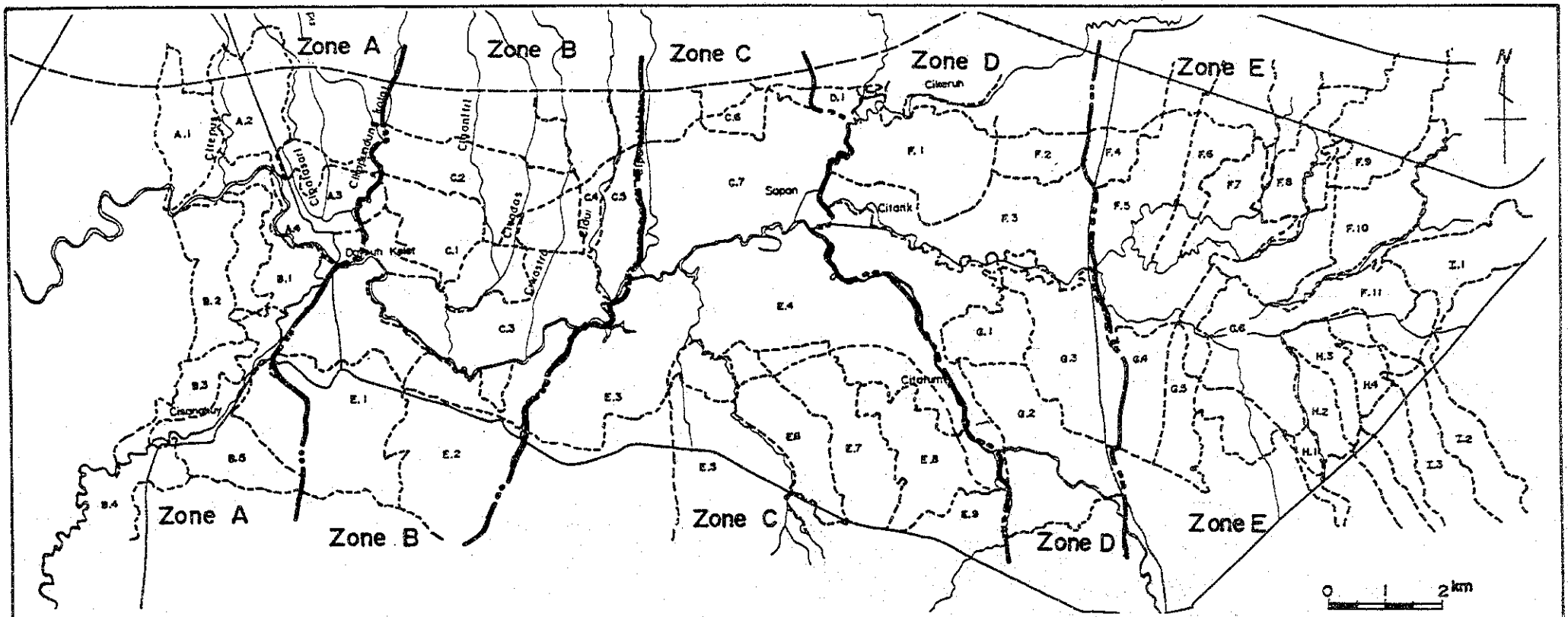


FIG. E.1 ADMINISTRATION OF THE STUDY AREA

STUDY ON THE FLOOD CONTROL PLAN OF THE UPPER CITARUM BASIN

JICA



Zone A

Kec.Dayeuh Kolot
A1 Cangkuang Timur
A2 Pasawahan
A3 Citeureup
A4 Dayeuhkolot

Kec.Pameungpeuk
B1 Andir
B2 Bojong Malaka
B3 Malakasari
B4 Sukasari
B5 Langonsari

Zone B

Kec.Buah Batu
C1 Bojong Soang
C2 Lengkong
C3 Bojong Sari
C4 Buah Batu
C5 Margasari

Kec.Ciparay
E1 Bale Endah
E2 MANG Gahang

Zone C

Kec.Buah Batu
C6 Cipamokolan
C7 Tegar Luar

Kec.Ciparay
E3 Jelekang
E4 Sumber Sari
E5 Ciheulang
E6 Serang Mekar
E7 Sarimahi
E8 Ciparay
E9 Mekar Sari

Zone D

Kec.Ujung Berung
D1 Cipadung

Kec.Ranca Ekek
F1 Tegal Sumedang
F2 Ranca Ekek Wetan
F3 Sukamanah

Kec.Majaraya
G1 Ranca Kasumba
G2 Bojong Emas
G3 Solokan Jeruk

Zone E

Kec.Ranca Ekek
F4 Ranca Ekek Kulon
F5 Bojong Loa
F6 Jelekong
F7 Linggar
F8 Sukamulya
F9 Cangkuang
F10 Haur Pugar
F11 Sangiang

Kec.Majaraya
G4 Cibodas
G5 Langensari
G6 Padamukti

Kec.Paseh
H1 Mekar Pawitan
H2 Tengsi Mekar
H3 Cipedes
H4 Cigentur

Kec.Cikancung
I1 Tanjunglaya
I2 Ciluluk
I3 Srirahayu

FIG. E.2 ADMINISTRATION OF THE FLOOD AREA

STUDY ON THE FLOOD CONTROL PLAN OF THE UPPER CITARUM BASIN

JICA

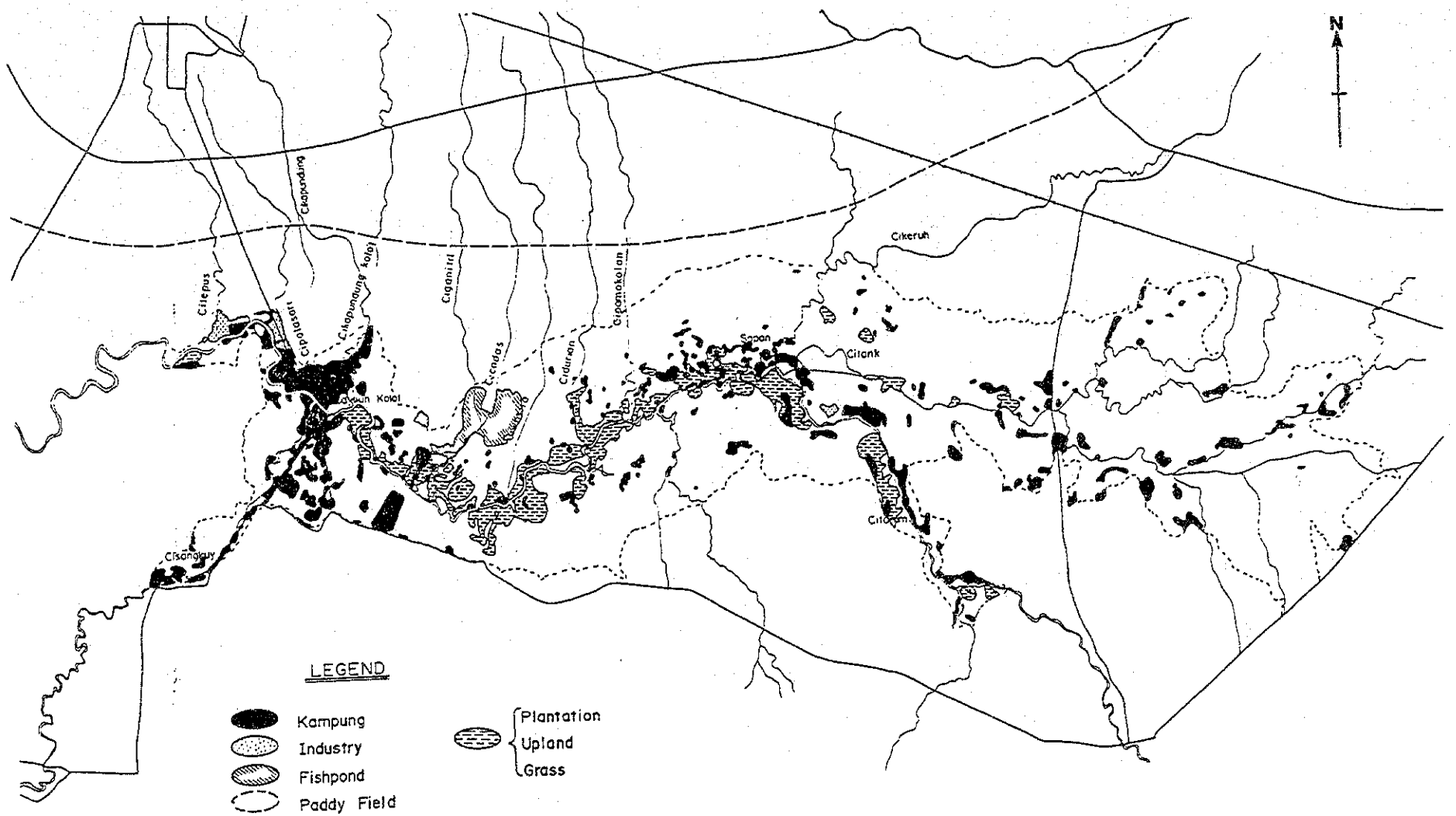


FIG. E.3 EXISTING LAND-USE OF THE FLOOD AREA

STUDY ON THE FLOOD CONTROL PLAN OF THE UPPER CITARUM BASIN

JICA

SUPPORTING REPORT F

ON-GOING PROJECT

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SUPPORTING REPORT F
ON-GOING PROJECT

1. Watershed Management

The Government of Indonesia made a guideline of the required forest area rate (30%) of the river basins as a national policy, in order to regulate a flood run-off, to protect an agricultural area from land erosion, and to maintain a good natural environment.

The forest area rate of the Upper Citarum Basin in 1986 is approximately 25%, which is 5% less than the guideline, due to the land developments. As a result, the problems of land erosion and sedimentation in the river are now on increase.

Considering the above situation, in March 1987, the Ministry of Forestry conducted a study on Land Rehabilitation and Soil Conservation of the Upper Citarum Basin of 4,543 km^2. In this study, the priority area of 1,506 km^2, which is the same as the JICA Study Area except the Ciwidey River basin, was selected and a feasibility study was carried out.

The main objectives of the feasibility study are:

- to prepare a land-use plan to achieve the guideline of the required forest area rate
- to propose erosion control measures to protect the agriculture areas from land erosion.

For advancement of the watershed management of the Upper Citarum Basin, the Ministry of Forestry proposed the land-use plan consisting of the following three (3) categories.

(1) Protection forest : No development will be permitted.
(2) Buffer zone forest : The area with limited development
(3) Cultivation area : Paddy, dry field, etc.

The land use proposal is shown in Fig. F.1.

Priority sequence of erosion control is given to each sub-catchment area as shown in Fig. F.2.

The following erosion control measures illustrated in Fig. F.3 are proposed for the areas of serious land erosion.

- Terrace formation of dry fields
- Small dams for sediment storage
- Drainage channel and grass plantation
- Stormwater infiltration works.

2. Citarum River Improvement

Taking the opportunity of 1984 serious flood, the DPU, West Java Province, started to study on the flood control project of the Upper Citarum Basin following the engineering plan by the Directorate of Rivers (DOR) and proposed the implementation program that comprised the following short-term and middle term activities.

(1) Short-term activities

The following two (2) activities are proposed. The required project cost is estimated to be Rp. 8,323.5 million at 1986 price.

(a) Dredging of the Citarum River in the area of Dayeuh Kolot over a 5.8 km distance, starting from a point 4.4 km downstream of the Dayeuh Kolot bridge, in the upstream direction.

(b) Cut-off channel I of 1.7 km long

(2) Middle-term activities

The following five (5) activities are proposed. The required project cost is estimated to be Rp. 37,626 million at 1986 price.

(a) Diversion of the Cisangkuy River of 3.1 km long
(b) Cut-off channel II of 0.56 km long
(c) Cut-off channel III of 1.26 km long
(d) Normalization of river channel of 34.5 km long
(e) Construction of dikes of 46 km long

The total estimated cost is Rp. 45,949.5 million at 1986 price. However, the proposed project will be subject to change after completion of the JICA Study.

Location of the proposed projects are shown in Fig. F.4. The implementation schedule is shown in Table F.1.

At present, the short-term activities of the Citarum River improvement are on-going by using the President Special Budget. The investment cost in the past two (2) years (1986-1988) is approximately Rp. 3 billion.

3. River Improvement of Tributaries

3.1 General

Bandung urban area has been expanded as shown in Fig. B.5. Population of Kota Bandung has increased from 980,000 in 1961 to 1,202,000 (1971), 1,461,000 (1980) and 1,514,000 (1985) respectively. The urbanization has occurred in the catchment areas of the right side tributaries which were mostly paddy fields and flood prone.

The progression of the urbanization and poor capacity of the drainage channel and tributaries in Bandung Urban Area have increased the flood and flood damage. So, the DPU, West Java Province, is undertaking the improvement of the tributaries flowing through the Bandung Urban Area with the financial assistance of ADB.

3.2 Flood Damage

Outline of the flood conditions of the 7 tributaries flowing in the urban area were surveyed by interviewing the residents. (Refer to Fig. F.5 and Table F.2) The location of the flood areas are based on the previous data from WJRDP office and modified according to the results of interviewing. The results are summarized below.

- Previous flood area (before commencement of the on-going project)	:	971 ha	residential	314 ha
			paddy	657 ha
- Existing flood area (as of 1986)	:	740 ha	residential	253 ha
			paddy	489 ha
- Flood depth	:	ranges from 0.5 to 1.5 m		
- Flood duration	:	less than 12 hours in residential area and about 2 days in paddy area.		

Flood areas of the Citepus, Cidurian and Cipamokolan Rivers were decreased by the on-going river improvement project.

3.3 Existing Improvement Plan

The existing improvement plan consists of the following river improvement works. (Refer to Fig. F.4)

Name of River	Catchment Area (km^2)	Improvement Length (km)	Remarks
(1) Cipamokolan	44.8	8.7	Under construction (ADB assistance)
(2) Cidurian	23.1	8.4	Under planning ready for construction
(3) Ciwastra	8.9	6.4	Under planning ready for construction
(4) Cicadas	24.1	9.6	Completed partially
(5) Cikapundung Kolot	22.5	5.3	Under construction (ADB assistance)
(6) Citepus	18.4	6.5	Under construction (ADB assistance)
(7) Cikapundung-Cipalasari	110.2	6.7	Under planning ready for construction
(8) Downstream Cikapundung & Cipalasari	26.0	5.5	Under planning ready for construction
Total		57.1	

Summary of the tributary improvement plan is shown in Table F.3. Proposed design flood distribution, cross sections and profiles are illustrated in Fig. F.6 to Fig. F.10.

3.4 Review of Existing Improvement Plan

3.4.1 Design Discharge

The design discharges of the existing improvement plan were determined comparing the values estimated by several flood run-off computation methods. As the results, the specific discharge of 20-year frequency flood for each tributary, varies ranging from 1.7 to 6.8 $m^3/s/km^2$ as shown in Table F.8, due to the different computation

methods. Similar run-off computation method should be applied for the rivers with similar catchment area, land use, topography and rainfall.

In this study, the Rational method is basically applied for the estimation of the design discharge of tributaries, because the drainage areas are small and land use is mostly urban. For only Cikapundung River basin, however, the combined method of the Storage Function Method (for upper non-urban basin) and the Rational Method (for lower urban basin) is applied considering the scale and characteristics of the drainage basin.

Calculation basis of the design discharge are as follows.

(1) Rainfall intensity-duration curve of the Bandung station was used.

(2) Flood run-off coefficients by land use condition are;

Lake and marsh	:	1.0
Forest	:	0.30
Paddy field	:	0.35
Dry field	:	0.35
Urban area	:	0.50

(3) Flood run-offs were estimated under the future land use conditions in 2005.

Table F.4 shows the calculation results together with the design discharges of the existing plan. Detailed calculations by river are shown in Data Book III.

The comparison of the design discharges (20-year frequency flood) of the existing plan and the JICA review at the downstream ends is shown below.

Comparison of Design Discharge of 20-year Frequency Flood

Name of River	Drainage Area	Existing Plan	JICA Review
	km^2	m^3/s	m^3/s
Citepus	18.4	80	105
Cipalasari-Cikapundung/1	108.0	195	190
Cikapundung Kolot	22.5	90	125
Cicadas	24.1	55	80
Ciwastra	8.9	20	40
Cidurian	23.1	100	70
Cipamokolan	44.8	190	110

/1: Cipalasari and Cikapundung Rivers are connected by a diversion.

The design discharge of the existing plan is larger than that of the JICA review in the Cipalasari-Cikapundung, Cidurian and Cipamokolan Rivers. However, it is smaller than the JICA review in the Citepus, Cikapundung Kolot, Cicadas and Ciwastra Rivers.

3.4.2 Possibility of Discharge Capacity Increase

It was evaluated whether the discharge capacity of the Citepus, Cikapundung Kolot, Cicadas and Ciwastra Rivers can be increased upto the design discharge of the JICA review by enlarging river cross section within the river widths of the existing plan. As the representative section of each river for the evaluation, the section at downstream end was selected.

The required enlargement of the river cross sections of the existing plan is shown in Fig. F.11. The Cicadas and Ciwastra Rivers can be enlarged by dredging the high water channels. The Citepus and Cikapundung Kolot can be enlarged by deepening the river beds. Construction of retaining wall or revetment will be required for the enlargement works.

3.4.3 Evaluation of Channel Improvement Plan

(1) Cipalasari-Cikapundung, Cidurian and Cipamokolan Rivers

The design flood frequency of 20-year is reasonable to meet the long-term flood control requirement of the rivers. The design discharge is large enough to carry flood run-offs which may occur under the future land use conditions in the year 2005. The river channel improvements may be implemented according to the existing plan.

(2) Citepus, Cikapundung Kolot, Cicadas and Ciwastra Rivers

The design flood frequency of 20-year is adequate to meet the long term flood control requirement of the rivers. The design discharge is not sufficient in scale to cope with the increasing flood peaks in the future (2005 year). However, the river channel improvements may be implemented according to the existing plan to meet the urgent flood control requirement based on the following considerations;

It will be possible to increase the discharge capacity of the river channels to meet the increased flood peaks in the future by dredging within the river widths of the existing plan ever after the completion of the existing plan.

3.4.4 Evaluation of Toll Road Opening Plan

A toll road is planned to divert traffic from Bandung city. The toll road crosses the Citepus, Cipalasari-Cikapundung, Cikapundung Kolot, Cicadas, Ciwastra, Cidurian and Cipamokolan Rivers. The crossing locations are shown in Fig. F.12.

The design discharges with a 20-year frequency of the above rivers at the crossings of the toll road were reviewed. The design discharges of the existing plan and JICA review are compared as shown below.

Comparison of Design Discharge

Name of River	Drainage Area (km^2)	Discharge (m^3/s)	
		Existing Plan	JICA Review
Citepus	16.8	75	95
Cipalasari-Cikapundung	108.9	175	190
Cikapundung Kolot	20.5	85	115
Cicadas	16.6	33	55
Ciwastra	7.8	20	35
Cidurian	20.4	90	60
Cipamokolan	41.9	185	130

The toll road is planned to cross the rivers of:

- Cicadas, Cidurian and Cipamokolan by bridge
- Citepus, Cipalasari-Cikapundung Kolot and Ciwastra by box culvert

The proposed cross sections of the box culverts and river channels are shown in Fig. F.13. The estimated discharge capacities of the sections are also shown in the same figure.

The proposed cross sections of the Cicadas, Cidurian and Cipamokolan Rivers can carry the design discharge of the JICA review. However, box culverts proposed for the Citepus, Cipalasari-Cikapundung, Ciwastra and Cikapundung Kolot are not sufficient in size to carry the design discharge of the JICA review.

It is recommended to construct bridge instead of box culvert for the toll road crossing of the Citepus, Cipalasari-Cikapundung, and Cikapundung Kolot Rivers from the following considerations.

- The river basins are subject to disorderly land developments, resulting in unexpected increase of flood run-off in future. As a result, improvement of the rivers may be required again to meet increased flood discharges.

- In case of bridge type crossing, the river section at crossing can be easily enlarged by dredging. However, in case of box culvert type crossing, re-construction of the entire box culvert is necessary to increase discharge capacity. But the reconstruction of box culvert is difficult.

- Box culvert type crossing is easily subject to clogging by garbages and logs, compared to bridge type crossing.

3.4.5 Necessity of Comprehensive Flood Control

The drainage basins of the tributaries in Bandung urban area are subject to haphazard land developments due to the high pressure of the increasing population.

Haphazard land developments will often bring an unexpected increase of flood peak in the tributaries by the excessive development of the forest and low-lying areas that served as retarding areas. It may also lead to contiguous housing developments up to the river banks, making future widening of the tributaries very difficult.

The on-going river improvement plan of the tributaries is prepared to carry the flood run-offs under the land use conditions in 2005. However, it can not meet the increasing floods in the far future beyond the year 2005.

To cope with the above-mentioned future situations, a comprehensive flood control approach will be required. The possible components of the comprehensive flood control are:

- Re-dredging of the river bed within the river widths
- Provision of retention ponds
- Emergency use of play ground, park and other public space for flood retention
- Preservation of forest area

Table F.1 IMPLEMENTATION SCHEDULE OF ON-GOING CITARUM RIVER IMPROVEMENT

WORK ITEM	COST	84 85	85 86	86 87	87 88	88 89	89 90	90 91	91 92	92 93	93 94	94 95	95 96	96 97	97 98
DETAIL DESIGN	100		100												
DREDGING CITRUM (5.8km) (690,000m3)	3,760			300	1720	1740									
CUT-OFF CISANGKUY(3.1km) (495,000m3)	5,838				500	500	1500	1600	1688						
CUT-OFF I CITARUM(1.7km) (770,000m3)	4,463.5			255.5	2100	2107									
CUT-OFF II CITARUM(0.56km) (150,000m3)	1,070					90	480	500							
CUT-OFF III CITARUM(1.26km) (650,000m3)	3,386						90	99	1000	1000	1197				
NORMALIZATION CITARUM(34.5km) (3,510,000m3)	20,982						450	450	450	450					
								1500	1750	2000	2500	3000	3000	3000	2482
Dike(46km) (685,000m3)	6,350				400	460	520								
						403	1500	1500	1567						
TOTAL	45,949.5			2,396.5	4,720	5,110	4,640	5,737	4,767	3,400	3,697	3,000	3,000	3,000	2,482

Detailed Design Land Acquisition Construction Works

Table F.2 FLOOD CONDITION OF THE TRIBUTARIES

No	Basin Name	Area (Ha)	Land Use		Depth (m)	Time (Occur)	Duration (Hour)	Remarks (Flood Condition)
			Residential	Paddy				
1	Citepus (T1)	43Ha	38Ha	5Ha	1-0.5	87'Dec	7-12	Often occur, (until now)
	(T2)	9Ha	9Ha	-	1	83'Apr	6	Often occur, from 86' up to
	Sub Total	52Ha	47Ha	5Ha				
2	Cikapundung (K1)	50Ha	43Ha	7Ha	1-1.50	83'Apr	6-12	Many damages occur (in 83') Routine inundation happen until now
3	Cikapundung Kolot							
	(KK1)	59Ha	50Ha	9Ha	1-0	87'Dec	3	Often occur, until now
	(KK2)	33Ha	20Ha	13Ha	1-0.5	87'Nov	6	Often occur, until now
	Sub Total	92Ha	70Ha	22Ha				
4	Cikadas (C1)	53Ha	13Ha	40Ha	0.50	83'Apr	4-12	Often occur, until now
	(C2)	61Ha	54Ha	7Ha	0.50	83'May	3	Often occur, until now
	Sub Total	114Ha	67Ha	47Ha				
5	Cikurian (B1)	61Ha	8Ha	53Ha	0-50	87'Dec	24	Often occur, until now
	(B2)	10Ha	2Ha	8Ha	0.80	83'Apr	48	Often occur, until now
	(B3)	52Ha	14Ha	38Ha	0.80	83'Apr	24	Often occutr, now inunfdation never happen
	Sub Total	123Ha	24Ha	99Ha				
		71	10	61				
6	Cipamokolan (P1)	118Ha	-	118Ha	0.75	87'Nov	48	Often occur, until now
	(P2)	34Ha	2Ha	32Ha	0.50	83'Apr	48	Often occur, but now never happen
	(P3)	34Ha	6Ha	28Ha	0.50	83'May	48	Often occur, but now never happen
	(P4)	22Ha	10Ha	12Ha	0.50	83'Apr	24	Often occur, but now never happen
	(P5)	42Ha	10Ha	32Ha	0.60	87'Dec	24	Often occur, now inundation never happen
	(P6)	36Ha	10Ha	26Ha	1.00	83'Apr	36	Often occur, now inundation never happen
	Sub Total	286Ha	38Ha	248Ha				
		118	0	118				
7	Cikeruh River System (S1)	29Ha	-	29Ha	0.80	83'Apr	48	Often occur, until now
	Cipamokolan (S2)	225Ha	25Ha	200Ha	0.80	83'Apr	48	Often occur, until now
	Sub Total	254Ha	25Ha	229Ha				
	Total	971Ha	314Ha	657Ha				

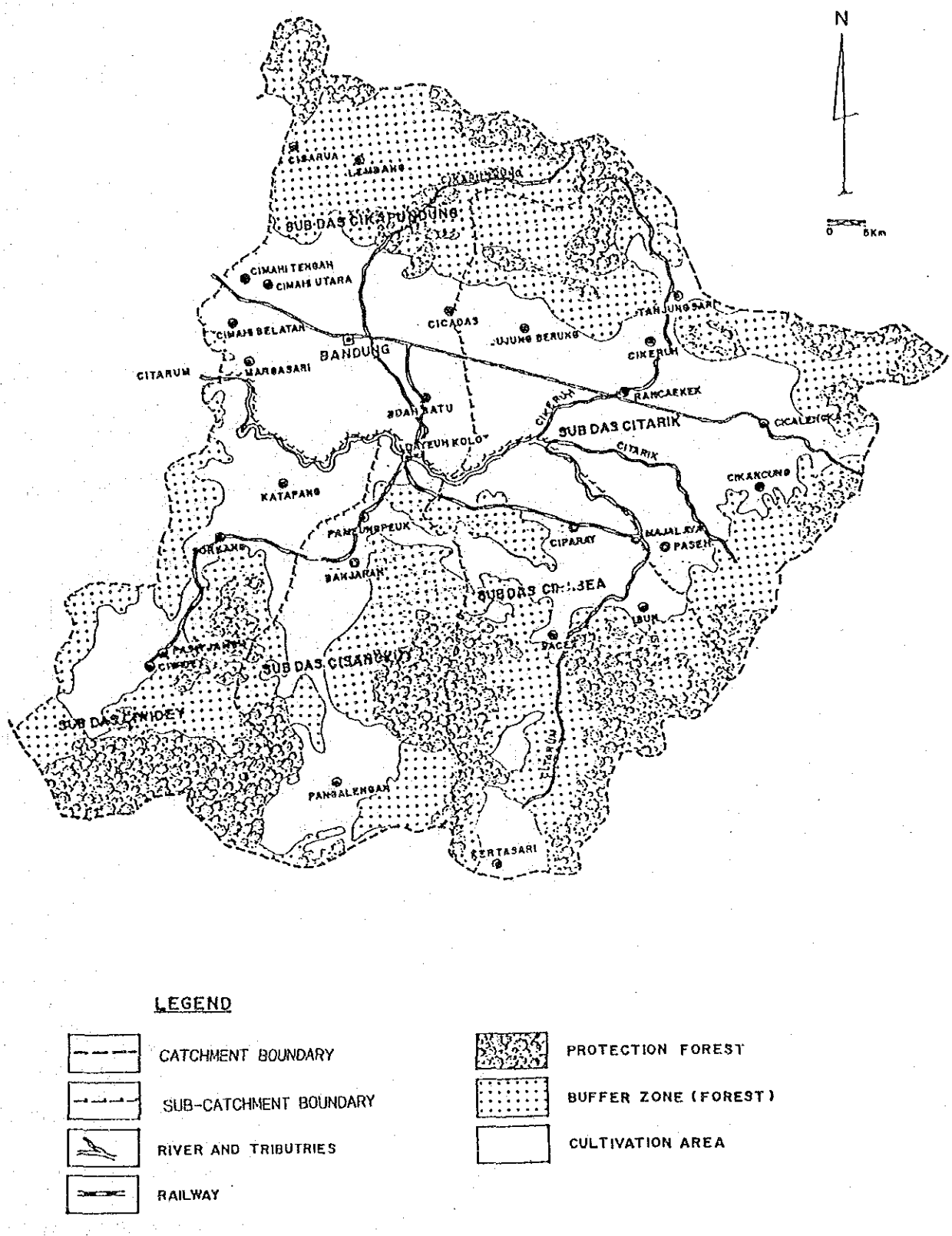
Table F.3 SUMMARY OF TRIBYTARY IMPROVEMENT PLAN

No	Name of River	Catchment Area (Km2)	Catchment Land Use	Design Flood Frequency	Design Discharge	Run Off Coefficient	Length to be Improvet (km)	Cost (Rp)
1	Cipamokolan River	44.75	Paddy Housing	20 Year	Q 2 = 115m3/sec Q20 = 190m3/sec	0.62	8.7	2,727,650,738
2	Cidurian River	23.13	Paddy Housing	20 Year	Q 2 = 60m3/sec Q20 = 100m3/sec	0.62	8.44	3,893,000,000
3	Ciwastra River	8.92	Housing Paddy Fish Pond	20 Year	Q20 = 20m3/sec	0.65	6.40	1,557,000,000
4	Cicadas River	24.10	Paddy Housing	20 Year	Q 2 = Q20 = 55m3/sec		9.6	
5	Cikapundung Kolot River	22.50	Forest Housing Paddy Industrial	20 Year	Q 2 = 70m3/sec Q20 = 115m3/sec	0.65	5.3	1,224,000,000
6	Citepus River	18.40	Forest Housing Paddy Industrial	20 Year	Q 2 = 50m3/sec Q20 = 80m3/sec	0.65	6.5	583,467,445
7	Cikapundung - Cipalasari System	110.20	Forest Housing Paddy Industrial	20 Year	Q 2 = 110m3/sec Q20 = 190m3/sec (Design Discharge for Cikapundung River-Cipalasari River)	0.45	8.76	8,903,000,000

Table F.4 COMPARISON OF TRIBUTARY DESIGN DISCHARGE

Name of River	Area (km2)	Return Period (Year)	Existing Plan				JICA Review			
			Run-off Coefficient	Design Discharge Qp (m3/s)	Design Discharge q (m3/s/km2)	Simulation Method	Run-off Coefficient	Design Discharge Qp (m3/s)	Design Discharge q (m3/s/km2)	Simulation Method
Citepus	18.4	5	0.65	60	3.3	Weduwen	0.50	90	4.1	Rational
		20	0.65	80	4.3	Weduwen	0.50	105	5.7	Rational
		50	0.65	15	5.2	Weduwen	0.50	115	6.2	Rational
Cipalasari	7.4	5	0.65	35	4.7	Weduwen	0.50	40	5.4	Rational
		20	0.65	50	6.8	Weduwen	0.50	45	6.1	Rational
		50	0.65	60	8.1	Weduwen	0.50	50	6.8	Rational
Cicapundung-Cipalasari	110.2	5	0.65	150	1.4	Melchior	0.46	165	1.5	*1
		20	0.65	195	1.8	Melchior	0.46	190	1.8	*1
		50	0.65	230	2.1	Melchior	0.46	200	1.9	*1
Cikapundung Kolot	26.5	5	0.65	70	3.1	Rational	0.50	115	5.1	Rational
		20	0.65	90	4.0	Rational	0.50	125	5.6	Rational
		50	0.65	105	4.7	Rational	0.50	135	6.0	Rational
Cicadas	24.1	5					0.50	70	2.9	Rational
		20					0.50	80	3.3	Rational
		50					0.50	85	3.5	Rational
Ciwastra	8.9	5	0.65	15	1.7	Weduwen	0.49	35	3.9	Rational
		20	0.65	20	2.2	Weduwen	0.49	40	4.5	Rational
		50	0.65	24	2.7	Weduwen	0.49	45	5.1	Rational
Cidrian (Cibodogol)	23.1	5	0.62	70	3.0	Rational	0.41	60	2.6	Rational
		20	0.62	100	4.3	Rational	0.41	70	3.0	Rational
		50	0.62	115	5.0	Rational	0.41	75	3.2	Rational
Cipamokolan	44.8	5	0.62	140	3.1	Weduwen	0.36	110	2.5	Rational
		20	0.62	190	4.2	Weduwen	0.36	130	2.9	Rational
		50	0.62	220	4.9	Weduwen	0.36	140	3.1	Rational

Note *1:by Rational method and the storege function method



LEGEND

- CATCHMENT BOUNDARY
- SUB-CATCHMENT BOUNDARY
- RIVER AND TRIBUTRIES
- RAILWAY
- PROTECTION FOREST
- BUFFER ZONE (FOREST)
- CULTIVATION AREA

FIG. F.1 LAND-USE PLAN FOR FOREST/CULTIVATION AREA

STUDY ON THE FLOOD CONTROL PLAN OF THE UPPER CITARUM BASIN

JICA

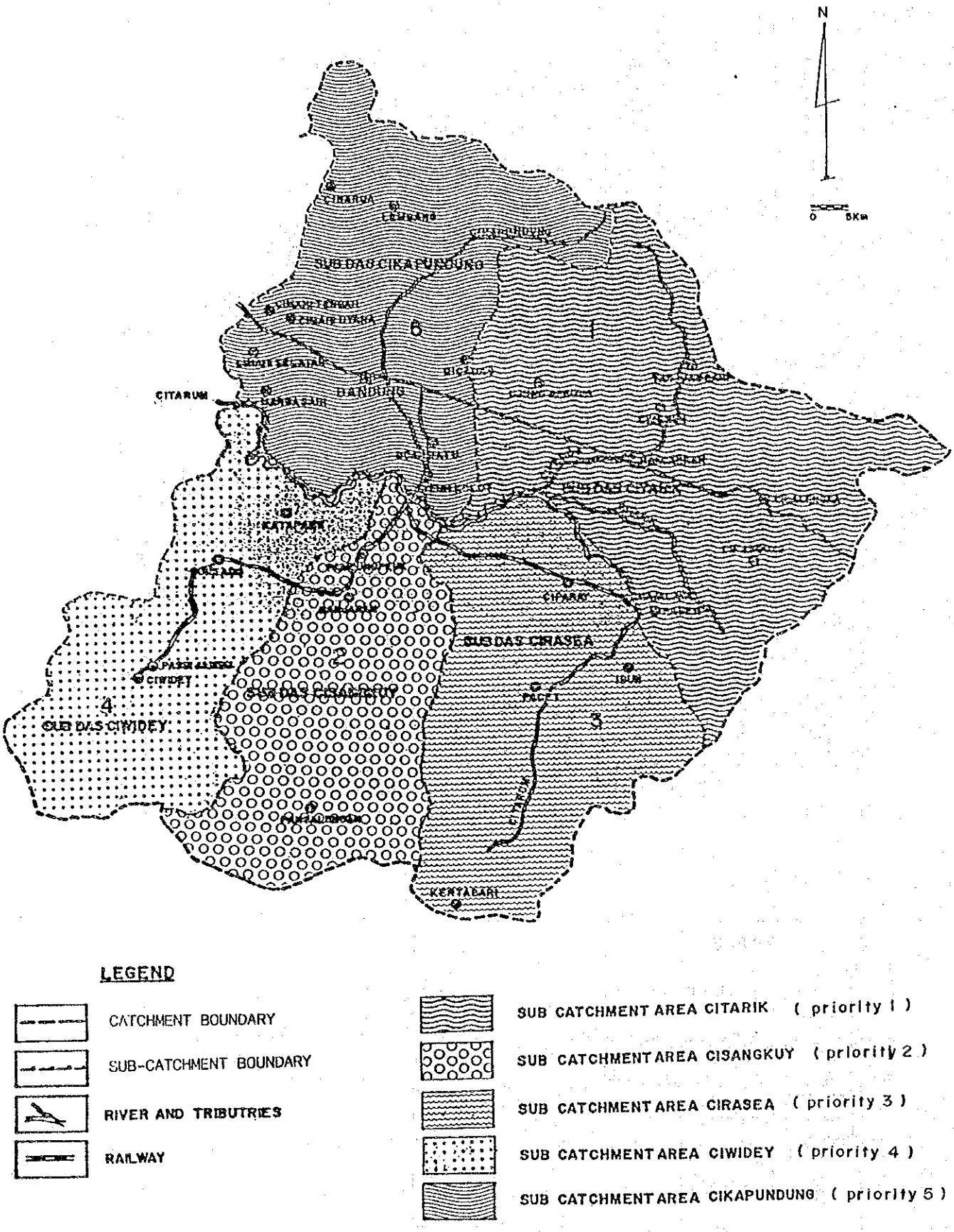
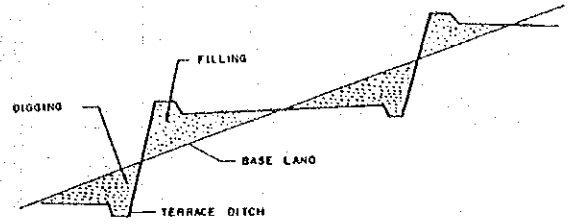


FIG. F.2 PRIORITY OF LAND EROSION CONTROL

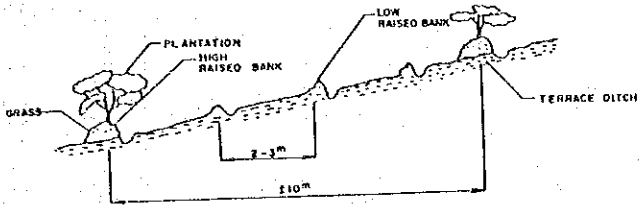
STUDY ON THE FLOOD CONTROL PLAN OF THE UPPER CITARUM BASIN

JICA

TERRACE FORMATION OF DRY FIELD



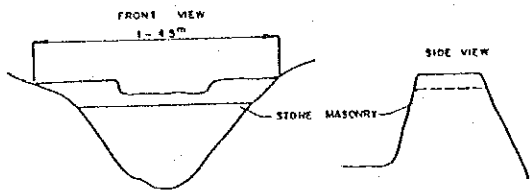
BENCH TERRACE



SMALL BANK TERRACE

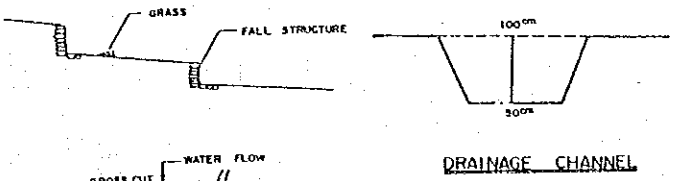
SMALL DAMS FOR SEDIMENT STORAGE

RETENTION DAM

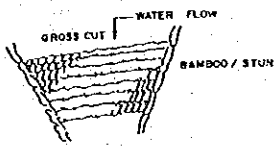


TORRENT WORKS

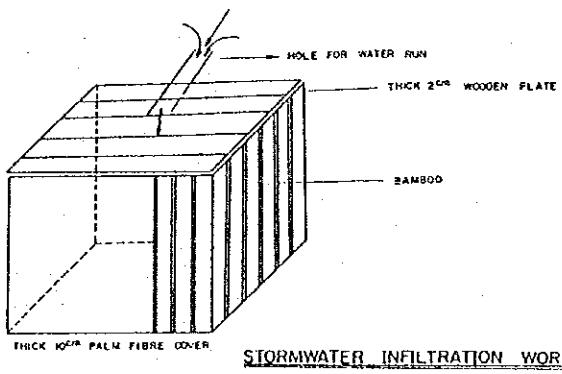
DRAINAGE CHANNEL



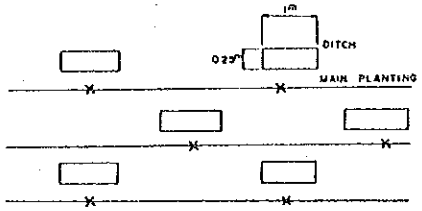
DRAINAGE CHANNEL



DROP STRUCTURE



STORMWATER INFILTRATION WORKS

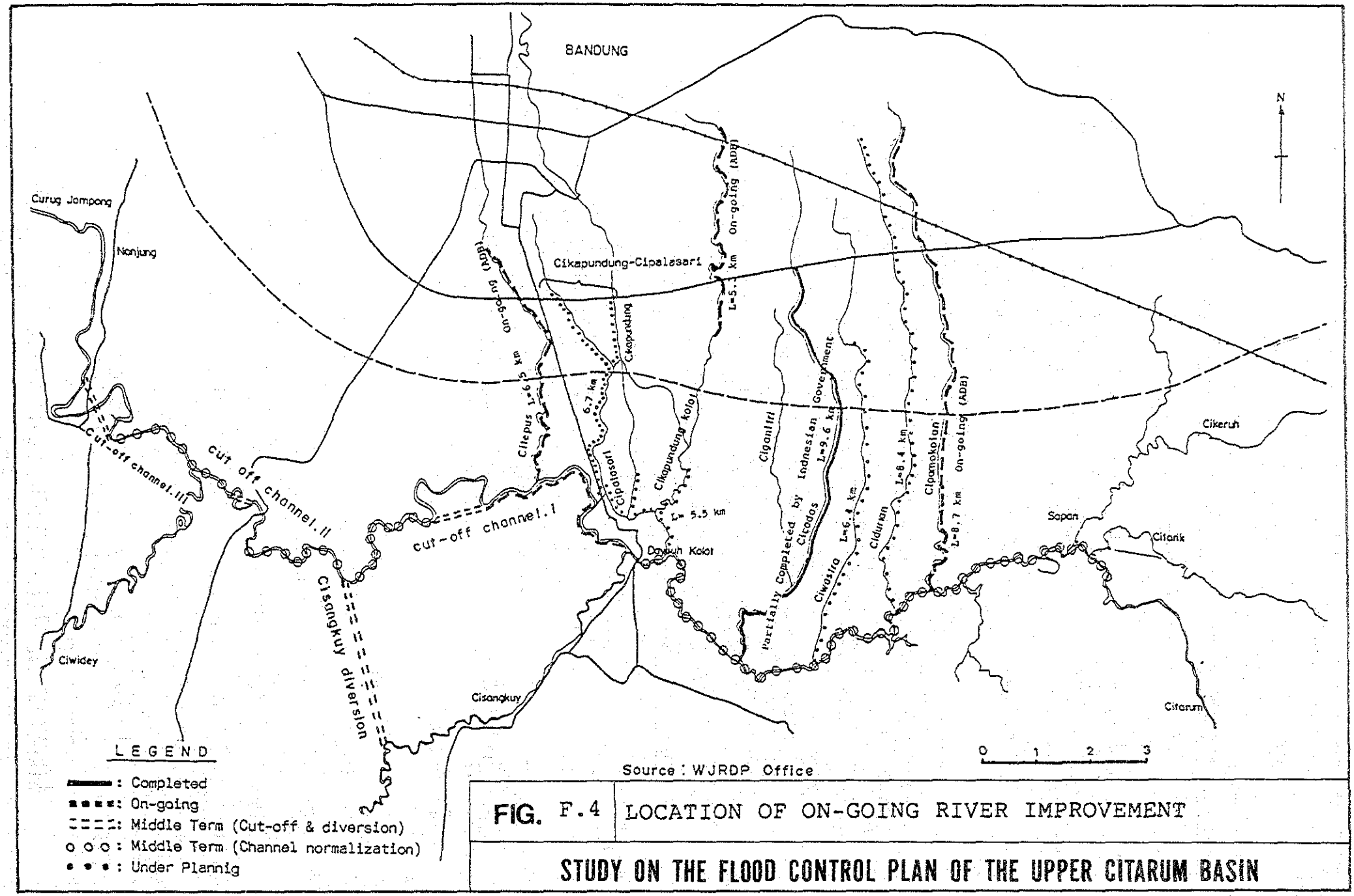


SEDIMENTS TRAP

FIG. F.3 EROSION CONTROL MEASURES BY MINISTRY OF FORESTRY

STUDY ON THE FLOOD CONTROL PLAN OF THE UPPER CITARUM BASIN

JICA



Source : WJRDP Office

FIG. F.4 LOCATION OF ON-GOING RIVER IMPROVEMENT

STUDY ON THE FLOOD CONTROL PLAN OF THE UPPER CITARUM BASIN

JICA

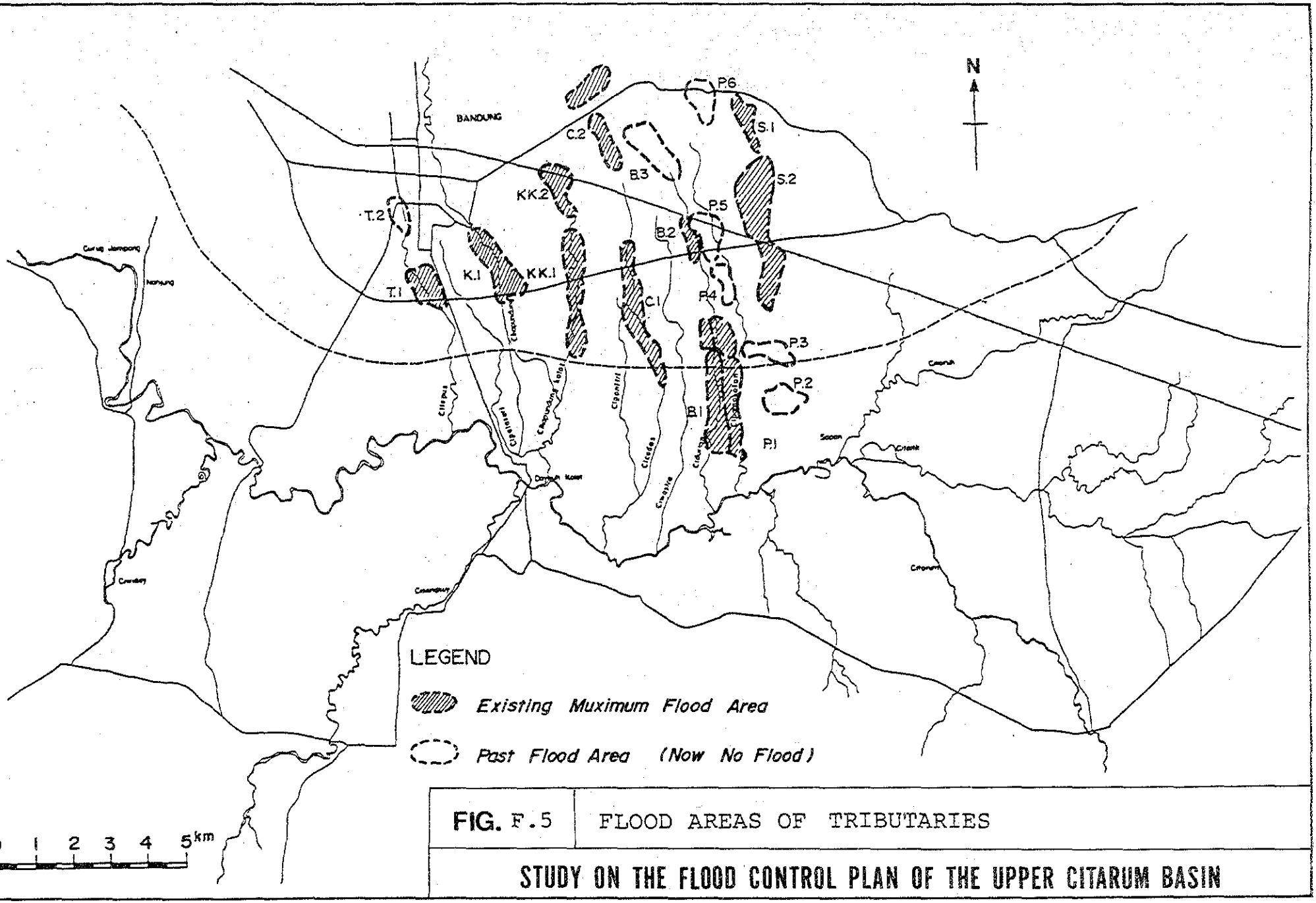


FIG. F.5 FLOOD AREAS OF TRIBUTARIES

STUDY ON THE FLOOD CONTROL PLAN OF THE UPPER CITARUM BASIN

JICA

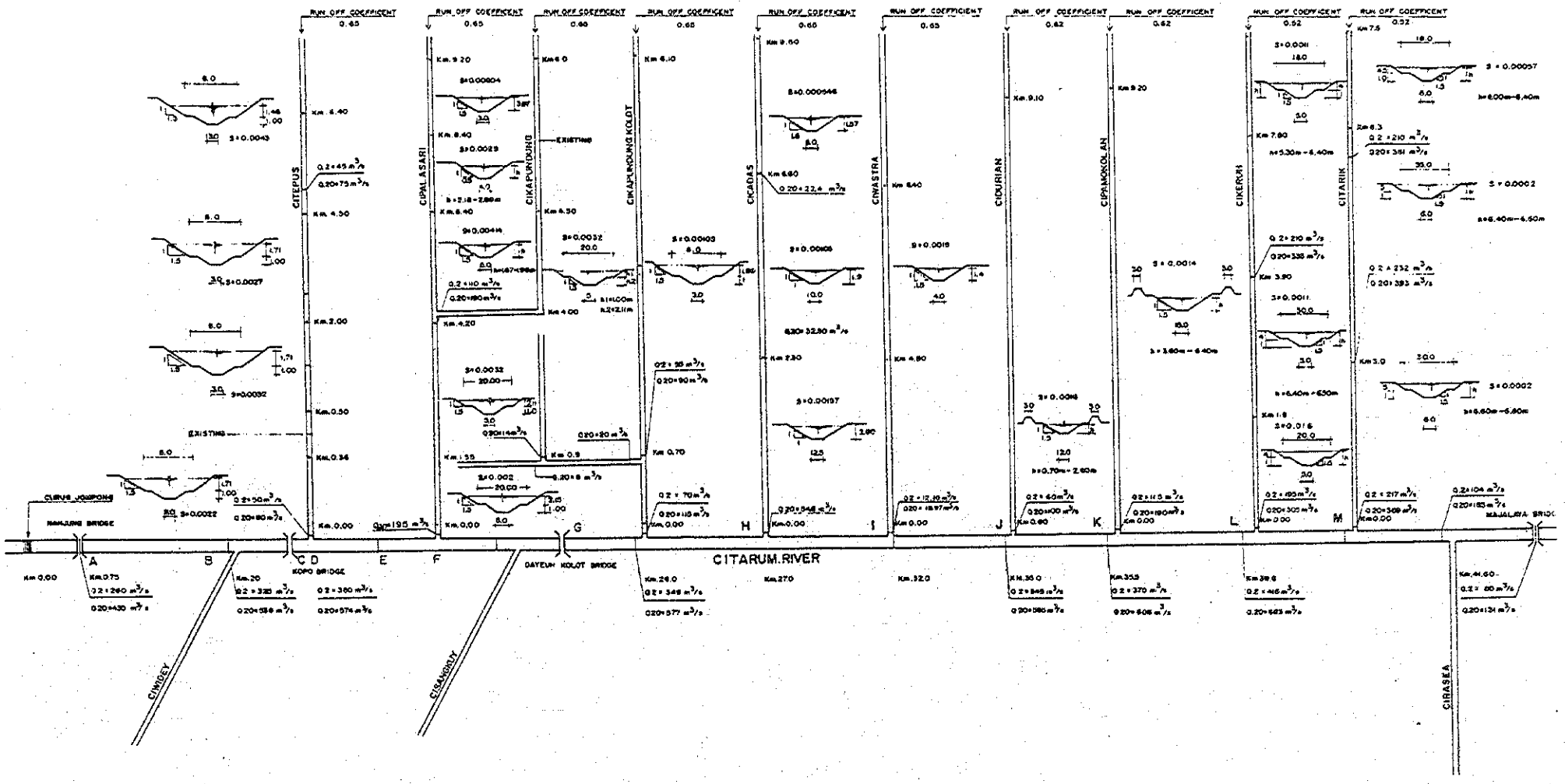
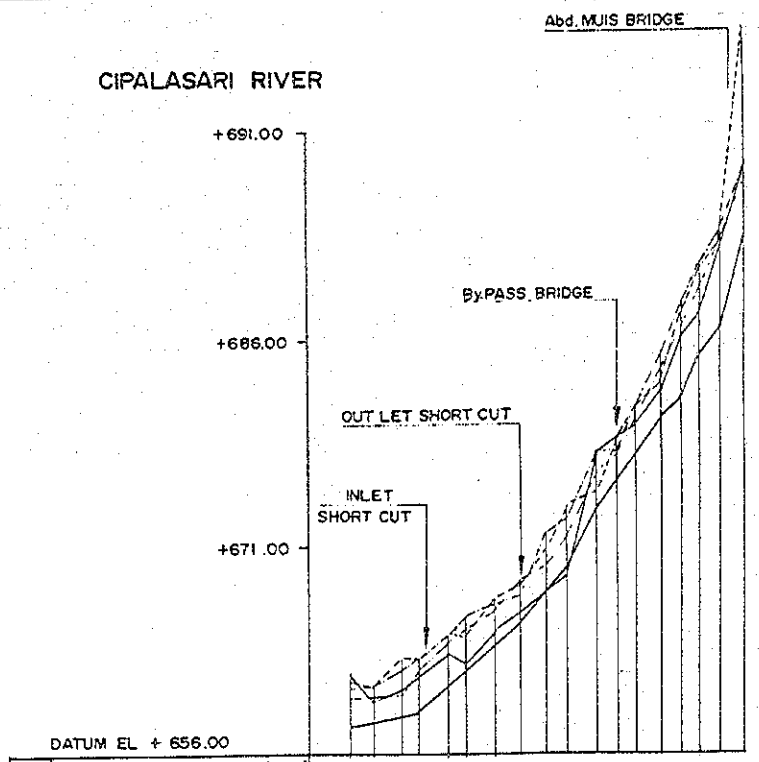


FIG. F.6 EXISTING RIVER IMPROVEMENT PLAN

STUDY ON THE FLOOD CONTROL PLAN OF THE UPPER CITARUM BASIN

JICA



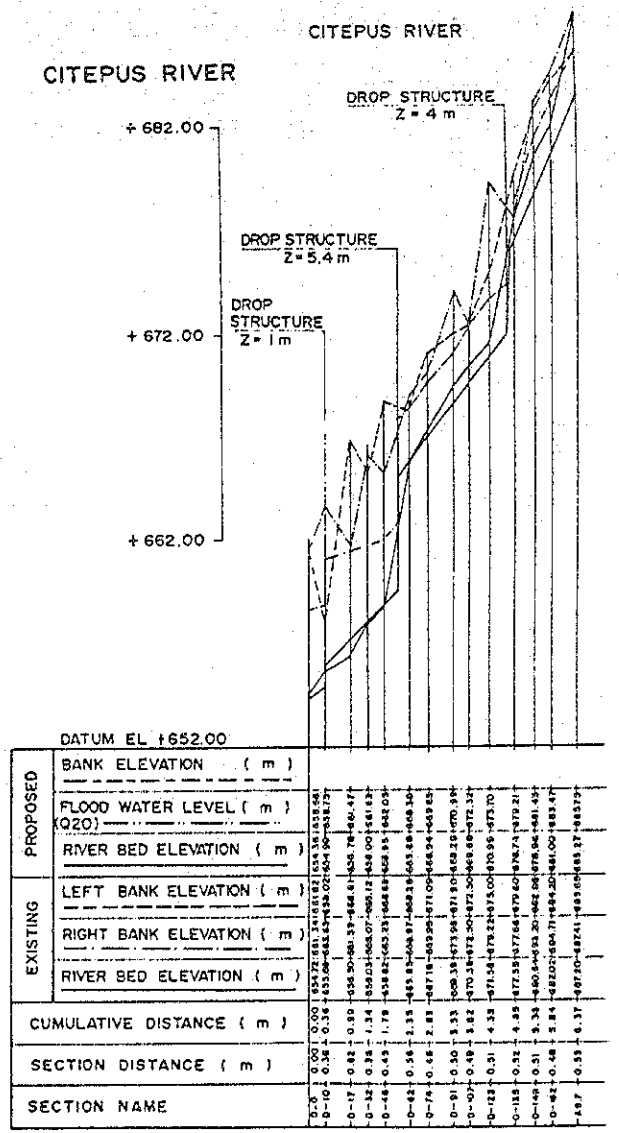
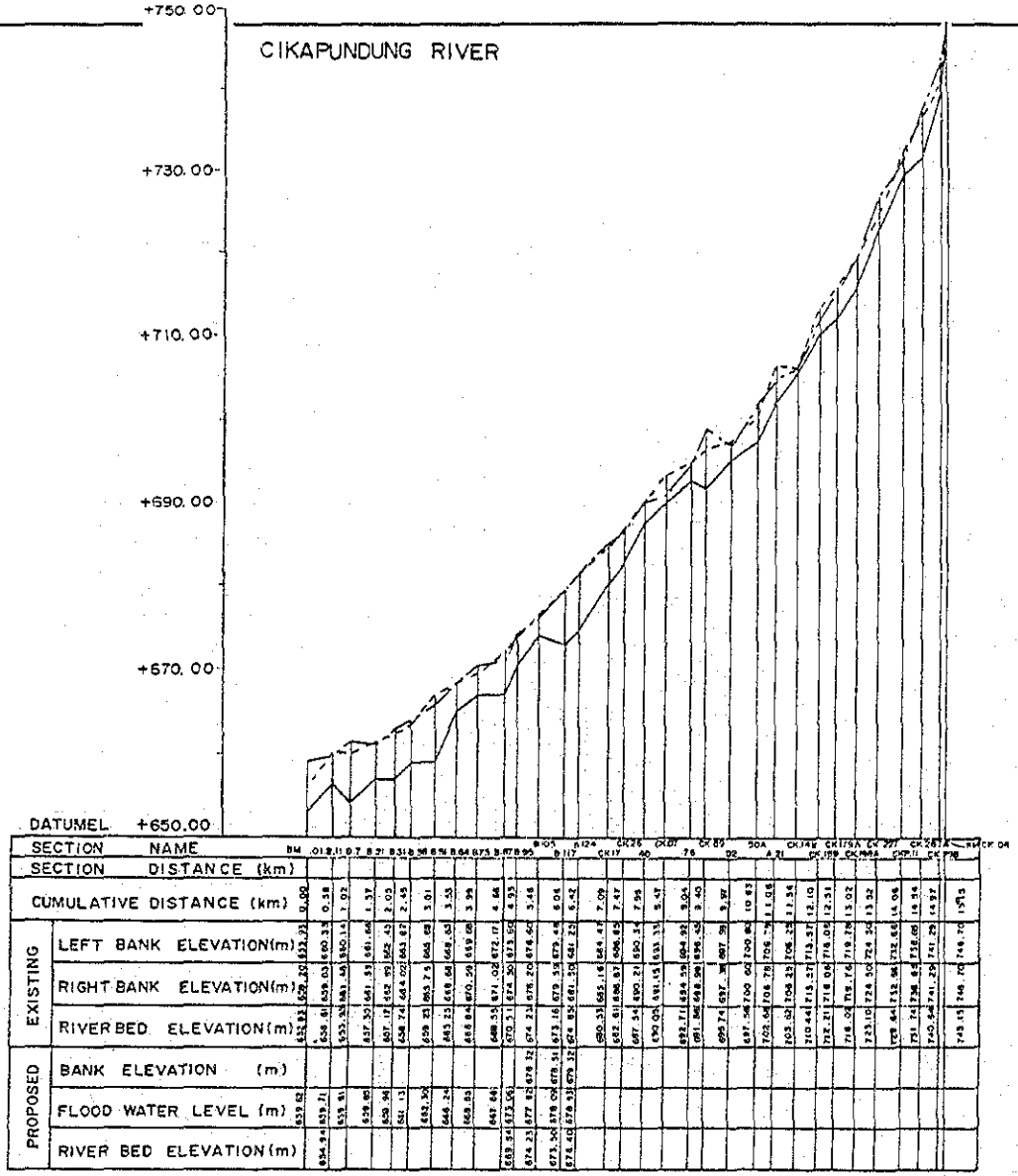
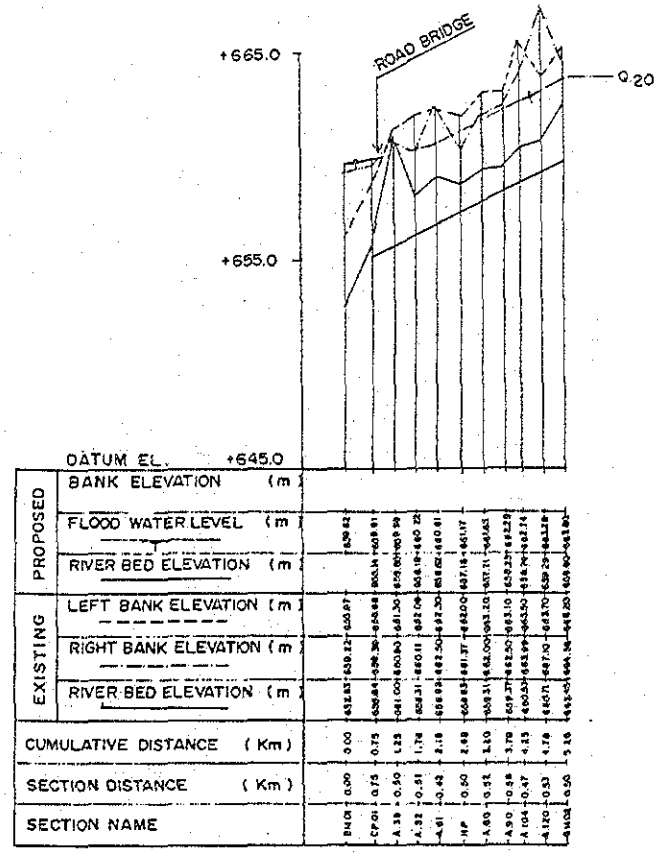


FIG. F.7 RROFILE OF TRIBUTARIES (1)
(CIPALASARI RIVER, CITEPUS RIVER)

STUDY ON THE FLOOD CONTROL PLAN OF THE UPPER CITARUM BASIN

JICA



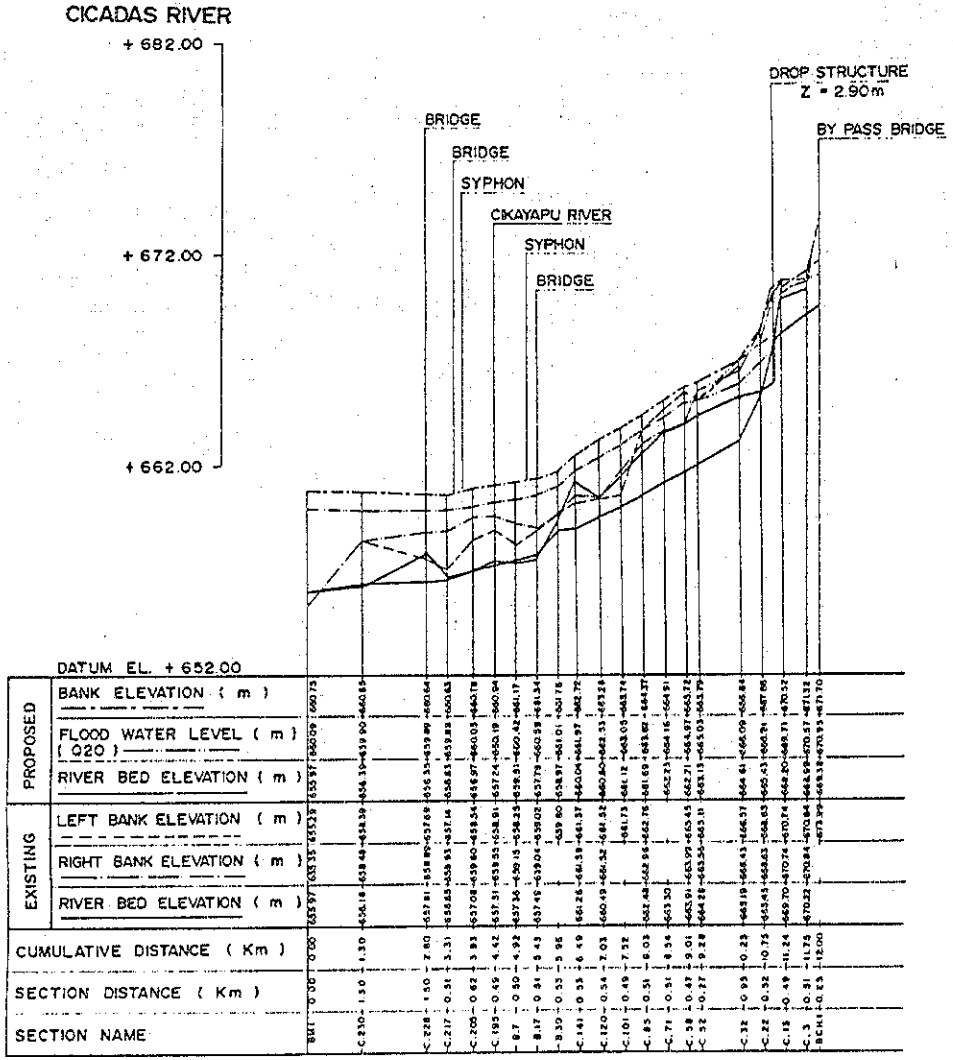


F-22

FIG. F.8 PROFILE OF TRIBUTARIES (2)
(CIKAPUNDUNG RIVER, CIKAPUNDUNG KOLOT RIVER)

STUDY ON THE FLOOD CONTROL PLAN OF THE UPPER CITARUM BASIN

JICA



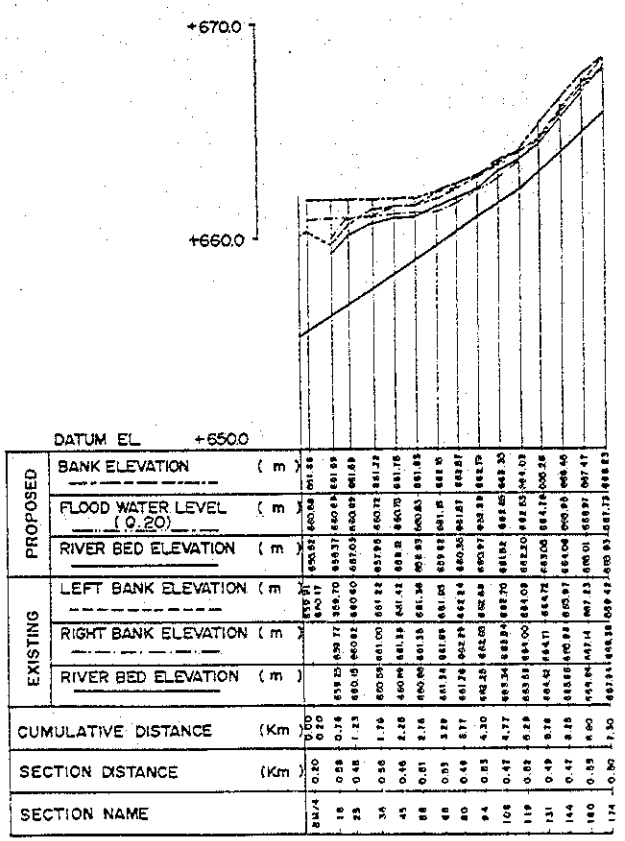
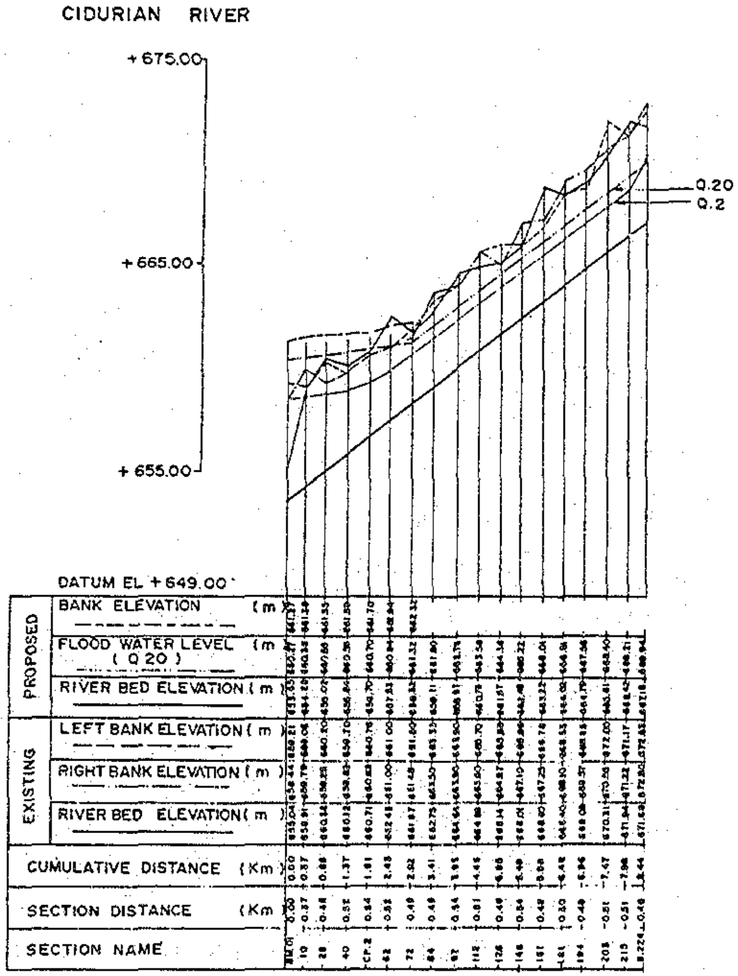


FIG. F.9 PROFILE OF TRIBUTARIES (3) (CICADAS RIVER, CIWASTRA RIVER)

STUDY ON THE FLOOD CONTROL PLAN OF THE UPPER CITARUM BASIN



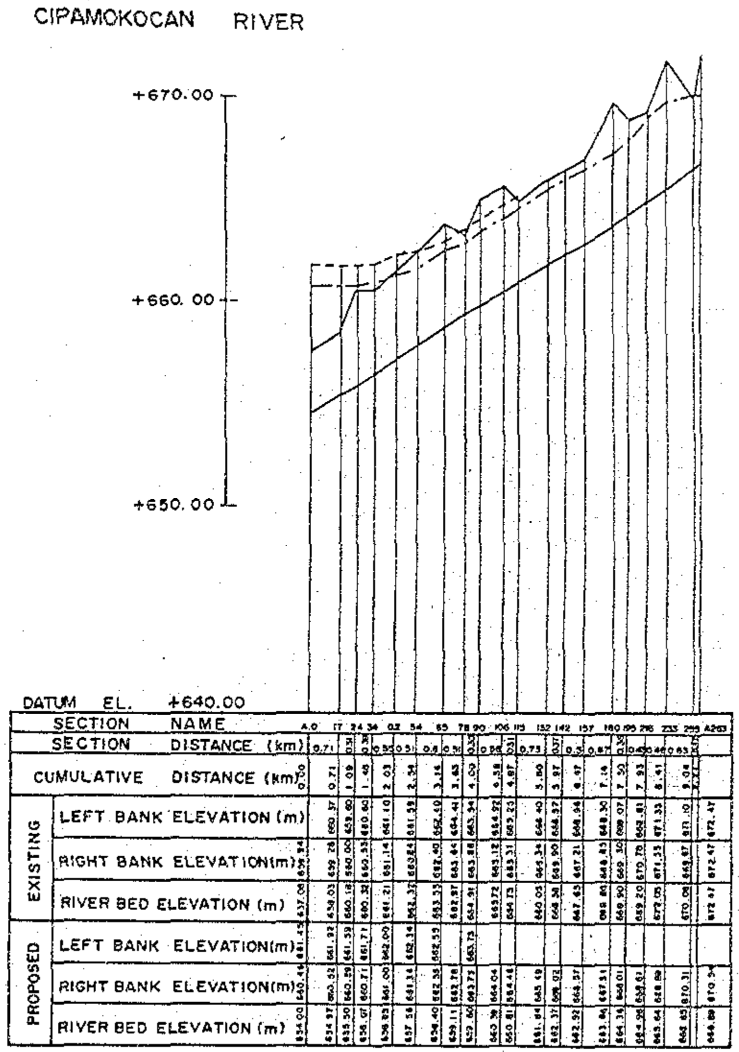
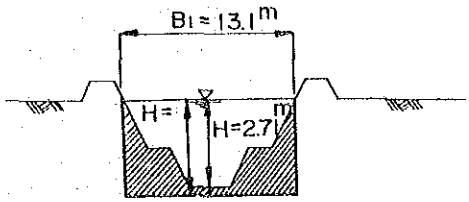


FIG. F.10 PROFILE OF TRIBUTARIES (4) (CIDURIAN RIVER, CIPAMOKOLAN RIVER)

STUDY ON THE FLOOD CONTROL PLAN OF THE UPPER CITARUM BASIN

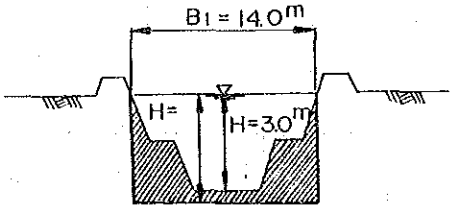
JICA

Citepus River



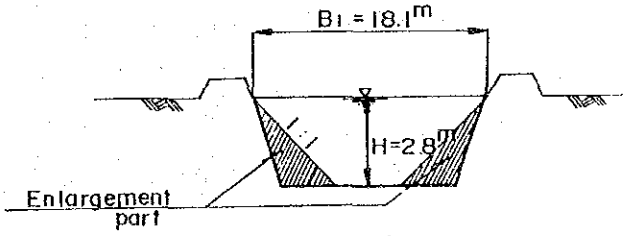
	Existing Plan	Reviewed Plan
Q_{20} (m^3/s)	80	105
B_1 (m)	13.1	13.1
H (m)	2.71	2.8
I	1/455	1/455

Cikapundung Kolot River



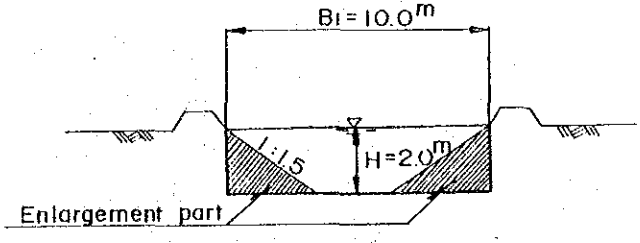
	Existing Plan	Reviewed Plan
Q_{20} (m^3/s)	90	125
B_1 (m)	14.0	14.0
H (m)	3.0	3.8
I	1/970	1/970

Cicadas River



	Existing Plan	Reviewed Plan
Q_{20} (m^3/s)	55	80
B_1 (m)	18.1	18.1
H (m)	2.8	2.8
I	1/637	1/637

Ciwastra River



	Existing Plan	Reviewed Plan
Q_{20} (m^3/s)	20	40
B_1 (m)	10.0	10.0
H (m)	2.0	2.0
I	1/667	1/667

FIG. F.11 ENLARGEMENT OF RIVER CROSS SECTION

STUDY ON THE FLOOD CONTROL PLAN OF THE UPPER CITARUM BASIN

JICA

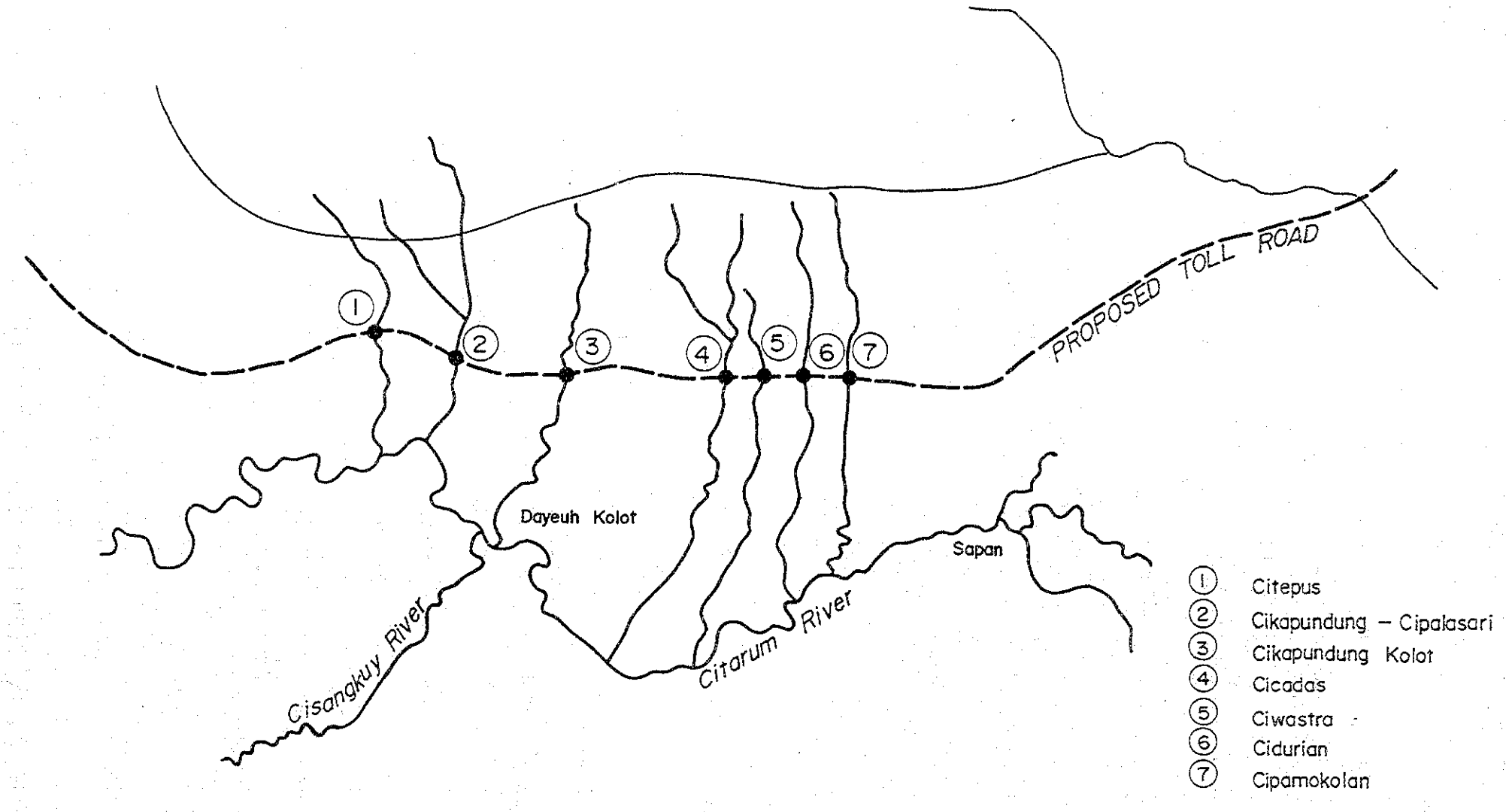


FIG. F.12 LOCATION OF TOLL ROAD CROSSING

STUDY ON THE FLOOD CONTROL PLAN OF THE UPPER CITARUM BASIN

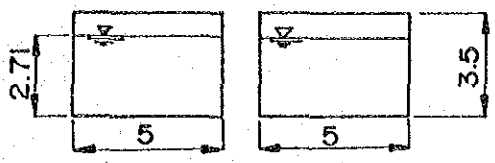
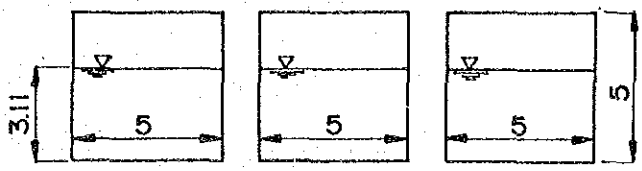
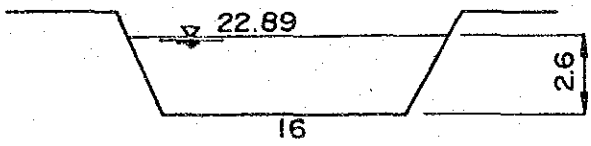
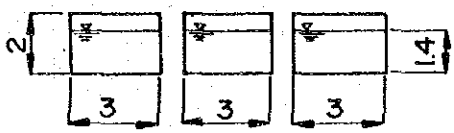
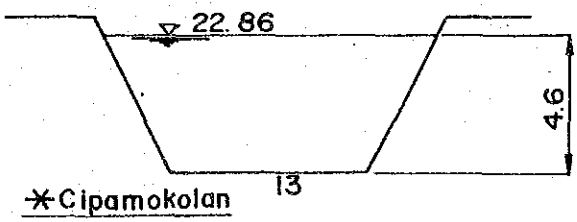
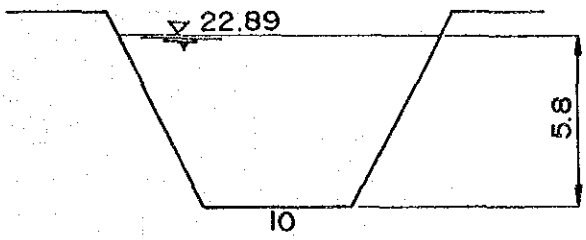
Opening by Existing Plan	Existing Plan (m^3/s)	JICA Review (m^3/s)	Discharge Capacity (m^3/s)
✳ Citepus River 	75	95	67
✳ Cikapundung — Cipalasari 	175	190	131
✳ Cikapundung Cdot			
SAME AS Cikapundung Kolot — Cipalacari H=2.99	85	115	124
✳ Cicadas 	33	55	105
✳ Ciwastra 	20	35	16
✳ Cidurian 	90	60	281
✳ Cipamokolan 	185	130	328

FIG. F.13 CROSS SECTION OF TOLL ROAD OPENING

STUDY ON THE FLOOD CONTROL PLAN OF THE UPPER CITARUM BASIN

JICA

SUPPORTING REPORT G

HYDROLOGICAL ANALYSIS

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SUPPORTING REPORT G
HYDROLOGICAL ANALYSIS

1. Hydrological Observation

1.1 Existing Hydrological Observation Station

There exist 59 rainfall stations in and around the Study Area, which are classified into the following three (3) types of observation method.

- Ordinary type : 35
- Automatic type : 15
- Automatic type with telemetering system : 9

The Study Area is also provided with 19 water gauging stations of which:

- Staff gauges are 5.
- Automatic gauges are 14.

Locations of the rainfall and water gauging stations are shown in Fig. G.1.

1.2 Availability of Hydrological Data

Available period of the following hydrological data is shown in Tables G.1 to G.4.

- Daily rainfall
- Hourly rainfall
- Daily water level and discharge
- Hourly water level and discharge